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Rice Today

International Rice Research Institute

July-September 2011, Vol. 10, No. 3

Mankind takes a giant leap—again

The Americas have two faces

Beware of bronzing

A rice breeder's odyssey

THE WHITE PLAGUE

Bangladesh fights its salinity problem

ISSN 1655-5422


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contents

On the cover:

White deposits of salt cover the rice fields in the coastal areas of South Asia, especially during the dry season. Dubbed the "white plague," soil salinity is a serious problem in farming that can push cash-strapped subsistence rice farmers further below the poverty line. Fortunately, farmers can now combat salinity by cultivating BRRI dhan47, a salt-tolerant rice variety that is now becoming popular in Bangladesh.

PEGGY REIMCHEN

Rice Today is published by The Rice Trader Inc. (TRT) in association with the International Rice Research Institute (IRRI).

TRT, for 21 years, has brought subscribers crucial, up-to-the-minute information on rice trade through its weekly publication, *The Rice Trader.* Acknowledged as the only source of confidential information about the rice market, this weekly summary of market data analysis has helped both the leading commercial rice companies and regional government officials make informed decisions, which are critical in today's market.

IRRI is the world's leading international rice research and training center. Based in the Philippines and with offices in 13 other 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 supported, in part, by members of the Consultative Group on International Agricultural Research (CGIAR – www.cgiar.org) and a range of other funding agencies.

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On the threshold of 7 billion

On 31 October, the United Nations estimates that the world's population will hit 7 billion. For many of us—occupied, most of the time, by the daily stresses of our own personal lives—this is merely a number. We cannot truly fathom the significance of this number. However, for people such as the agricultural scientists here at the International Rice Research Institute (IRRI) and other food-related research centers around the world, this number is a heavy weight to bear. The world is growing, but, given the many setbacks in food production, climate change, increasingly scarce resources, etc., production has often fallen short of consumption demand in many countries, especially the developing nations. Hence, scientists strive to always be one step ahead to meet the challenges of today and tomorrow.

This issue offers a fascinating look at how the world of rice science is keeping abreast of the emerging problems that affect people's ability to sustain their nourishment needs.

First, understanding the significance of preserving the diverse food crops and protecting them against destructive forces to ensure food security for the succeeding generations, a "Doomsday Vault" was constructed deep within the frozen mountains of Svalbard, Norway, just 1,130 kilometers from the North Pole.

Meanwhile, farmers and scientists in Bangladesh and sub-Saharan Africa are working together to battle their current problems of salinity and iron toxicity, respectively. Since land resources are as limited as they can possibly be, farmers have to make do with what they have—whether lands are favorable or not to rice production. Fortunately, scientists are constantly developing new and improved varieties that are equipped with tolerance against these environmental stresses, so farmers are able to cope with their farming problems. As one scientist puts it, reaping something is better than nothing.

Regarding Africa, our Maps section focuses on the Niger River, the river that provides irrigation to water systems in Mali, essentially bringing life to the many people in the region.

Interestingly, as we busy ourselves with the production of this issue, our publisher, The Rice Trader, is holding its 5th Rice Americas Conference in Panama City, Panama. Hence, you will find here a review of this significant event that gathered many important players in the rice industry. Along with this, we deemed it appropriate to put together a Latin America feature to highlight this region's importance in rice production, as well as in trade. Brazil particularly comes into the spotlight as we turn our attention to this country's overall rice production and its collaborations with IRRI, as well as the development of its hybrid rice industry.

With the population clock turning 7 billion soon, the future of the world is not about doom and gloom, however. This issue looks at the scientists who are working to solve agricultural problems—the hopes of world food production. We have Dr. David Mackill, who caught the wave of the advancing genetics research to help develop scuba rice, a flood-tolerant rice variety. Although IRRI will greatly miss Dr. Mackill, who has become an institution in plant breeding, we also welcome the younger generation of scientists who now hold much of the future in rice research. Two of them are postdoctoral research fellows Govinda Rizal and Shanta Karki, whose love story is intertwined with their love for rice science.

While these people found a love for rice science, some people found a love for rice as their art subject. Through the eyes of artists such as the famed Fernando Amorsolo, as well as contemporary British artist John Dyer, rice is seen in its cultural context—a vital aspect of life immortalized on canvasses.

You will find all these and more in this issue. And, as we have opened up the subject of the ticking population clock, watch for the October-December issue, as it will be a special edition about the world reaching 7 billion people.

Mia Aureus
Editor

Lanie Reyes
Editor

Thailand moves to stop insecticide use in rice

The International Rice Research Institute (IRRI) has applauded the Thai Sustainable Planthopper initiative to restrict the use of two types of insecticides that are major causes of outbreaks of brown planthoppers (BPH), which devastate rice crops across Thailand.

BPH outbreaks have affected nearly 11% of the Thai rice crop this year and are expected to cause losses of about 840 million baht (US$28 million), putting in jeopardy the lives of many farmers dependent on rice for an income and denting the country's rice exports.

"Thailand's Rice Department has developed a well-thought-out and integrated pest management initiative to reduce the damages caused by brown planthopper by promoting and facilitating best management practices, which includes stopping the use of insecticides such as abamectin and cypermethrin that significantly contribute to brown planthopper outbreaks," said Dr. Robert Zeigler, IRRI director general.

"It is of international significance that Thailand will undertake this initiative because, as the world's largest rice exporter, it is recognized as a global leader in the rice industry," he added. "Brown planthoppers are a problem across many other rice-growing nations and, if Thailand is successful in its battle against the pest, others can confidently follow suit and implement similar measures."

IRRI (3)

BROWN PLANTHOPPER outbreaks have affected nearly 11% of Thai rice in 2011.

"If Thailand is successful in its battle against the pest, others can confidently follow suit and implement similar measures."

Dr. Robert Zeigler
IRRI director general

A THAI poster that urges farmers to stop using insecticides that cause pest outbreaks.

The $12.8-million initiative, which is supported by Thailand's Minister of Agriculture and Cooperatives Theera Wongsamut, was announced at Thailand's National Rice Conference. It aims to multiply the seed of brown planthopper-resistant rice varieties to 15,000 tons and distribute this seed to Thai rice farmers, establish in 20 provinces giant light traps that attract and catch brown planthoppers, manage 300 BPH community centers and communication campaigns across the country, establish mobile units that will visit villages to promote best management practices to reduce the occurrence of BPH outbreaks, and discourage farmers from using abamectin and cypermethrin.

IRRI advocates that rice farmers use environment-friendly approaches to pest management, such as integrated pest management that controls pests through the use of pest-resistant varieties, a smarter understanding and management of pest ecology, and an elimination of ineffective and problematic insecticides.

According to Dr. Weerawooth Katanyukul, president of the Thai Agro Business Association, Thailand's pesticide industry association also supports the restricted use of abamectin and cypermethrin in rice due to their ineffectiveness in controlling BPH.

IRRI is currently developing clear recommendations about insecticide use in rice crops to help farmers make better decisions. Topics under consideration are the licensing of insecticide salespeople, identifying insecticides that should never be used in rice, identifying which insecticides could be used in rice and under what circumstances, and ways to support extension and communication of better insecticide use to farmers.

Mozambique gets new designer rice

Makassane is the first rice variety bred by the International Rice Research Institute (IRRI) that has been designed especially for Mozambique consumers and farmers to ensure it suits local market needs and production conditions. It has the same yield potential (6–7 tons per hectare) as the current most popular variety, *Limpopo*. Also, it is resistant to two major diseases—bacterial leaf blight and blast.

In addition, *Makassane* was chosen by farmers and scientists as the best tasting locally selected long-grain variety. It has a desirable texture when eaten, making it superior to the other existing varieties.

IRRI

IR80482 or *Makassane* is the first rice variety that IRRI bred especially for Mozambique.

"This is just the beginning," said Dr. Surapong Sarkarung, IRRI's coordinator for rice breeding in East and Southern Africa. "We have identified many promising rice varieties for Mozambique.

"Mozambique has a vast area of land suitable for rice production," he added. "If better varieties such as *Makassane* can be more widely adopted, Mozambique would not only become self-sufficient in rice, but could also become a rice exporter because the grain quality of *Makassane* and the other rice varieties we are developing meet international quality standards."

From 2002 to 2007, rice consumption per person in Mozambique more than doubled, exceeding 20 kilograms per person per year. Demand is expected to keep increasing and imports exploded from around 75,000 to 350,000 tons per year between 2002 and 2008—more than a fourfold increase.

This research is done in collaboration with the government agricultural research institute for Mozambique (Instituto de Investigação Agrária de Moçambique).

GM rice 10,000 years ago

Ancient humans selected different strains of rice and, without knowing, mixed different genes of the plant to create an ideal version of the crop with higher yields and better cultivation.

Dr. Masanori Yamasaki of Kobe University discovered that ancient humans started selecting for "semidwarf" rice more than 10,000 years ago.

This selection process helped them modify the genetic composition of one subspecies of modern rice such that it has shorter stems, sturdier stalks, and greater grain output.

Source: www.dailymail.co.uk

Bangladesh: zinc-rich rice

The Bangladesh Rice Research Institute (BRRI), with the support of HarvestPlus, is developing rice enriched with zinc.

"Seeds of the new rice variety will be made available to the farmers for cultivation by 2013," said BRRI Director General Mohammad Abdul Mannan.

Bangladesh's Agriculture Minister Matia Chowdhury said that, through the development of the new variety, it would be possible to protect the next generation from malnutrition caused by the lack of zinc.

Source: www.bdnews24.com

One-third of food wasted

Roughly one-third of the food produced in the world for human consumption every year—approximately 1.3 billion tons—gets lost or wasted, according to a study commissioned by the Food and Agriculture Organization.

The report also said that the amount of food lost or wasted every year is equivalent to more than half of the world's annual cereals crop, which was 2.3 billion tons in 2009-10.

The report, Global Food Losses and Food Waste, was released in May 2011.

Source: www.fao.org

New Golden Rice partners join forces against vitamin A deficiency

The International Rice Research Institute (IRRI) and the national rice research institutes in Bangladesh and the Philippines have joined with Helen Keller International (HKI) in a new effort to further develop and evaluate Golden Rice as a potential tool to reduce vitamin A deficiency.

Golden Rice contains beta carotene, a source of vitamin A.

Vitamin A deficiency is the leading cause of preventable blindness in children. It impairs immune system function and increases the risk of death from certain childhood diseases. Globally, approximately 670,000 children die every year and another 350,000 go blind because they are vitamin A-deficient.

"IRRI and its partners have been working on Golden Rice to develop a safe and effective way to overcome vitamin A deficiency, prevent blindness, and save lives," said Dr. Gerard Barry, Golden Rice Network coordinator and IRRI's Golden Rice project leader. "Our latest stage of work will bring in HKI—a new partner from the nutrition sector—to further understand how well Golden Rice can reduce vitamin A deficiency."

HKI has been advocating the elimination of vitamin A deficiency for more than 40 years. They have been working with governments and other partners to reach those most in need through various interventions.

GOLDEN RICE (*left*) **contains beta carotene and is a potential tool to combat vitamin A deficiency.**

"The most vulnerable children and women in hard-to-reach areas are often missed by existing interventions that can improve vitamin A status, including vitamin A supplementation, food fortification, dietary diversification, and promotion of optimal breast-feeding," said Ms. Nancy Haselow, HKI vice president and regional director for Asia-Pacific.

"We welcome the opportunity to see if Golden Rice is efficacious and can fill the gap in access to adequate vitamin A for all vulnerable groups in a sustainable way," she added.

According to a study published in the *American Journal of Clinical Nutrition*, daily consumption of very modest amount of Golden Rice—about a cup (or around 150 grams, uncooked weight)—could supply 50% of the Recommended Daily Allowance of vitamin A for an adult.

SENIOR SCIENTIST Parminder Virk shows samples of Golden Rice.

IRRI (2)

The Bangladesh Rice Research Institute (BRRI) and the Philippine Rice Research Institute (PhilRice) have been working with IRRI on Golden Rice for several years.

"We are conducting our breeding carefully to make sure that the new Golden Rice variety retains the same high yield, pest resistance, and excellent grain and eating qualities," said Dr. Antonio Alfonso, chief science specialist and Golden Rice team leader at PhilRice.

"I am delighted with our success in breeding a Golden Rice version of Bangladesh's most popular rice variety, BRRI dhan29, which we hope will make a substantial contribution to reducing vitamin A deficiency," said Dr. Alamgir Hossain, principal plant breeder at BRRI.

Golden Rice is genetically modified and will be available to farmers and consumers only after it has been approved by national regulatory bodies.

If, at the end of this project, Golden Rice proves to be safe and effective, and can reach those most in need, the partners will continue to work to introduce it.

This project is supported by the Bill & Melinda Gates Foundation, the Rockefeller Foundation, and the United States Agency for International Development, among other donors.

www.irri.org/goldenrice

TRAINING COURSES AT IRRI

Course Title	Date
Working in a Multicultural Organization and Working and Living in the Philippines	4 August
Intermediate R	8-12 August
Rice Breeding Course	9-24 August
Leadership in Rice Sciences	15-26 August
Research Data Management	16-18 August
Rice Technology Transfer Systems in Asia	16-27 August
Supervisory Training Program (2nd offering)	17-19 August
Project Management Level 2 (for scientists)	12-16 September
Molecular Breeding Course	19-30 September
Leadership Course for Asian and African Women for Research and Extension in Rainfed Rice Ecosystems (in Bangladesh)	19-30 September
Rice Production Techniques for Researchers (for African participants)	10-28 October
Rice Postproduction Training Course	17-28 October
Bioinformatics for Candidate Gene Discovery (BCGD)	18-20 October
Personal Skills for Professional Excellence (IRRI, Philippines)	18-20 October
Basic Scientific Writing Workshop	24-28 October
Working in a Multicultural Organization and Working and Living in the Philippines	27 October

For the complete list and information about the 2011 IRRI Training Courses, visit http://snipurl.com/training_courses.

For inquiries, email IRRITraining@cgiar.org, call (63-2) 580-5600 loc 2538/2824/ 2437/2324, or send a fax to (63-2) 580-5699, 891-1292, 845-0606.

Books

In Search of Biohappiness

By M.S. Swaminathan; published by World Scientific Publishing Co. Inc.

This book describes how an era of biohappiness, based on conservation and sustainable and equitable use of biodiversity, can be launched. It deals with all aspects of conservation such as *in situ*, *ex situ*, and community conservation. It covers the conservation issues related to mangroves and other coastal bioresources, the importance of which will grow with the emerging possibility of sea-level rise caused by global warming. Furthermore, this literature includes concrete examples of how local tribal families have taken to the establishment of gene, seed, grain, and water banks in villages, thus linking conservation, cultivation, consumption, and commerce in a mutually reinforcing manner.

For more background information, see www.scidev.net/en/news/biohappiness-key-to-future-says-swaminathan.html. To order online, go to www.worldscibooks.com/environsci/7987.html.

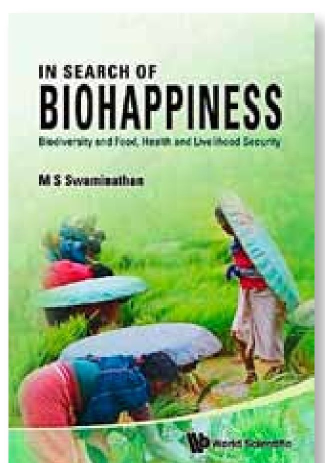
Research Methods in Toxicology and Insecticide Resistance Monitoring of Rice Planthoppers

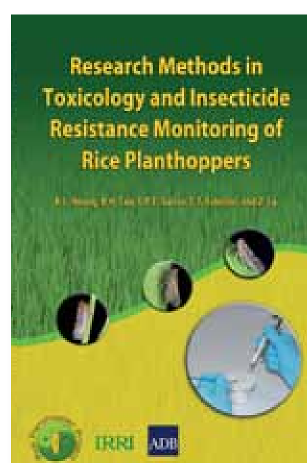
By K.L. Heong, K.H. Tan, C.P.F. Garcia, L.T. Fabellar, and Z. Lu

By 2020, the world will require about 500 million tons of milled rice a year. To achieve this, production will need to average 5 tons per hectare. Farmers, however, are constantly challenged by insects that cause losses in production. The regular application of prophylactic insecticides may get rid of these pests, but, at the same time, it will destroy ecosystem services and cause planthopper outbreaks. It will also induce rapid development of insecticide resistance. In the past 10 years, we have witnessed this type of insecticide resistance against some active ingredients. Note that insecticide resistance can be a major threat to the sustainability of rice production. Scientists will need to constantly monitor its development in order to design and implement strategies to manage the problem. In the field of insecticide toxicology, it is important that experimental techniques be well established and properly used to eliminate errors arising from biotic and abiotic variations in these methods.

This book will be an important tool for scientists, professors, and students involved in insecticide toxicology and research on insecticide resistance. IRRI thanks the Asian Development Bank for providing technical assistance that has made this publication possible.

A CD version of the book is available for sale. To order online, please e-mail RiceworldBookstore@cgiar.org. Also, see http://snipurl.com/planthopper_monitoring.





Rice Today around the world

1. **THE ADVENTURER. IRRI photographer Isagani Serrano packs *Rice Today* among his many essentials during his trip to the Taj Mahal in Agra, India.**
2. **THAIFEX 2011. *Rice Today* managing editor V. Subramanian is all smiles as he brandishes a copy of the magazine at the THAIFEX-World Food Asia 2011 in Bangkok, Thailand.**
3. **SUMMER LOVIN'. *Rice Today* and Communication and Publications Services summer trainees cozy up with Filipino crooner Nyoy Volante.**
4. **VALLEY OF THE ROCKS. Wearing his cool *Rice Today* shirt and IRRI hat, former director for program planning and communications Dr. Michael Jackson is unfazed by the hot sun, while traveling in the Monument Valley of Arizona and Utah in Southwestern U.S.**

A rice breeder's odyssey from surfer to scientist—and onward to "Mars"

by **Gene Hettel**

STRASA

David Mackill grew up in San Diego, California, in the 1960s and early '70s, enjoying the life of a surfer on the nearby Pacific coast. "I spent a lot of time on the waves and quite a bit of time being 'submerged' by the waves," he said, fondly recalling his surfer days. "And, I sometimes thought, 'it's too bad there isn't a career in this.'" Little did he know then, that—using the operational word "submerged"—he indeed would end up in a profession that would ultimately enable him to improve the lives of millions of rice farmers in Asia and beyond!

Father of the *SUB1* gene

Flash forward about 40 years to Tilaktajpur (photo *above*) and Samauta villages in Bihar State situated in northeastern India. In this region, vast expanses of rice fields are annually prone to total crop losses due to serious flooding or "submergence" of the plants. When farmers from these areas heard that Dr. Mackill was in India, they invited the former principal scientist and plant breeder for the International Rice Research Institute (IRRI) to visit them in their fields. When he arrived in Samauta village, many hailed him as their "messiah" and the "father" of the *SUB1* gene.

These farmers had started planting Swarna-Sub1, a new submergence-tolerant rice variety, during the 2009-10 growing season. They had received the seeds through Rajendra Agricultural University in Pusa, Bihar, under IRRI's *Stress-Tolerant Rice for Poor Farmers in Africa and South Asia* (STRASA) project.

During that cropping season, many rice fields around the villages were flooded for 8 to 12 days and the crop failed completely. However, some farmers who had planted Swarna-Sub1 in the same areas and experienced the same submergence were surprised to see the rice plants in their fields rapidly regenerate after the water receded. The farmers harvested 5–6 tons per hectare from their fields and found the new submergence-tolerant rice to have good cooking quality as well. They called it a "miracle variety"—a variety that Dr. Mackill and his colleagues at IRRI were responsible for developing.

"The farmers also shared their experiences and concerns with me," Dr. Mackill recalled. "Many of the farmers in Samauta village were excited about growing Swarna-Sub1 in the forthcoming season, which has started in June 2011. I thanked them for their invitation to visit them and promised that their feedback will help in our further research to improve rice."

Later, upon hearing about Dr. Mackill's interactions with the Bihar farmers, IRRI Director General Robert Zeigler commented: "The gratitude of the farmers expressed towards Dave is a profound reminder and endorsement of what IRRI is all about."

Those particular encounters also fulfilled a young surfer's dream to do something one day that would have a lot of impact and help people. As he planned his university studies back in 1972 to achieve that dream, Dr. Mackill began to look into agriculture and the agricultural sciences.

Rice by chance

He started college at UC San Diego, but then switched to the large agricultural college at UC Davis, the University of California campus just west of the state capital of Sacramento. "I was always interested in genetics, which was one of my best subjects in the biological sciences," Dr. Mackill said. "Fortuitously, I put genetics and agriculture together and came up with plant breeding. One thing I like about plant breeding is that it is kind of an art. It is not just confined to analyzing data; you never really know what is going to come out of your efforts."

During the time he was an undergraduate in college (1972-76), the international agricultural research centers were becoming well known for their work on the hunger problem in the world. IRRI, of course, was at the forefront of the Green Revolution in Asia. So, this came to his attention early on.

"More or less by chance, I ended up getting a job working as an undergraduate in a rice research project involving genetics at UC Davis," recalled Dr. Mackill.

While at UC Davis working on rice, the budding plant breeder got to know some of the people who occasionally visited from IRRI, including Gurdev Khush, future World Food Prize Laureate and IRRI rice breeder and principal scientist, 1967-2001; and Ronnie Coffman, IRRI plant breeder, 1971-81, and currently chair of Cornell University's Department of Plant Breeding and Genetics, and director of International Programs. Soon, he would be a colleague of both.

"I became aware of a project of the Rockefeller Foundation that gave students fellowships to work overseas at one of the international centers," said Dr. Mackill. "So, in 1978, Ronnie Coffman helped me set up my thesis research on heat tolerance in rice at IRRI."

After obtaining his PhD in genetics in 1981, he went job hunting still very interested in agriculture. He got an opportunity to work on sorghum as an international intern at the International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT). "I found that dealing with sorghum was quite different from working on rice and I missed IRRI," he said. "So, about a year later, when IRRI expressed an interest that I come back to the Philippines, I jumped at the opportunity to join IRRI's Plant Breeding Department as a breeder working on rice improvement for rainfed lowland conditions and the genetics of resistance to rice blast and tolerance for drought, problem soils—and submergence."

Bringing the Green Revolution to more farmers

His new job at IRRI was to try to bring the Green Revolution to probably more than half of the world's rice farmers who, as of the early 1980s, had not yet benefited from the new short-statured rice plants. The new varieties were not suited to the field-submergence conditions that prevailed in the densely populated deltas, estuaries, and river valleys of India, Bangladesh, Myanmar, Thailand, Cambodia, Vietnam, and Indonesia. There were other rice farmers in these same countries whose crops suffered due to drought and poor soils as well.

On the submergence front, Dr. Mackill pointed out that scientists had long known that an Indian rice variety, called FR13A, could survive a week or more of complete submergence, but conventional breeding methods were not successful in developing varieties popular with the farmers. So, he and his colleagues at IRRI and UC Davis—during his 1991-2001 stint there—began using marker-assisted selection (MAS) to transfer the FR13A submergence-tolerance trait to modern rice varieties. It turned out to be nearly a 30-year odyssey of ups and downs to achieve what now has farmers like those in Bihar so excited and grateful. This rice saga is aptly told in the 2009 article Sc*uba rice: stemming the tide in flood-prone Asia*, on pages 26-31 of *Rice Today* Vol. 8, No. 2.

When the article SUB1A *is an ethylene-response-factor-like gene that confers submergence tolerance to rice* was published in *Nature* (442:705-708, 10 August 2006), there was really tremendous excitement among the California and IRRI groups. "I was really pleased that this reflected the basic work that I started at UC Davis with Pamela Ronald and Kenong Xu in the Department of Plant Pathology there, and other colleagues at UC Davis and Riverside," said Dr. Mackill. "But it also included the work done at IRRI. That paper essentially recorded the development of Swarna-Sub1 and everyone's contributions. At that time, Swarna-Sub1 was so new that we didn't know how it would perform. But, since then, it has done rather well as, for example, the Tilaktajpur and Samauta village farmers can attest to."

Dr. Mackill thinks that, over the last several years, IRRI has been able to push the MAS technology to develop varieties that give farmers a better chance to have a decent crop when their fields are threatened by not only submergence but also other abiotic stresses such as drought and salinity.

IRRI researchers haven't found any single gene like the *SUB1* gene that bestows the same level of tolerance for other stresses, but they have, for example, found multiple genes that impart a significant drought tolerance. "By combining several of them," explained Dr. Mackill, "we can transfer a pretty good degree of multiple stress tolerance, for both submergence and drought, into a given popular variety that is already being used by farmers. Instead of introducing only the *SUB1* gene, a variety can now have two or three drought-tolerance genes in it as well."

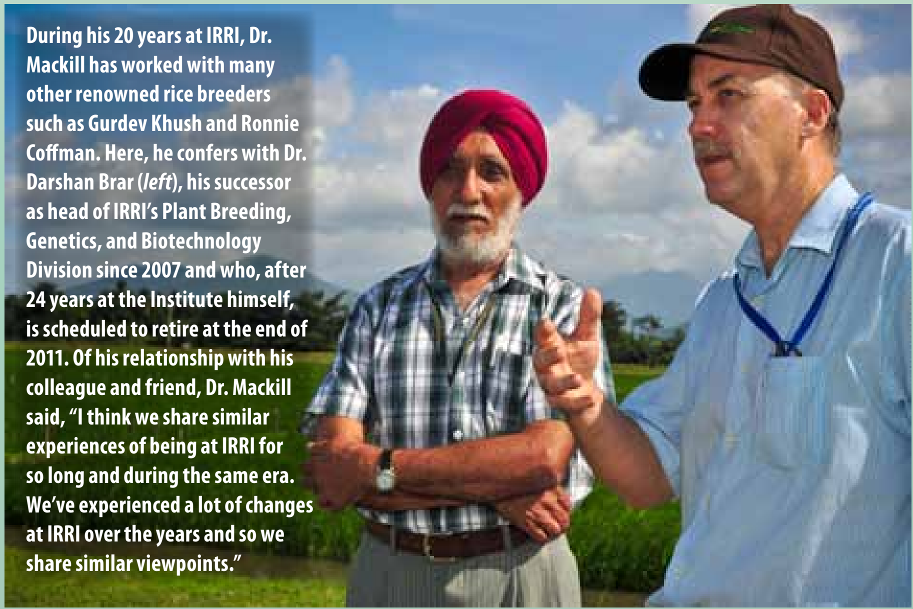
Onward to "Mars"

After nearly 20 years combined over two assignments at IRRI, Dr. Mackill has decided to try something new back home in California. "I don't know any scientist who has left IRRI previously who can say that he or she went to 'Mars' next, but that is where I've been since February," he smiled. "Mars Incorporated is a private company that owns, among many other enterprises, Uncle Ben's Rice."

In a press release, Marc Turcan, Mars Incorporated's vice president of R&D and supply, stated, "David will be the bridge between the company and the scientific community, initiating new research to advance global understanding as well as channeling the world's leading scientific expertise into Mars, to help us continually improve our sustainability and nutritional performance."

His future collaboration with IRRI was cemented with the announcement on 1 April that he had been appointed as a consultant to the Plant Breeding, Genetics, and Biotechnology Division at the Institute to assist in planning STRASA's Phase 2 work as well as to advise the Eastern India Rainfed Lowland Shuttle Breeding Network. The odyssey continues.

View Dr. Mackill's exit seminar at IRRI on YouTube at http://snipurl.com/mackill_seminar. His full IRRI Pioneer interview can be found at http://archive.irri.org/Mackill.asp.



CHRIS QUINTANA

During his 20 years at IRRI, Dr. Mackill has worked with many other renowned rice breeders such as Gurdev Khush and Ronnie Coffman. Here, he confers with Dr. Darshan Brar (*left*), his successor as head of IRRI's Plant Breeding, Genetics, and Biotechnology Division since 2007 and who, after 24 years at the Institute himself, is scheduled to retire at the end of 2011. Of his relationship with his colleague and friend, Dr. Mackill said, "I think we share similar experiences of being at IRRI for so long and during the same era. We've experienced a lot of changes at IRRI over the years and so we share similar viewpoints."

Head over heels in love—for rice

by **Leah Baroña Cruz**

In the incredibly small world of rice science, two hearts find their true love

LEAH BAROÑA-CRUZ

Somewhere within the halls of D.L. Umali Laboratory at the International Rice Research Institute (IRRI), two kindred hearts are smiling—Govinda Rizal and Shanta Karki, postdoctoral research fellows of the C_4 Rice Project.

The C_4 Rice Project is implemented by a team of experts from all over the world who look for a way to supercharge photosynthesis in rice and enable the plant to produce more grains than the current high-yielding varieties.

Part of this team, on whose shoulders rests one of the biggest challenges of rice research, are Govinda and Shanta, two scientists who found not only a passion for science but also a deep love for each other. And, although IRRI varieties have always been a labor of love for science, the time will soon come when we can perhaps say, these grains are also a labor of people in love.

Shanta

Shanta Karki, a native of Lamjung, Nepal, is a molecular biologist and plant breeder who came to IRRI in July 2009 to join the molecular engineering team of the C_4 Rice Consortium.

Shanta grew up in a farming community and was exposed very early to agricultural problems. She yearned to help find a way to increase crop yield and, hence, specialized in molecular breeding techniques, working on wild rice species.

Her affinity with agriculture started at a very young age. "My family planted rice, and, as a small child, I had fun playing with mud," says Shanta. "I was exposed to various areas of study as I got older but, somehow, I always knew I would end up in agricultural research."

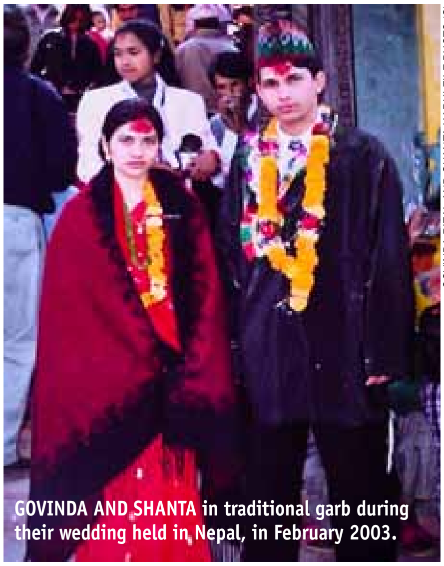
Did she always know she would end up with someone in agricultural research?

She smiles up to her ears and looks over at Govinda. He grins back.

Govinda

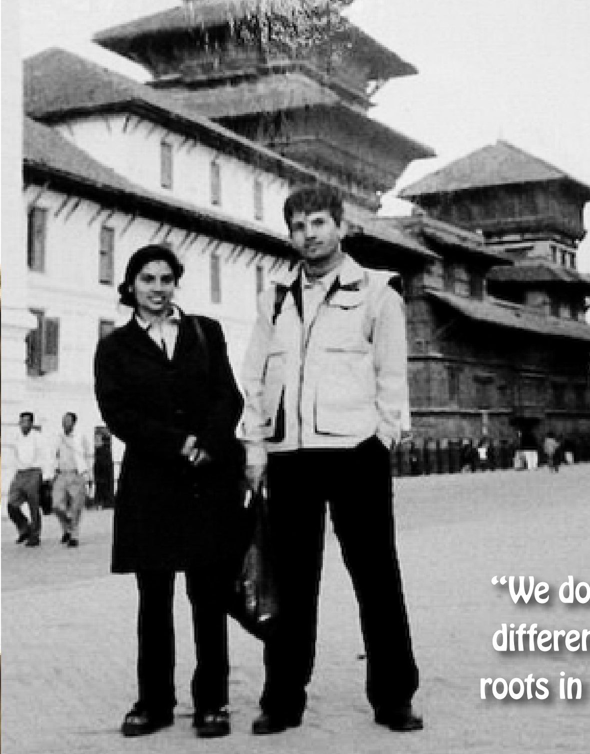
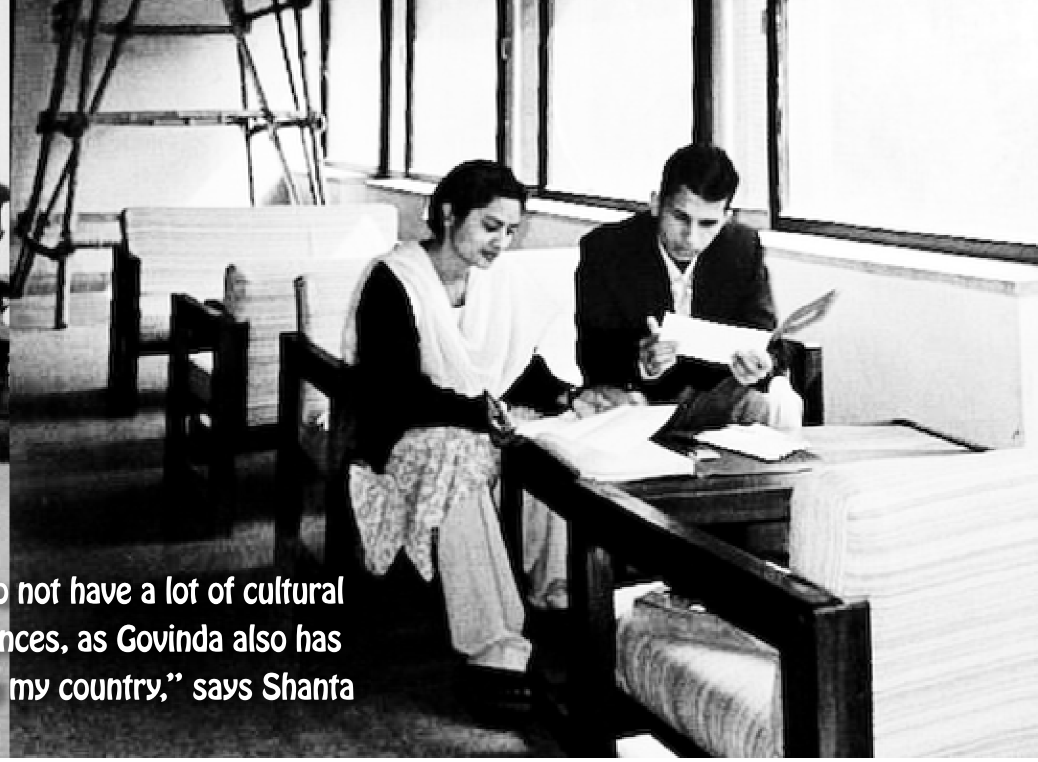
Govinda Rizal, from Lodrai in Gaylegphug, Bhutan, joined IRRI under the C_4 Rice Project in April 2010—less than a year after Shanta did. He is also a plant breeder whose experience includes work on rice, soybean, and wheat.

At IRRI, he "hunts" for genes for the C_4 syndrome among mutant sorghum populations. When his team finds such a gene, it is passed on to Shanta's team to insert into rice.



GOVINDA RIZAL AND SHANTA KARKI FILE PHOTO (3)

GOVINDA AND SHANTA in traditional garb during their wedding held in Nepal, in February 2003.

> "We do not have a lot of cultural differences, as Govinda also has roots in my country," says Shanta

BEFORE SAYING their vows, Govinda and Shanta enjoy a day out in Kathmandu, Nepal (*left*). The couple discusses crop yield data for a rural development project they were involved in at the Tribhuwan University Library in Nepal (2004).

Govinda had always wanted to pursue genetic engineering. As early as high school, he knew his mission was set. And yet, somehow, along the way, he made a few detours: he got himself a bachelor's degree from North Bengal University in India; taught high school in Kathmandu, Nepal; and worked as an editor for a mathematics journal and a university association.

Despite the meanders, his path ultimately led him to Shanta.

"Love" and "science"

These two words, laid down a mere word apart, are, as everything else, easier said than done. But, the two IRRI plant breeders prove that love and science do go together.

Govinda and Shanta met in 1998 as undergraduate students (for Govinda's second bachelor's degree) at the Institute of Agriculture and Animal Sciences in Nepal. Since then—even though they were not together at first—Shanta's and Govinda's lives have become inevitably intertwined.

"We were best of friends, for a long time," Govinda recalls, citing the friendship as the starting point for the attraction that later developed into something deeper.

Shanta, on the other hand, said she was drawn to him because "we were both interested in science."

Somewhere along the way, the two friends found they had more in common than a penchant for finding solutions to agricultural problems.

The two got married in February 2003, and then moved to Japan to do their master's and doctor's degrees in plant breeding at Kyoto University—on scholarships, alongside each other.

Common direction

When two paths merge and continue to advance in one direction without snags, it can mean only one thing—they were meant to be together. Govinda and Shanta have enjoyed a smooth relationship in the long time they have been together.

"We do not argue," says Shanta. "If he is upset, he becomes quiet. It's the same with me."

Govinda nods: "Even in my family, no one quarrels. It's just the way we were raised."

Was the match always one-to-one?

"We do not have a lot of cultural differences, as Govinda also has roots in my country," says Shanta. "The only thing, perhaps, is the way we like our food."

"I eat everything," Govinda starts, which Shanta finishes for him, "…except spicy food."

Shanta, on the contrary, always needs extra pickles, chili, and salt on the side. "Until now, I have to cook two different dishes for a meal."

Being with the C_4 Rice Project, Govinda and Shanta have, in fact, signed up on a common mission to help ensure that the world's population will have enough rice to go around long into the future. Is the difficult work ahead of them consistent with what they want for themselves?

"C_4 is a long-term endeavor, and I plan to continue working for it," Shanta says.

Govinda said that he had wanted to go back to Bhutan to help out, but eventually decided he no longer has to. "Working at IRRI, I feel that I am already working for my country."

The C_4 project evolved from an idea proposed by former IRRI scientist and now consultant John Sheehy and is now being led by Paul Quick.

If a project has a John and a Paul at the helm, can a George and a Ringo be far behind? Can Govinda and Shanta be our George and Ringo? Only time will tell. What we do know is that this couple is here to stay—for each other, and to ensure that there is enough rice in everyone's bowls long after the Beatles have all died.

To view Shanta's and Govinda's staff profiles, go to www.irri.org/govinda-rizal and www.irri.org/shanta-karki.

COUNTRY SNAPSHOT:

BRAZIL

Compiled by **Sophie Clayton** and **Péricles Carvalho Neves**

Brazil is the ninth-largest producer of rice worldwide and it is the biggest producer outside Asia (Fig.1). Brazil first reached rice self-sufficiency in 2003-04. Now, it imports and exports rice. In 2008, Brazil doubled its rice exports from the previous year to 400,000 tons—most of which went to Africa. Interestingly, Brazil exported only around 37,000 tons in 2004; so, it has increased its exports more than tenfold in just 4 years. But, in 2008, it imported around 615,000 tons.

Rice in Brazil is grown under two ecosystems: irrigated (75% of production) and upland (25% of production), and both have potential for expansion. Each system occupied around 50% of the total area of 2.9 million hectares in the 2010-11 cropping season. Since the early 1980s, there has been a steady reduction in upland rice areas and significant increases in irrigated rice area. Hence, although there was 50% less land (3 million hectares), rice production still rose by 50%—an enormous achievement in eco-efficiency (Fig. 2). Irrigated rice in Brazil represents indica subspecies, while upland cultivars are japonica.

The most important share of production comes from the subtropical-temperate environment of the south, under the irrigated system, accounting for 70% of Brazil's rice production.

Rice research in Brazil

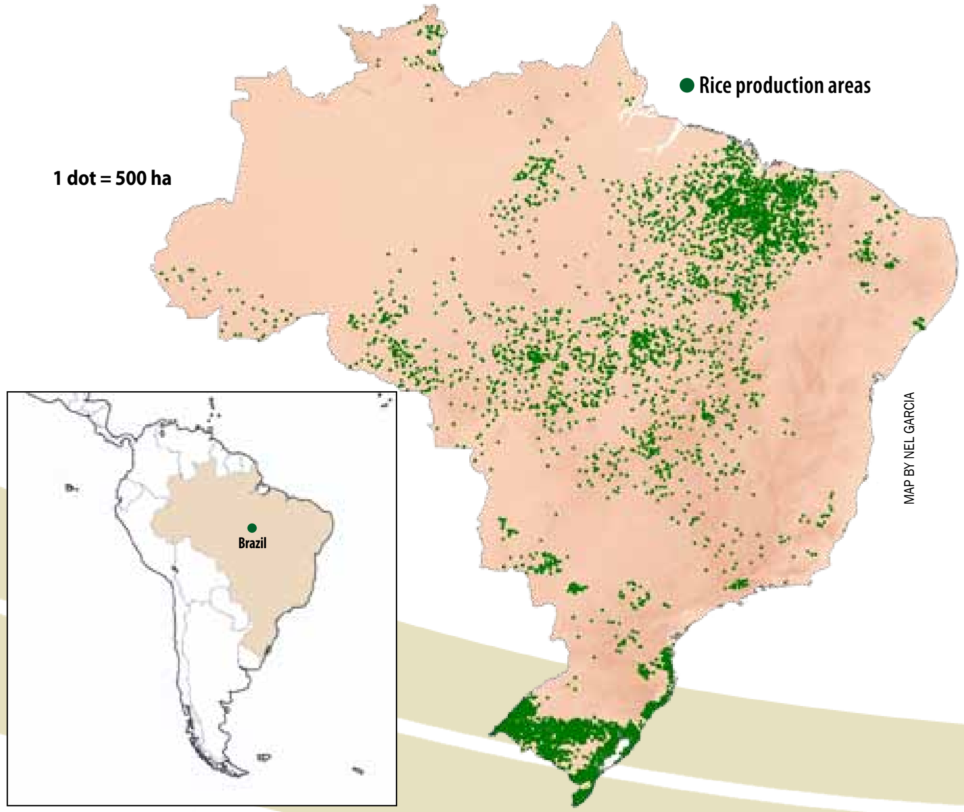
Three main public institutions are involved in rice variety development in Brazil: the Rice Institute of the State of Rio Grande do Sul (IRGA), the Santa Catarina *State Agricultural Research and Rural Extension Agency* (Epagri), and the Brazilian Agricultural Research Corporation (Embrapa) under the Ministry of Agriculture, Livestock, and Food Supply (see *The perfect marriage* on pages 18-19). IRGA was created in 1948, Embrapa in 1973, and Epagri in 1975.

PEGGY REIMCHEN

Rice breeding in Brazil

Several rice varieties have been released in Brazil. A total of 49 varieties were recommended for the 2010-11 cropping season from the 3 main public institutions. Of those, 7 were developed by IRGA, 7 by Epagri, 3 by IRGA and Embrapa, 2 by Epagri and Embrapa, and 30 by Embrapa (including 1 with the state institutions of Goiás and 6 with Minas Gerais). In total, 38 rice varieties have been developed for irrigated regions and 11 for the upland area. CIRAD germplasm contributed in 10 cultivars recommended for the upland system.

Hybrids delivered by RiceTec have been grown since 2003, and, in 2009-10, they occupied 34,000 hectares. Embrapa and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), a French research center working with developing countries to tackle international agricultural and development issues, released their first hybrid rice cultivar in 2010—a product of a joint research program.



MAP BY NEL GARCIA

In recent years, problems from contamination by red rice, the most important weed in irrigated areas, have pushed growers to use herbicide-resistant cultivars. Cultivar PUITÁ INTA CL, released in Brazil by BASF in 2008, occupied around 35% of irrigated rice fields in the 2009-10 cropping season. It was developed using IRGA 417 that was obtained from the cross of Newrex, IR19743-25-2-2, and BR-IRGA 409.

CIAT

The International Center for Tropical Agriculture (CIAT), established in Colombia, is the most important institution that introduces modern rice germplasm in Brazil, in both irrigated and upland systems. Out of 49 varieties released by the main public institutions in the market, 37 incorporate CIAT-originated germplasm. The most notable is BR-IRGA 409 that was released in 1978. It brought the indica's short stature, abundant tillering, long grains, and higher yields. BR-IRGA 409 has persisted in the market because of its remarkable grain quality.

FLAR

The Latin American Fund for Irrigated Rice (FLAR) is a public-private regional partnership founded to consolidate rice research and development in Latin America (see *FLAR synergy* on pages 40-41 of *Rice Today* Vol. 8, No. 3). As noted by its director, Mr. Gonzalo Zorrilla, FLAR has a grass-roots network of local institutions capable of focusing on applied research that can act as a bridge to bring new technologies to farmers (see *The new global rice agenda: A Latin American perspective* on page 46 of *Rice Today* Vol. 10, No. 1).

FLAR supports breeding efforts for the tropical and temperate zones of Latin America. However, it has taken on a particularly important role in undertaking agronomic research and technology transfer to boost yields. In alliance with IRGA, its partner in Brazil, FLAR helped transform crop management in Rio Grande do Sul, the southernmost state of Brazil, where average yields of a million hectares of rice have increased by 2 tons per hectare since early 2000 (see *Rice revolutions in Latin America* on page 38 of *Rice Today*, Vol. 6, No. 2).

Brazil: fast facts

Population (2011):	191 million[1]
Total land area:	851.5 hectares[1]
Land used for rice production:	2.9 million hectares[2]
Total rice production:	12.65 million tons[2]
Total rice consumption:	12.60 million tons[3]
Average rice consumption:	43 kg/person/year[4]

[1] IBGE-Brazil
[2] FAO, 2009
[3] Companhia Nacional de Abastecimento, Brazil, 2009
[4] Companhia Nacional de Abastecimento, Brazil, 2011

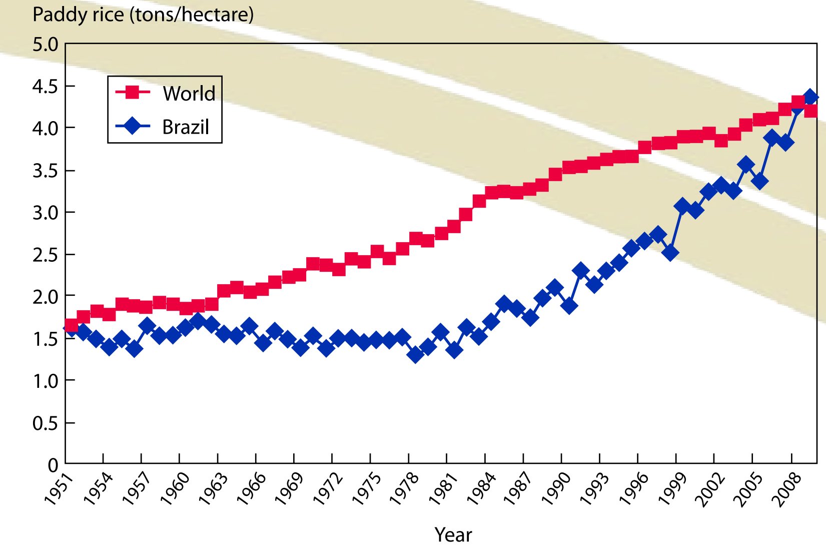


Fig. 1. Average rice yields (tons/hectare)

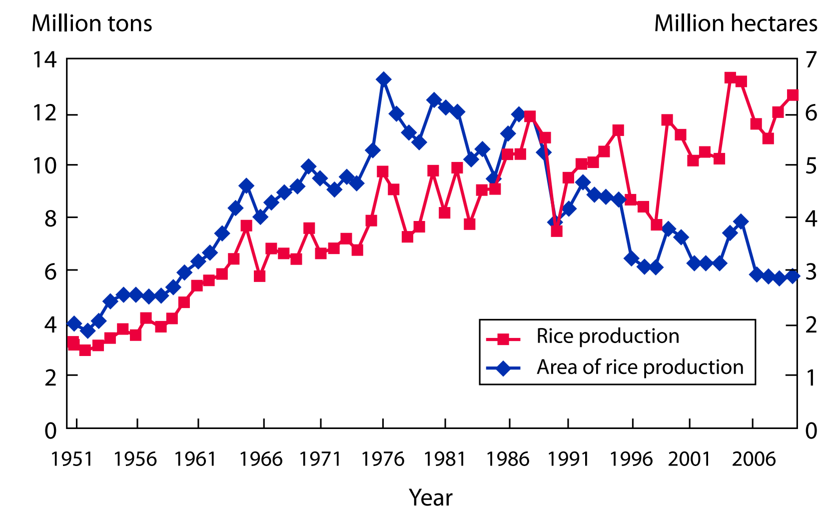


Fig. 2. Rice production area and quantity in Brazil.

IRRI

Through the Global Rice Science Partnership, the International Rice Research Institute (IRRI), together with its partners in the region, plans to play an increasing role in developing and delivering rice technologies to help advance the rice sector in Latin America, including Brazil (see *Blueprint for a greener revolution* on pages 18-21 of *Rice Today* Vol. 10, No. 1).

Acknowledgments go to Embrapa, CIAT, FLAR, Epagri, IRGA, and CIRAD.

Dr. Neves is a researcher for rice in Embrapa.

The perfect marriage

by **André Ribeiro Coutinho** and **Michela Okada Chaves**

Brazil develops a hybrid rice seed technology that weds good grain quality and high yield

THE EMBRAPA-Cirad hybrid seed production system in upland conditions at Sinop, Mato Grosso.

NEW HYBRIDS are achieving higher grain quality.

Worldwide, rice is an important staple food for billions of people. Since the demand for rice is projected to surpass supply eventually, researchers are challenged to develop ways to increase rice yield sustainably.

In China, hybrid rice covers about 60% of the total rice area, which thereby shows that this technology may represent one of the main strategies to meet the increasing demand (see *Hybridizing the world* on pages 32-35 of *Rice Today* Vol. 9, No. 4).

In Brazil, however, hybrid rice covers only about 2% of the total rice area and, therefore, it has considerable potential for growth.

In contrast to the Chinese technology of producing hybrid rice seed, which is based on hand-transplanting in small parcels, in Brazil, a high cross fertilization rate is desired, so it is essential that the parental lines have their flowering period synchronized by having the same vegetative cycle. As a result, extensive areas can be planted in a single operation, thus reducing costs. The success of this technology has a direct impact on the final cost of seeds, whose high prices are often one of the main constraints to adoption.

Moreover, this new seed production system in the upland conditions of Mato Grosso, in west-central Brazil, helped reduce the average market price of hybrid seeds. Notably, in Brazil, hybrid rice seed prices are about eight times higher than those of conventional seed. Hybrid rice seed sells for approximately US$8 per kilogram, thus making the technology almost out of reach for small farmers.

Furthermore, the new relationship model adopted between the Brazilian Agricultural Research Corporation (Embrapa) and its licensees involves close monitoring and intense training, which is a production system far more complex than that required for conventional seeds.

Meeting standards

Hybrid rice varieties have been made available to Brazilian farmers since 2003 by a private company. Yet, one of the greatest challenges for hybrids is to achieve the quality standards demanded by the Brazilian rice industry, especially in terms of head rice rate and cooking quality. This may be due to the stronger focus on yield adopted by most research programs. Nevertheless, yield in Brazil averages 7.6 tons per hectare under the irrigated conditions of Rio Grande do Sul and 3 tons per hectare in the upland production system of Mato Grosso.

Embrapa and the French Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) have established a partnership in order to research and develop hybrid rice of superior yield compared with conventional varieties, and with high-quality grain. In 2010, Embrapa and CIRAD released their first hybrid rice cultivar, named BRSCIRAD 302. It can yield up to 13 tons per hectare, with a head rice rate of about 64%, a smooth husk, and excellent cooking quality. The cultivar was recommended to the southern state of Rio Grande do Sul to be grown under irrigated conditions. To assess BRSCIRAD 302´s overall market performance further, and, aware of the existing negative perception on the quality of hybrid grains among the rice industry and growers alike, the Embrapa-CIRAD team carried out a two-round test with six large rice mills, to which coded BRSCIRAD 302 samples were sent. The results confirmed that the cultivar had an exceedingly high head rice rate, and very good cooking and visual qualities.

And, to understand better the concerns and prejudices about hybrid rice seeds, a survey and a focus group discussion were conducted in 2009-10 among growers from the main rice-producing area in the country. The results proved useful for designing a marketing strategy for the product.

"The perfect marriage between grain quality and yield" was the advertising slogan for BRSCIRAD 302, which was officially introduced in May 2010 at the 20th Fenarroz, a well-known national Brazilian rice fair. The launch was followed by direct marketing, broadcasting on radio stations, and advertising in local magazines and on rural Web sites. Also, several press releases were issued to supply ample knowledge to farmers and to motivate future adoption. The Web site (www.embrapa.br/hibridos) turned out to be an excellent channel for selling seeds as it facilitated contact between farmers and seed sellers. In fact, almost half of the sales came from growers who registered online.

Hybrids for the uplands

More developments are expected in 2011. BRSCIRAD 302 has been tested in upland conditions and the results are promising. In Sinop, in the state of Mato Grosso, production has reached 5 tons per hectare, a 40% increase over the average yield of conventional upland rice varieties. Today, Brazil has 1.4 million hectares of upland rice area.

The first BRSCIRAD 302 harvest began in March 2011. Some farmers reportedly faced hard negotiations with the rice industry because of the negative image that dogged hybrids in the market. Again, the preparation work proved to be worthwhile. Once they were able to appeal to the positive results of BRSCIRAD 302´s performance produced by the rice mills themselves, farmers were able to sell their produce without the usual price discounts given to low-quality grains.

BRSCIRAD 302 release for farmers at Fenarroz, Cachoeira do Sul, RS.

EMBRAPA (3)

Seed trials

Brazilian farmers usually test a new seed technology before deciding to adopt it on a larger scale. In its first year, BRSCIRAD 302 was tried in small areas by nearly every grower who had bought it. A good example of this took place at the Cooperative of Alegrete–CAAL, one of the many rice farmer cooperatives in Rio Grande do Sul. In order to assess the value of the different commercially available hybrid seeds, 20 hectares were planted with BRSCIRAD 302 under varying soil conditions at six associated farms. On 22 April 2011, CAAL organized a field day to show these varieties to farmers and the local press. According to Mr. Luciano Freitas, CAAL´s manager, this is a traditional strategy and the cooperative was very pleased with BRSCIRAD 302´s results. A marketing survey made among BRSCIRAD 302 grain producers has shown that many are satisfied with the yield and other plant aspects such as development, disease resistance, and lodging.

The history of hybrid seeds, their high prices, and mistrust in the industry show that adoption of hybrid rice technology in Brazil is likely to be slow. However, given the increasing number of companies in the business (two other private organizations also released hybrid varieties in 2011), it is reasonable to expect improvement from now on.

Perícles de Carvalho Neves, James Taillebois, and Ariano Magalhães Jr. contributed to this article.

Mr. Coutinho and Ms. Chaves are marketing analysts for rice and beans in Embrapa.

The Americas have two faces

by **V. Subramanian**

The changing trade in the Americas reveals recovering rice production in Brazil and a struggling crop in the U.S.

In 2010, the 4th The Rice Trader (TRT) Rice Americas Conference covered Brazil's poor production caused by unexpected rains and floods in late 2009, an expected record crop in the U.S., and the effort of the Southern Common Market, or MERCOSUR region (Argentina, Brazil, Paraguay, and Uruguay in this report), to help Brazil meet its shortfall—which meant giving up market share in key African and European rice markets. This year, however, it was the opposite. The 5th TRT Rice Americas conference in Panama revealed how the U.S. 2010 crop was eventually plagued with quality problems and how the current crop has been battered by floods around the Mississippi River and droughts in Texas in the Mid-South growing area.

Several analysts predict the worst for the expected U.S. rice output. The anticipated drop in yields caused by bad weather was aggravated by a decrease in rice area. Several farms also decided to move away from rice to plant soybeans, maize, and cotton. With these events, the TRT conference this year was not short of excitement. Delegates described quality problems seen from the imported American rice, with U.S. rice production expected to be lower, while South American production hit record highs, which could make up for the shortfall in the U.S.

Widespread risks

Conference Chairman and TRT President/CEO Jeremy Zwinger started the ball rolling with an explicit look at the risks, specifically the weather, currency, and the general state of the American and even European economies, and the well-documented turmoil that now grips the Middle East and North Africa.

"Risk has gotten more widespread," claimed Mr. Zwinger, "with rice trading no longer just about buying and selling rice." He said that buyers, sellers, and the broader rice supply chain are expected to face new challenges from increased risks that look set to keep global rice markets on edge. Although a good supply is available in 2011, Mr. Zwinger cited factors such as high oil prices, increasing wheat and maize prices, and a more volatile global food balance that will have an impact on rice markets. Comparing wheat, maize, and rice prices over the last 8 years, rice prices are relatively cheaper today than during the 2006-07 market years, which suggest a market imbalance that should result in lower wheat and maize prices or a higher price for rice.

Moreover, Mr. Zwinger noted that some analysts predicted a 40% reduction in the U.S. crop in 2011 because of the erratic weather in the country. Weather anomalies hit both the southern rice-growing regions and California rice belt.

Odd weather

Still on the subject of the weather, Elwyn Taylor, an extension agronomist from the Climatology and Meteorology Department of Iowa State University, revealed extensive studies on global weather patterns over a period of more than 100 years. Dr. Taylor suggested that the frequency and intensity of weather anomalies appear to be on the rise. Needless to say, crop output would be more difficult to predict in the future. He did, however, suggest that some quick tweaks to the way analysts combine

THE RICE TRADER (5)

DR. S. Elwyn Taylor | MR. JEREMY Zwinger | MR. NICOLAS Rubio

MR. ZWINGER (*far right*) and Mr. V. Subramanian (*middle*) with delegates from the Colegio de Ingenieros Agrónomos de Panamá.

OVER 350 delegates from various countries attended the TRT Rice Americas 2011.

weather developments with crop analysis could also yield more accurate forecasts that could aid planning.

Brazil's crop recovery

Tiago Sarmento Barata, a rice market analyst at Agrotendências Consulting in Agribusiness, highlighted a record crop in Brazil. In stark contrast with its 11.6-million-ton production last year, which represented an 8.3% drop compared with that of 2009 (see *Pressure in the South* on page 17 of *Rice Today* Vol. 9, No. 3), this year Brazil produced 23.3% or 2.3 million tons more than in 2010. With 13.9 million tons (milled equivalent), the country's production even surpassed its domestic consumption of about 12.5 million tons (milled equivalent). More interestingly, Mr. Barata revealed that, as a whole, the MERCOSUR bloc produced a total of 17.64 million tons, which more than cover the region's consumption of 14.31 million tons. MERCOSUR is then left with an exportable surplus of 3.33 million tons. Quite significantly, in 2011, Argentina and Uruguay will have a lesser role to play as suppliers to Brazil. This suggests that the region will have more rice to export to Africa, Europe, and within the Americas. However, Mr. Barata pointed out that exports will face restrictions in terms of logistical limitations, especially since Brazil will also compete for shipping capacity with its own lucrative soybean exports.

Looking forward to 2012, Mr. Barata projected that Brazil's production would fall by 10% because of the high costs of rice production. He further explained that the high cost and need for subsidies to support farmers and export programs would limit production growth in the future, in favor of other more profitable crops such as soybeans. To this effect, the excess rice available for exports from the MERCOSUR region will likely see a record export year in 2011, with more exports expected to reach Africa, the Middle East, Europe, and several markets in the Americas, which will have a South American supply option to consider at a time when the U.S. market looks plagued with quality and supply problems that could carry over to 2012 production.

The struggling U.S. crop

Nicolas Rubio, an international economist of the Foreign Agricultural Service of the United States Department of Agriculture, pointed out that the U.S. had a record production in 2010, but it suffered from quality and disease problems, thus resulting in a near-record-low milling rate. Consequently, demand for U.S. rice weakened, leaving the country with an ending stock of 1.75 million tons (milled basis)—the highest since 1986. The 2011 production has not fared any better as weather-related damage and some shift in area away from rice in favor of other crops have resulted in an estimated 22% drop in production compared with 2010. Supplies, however, are expected to remain unchanged, as the carryover from 2010 production helps offset the drop in 2011 production.

Although Mr. Rubio suggested an estimated 3.4 million tons of rice exports in 2011, several delegates questioned the production estimate, noting that some analysts projected a 35–40% decline in production. The low quality of the carryover stocks was also challenged in terms of their "acceptability" in the market and price. Several buyers revealed that the higher-than-usual "chalkiness" seen in U.S. rice exports, and other quality issues, have created some reluctance in accepting U.S. rice.

Volatility ahead

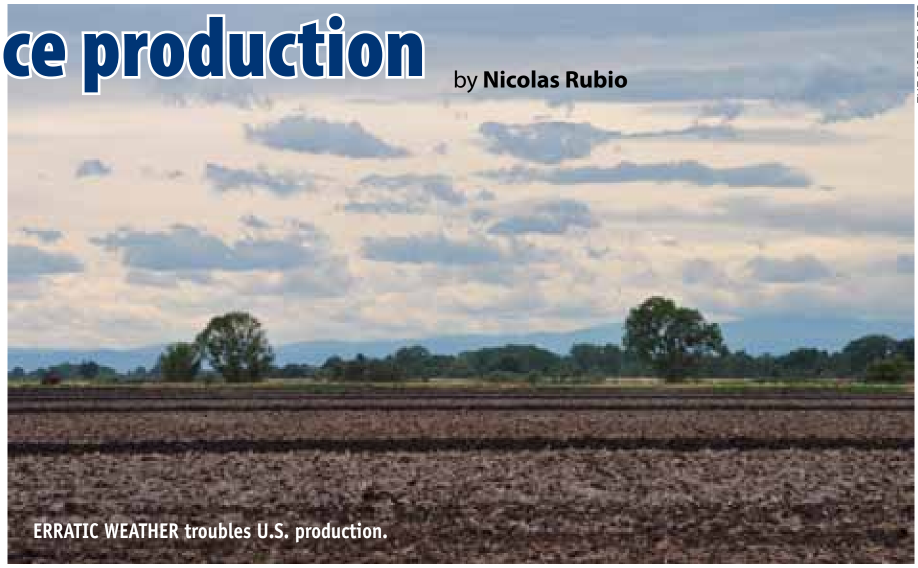
To sum up, the U.S. saw a fall in production, from a record 2010 crop to a smaller 2011 crop. Now, it faces more challenges, as the quality issues have dented U.S. rice's export potential. Meanwhile, MERCOSUR's 3.3 million tons of export availability looks likely to not only affect Asian sales to Africa but also attract buyers from the Americas to consider the South American option, which many have said to be of very good quality—certainly in comparison with U.S. rice.

The issues debated at the conference revealed global rice production's susceptibility to weather-related impacts. Although the rice supply, for the moment, looks good, the increased risk in commercial markets, a tightening global cereals market, and the fact that the lowest grade of rice (from Myanmar) trades at a $100-per-ton premium compared to 2010 suggest a global rice market that could quite easily struggle against volatility. In the near term, the two most important events that are expected to shape the trends in the market are India's decision whether to lift the ban on nonbasmati rice exports or not (expected after the monsoon season is over and once crop output for 2011 is better known) and Thailand's rice policy, which is expected to change depending on the results of the national elections on 3 July.

The Americas

A look at U.S. rice production

by **Nicolas Rubio**



THE RICE TRADER

ERRATIC WEATHER troubles U.S. production.

Despite the record crop in the United States in 2010, the very hot summer last year caused quality and disease problems that hit U.S. production hard. This resulted in near-record-low milling rates, weaker demand for rough rice from some Central American markets, record sales of brokens to sub-Saharan African markets, and the highest U.S. ending stocks since 1986, most of which are long-grain rice.

Regarding 2011-12 production, as of 9 June, the United States Department of Agriculture (USDA) projected that rice area would be smaller at 1.28 million hectares because of the floods in the Mississippi River Delta and shifts away from rice to grow more profitable crops this year. Arkansas and Missouri account for most of the decline in area, mainly in long-grain rice production. With rice yields estimated at 7.89 tons per hectare, the USDA forecast a rough production of 9.05 million tons, which is about 22% lower than that of 2010-11.

However, in spite of the drop in production, the level of U.S. supplies is almost unchanged. The current volume is the second-largest on record. The large carryover stocks in 2011-12 will offset the lower production.

Quite significantly, U.S. rice consumption is virtually flat. As a result, exports are extremely important. Close to 60% of U.S. exports go to Mexico, Canada, Haiti, Central America, and Japan. Except for Japan, these are all long-grain markets and they will continue to be important to the U.S. The country's rice industry is also trying to expand its market share in places such as Venezuela and other markets in South America. Exports are forecast to be 3.4 million tons (milled basis), slightly lower than in 2010-11.

The little giant

by **Tiago Sarmento Barata**

COURTESY OF IRGA

For the past 3 years, the Southern Common Market, or MERCOSUR region (Argentina, Brazil, Paraguay, and Uruguay), has caught much of the global market's attention. The 19.8% increase in the region's production, its expanding share in the international rice market, and its highly valued quality rice have made it recognized as a major player in the global market.

Many non-MERCOSUR rice players regard the region as a "little giant." The region is considered a competitive alternative supplier of excellent-quality rice.

MERCOSUR has a great potential in improving significantly its production capacity because it still has huge areas of land available and an abundant supply of water. However, rice production is limited by other crops grown on large areas such as soybeans, maize, cotton, and sugar cane because these crops are more profitable.

Notably, the relationship among the MERCOSUR countries has changed over the past years. In 2010, when the rice produced in Brazil was not enough to meet its domestic demand, it was quite natural for Uruguay and Argentina to fill the gap. It could be said that there was a synergy within the bloc: Brazil absorbed—in a much adjusted manner—the surpluses of the neighboring countries. However, things have now changed.

In the past 5 years, Brazil's rice crop soared by 15.4%, while consumption fell by 2.8%. The country achieved self-sufficiency and surpluses began to accumulate. Consequently, prices in the domestic market plummeted and Brazil was no longer an attractive market for Uruguay and Argentina.

Meanwhile, Paraguay is building its production capacity. Five years ago, it produced very little rice. But, now, it harvests approximately 270,000 tons (milled rice) of excellent quality.

In light of this, exports to countries outside the bloc have become an obsession among MERCOSUR traders. In 2011, their total exports are projected to reach 2.3 million tons (milled rice). The sales of Brazil are expected to reach 680,000 tons, which involves increasing parboiled rice shipments to Africa and higher sales to Central America, other countries in South America, and Europe. Meanwhile, Uruguay and Argentina are estimated to export 850,000 tons and 816,000 tons, respectively, mainly to the Middle East, other countries in South America, Central America, Europe, and Africa.

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Farmers push a rickshaw laden with sacks of paddy on a steep part of the road in Satkhira, Bangladesh. The flat wooden platform of this three-wheeled carriage makes it so versatile that it can carry almost anything, from people to pieces of furniture and farm produce such as rice and coconuts, among others. The rickshaw is the most common form of transportation in the country.

Bangladesh combats the WHITE PLAGUE

Story by **Lanie C. Reyes**
Photos by **Isagani Serrano**

Salt may be a blessing to good cooking, but, in rice cultivation, it is a deadly sin

Each year, during the boro season (November-May), salinity is so high that a white film of salt covers paddy fields in the coastal areas of Bangladesh. For Bangladeshi farmers, this white color on top of their soil is a warning sign that their land is "sick." Salinity is even dubbed the "white plague" in Australia's newspapers and magazines, which indicates the seriousness of the problem when it strikes.

Salinity affects around 1 million hectares in Bangladesh. Some climate experts say that sea-level rise will cause the country's landscape to become "sicker."

No other country in South Asia is more vulnerable to sea-level rise than densely populated Bangladesh.[1] With higher sea level, more areas would be affected by cyclonic surges; inland freshwater lakes, ponds, and aquifers could also be affected by saline-water and brackish-water intrusion according to the Intergovernmental Panel on Climate Change.[2]

Md. Lutfor Rahman, a 62-year-old farmer in Satkhira, is not an alien to salinity. "Everything is lost to salinity," Mr. Rahman said with a sigh. He was referring to the 10,000 taka (US$135) and the labor he had invested in his 0.2 hectare of land. Now, his family is left with nothing but a cow. "These rice stalks will be used as her feed," said Mr. Rahman.

His next step is to find a job as a laborer and earn a daily wage of 150 to 200 taka ($2–3). "But, only God knows how soon that will be," he added.

The salty challenge

Salt as a seasoning goes well with rice—especially in developing countries, where the poor use salt as a dish to accompany their boiled rice. But, in rice cultivation, salt has a negative effect. Once salt gets to the roots, it becomes detrimental to the whole plant.

According to Dr. R.K. Singh, International Rice Research Institute (IRRI) plant breeder who is now based in Africa, there are two ways to combat the problem of salinity—either change the plant's growing environment (make it normal) or change its genetic architecture so that it can grow in such areas.

"The first approach requires major engineering processes to improve soil quality, which are often expensive for small and marginal farmers," Dr. Singh said. "The second approach, which is breeding crop varieties with *built-in* salinity tolerance, is the most promising. It needs fewer resources, is economical, and is socially acceptable."

For IRRI, making plants tolerate salt stress, up to an extent, is the way to go. The Institute has invested its resources for many years to develop varieties that can solve farmers' problems in saline-prone areas.

Farmers' defense

It has been more than a decade now since the discovery of *Saltol*—a gene that confers salinity tolerance (see *Less salt, please* in *Rice Today*, Vol. 6, No. 2). Glenn Gregorio, an IRRI plant breeder, credited most of salinity tolerance to the development of IR66946-3R-178-1-1, popularly known as FL478. The *Saltol* gene had been incorporated into this variety, and had shown significant tolerance of salinity.

Since then, through molecular-assisted breeding, the IRRI multidisciplinary team on salinity tolerance composed of physiologist Abdelbagi Ismail, molecular biologist Mike Thomson, Dr. R.K. Singh, and Dr. Gregorio as well as country partners in Asia and Africa were able to introgress *Saltol* into popular rice varieties.

One of these varieties is BRRI dhan47, which was released in Bangladesh in 2007. It is an IRRI-bred variety, labeled as IR63307-4B-4-3, which was evaluated and released by the Bangladesh Rice Research Institute (BRRI) in collaboration with the IRRI team for salinity tolerance now headed by Dr. Gregorio.

"The development of BRRI dhan47 is one of the best results of a strong collaboration between IRRI and BRRI," said Dr. Md. Abdul Mannan, BRRI director general. "The transfer of materials from IRRI that can perform in stress conditions and the Institute's assistance in our manpower development through both short- and long-term training have played a key role in this project."

"Now, BRRI dhan47 is creating enthusiasm among Bangladeshi farmers in coastal areas because it is helping them alleviate their poverty and secure their food for the whole year," said Dr. Md. Rafiqul Islam, principal plant breeder on salinity tolerance at BRRI.

Just a bund away from Mr. Rahman's farm, a 0.4-hectare rice field is teeming with ripening rice grains. It is owned by Sirajul Islam, 50. Just like Mr. Rahman, he experimented by planting different kinds of varieties each season, hoping that one could survive the land's salinity.

BRRI dhan47 helps farmers like Md. Lutfor Rahman to overcome salinity in Bangladesh.

[1] Sarwar GM, Khan MH. 2007. Sea Level Rise: A Threat to the Coast of Bangladesh. Internationales Asienforum. Vol. 33 (3–4):375-397.
[2] www.ipcc.ch/ipccreports/sres/regional/300.htm.

The only difference between them is that Mr. Islam tried BRRI dhan47.

"With the way my rice is growing now, I am expecting a good harvest," Mr. Islam said.

"BRRI dhan47 is better," Mr. Rahman readily agreed.

Another farmer in Satkhira, Abu Abdullah, 35, was also enthusiastic. He had good reasons. Three years ago, he could not harvest anything because his fields had become too "salty" for his regular variety. During those lean years, he borrowed money even at a very high interest rate of 2% per week.

He said that he was more than happy to see that rice could once again grow on his "salty" land. And, he is expecting to harvest 4 to 5 tons at the end of the boro season.

Now, Mr. Abdullah hopes to start repaying his loans. "I may not be able to write off all my debts immediately, but, at least, I can program my payments in 2 years," he said.

Just like most farmers in the world, Bangladeshi farmers are mostly subsistence farmers. They cultivate rice on a piece of land for their food.

"When salinity strikes, they can no longer grow food and they can't afford to buy food," explained Dr. Islam. "For these people, there is no option. For them, the difference of having salinity-tolerant varieties is between nothing and something."

And, this "difference" could eventually have an impact nationwide.

(*Left to right*) **DR. MD. Rafiqul Islam, plant breeder; Dr. Md. Khairul Bashar, director for research; Dr. Md. Abdul Mannan, director general of BRRI; and Dr. Glenn Gregorio, IRRI plant breeder, discuss the traits of BRRI dhan47 at BRRI research station in Gazipur District, Bangladesh.**

"Our food security depends entirely on rice production," said Dr. Md. Khairul Bashar, BRRI director for research. "Even if salinity-tolerant varieties cover only half a million hectares that are affected by salinity, the effect will be tremendous," he added.

Dr. Gregorio is also happy to see this positive result because to make rice withstand salinity is the heart of his team's job at IRRI. "Seeing our work in the field gives us this great feeling of fulfillment," he shared.

"Humble" rice

Aside from its yield, farmers prefer BRRI dhan47 because of its erect flag leaves. Dr. Gregorio described it as a "humble" variety. At a distance, the grains are not noticeable at once because of the crop's green, erect flag leaves on top of the rice fields. But, hidden just below the green flag leaves are stooping panicles heavy with round fat grains—making the grains less conspicuous to birds.

"BRRI dhan47 is not a lodging type," said Dr. Islam. "It remains erect when some varieties bend over from the force of a strong wind.

"The farmers also like its long stalks of 100–110 centimeters, which stay green even at maturity, because they use them as feed for their cattle and roof thatches for their homes," he added.

SALINITY-TOLERANT BRRI dhan47 is not a lodging type, has erect flag leaves, which hide its grains from the birds, and long, green stalks that can be used as roof thatches and feed for the cattle. It can yield 4.0 to 7.2 tons per hectare.

To the rescue

BRRI dhan47 also made its mark in helping the lives of Bangladeshi farmers when cyclone Aila decimated the rice fields in the southern part of the country in 2009. Aila brought with her sea water that encroached on ponds and rivers. "Some fields remained flooded by sea water for some time, thus increasing the salinity in the soil," Dr. Islam said.

The variety was then considered as a solution by the United Nations Food and Agriculture Organization (FAO) to help Bangladeshi farmers recover from the disaster. FAO, through the Department of Agricultural Extension, distributed 62.5 tons of BRRI dhan47 seed to 15,000 farm households affected by the cyclone.

Afterward, an FAO-commissioned study assessed the performance of BRRI dhan47 in the Aila-affected southern region.[3] The results showed that BRRI dhan47 did perform well. Being able to tolerate salinity up to 12 deci-Siemens

[3] Islam SMF. 2010. Impact Assessment Report of TCP/BGD/3204(E): A Focus on Performance Assessment of BRRI dhan47 in the South. Dhaka. FAO. 42 p.

per meter, the variety was able to give farmers a good harvest that ranged from 4.0 to 7.2 tons per hectare, with an average of 5.5 tons. It is found to be profitable, with an average net return of 35,693 taka ($483) per hectare and a mean benefit-cost ratio of 1.73.[4]

Version 2.0

Without a doubt, BRRI dhan47 has made a positive impression on farmers. But, "BRRI dhan47 is not a perfect variety," stated Dr. Gregorio. "Just like an electronic gadget, it is just the 'first model.' The next variety will be even better."

Achieving a better model, however, requires knowledge of what farmers like or how farmers define a "better" variety. This is why IRRI plant breeders, along with their national partners, involve farmers in a process called participatory varietal selection (PVS).

Through PVS, plant breeders were able to learn that, aside from salinity tolerance, farmers in Satkhira prefer the long, slender type of rice grains, while farmers in Sonagazi like short, bold ones. Farmers also favor the nonshattering type of variety because they carry newly harvested panicles from their fields to be threshed at their homes.

Although farmers are satisfied with the amount of rice that BRRI dhan47 yields, it goes without saying that farmers desire a better-yielding salinity-tolerant variety in the future.

Good seed

Saltol contributes about 45% of the salinity tolerance in rice. But, even with this quantifiable success, Dr. Gregorio and his team continue to roll up their sleeves in order to pinpoint the location of the gene on the chromosome. Their aim is to improve the performance of salinity-tolerant varieties and to minimize trial and error in breeding. So, they have embarked on fine-mapping and marker-assisted backcrossing for the *Saltol* gene.

Using new sources of germplasm in mapping more quantitative trait loci (QTLs) for salinity tolerance, they discovered major QTLs on chromosomes 1, 7, 8, and 10. And, they were able to identify three putative candidate genes, *SKC1*, *SalT,* and *pectinesterase*.

"We are presently working toward identifying and combining more genes related to salinity for more stable tolerance," Dr. Gregorio said.

For Dr. Gregorio, developing these varieties for farmers is important. "Everything starts with a good seed," he said. "One may have good management practices, but, if the seed is not tolerant of a stress like salinity, it will fail. A good seed, however, even with fewer good management practices, can yield something somehow."

A FARMER signs up for the participatory varietal selection activity in Pirojpur District, Bangladesh.

Moreover, good seeds enable farmers to be more confident in investing in their crops—applying some inputs such as fertilizers.

A dynamic business

BRRI dhan47 has attracted more players in the business of development. Extension workers from the Department of Agricultural Extension in Bangladesh played an important role in creating awareness about BRRI dhan47. Nongovernment organizations were also involved in extension work and helped in the distribution of seeds.

Even the private sector has played a critical role in the wider and more sustainable adoption of this technology. How? When private companies produce and sell salinity-tolerant seeds, they help ensure that seeds that get to the farmers are "pure and certified" and of high quality. Otherwise, if low-quality seeds reach farmers, the credibility of the technology will naturally suffer.

Too much is at stake when it comes to the delivery of a technology that combats climate-related problems such as salinity. Once salinity reaches the soil and water in farmers' rice fields, it can literally obliterate rice production in just a few days.

Because salinity is a real threat to farmers' food security, IRRI, through its projects, such as the Consortium for Unfavorable Rice Environments (CURE), now funded by the International Fund for Agricultural Development, and Stress-Tolerant Rice for Poor Farmers in Africa and South Asia (STRASA), which is funded by the Bill & Melinda Gates Foundation, facilitates and coordinates the efforts of these different stakeholders in order to distribute seeds of stress-tolerant rice varieties, including BRRI dhan47, to more farmers the quickest way possible.

"As of now, more than 500 tons of BRRI dhan47 seeds have been produced and distributed through STRASA partners in south and southwest Bangladesh over the last 2 years," said Dr. Umesh Singh, senior scientist and STRASA regional coordinator for South Asia. "Approximately 450 tons of seed have been produced during the 2010-11 boro season, which will be available to farmers in the next crop season."

The outlook for the future through the lens of climate change seems bleak, and maybe even scary for rice production in coastal areas. More areas may be affected by salinity. But, with climate-change-ready rice varieties such as BRRI dhan47, the future is brighter. As the "first model" that can combat salinity, BRRI dhan47 is a good start in securing this staple food in saline-prone areas of Bangladesh.

[4] Comparison of the present value of an investment decision or project with its initial cost. A ratio of greater than 1 indicates that the project is a viable one.

Governments, individuals, and organizations, including IRRI, come together to secure the world's food in a frozen cellar located just over a thousand kilometers away from the North Pole

Mankind takes a giant leap—AGAIN

by **Ma. Lizbeth J. Baroña**

THE VAULT amidst the vastness of the cold, icy surroundings.

The first was a footprint on the Moon. The second one is a freezer.

This *freezer,* however, is one dug deep inside a frozen mountain about 1,130 kilometers from the North Pole, in the archipelago of Svalbard, Norway. Tucked away in this giant refrigerated vault is the foundation of humans' food—seeds.

Neatly packed and frozen to withstand hundreds of years of storage and just about any conceivable destructive force known to humans are duplicates of seeds of different crops from all over the world, including more than a hundred thousand seeds of different rice types.

The International Rice Research Institute (IRRI) sent its final batch of rice seeds to the Svalbard Global Seed Vault, dubbed the "Doomsday Vault," in November 2010. IRRI deposited the largest shipment of 70,180 for the inauguration of the Vault in February 2008. Following its last shipment, IRRI now has the largest number of accessions, amounting to 112,807, for any single crop and its wild relatives kept in the Vault. These are duplicates of the rice diversity conserved in IRRI's International Rice Genebank (IRRI-IRG).

Dr. Ruaraidh Sackville Hamilton, evolutionary biologist and IRRI's T.T. Chang Genetic Resources Center head, assures that IRRI takes every reasonable measure to make the collection in the IRRI-IRG safe.

"The IRRI-IRG is earthquake-proof, typhoon-proof, and flood-proof," Dr. Sackville Hamilton explains. "We also have an independent backup power supply to protect against power cuts, and we keep a supply of spares in stock to deal rapidly with equipment failure. We also have a backup collection to the primary collection kept at IRRI that is untouched, but provides immediate backup."

Dr. Sackville Hamilton said that, since 1980, IRRI has also been keeping another backup of the IRRI-IRG collection at Fort Collins, Colorado, in the United States. "The United States' environmental and political risks are different from those in the Philippines," he further explains. "This backup collection in Fort Collins adds to the safety measures being taken at IRRI.

"The collection kept in Svalbard is our ultimate backup. We cannot conceive of any other measure we could take to make it safer. We cannot think of a more secure system to safeguard this vital resource."

Life's frozen cellar

The frozen mountains, the isolation, and the polar bears that provide extra layers of security are just some of the reasons why the world's agricultural heritage found itself a fortress in Svalbard, Norway.

According to the Global Crop Diversity Trust, "The technical conditions of the site are virtually perfect. The location inside the mountain increases security and unparalleled insulation properties. The area is geologically stable, humidity levels are low, and it has no measurable radiation inside the mountain. The Vault is placed well above sea level (130 meters), far

THE VAULT'S illuminated roof against the scenic surroundings (*left photo*). IRRI Director General Robert Zeigler (*second from left*) with GCDT Executive Director Cary Fowler (*second from right*) during the inauguration of the Vault in February 2008.

above the point of any projected sea-level rise."[1]

The Trust is a public-private partnership that raises funds from individual, corporate, and government donors to establish an endowment that will provide complete and continuous funding for key crop collections.

The Trust explains that, even if the supply of electricity gets cut off, the frozen mountain and its thick rocks will keep the seeds frozen for a long time.

The Vault, constructed by the Norwegian government as a "service to the world," is managed under terms between the Global Crop Diversity Trust, the Norwegian government, and the Nordic Genetic Resource Center.

The International Treaty on Plant Genetic Resources for Food and Agriculture in 2004 provided the platform through which an international legal framework for conserving and accessing crop diversity, as well as building the Vault, became a reality.

Taming the wild

Although thousands of rice species exist around the world, only a few of these are being cultivated. These cultivated rice varieties are naturally diverse. This diversity, however, is not enough to build better varieties. It is, in this case, more than in any other, that the extraordinary diversity in rice and its wild relatives becomes crucial.

For decades, scientists have been scouring the unbeaten path of the vast wild rice gene pool to look for genes that allow them to develop rice that provides more yield and is tolerant of stresses such as drought, heat, flooding, and saline soil.

Among the major setbacks to food production today is the increasing scarcity of resources. Hence, we look more closely at rice, and at every other crop species, to find ways to unlock the many secrets of its gene pool and help it adapt, survive, and thrive despite the many challenges.

Such is the story of "scuba rice"—the IRRI-bred variety that can withstand being submerged under water for 2 weeks (see *Scuba ric*e on pages 26-31 of *Rice Today* Vol. 8, No. 2). Many years ago, an Indian low-yielding rice variety called FR13A caught the imagination of scientists due to one remarkable trait: flood tolerance.

For years, scientists looked for the genes that gave FR13A its flood-resistant characteristic. And, when they found it, they named the gene "*SUB1*." Today, high-yielding varieties that had been given the flood-resistance gene are helping rice farmers cope with frequently flooded rice fields.

The wonderful story of the previously unremarkable FR13A highlights why the world should be worried about vanishing plant species and rice varieties.

Treasure on loan

A nuclear holocaust need not happen to spell doomsday for food sources. Every day, a crop species is lost to typhoons, floods, war, and, sometimes, to simple things like mismanagement or lack of a sustained power supply.

It is hard for some people to appreciate the importance of conservation. But, thinking of crop conservation as a way of keeping a good credit record may help, because "*biodiversity, the world's most valuable resource, is on loan to us from our children.*"[2]

Diversity is the insurance for food security. Every time a species is lost, that diversity narrows, which means that the number of options shrinks as well. There is something "in" these vanishing varieties that is priceless: genes. These genes hold the many answers to questions on basic survival and sustaining life on the planet.

Scientists said that warmer temperature causes lower yield for rice. They may not be able to do something about the heat that gets trapped in the atmosphere, but they can do something about the food. They can breed varieties that can stand up to climate change.

Food for the next generation

Backing up and protecting the world's diverse agricultural heritage are giving this generation, and the next, options to get around nature's roadblocks as the human population grows, while the resources that are needed to meet the corresponding demand for nourishment become scarce.

These "options" are kept frozen, ready to be retrieved when events of the future require it. It is a way of ensuring that food keeps coming even well after this generation has passed on.

See related video at http://snipurl.com/svalbard_shipment.

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[1] www.croptrust.org

[2] IRRI. 1998. Biodiversity: Maintaining the Balance (1997-1998). Manila (Philippines): IRRI. 60 p.

CHRIS QUINTANA (2)

SAM'S Chicken Biryani

Biryani is a rice-based meal made with spices, rice (usually basmati), and meat, fish, eggs, or vegetables. The name is derived from the Persian word *beryā*, which means fried or roasted.

The dish originated from Iran (Persia) and was brought to the Indian subcontinent by Iranian travelers and merchants. Biryani is popular not only in South Asia but also in Arabia and within various South Asian communities in Western countries. It has many local variants.

The recipe presented here by Sam Mohanty, head of the Social Sciences Division at the International Rice Research Institute (IRRI), is a somewhat simplified Indian version of what he says can be a very complex confection.

Dr. Mohanty, who joined IRRI in 2008, is a widely published and award-winning economist with a knack for cooking for his family when he is not searching for the direction of the global rice market (see *Rice Facts* on pages 44-45).

Ingredients

- 4 tablespoons vegetable oil
- 4 small potatoes, peeled and halved
- 6 eggs, boiled and peeled
- 3–4 large onions, sliced
- 2 cloves garlic, crushed
- 1 tablespoon ginger paste
- 1/2 teaspoon chili powder
- 1/2 teaspoon ground turmeric
- 1 teaspoon salt (according to taste)
- 2–3 medium tomatoes, chopped
- 2–3 green chilies (according to taste)
- 2 tablespoons plain yogurt
- 15–20 fresh mint leaves
- 2 tablespoons chopped fresh cilantro leaves
- 3 pounds skinless chicken pieces (thigh and leg)
- 8 pods green cardamom
- 10 pods black cardamom
- 5–6 bay leaves
- 8 whole cloves
- 1 (1 inch) piece cinnamon stick
- 1 pound basmati rice
- 1 1/2 teaspoons salt

Directions

1. Clean and wash the chicken. Marinate the chicken with yogurt, salt, turmeric, and chili powder for 2 hours.
2. In a pot, add vegetable oil and fry the onions until they are soft and golden. Add garlic and ginger paste and the whole spices. Fry and continuously stir for 5 minutes. Add green chilies and tomatoes and fry for another 5 minutes. Cover and cook over low heat, stirring occasionally until the tomatoes are cooked to a pulp. It may be necessary to add a little hot water if the mixture becomes too dry and starts to stick to the pot.
3. When the mixture is thick and smooth, add the marinated chicken pieces and potatoes and stir well to coat them with the spice mixture. Cover and cook over very low heat until the chicken is tender—approximately 35 to 45 minutes. There should be only a little very thick gravy left when the chicken is finished cooking. If necessary, cook uncovered for a few minutes to reduce the amount of gravy.
4. Wash rice well and soak it for 30 minutes.
5. Put plenty of water in another pot, add salt, and boil the water. Once the water starts to boil, drain the soaked rice and put it in the boiling water. Boil it again at a high temperature for 5–7 minutes.
6. "Par cook" the rice (meaning 3/4 cooked, while the rest will just get cooked later). Do not boil the rice too much.
7. Put cilantro leaves on top of the cooked chicken, stir them in, then add mint on top. Drain and add the "par-cooked" rice on top of this mixture.
8. Cover the pot tightly, turn heat to very low, and steam for 20 minutes. Do not lift the lid or stir while cooking.
9. Spoon the biryani onto a serving dish and garnish with halved boiled eggs.

Watch Dr. Mohanty demonstrate how to prepare this dish in a 12:26 video on YouTube at http://snipurl.com/sams_chicken_biryani.

AGUS KAMA LOEDIN (2)

Rice in their EYES

by **Alaric Francis Santiaguel** and **Darja Dobermann**

Visual artists give us a glimpse of the ethereal essence of rice that otherwise lies invisible to the naked eye

Different people can look at the same grain of rice and see different things. Rice, to farmers, represents food security and their children's future. Economists see a form of currency, while governments view it as a means to achieve sociopolitical stability. For scientists, rice is a key to ending global hunger.

But rice can also be a muse. The humble grain has inspired artists to conceive exhilarating bursts of creative expressions captured on canvass, in tapestries, on film, in poetry and song, and in many other forms of art.

A grain of soul

"Most people see rice as something you eat, but there is more to rice," said Kwanchai Gomez, executive director of The Asia Rice Foundation (ARF) and former scientist at the International Rice Research Institute (IRRI). "There's something inside it that's not physical. Rice has a soul."

Not surprisingly, the "soul of rice" has been immortalized in so many ways because rice is part and parcel of many Asian cultures. **"**In Asia, culture is rice-based," Dr. Gomez explained. "Many things such as festivals and rituals originated from rice because most of the Asians before were farmers. Agriculture was our bread and butter and a large proportion of the people deal with rice farming. Rice is in the culture itself."

"The connection between rice and the arts is the affirmation of the essentiality of rice to Filipino life, and to most, if not all, Asians," Corazon Alvina, former director of the National Museum of the Philippines, wrote in *Rice in the Seven Arts,*[1] a collection of essays published by ARF in celebration of the 2004 International Year of Rice.

Rice on canvass

Initiated by Dr. Gomez, *Rice in the Seven Arts* features the role of the golden grain in Philippine traditional dances, music, theater, motion pictures, architecture, literature, and the visual arts.

In the field of visual arts, paintings in particular, rice was the subject of some of the Philippines' iconic artists, among them, Carlos Botong Francisco (*Angelus*), Fabian de la Rosa (*Planting Rice*), Cesar Legaspi (*Gleaners*), Jose Blanco (*Lucban*), and Anita Magsaysay-Ho (*In the Rice Field*), to name a few.

But, Fernando Amorsolo was perhaps the most famous Filipino painter who used rice as a subject in his art. Although his artistic talent virtually knew no bounds, he is celebrated for his vibrant depiction of the ideal beauty of the Philippine rice landscape and the romanticized life of Filipino farmers and peasants.

He was born in 1892 in prewar Manila, which, even then, was keen on shedding all traces of its agrarian past. His family, however, moved to Camarines Norte in southern Luzon soon after. Growing up in a rustic environment, the rice-driven rhythm of rural life made an indelible mark on the young Amorsolo, according to his daughter, Sylvia Amorsolo-Lazo.


KORKON MAGAZINE

KWANCHAI GOMEZ, executive director of The Asia Rice Foundation, believes rice is food for both the body and the spirit.

"He wanted to portray what he saw every day—the simple life of Filipinos and their daily chores," said Mrs. Amorsolo-Lazo, herself an artist. His paintings also depicted how the cultivation of rice acted as a cohesive force that bound families and communities together, she added. "In *Afternoon Meal of Rice Workers,* you could see the families, relatives, and farm laborers working together, their lives closely entwined. It is there in the rice fields where they eat their lunch and supper."

"Rice fields were not close to homes," Jane Allinson[2] remarked in *Maestro Fernando C. Amorsolo.* "The harvesters worked from early morning until dusk. They did not have time to return home for meals; they either brought food or food was brought to them."

Rice through the maestro's eyes

It was in 1922 when Mr. Amorsolo focused his creative depiction of rural life as colorful and effortless. His peasants welcomed the grueling labor involved in every stage of producing rice, from transplanting the seedlings to harvesting the grains, and winnowing the chaff, with gentle smiles on their faces.

"Idealized agricultural Philippine scenes are the heart of Amorsolo's work," said Ms. Allinson. "There is no hint of the extremely arduous work and the uncomfortable task of constantly bending to plant seedlings in a flooded field that provides unstable footing."

"The works of Mr. Amorsolo are an iconographic representation of the countryside," Mr. Patrick Flores, professor of Philippine art history, noted in *Rice and the Seven Arts*. "This ideal is a political construction of a Philippines insulated from the material constitution of war, imperialism, urbanization, and industrialization."

"His art showed how he wanted life to be and not how it really was," said Romeo "Romi" MananQuil, an accomplished Filipino artist. "It is idealism on canvas, more of interpretations than representations. Of course, every artist sees and interprets life in his own way."

Blood, sweat, and beauty

Artists do see the world in more ways than one. Through their works, they allow us to use our eyes not just as an

[1] Zafaralla PB, editor. 2004. Rice in the Seven Arts. Manila: Asia Rice Foundation. 113 p.

[2] Allison J. 2009. *Amorsolo and the American Experience*. In: Amorsolo-Lazo S et al. *Maestro Fernando C. Amorsolo: Recollections of the Amorsolo Family.* Quezon City (Philippines): Fernando C. Amorsolo Art Foundation. p 123-147. Text reprinted with permission.

ROMI C. MANANQUIL

THE RICE-CENTRIC life, depicted in this painting by Filipino artist Romi C. MananQuil, is not always beautiful, says Mr. MananQuil. "Oftentimes, it is more of a struggle than a picnic."

organ of sight but as a sense of insight. Many farmers have been conditioned to regard themselves as tillers of the earth and lowly workers. But perhaps, like Belle, the lead character in the movie *The beauty and the beast*, Mr. Amorsolo was looking past the profuse sweat and the tired muscles to reveal the inner beauty of the hardened life most people do not see. Through his eyes, he could find every reason to feel proud and joyful because they produce the grains that make it possible for towns and cities to exist in the first place.

"This is hot, dry, and uncomfortable work," said British artist John Dyer. But in the midst of the back-breaking labor that supports only a meager standard of living, his paintings captured what art director Sue Hill aptly described as the sheer human thrill of being alive. "It is a tough harvest but one that is worth celebrating," Mr. Dyer said. (See *Rice is life* on page 37.)

FERNANDO LAZO

MRS. SYLVIA Amorsolo-Lazo, daughter of the maestro, recalls how her father's childhood spent in a rustic environment made an indelible mark on his future paintings that earned him national and international recognition as an artist.

A new crop of soul seekers

Although the idyllic agrarian life that stirred and stoked the passions of venerated artists of the past has largely given way to urbanization, the fascination with the staple grain as a subject of paintings and other art forms is very much alive among the newer generation of artists.

Aside from winter and fall scenes, Mr. MananQuil, now based in Canada, continues to paint Philippine subjects, rice planting included, but from another angle. “Although I have always admired the works of Amorsolo, his colors especially, I do not exactly subscribe to his idealized romanticist style,” he said. “I paint what I see and feel. Beauty inspires me, but there is also something in life’s ugliness that drives me to paint. Pastoral life is not always beautiful. Oftentimes, it is more of a struggle than a picnic.”

For Indonesian visual artist Agus Kama Loedin, rice, as his subject, stemmed from the jump in rice prices in 2008. He wanted to contribute something that would draw attention to the price rise, being an indicator of the world rice crisis for all rice-consuming countries, and also its impact on the people of major rice-consuming nations.

Mr. Loedin used montage and mirror techniques to create his pieces in his 2009 art exhibit “Patterns: Rice-Life” in IRRI’s Riceworld Museum. Montage is the use of multiple images, though he generally sticks to the use of one image and repeats it, transforming it into multiple images. Mirror, on the other hand, simply takes a starting image and then mirrors it to create a completely new image.

Through his art works, which also incorporate images, objects, music, poetry, and dance, Mr. Loedin beautifully and accurately depicts one of Asia’s most vital sources of life. “Rice is life,” he said. “You are not planting it for nothing. It is for eating, for food, for life.” He has already taken steps forward for his next exhibit and, just like rice, Loedin and his art are constantly growing and evolving in what is simply a pattern of life.

Ms. Dobermann is a student at the University of Victoria in Canada and was a trainee in IRRI’s Communication and Publications Services.

Rice is life

by **John Dyer**

In 2004, British painter John Dyer spent his time at the International Rice Research Institute (IRRI) as resident artist. He completed “Rice Is Life,” a series of paintings intended to highlight the importance of rice. His subjects were farm workers harvesting rice, threshing grains by machine, and collecting the remaining rice straw by hand in IRRI rice fields. Through his brushstrokes and exuberance for bright colors, Mr. Dyer unveiled the joie de vivre *that appears to be inherent in the grain.*

The saying “Rice is life” really does mean something to me now. As a Westerner, I am used to popping into my local supermarket for food and selecting from a wide range of products from all over the world. Rice is one of these staples. But, after witnessing first-hand the rice production process, I started to view this basic food in a whole new way.

As an artist, I am fascinated by the ethnobotanical stories connected to the world’s major food crops—and rice proved to be an exceptional subject to paint. The plant itself is not visually dynamic, but the landscapes it produces when it is cultivated are. IRRI took me to the heart of the harvest and, each day, I explored a different location. The interconnections and stories of the harvest slowly emerged and I gathered more information and inspiration that helped form the paintings.

I was struck by the harshness of the environment that the dry rice fields create. Farmers wrap their bodies and heads to protect themselves from the sun and dry rice straws. It is hard work, but a real community effort. At the end of the main harvest, villagers appeared with their families to scour the land for a bowl of rice—perhaps enough for a meal, and after this, the ducks are let loose to pick up the last of the rice that may have been missed.

Watching this rice story played out in front of me not only provided huge inspiration and visual material, but it focused my thoughts on just how precious each grain of rice is—very little is wasted. Rice really does equal life and the paintings aim to highlight these amazing stories and locations.

I arrived at IRRI with the normal bag of preconceptions that any Westerner would have, but, after painting in the paddy fields of the Philippines and talking to the scientists and farmers on the ground, I left with an open mind and a whole set of stories and experiences that I have been sharing ever since. For me, my paintings explain my thoughts and experiences: it is a tough harvest but one that is worth celebrating.

We all know rice is the world’s most important harvest. But not many people get to experience or discover the family and community stories behind their packet of rice. I feel privileged to have been able to do so. I hope my colorful and optimistic paintings are seen as a celebration of rice.

You can view Mr. Dyer’s *Rice Is Life* and other works at www.johndyergallery.co.uk/exhibition/riceislife/index.html.

Beware of bronzing

by Savitri Mohapatra

Rice faces its own kryptonite—iron toxicity—and AfricaRice is finding a way to help rice survive it

A bronzed look may be attractive for human beings but, for rice plants, it could be fatal. Rice leaves turn bronze when the plants are affected by iron toxicity—a widespread nutrient disorder in lowland (wetland) rice.

Iron is a trace element that is essential for rice plants for normal growth and development, especially for photosynthesis and maintenance of chlorophyll. However, at high concentrations, it becomes toxic to the plants.

Rice yield loss due to iron toxicity ranges from 10% to 100%, depending on the severity of the toxicity and the tolerance of rice varieties. The loss is greater when toxicity is accompanied by nutrient deficiencies.

Symptoms of bronzing

The stress is significant in areas where reddish soils are predominant. These soils have low fertility but are rich in iron, which, however, is in the ferric (nonsoluble) form and is therefore not accessible to rice plants.

Under prolonged flooded conditions without drainage, the ferric iron converts into ferrous (soluble) iron and becomes available for uptake by rice plants. The soluble iron is then absorbed by the roots of the rice plants and accumulates in the shoots.

Lowlands are often affected by iron toxicity. It is particularly common in acid soils, especially those with a very low pH (less than 5.0), as acidity increases the availability of ferrous iron to the plants.

In sub-Saharan Africa (SSA), where lowland rice ecologies represent about 53% of the total rice area in the region, iron toxicity is a serious problem for smallholder rice farmers.

The first signs of iron toxicity in the rice plant are bronze spots, beginning at the tip and spreading toward the base of the rice leaves. Other effects include stunted plant growth, decreased tillering, and high spikelet sterility (leading to reduced yield).

Iron also damages the root structure of the rice plant and reduces its capacity to absorb soil nutrients. For example, when the ferrous iron concentration in the root zone is high, iron plaques are formed, which prevent the plant from taking up other nutrients. Iron toxicity is generally associated with a deficiency of phosphorus, potassium, and zinc.

Increasing tolerance

Several management and cultural practices can be used to reduce the occurrence of iron toxicity in rice fields. Options include improved water management in rice fields to wash out excess iron or bring oxygen into the soil solution; good cultural practices, such as planting rice on ridges; and improved soil fertility management, such as the application of phosphorus and zinc.

However, most of these methods are impractical or unaffordable for resource-poor rice farmers in SSA. The use of varieties tolerant of iron toxicity offers the most practical and economical solution to the problem.

Research by the Africa Rice Center (AfricaRice) has shown that genetic tolerance of iron toxicity can contribute significantly to rice production in toxic soils; hence, the Center and its partners are now focusing their efforts on improving rice's ability to withstand or even survive the poison.

They have evaluated rice varieties, selected promising lines, and developed agronomic practices that can help farmers cope with iron toxicity. Rice varieties with moderate tolerance, such as WITAs 1, 3, 4, and 12, have been released for cultivation in lowlands.

HIGH IRON toxicity can completely destroy rice plants, as seen in this field, Valley du Kou, Burkina Faso.

ABOURASMANE KONATÉ, INERA

WITA 12, a rice variety with moderate tolerance of iron toxicity, in a field trial, Niaouli, Benin.

MOUSSA SIE

Lines of defense

Traditional varieties that have been grown and selected by farmers for many years tend to be relatively iron-tolerant, such as CG14, which was one of the parents of the first group of NERICA varieties developed by AfricaRice. CG14 is a variety that belongs to the indigenous African rice species, *Oryza glaberrima*. Researchers have been trying to transfer tolerance from these known donors into high-yielding but iron-sensitive varieties.

According to Dr. Khady Nani Dramé, AfricaRice molecular biologist, the current focus of research at the Center is on the genetics of tolerance of iron toxicity and also on the transfer of genes and molecular markers (QTLs) for iron toxicity tolerance into widely grown local varieties or "mega-varieties" using molecular marker techniques. She is closely involved in the project Stress-Tolerant Rice for Poor Farmers in Africa and South Asia (STRASA).

The STRASA project, which is funded by the Bill & Melinda Gates Foundation through the International Rice Research Institute (IRRI), aims to accelerate the development and delivery of improved rice varieties that are tolerant of five major stresses: drought, submergence, salinity, iron toxicity, and low temperature.

As the lack of a standardized, controlled, and reliable suitable screening technique has been a major hindrance to breeding rice tolerant of iron toxicity, Dr. Dramé and her colleagues have been testing several screening methods, including fields in hot spots, pots on-station, and a hydroponic (soil-free) environment.

Marker-assisted selection (MAS) will be used to introduce the genes that confer tolerance to iron toxicity in rice to popular varieties in the region in partnership with national programs. A few molecular markers (QTLs) associated with tolerance of iron toxicity have already been validated by the research team.

As part of the project, an inventory comprising about 180 tolerant varieties has been made from rice breeding programs of AfricaRice, IRRI, the International Center for Tropical Agriculture, and national programs.

To evaluate promising iron-tolerant lines, participatory varietal selection (PVS) trials have begun in four West African countries (Burkina Faso, Ghana, Guinea, and Nigeria).

In the first year, farmers examined 80 varieties (including a local check), from which they selected the varieties they preferred. Ten varieties were retained per country for further testing. In the second year of PVS, farmers grew these varieties with their local varieties and made further selections.

Currently, the three best varieties tolerant of iron toxicity per participating country (except for Ghana) have been retained and are expected to be nominated for national release.

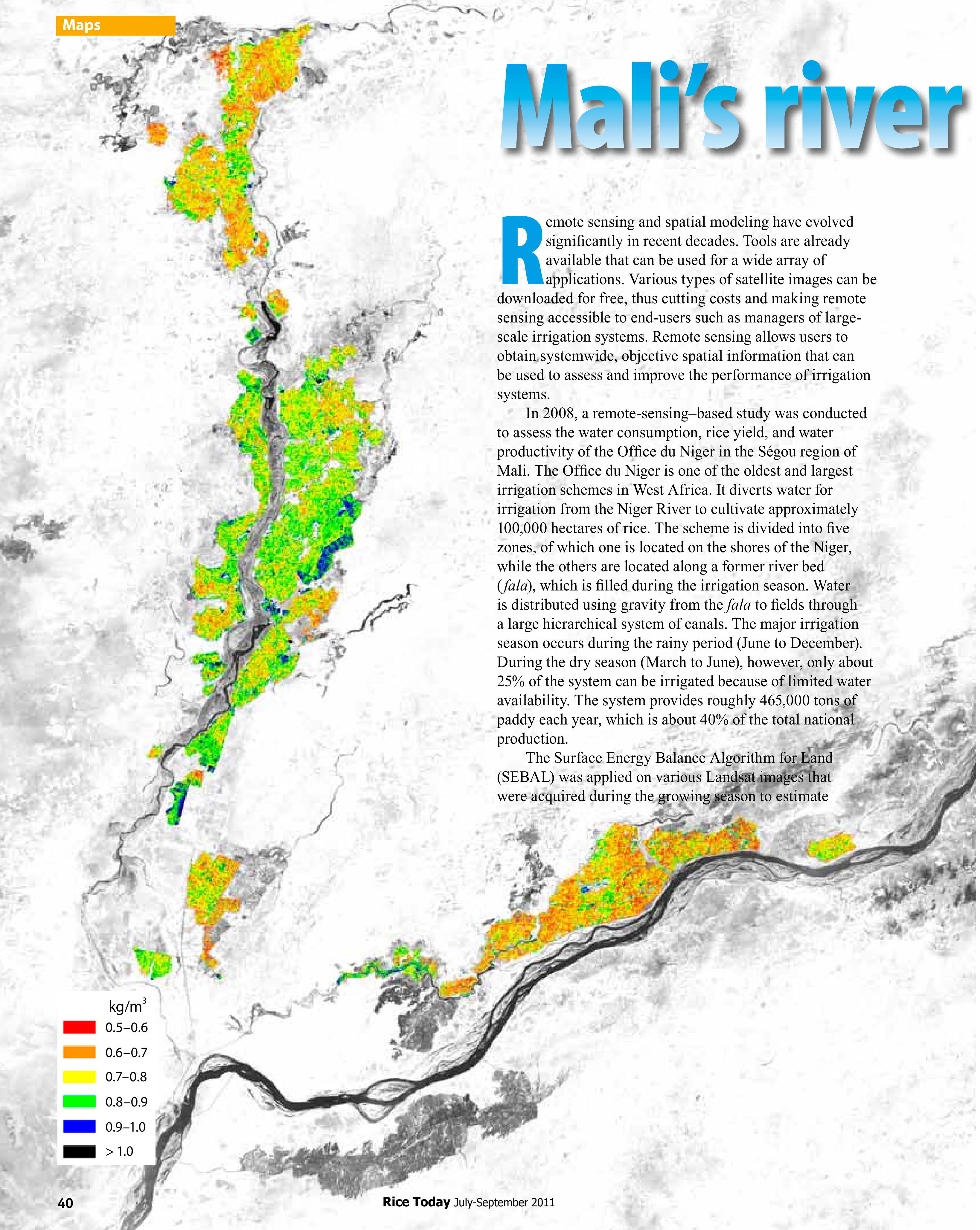
The analysis of the PVS trials indicates that the new varieties performed quite well in farmers' fields compared with the local varieties. "We are happy that, at the end of the PVS trials, we can offer to resource-poor farmers in SSA promising rice varieties that can thrive in iron-rich soils," said Dr. Dramé.

IRON TOXICITY symptoms (*bronzing*) on the leaves during a field trial, Edozighi, Nigeria.

NANI DRAMÉ, AfricaRice

Mali's river of life

by **Sander Zwart**



Remote sensing and spatial modeling have evolved significantly in recent decades. Tools are already available that can be used for a wide array of applications. Various types of satellite images can be downloaded for free, thus cutting costs and making remote sensing accessible to end-users such as managers of large-scale irrigation systems. Remote sensing allows users to obtain systemwide, objective spatial information that can be used to assess and improve the performance of irrigation systems.

In 2008, a remote-sensing–based study was conducted to assess the water consumption, rice yield, and water productivity of the Office du Niger in the Ségou region of Mali. The Office du Niger is one of the oldest and largest irrigation schemes in West Africa. It diverts water for irrigation from the Niger River to cultivate approximately 100,000 hectares of rice. The scheme is divided into five zones, of which one is located on the shores of the Niger, while the others are located along a former river bed (*fala*), which is filled during the irrigation season. Water is distributed using gravity from the *fala* to fields through a large hierarchical system of canals. The major irrigation season occurs during the rainy period (June to December). During the dry season (March to June), however, only about 25% of the system can be irrigated because of limited water availability. The system provides roughly 465,000 tons of paddy each year, which is about 40% of the total national production.

The Surface Energy Balance Algorithm for Land (SEBAL) was applied on various Landsat images that were acquired during the growing season to estimate evapotranspiration, rice yield, and water productivity during the 2006 wet season. SEBAL calculates, on a pixel-by-pixel basis, the components of the surface energy balance using surface temperature information gathered by satellites and standard meteorological measurements of air temperature, relative humidity, wind speed, and incoming radiation.

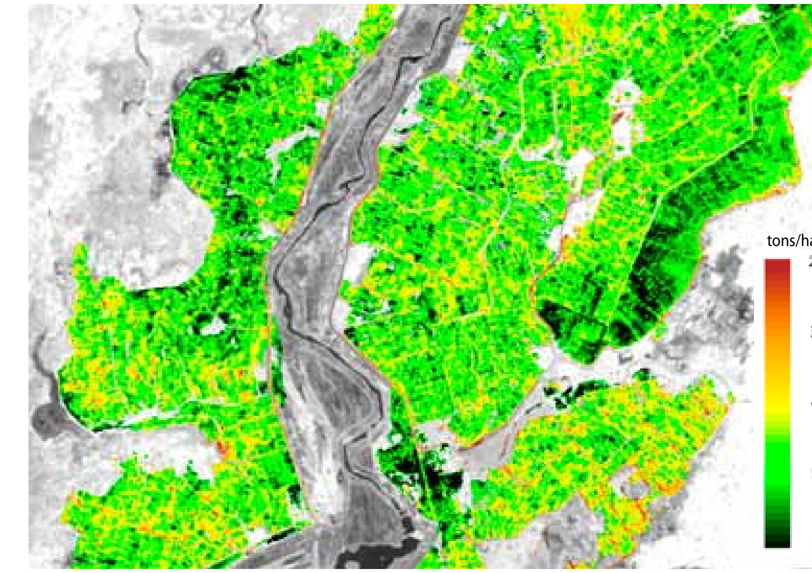
The maps show a significant variation between different locations in the system, indicating that scarce water resources are not used efficiently throughout the system. Average water productivity in the most northern zone and the zone located along the Niger amounts to 0.6 kilogram per cubic meter (kg/m^3), whereas the centrally located zones show values of 0.7 to 0.8 kg/m^3. Also, at field level, the variation in water productivity is high, indicating that farmers can still become more productive with their water resources. Although the global average value of water productivity is 1.0 kg/m^3, this value cannot be set as a benchmark as a result of prevailing unfavorable conditions regarding the climate and soil fertility.

The causes of high and low water productivity can be investigated by combining these maps with soil fertility, groundwater levels, water quality, irrigation infrastructure, and measured water supplies, among other secondary information.

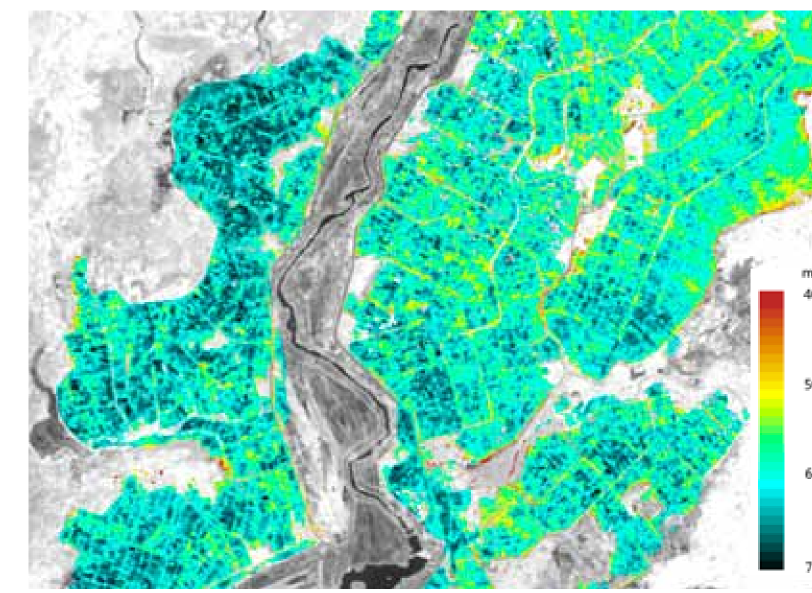
Unproductive and inefficient areas can be located and appropriate measures taken to improve the system's irrigation performance. Examples are improvement of drainage infrastructure, reduction of irrigation water supplies to better match demand, and improvement of field water and fertility management.

The technical and scientific details on this study were published in Zwart SJ, Leclert LMC. 2010. A remote sensing-based irrigation performance assessment: a case study of the Office du Niger in Mali. Irrigation Science 28:371-385.

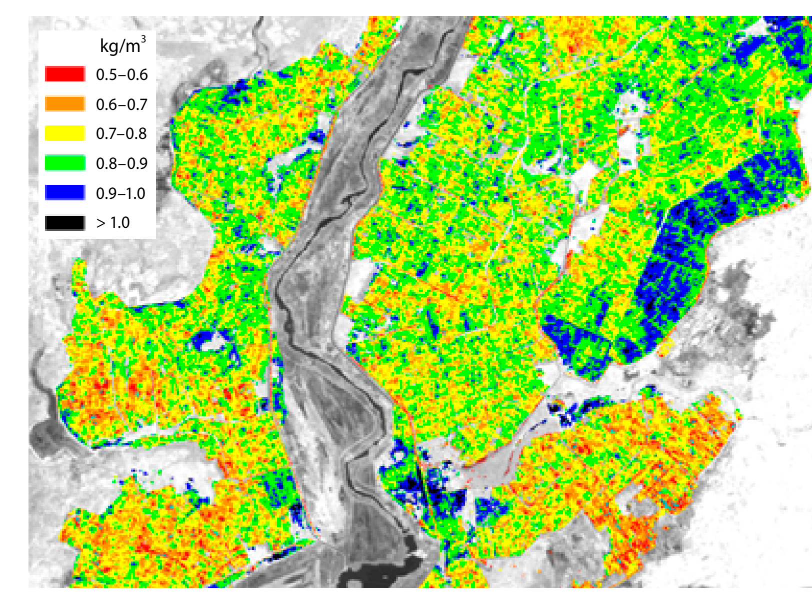
Dr. Zwart is a remote sensing and geographic information systems specialist at Africa Rice Center.



Rice yield



Water consumption by evaporation



Water productivity—kg of paddy produced per m^3 of water evaporated

The search for direction

by **Samarendu Mohanty**

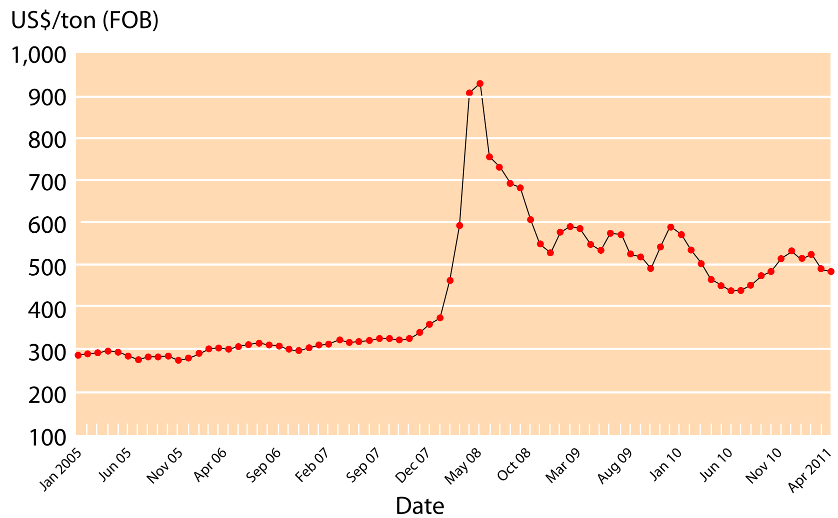


Fig. 1. Monthly export price (US$/ton FOB) of Thai rice (5%-broken), January 2005 to May 2011.
Data source: Pink Sheet, World Bank.

The global rice market has been in a subdued state since 2010 (Fig. 1), during which time the prices of many other agricultural commodities such as wheat, soybeans, cotton, and sugar have shot up in the backdrop of weather-induced supply losses. Both cotton and sugar prices have reached all-time highs during this period. The Food and Agriculture Organization food price index, in recent months, has exceeded the level it reached in 2008, but the number of hungry people is estimated to have risen by only 44 million compared with 100 million during the 2008 food crisis. Interestingly, the lower rice prices have kept a lid on the rise in the number of hungry people during the current food price spike—a shining example of the importance of keeping rice prices affordable for the one billion hungry people in the world.

The lower rice prices can be attributed to good harvests and to the comfortable inventory in the major rice-producing countries in 2010-11. Rice prices have weakened by more than 10% in the last few months because of good spring harvests in Thailand and Vietnam in March. In addition to the abundant supply in major rice exporters, favorable weather and comfortable inventory in the Philippines have kept the world's largest rice importer away from the global market. According to the United States Department of Agriculture (USDA), the Philippines' rice imports for 2010-11 will be 45% lower, from 2.2 million tons in 2009-10 to 1.2 million tons in 2010-11.

Moreover, inventory in India, the second-largest producer of rice, is also at a very comfortable level, with procurement stocks of nearly 28 million tons by April 2011. Now, they have a problem of "too much" rice and the gravity of the situation was reflected in a news report published by *The Hindu Business Line* on 30 May 2011. The article reported that farmers in the tiny village of Achanta in West Godavari District of Andhra Pradesh were forced to sell their summer rice to private traders at prices lower than the minimum support price (MSP) because of a lack of storage space for the Food Corporation of India, the public agency in charge of procuring rice from the farmers. In protest, 3,500 farmers in the village have declared a "crop holiday" for the upcoming kharif season. According to the report, similar stories have been heard in many other villages in the region.

Apart from India, Thailand is also entering its 2011-12 marketing year with an inventory close to its all-time high. The change in the government rice policy from a mortgage scheme to a price insurance program late last year has moved publicly held stocks to private holdings, with an overall level that is more or less the same as that of 2009-10. Global rice stocks are at their highest since the 2007-08 rice crisis, according to the USDA's May 2011 PSD database.

In addition to comfortable inventory, the world is also going into the main rice season with a normal forecast of the Southwest monsoon on the Indian subcontinent. Premonsoon showers have been active in many parts of India. The monsoon already arrived in the southern state of Kerala in the last week of May and is expected to spread to other parts of the country in the first half of June. The monsoon is significant to the global rice market. Back in 2009, delayed and irregular monsoon kept the market on edge for 2 months before calming down, thanks to India's prudent handling of its procurement stocks to avoid agitating the international market.

Rice area in Asia for the coming season is also unlikely to shift to other crops despite higher prices because of the strong push by the national governments to keep rice production stable through interventions. For example, the 15–17% increase in India's MSP for rice is likely to keep rice area intact in the coming season. Similarly, for Thailand, both of the campaigning political parties intend to raise the guaranteed price for the farmers, ahead of the general election in July 2011. The opposition party—favored to win the election—has promised to bring back the old rice mortgage scheme and significantly increase the pledging price. The national governments in other rice-growing countries in the region are also likely to implement programs to keep rice area undisturbed, keeping in mind domestic food security. The USDA predicts that the 2011-12 rice area in most Asian countries will either increase or stay the same as last year's with the exception of Japan, where rice area is projected to decline slightly because of the tsunami. Rice production in Pakistan is also likely to recover this year as area lost to last year's severe floods is brought back into production but is expected to face competition from high cotton prices in some parts of the country.

"Not-so-good" prospects

The higher prices for competing crops such as wheat, soybeans, and maize are likely to prompt farmers in countries such as the United States and Brazil to switch from planting rice to any of these crops. The USDA's May 2011 rice outlook report says that U.S. rice area for 2011-12 is estimated to decline by 17% and rice production by 13%. A similar shift is also likely to happen in Brazil, where lower prices for rice relative to other competing crops will encourage farmers to plant primarily more soybeans. The USDA report predicts a production drop of 17% in Brazil in 2011-12 because of smaller area planted to rice. Likewise, some decline is expected in Uruguay and Argentina as some rice areas are converted to soybean farms.

Furthermore, inclement weather in the U.S. is almost certain to push its rice production down. The recent flooding in the southern part of the country has affected the progress of rice crops in some rice-growing states and its impacts on rice production are yet to be ascertained. Also, the ongoing drought in the eastern, central, and southern parts of China, particularly in two major rice-growing provinces, Hunan and Hubei, is definitely a major concern for the global rice market. Both Hunan and Hubei produced more than 41 million tons of rice in 2009[1] and the ongoing drought is likely to damage early-season rice crops in these provinces. Other drought-affected provinces are Jiangxi, Anhui, and Jiangsu. If the dry spell persists, it will significantly affect China's rice production and it may force the country to enter the global market to increase its domestic supply. Fortunately, Chinese rice stocks are at a relatively comfortable level and should provide adequate buffer to temper the moderate shortfall in this season's production. Depleted stocks, however, will make China vulnerable to more weather shocks in the next crop year.

This situation can change quickly as the rains arrive, but, at this point, it is difficult to gauge the extent of the damage to production. In fact, flash floods have been reported in many parts of the drought-affected areas as of 7 June because of the continued rainfall since the first week of the month. This does not mean, however, that the drought is over. Some damage has already been done and crops are unlikely to fully recover even if the rain becomes regular for the remainder of the season. Nonetheless, regular rainfall from now on will benefit the late-season crop, which will be planted in July. In the worst-case scenario, if the rain withdraws again and rice production is affected, it will be difficult to predict what China will do to make up for the shortfall. If China decides to import significant volumes of rice, it will be even harder to predict how other countries will react and how high the price will go.

Looking ahead

The main rice season has just begun. It is almost certain that Mother Nature has a few more surprises up her sleeve similar to last season's floods in Pakistan and the prolonged monsoon in parts of India. Even if the current rice crop escapes with only some minor weather damage, it is still critical that wheat and maize production recover from the severe weather-related shortfalls in 2010. Global stock-to-use ratios for wheat and maize are estimated to decline by nearly 3% in 2010-11 to offset the production shortfall (Fig. 2). Another bad year for wheat and maize may be too much for the global market to handle and, if that happens, it will definitely have an adverse effect on rice prices.

Looking ahead into 2011-12, global rice consumption will be strong because of higher prices for other food items. This will prompt the poor people in the developing and least developed countries to eat more rice. According to the USDA, global rice consumption in 2010-11 was reported to be 448 million tons on a milled basis. Based on our estimates, demand will grow by 2% in 2011-12 to 455–460 million tons. Thus, global production of 460 million tons of milled rice is likely to keep the market stable. Apart from weather uncertainties, politics will also play its part in shaping the market in the coming few months. Thailand's general election in July will certainly have some effect depending on who wins. If the Thai opposition leader wins and carries out his election promises, global prices are likely to move upward. However, if the current government wins the election and raises the insurance price from 11,000 to 12,000 baht (US$360 to $392) per ton, this will have an opposite effect on the global market. It will push prices further down.

We also have the "1,000-pound gorilla," such as that in India, which can flood the market with the reversal of its ban on nonbasmati rice exports and bring the global rice market to its knees. Good world rice production and the resumption of India's exports in 2011 can put significant downward pressure on this market.

Overall, the global rice market is headed for some dull moments in the next few months and prices are likely to remain range-bound. However, weather-related problems such as large-scale flooding and drought as well as policy shifts in rice-growing regions can quickly transform the market from directionless to either a bear or a bull market.

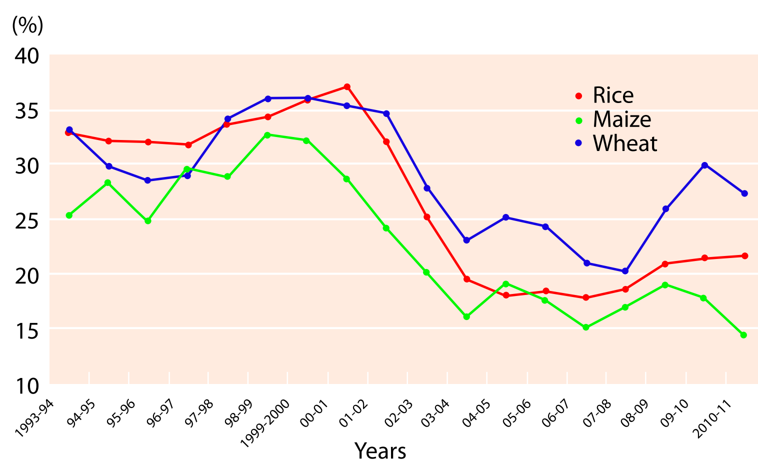


Fig. 2. Global grain stock-to-use ratio (1993-94–2010-2011).
Data source: Production, Supply, and Distribution (PSD) database, USDA.

[1] World Rice Statistics, IRRI.

"Iron-clad" rice

BY INEZ H. SLAMET-LOEDIN

In 2010, the number of hungry people surpassed 1 billion worldwide because of increases in food prices. Unbeknownst to many, more than 2 billion people are suffering from ''hidden hunger,'' a term used to describe micronutrient malnutrition. Anemia affects more than 2 billion people globally, with women and children most at risk. Deficiency in dietary iron is a main cause of anemia. It is the most common and widespread nutrition problem, together with deficiency in zinc, iodine, and vitamin A.

IRON-ENRICHED rice will soon contribute to reducing "hidden hunger."

KURNIAWAN RUDI TRIJATMIKO

Iron deficiency and iron deficiency anemia cause a range of health problems in humans, including increased chances of maternal and child mortality and negative consequences on cognitive and physical development of children. They also affect an individual's physical performance, especially the work productivity of adults.

Combating micronutrient malnutrition is considered to be among the best investments that generate a high return in socioeconomic benefits according to the 2008 Copenhagen Consensus. The Consensus listed biofortification, a method of breeding crops in order to increase their nutritional value, as one of its top five investments to address global challenges.

In developing countries, rice, as a staple food, may still provide as much as 80% of the daily calorie intake. Unfortunately, polished white rice contains low amounts of iron. A study of the iron content of polished rice marketed in a number of rice mills in the Philippines and Vietnam showed that popular varieties such as IR64, Sinandomeng, Intan, and Jasmine 85 generally contain 2–3 milligrams of iron per kilogram (ppm) of rice, and a maximum of 4–5 ppm in a few rice mills in Vietnam. Similar studies in the U.S. and Brazil have verified the very low iron in white rice.

Breeders at the International Rice Research Institute screened thousands of rice seeds from the International Rice Genebank (a seed bank) and from breeding lines and varieties for the iron content in the polished rice. They identified a few potential breeding materials with 5–8 ppm iron. Biofortified crops need to contribute at least 30% of the estimated average requirements for them to be meaningful to a target population group. The HarvestPlus Program of the Consultative Group on International Agricultural Research has set a minimum of 14 ppm iron in polished rice to benefit women and children.

Now, the next question is, how to fill the gap.

In addition to more breeding, one option is to use modern biotechnology to introduce other genes to increase the uptake and storage of iron in the rice endosperm (white rice when polished). In earlier work, it has been established that the iron in rice is highly bioavailable (can be absorbed and used by the human body) and additional iron should also be bioavailable. One preferred biotechnology approach uses the gene from soybean for the protein ferritin. Ferritin is an iron-storage protein that can hold up to 4,500 atoms of iron per molecule in its central cavity. A study with humans with ferritin purified from soybean has shown that the iron from this source is one of the most bioavailable forms known. Several studies have reported that the ferritin biotechnology approach can increase the iron content to 8–10 ppm, but not yet to 14 ppm.

Recently, some studies have shown that modifying the iron transporter nicotianamine in rice can be effective in increasing iron concentrations in the grain. This approach uses a number of rice genes for nicotianamine synthase to boost the overall levels of the transporter and thereby increase the movement of iron into the grain. The incorporation of the two approaches, soybean ferritin and rice nicotianamine synthase, together in popular varieties, is now being advanced to determine whether the combination will lead to achieving the very important goal of rice with higher iron.

Biofortification can serve as an important sustainable tool in combination with existing ways of overcoming iron deficiency and iron deficiency anemia; these existing approaches include a diverse diet, fortification, and supplements. The main advantages of developing varieties with high iron content are that this is a food-based approach and delivering the solution in such a widely consumed crop could contribute to a large effect.

Dr. Slamet-Loedin is a senior scientist in IRRI's Plant Breeding, Genetics, and Biotechnology Division.

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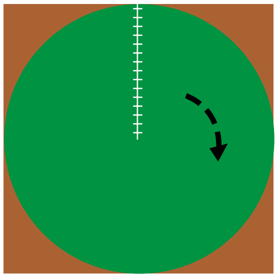

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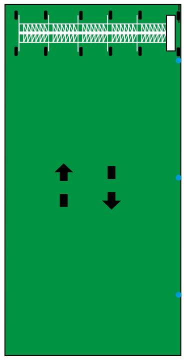

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