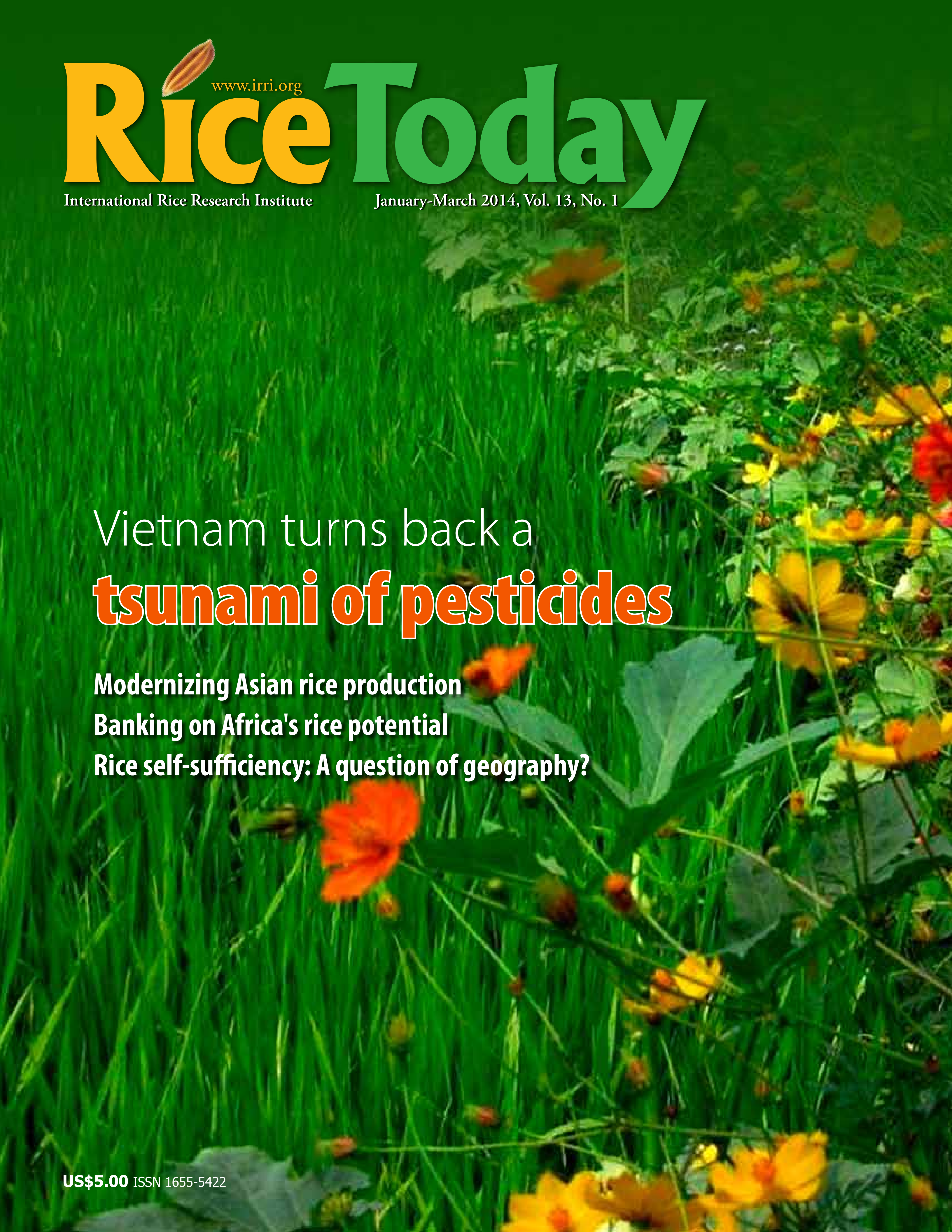


Rice Today

www.irri.org

International Rice Research Institute

January-March 2014, Vol. 13, No. 1

Vietnam turns back a tsunami of pesticides

Modernizing Asian rice production

Banking on Africa's rice potential

Rice self-sufficiency: A question of geography?

US$5.00 ISSN 1655-5422

First Announcement

44th CSSP SCIENTIFIC CONFERENCE

12-16 May 2014 | Cebu Parklane International Hotel, Cebu City

CONFERENCE FEE

The conference fee of **Php 4,500.00** shall cover participation in the scientific sessions, morning and afternoon snacks and lunch for three (3) days, and conference materials. Accommodation and travel costs are not included. Undergraduate student rates will be made available.

CALL FOR . . .

I. PAPERS

Everyone is encouraged to submit papers for presentation. A plaque and cash prize will be given to the winners of the CSSP Best Paper and Best Poster competitions.

Guidelines for Abstracts/Paper Preparation

- All papers (oral and poster) should be in English, an original research output in crop science, that has never been published nor presented elsewhere.
- Abstracts should be submitted on time following the suggested format:

  1. The whole title of the paper should be CAPITALIZED;
  2. The authors' full name should be underlined and should always start with the first name. Put an asterisk after the name of the author who will present the paper. The complete office/institution address of the researchers should follow. In cases where there are several authors coming from different institutions, superscript number should be indicated corresponding to the person's address. Do not abbreviate;
  3. The text should start on the next line, indented five spaces, 12 pt Times Roman with 300 words maximum;
  4. Provide 5-6 keywords.

Poster paper may be a preliminary report of an on-going research/study or a completed research report. The poster should be well-organized, concise, self-explanatory and should be 30" x 40" portrait with the following information: title, authors' names, address (unabbreviated), brief introduction, objectives, methodology, results, and conclusion. One of the authors should be present during the Poster Paper Session.

- Submit all abstracts using the CSSP abstract form that you can download at: **http://www.cssp.org.ph** or send request at **cssp2014@gmail.com**, not later than **15 January 2014** to:

DR. ANTONIO G. LALUSIN
Chair, Paper & Abstract Committee
Phone: +639165384419
Email: cssp2014@gmail.com

For more information, please contact:

The SECRETARIAT
Phone: +639084116872
Email: cssp2014@gmail.com

OR

MR. RAMON A. OLIVEROS
CSSP President
Phone: +639194221857
Email: r.oliveros@irri.org

DR. MA. REBECCA C. LAZA
Chair, Secretariat
Phone: +639084116872
Email: cssp2014@gmail.com

Harnessing
BIODIVERSITY and BIOTECHNOLOGY
for Climate Change Adaptation

contents

SYLVIA VILLAREAL, IRRI

About the cover. Rice farmers in Vietnam and elsewhere are being encouraged to not only use less pesticide but also grow flowers and vegetables on the banks of their fields. This creates a healthy ecosystem that is frequented by bees and other beneficial insects. See more on pages 12-13 about how Vietnam has turned back a tsunami of pesticides. (Photo by ©Ho Van Chien)

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

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

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

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

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

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

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

The International Year of Family Farming and its relevance to rice production

The Food and Agriculture Organization (FAO) of the United Nations has declared 2014 as the International Year of Family Farming (IYFF; www.fao.org/family-farming-2014/en). The International Rice Research Institute (IRRI) applauds the goals of the IYFF, which are to raise the profile of family farming and smallholder farming by focusing the world's attention on their significant role in eradicating hunger and poverty, providing food security and nutrition, improving livelihoods, managing natural resources, protecting the environment, and achieving sustainable development, in particular in rural areas. Certainly, these objectives mirror what IRRI strives to help achieve as well.

As pointed out in the 4th edition of the *Rice Almanac* just released, rice is grown on some 144 million farms worldwide, mostly smaller than 1 hectare. Obviously, 2014 will be a very special year for the millions of rice-farming families who depend on growing the staple for their daily needs as well as their future. So, in our magazine's first issue for the year, we are pleased to bring our readers' attention to the challenges that face smallholder farmers everywhere.

For example, in this issue's *Grain of Truth*, former IRRI Director General M.S. Swaminathan explains the need for a better understanding of what smallholder farmers need and the future of small-scale agriculture (page 42). Bas Bouman, director of the Global Rice Science Partnership (GRiSP), proposes a strategy to bring smallholder farmers in Asia out of poverty by increasing "virtual" farm size (pages 32-33).

In *Shaping the future of rice* (pages 30-31), *Rice Today*'s managing editor writes of how public and private sector institutions are coming together to find solutions to the challenges faced by the rice sector in creating a better life for both consumers and producers. Representatives of these institutions offer some interesting perspectives for developing better policies, technologies, and innovations and, most importantly, improving collaboration among stakeholders.

A great example of IRRI's partnership with both the public and private sectors in a single project is illustrated in the feature on pages 18-19, *The bubble that dries.* It tells how the private company GrainPro Inc., the University of Hohenheim (UHOH) in Germany, and IRRI have worked together to develop an inexpensive grain dryer that will help small-scale farmers in the Philippines and elsewhere dry their rice crop more effectively and efficiently.

As we all know, improved varieties play a strong role in producing more even in flood-, drought-, and salinity-prone areas. In *Sowing their choices* (pages 16-17), we learn how farmers in Myanmar are deciding on the kind of rice that they will plant in their fields. And, in his *Rice Facts* installment (pages 40-41), Sam Mohanty reports that many farmers in Odisha, India, have adopted an IRRI-developed flood-tolerant Swarna-Sub1 not only for food but also as a worthy offering in their religious rites.

In addition to protecting the environment, helping smallholder farmers in Vietnam profit more is another reason why IRRI and other organizations are urging far less use of pesticides. K.L. Heong, a leading expert on ecological engineering, shares how he has devoted more than 25 years to weaning farmers from their heavy dependence on pesticides and helping them improve the management of rice pests instead to reduce their crop losses. (See *Vietnam turns back a tsunami of pesticides* on pages 12-13 and *Reducing pesticide use in Asia's rice fields: the job is far from finished* on pages 14-15.)

In Cameroon, the recent 3rd Africa Rice Congress also focused on smallholder farmers. Congress participants recognized the need to scale up investments for modernizing Africa's rice sector and its R&D and capacity building (see *Banking on Africa's rice potential* on pages 34-35).

And, while on the subject of Africa, without a doubt, one of the prime movers of rice science on the continent is Papa Abduolaye Seck. A staunch advocate of research for Africa's development, his conviction that Africa would either develop through science and technology or not develop at all has transformed the continent's rice sector into a thriving industry that has yet to reach its full potential. Read about this pioneer's contributions on pages 36-37.

Finally, the goal of helping smallholder farmers get out of poverty and secure their livelihood in a sustainable way can be better achieved by partnering between governments and institutes such as IRRI. This is made clear in *Myanmar rises* (pages 28-29). Over the last half century, IRRI has been working with researchers, extension workers, and farmers in the country. Myanmar President U Thein Sein recently visited IRRI headquarters to personally solidify the Myanmar-IRRI partnership to help his country regain its former stature as one of the world's top rice exporters.

I hope you enjoy reading these and other features in this issue and that you have a happy and prosperous year ahead.

Gene Hettel
Rice Today editor-in-chief

New gene could boost yield of indica rice


ISAGANI SERRANO, IRRI

RICE BREEDERS such as Tsutomu Ishimaru are now using SPIKE to boost the yield potential of leading local rice varieties.

Scientists from the Japan International Research Center for Agricultural Sciences (JIRCAS) and the International Rice Research Institute (IRRI) have discovered a rice gene that, in preliminary testing, increased production by 13–36% in modern long-grain indica rice varieties—the world's most widely grown types of rice.

"We discovered the gene, *SPIKE*, in an Indonesian tropical japonica rice variety," announced rice breeder Nobuya Kobayashi of the National Agriculture and Food Research Organization—Institute of Crop Science in Japan. Dr. Kobayashi is a former IRRI scientist seconded from JIRCAS. Tropical japonica rice is mainly grown in East Asia and accounts for only about 10% of global rice production. Incorporating *SPIKE* into indica varieties that are very popular and widely used across 70% of global rice-growing areas could significantly boost food security.

SPIKE is a rice gene that, in preliminary testing, increased production by 13–36% in modern long-grain indica rice varieties.

The discovery of *SPIKE*, which is now published in the scientific journal *Proceedings of the National Academy of Sciences of the United States of America* (PNAS), means that breeders can now start incorporating the gene into popular indica rice varieties. The gene can improve plant architecture without altering grain quality or growth periods.

Breeders at IRRI are now using *SPIKE* to boost the yield potential of leading local rice varieties.

New Rice app to help Filipino farmers earn more

Rice Crop Manager is a free phone application that allows extension officers to give Filipino farmers recommendations on nutrient, pest, weed, or water management for specific varieties and field conditions. It is currently being field-tested in five provinces.

The app is expected to increase the productivity and income of farmers by almost US$100 per hectare.

Rice Crop Manager was developed by the International Rice Research Institute in collaboration with the Department of Agriculture-Philippine Rice Research Institute. It is available at http://webapps.irri.org/ph/rcm and the Google play store as RCM PH.


JP SINOHIN, IRRI.

THE RICE Crop Manager app can increase farmers' productivity and income.

Satellite images assess impact of Typhoon Haiyan on rice production

The satellite-generated maps, developed by the International Rice Research Institute (IRRI) in collaboration with sarmap and the Department of Agriculture-Philippine Rice Research Institute (DA-PhilRice), have been released as part of ongoing work to track rice production in the Philippines.

The images show that flooding has affected about 1,800 hectares of standing rice crop across 15 municipalities. Additional data released by DA-PhilRice and IRRI showed that harvesting in the region, usually from September to October, was done just before the typhoon hit on 8 November 2013. Extensive damage to infrastructure, however, will have affected rice in storage, irrigation facilities, farm equipment and, likely, planning and preparation for the next rice-growing season.

"The Department of Agriculture appreciates the timely release of satellite maps on rice areas affected by Typhoon Haiyan," said DA Undersecretary for Operations and National Rice Program Coordinator Dante Delima.

"Geographic information on the location and seasonality of rice can help in quantifying rice production and evaluate losses following extreme weather events, but it can also be used to plan proactively," said Andy Nelson, head of IRRI's Geographic Information Systems Laboratory.

Leyte is one study site within the Remote Sensing-based Information and Insurance for Crops in Emerging Economies project in which IRRI, sarmap, and DA-PhilRice work with German International Cooperation (GIZ), Allianz, and the Swiss Agency for Development and Cooperation to develop technologies that monitor rice-growing areas for food security and crop insurance applications.

"With the satellite maps, we are able to understand faster the extent of Typhoon Haiyan's damage to rice production and, hopefully, improve our response to the situation," said PhilRice Deputy Executive Director for Development Eduardo Jimmy Quilang.

New technology to detect herbicide-resistant red rice in Uruguay

Red rice is a weed that infests rice fields worldwide and can reduce yield and grain quality.

INIA

Since 2005, Uruguayan farmers have been using Clearfield® Rice Production System (BASF) in controlling red rice. The system, which uses imidazolinone herbicides and imidazolinone-resistant cultivars, has been effective against red rice in intensively used fields. It is also an excellent part of an integrated weed management strategy. Today, 7% of Uruguayan rice area is seeded with imidazolinone-resistant cultivars. However, gene flow from the imidazolinone-resistant cultivars to red rice has been reported producing herbicide-resistant red rice, which threatens the sustainability of the technology.

The Rice Research Program of Instituto Nacional de Investigación Agropecuaria (INIA) Uruguay launched a novel Molecular Detection Service that can monitor red rice in fields where imidazolinone-resistant cultivars are grown. It can identify herbicide-resistant red rice using a quick and inexpensive molecular marker technology. Farmers or technicians bring fresh tissues from suspected seedlings or flowering plants for testing. Plants growing from positive points are then thoroughly removed to prevent herbicide-resistant red rice from spreading its seeds.

This initiative has been done through collaboration among the National Agriculture Research Institute of Uruguay, INIA, the National Agency for Research and Innovation, BASF Uruguay, the Uruguayan Rice Growers Association, and Solaris-Sembril.

Source: www.inia.org.uy

More rice for Africa, target of new research hub

With the assistance of the International Rice Research Institute (IRRI), the government of Burundi has established a regional rice research and development hub to improve food security in eastern and southern Africa. The new regional office will focus on developing and testing new rice varieties matched to the different rice production environments across eastern and southern Africa. The regional office was inaugurated on 30 October 2013 as part of the IRRI Board of Trustees meeting in Bujumbura, Burundi.

GLADY'S EBRON, IRRI

IRRI'S EASTERN and Southern Africa regional office in Bujumbura, Burundi.

First Vice-President Busokoza said that the government of Burundi shares the same vision as IRRI to provide sustainable ways of growing rice in order to improve the well-being of rice producers and consumers, reduce poverty, and preserve the environment.

> **"I am very optimistic that this new regional hub will substantially contribute to the development of the rice sector in eastern and southern Africa."**
>
> –Robert Zeigler, IRRI director general

Dr. Robert S. Zeigler, IRRI director general, said, "I am very optimistic that this new regional hub will substantially contribute to the development of the rice sector in eastern and southern Africa, and build our collaboration with our partners in Burundi and the greater region."

"With advances in technology, we can expedite the breeding process to ensure that new rice varieties are available every year for the region," said Dr. Achim Dobermann, IRRI's deputy director general for research. "It is our vision for Burundi to become a leading regional hub for excellent, high-yielding rice varieties that also have good grain quality."

Dr. Adama Traoré, interim director general of AfricaRice, highlighted the importance of Asia-Africa knowledge exchange that has been made possible by the CGIAR Research Program for Rice, known as the Global Rice Science Partnership.

New machine can cut postharvest losses in Cameroon

A machine that mills rice, cleans it, and separates the broken grains from the good ones has been developed by the National Institute for Agricultural Research for Development (IRAD) to improve rice growing in Cameroon.

Eddy Ngongkeu, coordinator of annual crops at IRAD, said that the machine could help reduce postharvest losses of around 125,000 tons of rice.

"If postharvest losses decline to 15%, this may create a greater effect than planting new varieties," said Ndindeng Sali Atanga, Africa Rice Center grain quality and postharvest expert.

For this innovation to reach the farmers, however, an effective policy framework for the dissemination of technologies to farmers still needs to be in place.

Source: www.scidev.net

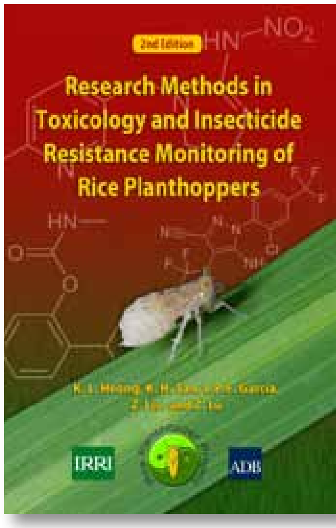
R RAMAN, AFRICARICE

LOSSES CAN be reduced by using some postharvest technologies.

Research Methods in Toxicology and Insecticide Resistance Monitoring of Rice Planthoppers (Second edition)

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

Published by the International Rice Research Institute (IRRI) and the Asian Development Bank (ADB). 145 pages.



Since the first edition was completed in 2010, research partners in the ADB-IRRI Rice Planthopper Project have been conducting routine monitoring as well as evaluating repellents, studying reversion of resistance, and using molecular techniques. Several workshops were held to compare results and discuss the methods, analyses, and interpretation.

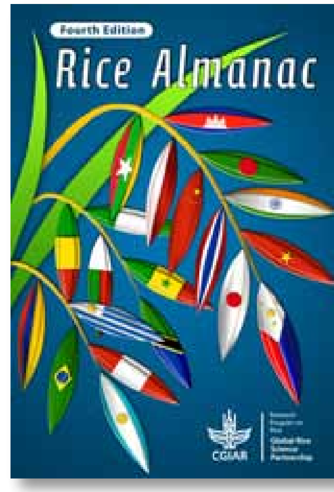
The feedbacks were the basis of this second edition of the book. The other update of this book is that Professor Z. Liu of Nanjing University, now one of the authors, has contributed to beef up the contents of this book. In fact, four more chapters are added in this edition.

In general, this book provides step-by-step procedures for readers to design experiments and use the program for analyses. It describes insecticide resistance reversion and how to use the resistance stability point as a steadier baseline for comparing resistance. Also, it provides information on the use of molecular tools to detect field resistance.

In a nutshell, this second edition of the book is now more complete and provides readers the whole range of research methods in toxicology and insecticide resistance monitoring. Although all the methods described are applied on rice planthoppers, the principles and methods can be mainly applied to other test organisms. ■

Rice Almanac (Fourth edition)

Published by the Global Rice Science Partnership (GRiSP). 283 pages.



The fourth edition of the Rice Almanac continues the tradition of the first three editions by showcasing rice as the most important staple food in the world. It also breaks new ground in its coverage of issues related to rice production, both environmental—including climate change—and its importance for food security and the global economy.

It also further expands its coverage to include 81 of the 117 rice-producing countries representing 99.9% of the world's rice production.

Published by GRiSP, the CGIAR Research Program on Rice, this book is a product of collaboration among key institutions. In addition to the International Rice Research Institute (IRRI), Africa Rice Center (AfricaRice), and International Center for Tropical Agriculture (CIAT), other major partners in GRiSP include the Centre de coopération internationale en recherche agronomique pour le développement (Cirad), L'Institut de recherche pour le développement (IRD, formerly ORSTOM), and the Japan International Research Center for Agricultural Sciences (JIRCAS).

The statistics presented are derived primarily from FAO, which include official country data (FAOSTAT), surveys, reports, and personal communications; IRRI's RICESTAT database, which is based on primary data from requests and questionnaires and secondary data from statistical publications and international organizations including the International Labor Organization and the World Bank; and regional data from AfricaRice and CIAT. ■

For orders, send email to: riceworldbookstore@irri.org or visit http://books.irri.org.

Read the Almanac on Kindle: http://www.amazon.com/dp/B00GZC56TC

TRAINING COURSES AT IRRI

Course title	Date	Venue
Basics of Rice Production (First offering)	1-3 April	IRRI, Philippines
Rice: Postproduction to Market Training Course (First offering)	21 April-2 May	IRRI, Philippines
SNP Data Analysis	5-9 May	IRRI, Philippines
Rice: Research to Production	19 May-6 June	IRRI, Philippines
Rice Production Techniques for Research Technicians (for African participants)	28 July-15 August	IRRI, Philippines
Basics of Rice Production (Second offering)	9-11 September	IRRI, Philippines
Scientific Writing Workshop	10-14 November	IRRI, Philippines

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

Let's talk rice at IRC2014!

Held every 4 years, the International Rice Congress brings together the brightest minds to discuss the latest scientific findings, industry trends, and changes in the marketplace

The International Rice Congress is the largest gathering of rice scientists and experts who come from all over the world to share their latest research work. The upcoming Congress (IRC2014), which will be held on 27 October-1 November 2014 in Bangkok, Thailand, will focus on increasing the food security of half the world's population.

Why attend?

IRC2014 is a forum for exchanging ideas, experiences, and best practices, and learning about the latest developments in rice science as well as key issues in the rice industry. But, it is also a great opportunity for participants to be part of a community for networking and contributing to trends and initiatives.

"'Participants will be among 2,500 intelligent, innovative, and engaging players in global rice science and industry—surely a rich learning and networking environment," said Bruce Tolentino, IRC2014 chair and deputy director general for communication and partnerships at the International Rice Research Institute.

"Participants' perspectives will be broadened because IRC2014 will enable delegates to meet and interact with a wide range of delegates, scientists, and other rice industry players," he added. "This promotes synergy in meeting shared challenges together."

What to expect

"With its theme, *Rice for the world*, we are obviously looking at the whole range of topics from growing rice in the deltas to looking at root physiology, for example, or from climate-ready rice to real-time satellite mapping and remote sensing," said Mike Jackson, science chair of IRC2014.

The IRC2014 organizing team wants to be quite innovative. Each morning and afternoon, there will be a plenary lecture given by speakers who are not necessarily rice scientists.

"We have invited several speakers who will bring new perspectives on agricultural development issues relevant to rice science," Dr. Jackson added.

"We also want to add a great deal of value by carefully identifying the best speakers," said Dr. Tolentino. "They must have the necessary expertise, practical experience, and the ability to engage audiences in an interesting way."

Open invitation to young scientists

"We are in the process of building a program that is broad in its scope, scientifically very strong, and interesting in its detail," said Dr. Jackson. "We want to encourage the participation of rice researchers and experts everywhere, especially young rice scientists, and give everybody a chance to have their work presented."

Most rice researchers or graduate students for MS or PhD degrees working in a relevant rice research discipline under the age of 35 are considered to be "young rice scientists."

"They should think seriously about presenting their work at IRC2014," added Dr. Jackson. "They never know; theirs might be selected for the oral program. If not, they can always present a poster."

However, those below 35 years of age who received their PhD degree before 1 January 2012 will not be considered in this category. "Well, it's possible that someone like this could be already on their second postdoctoral fellowship, and we'd like to even the opportunities somewhat," explained Dr. Jackson.

The *Call for Papers and Posters-Submission of Abstracts* will begin in mid-January once the IRC2014 website has been launched. For oral presentations, young rice scientists must be the lead author. All abstracts for oral presentations will be selected on merit, and, if their abstracts are chosen, each young rice scientist will receive a travel grant and free registration.

"This is a huge event," stated Dr. Jackson. "Imagine it as an excellent networking opportunity. There will be more than 200 oral papers and perhaps as many as 800 or more posters."

Interested parties can visit the IRC2014 website (http://ricecongress.com/) for further announcements and the latest information.

Rice Today around the world

R. RAMAN, AFRICARICE

RICE BREEDERS taking a breather. Dr. Moussa Sié, Africa Rice Breeding Task Force coordinator, and Dr. Iliyath Bello, rice breeder at the National Institute of Agricultural Research of Benin, stop by the Grotto of Our Lady of Arigbo. Built in 1954, after an apparition of the Virgin Mary, it has since become an important place of pilgrimage in Benin.

IN THE company of twin giants. Sharlene Santos-Peralta, IRRI public relations staff, and *Rice Today* are framed by the famed Petronas Towers in Kuala Lumpur. At more than 450 meters high, they are the tallest twin buildings in the world and a symbol of Malaysia's pride.

BEN PAMATMAT

WONDER WOMEN. Officials of the Department of Agriculture of Sri Lanka strike a pose during the 17th Annual Meeting of the Council for Partnership on Rice Research in Asia, co-hosted by IRRI at Hotel Thilanka, Kandy, Sri Lanka. These women provide the council with a strong intellectual and political voice in influencing on important research and policy issues affecting the livelihoods of rice farmers and consumers in the country.

Masato de arroz or fresh rice beverage is a creamy, refreshing beverage enjoyed throughout Latin America. The drink originated on the eastern plains of Colombia. Its original recipe has rice and sugar only. There, it is served at any time as a thirst quencher because of the relentless hot weather. To add a tropical touch, we usually use fruits such as pineapple and starfruit as garnish. We also serve it during fiestas or any festivities and normally in our homes, using a different fruit each time.

This drink is best served with cookies and breads. In Colombia, it is usually served with *mantecada* (Colombian corn bread) or *almojábanas* (Colombian cheese bread), among other breads.

FLAR (4)

Colombian fresh rice beverage

Ingredients

50 grams rice
1 cup water (for cooking rice)
3 cinnamon sticks
4 tablespoons sugar
1 liter water
150 grams of sliced pineapple, starfruit, or any preferred fruit

Directions:

Cook rice in 1 cup of water. Add cinnamon sticks for flavor.
When cooked, remove the cinnamon sticks and put the rice in a blender.
Add sugar and 1 liter of water.
Blend until smooth.

To serve, put ice cubes in a glass and add a few pieces of pineapple. Pour the rice beverage over the ice cubes and pineapple. Garnish with sliced starfruit.

Note:
Flavors can be combined with aromatic herbs or different fruits. The most important ingredient is rice.

Serves 4.

This recipe was submitted by the Latin American Fund for Irrigated Rice (FLAR), which was established on 16 January 1995. Thanks to the concerted efforts of various rice producers' associations from Brazil, Colombia, Venezuela, and the International Center for Tropical Agriculture (CIAT).

FLAR comprises a heterogeneous group of associations from both the private and the public sectors, from Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, the Dominican Republic, Uruguay, Venezuela, and CIAT. FLAR's team like to prepare *Masato de arroz* when they have special events such as CIAT's field day or Rice Research Program field day, or when they are visiting their colleagues in the eastern plains of Colombia.

Watch Johanna Loaiza, a CIAT staff member, demonstrate how to prepare this delicious rice beverage in a 3-minute video on YouTube at http://youtu.be/oQYNwhFw-9c.


©HO VAN CHIEN

Vietnam turns back a TSUNAMI OF PESTICIDES

by **Dennis Normile**

Convincing Vietnamese rice farmers to use less pesticide came down to letting them see the benefits for themselves

For years, the entomologists at Vietnam's Southern Regional Plant Protection Center in Long Dinh had tried to sell rice farmers on the benefits of reducing pesticide use—to little effect. So, in 2001, they took a different tack: they challenged 950 farmers to try for themselves.

In one plot, the farmers grew rice using their usual amounts of seed and fertilizer, spraying insecticide whenever they thought it was needed—which was often. In a nearby plot, they didn't spray at all for 40 days after planting and used less seed and fertilizer as well. To the farmers' surprise, the yield from the experimental fields was as good or better, while costs were lower, generating 8–10% more net income. From then on, they were convinced, recalls Ho Van Chien, who collaborated on the project.

The exercise, designed with colleagues at the International Rice Research Institute (IRRI) in Los Baños, Philippines, was the first step in a campaign that Dr. Chien says has led Mekong Delta farmers to cut insecticide spraying from five times per crop cycle to once—or even none at all. Experts are now trying to replicate that success throughout Southeast Asia.

Thanks to misunderstandings about pest control and heavy marketing, Asia's pesticide use has skyrocketed in recent decades. Pesticide imports by 11 Southeast Asian countries grew nearly sevenfold in value between 1990 and 2010, according to Food and Agriculture Organization (FAO) statistics, with disastrous results. Overuse indiscriminately kills beneficial as well as harmful insects, and decimates bird and amphibian populations. Pesticides are also suspected of harming human health and are a common means for rural Asians to commit suicide.

Ironically, the main target of this chemical warfare, the brown planthopper (*Nilaparvata lugens*), has become increasingly resistant to it. Over the past 5 years, planthopper outbreaks have devastated rice harvests throughout Asia—"but not in the Mekong Delta," says K.L. Heong, an IRRI insect ecologist. Thanks to the more judicious use of chemicals, natural predators helped keep planthoppers in Vietnam in check (see *Reducing pesticide use in Asia's rice fields* on pages 14–15).

Clean as a swimming pool

The Green Revolution of the 1960s and '70s introduced sturdier plants that could support heavier grain loads resulting from intensive fertilizer use. Rice production in Asia more than doubled. But, it left farmers believing more is better—whether it's seed, fertilizer, or pesticides.

Rice farmers became accustomed to spraying soon after planting, when they first saw signs of the leaffolder, which appears early in the crop cycle. That bug causes only superficial damage that doesn't reduce yield. Worse, early spraying also takes out the frogs, spiders, wasps, and dragonflies that prey on the brown planthopper, which arrives later and is far more dangerous. Instead of "landing in a sea of sharks," planthoppers find something as "clean as a swimming pool," Dr. Heong says. What's more, tests have shown that killing planthoppers now takes pesticide doses 500 times greater than in the past. More and more planthoppers survive to suck sap from the young rice plants, causing them to wither.

As early as the 1980s, IRRI and the FAO convinced some Southeast Asian governments that, with integrated pest management (IPM), natural predators could control planthopppers. In 1986, Indonesia banned 57 pesticides and completely stopped subsidizing their use. But, progress was reversed in the 2000s, when growing production capacity, particularly in China, unleashed a "tsunami of pesticides," says FAO entomologist Peter Kenmore. Even some in the agrochemical industry concur. "We all agree that, in Vietnam, farmers have overapplied pesticides in some production environments," says Kee Fui Kon, who oversees rice-related R&D at the Swiss agrochemical giant Syngenta.

Radio soap opera

In Vietnam, the Mekong Delta trial helped change conventional wisdom among farmers and agricultural officials. The study led to the "three reductions, three gains" campaign, to convince farmers that cutting the use of seed, fertilizer, and pesticide would boost yield, quality, and income. Word was spread through posters, leaflets, TV commercials, and a serialized radio soap opera, broadcast in 2004, that featured a rice farmer who gradually became convinced of the benefits of IPM. It didn't hurt that a 2006 planthopper outbreak hit farmers using insecticides harder than those who didn't.

Recently, the Plant Protection Center and IRRI have also been encouraging farmers to grow flowers, okra, and beans on the banks of paddies, instead of stripping vegetation, as was typical. The plants attract bees and a tiny wasp that parasitizes planthopper eggs, while the vegetables diversify farm income. Dr. Chien says that few Mekong Delta farmers now routinely use insecticides, though many still use fungicides.

SPRAYING INSECTICIDES also kills beneficial insects and other organisms that help control rice pests.

SYLVIA VILLAREAL

"I think that there are signs that things have gone pretty well in Vietnam recently," Dr. Kenmore says. Other experts are reserving judgment. "I take the reports [of reduced insecticide use] at face value, but as a scientist I would like to see data," says agroecologist Steve Wratten of Lincoln University in Canterbury, New Zealand. Geoff Gurr of Charles Sturt University, Orange, in Australia, who collaborates with Dr. Heong and Dr. Chien, says that they are now crunching data from studies on pesticide use and the effects of planting flowers and vegetables; a paper will be ready soon.

Syngenta's Dr. Kon says that insecticides still have a role to play, especially those targeting other pests, such as stem borers and the larvae of several moth species that feed on rice plants. The company's internal data show that yield gains of 21% can be achieved with proper use of pesticides, he says.

Other countries are taking note of Vietnam's approach. In 2010 and 2011, massive planthopper outbreaks hit 400,000 hectares of Thai rice fields, causing losses of about US$64 million. "We're starting to increase the awareness that farmers are losing a lot because of the misuse of pesticides," says Kukiat Soitong, an extension specialist with the Thai Ministry of Agriculture and Cooperatives. The Thai government is now pushing the "no spray in the first 40 days" approach.

All of these initiatives, Dr. Heong says, "have to overcome very powerful marketing forces," such as bundling pesticides in packages with seeds and fertilizer, offering incentives for volume purchases, and hyping the benefits. Here, too, Vietnam is taking action. A proposed law calls for licensing pesticide dealers and government approval of advertisements to prevent exaggerated claims. FAO pest management expert Kevin Gallagher thinks that such regulation is needed in the region. "Farmers everywhere are influenced by advertisements," he says. There is "a lot of misinformation everywhere, all the time."

Mr. Normille is a contributing correspondent for Science.

GENE HETTEL (4)

Reducing pesticide use in Asia's rice fields: the job is far from finished

THE IRRI PIONEER INTERVIEWS

Conducted by **Gene Hettel**

For more than 25 years, Kong Luen "K.L." Heong worked at the International Rice Research Institute (IRRI) as an entomologist, trekking across Asia to visit farmers and help them improve the management of rice pests, thus reducing their crop losses. This IRRI principal scientist, until his retirement in late 2013, was responsible for research on arthropod ecology and integrated pest management (IPM). He conducted pioneering research (see *The pesticide paradox* on pages 32-33 of *Rice Today* Vol. 7, No. 1) and won many awards, including the 2006 Third World Academy for Science Prize for Agriculture, for furthering IPM concepts and pushing for greater understanding of pest problems in rice among farmers, extension personnel, and governments alike. However, he told the following anecdote during his recent pioneer interview to emphasize that there is still much more to do.

"Lucky" farmer will still spray next season

"In Thailand, I went to observe an outbreak in farmers' fields of the brown planthopper (BPH), the insidious insect pest that continues to devastate rice harvests across Asia. In one village, a farmer experienced a serious yield loss due to the BPH while his neighbor just across the road had a good crop with virtually no BPH infestation. Talking to both of them, I discovered that they used the same variety, planted it at the same time, and applied the same fertilizer. What did they do differently? The farmer who suffered the crop loss said proudly that he had sprayed eight times, but he still could not control the pest. His neighbor was almost too shy to tell me that he actually didn't spray anything because he had been in the city and had just returned. So, I asked the farmer who did not spray, what lesson had he learned? He replied, 'I was just lucky; next season, I will definitely spray.'"

Dr. Heong pointed out that farmers such as these are stuck in a broken system. They are really victims—paying for pesticides that they don't need; yet, in the end, their crop is still severely damaged if not destroyed. They have no idea what happened to them! Sadly, this scenario is repeated too many times across Asia. There have been successes in reducing pesticide applications, especially in Vietnam (see *Vietnam turns back a tsunami of pesticides* on pages 12-13). Here, the "Three Reductions, Three Gains" campaign and radio soap operas have successfully helped change the conventional wisdom on pesticide use among farmers and agricultural officials. However, the pressure on farmers to use pesticides continues to be relentless.

New false reasons to spray: hybrid rice and climate change

"Many farmers tend to remember the last thing they hear from anyone with a convincing story, such as a pesticide salesman," said Dr. Heong. "For example, I have found farmers who, after they had undergone 16 weeks of training on how to manage their crops without spraying pesticides, started spraying again only 2 months later! When I asked one farmer why, he said, 'Sir, we've been told that, since we are now planting hybrid rice, it is susceptible to pests and we must spray five times.' So, all those weeks of training were wiped away by a wily salesman who told the farmers that hybrid rice is somehow pest susceptible. Of course, it is not, but that doesn't matter."

PLANTHOPPER OUTBREAKS, such as this one in Indonesia, can be triggered by high dependence on or misuse of insecticides. Such a scenario is certainly a threat to sustainable rice production.

IRRI

Another tall tale: pesticide pushers are warning farmers that climate change is here and, with it, new pests are arriving on the scene, which require insecticides to control them.

When an insecticide might be effective

Dr. Heong said that an insecticide can be effective only if the right chemical is applied with the right equipment at the right time and targeted to the right pest.

"Otherwise," he said, "it is either completely wasted or, worse, it may actually cause more trouble, such as creating a predator-free environment in which the BPH can wreak its havoc on the rice crop. In the early stage of the crop (the first 40 days), chemical applications are absolutely unnecessary. Toward the later stage of the crop, there might be an occasion during which a field is invaded by a pest from an external source. A farmer then might effectively apply one, just one, targeted spraying to control such a pest."

Myanmar: perhaps taking a different path

In November 2013, just a few weeks before his retirement, Dr. Heong and his team went to Myanmar to conduct a symposium on ecological engineering in rice. "The BPH threat in Myanmar is real because it's next door to Thailand, where the pest is a serious problem right now," he explained. "The good thing about this Southeast Asian nation, which has the potential to reclaim its title as a major rice exporter if not the top exporter in the next 10 to 20 years, is that most of its farmers spray very little because they have, up to now, been unable to obtain insecticides. However, with Myanmar opening up economically, many pesticide companies are, I would say, 'invading' the country. These companies are queuing up at the Department of Agriculture daily to get their products registered."

This sudden influx of insecticides coming into Myanmar could possibly make farmers start using chemicals heavily—especially if the country's existing pesticide laws and regulations are not well secured and implemented. "If this happens, the BPH will become a very serious threat," Dr. Heong predicted. "So, the symposium aimed to influence the pathway of how pest management in the country is to be practiced, hopefully preserving ecosystem services (i.e., predators and natural enemies of the pests) rather than relying on the pesticide trap and 'addiction' that has befallen many farmers of Myanmar's Asian neighbors."

Since insecticide resistance in rice planthoppers is developing rapidly, Dr. Heong even rushed the printing of the greatly updated second edition of his book, *Research methods in toxicology and insecticide resistance in monitoring of rice planthoppers* (see the Book section on page 8) to have it available during the symposium. "We want to get to Myanma farmers and policymakers before the pesticide companies do," he said. "IRRI is in a position to help Myanmar build a different path toward more sustainable pest management than the direction taken by its neighbor countries in the first Green Revolution. Although it will be a big challenge to stay a step ahead of the pesticide merchants, it will also be fascinating to follow this case study in the making."

A quest after "retirement"

Although Dr. Heong has retired from IRRI, he will be pursuing a personal quest over the next 5 years. "I will focus on designing governing structures in countries such as Myanmar, Vietnam, Thailand, Indonesia, and others that will make scientific technologies—be they resistant varieties or new practices—more sustainable and viable in the face of how pesticide companies cleverly market their products," he said. "Although pesticide use is indeed a pest management tool, the practice tends to overshadow all the other technologies that can help farmers."

Science and other logical methods cannot compete with the pesticide marketers unless the rules that regulate these chemicals are enforced. "Unfortunately, most countries don't have the governing structure required to do so," concluded Dr. Heong. "I hope to help change that."

To view some video clips from Dr. Heong's Pioneer Interview, go to www.irri.org/ricetoday.

Gene Hettel is a senior science editor and historian at IRRI.

ROMEO LABIOS (2)

FARMERS ALSO check the taste when choosing their preferred salinity-tolerant variety.

Sowing their choices

by **Trina Leah Mendoza**

A project in Myanmar is giving farmers a say on what they want in a rice variety

Soe Moe Kyaw's family was fishing in a different village when Cyclone Nargis devastated their township in 2008. The result was grim. He lost his wife and child, and several of his relatives. After this tragic loss, the remaining members of his family abandoned fishing and turned to rice farming, vowing to always be close to their homes and loved ones in case another catastrophe strikes.

However, their village in Labutta Township is near the Ayeyarwaddy River. During the summer, the water of the river is so low that waters from the sea intrude into the river and the water becomes brackish and unsuitable for growing crops. Rice crops in the village could never survive during the summer. Mr. Kyaw and other farmers in some villages in the lower Ayeyarwaddy Delta can plant only one rice crop a year because of the high salt content in the soil. To make matters worse, the traditional rice varieties they cultivate not only produce low yields but also take longer before they can be harvested. As a result of these conditions, farmers usually harvest an average of only 2.8 tons per hectare, compared with the 4.2 tons per hectare in more favorable areas.

Taking charge of their lives

Replacing the rice varieties they plant is one solution available to Mr. Kyaw and his fellow farmers. But, in the past, the choices were usually limited to a few varieties that were introduced each year by seed companies and government agencies. Most of these were developed through conventional breeding programs and tested at research stations, which do not represent farmers' fields. Although varietal release systems prioritize some traits, farmers often look for other traits when choosing varieties.

The International Rice Research Institute (IRRI) has been working with Myanmar's Department of Agricultural Research (DAR), Department of Agriculture, and nongovernment organizations led by Welthungerhilfe, Mercy Corps, and GRET to provide new options for rice production along the coastal areas of the Ayeyarwaddy Delta. Funded by the United Nations Office for Project Services, the Livelihood and Food Security Trust Fund Project aims to improve food security and livelihoods of rice-producing households, particularly in Labutta, Bogale, and Mawlamyinegyun townships.

The 3-year project introduced farmers' participatory varietal selection (PVS) of high-yielding varieties for favorable areas and stress-tolerant varieties for salt- and flood-prone areas.

"Grain yield is not the only criterion for selecting rice varieties; we also consider other factors such as

TRINA MENDOZA

SOE MOE Kyaw, a farmer from Kant Ba Lar Village, Labutta Township, shares his experiences and new knowledge after joining the participatory varietal selection.

SA NAY LINN TUN

FARMERS' VOTES on their most preferred varieties are tallied.

the results of grain quality preference analysis and sensory evaluation of PVS," explains Dr. Glenn Gregorio, deputy head of IRRI's Plant Breeding, Genetics, and Biotechnology Division.

Farmers' choice

Fifteen flood-prone and 12 salt-tolerant high-yielding rice varieties, as well as those that yield well in favorable conditions, were evaluated in researcher-managed fields and compared with the farmers' variety at six sites during the 2012 wet season, and at 15 sites during the 2013 dry season. A total of 181 farmers joined the PVS preference analysis training in the 2012 wet season. And, in the 2013 dry season, 134 farmers joined a similar activity.

The eating and cooking qualities of the four or five most preferred varieties selected from field performance were then sensory evaluated by 126 farmers in the 2012 wet season and by 123 farmers in the 2013 dry season. Notably, a quarter to more than half of the farmers who participated in each of these activities were women.

"PVS is useful for us because we can now change our old traditional varieties for new ones that are higher-yielding or resistant to pests and diseases and tolerant of stress," says Soe Oo, a 51-year-old farmer from Min Kone Village.

"At five of the six sites during the 2012 wet season, Saltol Sin Thwe Latt was the consistent choice of farmers because of its good taste, color, gloss, softness, and cohesiveness," explains Romeo Labios, IRRI's PVS consultant in Myanmar. "At all sites, Saltol Sin Thwe Latt and Swe Ta Soke had the highest average yield—3.9 tons per hectare."

Based on yield and sensory evaluation during the 2012-13 dry season, five rice entries produced the best yield, ranging from 3.3 to 4.1 tons per hectare. These are IR10T 107, IR10T 108, IR10T 109, IR10T 111, and CSR 36.

"The seeds of these varieties are being multiplied at DAR in Yezin for the large-scale farmer-managed trials in the 2013-14 dry season," says Dr. R.K. Singh, IRRI's senior scientist who is leading the varietal improvement program in Myanmar. "Farmers will receive 5 to 10 kilograms of seeds from three selected new varieties to be planted in larger plots in their fields. To sustain the availability of good-quality seeds in the community, selected farmers will produce seeds on their farms with technical guidance from our project staff."

Knowledge flows

Aside from discovering new varieties, the farmers also learned better practices for growing their crop, such as direct seeding, proper fertilizer, and weed and herbicide management, through PVS trials. This new knowledge brings changes in old traditions and farmer practices in rice cultivation.

"I learned how to grow salt-tolerant varieties," says Mr. Kyaw. "For our crops to avoid the harsh salt waters in March and April, we need to plant in December instead of January—one month earlier. If our plot is successful, it will be good for the whole region."

"This will ensure that their preferred salt-tolerant varieties will be harvested before the salinity of the river becomes too high," explains Madonna Casimero, IRRI's representative to Myanmar. She and Dr. Labios believe that adjusting the cropping calendar will allow farmers to plant another crop, one that is more suitable than rice during the dry season. This will help them earn more income.

The benefits of PVS trials have spread to neighboring villages and improved the food security and livelihood of farmers through higher-yielding and stress-tolerant rice varieties of their choice. Best of all, Mr. Kyaw and many other farmers who used to struggle with making ends meet no longer have to leave their loved ones behind in search of a better life.

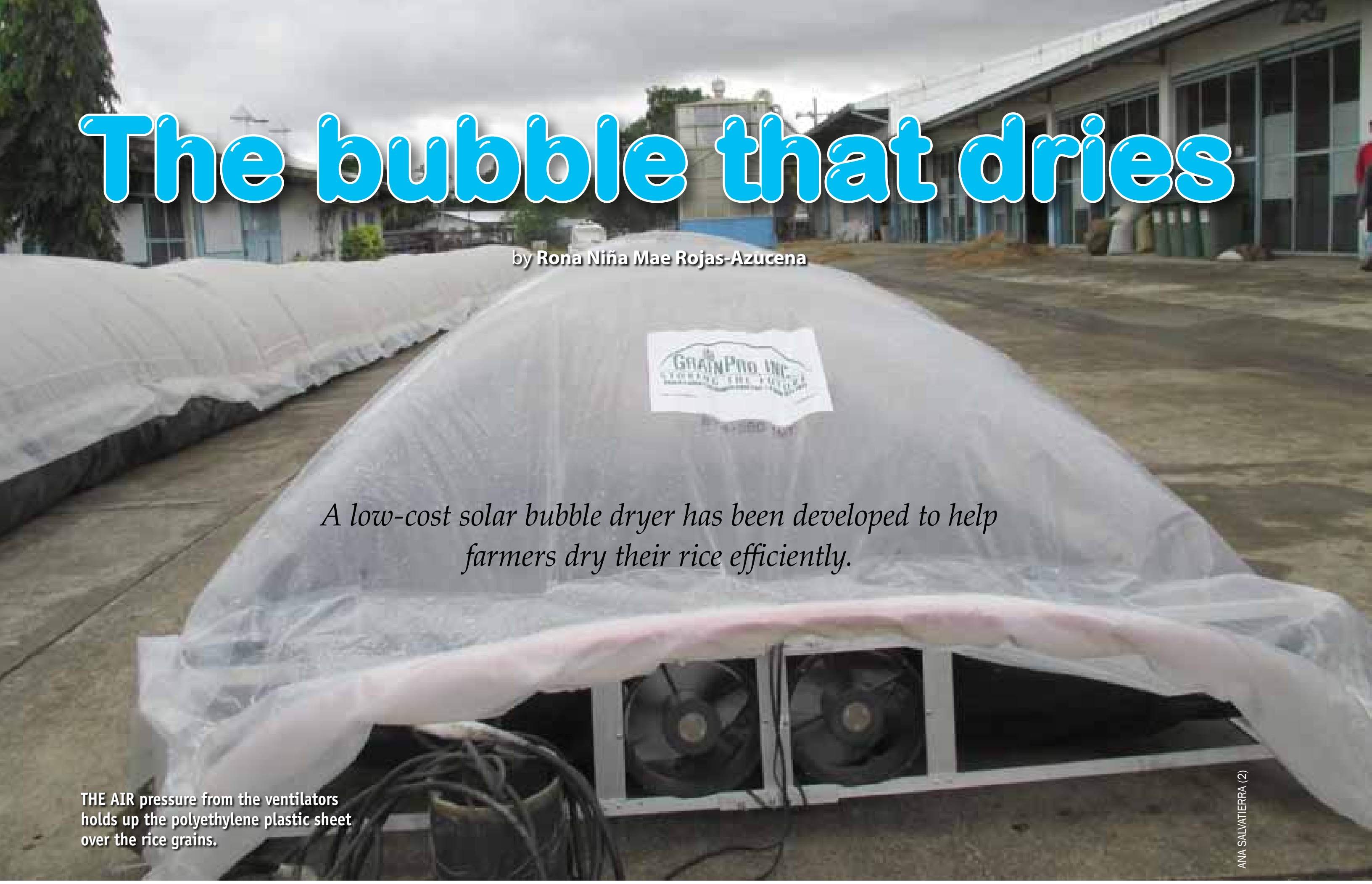
Ms. Mendoza is a senior communication specialist with the Irrigated Rice Research Consortium at IRRI.

WOMEN FARMERS from Labutta Township in Myanmar evaluate and select their most preferred varieties.

The bubble that dries

by Rona Niña Mae Rojas-Azucena

A low-cost solar bubble dryer has been developed to help farmers dry their rice efficiently.



THE AIR pressure from the ventilators holds up the polyethylene plastic sheet over the rice grains.

ANA SALVATIERRA (2)

In typical Philippine villages, rice grains spread out on open basketball courts or even on roads to sun-dry were a familiar scene for Ana Salvatierra, an agricultural engineer and researcher from the University of Hohenheim (UHOH) in Germany.

Sun drying is the most common drying method in the country, and also in Thailand, Cambodia, Laos, and India, among other tropical countries, because it is cheap. It uses the sun as the heat source. But, it is laborious and unreliable. Farmers need to mix the grains at least every half hour for even drying. They need to cover the grains when the sun is too hot to minimize cracking from overheating and constantly keep animals away from the grains. Obviously, overcast skies extend the drying period. And, when it rains, farmers hurriedly collect the grains to avoid getting them wet.

Engr. Salvatierra believed that the constant threat of rain made the traditional practice of sun-drying grains a terrible waste of farmers' hard work.

Certainly the quality of the grains decreases and postharvest losses could increase around 20% or even more," Engr. Salvatierra laments.

Building bubbles

Meanwhile, Tom de Bruin, president of GrainPro Inc., a long-time collaborator with the International Rice Research Institute (IRRI) and manufacturer of IRRI Super Bags, was searching for other ways to use the sturdy polyethylene plastic material of the Super Bags.

Martin Gummert, head of the IRRI Postharvest Unit, supported the idea of repurposing the plastic to build dryers for rice grains. Engr. Gummert and GrainPro sought the technical expertise of researchers from UHOH in solar drying. The project, *Development and optimization of a solar greenhouse dryer for drying rice*, was funded by the Federal Ministry for Economic Cooperation and Development (BMZ), German International Cooperation (GIZ). Engr. Salvatierra became the lead project researcher. With IRRI as coordinator, UHOH, GrainPro, and local country partners were able to work together and accumulate knowledge for the project.

Field testing for a 1-ton-capacity dryer started during the dry season in 2011. The dryer design underwent many changes throughout its testing phase in the Philippines. The first prototype had a chimney and steel pipes that held up the plastic sheet roof over the rice grains. Technicians who set up the dryer found it difficult to pull the plastic sheet over the steel pipes. The chimney was not very efficient in drawing air through the drying tunnel and it also toppled due to strong rains and wind.

"We recorded our observations and collected data," says Engr. Salvatierra. "Then, we modified the design of the solar bubble dryer based on the results from our field tests."

Then the idea for a simple design came in 2012. It is made of two plastic sheets, a black one at the bottom where the grains are placed and a transparent one as roofing. Both sheets are connected by a zipper. It's called the solar bubble dryer (or SBD)—"solar" because of the ambient temperature that provided heat from the sun for the dryer, and "bubble" because of the dome-like shape of the polyethylene plastic roof when set up.

The solar bubble dryer was evaluated for drying efficiency and grain quality.

Initial results looked promising and partial data were presented during the Global Rice Science Partnership conference held at IRRI in October 2013.

Domes of heat

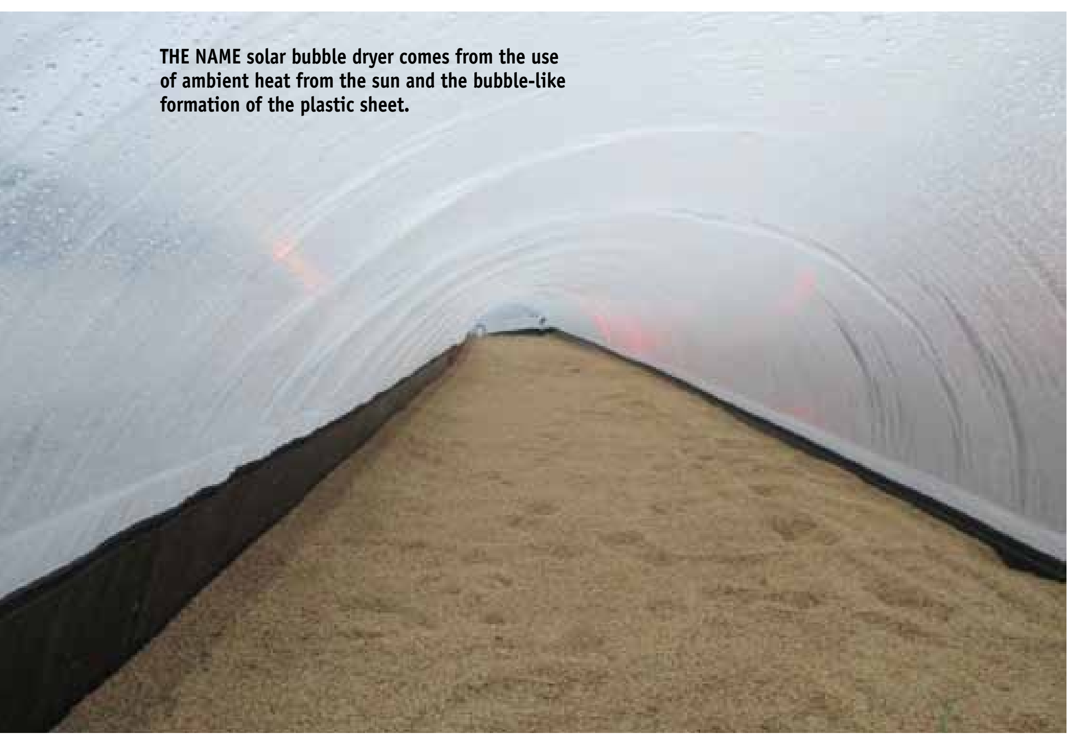
The current design now has two ventilators, in lieu of the steel pipes, placed at the air inlet at one end of the dryer to inflate and hold up the polyethylene plastic sheet, thus providing the dome shape. "The volume and air pressure are calculated so the dryer won't collapse—even if it rains," explains Engr. Salvatierra.

The ventilators also move the air inside the dryer, ensuring a homogenous distribution of heat and reducing the moisture content. The drying air leaves the dryer at the other end through an adjustable outlet.

Computer software from UHOH was also used to simulate the airflow inside the dryer to study the dryer's performance and to further optimize its design, to help overcome budget and weather restrictions.

On a typical sunny day, the surface of the grains heats up so much that users need to increase the frequency of mixing the grains. One of the features of the solar bubble design is a rolling bar underneath the dryer for mixing the grains. It takes only two persons to pull the handles of the bar and roll it down the whole length of the contraption to mix the grains inside. The roller has an additional gadget attached to it that enables it to mix grains more efficiently and evenly.

This low-maintenance, environment-friendly, hassle-free, and portable dryer also uses materials that are locally available, making it economical to build. Introducing a low-cost drying solution into the market is an important aspect that could encourage intended users—small farmers, in this case—to adopt the technology, according to Engr. Salvatierra.



THE NAME solar bubble dryer comes from the use of ambient heat from the sun and the bubble-like formation of the plastic sheet.

Engr. Gummert believes that after many attempts with more complex designs a low-cost dryer for farmers might now become a reality. Yet, even at this stage, because of the positive feedback from the 1-ton-capacity solar bubble dryer, some private millers from other countries have requested units that can accommodate 4 to 5 tons of grain.

Fast experiments

"The development of the solar bubble dryer was fast because of IRRI's partnership with a private company," says Engr. Salvatierra. "GrainPro was willing to invest in a product they believed would further help small farmers."

Engr. Salvatierra welcomes the challenge of conducting "fast experiments" under different environmental conditions as the second phase of the project is underway. She says that more tests will take place in other regions of the Philippines. IRRI's partners in other countries (Myanmar, Vietnam, and Cambodia) are also being tapped to test the dryer, whereas GrainPro's partners are testing the solar bubble dryer for commodities such as coffee and maize.

The research team has also looked into using solar panels to provide power to the battery of the ventilators. This enables operation of the dryer in areas where no electricity is available. Typically, a well-loaded battery can run up to 48 hours when charged by solar power, enough to cover a drying time of 2–3 days under rainy conditions, when traditional sun drying is not an option. When not used for drying, the solar panels can be used to produce electricity for other purposes, an additional feature for villages without a grid connection.

"It is a matter of adapting different engineering techniques in a technology," Engr. Salvatierra says. And technology, such as the solar bubble dryer, was adapted to the needs of the farmers—come rain or shine.

Ms. Azucena is a communication specialist at IRRI.

Rice self-sufficiency:
A question of geography?

by **David Dawe**

Why are some countries in Southeast Asia self-sufficient in rice but others not?

Southeast Asia is the hub of the world's rice economy. As a region, it has been a net exporter of rice for most of the past 110 years (the exception being some years between 1967 and 1978). It contains two of the world's top three exporters, but also two countries that, from time to time, have each been the largest rice importer in the world. Why are some countries in this region self-sufficient in rice while others are not?

Rice exporters vs. importers

Self-sufficiency is achieved when production exceeds consumption, so lower rice consumption should give a country a head start in achieving rice self-sufficiency. Yet, people in the traditional rice-importing countries (Indonesia, the Philippines, and Malaysia) eat less rice.

On the supply side, each exporting country in Southeast Asia (Thailand, Vietnam, Myanmar, Cambodia, and Lao PDR) has more production per person than each of the three rice-importing countries. But, surprisingly, the reason for higher per capita production in the exporters is not higher yield. In fact, the importing countries have higher overall yield than do the exporting countries, because a higher percentage of rice land is irrigated in the importing countries. Rather, the exporting countries have much more rice area per person.

In theory, the reasons why the exporting countries might have more rice area per person could be that their land is more suited to growing rice (as opposed to other crops), cropping intensity (the number of crops planted per unit of agricultural area) is greater, more land is used for agriculture, or more land is available per person (low population density).

Empirically, the proportion of total crop land devoted to rice, which is a measure of the suitability of land for growing rice, explains rice production per person across countries almost perfectly (the R^2 of a simple linear regression is 0.92; see Fig. 1). Thus, the importers are all to the lower left of the figure, while the exporters are to the upper right.

Other variables are less important. For example, the amount of land available per person is similar for many pairs of importers and exporters: in Indonesia and Thailand (0.76 and 0.74 hectare per person, respectively), in the Philippines and Vietnam (0.33 and 0.36 hectare per person, respectively), and in Malaysia and Myanmar (1.18 and 1.37 hectares per person, respectively).

The geography of rice production

A common feature of the five rice-exporting countries (in the upper right of Fig. 1) is that they are all on the Southeast Asian mainland, while the countries to the lower left are islands or peninsulas. Why might location make a difference to net trade status? Well, the countries on the mainland have dominant river deltas that provide ample water and flat lands, which make it easier to control the water. Such an environment is suitable for cultivating rice.

The importance of geography can also be seen at subnational levels: southern Thailand, a narrow peninsula, produces insufficient rice to feed its population and must "import" from the rest of Thailand, while Central Luzon in the Philippines, fed by the Pampanga River, produces more than enough rice for its own needs and "exports" rice to Manila.

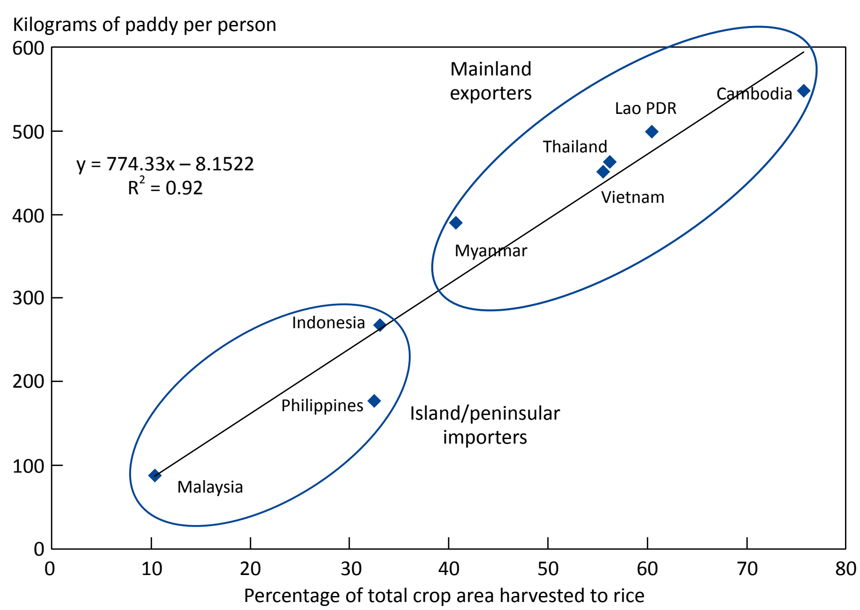


Fig. 1. Rice production per person versus share of crop area devoted to rice, ASEAN countries.

Other key rice importers in Asia are also islands or peninsulas: Japan, Korea, and Sri Lanka. Bangladesh is the exception that proves the rule. It is located on the mainland and devotes a large share of its crop area to rice, but the country is a small net rice importer because of its extraordinarily high population density, more than triple that of the Philippines, (which has the highest density of the eight countries studied here).

Thus, in terms of achieving rice self-sufficiency, island countries have a natural disadvantage. Less of their land is suited to growing rice. As a result, they cannot compete at the margin with the mainland rice exporters. On the best land, operating with the best technology, farmers in different countries are similar. But, the importing countries simply have less of that land than do the exporting countries.

In addition to this geographic pattern is a consistent temporal pattern. Malaysia, Indonesia, and the Philippines have been importing rice for more than a century, while the other countries have been exporting for most of that time (Fig. 2a and 2b). Of course, some exceptions exist for both groups, but these exceptions were due to "revolutionary" events.

The Philippines and Indonesia both became self-sufficient for a time in the 1980s, and even exported small amounts of rice. This achievement was due to the Green Revolution package of high-yielding varieties, irrigation, and fertilizer, which was adopted earlier in these two countries than in the exporting countries. On the exporters' side, Vietnam was a rice importer in the 1960s, '70s, and '80s due to the war and highly repressive farm policies.

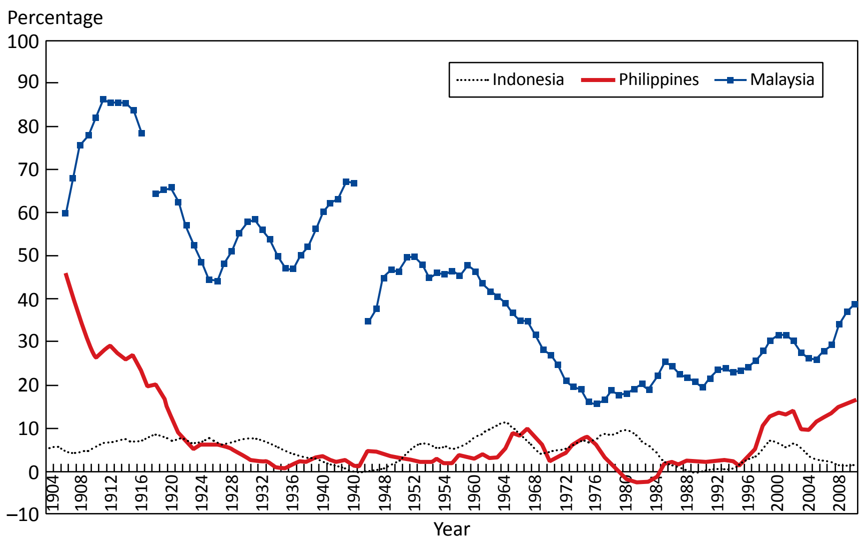


Fig. 2a. Net trade status, consistent rice importers, 1904-2010.

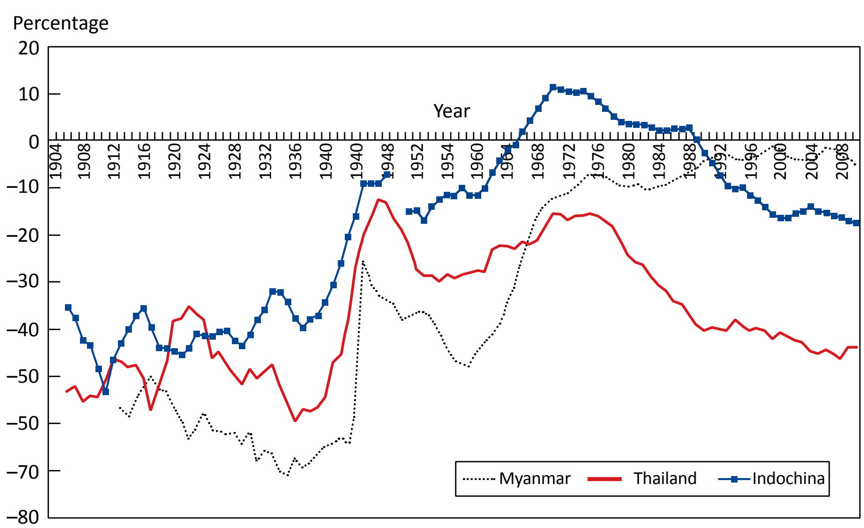


Fig. 2b. Net trade status, consistent rice exporters, 1904-2010.

Source of raw data: Rose (1985)[1]; FAOSTAT, 2013; USDA, 2013.

[1]Rose B. 1985. Appendix to the Rice Economy of Asia, Resources for the Future. Washington DC. 404 pp.

Strategy for rice importers

Should the rice-importing countries try to mimic the exporting countries and increase the proportion of cropped area devoted to rice? The problem with such a strategy is that there is a very good reason why fewer farmers grow rice in the importing countries, namely, other crops are more profitable. Forcing farmers to grow rice will reduce their income, which will work against household food security.

Thus, rice importers face a trade-off between national self-sufficiency (which is often equated with national food security) and household food security. The policy of restricting imports to achieve national self-sufficiency and reduce reliance on the world market raises domestic prices, which reduces household food security because most of the poor have to buy their rice in markets and are hurt by higher prices. Higher domestic prices also result in other costs, such as reduced farm diversification, poorer nutrition, and less competitiveness in other sectors of the economy. These costs should be considered in the design of national policies.

Note: Values shown are lagged five-year moving averages in order to smooth fluctuations. When imports exceed exports (+), net trade status is expressed as a percentage of consumption. When exports exceed imports (–), net trade status is expressed as a percentage of production. This convention avoids reporting values greater than 100% (in absolute value). Gaps indicate missing values.

Dr. Dawe is a senior economist in the Agricultural Development Economics Division of the Food and Agriculture Organization of the United Nations.

©Dave Leprozo, Jr.

Ready for transplanting. Carrying the seedlings of an heirloom rice variety Balatinow for transplanting, a young farmer of the Kankanaey tribe, in the Cordillera region in northern Philippines, walks along the bund of the rice terraces. The rice terraces were hand-carved out of the mountain slopes by his ancestors 2,000 years ago. (This photo by Dave Leprozo, Jr., published in the *Manila Standard* on 13 July 2013, won the "Agriculture Photo of the Year" prize during the 7th Bright Leaf Agriculture Journalism Awards.)

Measurements that matter

by **Gladys Ebron**

A global network aims to help plant breeders select specific genes for important traits under certain conditions

A GPS-guided field canopy sensor system mounted on a spray boom is used to measure some physical traits of rice plants.

RESEARCH TECHNICIANS manually measure plant traits.

IRRI (3)

MEMBERS OF the C4 Rice Project team are screening for rice leaf vein density using handheld microscopes.

C4 RICE CENTER

Since the first type of rice was sequenced in 2004, more than 3,000 additional ones have been sequenced, that is, their gene sequences—all their genetic information—have been deciphered. This is a remarkable scientific feat, which is an important step in understanding genes to breed new varieties of rice with beneficial traits to improve global food security.

With this sequencing comes a huge amount of genetic data, but the real power of this information is unleashed only when each gene is mapped to a specific trait. Without this additional knowledge, it's like having a phone directory full of numbers but no names attributed to them.

Thus, in 2011, the Global Rice Science Partnership (GRiSP), the CGIAR Research Program on Rice, initiated the Global Rice Phenotyping Network. This network brings together an international community of rice scientists in a joint effort to advance rice phenomics—the measurement of the physical and biochemical traits of a rice plant—and link these traits to genes.

Through phenomics, rice scientists can tell you which gene is responsible for what trait, and how many different versions of the gene are out there. The key is to measure just about anything that can be observed on huge and diverse populations of rice plants such as leaf size, number of panicles, or grain nutritional attributes. It is a numbers game that powers gene discovery through a sophisticated statistical procedure called association study.

Currently, the network focuses on important traits related to yield, efficient use of water and nutrients, and responses to major environmental stresses.

Building a gene library

The availability of genomic sequence information and the traits it stands for has propelled breeding into the "molecular age." Scientists now use molecular genetic information to quickly and precisely combine and select useful genes, as opposed to the trial-and-error process of conventional breeding. However, to enable molecular breeding, large libraries of genes must be established in the form of molecular markers. These are probes that help track the incorporation of specific genes into new varieties. This is not to be confused with the technology on genetically modified organisms—no modified genes are used or introduced. The Global Rice Phenotyping Network aims to contribute to massive gene discovery, with each partner bringing in its own research expertise and facilities.

Importantly, for the field work, since partners are located in different parts of the world, the crop can be tested under different environmental conditions. This means that the performance of rice plants—and the effectiveness of the genes that control this performance—can be measured in different climates, soils, and cultural practices. Some genes may have beneficial effects in one environment but not in another whereas others may improve growth and yield stability. Pooled observations across the network thus provide a handle on the interaction of the plant's genetic makeup and its environment.

The resulting database will teem with information such as how a plant looks, how it grows, how well it withstands extreme temperatures, or how nutritious its grains are. Most of all, researchers can assess whether or not the expression of a given trait is stable, that is, whether the gene does exactly the same thing regardless of the environment.

"The task is so enormous that no institute alone can do it," explains Michael Dingkuhn, crop physiologist for the Center for International Cooperation in Agricultural Research for Development (Cirad) based at the International Rice Research Institute (IRRI) and coordinator of the Global Rice Phenotyping Network. "This requires many different technical setups and environments, and the willingness of partners to jointly invest in a common goal."

RESEARCH TECHNICIANS record the physical traits of rice plants in the field.

For Dr. Dingkuhn, the keyword is sharing. "We all have agreed to work on the same types of rice—300 types of indica rice and 300 types of tropical japonica rice.

"All contribute what they can do best in terms of traits, experimental design, and analytics. We search for characteristics and associated genes that deliver higher yield potential and improved abiotic stress adaptations, notably those related to climate change."

Hubs across the planet

The network's activities need to be closely associated with breeding. Sites in Colombia, Brazil, the Philippines, and Senegal, for example, serve as phenotyping hubs where rice seed can be easily imported and tested for many traits, in direct association with a major rice breeding program. The field hubs also represent different types of climate. For example, to check the effect of temperature on grain filling, the network has hubs in the Philippines, India, Senegal, and China.

In addition, two upland hubs are set up in Colombia and Brazil and a rainfed lowland hub in Benin for traits contributing to yield under drought conditions. Scientists are examining salt tolerance traits in Senegal and at IRRI.

All network partners will share access to the data and analyses. Eventually, when results are published, the database will be public.

"Previously, each center analyzed its own data," says Dr. Edgar Torres, plant breeder at the International Center for Tropical Agriculture (CIAT), who is leading the work on yield potential in Cali, Colombia. "The process in exploring the relations among traits, stresses, and varieties was tedious because many trials had to be established.

"But now, we have developed laboratory information management systems to integrate all the data on physical traits, which are shared with molecular biologists to make breeding more efficient."

Reducing human error

The process of taking the measurements and recording them is tedious, labor intensive, and time consuming. And, since these are done by humans, they are prone to error.

"The greatest challenge is quality control," says Dr. Dingkuhn. "Experiments in many locations worldwide, with thousands of plots, are prone to errors from wrong labeling and data recording to the management of the crop itself. The data pass through many hands, thus multiplying the potential error."

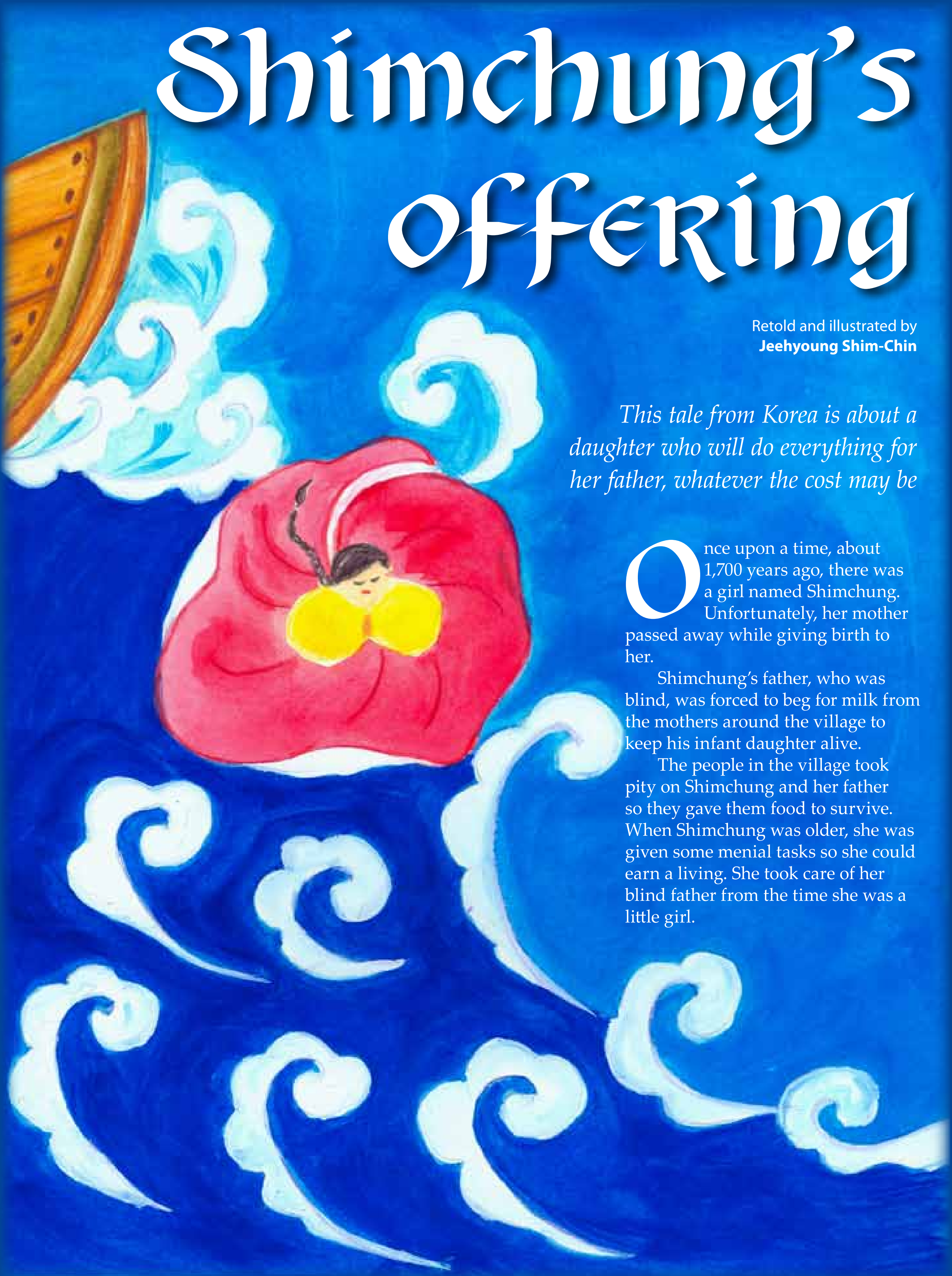
In 2013, IRRI scientists conducted initial trials using automated, nonintrusive robots to take field measurements of the rice plants to reduce human error and labor costs. "Although it is too early to conclude whether the setup will be successful, the potential is great," says Dr. Dingkuhn.

Since this endeavor involves huge amounts of data, IRRI and Cirad scientists are working together to streamline the process of data analysis and make it more transparent.

"This is going to be a gold mine of data!" Dr. Dingkuhn says. "Eventually, we want to get to the point where a breeder can directly combine and select for specific genes, knowing exactly what they do in different environments and how effective they are in different combinations."

Core partners of the Global Rice Phenotyping Network are the Africa Rice Center, CIAT in Colombia, and Cirad in France. But, many other research centers are involved, such as the French Research Institute for Development (IRD), Brazilian Agricultural Research Corporation (EMBRAPA), Chinese Academy of Agricultural Sciences, Philippine Rice Research Institute, India through local IRRI teams, Commonwealth Scientific and Industrial Research Organisation and Flinders University in Australia, Cornell University and Colorado State University in the U.S., and, from the private sector, Syngenta.

Ms. Ebron is a public relations officer at IRRI.



Shimchung's offering

Retold and illustrated by
Jeehyoung Shim-Chin

This tale from Korea is about a daughter who will do everything for her father, whatever the cost may be

Once upon a time, about 1,700 years ago, there was a girl named Shimchung. Unfortunately, her mother passed away while giving birth to her.

Shimchung's father, who was blind, was forced to beg for milk from the mothers around the village to keep his infant daughter alive.

The people in the village took pity on Shimchung and her father so they gave them food to survive. When Shimchung was older, she was given some menial tasks so she could earn a living. She took care of her blind father from the time she was a little girl.

One day, a Buddhist monk from a nearby temple told Shimchung that an offering of 300 *suk* of rice to Buddha could restore her father's sight. Unfortunately, this was too much for Shimchung because 300 *suk* of rice is about 43 tons!

Then Shimchung heard that some merchants were looking for an immaculate virgin to sacrifice to the Yongwang, the god who rules the water (rivers, lakes, seas, oceans, and water creatures), to keep their voyage safe as they sail from Korea to China. Because Shimchung loved her father so much and desired nothing more than to give back his sight, she sold herself to the merchants for 300 *suk* of rice.

Her father protested that he would not let her go. But, Shimchung had already made up her mind out of love and sacrifice that she was even willing to give her very life. As Shimchung sailed with the merchants, she could still hear her father's dissuasion and wailing.

When the ship was somewhere in the west of the sea called In Dhang Soo, Shimchung and the merchants encountered a powerful storm and wild waves. It was time for Shimchung to sacrifice herself to Yongwang. As she wished for her father's sight to return, Shimchung threw herself into the wild waves. Soon after, the storm disappeared and the sea became calm and gentle.

Under the sea, a turtle led Shimchung to Yongwang, who was deeply moved by her sacrifice and devotion to her father and he decided to let her live. He wrapped Shimchung in a large lotus flower, which then floated to the surface of In Dhang Soo.

The wind carried the lotus flower to a far-away land.

The people found the mysterious large flower and brought it to the emperor. Inside the palace, the giant lotus flower opened to reveal Shimchung before the emperor. The emperor immediately fell in love with her and decided to marry her.

After the wedding, Shimchung told the emperor that she wanted to see her father. So, the emperor threw a big ball at the palace for all blind people. Shimchung excitedly searched for her father among the guests. Finally, she heard her father's voice at the gate. He arrived late because he had helped gather all the blind people and bring them to the palace.

She ran to him and greeted her father, who was still blind. Her father was bewildered for a moment but soon realized it was his daughter. He hugged her while his tears rolled on his cheeks. He touched her face again to make sure it was indeed Shimchung.

Shimchung also cried when she saw her father. When her tears touched her father's blind eyes, in an instant, his sight was restored! And, for the first time in his life, he saw the face of Shimchung, his beautiful daughter who was willing to sacrifice her life because she loved him so much.

Ms. Shim-Chin was a preschool teacher in South Korea. She temporarily gave up her job in Korea to join her husband, IRRI plant breeder Joong Hyoun Chin, and her children in the Philippines. Some of her free time is devoted to painting.

ISAGANI SERRANO

MYANMAR RISES

by **Ma. Lizbeth Baroña-Edra**

PRESIDENT U Thein Sein (*right*), with key government officials, came to IRRI in December 2013 to strengthen research ties with the Institute, here represented by Achim Dobermann, deputy director general for research.

Myanmar is all set to regain its former stature as the world's top rice exporter

When President U Thein Sein visited the International Rice Research Institute (IRRI) headquarters in the Philippines in December 2013, he commended the decades-long partnership between IRRI and his country.

Since 1965, IRRI has been involved with researchers, extension personnel, and farmers in Myanmar in introducing rice breeding material, hybrid rice technology, and locally adaptable designs of rice transplanters and threshers. The rice variety IR8, which marked the beginning of the Green Revolution, was introduced in Myanmar in 1967.

But, given today's challenges and opportunities that abound for the country that could emerge as the next major rice producer in the world, President Sein called for an even stronger partnership, setting the tone for years of future collaboration.

Myanmar has 60 million people and grows rice on 7.6 million hectares per year. The major rice-producing regions are in the delta, including Ayeyarwaddy, Bago, Yangon, and Mon states. These four areas make up more than half of the monsoon crop. The country's major rice ecosystems are rainfed lowland rice, deepwater submerged rice, irrigated lowland rice, and rainfed upland rice.

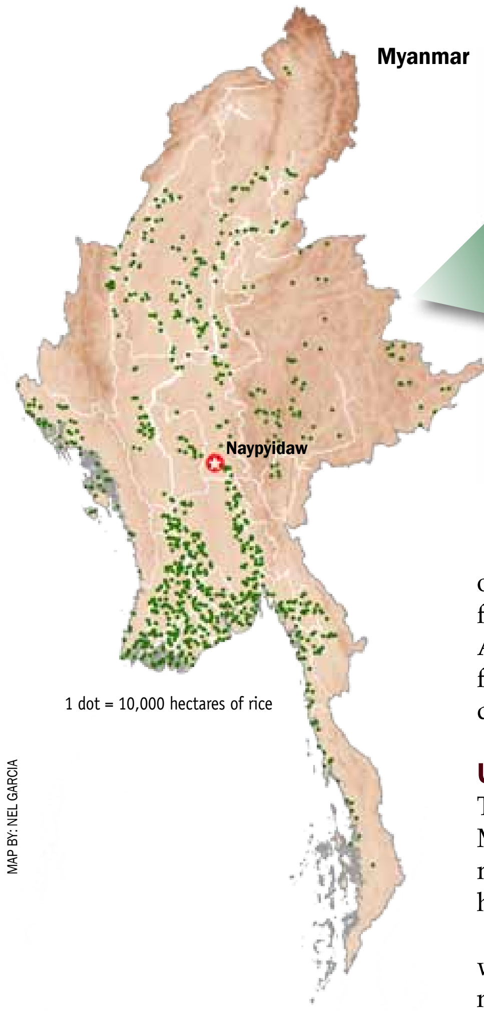
In 2011, production was approximately 29 million tons, the seventh highest in the world, behind Vietnam and Thailand.

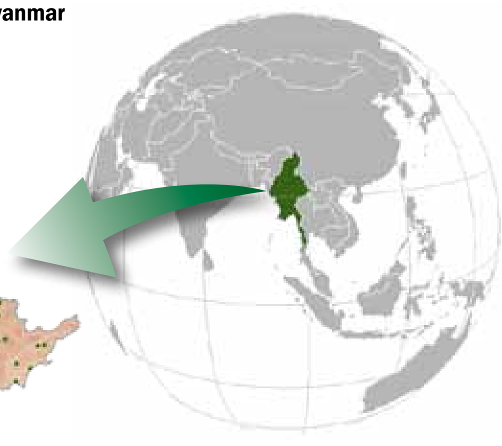
A president and a farmer

As someone who starts his day checking on his farm before attending to affairs of the state, President Sein said that he came to IRRI as president—and as a farmer who knew firsthand the problems in the country's rice sector.

"Our country has different topography and agroecological zones," the president said. "We need rice varieties that respond to challenges from these difficult environments." He asked IRRI to develop more improved rice varieties suitable for the unfavorable environments of the hilly and dry regions in the north, and the wet, frequently flooded areas in the southern part of the country.

"Flooding is a serious problem in Myanmar, affecting 14% of all our rice areas," said Daw Tin Tin Myint, director of rice research at the Myanma Department of Agricultural Research. "We have released submergence-tolerant Swarna-Sub1 to our farmers, but we also face another problem during monsoon seasons—salinity. With the help of IRRI, we are





trying to develop varieties that can tackle both flooding and salinity."

IRRI in Myanmar

To date, IRRI has released 69 improved rice varieties in Myanmar. Most of these are suited for rainfed and irrigated lowlands. Others are for the upland ecosystem and areas prone to drought, deep water, and salinity.

IRRI is also sharing best management practices to help farmers improve crop nutrition and productivity, crop establishment and weed control, and rodent and water management. Since 2006, 33 sites have used the alternate wetting and drying technology to conserve irrigation water.

IRRI has provided training to more than 400 Myanma agricultural scientists and extension workers. Today, these scientists hold key positions in Myanmar's agricultural research agencies.

Partnerships with the private sector have resulted in the adoption of more than 50 IRRI-developed flatbed dryers across the country. Around 7,500 farmers are benefiting from these dryers for better rice quality that commands higher prices.

United collaboration

The president also asked IRRI to help Myanma rice farmers develop crop management technologies that will help achieve higher yield.

"We are self-sufficient in rice, so we export our surplus to help our neighboring countries," he said. But, the president expressed Myanmar's hope to once again become a leading global player in the rice market.

"IRRI, being the premier rice research facility in the world, and considering how much help the country has received in terms of technology, I think IRRI can really help Myanmar," said Putu Kamayana, head of the Asian Development Bank (ADB) Extension Mission in Myanmar. ADB works with IRRI and Myanmar national partners to promote sustainable pest management, particularly in the area of ecological engineering (see *Reducing pesticide use in Asia's rice fields* on pages 14–15).

"Rice is Myanmar's most important crop," said Nick Austin from the Australian Centre for International Agricultural Research (ACIAR). ACIAR and IRRI are working with farmers in the country's upper delta to help raise their productivity. "We believe that there are exciting research opportunities to help smallholder rice farmers grow more rice and diversify into other crops to improve their profit."

Tin Htut, director of Yezin University in Myanmar, and one of the 2010 outstanding IRRI alumi, also believes IRRI can contribute a lot to Myanmar's transformation.

"We've been working together for decades, and IRRI has a lot of support here in Myanmar," said Dr. Htut. "Our strong relationship can be gleaned from the fact that 80% of the country's rice areas are grown with IRRI-bred varieties."

A determined nation

In the coming months, IRRI and partners from the Ministry of Agriculture and Irrigation will finalize the Myanmar Rice Sector Development Strategy—the road map to Myanmar's plan to become a global player in the rice market. The strategy was developed in September 2013 when the Myanmar government gathered its partners in Nay Pyi Taw, a government center about six hours from Yangon.

IRRI, along with donors and national agricultural agencies, discussed points of collaboration in mapping out a strategy to revive Myanmar's rice sector, and regain its former stature of some 50 years ago when it was the leading rice exporter in the world (1960-63). Other partners in Myanmar are the Consortium for Unfavorable Rice Environments-International Fund for Agricultural Development, Closing Rice Yield Gaps in Asia-Swiss Agency for Development Cooperation, the Livelihood and Food Security Trust, and the United States Agency for International Development in projects led by IRRI scientists Grant Singleton and Madonna Casimero.

This strategy is built around successes that have already been achieved in the country, as well as current and emerging problems due to climate change, and the management of diminishing natural resources. All these point toward improving rice farmers' livelihood and increasing their income.

Ms. Baroña-Edra is a public relations specialist at IRRI.

Shaping the future of rice

by **Lanie Reyes**

Public and private institutions have come together to find solutions to the challenges faced by the rice sector

How will we create a better life and a better future for rice? How can we do much more, with less? These were the questions posed by Tobias Marchand, head of the Asia Pacific region, Bayer CropScience, to 200 rice experts and policymakers during the Rice Future Forum on 8-9 October in New Delhi, India.

These questions are not rhetorical but practical. Mr. Marchand and the forum participants agree on the issues surrounding the rice industry. Increasing global population, rising demand for rice production, malnutrition and poverty, threats of climate change, limited resources (farm land, water, and labor), and gaps in technology were the nagging issues that reverberated during the forum. And it was said that "understanding the problem is half the solution."

Improved technologies

India Agriculture Commissioner J.S. Sandhu acknowledged the role of the development of agricultural technologies for improving the grain industry. For the last 60 years, India's food grain production has increased from 50 million tons in 1947 to 250 million tons in 2012-13—which made India an exporter of food grains, including rice. He attributed the increase in grain production, particularly in the 1970s, to high-yielding varieties developed during the Green Revolution, and the recent advances in research and development in agriculture.

For B.C. Viraktamath, project director, Directorate of Rice Research of the Indian Council of Agricultural Research (ICAR), "Increasing productivity through partnerships in R&D is the way to go." He cited many research programs and projects of ICAR in partnership with the International Rice Research Institute (IRRI), among other organizations. Examples of these projects are Stress-Tolerant Rice for Africa and South Asia (STRASA) and the Cereal Systems Initiative for South Asia (CSISA).

Hybrid rice, noted for helping increase production in China, is set to reach an average yield of 16 tons per hectare there. Other technologies such as those of stress-tolerant rice varieties help improve productivity in unfavorable conditions.

A five-point plan

Bas Bouman, director of the Global Rice Science Partnership, the CGIAR Research Program for Rice, proposed a five-point plan to modernize the Asian rice sector, which consists of (1) land consolidation, (2) mechanization, (3) making farmers modern entrepreneurs, (4) strengthening the whole value chain, and (5) sustainable intensification (see *Modernizing Asian rice production* on pages 32-33).

"Most rice farmers are poor," Dr. Bouman pointed out. Even with a farm of 2 hectares and growing two crops a year, many farmers earn only US$1,200–2,000 per year. "Even if their productivity is doubled—increasing their annual income to $2,400–4,000—it is not sufficient to bring them out of poverty."

He argued that it is not a question of whether rice farming is profitable or not. "Land consolidation is needed to increase the farm size of marginal farmers," Dr. Bouman said. "The farm size of most farmers is too small for them to attain an income above the poverty line."

Solutions to limited resources

Dr. Bouman, among other speakers, sees hope in mechanization for solving the problem of labor shortage because of the migration of farm workers to cities. Satoshi Ida, deputy general manager of R&D, Kubota Corporation, shared that they have been designing farm machines to solve the problem of insufficient labor in Asia. He reported that many Asian rice farmers have been using these machines, thus saving on labor cost and time.

Dr. J.K. Ladha, IRRI principal scientist, highlighted the challenges facing rice systems in Asia, which include shortages and untimely availability of water and labor. "Manual transplanting is highly labor intensive and requires 25–50 person-days per hectare." He stressed that rice consumes about 50% of the total irrigation water in Asia and on average 2,500 liters of water are needed to grow a kilogram of rice.

Dr. Ladha recommended dry direct-seeding technology, with which the seed is manually broadcast onto the soil and then incorporated either by plowing or by harrowing while the soil is still dry. In this way, puddling and transplanting can be avoided.

He said that much progress has been made in perfecting this technology and in developing a package of practices. Aside from saving water and labor, this technology allows crop residue recycling (otherwise residue is burned), reduces methane emissions, lowers energy use, and increases farmers' profit. He added, "Avoiding puddling improves soil structure, which is needed for the succeeding crops such as wheat, maize, and vegetables."

The importance of policies

In addition to technologies, policies have played a vital role in the direction of the rice industry across the globe. Dr. Trilochan Mohapatra, director of the Central Rice Research Institute in India, shared how policies helped increase rice production in the country. The policy of bringing the Green Revolution to eastern India allowed Odisha, which had the lowest average rice yield among the eastern states, to increase its average yield from 1.7 tons per hectare in 2007-08 to 2.3 tons in 2012. Dr. Mohapatra attributed this to large-scale demonstrations of technologies. Eventually, this jump in rice had a domino effect nationally. The country's rice production rose to more than 104 million tons in 2012-13. From this, about 8 million tons of additional rice came from the eastern states.

Looking at the four or five decades after the Green Revolution, Sam Mohanty, head of IRRI's Social Sciences Division, noted that government policies on rice have focused on reducing price risk and reducing the cost of inputs for farmers. Surprisingly, many rice-importing countries such as Malaysia and China have food security through self-sufficiency as a policy direction.

J.S. Sandhu


Tobias Marchand


B.C. Viraktamath

According to Dr. Mohanty, if every country wants to achieve food security through self-sufficiency, we might be in big trouble—globally speaking. "This will make the volume of the market smaller. If we have a bad year, the price of rice could skyrocket." He added that there might be a need for a policy intervention at the global level, not just domestically.

Public-private partnership

The problems that the rice sector faces now cannot be solved by one institution alone. The public and the private sectors must work together. "But, for the partnership to be sustainable, it should go beyond the usual sharing of the social responsibility fund by the private sector," said Richard Rogers, senior program officer of the Bill & Melinda Gates Foundation. He pointed out that both the public and the private sectors should profit from the "partnership."

This public-private partnership was better understood when speakers from private companies such as Kellogg, Bayer CropScience, and Tiga Pilar Sejahera Food shared concrete examples of how these companies work together with government institutions and with farmers across the rice value chain while mutually benefiting each other.

Lastly, Christel Weller-Molongua, division head, Rural Development Agriculture of the German International Cooperation (GIZ), reminded all participants that "as we find solutions to the challenges in the rice sector, let us not forget the importance of preserving biodiversity and environmental sustainability."

Indeed, the forum, organized by Bayer CropScience in association with ICAR and IRRI, has stimulated fresh perspectives on topics that range from research and new innovations to government policies, collaboration among stakeholders, and sustainability across the rice value chain.

Ms. Reyes is the managing editor of Rice Today.

Modernizing Asian rice production

by **Bas Bouman**

A comprehensive action plan to transform rice farming into a vibrant and profitable business

In 1968, Sicco Mansholt (1908-95), the European commissioner for agriculture, sent a memorandum to the Council of Ministers of the European Community concerning agricultural reform. This plan became popularly known as the "Mansholt Plan."

The plan noted that, despite costly policies of price and market support, and despite increases in production, farmers' standard of living was still way behind that of other sectors of society.

Europe's farm reformation

At that time, the average farm size in Europe was 11 hectares. Two-thirds of the farms were less than 10 hectares, though it was noted that, "*with modern techniques, one man can cultivate 30 to 40 hectares of crop land.*" Labor had steadily been migrating out of agriculture and "*half of the persons who run a farm are more than 57 years of age.*" There was a lot of concern about whether young people would still be willing to keep farming.

The plan also recognized some issues on the changing role of women: "*Elsewhere, every effort has been made…to liberate women from the more onerous and unpleasant forms of work…yet the farmer's wife finds more and more that she has to do a man's full-time job!*"

Thus, Mr. Mansholt suggested that production methods change—they should be modernized, and small farms should increase in size. The latter was the cornerstone of his plan: "*The new structure envisaged rests, essentially, on enterprises of adequate size.*"

Between 1970 and 1980, the plan faced controversy because it encouraged nearly five million farmers to give up farming so that the remaining farmers could increase their farm size. However, the plan included a social component such as vocational training and welfare programs so that it would be easy for farmers to take up new jobs outside farming.

Under the "Mansholt Plan" for rice in Asia, governments are urged to expand farm size, promote mechanization, and improve yields and farm efficiencies to increase farmers' income.

MARTIN GUMMERT, IRRI

BAS BOUMAN, IRRI (3)

The Asian situation

So, why dwell so much on this Mansholt Plan? Despite its being controversial and the differences in location and time, some conditions of rice farmers in Europe then and those in Asia today are strikingly similar.

Asia has about 140 million rice farms with average sizes of around 1 hectare only. Returns from rice farming are generally low, only US$200–600 per hectare per season. Even with a farm size of 2 hectares and two rice crops a year, income from rice farming averages only $800–2,400 per year. So, how can any family live off the income from rice farming?

In recent years, labor migration from rural to urban areas has accelerated tremendously in many parts of Asia. Usually, the able-bodied young men migrate while the women and the old stay behind. But, despite labor outmigration, farm size has been getting smaller and the number of farms is increasing.

So, just like Europe in the 1960s, we have to wonder about the future of rice farming in Asia. Since prospects of earning a decent income from rice farming are few, who will want to produce our rice tomorrow?

A proposal for modernization

So, maybe it's time to develop a "Mansholt Plan" for Asia's rice sector. The structural transformation we're witnessing in Asia offers great opportunities for rice farming to be vibrant and profitable. Many examples of progress are already there, but these need further support.

Consolidation

Increasing farm size (consolidation) will have to be the cornerstone of any transformation. Even if yields increase dramatically, no one can obtain a decent livelihood from farming 1 to 2 hectares of rice area. However, many land markets in Asia are "locked," so different options for putting more land into single management units (besides buying or renting) must be explored.

Some ways of increasing "virtual" farm size are already in progress. For example, China is experimenting with something called "village farming." Vietnam is exploring a concept of individual farmers managing large tracts of land together in their "small farmers, large farm" program. Mechanized farm operations are increasingly outsourced so that large tracts of land can be run by contractors. In this way, economies of scale are realized.

Mechanization

The use of farm machines has to increase for higher labor efficiency, or at least make it on a par with the productivity in other sectors of the economy. In Asian rural areas, labor is becoming scarcer, which goes with having more costly labor. This makes investing in mechanization more attractive. Already, we see a rapid rise in mechanized transplanting, sowing, land leveling, and harvesting. Some new business models of the private sector facilitate the introduction and operation of farm machines.

Intensification

Finally, yields and resource-use efficiencies simply have to go up. With resources (water, energy, and labor) becoming scarcer, it is paramount to produce "more with less." Yields need to go up to meet the ever-rising demand for food without bringing new land into production. In addition, we need to come up with a more sustainable and environment-friendly way of growing rice.

Like the original Mansholt Plan, we need a social program to facilitate the transition. Smallholder famers should find it easy to leave agriculture. Some investment should be made in vocational training for retooling those who want to leave farming, and in training on modern production technologies for those who want to stay. Also, we need to stimulate rural nonfarm enterprises so that farmers and agricultural laborers can stay in rural areas and not need to migrate to the already overcrowded cities.

Dr. Bouman is the director of the Global Rice Science Partnership (GRiSP), the CGIAR Program on Rice.

R RAMAN, AFRICARICE (7)

Banking on Africa's rice potential

by **Savitri Mohapatra**

The 3rd Africa Rice Congress issued a clarion call to increase investments in Africa's rice sector so that the continent can realize its rice promise

The 3rd Africa Rice Congress, held in Yaoundé, Cameroon, in October 2013, emphasized the need to invest in the modernization and mechanization of Africa's rice industry and aggregation of farm output, while safeguarding land rights of smallholders and improving livelihoods. There was also a call to establish a world-class research infrastructure in Africa to identify rice genetic materials for resistance to major biotic and abiotic stresses and to strengthen the rice sector development hub network as well as other rice-related research, extension, and capacity building for greater and faster impact across the rice value chain.

Rice has become more critical to achieving food security and political stability on the continent. Despite rapid growth in rice production in sub-Saharan Africa (8.4% per year) from 2007 to 2012, the African continent continues to rely heavily on the world market to satisfy increasing consumption demand for rice, with imports reaching 12 million tons of milled rice in 2012, costing more than US$5 billion.

Engine of Africa's growth

Themed *Rice Science for Food Security through Smallholder and Agribusiness Development in Africa*, the Congress was organized by the Africa Rice Center (AfricaRice), the Food and Agriculture Organization of the United Nations (FAO), and the Institute of Agricultural Research for Development of Cameroon (IRAD) under the aegis of the Cameroonian government.

"We recognize the need to scale up our investments for modernizing the rice sector and also increase our support to research and extension," stated Cameroon Prime Minister Philemon Yang, in his opening message that was delivered by Cameroon Minister of Scientific Research and Innovation Dr. Madeleine Tchuinte.

The Congress took stock of advances in rice science and technology and provided opportunities to discuss institutional innovations, policies, partnerships, and investments needed to ensure that rice sector development becomes a veritable engine for smallholder and agribusiness development and economic growth in Africa.

"This will not only contribute to food security, but will also help reduce rice imports and create attractive employment across the rice value chain," said AfricaRice Deputy Director General Marco Wopereis. "Let's not forget that, over the next 15 years, an estimated 330 million young Africans will be looking for a job."

These issues were debated in a Ministerial Policy Dialogue—organized with support from FAO—involving ministers from Chad, Cameroon, The Gambia, Mali, and Senegal.

Special events

Private-sector and research and development partners showcased their work in the Congress

Exhibition, which featured a special section on small-scale rice mechanization. A Cameroon Rice Day allowed participants to visit the IRAD research facilities in Yaoundé.

Realizing Africa's Rice Promise, a new book jointly published by AfricaRice and CABI, was also released as part of the special events of the Congress. The book provides a comprehensive overview of Africa's rice sector and ongoing rice research and development activities, indicating priorities for action on how to realize the promise of rice in a sustainable and equitable manner.

A side event focused on a training course in science journalism relating to rice R&D activities in Africa was organized with support from the Global Rice Science Partnership (GRiSP), the CGIAR Research Program on Rice.

A plaque of appreciation was presented to Cameroon President Paul Biya for the support of the Cameroon government to the rice sector. A distinguished service award was presented to Dr. Papa Abdoulaye Seck, former AfricaRice director general and current minister of agriculture and rural equipment of Senegal.

Promising initiatives and exchanges

During the closing ceremony, awards were presented for best papers, best posters, most promising young scientist, and outstanding local entrepreneurs from Africa in seed production and local manufacturing of small-scale machinery.

Immediately after the closure of the Africa Rice Congress, the 2013 Global Forum of GRiSP was held, at which updates on global and African rice initiatives were presented, followed by sessions on *Bilateral support for African rice* and *Coordinating investments in rice development in Africa* involving a broad range of investors interested in Africa's rice sector.

"Such exchanges will help us find ways to leverage opportunities and make the most of our resources and knowledge to boost Africa's rice sector," said GRiSP Director Bas Bouman.

More than 650 participants attended the Congress from 60 countries—including 35 African countries. They comprised rice farmers, seed producers, rice processors, input dealers, agricultural machinery manufacturers, representatives from agricultural ministries, national and international rice research and extension communities, nongovernment organizations, donors, and other development partners.

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

The Congress formulated the following recommendations for governments, farmer organizations, civil society, the private sector, R&D partners, regional economic communities, and donors:

Investments in Africa's rice sector

- Invest in modernization and mechanization of Africa's farming and in aggregation of farm output, while safeguarding land rights of smallholders and improving livelihoods;
- Strengthen farmer organizations to ensure that farmers capture a fair share of value added in the value chain;
- Stimulate the development of public-private partnerships and small-scale enterprises, and provide technical and business training to Africa's rapidly growing cadre of unemployed youth to find jobs in the rice sector;
- Combine supply-shifting, demand-lifting, and value-adding investments to ensure rapid and sustainable development of affordable rice and rice-based products for different consumers;
- Consider the establishment of strategic regional rice reserves, relying on national stocks, but with coordination at the regional level to reduce price volatility;
- Establish minimum and maximum import tariffs agreed upon at the regional level that allow for raising import tariffs in times of low world market prices and vice versa;
- Develop sustainable seed systems through coherent policies, strategies, and functional public–private partnerships.

Investments in rice R&D and capacity building

- Foster greater regional and international collaboration on the development and diffusion of improved varieties, ecological intensification of rice farming, and management of abiotic and biotic stresses in the face of climate change to sustainably increase rice production;
- Establish world-class research infrastructure in Africa to evaluate rice genetic material for major stresses and consumer demand, and ensure that progress made worldwide in rice genetics and breeding can be captured;
- Strengthen and expand the rice sector development hub network and facilitate rice knowledge exchange to achieve greater and more rapid impact across the rice value chain;
- Urge African governments and their development partners to substantially strengthen the retention and training of new research and extension staff, while updating agricultural curricula in vocational training schools and universities;
- Urge African governments to comply with the Maputo Declaration and increase the proportion of their national budgets to scientific research to levels commensurate with international standards;
- Acknowledge AfricaRice as leading the African component of GRiSP to enable the pooling of resources, building capacity, and aligning of national and international rice research agendas;
- Ask FAO to stimulate national, regional, and global partnerships to develop Africa's rice sector, as part of the efforts of the Coalition of African Rice Development and under the overall umbrella of the Comprehensive Africa Agriculture Development Program.

PAPA SECK (*third from left*) has helped smallholder farmers gain access to improved technologies.

R RAMAN, AFRICARICE (2)

PAPA ABDOULAYE SECK: an advocate of research for Africa's development

by **Savitri Mohapatra**

His vision and commitment to the goals of AfricaRice have taken it to new heights of excellence and impact

The winds of change that swept across the Africa Rice Center (AfricaRice) were unmistakable. This occurred from the time Papa Abdoulaye Seck, a specialist in agricultural strategy and policy analysis from Senegal, was appointed as AfricaRice director general in 2006 until his departure in 2013 to become Senegal's minister of agriculture and rural equipment.

His vision and commitment to the goals of AfricaRice have transformed the Center and have taken it to new heights of excellence and impact.

As an outstanding spokesperson for effective economic policies that aim to transform the rice production of African countries, Dr. Seck has enabled several governments to formulate favorable rice policies and make rice more available to the poorest in each country. Thanks to him, AfricaRice has become a catalyst behind the remarkable visibility of the rice sector in sub-Saharan Africa (SSA).

Today, he is highly regarded by many young Africans as a man with a mission to help fulfill Africa's dream of feeding itself and as an epitome of a new breed of leaders who believe in the need to move from theory to practice, and from thinking to action.

Inventing a new type of scientist

On joining AfricaRice, Dr. Seck reiterated his strong conviction that Africa would either develop through science and technology or not develop at all.

"One of my cherished dreams has been fulfilled—to be in a strategic position to serve Africa better because this Center is without doubt an invaluable tool to develop a more vigorous African rice sector," he said.

As part of his vision and strategy for a competitive, diversified, and sustainable institute, Dr. Seck put forward the idea of a "total scientist."

He said that the need of the hour for Africa was a "total scientist" who would not just confine himself or herself to a laboratory or a research station. This scientist would also be able to listen, understand, and tackle the real problems of end-users, develop winning project proposals, generate relevant knowledge and technologies, communicate effectively with partners, anticipate problems, and be ready with options.

"In brief, in today's world, a 'total researcher' must be able to raise funds, obtain reliable scientific results, communicate effectively, and anticipate future research needs," he explained.

He called for a change in attitude of researchers and research administrators when spelling out the key principles of his new vision—transparency, equity, scientific excellence, interdisciplinarity, a systems approach, strengthening of the national agricultural research and extension systems, and openness toward all partners.

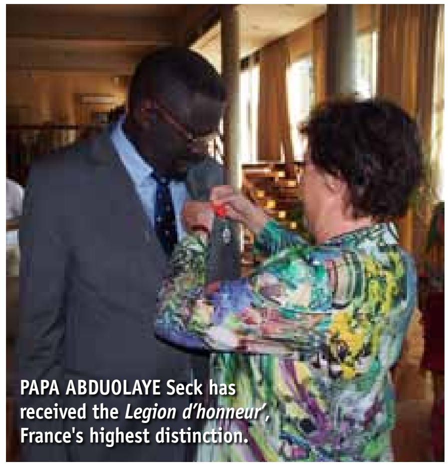
Putting rice on the policy agenda of African countries

In 2006 and 2007, Dr. Seck, an experienced agricultural economist, was aware of the significant changes that were happening in the major exporting countries in Asia and that rice prices on the international market were likely to spike considerably.

In his policy communication, *Rice Crisis in Africa: myth or reality*, to the AfricaRice Council of Ministers in 2007, he warned of a looming rice supply crisis in Africa. He proposed some policy options for turning that crisis into an opportunity by putting the African rice industry on a path of sustainable development, capitalizing on existing science-generated technologies and on the continent's large natural resources.

"Relying much on rice from other countries is a recipe for disaster for Africa," Dr. Seck remarked. "The future of rice farming lies in Africa. Unlike Asia, this continent has great untapped potential—large tracts of land and underused water resources."

In response to the 2007-08 rice crisis, many African countries carried


PAPA ABDUOLAYE Seck has received the *Legion d'honneur*, France's highest distinction.

out policies and projects that helped smallholder farmers gain access to improved technologies through subsidized certified seed, fertilizer, and farm machinery. The flurry of policy activity since the onset of the rice crisis has had a positive impact on rice production in SSA.

A recent analysis by AfricaRice showed that paddy rice production in SSA grew from 3.2% per year before the rice crisis to 8.4% per year after the rice crisis. Moreover, average rice yield jumped by about 30% from 2007 to 2012.

Truly, concerted efforts have succeeded in firmly putting rice on the policy agenda of African countries. AfricaRice's research achievements and policy communication efforts have greatly helped frame the challenges, opportunities, and policy options in order to develop domestic rice production and increase the productivity and profitability of the rice sector.

Transforming AfricaRice

Dr. Seck was a vocal advocate for higher investment in rice research and increased ownership of AfricaRice by African countries. As a result, the pan-African ownership of the Center has increased and several countries from Central, eastern, and northern Africa have joined and increased the member countries from 17 in 2006 to 25 in 2013.

In addition to the geographic expansion, the Center has transformed itself in many other ways. The budget of AfricaRice has tripled since 2006, which helped substantially increase the number and volume of joint rice projects covering member states.

"He has left behind an exceptionally well-managed, financially sound, and scientifically vibrant organization," the AfricaRice Board of Trustees commended.

Stronger partnership

Dr. Seck is a solid believer in the power of collaboration. He and Robert Zeigler, director general of the International Rice Research Institute, made history in 2006 by entering into a real partnership for rice research.

"We have to generate knowledge and technology that can have an impact in Africa by pooling together our resources, our intelligence, and our efforts," said Dr. Seck. "Alone, it will be impossible for anyone to carry out an effective research agenda in Africa; together, we can succeed."

This partnership set the stage for the launch of the Global Rice Science Partnership (GRiSP), the CGIAR Research Program on Rice, in 2010.

Enduring passion for research

Dr. Seck has received many awards and distinctions, including the *Legion d'honneur'*—France's highest distinction—but he wears his fame lightly. In Senegal, he is known as *Ndanaane*, which in Wolof means "a star or an erudite who masters many subjects."

He is justifiably a proud member of the Senegal Academy of Sciences and Technologies, the African Academy of Sciences, and The World Academy of Sciences.

When asked about his top three options for a profession in his youth, Dr. Seck said that his only choice was research.

As he says in his book, *Eloge de la recherche: passion et tension d'un chercheur africain* (In praise of research: passion and tensions of an African scientist): "Research has remained my passion for almost 30 years."

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

Mapping rice in Africa

by **Sander Zwart, Francesco Holecz, Andrew Nelson, Francis Mwambo,** and **Olusola Adefurin**

Remote sensing or satellite image interpretation is a promising alternative in getting information on where and how much rice is produced. Rice in several Asian countries has been successfully mapped already because it is usually grown in monoculture and in larger areas with flooded field conditions during land preparation.

However, a field exploration tour in Benin, during the remote sensing experts' meeting co-organized by the International Rice Research Institute (IRRI) and the Africa Rice Center (AfricaRice) under the Global Rice Science Partnership (GRiSP), revealed that the situation in Africa can be very different from Asia. This is especially true in the rainfed areas in humid and semihumid zones, where rice cultivation is highly dynamic, spatially fragmented, and in small fields. These factors complicate the search for rice from space; thus, an alternative for mapping rice in Africa is needed.

IRRI, AfricaRice, and Swiss-based Sarmap are now working together to check whether radar remote sensing imagery can be used for mapping rice areas in Africa. They selected the Glazoué rice hub in central Benin, characterized by rainfed rice production in both uplands and lowlands, and the Fanaye rice hub in the Senegal River Valley, which is dominated by the irrigated rice ecosystem. During the rice-growing seasons, high-resolution COSMO-SkyMed radar images were taken every 16 days for both regions. Field observations of crop type were made in about 200 fields in Senegal and 300 in Benin.

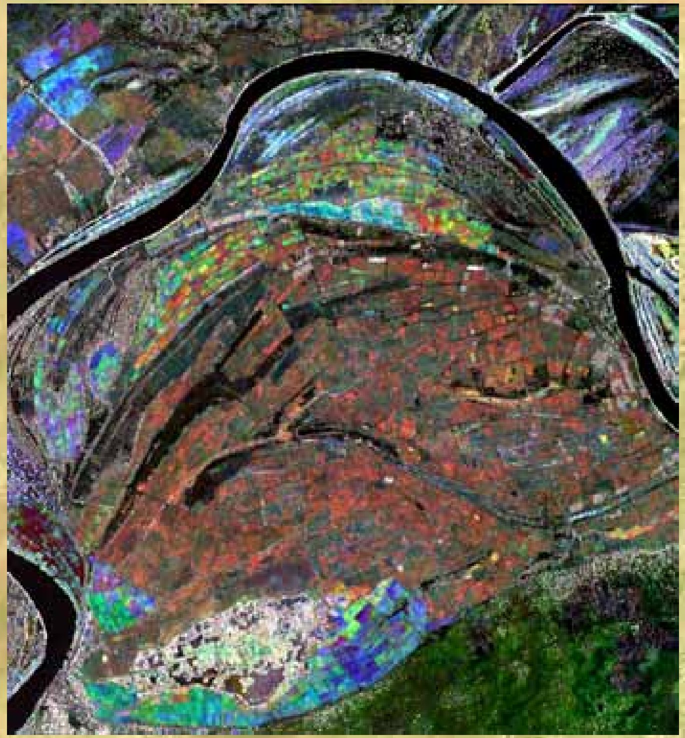
In Benin, agricultural areas can be distinguished from nonagricultural areas with an accuracy of 76%, which can be improved to 85%. Eventually, the plan is to be able to distinguish rice from nonrice crops. As of now, the maps depict a tranche of the Senegal River Valley near the village of Dagana. For a small sample area, the irrigated rice areas have been mapped.

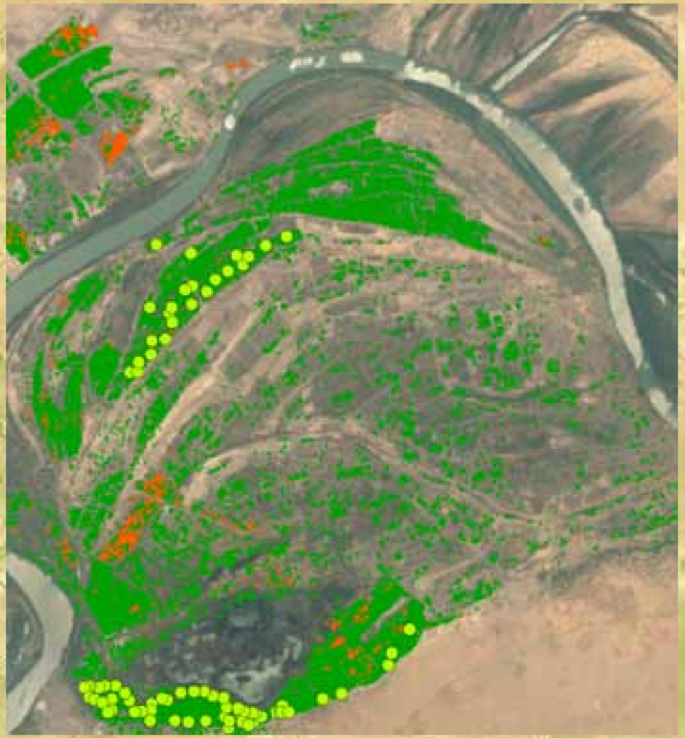
Initial results show that radar time-series data can map and monitor the conditions of African rice systems. The accuracy for irrigated rice is high in Senegal and Benin, despite the small field sizes. The challenge will be to apply this method using imagery with slightly lower spatial resolution such as what will be provided in the Sentinel program.

The end goal is to set up a mapping and monitoring system for the more than 60 rice-sector development hubs across Africa to assess the impact of the activities of AfricaRice and its national partners.

The authors acknowledge financial support from GRiSP partnership funds, general GRiSP funds provided by AfricaRice, and the RIICE project funded by the Swiss Agency for Development and Cooperation.

Dr. Zwart is a remote sensing and GIS specialist at AfricaRice. Dr. Holecz is the director of Sarmap. Dr. Nelson is a geographer and head of the GIS laboratory at IRRI. Mr. Mwambo and Ms. Adefurin are research assistants at AfricaRice.





Rice classification of rice (green) and late rice (orange) superimposed on a Google Earth image. The green dots are field verification points of rice (see below).

Swarna-Sub1:

Odisha's food for a goddess

by **Samarendu Mohanty** and **Debdutt Behura**

Odisha farmers embraced flood-tolerant rice not only as food on their table but as a worthy offering to Lakshmi, their goddess.

Swarna-Sub1 is the flood-tolerant version of the popular mega-variety Swarna (MTU 7029) in eastern India. It was developed by scientists from the International Rice Research Institute (IRRI), evaluated and released in India by Central Rice research Institute (CRRI), and disseminated by IRRI in collaboration with the national agricultural research systems, government organizations, nongovernment organizations, and public and private seed companies in India. In the eastern state of Odisha, where Swarna occupies more than 30% of the total rice area, both the state and central government are distributing Swarna-Sub1 seeds through various schemes such as the National Food Security Mission and Bringing Green Revolution to Eastern India (BGREI).

MANA FILLED with freshly harvested Swarna-Sub1.

DEBDUTT BEHURA (3)

Swarna-Sub1 is almost identical to its counterpart Swarna in terms of grain yield and grain quality, but it has an added advantage—it can survive full submergence for more than 2 weeks. However, the husk color of Swarna-Sub1 is much lighter than that of Swarna, which is reddish. Because of this difference, the farmers in Odisha call Swarna "Nali Swarna" (Red Swarna) and Swarna-Sub1 "Dhala Swarna" (White Swarna).

Farmers' feedback

In October 2013, during our visit to Jajpur District, a stronghold of Swarna, which is grown on 65% of the total rice area, we made several stops throughout the day and talked with farmers about the performance of Swarna-Sub1. Our visit took place 2 days before the state was expected to be pounded by cyclone Phailin, one of the most powerful tropical storms ever to make landfall in India.

Most of the feedback from farmers on Swarna-Sub1 was quite positive. There were a few complaints regarding seed shattering of Swarna-Sub1 during harvest and transportation. But, most of the farmers who grew Swarna-Sub1 for the first time in 2012 on parts of their land have expanded it to their entire landholding.

In Amathpur Village, located between two rivers, the Birupa and Brahmani, we also came across a large patch of land of about 80 hectares, which was mostly planted with Swarna-Sub1. Normally before, this area was left fallow because of frequent flooding during the kharif season. Then, the farmers would plant the area with mungbean once the floodwater receded.

We were told that that was the first time many farmers planted rice in the area because they were able to get access to flood-tolerant Swarna-Sub1 through the BGREI seed distribution program. Coincidently, the area was flooded for 6 to 8 days due to heavy rainfall that preceded the cyclone and, as expected, Swarna-Sub1 recovered quite well from the flood.

In the late afternoon, we visited a few nonflood-prone villages in Binjharpur block where a nonprofit organization had distributed Swarna-

BRAIDED SWARNA-Sub1 paddy is hung in front of the house to bring prosperity.

Sub1 seeds in the 2012 wet season. Surprisingly, even in areas that are not prone to flooding, many farmers had a favorable opinion about Swarna-Sub1. Swarna-Sub1 has been adopted by some farmers in the second season because of its resistance to diseases, particularly to sheath blight. However, many other farmers have decided to grow Swarna-Sub1 on parts of their land because of its lighter husk color, which is preferred for offerings to their deities during religious rites.

Margasira masa (month in Oriya), which normally falls in mid-November to mid-December, is one of the auspicious months that coincides with the paddy harvest, threshing, and storage. Every Thursday of this month, known as the *Manabasa Gurubar*, freshly harvested paddy is filled in a *mana* (a pot made out of bamboo cane used for measuring paddy in the old days) and is placed at the center of a circular *chita* to worship the goddess Lakshmi.

Chita is the traditional Oriya art form in which walls and floors are decorated with murals using semi-liquid rice paste. The drawings could be small footmarks of Lakshmi, a stack of paddy, flowers, peacocks, and elephants, among other designs. The married women in every household clean and decorate the floor, wall, entrances, and grain storage structure with *chita*. The new paddy harvest is also braided and hung in front of the house, near a *pooja* altar (a special place in the room used during worship and also kept near the *mana*).

We went back to Jajpur District in December, the last *Manabasa Gurubar* of 2013, to witness the use of new Swarna-Sub1 paddy during this holy month. After visiting around 15 villages in Binjharpur block, we knew already that Swarna-Sub1 is widely accepted by the community for *Manabasa Gurubar* and for other religious uses.

The future of Swarna-Sub1

Swarna-Sub1 outyields Swarna and other popular varieties under submerged conditions. This makes Swarna ideal for flood-prone rice areas in the state. Apart from replacing Swarna and other popular nonflood-tolerant varieties, it can make perennially flooded areas flourish with rice. Before, these areas were normally left fallow during the kharif season, just like what has happened in Amathpur Village. Lastly, Swarna-Sub1 may not be just limited to flood-prone rice areas. It could potentially take a slice of nonflood-prone rice areas because it is becoming more acceptable for cultural and religious uses.

Note: Thanks to Drs. Achim Dobermann, Umesh Singh, Abdel Ismail, and Takashi Yamano for some excellent suggestions.

Dr. Mohanty is the head of the Social Sciences Division and program leader (Targetting and policy) at IRRI. Dr. Behura is an assistant professor at the Orissa University of Agriculture and Technology.

THE ENTRANCE of a house decorated with chita.

How to support smallholder farmers throughout the world

BY M.S. SWAMINATHAN

Today, the world's population is growing faster than ever before and humankind faces an enormous task of producing enough food for all. Most farm families in the world are smallholder farmers and they undeniably contribute a lot to household, national, and global food security. The Food and Agriculture Organization said that smallholder farmers produce half of the global food. Thus, investment for agriculture and especially for smallholders is absolutely needed, especially because many of the hungry people worldwide are, paradoxically, smallholder farmers. So, what is smallholder agriculture and what is the future of small-scale agriculture?

Smallholder agriculture is practiced by families (including one or more households) using only or mostly family labor, and, from that work, they derive a large but variable share of their income, in kind or in cash. In fact, smallholding is the foundation of food security in many countries and it is important in the socioeconomic and ecological landscape in all countries. With urbanization, integration, and globalization of markets, the sector is undergoing great changes.

Improving livelihood

We often confront contrasting visions based on national situations and trajectories. But, smallholding offers great opportunities for sustainable intensification. Thus, the challenge is understanding what smallholders need. From the 1960s until the last food security crisis of 2007-08, policies and trends in the economy were not particularly oriented to smallholder agriculture as they are today.

The visions were geared toward large-scale and industrial rather than small-scale agriculture. Despite, and perhaps because of, these policies, the global community is realizing that some of the major Millennium Development Goals set to expire in 2015 (notably poverty alleviation and eradication of hunger) will not be reached. Nearly 70% of global poverty is rural poverty, and many of the rural poor depend on agriculture. The same applies to hunger and malnourishment, which are often located in rural areas.

This points to a central solution: the livelihood of smallholders needs to be improved by achieving food security, overcoming poverty, and attaining economic development.

In this context, the United Nations has declared 2014 as the International Year of Family Farming. We urgently need to upgrade and finance national research and extension systems targeted specifically to the needs of smallholders. Smallholder farmers need the right seeds and the right machines for their field operations, food processing, and other value-adding transformations. International collaboration and the sharing of experiences in technology development for smallholder farmers should be promoted with a strong engagement, if not leadership, of smallholder organizations. With resources becoming less and less, especially farm land, the first goal is to increase land productivity, in volume or in value. Yield is the most common metric of productivity, particularly in areas where land is scarce. Many areas have a "yield gap," the difference between actual yield and the highest potential yield.

Biotechnology has also opened up new avenues of research and offers a great promise and possibility for food security, improved human nutrition, and ecological security. Biotechnology programs should be based on societal needs and should have a careful blend of conventional technologies and advanced state-of-the-art technology. Now, researchers have identified some promising genes that confer stress tolerance. They have also mobilized some of these genes into transgenic systems.

For example, Asian countries, where most of the world's rice is grown, have different agroecological zones, and micronutrient deficiencies such as iron and it is important to enhance iron content in highly adapted and specific native indica rice varieties.

A complex set of objectives

Another approach is information, education, and communication. Using different communication tools at different levels will help bridge the digital, gender, and knowledge divides. Since 1992, the M.S. Swaminathan Research Foundation has been developing village resource centers (VRCs) and village knowledge centers (VKCs). These centers mainly provide need-based, local and specific, demand-driven information content by collecting secondary data and need assessments, organizing training and awareness programs, and linking with several leading institutions and organizations so that the content can be translated into something that can be used in fields.

The list of possibilities is long. But, together, we must tackle a more complex set of aims to include climate, energy, environment, biodiversity, and resource management as well as old ones such as productivity and production to promote diversification, and guarantee food and nutrition security to all citizens in a sustainable way.

Dr. Swaminathan is the founder chairman of the M.S. Swaminathan Research Foundation. He is a former IRRI director general and is known as the father of the Green Revolution in India.

This edited version of the article is reprinted with permission from Farming's Future *magazine and the author.*