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Rice Today

International Rice Research Institute
January-March 2008, Vol. 7, No. 1

IRRI 50 1960-2010 Rice Science for a Better World

EXCLUSIVE PIONEER INTERVIEWS

Pesticides, pests, and predators

Philippines
Documenting drought

Bird's-eye views of an enduring rice culture

ISSN 1655-5422 US$5.00

5th International Crop Science Congress

13-18 April 2008
www.cropscience2008.com

5th International Crop Science Congress
JEJU, KOREA 2008
ICSC

The 5th International Crop Science Congress (ICSC), sponsored by the Korean Society of Crop Science, will be held 13-18 April 2008 in Jeju, Korea. The Congress offers an excellent opportunity for crop scientists from all over the world to interact with each other and exchange scientific information.

The ICSC celebrates the role of science in developing crop production systems that are sustainable, benefit the environment, and can meet Earth's increasing demands for food production. These goals can be achieved only through international cooperation among crop scientists.

The theme of the 5th ICSC, Recognizing Past Achievements, Meeting Future Needs, reflects the future direction of crop production systems. By developing better agricultural systems, we can contribute to the well-being of the world.

Session themes

- Crop science for agroecosystem sustainability
- Genetics and molecular breeding for crop improvement
- Interdisciplinary approaches and technologies in crop science
- Emerging biotechnologies and social issues in crop science

Lecture topics

- Rural development or combat against malnutrition in developing countries, HRH Maha Chakri Sirindhorn, Princess of Thailand
- Science, food security, and achieving the UN Millennium Development Goal in the eradication of hunger and poverty, M.S. Swaminathan (M.S. Swaminathan Research Foundation, India)
- Can genome sequencing of model plants be helpful for crop improvement?, Ron Phillips (University of Minnesota, USA)
- Nutrient management in crop production systems for agroecosystem sustainability, Fusuo Zhang (China Agricultural University)
- Adaptative crop strategies for changing environments, Makie Kokubun (Tohoku University, Japan)
- Super hybrid rice breeding through a functional genomics approach, Qifa Zhang (Huazhong Agricultural University, China)
- Genetic dissection and cloning of QTL, Roberto Tuberosa (University of Bologna, Italy)
- Recent progress and future perspectives of rice production technologies, Takeshi Horie (National Agricultural Research Organization, Japan)
- Physiological understanding for increased crop productivity, Yong-Woong Kwan (Seoul National University, Korea)
- Functional genomics and crop improvement, Gary Stacey (University of Missouri, USA)
- Crop genetic engineering for future use, Steve Padgette (Monsanto Co., USA)

Further information

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IRRI INTERNATIONAL RICE RESEARCH INSTITUTE

contents

Rice Today
Vol. 7, No. 1

On the cover:
A close overhead view of wet stone-walled rice fields ready for transplanting near Mayawyaw town (location 1 on the map on page 14) in Ifugao Province in northern Luzon, Philippines. For more stunning aerial photography showing the changes of an indigenous people's environment over the years, see the feature article on pages 14-21.

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Rice Today is published by the International Rice Research Institute (IRRI), the world's leading international rice research and training center. Based in the Philippines and with offices in 13 other countries, IRRI is an autonomous, nonprofit institution focused on improving the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes, while preserving natural resources. IRRI is one of 15 centers funded through the Consultative Group on International Agricultural Research (CGIAR), an association of public and private donor agencies. For more information, visit the CGIAR Web site (www.cgiar.org).

Historic angles: pioneer interviews, arthropod surveys, and bird's-eye views

Officially starting in December 2009 and running through December 2010, the International Rice Research Institute (IRRI) will be celebrating the 50th anniversary of its founding. Considering the enormous impact that the Institute has had on the well-being of hundreds of millions of people and the contributions it has made to global economic growth, this is a milestone of universal significance. This occasion will present a tremendous opportunity for the IRRI family to reflect on what has been achieved, thank those who have worked with and supported it over the last half century, and look forward to the challenges to come.

With this issue, *Rice Today* begins publishing edited excerpts from selected interviews with the pioneers of rice research that colleagues and I have been conducting since December 2005. As one of the activities to commemorate IRRI's 50th, we have already logged around 70 hours in conversation with 35 pioneers, ranging from those who first roamed the rice plots with IRRI's first director general, Robert F. Chandler, Jr., to others who retired as recently as December 2007. Through 2010, each issue of *Rice Today* will feature an interview, with the full transcript and video highlights appearing at www.irri.org/ricetoday, which will eventually archive all of the interviews.

So, with whom do we begin this historic series? In his book, *An Adventure in Applied Science*, Dr. Chandler, when allocating credit for the creation of IR8, the first Green Revolution variety, wrote:

> *"[Dr. Peter] Jennings for selecting the parents and making the cross, [Dr. Hank] Beachell for identifying IR8-288-3 from the multitude of segregating lines, and [Dr. T.T.] Chang for having brought to the immediate attention of IRRI breeders at the start the value of the short-statured varieties from Taiwan...."*

Dr. Jennings is the only one of these three still with us, so we cannot think of a more fitting choice than IRRI's first rice breeder. He talks about predestination, fate, and luck, and the vexing question of just how a young breeder was going to increase Asian rice yields back in 1961 (see *Luck is the residue of design* on pages 10-11).

Since we are looking into history, see *The pesticide paradox* on pages 32-33, which points out that pesticide use on the IRRI farm dropped nearly 90% over the last 14 years. In fact, arthropod surveys in 1989, 1993, and 2005 indicate that the IRRI farm's rice ecosystem may be at its healthiest since Drs. Jennings, Beachell, and Chang were roaming the plots in the mid-1960s. Indeed, research on the IRRI farm and in Philippine rice fields suggests that many poor farmers do not benefit financially from using pesticides (see *The unsung heroes of the rice field* on pages 30-31).

Finally, this issue's cover story illustrates the enduring history of rice growing among the Ifugao people of northern Luzon in the Philippines. Our guide is another renowned pioneer, anthropologist Harold C. Conklin, who has never officially been on IRRI's staff, but who has been collaborating with the Institute since the Bob Chandler era in the 1960s. His latest foray was with IRRI staff photographer Ariel "Biggs" Javellana, during which they documented with digital aerial photography some 40 years of change and stability across a rugged terrain of rice terraces, rivers, and forests. See *Bird's-eye views of an enduring rice culture* on pages 14-21, which contains unquestionably the most striking photography the magazine has published to date.

Gene Hettel
Contributing Editor

Farmers struggle after Bangladesh cyclone

Cyclone Sidr smashed into the southern coastal districts of Bangladesh on 15 November, killing almost 4,000 people and leaving millions homeless and short of basic staples such as rice. Based on initial estimates, about 1 million hectares of rice are affected.

The cyclone and two major floods earlier in 2007 have contributed to major food shortages in the South Asian country, which was added to a list of 37 countries facing a food crisis and requiring external assistance, published on 17 December 2007 by the Food and Agriculture Organization (FAO) of the United Nations.

According to the FAO, the livelihood of more than 8.5 million people has been adversely affected by the cyclone damage. Estimates of the rice shortfall caused by the cyclone and floods range from 1.4 million to 2 million tons.

The country's food-grain imports—usually 2 million to 2.4 million tons—are likely to rise to around 3.5 million tons in 2008. Adding to the burden for the millions of afflicted people, the increased imports combined with high global grain prices will probably lead to higher prices for consumers.

To see what role IRRI might play both in response to this disaster and to mitigate the effects of future cyclones—predicted to occur with greater frequency and severity due to climate change—Institute scientists Zainul Abedin, Abdelbagi Ismail, and David Johnson traveled to the affected areas of Bangladesh on 14-16 December. They were joined by the Bangladesh Rice Research Institute (BRRI) and several nongovernmental organizations working on the IRRI-coordinated Food Security for Sustainable Household Livelihoods (FoSHoL) project.

"Farmers in affected areas are in immediate need of relief efforts to cope with the current devastation," said Dr. Ismail. "Short- and long-term measures are needed to ensure sufficient seed supply for these farmers, particularly for 2008. This is because most farmers lost their rice crop and the grain yield of the remaining crop is expected to be very low, and will mostly be consumed within a few months. Besides, seeds are of low quality and cannot be stored for the next transplanted aman [wet] season."

BANGLADESHI FARMER Nasiruddin Khan shows his damaged harvest after Cyclone Sidr hit his village of Purbohajipur.

ADAM BARCLAY

Farmers were unsure of how they would meet their food needs up to their next season's harvest, 4–5 months away at the earliest. Crops that were able to be harvested tended to produce small yields of poor-quality grain that, according to farmers, tastes bitter. Many families lost everything—not only rice but also their houses, personal belongings, vegetables, poultry, and livestock.

With BRRI and FoSHoL collaborators, the IRRI scientists developed preliminary recommendations for restoring farmers' livelihoods. These included provision of seeds of suitable rice varieties in the short term and, in the longer term, the development of new varieties and crop management and intensification strategies to increase the chances of crops surviving future severe weather events.

On 17 December, Drs. Abedin, Ismail, and Johnson, along with IRRI liaison scientist Hamid Miah, discussed their observations at a series of meetings with the secretary of the Ministry of Agriculture, Md. Abdul Aziz, the Bangladesh Agricultural Research Council, and the Bangladesh Rural Advancement Committee.

Doomsday vault preparation

The Svalbard Global Seed Vault—dubbed the Doomsday Vault by the media—will be a subterranean genebank built into the rock of Norway's Svalbard group of islands in the Arctic, nearly 1,000 km north of mainland Norway. The vault will store seed samples of the world's most important crops as protection against extinction and disaster.

As part of a project to document preparation for the vault, Cary Fowler, executive director of the Global Crop Diversity Trust—which aims to safeguard and conserve the diversity of all major food crops—visited IRRI on 6-7 December, together with Laurent Cibien and Alain Guillon, a film crew from ARTE TV. They were in the Philippines to film at IRRI and the National Genebank and to visit farmers in the southern Philippines.

"What we're trying to do is to provide an insurance policy for rice and other major crops—a plan B, a backup," said Dr. Fowler. "Soon, IRRI will be sending 70,000 rice accessions to the Svalbard Global Seed Vault, and that's a remarkable contribution."

ARIEL JAVELLANA

CARY FOWLER (*second from left*) and IRRI Genetic Resources Center Head Ruaraidh Sackville Hamilton (*standing, right*) inspect wild rice varieties with research technician Nora Kuroda (*left*), assistant scientist Soccie Almazan (*center*), and research technician Liza Yonzon.

Improve your English and help end hunger

www.FreeRice.com has two goals: provide English vocabulary to everyone for free and help end world hunger by providing rice to hungry people for free. The site offers an addictive multiple-choice vocabulary quiz. Every time a player gets a question correct, FreeRice, through sponsors who advertise on the site, donates enough money for 20 grains of rice. This was raised from the initial 10 grains on 28 November 2007. As of 31 December, 12,255,121,230 grains had been donated. The rice is distributed by the United Nations World Food Program.

JERBY AGUIHON

Seeing is believing

The *Sub1* gene—identified by IRRI and University of California researchers—allows rice to survive complete submergence for up to 17 days (see *From genes to farmers' fields*, on pages 28-31 of *Rice Today* Vol. 5, No. 4). The photo at left shows the end-result harvest of a plot on 16 October 2007, which yielded the equivalent of 3.8 tons per hectare for IR64+*Sub1* and 1.4 tons per hectare for IR64. A striking time-lapse video showing the entire 127-day cropping season of this particular experiment of IR64 with and without *Sub1*—standing side by side and subject to 10 days of submergence—is available at www.irri.org/timelapse.asp. Links to this and other IRRI videos on YouTube are available at this Web location.

Irrigated rice production system under pressure

In the face of growing pressure on one of Asia's most important food production systems, experts are warning that farmers must get more help to make them more efficient.

Irrigated rice production provides approximately three-quarters of the world's rice needs, and has a particularly important role to play now, with international rice prices at a 10-year high and global stocks at a 30-year low. However, at the 3rd Steering Committee meeting of the IRRI-coordinated Irrigated Rice Research Consortium (IRRC), more than 50 rice scientists from 13 countries highlighted the problems facing farmers of irrigated rice. The meeting, held on 8-9 October 2007, was hosted in Hanoi by the Vietnamese Academy of Agricultural Sciences.

Major issues discussed included competition for land and water from industrial development, the increased migration of farm laborers to cities, the reemergence of rice pests and diseases, and the increasing costs of production and inputs. In Vietnam alone, industrial development has caused the loss of 300,000 hectares of irrigated rice land in the past 5 years.

On a positive note, research efforts to help rice farmers boost their production efficiency and rein in their costs are being helped by new scientific knowledge in several key areas, including new technologies to optimize the use of fertilizers and reduce water use.

The IRRC, with major support from the Swiss Agency for Development and Cooperation, promotes and sustains partnerships between national agricultural research and extension systems and IRRI to help farmers achieve increased profitability, food security, and environmental sustainability. The Consortium operates in the Philippines, Bangladesh, China, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, Sri Lanka, and Vietnam.

AMPING PERSONAL COLLECTION

THE GRAIN OF FREEDOM: former IRRI staff member Faiga Amping poses wearing her *Rice Today* T-shirt at the Statue of Liberty in New York. Readers who send in a photo of themselves holding a copy of the magazine in front of a famous landmark will receive a free T-shirt (email to a.barclay@cgiar.org; post to Adam Barclay, IRRI, DAPO Box 7777, Metro Manila, Philippines).

BRIEFLY

Key factor in high yields

Longer grain-filling duration in tropical irrigated rice is a major factor in higher yields. This was a key conclusion of a study reported in the 26 November 2007 issue of *Field Crops Research*. The paper, *Grain-filling duration, a crucial determinant of genotypic variation of grain yield in field-grown tropical irrigated rice*, authored by the Korean National Institute of Crop Science's Woonho Yang et al, was based on research by a team that included several IRRI crop scientists. The team determined that longer grain-filling duration provided rice plants with more cumulative mean temperature and cumulative solar radiation throughout the grain-filling period, leading to higher grain weight per unit area. The study also found that grain-filling rate and duration were highly genetically variable traits, that grain weight was negatively or not significantly associated with grain-filling rate, and that grain-filling rate and duration were negatively correlated with each other.

Rice vaccine for hepatitis?

A group of Chinese scientists has developed a transgenic rice line that could offer a hepatitis B virus (HBV) vaccine. Rice was chosen because it is a staple in many developing countries where HBV causes severe problems and large numbers of people do not have access to existing vaccines. The research team introduced to rice a gene known as *SS1*, which codes for an HBV surface protein. When given to mice, the SS1 protein stimulated the production of antibodies that provided protection against hepatitis infection. The researchers, who reported the study in the 20 September 2007 issue of *Transgenic Research*, hope to develop an oral vaccine for preventing hepatitis infection in humans.

Rice traders predict prices to increase further

Rice prices will continue to increase, according to participants at the World Rice Commerce Conference held in Bali 31 October–1 November 2007. According to Randy Barker, head of IRRI's Social Sciences Division, who represented the Institute along with Development Director Duncan Macintosh, "No one was selling and it seemed generally assumed that the new crop was already sold."

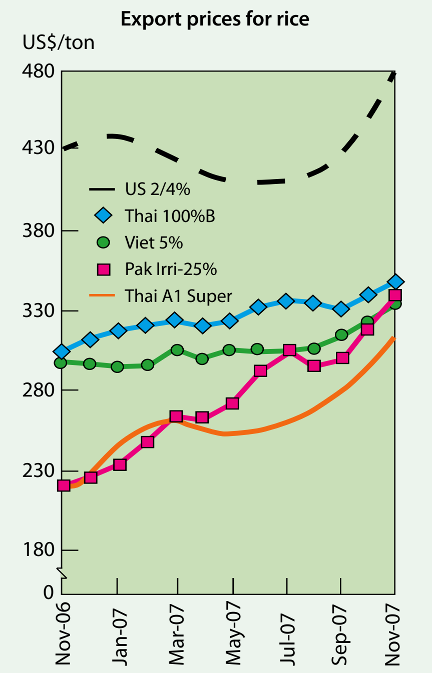
Jeremy Swinger, from Farm and Trade Inc., in his presentation on *General trends in the commodity markets*, looked at the tight situation for all food stocks, especially rice, wheat, and maize. Mr. Swinger sees the current price increases as not just a short-term phenomenon but a fundamental shift in the grains markets.

Bob Papanos, who publishes *The Rice Trader*, focused on the near term, projecting export supplies for the coming year. He suggested that prices would continue to rise steeply, peaking in February to March 2008.

Delegates noted that recent increases in production have been highest in the delta areas of South and Southeast Asia—particularly Bangladesh, a major importer, and Thailand, Vietnam, and India, which have been a source of major exports. Exports have been rising with the increase in exports to sub-Saharan Africa coming largely from India and Pakistan. However, with the exception of Cambodia and Myanmar, it appears that the production increases in the deltas have reached a limit.

The current trade situation was brought to a head by India's 9 October decision to ban exports, suggesting a desire to maintain domestic stocks and stable rice prices. Whether and when India will again become a major exporter is uncertain.

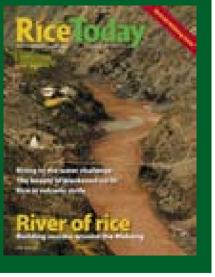
"The conclusion is that prices will rise—how far, how fast, and for how long is anyone's guess," said Dr. Barker. "Then the question is how the price rise will affect supply response in Asia. Sub-Saharan Africa is likely to experience the sharpest reduction in imports. It is difficult to ship to Africa because of high freight costs and poor port facilities, and India and Pakistan have been two of the main suppliers. Adding to the woes of the African importers is the very sharp rise in Pak Irri and Thai A1 Super (see figure) low-quality grades favored by most African countries."



Source: FAO Rice Price Update December 2007

There was speculation on whether the situation could be reversed if India were to again export in 2008 or China were to draw down stocks. The sentiment was that this may stave off higher prices for 2008 but not in the long run, with no clear sign of where future increases in supply will come from.

***RICE TODAY* COVER INSPIRES MUSICIAN:** Jay Maclean, a freelance writer, information specialist, and musician, was struck by the cover photo in the April-June 2007 issue of *Rice Today*, which depicts the Mekong River as it winds through Yunnan Province in China. He writes: "I was sitting at my piano, looking at the cover, seeing the rugged landscape rolling down onto a narrow river, a temple, shoals, and mud; nevertheless, the same river that later calms down on its voyage through Cambodia and beyond. So, I began to play an impression of the scene. After an hour I had a piece that runs for nearly 4 1/2 minutes." He calls it, naturally, *River of Rice*. To listen to the melody, go to www.irri.org/ricetoday.



Rice diseases as bio-weapons

Microbiologists in the United States are, according to a story in the 29 November 2007 issue of *Nature*, expressing concern about a government proposal to limit research on several plant pathogens because of their potential to be used as bio-weapons. The researchers say that the plan to subject rice and citrus disease agents to the same restrictions as *Ebola* virus and anthrax are ill conceived and will limit the response to a natural outbreak. The U.S. Department of Agriculture plans to add four plant pathogens to the government's list of "select agents," created to keep infectious diseases out of the hands of would-be terrorists.

Slaves brought U.S. rice?

Preliminary research reported in *National Geographic News* suggests that a rice variety grown successfully by many colonial plantation owners was brought to the United States from West Africa. If confirmed, the finding suggests that African slaves are responsible for not only working the farms and bringing the knowledge to grow rice but also for supplying the variety itself, which was one of the most lucrative crops in early American history. West Africans grew varieties of rice for several thousand years before the start of the slave trade with the colonies.

IRRI-China office turns 10

The IRRI-China Office celebrated its 10th anniversary on 28 November at the Institute of Crop Science, on the Chinese Academy of Agricultural Sciences campus. China-IRRI collaboration has resulted in the release of 46 IRRI germplasm accessions as varieties in China; more than 800 IRRI alumni, many of whom are now leading their institutions in rice research; and an increasing number of collaborative projects.

Relevance of rice researchers recognized

The work of rice researchers received major encouragement in 2007, with staff at the International Rice Research Institute (IRRI) and their colleagues receiving widespread recognition and several major awards.

"These awards and the recognition that comes with them are clear confirmation of the world-class rice research being conducted today in Asia and elsewhere," IRRI's Director General Robert S. Zeigler said. "More people rely on rice for their sustenance than any other type of food. Millions, if not billions, of these people live in poor communities throughout the developing world. Research that helps rice farmers boost their production and income, or helps reduce prices to make rice more affordable, has the capacity to pull vast numbers of people out of poverty and, therefore, does nothing short of offering them better lives."

Outgoing IRRI Board of Trustees Chair **Keijiro Otsuka** accepted the Iue Asia Pacific Culture Prize on behalf of IRRI at a 12 October ceremony during the Asia Pacific Forum of the Awaji Conference in Kobe, Japan. This prestigious award was established in 2001 to recognize individuals and organizations pursuing cultural and social activities within the Asia Pacific region that have made outstanding contributions to the promotion of international exchange and/or regional development. According to the Prize organizers, IRRI has "made many great contributions to reduce poverty and solve environmental problems, and, through your efforts, we expect that in the future you will further lead the way to a multicultural society in the Asia Pacific region."

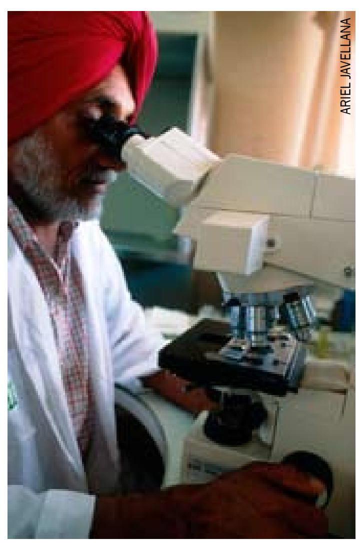
DUNCAN MACINTOSH

KEIJIRO OTSUKA (*left*) receives the Iue Asia Pacific Culture Prize on behalf of IRRI from Satoshi Iue, representative director of the Asia Pacific Forum and son of the founder of the Sanyo Corporation, which sponsors the prize.

TWAS

K.L. HEONG (*left*) receives the Academy of Sciences for the Developing World (TWAS) Prize for Agriculture from TWAS President Professor J. Palis.

Further validating the Institute's environmental credentials, IRRI entomologist **K.L. Heong** received the Academy of Sciences for the Developing World (TWAS) Prize for Agriculture, recognizing his pioneering work in ecology and integrating biological and social sciences to promote integrated pest management, which has helped millions of rice farmers reduce their pesticide use. Dr. Heong received the prize, which included a plaque and US$10,000, at the 18th TWAS General Meeting held in Trieste, Italy, 13-14 November 2007.



ARIEL JAVELLANA

Rice breeder **Darshan Brar** (pictured, *right*) was one of two winners of the 2007 Koshihikari International Rice Prize, 30 October in Fukui Prefecture, Japan. Dr. Brar, who does wide crosses to transfer desirable characteristics of wild rice species to commercial rice varieties, shared the award—named for a prized Japanese rice variety—with co-winner Tantawi A. Badawi, president of the Agricultural Research Center, Cairo, Egypt. They each received 500,000 Japanese yen (US$4,630).

IRRI scientists also received several awards at the 2007 Annual General Meeting (AGM) of the Institute's parent organization, the Consultative Group on International Agricultural Research (CGIAR). At the early December meeting in Beijing, China, **Dr. Brar** was honored with the Outstanding Scientist Award, which honors original work by a senior scientist whose contributions have actual or potential regional or international significance that furthers CGIAR goals. **Dr. Heong** picked up the COM+ Award for Communicating Science for People and the Planet, honoring the Environmental Soap Opera for Rural Vietnam, an entertainment-education initiative led by Dr. Heong to help farmers improve their crop management systems.

A team of scientists led by IRRI plant breeder **David Mackill**, in collaboration with colleagues from the University of California (Riverside and Davis), won the Outstanding Scientific Article Award, also presented at the AGM. The winning paper, "*Sub1A* is an ethylene response factor-like gene that confers submergence tolerance to rice," appeared in the 10 August 2006 issue of the journal *Nature*. Authors K. Xu, X. Xia, T. Fukao, P. Canlas, **R. Maghirang-Rodriguez**, **S. Heuer**, **A. Ismail**, J. Bailey-Serres, P.C. Ronald, and **Dr. Mackill** described their discovery of a gene (*Sub1A*) that confers submergence tolerance to rice, and the consequent breeding of this gene into a popular commercial variety. The resultant variety is identical to the popular cultivar but is able to withstand up to 17 days of severe flooding. Since the paper was published, the IRRI team has bred *Sub1A* into several other popular varieties, which have undergone successful on-farm trials and are poised to make a big impact on flood-prone farms in countries such as Bangladesh and India. See *Seeing is believing* on page 6.

Keeping up with IRRI staff

Other IRRI staff receiving awards in 2007 included

- Director General **Robert Zeigler**, who was also featured in *TIME* Magazine's *Innovators* series, was awarded the distinction of Fellow of the American Association for the Advancement of Science, "For distinguished contributions in plant pathology, plant breeding, and microbial biology covering a range of food crops and microorganisms, and for leadership in international agriculture."
- Soil scientist **Roland Buresh** was awarded the 2007 International Soil Science Award by the Soil Science Society of America at its annual meeting on 5 November in New Orleans, Louisiana, USA. Dr. Buresh received the honor for his leadership in formulating and disseminating improved practices of site-specific nutrient management. Another IRRI soil scientist, **Achim Dobermann**, received the Agronomic Achievement Award from the American Society of Agronomy.

BIOASIA

- **Gurdev Khush** (pictured *above* with H.R.H. Princess Maha Chakri Sirindhorn of Thailand), former IRRI breeder and World Food Prize laureate, and **Susan McCouch**, former IRRI geneticist, shared the Golden Sickle Award presented during the BioAsia 2007 Conference in early November in Bangkok. They were cited for outstanding research that has contributed significantly to propelling rice research into the future.
- **Gene Hettel**, head of Communication and Publications Services, received the 2007 International Award of Excellence from the Association for Communication Excellence in Agriculture, Natural Resources, and Life and Human Sciences (ACE) at its annual meeting in Albuquerque, New Mexico, USA.

In other news, water scientist **Bas Bouman** was appointed Crop and Environmental Sciences Division (CESD) head, effective 1 January 2008, with an initial appointment for 5 years. Geographic information systems specialist **Yann Chemin** and biochemist **Dilantha Gunawardana** began work as postdoctoral fellows in the Social Sciences Division and CESD, respectively.

Moving on

Rene Villanueva, Filipino playwright and author of IRRI's children's book *Graindell*, passed away on 5 December. Mr. Villanueva was a leading figure in children's literature in the Philippines.

RECIPE

Pea and mint risotto

JOSE RAYMOND PANALIGAN

Risotto is a traditional Italian rice dish. This recipe serves 4 as an appetizer.

Ingredients

60 ml olive oil
1 onion, finely chopped
2 cloves garlic, thinly sliced
200 g risotto rice (e.g., arborio or carnaroli)
1 liter warm vegetable stock
120 g frozen baby peas
¼ cup loosely packed mint leaves
Finely grated parmesan to serve

Preparation

Heat olive oil in a large saucepan, add onion and garlic, and sauté over low heat for 8 minutes or until onion is soft and translucent. Add rice and sauté over medium heat for 5 minutes, then add a little stock and stir until stock is absorbed. Continue to add stock, stirring until rice is *al dente* (firm but not hard). Next, add peas and mint and cook for 2 minutes or until peas are tender. Season to taste with salt and freshly ground black pepper. Sprinkle risotto with parmesan and serve immediately.

Source: *Gourmet Traveller*, modified by Melissa Fitzgerald, head of IRRI's Grain Quality, Nutrition, and Postharvest Center.

GENE HETTEL (3)

Luck is the residue of design

Peter Jennings, the International Rice Research Institute's first rice breeder (1961-67), with a long career in Latin America after his work in Asia, kicks off this historic series with a singular wit. He played a major role in the development of IR8, the rice variety that would ultimately change the face of agriculture across Asia (see* Breeding History *on pages 34-38 of* Rice Today *Vol. 5, No. 4). He reminisced on a warm, muggy day (20 July 2007) at his home in Gainesville, Florida. Here are edited highlights of the interview.

A matter of 5 minutes

I started graduate school at Purdue University in 1953. I was there almost 3½ years for my master's and doctorate. During my second year, a Mexican kid—Ignacio Narvaez—was in the office adjacent to mine. Ignacio was a wheat breeder for the Mexican Ministry of Agriculture associated with the [Nobel Laureate Norman] Borlaug group and he talked about Mexico and his work. I said to myself, "I want to work in international agriculture." I was consumed by this. But everything I tried to become affiliated with the Rockefeller Foundation was useless. Nothing happened. Rockefeller didn't need another plant pathologist.

So, I finished in 1957. Jobs were scarce. There was one job available in Madison, Wisconsin—a forage pathologist for the U.S. Department of Agriculture, which I was about to accept. At Purdue, I lacked one form for my doctoral thesis. I went to the dean's office in the School of Agriculture to pick it up. While I was talking to the secretary, Dean Ernest C. Young—also a consultant to the Rockefeller Foundation who knew me because of my frustrated attempts to get into the Foundation—walked by. He said, "Peter, what are you going to do?" I said, "Well, Dean, I'm going to go to Wisconsin." He responded, "Didn't you want to work with Rockefeller?" I said, "Yes." He said, "Wait a minute." The dean walked into his office, picked up the phone, and called George Harrar [then RF's director for agriculture and later RF president, 1961-72]. He left the door open so I could hear. He said, "George, I've got a kid here. He set some sort of an academic record here at Purdue and he wants to work for you and what are you going to do about it?"

So, I had two phone conversations with George Harrar. During those conversations, he said something I never forgot, "Would you want to live in the Philippines?" I said, "Of course!" That night, I had to look in my atlas to see exactly where in the Pacific the Philippines were. He said, "Well, we're going to do something there. It's going to take 3 or 4 years to get organized. Meanwhile, we'll have to find something for you to do [ultimately, brief stints in Mexico and Colombia]."

I have a profound belief in predestination, fate, and luck. Had I been 5 minutes earlier or later that morning at Purdue in the dean's office, I would not have crossed paths with Dean Young, there would have been no phone conversations with Harrar, and I would have had a career as a forage pathologist in the U.S.

George Harrar—he was magnificent!

So, I got a job with the Rockefeller Foundation in 1957. Terrific! What's the significance of this? Bob [IRRI's first director general, Robert F.] Chandler's book [*An Adventure in Applied Science*] cites the year 1958—about a year and a half after my telephone calls with Harrar—as the time when the Rockefeller and Ford Foundations first connected to thrash out the concept of IRRI. Harrar had "IRRI" on his mind when he talked to me much earlier on the phone about rice and the Philippines. You don't see that in Chandler's book. The driving force behind IRRI was George Harrar. He was magnificent, a giant!

Getting germplasm in the early days

When I finally got to IRRI in October 1961—as a breeder, not a pathologist—the first challenge was to assemble a comprehensive world collection of rice varieties. For germplasm, IRRI had only some 300 odd varieties. I spent a lot of time wandering back and forth in the mud trying to look at these plants. I wrote a letter, co-signed by T.T. Chang [IRRI geneticist, 1961-91], requesting any germplasm in small seed samples, and sent it to rice workers or experiment stations in some 60 countries. These were the days when it was pretty easy to move germplasm from one country to another. The response was wonderful. Within months, boxes and boxes of seed packages were coming in. I guess within 2 or 3 years we had several thousand accessions.

Increasing rice yields

Another challenge was more complicated. Chandler kept preaching: increase yield! Okay, that's easy to say, but how do you do it? I spent a lot of time talking with Akira Tanaka, head of IRRI's Plant Physiology Department [1962-66]. We tried to develop a mental image in our minds of what the leaves, stems, culms, and general architecture would look like on an ideal rice plant that would yield more. We determined that, if we were going to make any progress, we had to dramatically change the plant type.

The first seminar I gave at IRRI was on what an ideal plant type had to look like if we were going to get higher yield. I wrote that up and sent it to *Crop Science* [Plant type as a rice breeding objective, 4:13-15, 1964]. There were no data, it was just philosophy. For some reason, *Crop Science* published it. Years later, I reread that paper, long after IR8 came out [in late 1966]. And it just seems to me that IR8 looks very much like what we were theorizing.

An epiphany

Well, the rest is history and just sheer luck. And it goes back to that first set of 38 crosses [that ultimately led to IR8] we made in late 1962. About half of them involved the three famous Taiwan short-statured varieties [Dee-geo-woo-gen, Taichung Native 1, and I-geo-tze]. They looked terrible under Philippine conditions. They were riddled with bacterial leaf blight. They were shaded by tall things. They were sterile and miserable, but short!

We grew out the F_1s [first generation]—38 combinations, which is ridiculous by today's standards. Thirty-eight crosses in a year—absurd! But that's what we had. So, we grew out the F_1s; they were terrible. They were worse than the parents themselves. They were gigantic—6–7 feet tall. We harvested the seed from each of the single crosses—38 populations. And for not having anything else, we had a large F_2 [second generation] population—4,000–6,000 plants from each single cross.

Maybe a month after transplanting, one day we looked out there. The plants from the first cross were tall—terrible. It was a jungle. It was bad. Then, we came onto the plants from one of the crosses that involved one of the three Taiwan short-statured varieties. We looked down the rows. Something had happened! It was an epiphany! I never had an experience like that in my life—before or since. There were tall plants and there were short plants, but there were no intermediate plants! The short ones were erect, darker green, and had sturdy stems and a high number of tillers. We counted the tall plants and short plants. Essentially, the ratio of tall to short was 3 to 1—obviously a single gene recessive for shortness! It may sound something like arrogance, but I contend that I knew, at that moment, the significance of this.

Mixing good science with luck

When I was a little boy, I was a fan of an American baseball team, the Brooklyn Dodgers. Their famous general manager was Branch Rickey. This wizard said, "Luck is the residue of design." I think he was right. Some people are lucky, some people are not lucky. Luck does appear on its own volition, I know, from time to time. But luck is a consequence of putting a lot of mental observational evidence all together and all of a sudden it happens, it works. There is always luck. But sometimes you earn your luck. You influence your luck for sure.

Go to www.irri.org/ricetoday to read the full transcript of the Peter Jennings interview in which he discusses more of his version of the IR8 story, distributing IR8 in the Philippines, his impressions of Bob Chandler and other colleagues during the early days, his rice work in Latin America including genetic versus agronomic advances, and his view on what are the challenges for IRRI as it approaches its 50th anniversary.

URBITO ONGLEO

IRRI'S FIRST rice breeder, Peter Jennings, briefs visitors on IR8 in April 1966 just 7 months before its official release.

Cartograms: distortion for a better view

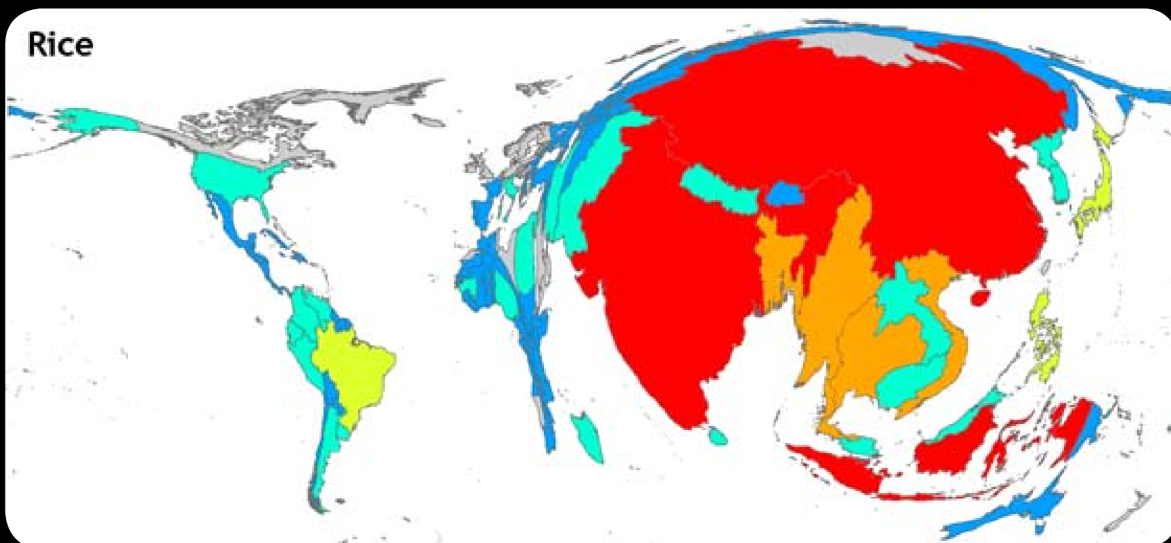
by Robert Hijmans
Geographer, IRRI Social Sciences Division

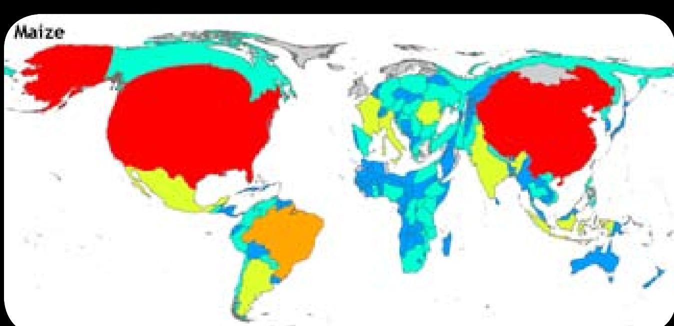
Cartograms are maps on which areas are altered to reflect the subject of interest. They accentuate patterns, making it easier to understand them. Because these maps violate most rules of cartography, we advise against their use in navigation!

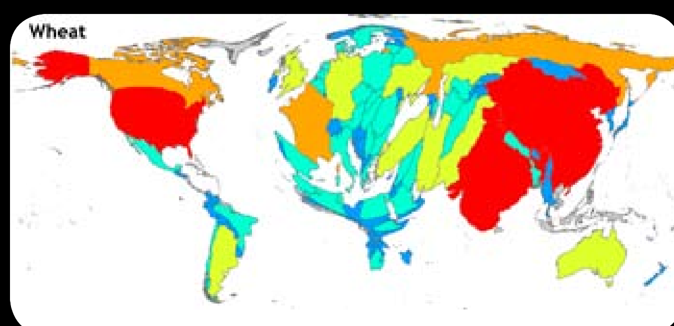
Figure 1 shows cartograms[1] of the domestic production of the three main grain crops—rice, wheat, and maize—and of root and tuber crops (including cassava, potato, sweet potato, and yams).[2]

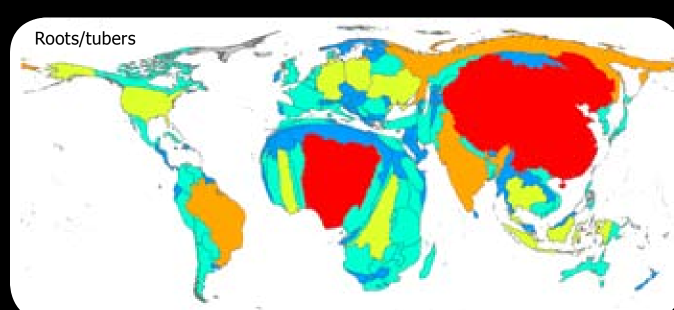
These maps show how rice production is concentrated in South, Southeast, and East Asia. Maize production is particularly high in North America and China, but it is relatively evenly spread across countries. Wheat is a crop

Fig. 1. Annual production of selected grain crops and all root and tuber crops by country.









[1] There are different types of cartograms. Here we use "area-cartograms" produced with the algorithm of Gaster and Newman (*Diffusion-based method for producing density equalizing maps*. 2004. Proc. Natl. Acad. Sci. USA 101:7499-7504), implemented by Rachel O'Brien.

[2] Data for Figures 1 and 2 are from the FAO Web site: http://faostat.fao.org.

of temperate and subtropical climates, including being a winter crop in northern India, but it is mostly absent in tropical countries. Root and tuber crops are relatively important in sub-Saharan Africa (particularly cassava), China (sweet potato), and Central Europe (potato).

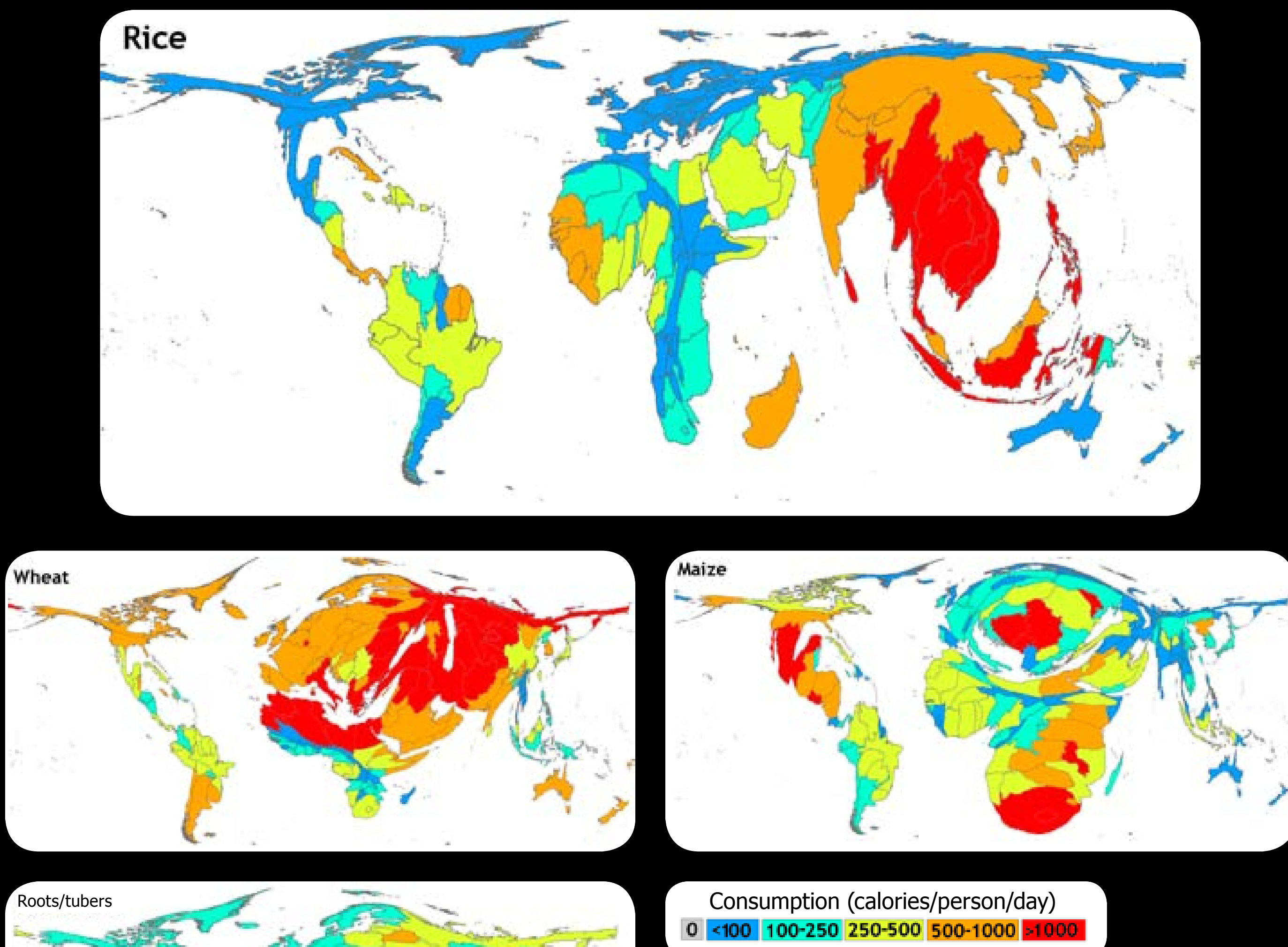
The amounts produced in a country in part reflect the number of people living there. To some extent, that explains why China, the world's most populous country, is a large producer of all crops mapped.

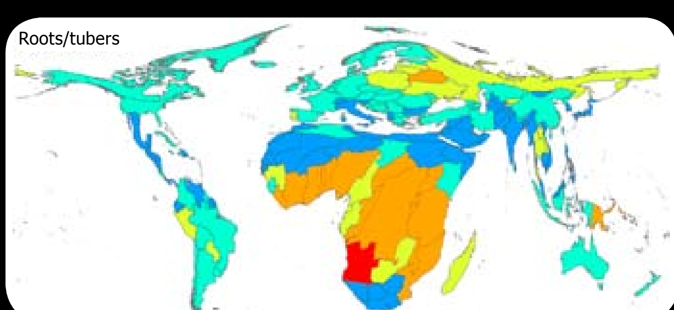
The maps of Figure 2 show cartograms of daily per person consumption of these crops.[3] These maps account for the number of people in a country, but they are also influenced by international trade and the degree to which the crop is used for (direct) consumption.

Rice consumption per person in West and East Africa is higher than you would expect from the production cartograms. This is in part because of rice imports. Particularly striking is the importance of maize in Africa, Central America, and southeast Europe. It is not consumed as much in mega-producer United States. This is because, as in Asia, most maize is consumed indirectly, as it is used for animal feed and sweeteners. Some of it is used for biofuel and not consumed at all. Wheat is the prime energy source for people in North Africa, Europe, and Central Asia. Roots and tubers are a very important source of energy in Africa.

Have these maps whetted your appetite for cartograms? A very good source of other cartograms is the WorldMapper Web site at www.worldmapper.org.

Fig. 2. Daily per-person consumption of selected grain crops and all root and tuber crops, by country.





[3] Note that here we are mapping a rate rather than an amount. Daily energy requirements depend on various factors, including age and activity level, but are about 2,000 calories per person for an adult.

Bird's-eye views of an

Ifugao Province
Eleven municipalities and photo locations
● Municipality town center

enduring rice culture

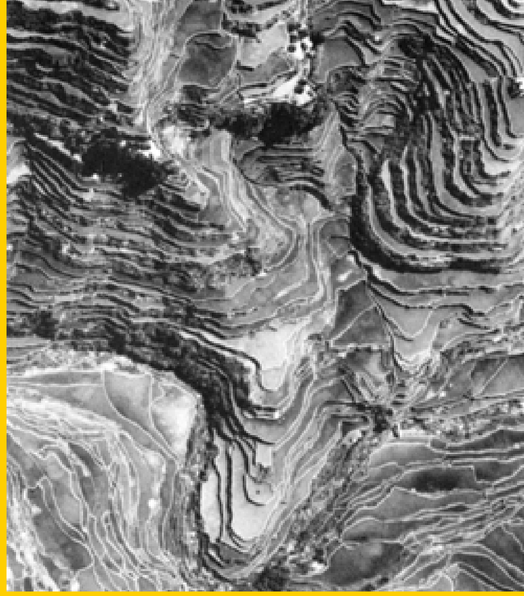
AN OVERHEAD VIEW of the central part of Batad District with its famous ampitheater-like terraces rising to the mountaintops (about 16 km from Banaue town center; location 2 on map). Getting there requires hiking over a steep ridge into the bowl-shaped valley.

By **Gene Hettel**
Color photography by **Ariel Javellana**

In early 2006, *Rice Today* editors decided to begin featuring a breathtaking photo in each centerfold, starting with the April-June 2006 issue. We anticipated that this would normally be a visually stimulating rice landscape. But coming up with something particularly spectacular for the inaugural centerfold was easier said than done.

Then, fortuitously, Harold C. Conklin, the renowned anthropologist, linguist, ethnobiologist, and preeminent authority on the Ifugao people of northern Luzon in the Philippines, approached staff photographer Ariel "Biggs" Javellana with a proposition. He offered to take him on a couple of unforgettable rides in a small airplane if he would bring along his camera equipment. The expedition would document some 40 years of both change and stability across Ifugao Province's topography encompassing rice terraces, rivers, and forests.

Mr. Javellana accepted. Dr. Conklin located a hard-to-find but suitable small plane with an experienced pilot for the journey. The unpredictable cloud cover in the region cleared for two rare back-to-back glorious days. And the rest is history. *Rice Today* got its first stunning centerfold photo (see *Claiming rice fields from wild rivers* on pages 19-21 of *Rice Today* Vol. 5, No. 2), award winning no less. And Dr. Conklin got his treasure trove of 1,000 photos to pore over and evaluate, capping more than 40 years of study he has made of the Ifugao people's



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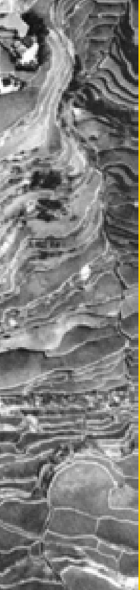
environment, culture, and society.

Rice Today is also fulfilling a promise to publish more spectacular photography from this collection. These images have the same incredible detail as the first centerfold of a bird's-eye view of the winding Alimit River in northeastern Ifugao Province. As stated by the judge, who awarded that image the Silver Medal in the feature photo category of the 2007 photography competition sponsored by the Association for Communications Excellence (ACE), "The oxbows create a stunning graphic. The photo is sharp, bold, and interesting. Readers will take time to stop and look. When they do, they'll spot the rice fields in the lower right. It's fun to look at the buildings, the rapids, the steeply forested banks, and other details." Many of these details show up in the photos of this article. This undoubtedly leads to a very important question: What observations does Dr. Conklin make from the photographs and, apart from being a magazine editor's dream, what is their significance, culturally and scientifically?

Dr. Conklin, now professor emeritus at Yale University, Connecticut, began his research on the Ifugao people in 1961 and has since devoted half a lifetime to studying these architects of the famous Banaue rice terraces. In addition to the Ifugao's well-known magnificent skills in agricultural terracing, he has observed and examined their intricate ritual and legal systems; their distinctive patterns of social organization, sex, and warfare; their rich oral literature; and their artistic achievements in wood carving and basketry. For more about the Ifugao, see *Contours of change*, on pages 8-13 of *Rice Today* Vol. 3, No. 1).

"I took my first aerial photographs of the Ifugao area from a small plane in the summer of 1961," says Dr. Conklin. "I also arranged for concentrated photographic efforts in 1962, 1963, 1968, and 1969. Additionally, I had vertical aerial pictures taken, which facilitated the photogrammetric plotting and mapping of a significant part of the region. During those years, I also took many photos of Ifugao rice agriculture at ground level (see page 22)." Many of these photos and resulting maps appear in his *Ethnographic atlas of Ifugao* (see box on the next page) published in 1980, some of which are reproduced in this article with permission from Yale University Press for comparison with those taken during the March 2006 Conklin-Javellana foray.

THIS BIRD'S-EYE VIEW of central Hingyon District (location 4 on map) shows hamlets, fields, and woodlots. A new road can be seen alongside the ritual field (circular field in the center) when compared to the inset photo at right, taken on 24 April 1963.



THIS OVERHEAD shows a central section of Bannāwol District (location 3 on map), which can be compared to the photo inset at left taken on 23 April 1963. After 43 years, nothing much has changed, even the shape of the terraces. Compare this with the development activities in the Banaue town center in the photo on page 19.

"Unfortunately," says Dr. Conklin, "during the 1960s, I never had the chance to survey the whole area from the air at the same time. But, thanks to the unusual break in the often dense cloud cover, Biggs and I were able to do this over most of the 140+ traditional Ifugao agricultural districts (within 9 of the province's 11 municipalities; see map on page 14) spread across a vast area of rugged terrain." Up until then, he had walked through some of the valleys only once or knew of them only from reputation.

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Pictures then and now

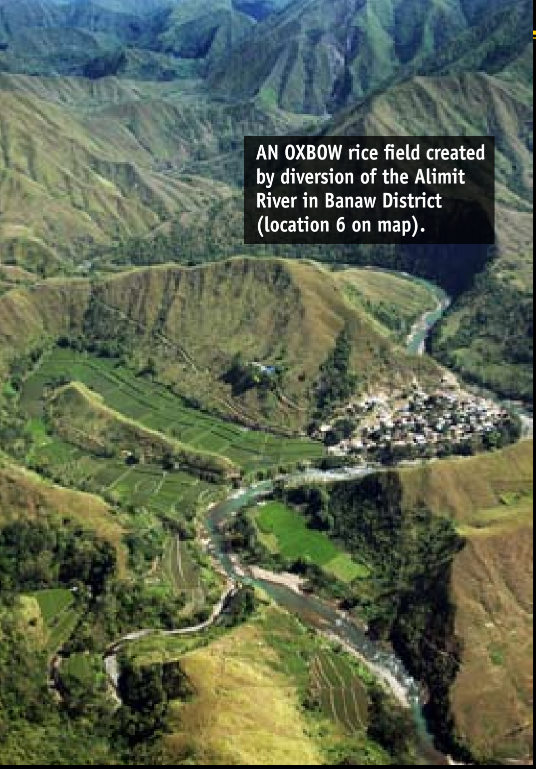
GENE HETTEL (2)

Although officially out of print, Harold Conklin's *Ethnographic atlas of Ifugao: a study of environment, culture, and society in northern Luzon* (Yale University Press, 1980) can still be found in little out-of-the-way bookshops in Manila and through Amazon.com itself, which warned at this writing that "only two copies are left in stock but more are on the way." Pricey at $296, strategically sized at 18 1/4 × 16 × 1 inches to show the photogrammetric plotting and mapping to scale, and weighing 6.5 pounds, this atlas has been called a work of art and a Philippine national treasure by one reviewer, who adds, "Rarely in this world do we find individuals as dedicated to their scholarly work as Dr. Conklin."

Another reviewer writes, "There are books that are fine and attractive volumes, books that are valuable for their purview of other cultures, books that stand alone as art. This atlas, in truth a working volume and nothing to be set aside in some sterile cabinet, is all of those and then some. There are a couple of books that joust for the title of the most beautiful and well-conceived in late 20th century bookmaking—without a doubt this would be one of the very few." Read more reviewer comments at Amazon.com.

In the photo above right, Dr. Conklin shows long-time Ifugao friend Aurora Ammayao and her daughter Maria Hettel some of the 40-year-old aerial images of the terraced landscapes appearing in his atlas. He says these landscapes have both delighted and baffled him over the years. How have these and similar tropical upland agricultural systems developed? And what are their long-term effects on soils, terrain, vegetation, and animal life as well as on human activities? The atlas is at least a partial report of his first 20 years of investigations.

In the photo at left, Dr. Conklin and *Rice Today* photographer Ariel Javellana inspect more than 1,000 new aerial photos taken over Ifugao Province in March 2006. These exquisite images may add more pieces to the puzzle or perhaps, in some cases, raise even more questions than provide immediate answers.



AN OXBOW rice field created by diversion of the Alimit River in Banaw District (location 6 on map).

According to Dr. Conklin, his very preliminary inspection of the photos has yielded some fantastic and perhaps surprising findings. "Of course, the greatest changes across Ifugao have been in the vast improvement and expansion of roadway networks and population growth, especially along these routes," he says. "The town centers of Banaue (photo at top of page 19) and Lagawe are now tremendous little cities instead of small crossroad hamlets." However, when flying over most of the districts, they found that the agricultural centers—the places where the largest pond fields are located—have not been affected by the urban sprawl or the roadway system.

The photos show that no valleys where agricultural activities were under way in the early 1960s have been abandoned since then. Dr. Conklin pointed out that Ifugao Province is blessed with abundant rainfall and irrigated fields are kept inundated during all seasons.

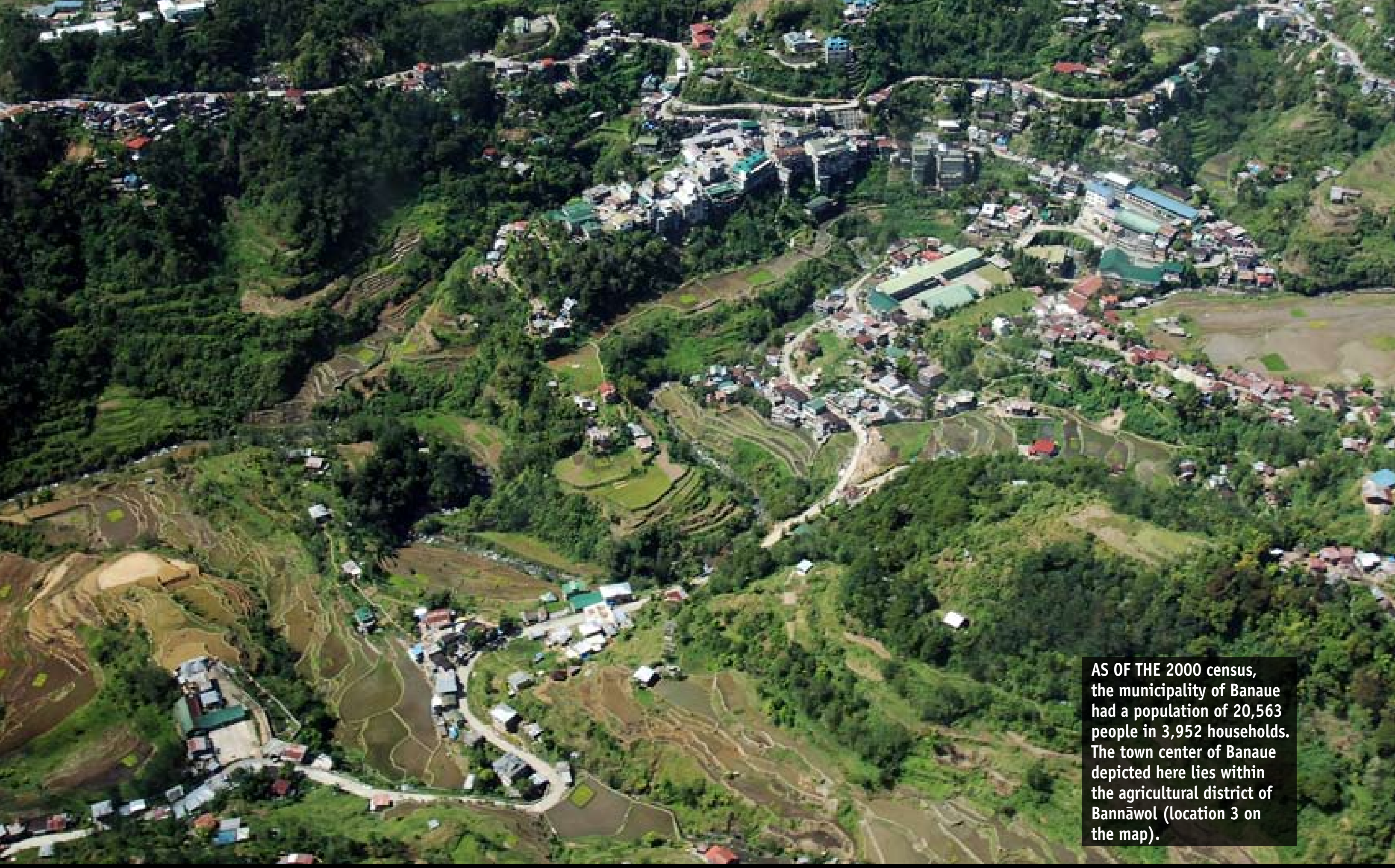
"Cement has been the greatest additional 'concrete' input," he says with a smile. "It did not exist before—at all. The cement does not go into the pond fields or into agricultural landscape. It stays along the roads, which are usually above the terraces and the agricultural land below."

One thing that truly surprised and impressed Dr. Conklin is the amount of forest land in Ifugao today. "Looking at any early picture of an Ifugao agricultural district (as a whole) will show considerably less forest cover than was revealed by our recent survey," he says. "In terms of luxuriousness, density, and height, the forest landscape is remarkable, a situation not at all the case in most of the rest of the Philippines."

Why is this? Dr. Conklin surmises that, as in many other parts of the Philippines, Ifugao overseas workers are sending back remittances, which have allowed many Ifugao remaining at home to buy imported food and be able to eat rice more than once a day.

"Certainly, the amount of rice being produced on the terraces has also increased tremendously," he says, "but unquestionably the Ifugao diet is now less dependent on sweet potato than before. Previously, most Ifugao didn't eat rice two or three times a day throughout the year. They often depended on sweet potato tubers

THIS AREA in Hu'yu district (location 7 on map) shows one of the few areas in Ifugao where new terracing has occurred. Many Japanese soldiers died here in the final stages of World War II.



AS OF THE 2000 census, the municipality of Banaue had a population of 20,563 people in 3,952 households. The town center of Banaue depicted here lies within the agricultural district of Bannāwol (location 3 on the map).

cultivated in temporary slopeland fields that did not have access to sufficient water for rice field terracing. The area devoted to these shifting cultivation plots has very greatly diminished and has grown back as second growth forest and woodlots."

Dr. Conklin speculates why there are so many Ifugao overseas workers who have directly made it possible for local forests in the province to flourish by putting less pressure on the land. "The Ifugao were among the first Cordilleran pioneers to venture far from home, initially in-country and then around the world," he says.

One unique cultural quirk contributing to so much out-migration from the province is the Ifugao custom of primogeniture, that is, inherited fields are not split up. Explains Dr. Conklin: "If there are seven children in a family (and even today, there often are), only the oldest will get the 'lion's share' of the landholdings. The rest of the siblings have to seek their livelihoods elsewhere." Also, there are no absentee landlords. Very little land is in the hands of others outside of Ifugao. Land tenure and land usage in Ifugao have traditionally been tightly managed and integrated culturally.

Some other ecological observations that can be made from comparing photos from the 1960s with those taken in 2006 show that many partially terraced areas have expanded a little. However, significant new terraces can be detected in only about three or four districts, such as shown in Hu'yu (see photo at left). "They are very important for these people who have not had much land before," says Dr. Conklin, "but I don't think these new terraces are very economic."

At the spry age of 82, Dr. Conklin is working on yet another book to complement his ethnographic atlas. Featuring Ifugao rice specifically, it will show the staple from a traditional Ifugao view. "I am tapping into a large body of information that is shared by the people living in the agricultural districts and doing the agricultural work in the pond fields all year long," he says. "What do they know about rice? How do they feel it, taste it, live with it, use it, classify it, sample it, and use all of its by-products? This will be a culmination of my, to date, 47-year study of the Ifugao people. The body of information is very great. I've written and given papers and now I'm trying to put all of it together."

He anticipates that many of the aerial photos will certainly have a place in his book, but surmises that it might be worth doing something separate on the photos themselves as well. "One really good aerial picture can tell researchers a tremendous amount if they know what's truly happening on the ground. A collection of such photos showing the variation of landscapes and places—which we now have—can tell us a very rich story."

Editor's note: The photos featured in this article and other magnificent scenes shot during the March 2006 Conklin-Javellana expedition can be accessed and downloaded on the *Rice Today* Web site at www.irri.org/ricetoday.

Ariel Javellana

© H.C. Conklin Collection (R.F. Barton photo)

This view of Happaw, Du'lígan (Dukligan) District (location 5 on map), shows no substantial change since 1913 (*inset*).

At ground level...

A closer view of Ifugao rice agriculture

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Bringing in the rice harvest to the drying ground (1963).

Removing rice seedlings from a seedbed for transplanting. Remaining seedlings will be carried to other pond-field plots (1963).

An elder chooses the best rice panicles containing the next season's seed for planting (1963).

Terrace maintenance and dike repair are backbreaking work (1962).

GENE HETTEL

A traditional Ifugao priest sacrifices a pig to the rice gods during a harvest ritual in Lugo near location 3 on map (1995).

African rice research expands

by Savitri Mohapatra

Member states of the Africa Rice Center (WARDA), with new members in red.

Four new countries have become members of the Africa Rice Center, signaling increased investment in rice research and the growing importance of rice in Africa

The 26th session of the Council of Ministers of the Africa Rice Center (WARDA), held in Abuja, Nigeria, 27-28 September 2007, signaled a historic change for rice research in sub-Saharan Africa.

The expansion of the geographic mandate of WARDA, which is primarily based in West Africa, was formally approved and four East and Central African countries were admitted as WARDA members.

The new member states are Uganda—the first East African country to be admitted to WARDA—the Central African Republic, the Democratic Republic of Congo, and the Republic of Congo. These additions take the number of WARDA member states from 17 to 21.

"This is the first time since 1987 that new members have joined WARDA," stated WARDA Director General Papa Abdoulaye Seck. "But what is more important is that the new member states are from East and Central Africa—regions that, unlike West Africa, were not traditionally known for rice cultivation."

"With the success of WARDA's technologies, particularly the New Rice for Africa (NERICA®), Central and East African countries are seeing for themselves the benefits of investing in rice research," Dr. Seck said.

In his opening address, His Excellency Umaru Musa Yar'Adua, president of the Federal Republic of Nigeria (represented by the vice-president, Dr. Jonathan Goodluck, who delivered the message) mentioned that, aside from NERICA, another major contribution from WARDA to Nigeria was in the area of rice policy research.

The Council of Ministers thanked Dr. Seck for his strong advocacy for rice research and development, which has led to tangible improvements in contributions from member states—including Nigeria, which has fulfilled its financial obligations to WARDA to date.

"The contribution received from member states in 2007 is equivalent to that of the last 10 years," the Council affirmed.

The Council strongly backed a new pan-African Rice Initiative that will be launched in 2008 by Benin President Yayi Boni with WARDA, as part of advocacy efforts to support Africa's rice sector.

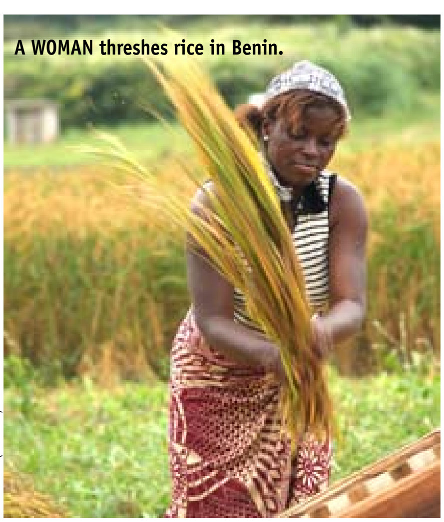
Dr. Seck's vision and strategy for a more competitive, diversified, and sustainable Africa Rice Center were fully endorsed by the Council, particularly the post-M.Sc. internship program for young educated Africans designed to create the next generation of rice researchers in sub-Saharan Africa.

The Council urged WARDA to strengthen links with subregional and regional bodies and reiterated its commitment that WARDA, while remaining one of the 15 international centers supported by the Consultative Group on International Agricultural Research (CGIAR), be recognized as a Center of Excellence of the African Union.

As the shortage of seed of improved varieties continues to be a major constraint to rice production in sub-Saharan Africa, the Council encouraged WARDA's involvement, in association with national programs, in seed production and urged it to help in the development and harmonization of seed legislation at the regional level.

One of the highlights of this session was the presence of invitees from the Network of Farmers' and Agricultural Producers' Organizations of West Africa. The Council resolved to invite farmers' associations as observers to the WARDA National Experts Committee meetings on a regular basis.

The 26th session was held under the chairmanship of Abba Sayyadi Ruma, Nigeria's minister of agriculture and water resources. Before concluding its historic session, the Council approved Togo's assumption of the Council chairmanship for the next 2 years.


A WOMAN threshes rice in Benin.

R. RAMAN (WARDA)

OUT with the wet, IN with the dry

How a farmer achieved a better life by using dry-season rice technology

IRRIGATION TECHNOLOGY, such as low-lift pumps, helps farmers like Rajib Neog to grow dry-season rice in Assam, India.

PALASH DEB NATH (3)

By Nivedita Deka, Kabindra Borkakati, and Zahirul Islam

Ganakabari is a small village with 87 households in Jorhat District of the Indian state of Assam. Every year, the low-lying area is subject to deep flooding due to monsoons that cause the overflow of the Brahmaputra and Bhogdai rivers. For centuries, rice has been the major crop of the area, the staple of the local population. During the *kharif* (wet) season, farmers monocrop *sali* rice; their next crop consists of seasonal vegetables, oilseeds, and pulses. Most farmers in the village are either marginal, having less than 1 hectare of farmland, or small, with a farm size of 1–2 hectares. Most farmers have a primary education.

The average yield of *sali* rice is only about 2 tons per hectare. The combination of small farms and poor yields is a formula for poverty in this area. Compounding this, the Brahmaputra and Bhogdai often cause flood damage to the *sali* rice, contributing further to food insecurity and poverty for the local farmers. To improve livelihoods in such areas, farmers wanted to grow rice during the dry (*boro*) season.

Monsoons bring too much water but the dry season brings too little. Therefore, irrigation is a must for *boro* rice. To encourage *boro* rice cropping, the Assam state government started providing subsidies for low-lift pumps in the year 2000. Five farms began *boro* rice cropping for the first time during the 2002-03 season, irrigating about 2.5 hectares of land using the pumps to lift water from the Bhogdai River.

Although they had water for irrigation, the farmers lacked an appropriate variety of *boro* rice. In their first *boro* season, they grew an unknown variety, the so-called No. 9, and two *sali* varieties—*Luit* and *Lachit*. No. 9 yielded about 5 tons per hectare; the *sali* varieties yielded about half that.

From 2003 to 2004, Assam Agricultural University (AAU) at Jorhat initiated efforts to intensify *boro* cropping at Ganakabari, in cooperation with the International Fund for Agricultural Development (IFAD)-funded project *TAG 634: Accelerating technology adoption to improve rural livelihoods in the rainfed eastern Gangetic Plains*. The AAU research team provided farmers with modern *boro* varieties developed by AAU—*Kanaklata, Joymati,* and *Jyotiprasad*—and offered information and technical support.

RAJIB AND HIS WIFE, Pranita, share the responsibilities of farming and taking care of Rajib's father and mother, Rameswar and Maloti Neog.

In the 2003-04 season, 24 farmers cropped *boro* rice in a 27.5-hectare area. The AAU team promoted biofertilizer-based integrated nutrient management (BINM), which reduces the use of inorganic fertilizers and thus lowers production costs and water pollution.

In the 2004-05 season, 33 farmers grew *boro* rice on 39 hectares and, in the 2005-06 season, 25 farmers cropped *boro* rice on 20 hectares. The decrease in 2005-06 was caused by severe drought, which raised the cost of fuel and, consequently, irrigation. Most farmers who grew these modern varieties harvested more than 5 tons per hectare, compared with the 2-tons-per-hectare yield of *sali* rice, which was often damaged by floods.

Most farmers have not abandoned *sali* rice; rather, they have adopted a *boro–sali* system. *Boro* rice is currently grown on about 30% of rice lands in Ganakabari. About 70% of the land is now under the *sali–boro* system; the other 30% is planted to *boro* only. Among the three introduced *boro* varieties, *Kanaklata* has become the most popular.

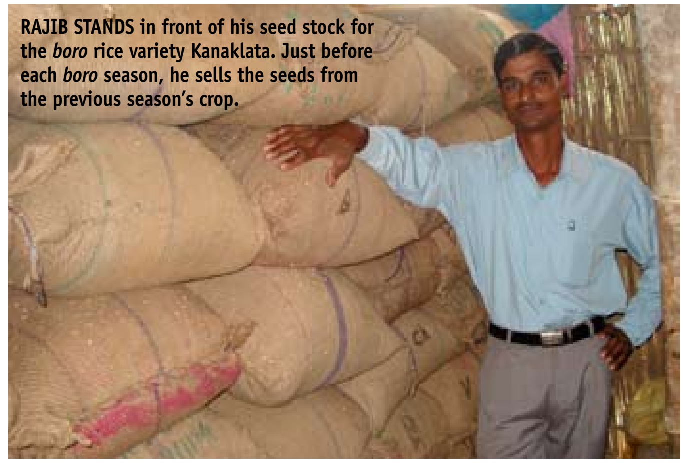
Rajib Neog is a young farmer from Ganakabari village. With a secondary education, he has more schooling than many farmers. His brother, a school teacher, has settled with his family in the nearby suburban town of Dergaon. His three sisters are all married and have settled in other villages with their families. Rajib, the youngest sibling, remained at the family house in Ganakabari village to look after his elderly parents and their 2-hectare farm. Cultivating mostly rice and seasonal vegetables, his family's life was difficult.

A receptive and technology-savvy farmer, Rajib saw the potential of *boro* cropping. In 2002-03, he was one of five farmers who cultivated *boro* rice for the first time in the village. In 2003-04, he adopted the *Kanaklata* and *Joymati* varieties, and BINM, on 1.2 hectares. Later, he increased the coverage to 1.5 hectares—75% of his land.

In the 2004-05 season, Rajib had stunning success with his first attempt at growing *Kanaklata*. He reaped 6.25 tons per hectare, while yields of the *sali* varieties averaged 2.3 tons per hectare. Rajib's yield was the highest in his village. In the 2005-06 season, Rajib also harvested an excellent crop that yielded 6.3 tons per hectare. In 2004-05, his total harvest was 8.5 tons; in 2005-06, his total harvest was 9.95 tons.

Rajib expected another bumper crop in the 2006-07 *boro* season. In addition to the higher yields of *Kanaklata,* Rajib grows the variety for its finer grain quality, good eating quality, and high market price. Currently, he is growing mostly *Kanaklata* and No. 9.

By adopting the new technology package, Rajib has been able to grow more rice than he needs and he has become a relatively wealthy farmer. Occasionally, his brother collects rice from Rajib for his family's consumption. Higher yields also mean that Rajib has become a grower of *Kanaklata* seeds. He stores most of his product until just before the next planting season and then sells it at a good price.


RAJIB STANDS in front of his seed stock for the *boro* rice variety Kanaklata. Just before each *boro* season, he sells the seeds from the previous season's crop.

In 2005, Rajib earned about 24,000 rupees (US$600) by selling 4 tons of rice seeds, and in 2006 he earned 36,000 rupees ($900) by selling 6 tons. In addition to income from rice farming, Rajib earns supplementary income by growing vegetables and raising goats and ducks.

People who know Rajib can see physical proof of his improved livelihood. In 2005, in preparation for starting his own family, Rajib used the additional income to construct an improved mud-walled tin-roof house. In July 2006, he married Pranita (Munu), who has become his constant companion. Rajib also bought a single-burner gas stove for cooking, which saves his family the time and labor of finding firewood for cooking.

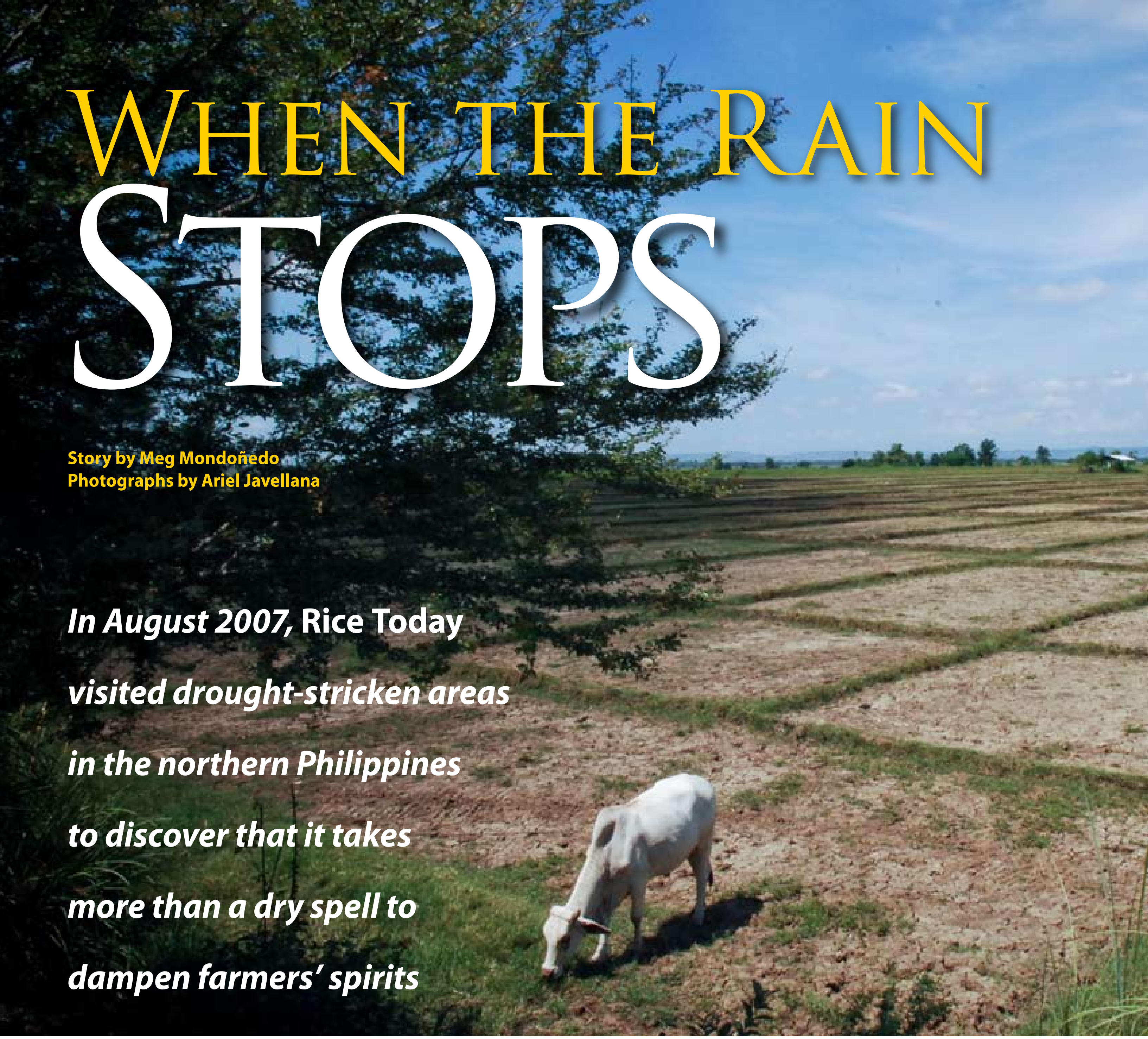
In Ganakabari and beyond, people quickly figure out who the prosperous farmers are. Successful *boro* cropping with record high yields has brought a degree of fame to Rajib. Many seek his counsel: neighbors in his farming community, scientists at development agencies and nongovernmental organizations, and agricultural extension specialists at the state government's Department of Agriculture.

In April 2006, Rajib achieved formal recognition as a successful farmer. Participating in a training course on seed selection and storage, presented at AAU by experts from the International Rice Research Institute and Bangladesh, Rajib received from the NGO Jeuti a certificate of appreciation. Jeuti—which means "light"—advocates and promotes the use of improved farming practices by poor farmers in Assam.

By presenting the certificate, representatives from Jeuti recognized Rajib's achievements in growing *Kanaklata*. Since the training course, as a way of sharing his knowledge with other farmers, Rajib helped organize a self-help group for resource-poor farmers in his village. In recognition of Rajib's accomplishments, members of the group, named Bhogdaiporia, selected him to be the secretary—a position that confers higher social status.

Only a few years previously, Rajib was a struggling farmer. Now, neighboring farmers ask him for seeds and seek his advice on modern cultivation practices.

Dr. Deka is an agricultural economist and Prof. Borkakati is an agronomist at Assam Agricultural University. Dr. Islam worked as an international research fellow at the International Rice Research Institute. *This article was adapted from* Rajib finds a better life by using dry-season (*boro*) rice technology: a case study in Jorhat District of the Indian state of Assam, *a chapter in* Technologies for improving rural livelihoods in rainfed systems in South Asia, *edited by Zahirul Islam, Mahabub Hossain, Thelma Paris, Bill Hardy, and Joyce Gorsuch, and published by the International Rice Research Institute and online at http://tinyurl.com/2hjhy5.*



When the Rain Stops

Story by Meg Mondoñedo
Photographs by Ariel Javellana

In August 2007,* Rice Today *visited drought-stricken areas in the northern Philippines to discover that it takes more than a dry spell to dampen farmers' spirits

Bright oranges, rich yellows, piles of husks in wheat-colored hues—all maize, no rice.

This was the scene in late August 2007 throughout towns on the Philippine island of Luzon in the Central Region, Cagayan Valley, and the Ilocos Region (see brown-shaded area of map). Drought hit these areas in July, forcing most rice farmers to plant maize, vegetables, and other dry-season crops instead of rice.

Venturing north from its Los Baños headquarters, *Rice Today* expected to see parched land studded with dry rice plants, but there were none. Our first reaction was relief for the farmers mixed with fears that our attempt to document the effects of drought would be futile. Fortunately—or unfortunately—after several interviews with farmers and farm workers, we discovered that the absence of dry rice fields was *not* because the reports of drought had been exaggerated, but because many farmers had simply ceased their planting operations altogether due to the absence of rain.

"Most of the farmers here did not plant rice anymore when we

A LACK OF RAIN in the northern Philippines in July and August 2007 meant that many farmers' rice fields—such as these in Isabela Province—remained empty.

DESPITE ATTEMPTS to bring rain through cloud seeding, rice fields throughout central and northern Luzon remained bone dry during the usual planting period.

knew there was a drought," explains Marlon Ortilla, 34, a rice farmer in Sinait, Ilocos Sur. "I planted rice seeds on 24 June but was able to transplant the seedlings only on 25 August due to drought. The 2-month delay caused yellowing of the rice seedlings, which is no good."

Like many other rice farmers in the area, Marlon Cabato, 42, from Amulog, Cagayan, planted maize instead of rice. "We should have started planting rice in June," he laments, "but because

ROLANDO DIEGO, from Allacapan, Cagayan Province, had a very small harvest because of the drought.

LITTLE AND LATE rain meant that instead of transplanting rice seedlings in late July 2007, farmers had to wait until late August.

ANGEL PARAYO'S rice crop in Candaba, Pampanga, was hit by not only drought but also a typhoon.

there has been no rain, we planted maize just now [late August]. My rice seedlings are short and small because of the lack of water."

"My harvest was very small because of the drought," relates Rolando Diego, 52, of Allacapan, Cagayan. "Our planting was delayed for 4 months, but I planted some maize. It hardly rains here. This October, I'm hoping for a good harvest, because my last harvest was in 2006!"

According to the Philippine Department of Agriculture (DA), when the dry spell struck, farmers had already planted rice on 1.071 million hectares of land, with maize planted on another 288,311 hectares. The DA noted that, of the total area planted, 85,741 hectares of land planted to rice and 128,543 hectares of land planted to maize were affected by the dry spell.

In early August, the DA started giving aid to small farmers reeling from the dry spell, in efforts to boost yields and help put agricultural growth on track despite the adverse climate. Aid provided several means of assistance including cloud-seeding, shallow tube wells, seeds, and water-impounding projects. But, for most farmers, help came too late to save their crops.

MARLON ORTILLA from Sinait, Ilocos Sur, had to delay his transplanting by 2 months.

INSUFFICENT WATER for healthy rice seedlings meant that Marlon Cabato from Amulog, Cagayan, planted maize instead of rice.

"Because of the drought, planting was delayed for 2 months, and, when we were finally able to plant, a typhoon hit us," says Angel Parayo, 68, who lives in Candaba, Pampanga. "All my seedlings were submerged in water for 5 days; the seedlings recovered but the *palay* [rice] became soft, which could cause losses."

The weather has meant that, for many rice farmers, this year has been disappointing in terms of harvest and income. This, in turn, had a negative impact on business in general in this region.

"Business is suffering," says a gas station owner in Tumawini, Isabela. "All the businesses here are dependent on farmers' produce. Farmers were not able to harvest much last year due to strong typhoons; this year, it's because of the drought. The farmers have no more money; the money lenders are now broke because farmers cannot pay them. All the farmers here are having a difficult time. Business is bad because of the drought."

DESPITE THE POOR cropping season, Rizal Laforga of Lalo, Cagayan, remains hopeful.

With little to look forward to, the farmers can only pray for rain to come. Although the future looks bleak, some—such as Rizal Laforga, 44, of Lalo, Cagayan—are still hopeful.

"Because of the drought, my rice field just grew weeds and grass, and my rice plants didn't grow," says Mr. Laforga. "The tillers became really short; planting was delayed by one month. We waited for the rain to come; we would have started planting in June, but there was still no rain in May, so we were able to plant only late in July. Our fields are just rainfed; without rain, our plants will die."

"It doesn't help to be sad," he adds with a smile that belies his fortunes. "We should still smile so others won't notice we are suffering. There is always hope."

The unsung heroes of the rice field

by Yolanda Chen

Simply by growing rice, farmers cultivate a complex—and free—pest control system without doing a single extra thing

PREDATORS OF RICE PESTS, such as this meadow grasshopper (*Conocephalus longicornis*) and the orb-weaver spider (*Argiope* sp.; *bottom*), offer farmers a free, natural pest control system.

Tropical irrigated rice fields are ecosystems of extraordinary biological diversity and a high level of natural biological pest control. A wide-ranging assemblage of predatory spiders, beetles, bugs, and wasps hunts insect pests throughout the growing season. This highly effective pest control is much greater than that of most temperate agroecosystems, and rice agroecosytems are arguably some of the most diverse in the world. Both the diversity and complexity of species interactions contribute to the robustness of natural pest control—a free service provided by the ecosystem.

Why is the biological control of irrigated rice so unique among agroecosystems? Early in the cropping season, flooding of the field stimulates the activity of aquatic insects, such as midge larvae, which feed on decaying plant material. These species are harmless to the crop, but have a beneficial role for pest control. When the aquatic insects emerge out of the water to fly away, they are consumed by hungry spiders and predatory insects. The predator populations mostly feed on the emerging aquatic insects early in the season, and then switch to feed on the terrestrial insect pests as the canopy closes and aquatic insect populations fall. Thus, the predators benefit from an early flush of food that helps to build up their populations before insect pests become abundant.

Many modern rice production practices actually favor pest outbreaks. For instance, populations of sucking insect pests such as the brown planthopper (BPH), green leafhopper, and aphids are actually limited by the amount of available protein. When too much nitrogenous fertilizer is added, plants have an excess of amino acids in their sap, which favors the buildup of sucking pest populations. Leaffolder moth damage also increases when fertilizer is overused. Therefore, excess fertilizer makes the entire system more vulnerable to pests.

If biological control is so effective, what causes insect pest outbreaks? The two most important insect pests of rice throughout Asia are the yellow stem borer and the BPH. Found every season throughout the rice-growing regions of Asia, the yellow stem borer's ubiquity has given it a reputation as a major pest—yet it causes only 2–5% yield loss. Stem borer damage during the vegetative stage of rice plant growth does not cause yield loss because the plant can compensate by growing more vigorously. Only stem borer moth damage during the reproductive stage results in yield loss, and research has documented that there is a strong tendency to overestimate such loss because the white, unfilled panicles look particularly bad to farmers. In truth, the yellow stem borer is not really a significant pest that warrants serious interventions.

The BPH, however, was responsible for huge and devastating outbreaks throughout Asia in

JOSE RAYMOND PANALIGAN (2)

DR. CHEN (*right*) surveys pests and predators with assistant scientist Carmen Bernal (*rear*) and research technician Alberto Naredo.

the 1970s, and is considered the preeminent pest of the Green Revolution. Some of the key factors that facilitated BPH outbreaks during the 1970s were year-round cropping of rice, increased use of nitrogenous fertilizer, and the use of insecticides known as synthetic pyrethroids. These pesticides kill off the natural enemies (known as predators and parasitoids) of BPH, allowing subsequent cohorts of BPH a predator-free period to develop. Because their populations develop more quickly than the predators, BPH populations can result in an outbreak, causing devastating losses. Repeated pesticide overuse over large areas can reduce the ability of natural enemies to recolonize and establish natural biological control (see *The pesticide paradox* on pages 32-33). In areas throughout Asia where pesticide subsidies have been terminated, BPH outbreaks have largely stopped. But in countries where there has been an increase in pesticide production and pesticides are cheap, there have been sizable BPH outbreaks. In 2005, about 2.7 million tons of rice were lost in China alone. In 2006, Vietnam suffered enough rice crop losses due to BPH and secondary viral outbreaks to threaten the country's rice exports.

DR. CHEN prepares to get her feet muddy in an IRRI experimental field.

Are there ways to boost and retain the natural biological control services in the rice field? In his 1996 publication in the journal *Ecology*,[1] William Settle and colleagues reported that adding manure to rice fields boosts natural control. At the International Rice Research Institute, my team is studying the relationship between manure inputs and rice variety on natural biological control. We have found that 2 tons of composted manure added at the beginning of the season significantly lowers stem borer damage during the reproductive phase—the period when pest damage is the most difficult to manage. It also appears that some plant varieties show slightly higher levels of damage than others. Currently, we are evaluating manure as a pest-management tool by determining whether more manure further increases pest control. This will allow us to make simple pest-management recommendations for boosting natural control in farmers' fields. So far, we are encouraged by these positive pest control measures, which appear to boost natural biological control without causing negative side effects.

Animal wastes are a growing source of pollution in developing countries, and a real public health issue. If done properly, channeling animal manure into rice production could lead to myriad benefits, including better water quality, better pest control, and reduced reliance on pesticides. If we focus on irrigated rice as an ecosystem, we can appreciate how the system works together as a whole, and focus on how we can subtly manipulate it in our favor.

One of the most difficult challenges ahead will be convincing researchers, policymakers, farmers, and extension agents of the efficacy and robustness of natural biological control, underpinned by the amazing wealth of biodiversity, in the rice field. Given the many conflicting political, social, and economic pressures on pest management practitioners at the local, regional, and national level, we hope that the science will speak for itself.

Dr. Chen worked as an entomologist in IRRI's Crop and Environmental Sciences Division, 2004-07.

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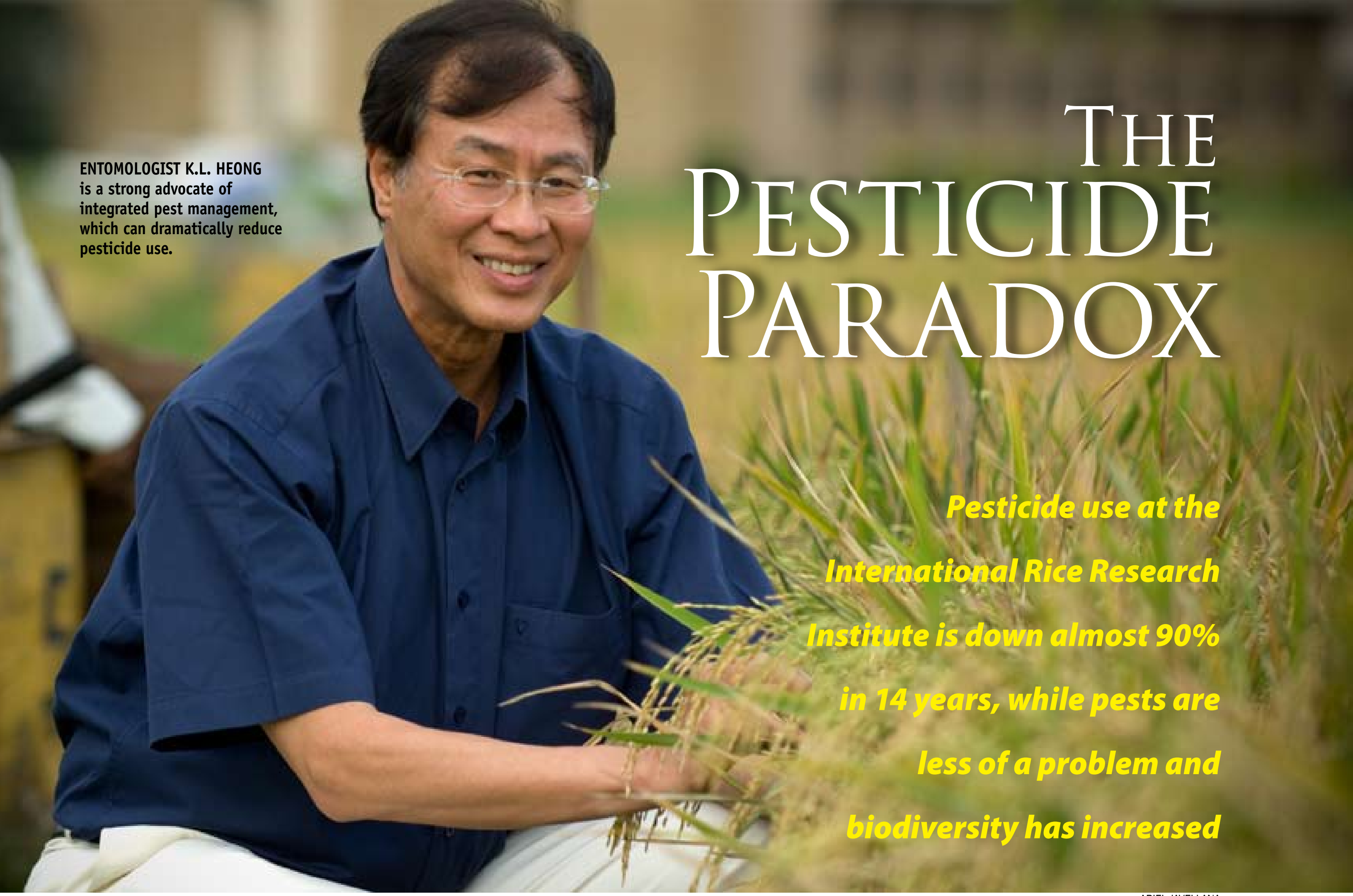
[1] William H. Settle, Hartjahyo Ariawan, Endah Tri Astuti, Widyastama Cahyana, Arief Lukman Hakim, Dadan Hindayana, and Alifah Sri Lestari. *Managing Tropical Rice Pests Through Conservation of Generalist Natural Enemies and Alternative Prey. Ecology*, Vol. 77, No. 7 (Oct., 1996), p 1975-1988.

The Pesticide Paradox

Pesticide use at the International Rice Research Institute is down almost 90% in 14 years, while pests are less of a problem and biodiversity has increased



ENTOMOLOGIST K.L. HEONG is a strong advocate of integrated pest management, which can dramatically reduce pesticide use.

ARIEL JAVELLANA

by Henry Sackville Hamilton

If pesticides are supposed to control pests, why does an enormous reduction in use actually lower their numbers? Tests performed on the research farm at the Philippines-based International Rice Research Institute (IRRI) have shown that, if pesticides are used less and less, then nature itself, in the forms of predators and parasitoids, will join the fight on the farmers' side.

The research, performed by a team led by IRRI entomologist K.L. Heong,[1] describes how, when IRRI farm operations were centralized in 1993, a new scheme for spraying pesticides was introduced. Instead of routine spraying once a week, pesticides would be sprayed only when pest densities in a field reached a certain level. Dr. Heong writes that "in most seasons, insect pest populations did not reach threshold levels and thus no insecticides were used." After 14 years of the program, pesticide use on the farm has decreased by a staggering 87.5%. Insecticides, which are the main type of pesticides used on the farm, have fallen in use by 95.8%.

The study focuses on arthropods: invertebrates with a tough external protective layer (called a chitinous exoskeleton) and segmented bodies, and which make up more than 80% of all living animal species. For the paper, the arthropods were separated into four functional groups: herbivores, predators, detritivores, and parasitoids. Herbivores attack rice plants. Predators and parasitoids attack herbivores and detritivores. Detritivores eat detritus in the field.

Arthropods on the farm were surveyed in 1989, well before the introduction of the spraying scheme in 1993, and in 2005, well after it. Comparing those two surveys reveals some telling figures. In 1989, 46.2% of the arthropod population on the farm was herbivores. In 2005, when arthropods were next counted, only 11.2% was herbivores. The number of predators had risen from 40% in 1989 to 58% in 2005. Detritivores in 2005 formed 26.1% of the total arthropod density, up from 8.1% in 1989. Parasitoids experienced a smaller change: 5.6% in 1989 to 4.3% in 2005.

The reason for these swings is the unintended effects of pesticides. Pesticides can affect all creatures. Predators, parasitoids, and detritivores can be killed along with herbivores. In fact, because of their superior mobility, predators are more likely to come into contact with the poison and

[1] K.L. Heong, A. Manza, J. Catindig, S. Villareal, and T. Jacobsen. *Changes in pesticide use and arthropod biodiversity in the IRRI research farm*. Outlooks on Pest Management, October 2007, p 1-5.

thus are often more exposed to the toxins than herbivores. And, if predators are killed off, they can't help suppress herbivore numbers.

As well as killing nontarget arthropods, heavy pesticide use can help "secondary pests"—which are favored when predator numbers are lowered—to rise to power. In a balanced ecosystem, the numbers of secondary pests stay relatively low. But, if large numbers of predators have been killed, secondary pests face less competition from primary pests and can thrive.

Reducing pesticide use lets both the predator and parasitoid populations recover, thereby keeping secondary pest populations low. Also, because fewer predators are being killed through pesticides, their food sources—pests and detritivores—remain abundant and their numbers can swell. This is natural pest control.

Dr. Heong's team also compared the arthropod diversity before and after the introduction of the low-pesticide regime. Sure enough, the 2005 survey showed that the diversity of all four types of arthropods has increased significantly. According to the paper, "there were twice as many species of herbivores, about 48 more species of predators and parasitoids, and greater than 5 times more species of detritivores."

More species of herbivores may not seem good for rice, but such an across-the-board increase in diversity is a sign of a healthy ecosystem, especially as many of the species that survive under low-pesticide conditions are unimportant pests. For an ecosystem to thrive, the organisms in it must be diverse and adaptable. In particular, a diverse range of predators helps prevent pest invasions or outbreaks, which can often be caused by abnormal climatic conditions. Thus, a balanced ecosystem with adequate functional biodiversity will also have reduced vulnerability to adverse effects of climate change.

For poor farmers, the key part in the question of pesticide use remains the debate of "yield versus profit." With intelligent and focused use of pesticides, yield can be increased. However, Dr. Heong suggests that many poor farmers do not benefit financially from using pesticides. For example, a study in the Philippines showed that farmers overestimated their potential loss of profit due to stem borer infestation by ten times (see *The unsung heroes of the rice field* on pages 30-31). The money they were spending on pesticides was more than double their actual loss. On top of that, the low-quality sprayers that poor farmers use often result in less than 10% of the pesticide reaching its target.

For poor farmers, then, the cost of spraying pesticides can outweigh the benefit. To lower pest numbers, improve diversity, and increase profits, many farmers should steadily cut down on the pesticide they use. The challenge is to persuade them to reduce their pesticide use in the first place. Poor farmers, who have too narrow a profit margin to experiment with production techniques to improve yield, tend to be loss-averse—if the crop fails, they go hungry.

This is where advertising and national governments can play a key role. In Vietnam, for instance, the national government and IRRI cooperated on a large-scale information campaign called *Ba Giam Ba Tang* (Three Reductions, Three Gains). One of those reductions was in pesticide use. The campaign has contributed to decreasing pesticide use in Vietnam, and ongoing economic analyses by IRRI are positive.

Ideally, Dr. Heong wants to go even further than significant reductions in pesticide use. He firmly believes that "pesticide does more harm than good in rice ecosystems." For rice, he says, insecticides need not be used at all in most cases. A rice plant, for example, can lose half of its leaves without yield being significantly affected. Pesticides won't be disappearing quite yet, though. Farmers need to adapt to using fewer toxins. Only when farmers are confident that lowering their pesticide use will not lower their profit will the ecosystem be able to recover.

Mr. Sackville Hamilton is a science communication intern for Rice Today.

REDUCING PESTICIDE applications can allow predators of rice pests, such as this orb-weaver spider (*Argiope* sp.), to help farmers keep pests under control.

Into the UNKNOWN

by Anna Johnson

Every summer, the World Food Prize Foundation sends high school students from the United States to international agricultural research institutes to work with leading scientists and learn about agricultural development. Here, 2007 intern Anna Johnson tells her story.

When I learned that I had been selected to travel to the Philippines and Bangladesh to work at the International Rice Research Institute (IRRI) as a World Food Prize Foundation intern, I was both ecstatic and apprehensive. My closest encounter with rice farming had been the steaming bowl of rice that came with my orange chicken at the local Chinese restaurant in my hometown of Iowa City. I had never been to Asia or seen a rice field.

The Foundation, like the World Food Prize, was founded by Norman Borlaug, who received the 1970 Nobel Peace Prize for his work to boost agricultural production in the 1950s and 1960s, thus spurring the Green Revolution and helping to avert mass starvation at a time of dramatic population growth and stagnating crop yields.

Based in IRRI's Social Sciences Division under the supervision of Mahabub Hossain (then division head, now executive director of the Bangladesh Rural Advancement Committee), I spent the first few weeks of my internship reading books and articles relating to the Seed Health Improvement Project (SHIP).

SHIP was conducted in Bangladesh in 1999–2004 under the Poverty Elimination Through Rice Research Assistance project funded by the UK Department for International Development. Coordinated by IRRI plant pathologist Tom Mew, SHIP involved collaboration between the Bangladesh Rice Research Institute, IRRI, and CABI Bioscience (UK). Several local and international nongovernmental organizations also played significant roles.

ANNA JOHNSON

A SHIP participant takes a break from interviewing to milk her family's cow.

With around 150 million people and one of the highest population densities in the world, Bangladesh must overcome a lot of obstacles to feed its people. The population of Bangladesh increases by about 2 million people each year, meaning rice production must increase around 300,000 tons annually if everybody is to be fed. SHIP taught farmers improved seed selection and storage practices designed to increase rice yield and prevent losses.

More than 90% of the seeds planted each year in Bangladesh are retained from the farmers' own harvest, and most are of poor quality. Many farmers simply save some of their harvest, dry it on the ground, and store it in open containers or bags. This means that the seed they plant each year is often infested with insects and contaminated with soil and other plant matter. Planting good-quality seed can increase yield up to 12%; SHIP technologies and training sought to help farmers achieve this increase.

SHIP introduced several

THE AUTHOR (*far right*) sits with a group of villagers who have gathered to observe an interview.

SHANTA FOYJUNESSA (2)

Salahar

As Salahar ushers us into her home, I glance at a poster hanging on the wall that reads "The female of the species is more deadly than the male." I am struck by this bold statement, hung so prominently in a rural Bangladeshi household.

Married at the age of 13 without any formal education, Salahar speaks knowledgably about her farming system. She explains that, before SHIP, her family did not use any special seed management practices. They merely took seed from their grain supply to plant the following season. Often, they would need to buy seed, but would not have enough money. Now, they sell 30–40 kilograms of seed in the market each season for nearly twice the price of paddy.

Salahar not only continues to use SHIP technologies, but she is improving on them. She was able to start producing vegetables from the extra profit from seed production. Now, she sells spinach seeds in the market and has applied SHIP technologies to her spinach production.

When Salahar and her family first began SHIP, they spent an entire 3 days sorting 250 grams of seed. The neighbors teased them for all the time they spent sitting and sorting the seeds one by one, but Salahar said that her life started to change with that 250 grams, which yielded 35 kilograms of rice. Before SHIP, her rice production met only 4 months of the family's need and she and her husband both worked in other households to earn money. Now, they not only meet all of their own food need, they also have excess income to invest in vegetable production, livestock, and the education of their eldest son.

Salahar, who manages many aspects of the household and farming system, is very enthusiastic about the impact of SHIP on her life. It has stabilized her family and allowed them to weather life's unexpected storms, such as when a farming accident cut off some of her husband's fingers last year. They had to take a 500 taka (US$7.40) loan and sell a goat to pay for treatment, but they were able to do this and recover much easier because of their stable income from seed and vegetable production.

THE AUTHOR with Salahar, who demonstrates the airtight container she uses to store her seeds.

simple methods for improving seed health, including roguing (removing undesirable plants from the field) before harvest, selecting good panicles for seed, drying seed, and storing seed in airtight containers with additives such as naphthalene and neem leaves to prevent insect infestation.

One unique aspect of SHIP was its participatory approach to training women from resource-poor households. Farmers' knowledge and input were used at each step, and this had a profound impact on the success of the project.

Having equipped myself with as much knowledge about seed health as I could gather, I nervously boarded the plane that would take me to Dhaka, the capital of Bangladesh. I had read that Bangladeshis never smile, that they eat only with their right hand, and that women were hardly ever seen in public.

Adding to my disquiet, massive floods had swept the Chittagong region of Bangladesh, causing mudslides that killed more than 90 people, only days before. All of this raced through my mind as I sat on the tarmac of the Manila airport. "What have I gotten myself into?" I wondered nervously as the Philippines became a speck in the ocean behind me.

The answer, it turned out, was that I had gotten myself into the experience of a lifetime. While it is true that Bangladeshis eat only with their right hand, almost all of my preconceptions about the country were completely vanquished. I spent a lot of time with very bold women, and even more time listening to the Bangla language float around my head as the room broke out in laughter.

Although we had very different cultural practices and understandings, my Bangladeshi friends and co-workers graciously overlooked my clumsiness in their culture. From my supervisors in the IRRI office to the vendors on the street, everyone I met tried to make me as comfortable as possible.

After the incredible hospitality, what struck me most was the poverty. From the beggars on the streets of Dhaka to the farmers toiling to eke a living out of their land, extreme poverty was evident throughout the country.

I conducted my research in two villages in rural Bangladesh and interviewed 17 women (see box, *above*), both project participants and nonparticipants. In trying to synthesize my data and information, I had to accept the fact that isolating SHIP as a development factor is impossible. The world in which we live is extremely complex, and no single factor can be isolated from the rest.

Perhaps the most important element of SHIP was its intentional inclusion of women. By deliberately including both men and women in the training, SHIP enabled better communication between couples. It not only empowered the women, but it also demonstrated to the men the value of the women's work.

The importance of involving farmers in every level of training is summed up in two phrases found throughout SHIP literature: "learning by doing" and "seeing is believing." By including farmers in both the research and the implementation of the project, SHIP ensured that its technologies will not only continue to be used by the original farmer participants, but by surrounding farmers as well.

The true price of rice

by Sushil Pandey, *IRRI program leader, Rice Policy and Impact*

Rising rice prices will negate progress in poverty reduction

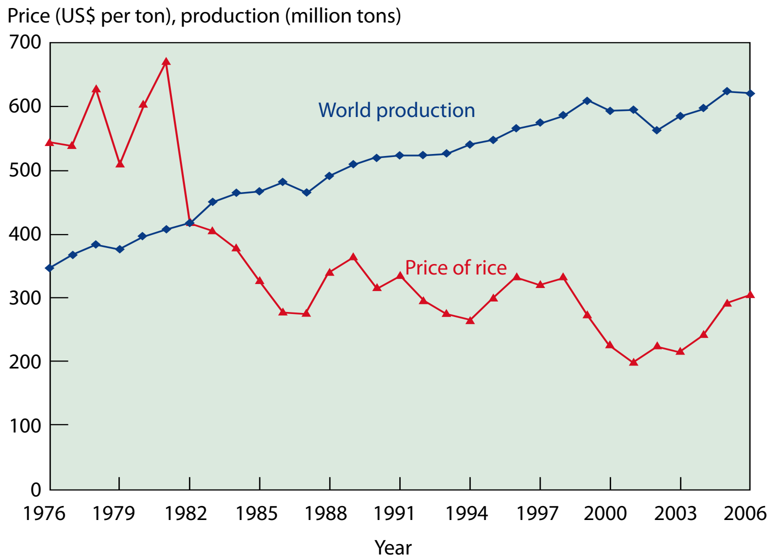


Fig. 1. World production and real price of rice, 1976-2006.
Production: Data source: FAOSTAT electronic database. FAO, December 2007.
Rice price:

- The price of rice was computed based on the nominal price of Thai rice 5%-broken deflated by G-5 MUV index deflator.
- Data source: World Bank quarterly review of commodity markets and http://tinyurl.com/2nn5g8.

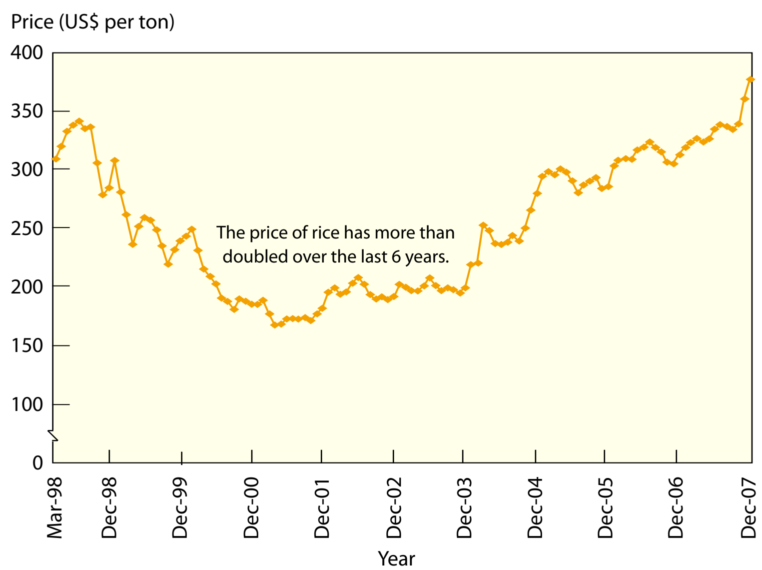


Fig. 2. Monthly export price (US$ per ton free on board) of rice (white rice, Thai 100% B second grade f.o.b. Bangkok (Friday closing time)), 1998-2007 (March 1998 to December 2007).
Data source: FAO electronic database (www.fao.org/es/esc/prices). FAO, December 2007.

Of the world's 1.1 billion poor people, almost 700 million people with income of less than a dollar a day reside in rice-growing countries of Asia. Rice is a staple food in Asia and accounts for more than 40% of the calorie consumption of most Asians. Poor people spend a large proportion of their income for buying rice. The level of rice production and prices is thus an important factor in determining the progress that can be made in reducing poverty in Asia. Keeping the price of rice low and affordable to the poor is crucial to poverty reduction. Given this, the current sustained upward trend in rice price is a major cause for concern.

The Green Revolution in Asia led to a rapid rise in rice yield and production. This contributed to poverty reduction directly through increased income of rice farmers and indirectly through a lower price of rice, which benefited poor consumers in both rural and urban areas (Figure 1). This long-term decline in rice price, however, seems to have come to an end in 2001, with the rice price taking a sustained upward turn over the past six years. The rice price continued to increase during 2007 and this upward trend seems unlikely to reverse anytime soon (Figure 2). Although a part of the increase in price can be explained by the continued depreciation of the U.S. dollar, there are other fundamental underlying causes of this rise in price.

A rise in the price of rice basically indicates that we have been consuming more than what we have been producing. This imbalance between demand and production is partly corrected by reducing the stock. In fact, rice stocks are being rapidly depleted, with the current stock being the lowest since 1988 (Figure 3). This depletion in stock has moderated the rise in price that would have occurred otherwise. A current low level of stock, however, compromises the ability to have such a moderating influence in the future and increases the risk of a sharp rise in price.

There is a saying in economics that "the solution to a high price is a high price." High prices provide incentives to producers to increase production, which will ultimately contribute to a price reduction. This traditional solution, however, is morally and economically unacceptable in the case of rice because any rise in price will affect the poor disproportionately and will lead to an increase in hunger and poverty. Indonesia provides a case in point: the number of poor people increased by several million as a result of a steep rise in the price of rice that occurred in the wake of the Asian financial crisis of 1997. There is no doubt that the economic and political turmoil Indonesia went through was compounded by the dramatic jump in rice price.

Demand for rice in Asia is expected to continue to rise in the future as its population expands. Even after allowing for some decrease in per capita consumption in Asian countries that have higher income levels, the projected demand for Asia is an additional 38 million tons of rough rice by 2015. Additional demand is likely to arise from Africa, where rice is becoming an increasingly important food crop. The worldwide increase in demand by 2015 is estimated to be 50 million tons of rough rice per year.

The best strategy for keeping the price of rice low is to increase its production at a higher rate than the increase in demand. Rice production can be increased by expanding the area, by increasing the yield per unit area, or by a combination of the two. The opportunity for further increasing the rice area in Asia is now quite limited. Rice production is facing increasing competition for land, labor, and water from other economic activities and the recent growth in biofuel production is likely to exert additional pressure. China provides an example—rice area decreased by almost 3 million ha between 1997 and 2006 because of this economic pressure. Although there may be some potential for expansion of rice area in other countries, the total rice area in Asia will unlikely increase much beyond the current estimate of 136 million ha.

Given this, the main source of additional production will have to be yield growth. Unfortunately, the current rate of yield growth is too low to generate the required supply. In the major rice-growing countries of Asia, yield growth during the past 5–6 years has been almost nil (Figure 4). The problem is likely to be compounded by increased production risks arising from global warming by adversely affecting rice yield and by increasing the frequency of events such as drought and flood.

Productivity growth through the development and dissemination of improved technologies is the only long-term viable solution for preventing rapid increases in rice prices. A second Green Revolution to reverse the rising trend in rice prices and to keep prices low is needed now as much as the first Green Revolution was needed earlier to avoid famine and mass starvation. The task is equally challenging but not insurmountable, provided a substantial boost is given to agricultural research, which continues to remain highly underinvested. Increased research investments together with policy reforms that make rice markets more efficient will ultimately help keep rice prices low and reduce poverty.

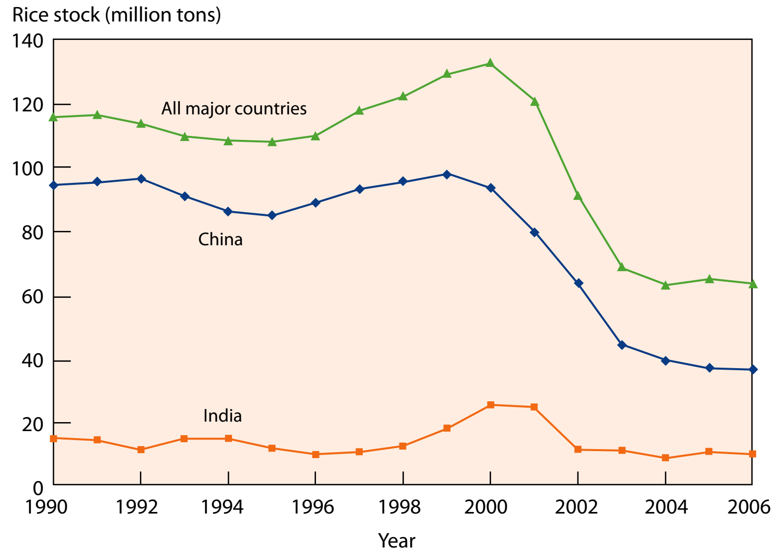


Fig. 3. Year-ending rice stock, 1990-2006.
Data source: PSD online database (www.fas.usda.gov/psdonline/psdhome.aspx). USDA, 2007.

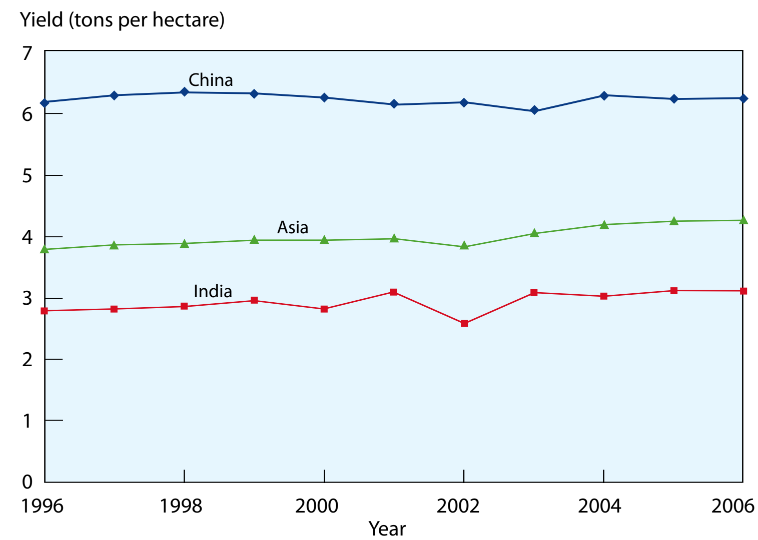


Fig. 4. Rice yield trend in Asia, 1996-2006.
Data source: FAOSTAT electronic database. FAO, December 2007.

Balancing fertilizer use and profit

BY ROLAND BURESH

As fertilizer prices increase, research and extension often send farmers a message of "reduce fertilizer use to save money." But, crop yield is directly related to the amount of nutrient taken up by the crop. At some point, less fertilizer use means lower crop yield and less profit for farmers. How much fertilizer use is just right for high profit?

The answer can come from site-specific nutrient management (SSNM). This approach to farming enables farmers to optimize their use of fertilizer by matching the amount and timing of each added nutrient (nitrogen, phosphorus, and potassium) with the needs of the crop for each nutrient.

> *Less fertilizer use can mean lower crop yield and less profit*

Nitrogen (N) is typically the nutrient that most limits rice yields and hence the nutrient needed in largest quantity from fertilizer. Much of the N in a mature rice plant comes from the soil. On a typical rice soil in the Asian tropics, the yield of irrigated rice often reaches about 4 tons per hectare without application of N fertilizer, as long as crop management uses best practices and water is sufficient. But, markedly higher yields of irrigated rice are required to meet food needs and achieve higher profit for farmers.

How much N is needed from fertilizer to increase rice yield from a baseline—in which the crop obtains its entire N from soil—to a yield that provides the highest profit for a farmer? Based on SSNM, about 40 kg N from fertilizer must be added to increase grain yield by 1 ton per hectare in a high-yielding season (typically the dry season) and about 50 to 60 kg N is needed to increase grain yield by 1 ton in a low-yielding season (typically the wet season).

Assume, for example, that a farmer can typically achieve a rice grain yield of 5 tons per hectare in the lower yielding season during the year. Achieving this yield would then require sufficient N from fertilizer to increase yield by about 1 ton from the baseline of about 4 tons per hectare. This requires about 50 to 60 kg fertilizer N per hectare. Assume that the farmer can typically achieve a rice yield of 7 tons per hectare in the higher-yielding season. Achieving this yield would require sufficient N from fertilizer to increase yield by about 3 tons from the baseline of about 4 tons per hectare. This corresponds to three times 40 kg or about 120 kg fertilizer N per hectare. Through the use of such simple guidelines, extension workers and farmers can quickly evaluate current practices, thereby determining whether more or less N fertilizer is required. The required N fertilizer should be split into about three applications during the growing season based on SSNM principles for optimally "feeding" the needs of the crop for N at critical growth stages.

The needs of rice for phosphorus (P) and potassium (K) are directly related to grain yield.

P in fertilizer is expressed on the basis of its oxide form—P_2O_5. For each ton of grain yield, a mature crop of modern high-yielding rice typically contains the equivalent of about 6 kg P_2O_5 within its biomass. Hence, a 6-tons-per-hectare crop contains about 36 kg P_2O_5 at maturity. Two-thirds of this P is in the grain. Therefore, with the harvest of grain and removal of some straw, about 5 kg P_2O_5 per hectare is removed from a rice field for each ton of grain yield. Hence, for a 6-tons-per-hectare crop, about 30 kg P_2O_5 must be replaced using P fertilizer.

As a general principle, irrigated rice with a history of P fertilizer use requires about 4 to 5 kg P_2O_5 per hectare from fertilizer—depending on the amount of straw retained—for each ton of grain yield to maintain soil fertility and achieve high profit.

The need for K fertilizer depends upon the management of rice straw—which contains most of the K in a rice crop. It also depends on K contained in irrigation water and the K-supplying capacity of the soil, which are typically not known by farmers. SSNM provides farmers with a simple field plot technique for tailoring K fertilization to field-specific needs.

The capacity of soil to supply nutrients and promote yield can vary markedly among fields of rice farmers. The SSNM approach helps farmers determine the needs for nutrients in their specific fields based on simple observations.

For more information, see www.irri.org/irrc/ssnm. For information on how SSNM is helping Asian rice farmers, see www.irri.org/irrc/ssnmrice.

Dr. Buresh is a senior soil scientist at the International Rice Research Institute.

中国农业科学院
The Chinese Academy of Agricultural Sciences

The Chinese Academy of Agricultural Sciences: *Celebrating 50 years*

The Chinese Academy of Agricultural Sciences (CAAS) celebrated its 50th anniversary in Beijing on 10 November 2007.

Hui Liangyu, Vice Premier of China, addressed the ceremony, conveying his appreciation for the work of CAAS's devoted agricultural scientists. He spoke highly of the scientific achievements made by CAAS and the Academy's role in China's agricultural development over the past 50 years.

At the ceremony, Minister of Agriculture Sun Zhengcai recognized CAAS's leading role in solving agricultural, rural, and farmers' problems and in tackling general, directional, fundamental, and critical science-and-technology issues as a national team. Mr. Sun said that, as a national agricultural innovation center of China's science-and-technology innovation plan, CAAS was positioned to develop agricultural science and technology, conduct human resource training programs, organize joint research activities, promote international exchange and communication, and serve the nation's major development goals.

Dr. Zhai Huqu, President of CAAS, spoke of the cooperative efforts of agricultural scientists in China and CAAS's breakthroughs in hybrid rice, hybrid maize, transgenic *Bt* cotton, dwarf-and-male-sterile wheat, and hybrid canola. The Academy has cultivated more than 4,000 new crop varieties and achieved high-yield plant cultivation, low- and medium-yielding farmland transformation, pest control, an equine infectious anemia virus vaccine, and a genetically engineered avian influenza vaccine. CAAS has thus contributed to increasing the nation's grain output, controlling agricultural disasters, protecting the environment, improving people's health, and ensuring the sustainable development of agriculture.

During the celebration ceremony, CAAS received letters of congratulation from more than 40 countries and all leading international agricultural research organizations. United Nations Under-Secretary-General and Executive Director of the United Nations Environment Programme Achim Steiner and Food and Agriculture Organization Director General Jacques Diouf sent their sincere congratulations to CAAS for its great achievements over the past 50 years.

第5届国际杂交水稻学术研讨会

THE 5TH INTERNATIONAL SYMPOSIUM ON HYBRID RICE

2008-09-11~15 CHANGSHA · CHINA

5th International Hybrid Rice Symposium

Accelerating hybrid rice development

11-15 September 2008, Changsha, China
www.5thishr.org

Hybrid rice has significant potential to improve food security and farmers' income by revitalizing yield growth and increasing resource-use efficiency in various rice ecosystems. Remarkable progress has been made in hybrid rice technology during the past decades and it is fast expanding in Asia and beyond.

Since the 4th International Hybrid Rice Symposium in May 2002, the area grown to hybrid rice outside China increased to an estimated 2.6 million hectares in 2006. However, further development of hybrid rice still faces many challenges, particularly in areas such as yield heterosis, grain quality, seed production, seed cost, field management, and public-private partnerships. Advances in new technologies such as functional genomics and marker-assisted selection provide new opportunities for breeding hybrids with higher yield potential, better grain quality, and multiple resistance to abiotic and biotic stresses.

This symposium will bring together leading researchers and industry experts to review current knowledge on hybrid rice development, seed production, molecular applications, crop and resource management, and economics, as well as to discuss future research strategies.

The program will include a combination of paper presentations, work-group discussions, field visits, and hybrid rice technology exhibits.

Symposium topics

- Improvements in breeding methodologies and products
- Application of biotechnology in hybrid rice breeding
- Technology of hybrid seed production
- Physiology and management for high yield and high resource-use efficiency
- Improving hybrid rice grain quality
- Hybrid rice economics, public-private partnerships, and intellectual property management
- Country reports: Bangladesh, China, India, Indonesia, Iran, Philippines, United States, Vietnam

Registration:
US$300 before 31 May 2008; $350 after 31 May 2008.

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