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Rice Today

International Rice Research Institute
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PHOTO FEATURE
RICE UNLOADED:
a different kind of landscape

Rice trade liberalization
Examining a tricky issue

New environment section
Can high food production and biodiversity coexist?

The future of rice in Asia
Inspiring youth to stay in the industry

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31 July - 4 August 2006
Dar es Salaam, Tanzania

www.warda.org/africa-rice-congress

The Africa Rice Congress will bring together scientists, the public, and private and civil society organizations (including nongovernmental organizations) engaged in rice development to examine past successes and pave a new direction for rice research and development in Africa for the next decade. The congress will be organized by the Africa Rice Center (WARDA), under the distinguished patronage of the Tanzanian Minister of Agriculture and Cooperatives.

Main theme

Beyond the first generation NERICAs in Africa: Paradigms and partnerships for the next decade

Sub-themes

- Natural Resource Management: Sustainable intensification and diversification strategies for African rice-based cropping systems
- The Integrated Pest Management philosophy and the major break-throughs in the upland-lowland continuum
- Economics: From policy to adoption/impact: An overview of the economics of the African rice subsector
- Breeding/crop improvement: The conceptual framework for rice varietal improvement for Africa
- Technology transfer: Seed and production-consumption chain

For more information:

www.warda.org/africa-rice-congress

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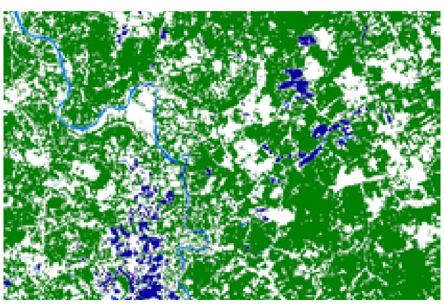

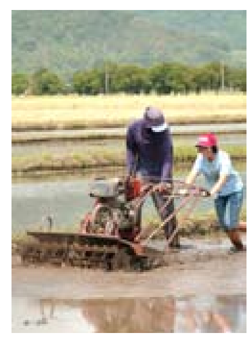

On the cover:
Leenlada "Oom" Monpo, a Thai high school student, learns how to prepare a ricefield for transplanting at IRRI headquarters. See page 25.

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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).

Fighting climate change

The 3 April issue of *Time* magazine carried a striking cover. Beside a photograph of a polar bear precariously perched on a narrow tongue of ice, the cover warned: "BE WORRIED. BE VERY WORRIED." The topic? Global warming and climate change. Inside, the magazine detailed in alarming terms the ecological systems that are working in concert to accelerate climate change that, it is now almost universally agreed, has been intensified if not catalyzed by human activity. The conversation on global warming has evolved—the debate is no longer about whether or not it exists, but how it will affect us and what we can do about it.

As the Earth warms up, one of the biggest—and under-researched—concerns is the effect on agriculture. How will higher temperatures and the attendant increased incidence of extreme weather such as droughts, storms, and floods affect agricultural production? What are the implications for feeding the world's burgeoning population, especially the billions of poor who rely on small-scale and subsistence farming and who tend to live in the areas that are expected to be worst affected? And, of course, what can we do to lessen the impacts?

These questions, as they relate to the grain that feeds almost half the world's people, are of particular interest to the International Rice Research Institute (IRRI). Already, research led by the institute and published in the 6 July 2004 issue of the *Proceedings of the National Academy of Sciences (USA)* has shown that global warming is likely to make rice crops less productive.

Now, following a March 2006 planning workshop at IRRI headquarters in the Philippines, the institute is establishing a Rice and Climate Change Consortium (RCCC) to study and ultimately help mitigate the impact of climate change on rice, and to determine ways to reduce greenhouse gas emissions from rice production. IRRI has committed US$2 million and is seeking funding of an additional $25 million.

The RCCC will undertake rice breeding for tolerance of heat, drought, ozone, and other air pollutants, and will establish three integrated sites in the Philippines, northern India, and southern China where new technologies can be tested. Data gathered from these sites will also be used to develop predictive models and guide future research.

In recognition of the importance of the relationship between rice and the environment, as well as the growing influence of climate change on rice production, *Rice Today* is introducing a regular environmental column—see pages 34-36 of this issue for our first, a look at wildlife diversity and rice. And, as research results emerge from IRRI's crucial initiative, *Rice Today* will keep you informed on the key findings and their implications.

Adam Barclay
Editor

Climate Change initiative ramps up

ARIEL JAVELLANA

New evidence is emerging that climate change could reduce not only the world's ability to produce food but also international efforts to cut poverty. However, the recent sequencing of the rice genome is already providing researchers with some of the tools they need to help poor rice farmers and consumers avoid the worst effects of the problem.

The new knowledge generated by the sequencing effort is allowing scientists to develop new rice varieties faster and with the specific characteristics needed to deal with climate change, such as tolerance of higher temperatures. However, scientists are calling for more research to fully understand the impact of climate change—especially the extreme weather it may cause—on international efforts to reduce poverty and ensure food security.

A *Climate Change and Rice* planning workshop in March 2006 at the International Rice Research Institute (IRRI) in the Philippines was told that climate change is already affecting Asia's ability to produce rice, and that this could eventually slow efforts to reduce poverty in the region, where most of the world's poor live.

The workshop was informed that, to overcome many of the climate change-related problems facing rice production in Asia—and continue to meet the demand for rice in the region—yields will have to double over the next 50 years. Research has confirmed that global warming will make rice crops less productive, with increasing temperatures decreasing yields.

"Clearly, climate change is going to have a major impact on our ability to grow rice," IRRI Director General Robert Zeigler said. "We can't afford to sit back and be complacent about this because rice production feeds almost half the world's population while providing vital employment to millions as well, with most of them being very poor and vulnerable."

Dr. Zeigler announced at the workshop that IRRI was ready to put up US$2 million of its own research funds as part of an effort to raise $25 million for a major five-year project to mitigate the effects of climate change on rice production. "We need to start developing rice varieties that can tolerate higher temperatures and other aspects of climate change right now," he said.

"Fortunately, the recent sequencing of the rice genome will allow us to do this much faster than we could have in the past," Dr. Zeigler added. "But, in addition to new rice varieties, we must develop other technologies that will help poor rice farmers deal with climate change."

The proposal plans include three sites on at-risk rice lands in the Philippines, southern China, and northern India. Researchers will use data from these sites to construct models designed to predict the effects of climate change and help develop research and policy directions and priorities.

IRRI's senior climate change researcher, John Sheehy, told the workshop that poor farmers need help in several challenging new areas. "We need to develop rice varieties tolerant of higher temperatures that can maintain yield and quality when extreme temperatures occur," Dr. Sheehy said. "We also need rice varieties that can take advantage of higher levels of CO_2 in the atmosphere, rice that is vigorous enough to recover quickly from extreme weather events and disasters, and very high-yielding rice that will provide a supply buffer for poor communities during periods of change."

Rice Knowledge Bank recognized

IRRI's digital extension service, the Rice Knowledge Bank (RKB; www.knowledgebank.irri.org), was selected as a finalist in the 2006 Stockholm Challenge Awards. The awards, in their sixth year, recognize some of the world's best information and communication technology (ICT) projects for social and economic development. The awards aim to find examples of ICT projects that show clear benefits to people and their communities, wide impact, and sustainable business models. The RKB, entered in the Economic Development category, was one of 151 finalists chosen from 1,155 entries. The eventual winner in the RKB's category was India's "ITC eChoupal," which uses ICT to help improve the competitiveness of small-farmer agriculture and enhance rural prosperity. Information about all finalists is available at http://event.stockholmchallenge.se.

MA. ANGIE MAGHUYOP demonstrates the RKB on board an ICT Road Show bus.

GINA ZARSADIAS

IRRI training staff also took the RKB aboard the Philippine Department of Science and Technology's (DOST) Mobile Information Technology Classroom—a bus that in March and April toured the Philippines as part of the K-AgriNet ICT Road Show. The Road Show is promoting the use of computers and the Internet to local government officials, agricultural extension workers, and farmers.

OSCAR vs. weeds

A new technology called OSCAR—Open-Source Simple Computer for Agriculture in Rural Areas—promises to help farmers in the Indo-Gangetic Plains identify and eliminate weeds in their fields. The software, which has a database of 50 different weed species found in the Indo-Gangetic Plains, was set to be updated with 250 more varieties of such unwanted plants found in the region.

"The project builds an open-source weed identification system for major weed species for rice-wheat cropping systems of Indo-Gangetic Plains covering India, Pakistan, Nepal, and Bangladesh," Rice-Wheat Consortium for the Indo-Gangetic Plains Head Raj Gupta said. The French Institute of Pondicherry initiated the project in collaboration with the consortium, International Centre for Agricultural Research and Development (CIRAD by its French acronym) of France, and the Netherlands-based Wageningen University.

Postharvest training goes digital

MARTIN GUMMERT

For the first time ever, electronic learning (e-learning) has featured in an IRRI postharvest training course. *Postharvest management for improved quality of rice grain and seed*, conducted by Martin Gummert of IRRI's Agricultural Engineering Unit and Geert Claessens of IRRI's Training Center, was held in Myanmar on 24-26 April and Laos on 10-12 May.

Participants were enthusiastic about the computer-based e-learning, which was part of the overall course on improving postharvest management and technology to increase grain quality and reduce postharvest losses, hence increasing income. In developing countries, inadequate postharvest practices are estimated to result in a 10–15% loss in quantity and a 25–50% loss in value.

The participants—23 in Myanmar and 18 in Laos—included extension workers, researchers, manufacturers, and rice millers. The course included hands-on exercises on drying and milling systems and demonstrations of how to set up hermetic storage. Gummert also trained participants to analyze rice seed and grain quality with simple tools such as a weighing scale, a thermometer, and a low-cost IRRI-designed moisture meter.

Bangladeshi food security

Poverty Elimination Through Rice Research Assistance (PETRRA), a five-year project funded by the Department for International Development of the United Kingdom and managed by IRRI in close partnership with the Bangladesh Rice Research Institute (BRRI), the Bangladesh Ministry of Agriculture, and the resource-poor rice farmers of Bangladesh, ended in August 2004.

In light of PETRRA's success, the European Union is funding the Food Security for Sustainable Household Livelihoods (FoSHoL) project—coordinated by IRRI and key NGOs—to deliver PETRRA technologies across Bangladesh, where around half the population lives below the poverty line of US$1 per day, most of them in rural areas. The project target is to reach at least 50,000 food-insecure households. For more information, visit the recently launched FoSHoL at www.foshol.org.

China protects new plant varieties

The Chinese Ministry of Agriculture (MOA) announced in Beijing that China today ranks fourth in the world in applications for protecting new agricultural plant varieties as it tightens its regulations against counterfeit goods and new plant varieties as part of the country's intellectual property rights protection strategy. According to a report carried by the *Xinhua* news agency on 24 April 2006, China has received 3,207 applications for protecting new plant varieties, including 114 applications from foreign entities. The MOA said more than 700 applications have been approved.

China signed the International Convention for the Protection of New Varieties of Plants in 1999, becoming the 39th member of the International Union for the Protection of New Varieties of Plants. China refers to a new plant variety as a cultivated or developed new plant variety based on a wild plant, which is new, distinct, uniform, and stable, with a designated name. No one is allowed to grow or sell these new varieties without the owner's permission.

In the last 7 years, the government has organized more than 30 training programs to increase the public's knowledge on plant breeders' rights, and issued laws and regulations to fight against illegal cases violating those rights. More than 800 violation cases have been investigated, 460 of which were taken to court.

BRIEFLY

No to rice futures trading

The Japanese agriculture ministry has disapproved plans by the Tokyo Grain Exchange and Kansai Commodities Exchange to list rice futures contracts for trading on an experimental basis, saying this would gravely affect rice production and distribution. Japan initiated rice futures trading in the 18th century and terminated it in 1939.

Highest Cambodian production

Prime Minister Hun Sen announced Cambodia's nearly 6 million metric tons of rice harvest in 2005, the best harvest in 27 years, representing a 43% increase over 2004 and a surplus of more than 2 million metric tons above the needed rice for domestic consumption, *Oryza.com* reported.

Joint forces in rice exports

Oryza.com reported on 18 April 2006 that Vietnam and Thailand agreed to strengthen their rice exports to stabilize rice prices in the international market. Rachane Potjanasutom, head of Thailand's Foreign Trade Department under the Trade Ministry, said the bilateral cooperation would include support by Thailand to improve the quality of Vietnamese rice in aspects of harvesting, storing, selling, and transportation. The two nations are creating and applying a general marketing strategy on a trial basis, which could later be applied by the world's top five exporters, including China, Pakistan, and India.

Emergency rice

Vietnam has contributed 14,000 tons of rice to the East Asia Emergency Rice Reserve (EAERR), a regional cooperation program among China, Republic of Korea, and Japan, which aims to assist member countries cope with difficulties caused by natural disasters and disease. Of the 337,000 tons of rice reserved so far, 87,000 tons come from countries of the Association of Southeast Asian Nations and 250,000 tons from Japan. EAERR is now formulating regulations on rice aid action to quickly respond to emergency cases occurring in member countries.

Forbidden seeds

The trading of any strain of genetically modified (GM) rice is strictly prohibited in China until it has passed a safety assessment, Director Fang Xiangdong of the Ministry of Agriculture's Biosafety Office said in reaction to Greenpeace China's allegations of illegal commercialization of pest-resistant GM rice cultivated and sold in Central China's Hubei Province over the past two years.

Mice, rice enemy number 1

Scientists from Vietnam, Australia, and IRRI recently held a meeting to implement a US$556,500 project, funded by the Australian Centre for International Agricultural Research, to control mice in the Cuu Long (Mekong) Delta, Vietnam's central-coastal region, and southern Sulawesi in Indonesia. Mice destroy 15% of the rice produced annually in the Southeast Asian region. The proj-

Archaeological finds in China and Japan

Large quantities of rice said to be more than 3,000 years old have been unearthed in Zhongshui town in Guizhou Province by archaeologists in China. *Xinhua* news agency quoted researcher Zhao Zhijun of the Archaeology Institute of the Chinese Academy of Social Science saying, "The rice was found in numerous pits and it's believed to be upland rice, since the rice grains are much smaller and rice shoots are much shorter than those of paddy rice." The discovery, which showed the systematic cultivation of rice in China more than 3,000 years ago, would provide valuable insights into the evolution of rice strains.

Meanwhile, archaeologists in Japan have unearthed an ancient wooden strip at the Shimoda Higashi archaeological remains bearing inscriptions of rice growing from seed to harvest. The archaeological find, measuring 36.8 centimeters long and 11.1 centimeters wide, dates back to the early 9th century and bears characters written in Chinese ink. Ancient history professor Takehiko Yoshimura of Meiji University said the strip indicated the role of women in growing rice and seedlings, the *Yomiuri Shimbun* reported.

Reducing grain shattering

Scientists from Michigan State University led by plant biology associate professor Tao Sang, while undertaking rice domestication research, have identified for the first time the genetic mutation that reduces grain shattering, a feat that could help improve rice production. The researchers pinpointed a mutation in DNA causing an amino acid change in a protein responsible for the nonshattering of rice varieties.

According to the electronic publication *Science Express*, which published the article *Rice domestication by reducing shattering*, the researchers first determined rice chromosome 4 as being responsible for the reduced shattering. Then, plant biology research associate Changbao Li invented a process that allowed researchers to efficiently complete the screening of 12,000 seedlings.

Science Express quoted Rich Triemer, chairperson of the Department of Plant Biology: "By tracing the breeding of rice and identifying the genetic mutations, the researchers have opened new doors to the science community that benefit the world through a more effective use of the land and water used to grow rice."

Managing sheath blight


IRRI

Scientists from the Tamil Nadu Agricultural University, India, are undertaking a study on managing sheath blight disease in rice through genetic engineering. The authors of the study, *Engineering sheath blight resistance in elite indica rice cultivars using genes encoding defense proteins*, which appeared in the journal *Plant Science*, aim to develop rice cultivars with enhanced resistance to sheath blight by genetically transforming high-yielding indica rice cultivars with a rice gene that encodes a protein. Pathogenesis-related proteins can enhance plant resistance to pathogens when overexpressed.

The researchers, led by Krishnan Kalpana, revealed that the engineered rice had increased resistance to the rice fungus *Rhizoctonia solani* when compared with nontransformed plants. In addition to sheath blight resistance, they found that the transgenic lines were also resistant to the rice sheath rot pathogen, *Sarocladium oryzae*.

ect, to be completed in 2009, will be carried out jointly by the Australian Commonwealth Scientific and Industrial Research Organisation, IRRI, and the Vietnamese Department for Plant Protection, the Vietnam News Agency said.

Irrigation rehab

Restoration work on the Philippines' national and communal irrigation systems is in full blast in response to President Gloria Macapagal Arroyo's goal of attaining rice self-sufficiency by year 2009. The project is expected to restore the productiveness of some 12,475 hectares of agricultural lands and benefit 21,500 farmers nationwide. Agriculture Secretary Domingo Panganiban said that the nationwide rehabilitation will result in "the efficient delivery and distribution of irrigation water."

Groundwater for rice production

Mahabub Hossain, head of IRRI's Social Sciences Division, has advised the Jharkhand government in India to tap groundwater for rice production. Speaking at a workshop on scaling up of technologies to improve rural livelihood organized by the Birsa Agriculture University, in collaboration with IRRI and the state's agriculture department, Dr. Hossain told *The Telegraph*: "Jharkhand is mainly dependent on rains for irrigation purposes. Even the Philippines has similar problems. The farmers depend on rains or canals that often dry up during summer. Therefore, groundwater becomes important. One can take out the groundwater and use it for irrigation. Even if the water dries up, the rain, which comes for a short period, can replenish the groundwater stock for further use."


GENE HETTEL

Clean boots for good crops

Farmers in the Cordilleras in northern Luzon, Philippines, were advised to regularly wash their boots because their soles and edges could transport pathogens or disease-causing organisms to their crops. Rhodesia Celoy-Manzan, an IRRI assistant scientist who specializes in molecular genetics, explained to farmers gathered at the Benguet State University that rubber boots, when soiled and muddy, could become potentially hazardous in moving potent organisms from farm to farm and affect the natural balance between pathogenic (disease-causing) and beneficial organisms on farmlands. Her advice also goes to some 300,000 farmers in 13 towns of the province, according to a report from online news agency *INQ7.net* on 21 April 2006.

IRRI

African rice news

Nutrition revolution for Africa

About 100 leading scientists and policymakers from Africa met in Kenya to discuss new technologies for fighting malnutrition and improving health. The Forum for Agricultural Research in Africa and HarvestPlus cohosted a workshop on biofortification on 4-5 May in Mombasa.

The workshop discussed the latest research on biofortification (developing crops with higher levels of nutrients), and identified strategies to develop biofortified crops, including rice, in Africa and integrate them into national agricultural and health policy agendas.

HarvestPlus Director Howarth Bouis, speaking to reporters in Nairobi, Kenya, said that "addressing micronutrient malnutrition requires a paradigm shift. Agricultural research needs to move beyond increasing productivity to improving food quality as well. In this way, biofortification can play a critical role in improving health."

According to Professor Ruth Oniang'o, professor of food science and nutrition at the Jomo Kenyatta University of Agriculture and Technology and IRRI Board of Trustees member, "Until now, the solution to micronutrient deficiency among the poor has focused on vitamin and mineral supplements, dietary diversity, and commercial food fortification. While these approaches have attained some success, they have not been able to reach all those in need, particularly people in remote rural areas. By targeting staple food crops grown and consumed by the rural poor, biofortification can reach large numbers of people in a cost-effective and sustained manner."

Tidal irrigation in The Gambia

A Taiwanese technical mission that specializes in rice cultivation has extended its operations in the northern part of The Gambia's Central River Division by building a tidal irrigation system in the area to enable farmers to grow rice and other crops throughout the year. About 4,000 farmers will benefit from the project, enabling each to cultivate 24 to 26 hectares of land, the *Daily Observer* reported on 16 February 2006.

Conserving dollar reserves

The governor of Nigeria's Osun State, Prince Olagunsoye Oyinlola, has advocated a stop to rice importation to conserve and harness much-needed foreign reserves during the inauguration of two committees on the Presidential Initiative on Rice Production. Prince Olagunsoye assured government support for rice processors in sourcing modern processing equipment by linking them to areas to obtain credit. Meanwhile, committee chair and deputy governor Erelu Olusola Obada announced the release by the government, through the State Agricultural Development Board, of funds to purchase equipment and 13 tons of rice seedlings, including upland and lowland seeds.

Low production in Ghana

Ghana is experiencing low levels of domestic rice production and the loss of thousands of jobs due to rice imports. The extent of Ghana's rice import surge was discussed during a recent workshop on *Agro-import surge study: the case of rice in Ghana*. Deputy Minister for Local Government and Rural Development Abraham Dwuma Odoom said the government is considering how the promotion of the production and consumption of locally produced rice could be achieved by incorporating it into the National School Feeding Program, according to a report at Ghanaian online news service www.myjoyonline.com.

New rice in Uganda and The Gambia

The Japanese government is extending the Grant Assistance for Underprivileged Farmers, through the FAO, for the dissemination of the New Rice for Africa (NERICA) and improvement of rice production systems in the Republic of Uganda. Japanese Ambassador to Italy His Excellency Yuji Nakamura and FAO Deputy Director General David Harcharik signed an implementing agreement in Rome early this year.

The project is intended to provide Ugandan farmers with NERICA seeds and necessary training at a Farmers' Field School, an FAO training system to raise the technical knowledge of farmers.

A Japanese government statement said, "In concrete terms, NERICA IV, whose unit crop yields are 30% higher than local rice and whose growth to harvest is 20–30% faster, will be cultivated on a total of 1,000 hectares of fields in the eastern, central, and western parts of the country. Farmers of 6,000 households will be provided with the seed, fertilizer, and pedal threshers. They will also receive training in sowing and fertilizing for cultivation and postharvest techniques after threshing. Farmers will also learn about self production of seed and the distribution system."

Meanwhile, NERICA has taken its roots in The Gambia because of its wider range of adoption in most Gambian soils, especially on loamy clay soil, with good vigorous growth. Its importance is also attributed to increased consumption due to rapid population growth and the low level of production, the *Daily Observer* reported on 27 May 2006.

Famara Badjie, an agriculture extension worker in the Kombo North, said that NERICA fits very well with The Gambia's erratic rainfall pattern, adding that the 2005-06 NERICA rice harvest in Jambur is three times more than that in 2004-05.

Agricultural boost for Sierra Leone

The Chinese government donated tractors and other agricultural implements to the government of Sierra Leone, the *Awareness Times Newspaper* reported on 29 March 2006. The equipment was formally handed over by the Ambassador of the People's Republic of China to Sierra Leone, His Excellency Cheng Wenju, to Minister of Agriculture, Forestry, and Food Security, Sama Mondeh.

China's assistance to Sierra Leone started in 2002 by providing professional training to 50 Sierra Leonean technicians in China on rice cultivation, sending two expert missions in 2002 and 2005 to examine the possibility of establishing a technical hybrid rice research and production team in the country, and sending eight experts to the Bo Agricultural Station to enhance large-scale production and processing of hybrid rice.

China is also this year providing 18 technicians for a food security program under the South-South Cooperation Scheme of the Food and Agriculture Organization (FAO) of the United Nations, and sending three senior Chinese scientists to train ministry officials and senior university students on modern rice production for 6 months.

Rice genetics pioneer passes away

JESSE VICTOLERO

Te-Tzu (T.T.) Chang, 79, passed away in Taiwan on 24 March 2006. Dr. Chang, IRRI's principal geneticist for more than 30 years and head of the International Rice Germplasm Center when he retired in December 1991, was considered a world authority on rice genetics and conservation. His research on the evolution and variation of rice led to major advances in plant breeding, productivity, and disease resistance with a profound impact on agricultural productivity throughout much of Asia, Africa, and South America.

Dr. Chang introduced Dee-geo-woo-gen, a Chinese dwarf rice, to IRRI's breeding program in 1962. That led to the development of the first high-yielding semidwarf rice varieties. IR8, the first such variety to be widely grown in the tropics, was released late in 1966. It was followed by a succession of improved, early-maturing varieties with genetic resistance to many of the major insect pests and diseases of rice.

Faced with the peril of losing genetic resources that hold the key to the future development of newer and better rice crops, Dr. Chang perceived the danger and put great effort into saving unimproved varieties and their wild relatives.

He mobilized international and multi-agency resources in 14 Asian nations and several African nations to undertake massive field collections of nearly 40,000 specimens, many on the brink of extinction. This effort made IRRI's rice gene bank holdings the largest collection in the world for a single crop plant. Desirable genes from this invaluable resource continue to sustain advances in global rice production.

Over the years, Dr. Chang had shared his expertise in genetic conservation with national agricultural research centers in China and India as they established gene banks for other crop species.

A native of Shanghai, China, Dr. Chang completed his undergraduate degree at the University of Nanking and earned masters and Ph.D. degrees from Cornell University and the University of Minnesota, respectively. He was a fellow of the American Society of Agronomy, the Institute of Biology of the UK, the Crop Science Society of the Philippines, and the Crop Science Society of America. Among his many awards were the 1988 Rank Prize for Nutrition and the 1999 Tyler Prize for Environmental Achievement.

Keeping up with IRRI staff

Zahirul Islam, international research fellow, has joined IRRI's Social Sciences Division (SSD) to coordinate the IRRI-International Fund for Agricultural Development project on accelerating technologies and adoption to improve livelihoods on the rainfed Indo-Gangetic Plains at seven sites in India and Bangladesh. **Hari Gurung** also joined SSD as an international research fellow.

Yuichiro Furukawa, **Ruben Lampayan, and Rachid Serraj** joined the Crop and Environmental Sciences (CES) Division as a project scientist, postdoctoral fellow, and senior crop physiologist, respectively.

Inez Slamet-Loedin joined the Golden Rice Network as a shuttle scientist responsible for developing the non-event-specific regulatory dossier for Golden Rice SGR2, while **Florencia Palis** is a new postdoctoral fellow with the CES Division responsible for coordinating projects under the Irrigated Rice Research Consortium (IRRC), among others. **Trina Mendoza** also joined IRRC as an associate in communication and extension.

Appointed heads of Organizational Units as part of IRRI's new strategic plan are **David Mackill**, Plant Breeding, Genetics, and Biotechnology (PBGB) Division, including current PBGB staff and the plant pathology research groups of the former Entomology and Plant Pathology Division (EPPD); **T.P. Tuong**, CES, including staff of the former Crop, Soil, and Water Sciences Division and the entomology and ecology research groups of the former EPPD; **Mahabub Hossain**, SSD, including current staff and units of SSD; **Ruaraidh Sackville Hamilton**, the T.T. Chang Genetic Resources Center (GRC), including current staff of GRC; **Graham McLaren**, the IRRI-CIMMYT Crop Research Informatics Laboratory (CRIL), including current staff of the former Biometrics and Bioinformatics Unit; and **Melissa Fitzgerald**, the Grain Quality, Nutrition, and Postharvest Center, including current staff of the former Grain Quality and Nutrition Research Center and the agricultural engineering and post harvest research groups of the former Agricultural Engineering Unit.

Achievements

Adam Barclay, *Rice Today* editor, won a Gold Award (1st place) in the Writing for Magazines Category for the article, *Dreams beyond drought* that appeared on pages 14-21 of Vol. 4, No. 2 of *Rice Today*. The award was presented by the Association for Communications Excellence (ACE) during its annual meeting in Quebec City, Canada, 2-6 June 2006. ACE is an international organization of communicators and information technologists that develops the professional skills of its members to extend knowledge about agriculture, natural resources and life and human sciences to people worldwide. The article explored how drought in Asia delivers heartbreak and rips communities apart among the rural poor, but also how promising new research is helping rice farmers avoid devastation.

Anthropologist **Florencia Palis** of IRRI's Social Sciences Division received the Nationally Recruited Staff Award for Outstanding Scientific Achievement at the recent Board of Trustees meeting at the institute's Philippine headquarters. Dr. Palis was chosen for her independent ethnographic research that encompassed many community settings and IRRI projects, including her research for the advancement of knowledge.

Yuan Longping, director general of the China National Hybrid Rice Research and Development Center, in April joined the elite U.S. National Academy of Sciences as a foreign associate, one of the highest honors in American science and engineering. Professor Longping, 76, is known as the "Father of Hybrid Rice" for his contribution in developing high-yield rice in China.

Setting the rice agenda

AILEEN DEL ROSARIO-RONDILLA

Global rice production hit a world-record 628 million tons in 2005, after increasing for the third consecutive season. The all-time high was announced in the April 2006 issue of the *Rice Market Monitor*, published by the Food and Agriculture Organization (FAO) of the United Nations, ahead of the 21st session of the International Rice Commission (IRC) on 3-5 May 2006.

What next?

Key recommendations to come out of the 21st session of the International Rice Commission included

- Member countries, fund donors, FAO, partner institutions, and all other stakeholders should increase collaborative efforts and funding support for a sustainable increase in rice production.
- The partnership in rice research and development among national and international institutions, nongovernmental organizations, and the private sector should be strengthened and broadened.
- Strategies and policies for sustainable rice production should aim to help rice farmers efficiently manage resources—especially water—and reduce the environmental impact of farming.
- Support should increase for initiatives to promote the development, dissemination, and adoption of rice varieties with high nutrient content (especially iron, zinc, and vitamin A).
- New rice varieties should combine high yield with increased nutritional value and improved tolerance of salinity, high temperature, drought, and flood.
- Rice production should be viewed as an integrated system, from selection of seed through to food on the table, encompassing the interactions and relationships among rice plants and other organisms in rice ecosystems.
- To increase returns and employment from rice production, support should increase for small and medium enterprises that use rice and its by-products (such as bran and husks) to manufacture value-added products.

The IRC Secretariat also recommended a Global Expert Consultation, to be held before the 22nd session in 2010, to review progress and to identify strategies for up-scaling the transfer of integrated crop management systems for increasing yield and profit, and reducing environmental degradation in rice production.

"Growth reflected relatively favorable weather conditions in Asia, western Africa, and South America, and the positive effects of high prices in 2004, which had fostered a general increase in plantings," according to the report.

However, tight domestic supplies and rising populations left a number of countries facing production shortfalls in 2004, leading to a spike in global imports in 2005 of 29 million tons—another record, but a figure that is expected to drop slightly in 2006.

The IRC session, held in Chiclayo, Peru, brought together nearly 100 participants, including officials from 61 countries, IRC members, and partner institutions, to discuss ways and means to promote international action on the production, preservation, distribution, and consumption of rice.

Organized by the Ministry of Agriculture of Peru and the FAO, the theme of the 21st session was *Rice is life*—bringing the implementation of the International Year of Rice to farmers' fields. The United Nations declared 2004 as the International Year of Rice to underline the need to coordinate efforts to combat poverty, improve food security, and achieve the United Nations Millennium Development Goals in the poor rice-producing areas of the world, which are home to close to half of all humanity.

Country representatives presented and analyzed their national rice research and development programs, discussing strategies for sustainable increases in rice production, reducing rice production's environmental impact, and reducing hunger in poor rice-producing populations.

The IRC holds a session every 4 years to review emerging issues and recent achievements in scientific, technical, and socioeconomic matters relating to sustainable rice production and rice-based farming systems. The session also helps member countries develop their national rice programs, and promotes interaction and collaboration among national, regional, and international institutions.

Rice, the main staple of around half the world's population, constitutes one-fifth of the total food energy intake of everyone on the planet. In Asia alone, more than 2 billion people obtain around two-thirds of their daily dietary energy from rice and its by-products.

But rice is not the preserve of Asian countries alone. According to FAO, almost a billion households in Asia, Africa, and the Americas depend on rice systems for their main source of employment and livelihood, and rice production in sub-Saharan Africa is now expanding faster than any other crop but continues to be outpaced by consumption. Further, 26 countries in Latin America and the Caribbean cultivate rice, although the region's production is only 4.3% of the world total. In Peru itself, rice consumption—about 50 kg of milled rice per person each year—is higher than in other Latin American countries.

Breeding rice for rainfed ecosystems

by Mahabub Hossain
Head, Social Sciences Division, International Rice Research Institute

Asia has made remarkable progress in boosting rice production and productivity over the last 4 decades. Most of this increase has been achieved through the adoption of improved rice varieties. But the progress has remained uneven—countries that rely predominantly on rainfed ecosystems continue to lag behind.

Rainfed ecosystems—sloping and plateau uplands, medium to deeply flooded monsoon-dependent lowlands, and salt-affected coastal areas—still account for about 45% of total rice lands in Asia. These ecosystems therefore remain crucial to sustaining future growth in rice production, especially as improvements in rice production in irrigated ecosystems are running out of steam, with near complete adoption of improved varieties and narrowing of yield gaps. Compared with this success, food insecurity and poverty are extensive in rainfed ecosystems and the demand for food is growing fast.

Rainfed ecosystems are characterized by severe abiotic stresses such as drought, submergence, problem soils, and strong winds. These factors must be considered, along with high yield and pest resistance, in any breeding strategies for improved varieties for rainfed systems. To develop high-yielding varieties appropriate for these ecosystems, rice breeders from the national agricultural research systems of the rice-producing countries of Asia seek to combine local traditional varieties that possess abiotic stress tolerance with elite lines obtained from international research centers. Such research involves complex breeding procedures and often has a low probability of success, and, when a variety is released, farmers and consumers may not accept it.

Progress in breeding rice for rainfed ecosystems is essential if poor farmers are to improve both their productivity and their livelihood

We have seen promising progress in developing varieties for the rainfed upland ecosystem but many farmers continue to grow traditional varieties. The only major success has been in China's Yunnan Province, where the adoption of improved varieties was facilitated by investment in terracing the sloping uplands and thereby modifying the growing environment.

Substantial efforts have also been made in improving varieties for the flood-prone ecosystem by changing the rice plant's capacity to elongate with rising floodwaters and developing kneeing ability—the ability of a plant that has been flattened by floodwaters to grow upright again when the water recedes. However, farm-level data from Thailand show limited adoption of improved deepwater rice varieties because the effect on yield has been marginal. Rather, farmers in the flood-prone ecosystem have abandoned deepwater rice in favor of growing shorter-duration high-yielding rice varieties (often raising two rice crops in the same year) developed for the irrigated ecosystem, thereby substantially increasing rice production and income. This development started in the Mekong Delta of South Vietnam and subsequently spread to the Ganges delta in Bangladesh and West Bengal, India, where it was augmented by pumping groundwater through small-scale irrigation. This approach is now proceeding rapidly in the Chao Phraya delta of central Thailand.

Progress in developing varieties for rainfed lowlands has been relatively slow. In India, for example, 18 varieties were released per million hectares in 1970-2000 for the irrigated ecosystem, compared with only 9 for the rainfed lowland ecosystem. But there has been considerable spillover of varieties released for the irrigated system into the rainfed lowland system. However, data on the effect of adoption show that rice yield has remained low because farmers are reluctant to invest in adequate inputs—such as fertilizer—because of the risks of crop failure from drought and submergence.

Recent efforts in using modern biotechnology tools to incorporate drought and submergence tolerance into popularly grown modern varieties may help increase rice production in the rainfed lowlands.

Adapted from a paper presented at the 21st Session of the International Rice Commission, held in Chiclayo, Peru, 3-5 May 2006.

Virtual challenges

by Johnny Goloyugo

In the fast-changing world of the digital era, the world's foremost collection of information on rice and rice research is moving with the times

At the helm of the IRRI Library—chief librarian Mila Ramos.

JOSE RAYMOND PANALIGAN

In 1960, the founding fathers of the International Rice Research Institute (IRRI) recognized the need, especially in the developing world, for accessible knowledge and information in the field of rice research.

In his book, *An adventure in applied science: a history of the International Rice Research Institute*, IRRI's first director general, Robert Chandler, wrote that an essential element of the institute "would be a good library that would contain the world collection of important rice literature and such other reference materials as would be needed by a group of natural and social scientists engaged in an active research and training program. Furthermore, the facility should be able to make available to scientists in developing countries any articles that they were unable to get in the libraries of the institutions where they were working."

Now, almost 50 years later, the progress of rice research is available for all to see in the world's largest repository of rice literature—IRRI's Library and Documentation Services (LDS).

The institute's first chief librarian was Lina Manalo, who, in the words of Dr. Chandler, "built the best library among the network of international agricultural research centers."

Today, the LDS houses a total bibliography of more than 230,000 references, including more than 138,000 books and monographs, and over 1,400 journals. There are also doctoral theses, conference proceedings, and comprehensive reference, audiovisual, and map collections. These publications are accessible not only to the library's average 70 daily walk-in clients, but also online at http://ricelib.irri.cgiar.org. The library also houses documents in around 80 languages—English accounts for just over half, Japanese almost one fifth, and Chinese 6%. The entire bibliography is available in print, on CD, and online, and is updated daily.

The library also offers electronic alerts, computerized literature searches, and electronic and print document delivery. Just as important, the LDS trains librarians from other organizations, and trains IRRI staff on database creation and management.

At the helm of the LDS is Mila Ramos. A graduate of the University of the Philippines, Ramos began at the library in 1965. Over the ensuing 41 years, she has served at the world's most comprehensive repository of information on rice, rising to her current position of chief librarian. Along with former LDS Head Ian Wallace (1993-99), Ramos has helped lead the library into the digital era. In 2001, the LDS received the Outstanding Academic and Research Library Award from the Philippine Association of Academic and Research Librarians.

The LDS's staff of 14—smaller than that of most comparable organizations—handles admirably the challenges that come with being responsible for such an important body of information.

"The big challenge," explains Ramos, "is being able to provide instant and easy access to electronic sources of information, journals especially. But the costs of e-resources are rising and we can provide only a fraction of what our scientists would like. The IRRI librarians need to be persistent and resourceful to be able to look for needed research articles for free or at the least cost."

The emergence of new information and communication technologies (ICT) poses another big challenge.

"With the new ICTs," says Ramos, "the role of the library will get bigger as the amount of knowledge available on the Web increases at an exponential rate. The task of the library is to navigate this maze, evaluate and select materials that would benefit rice scientists, keep users aware of what's available, and ensure quick access."

Meanwhile, assistant chief librarian and rice bibliographer Carmelita Austria points out that print publications remain as important as ever. "Computers will not replace books," she says. "We do not simply replace old technologies with new ones. Print and electronic resources have their own strengths."

Making the ever-increasing knowledge available to the people who need it is indeed a great challenge for librarians. Failure means that all those print and electronic resources are consigned to gather dust—both real and virtual— in the archives. With Ramos and her staff in charge, the needs of rice researchers across the globe are in safe hands.

False color gives a true impression

by Greg Fanslow

For this issue's article on bird diversity and wetland conversion (see *Balanced on a wing* on pages 34–36), *Rice Today* needed a land-cover map of Candaba marsh to compare historical and current conditions and plan a field visit. The only available maps weren't detailed enough and hadn't been updated since the mid-1970s, so the IRRI Geographic Information Systems lab used freely available LandSat data from the Global Land Cover Facility (http://glcf.umiacs.umd.edu/index.shtml) at the University of Maryland in the USA.

Because of our interest in vegetation cover, satellite data were reprocessed into false color images that exploit the high infrared reflectance of chlorophyll—the green pigment in plants—to render vegetation patterns.

The image is termed "false color" because the imaging process displays the intensities of red, green, and infrared radiation recorded by satellite sensors as shades of, respectively, green, blue, and red instead (see https://zulu.ssc.nasa.gov/mrsid/tutorial/Landsat%20Tutorial-V1.html). In the resulting image, vegetation is in varying shades of red, water is blue, and bare or fallow areas are light brown.

After field visits to several areas shown on the 2002 false color map (*bottom right*), image-processing software was used to characterize the spectral signature of areas under rice cultivation (*green on map below*) and fish ponds (blue). These signatures were then automatically applied to the rest of the image to approximate the extent of these types of land cover. While significant work on the ground would be needed to fully validate these results, they give a general impression of the extent of fish ponds and agricultural fields and illustrate the power of remote-sensing analysis to facilitate studies of landscape-scale phenomena.

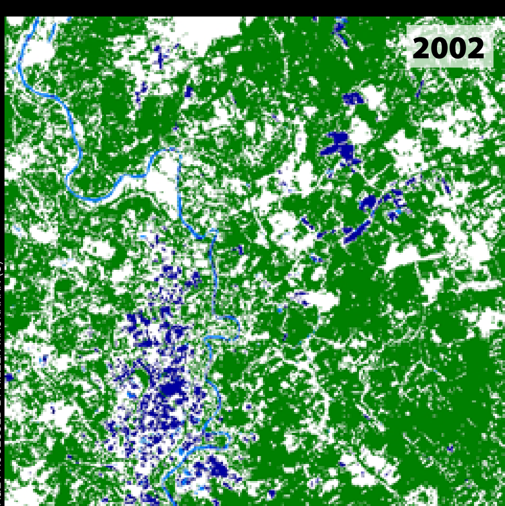
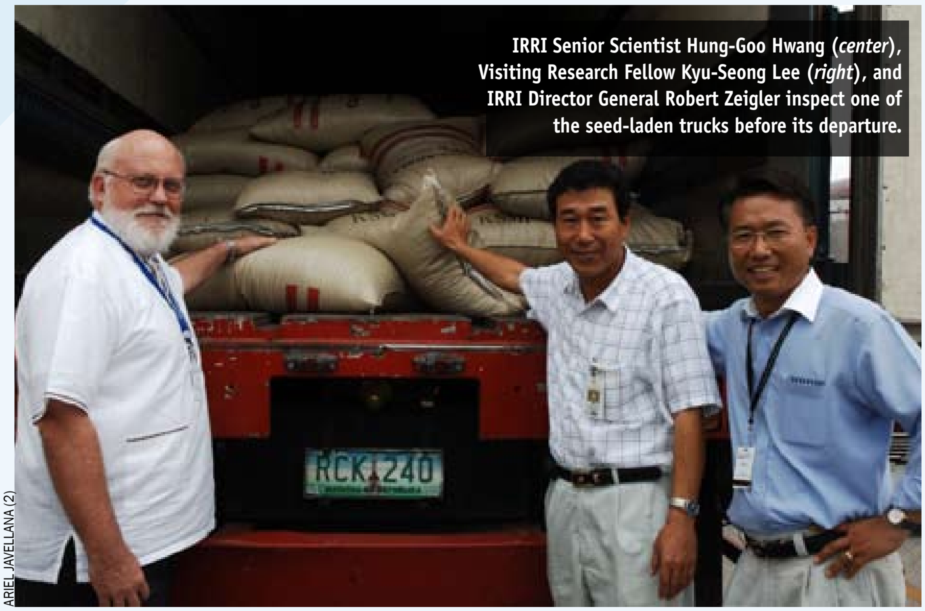


IMAGE PROCESSED BY AILEEN MAUNAHAN (3)

False color images of Candaba marsh on 17 March 1976 and 3 April 2002. While there were small differences in the infrared data collected between the two years, this comparison gives an immediate sense of the magnitude of change that has occurred to the landscape due to construction of agricultural fields and, to a lesser extent, fish ponds.

Korea-IRRI collaboration multiplies benefits



IRRI Senior Scientist Hung-Goo Hwang (*center*), Visiting Research Fellow Kyu-Seong Lee (*right*), and IRRI Director General Robert Zeigler inspect one of the seed-laden trucks before its departure.

ARIEL JAVELLANA (2)

As part of the "Top Rice Project" of the Republic of Korea's Rural Development Administration (RDA), 25 tons of high-quality rice seed were harvested in February-March at the Philippine headquarters of the International Rice Research Institute (IRRI). The seed was transported in a fleet of trucks to the Ninoy Aquino International Airport, Manila, on 31 March and has since made its way to the RDA's National Institute of Crop Science in Suwon, Korea.

The Top Rice Project, launched in 2005, aims to develop and popularize high-quality rice in Korea. As part of this drive, RDA and IRRI initiated the Large-Scale Korean Seed Multiplication Project in 2005-06.

Through this seed multiplication project, newly developed premium-quality varieties—known as Gopumbyeo and Unkwangbyeo—are being multiplied at IRRI before transport to Korea and distribution to Korean rice farmers.

Multiplication of Korean rice seed at the IRRI farm in the Philippines has been an important part of Korea's rice production for almost four decades. The country's achievement of rice self-sufficiency through the Green Revolution of the 1970s was made possible through similar past collaboration between IRRI and RDA. The first Korean Seed Multiplication Project, for rapid dissemination of the popular Tongil variety, occurred in the 1969-70 dry season.

Multiplication of Korean rice seed in the Philippines has also enabled Korea to accelerate its research programs. Since 1970, Korea has sent its rice breeding nurseries and advanced lines to the Philippines for seed multiplication during the winter, thus cutting years off the time required to develop new rice varieties.

This practice has also helped Korea protect its farmers against production threats. In 1980-81, for example, Korean rice breeders used the Philippine-grown winter crop to gain time in a "gene rotation" program to retain blast resistance in Korea's rice crop. In November 1980, 305 kilograms of Korean seed were multiplied at IRRI into 120.5 tons. Once back in Korea, that seed was further multiplied on 2,544 hectares during the Korean summer of 1981. The following year, it was used to plant 130,000 hectares of Korea's then 1.2 million hectares of rice land, so providing a genetic barrier to the spread of rice blast.

The most recent Korean rice seed multiplication was performed in a 14-hectare upland field at IRRI under the supervision of Hung-Goo Hwang, a senior Korean scientist seconded from RDA currently working in IRRI's Plant Breeding, Genetics, and Biotechnology Division, and Kyu-Seong Lee, visiting research fellow and RDA senior rice breeder.

"I am very happy that we reached our target production and we finished our project successfully," said Dr. Hwang.

A fleet of trucks loaded with 25 tons of high-quality rice seed leaves IRRI headquarters for Manila's Ninoy Aquino International Airport on 31 March 2006 enroute to Korea.

TRICKS OF THE

BY GENE HETTEL

In Asia, the question of whether or not to liberalize rice trade is a vexing one. If liberalization is to occur at all, it needs to happen gradually and with an understanding of how people—especially the poor—will be affected

TRADE

The smattering of provocative headlines (*at left*), appearing in recent issues of various Philippine daily newspapers, mirrors a basic issue on the minds of many Filipinos: Why does the Philippines import rice, and why can't the country produce enough of its staple food to feed its people?

"Indeed, in a country where half-full rice bins are a cause for great concern in a given household, having a sufficient rice supply for all Filipinos' consumption is our government's priority," says Leocadio Sebastian, executive director of the Philippine Rice Research Institute (PhilRice).

To meet this moving target, the Philippines has needed to buy rice from other countries such as Thailand, Vietnam, and even the United States for most of the past 130 years. "Rice is such an integral part of history and culture in the Philippines that, for some Filipinos, this fact is a source of national shame," says David Dawe, Bangkok-based economist for the Food and Agriculture Organization (FAO) of the United Nations.

Many reasons are typically put forth to explain the failure to achieve rice self-sufficiency—faulty government policy, corruption, conversion of rice land to other uses, backward rice farmers, deteriorating irrigation systems, and lack of farm credit, among others.

"But all countries," says Dr. Dawe, "including several rice exporters, complain about these problems. Although some of these problems are important, they do not explain why the Philippines imports rice."

But then what does explain it? In a word, it is geography. Says Dr. Dawe: "The Philippines imports rice because it is a nation of islands without any major river deltas like those in Thailand and Vietnam. The major traditional exporters—Thailand, Vietnam, Cambodia, and Myanmar—are all on the Southeast Asian mainland, while the countries that have been consistently importing rice for more than 100 years—Indonesia, the Philippines, Sri Lanka, Japan, Korea, and Malaysia—are all islands or narrow peninsulas." (See *Rice imports come with the territory* on page 37 of *Rice Today* Vol. 3, No. 2.)

JOSE RAYMOND PANALIGAN (2)

Although the presence or absence of river deltas is the overriding factor in explaining why some Asian countries import rice and others export it, other reasons are also at work. In the Philippines, geography is again the culprit. Located off the eastern edge of the Asian continent, the Philippines bears the brunt of numerous typhoons, making rice production more difficult, risky, and often unpredictable. Thailand and the Mekong and Red River deltas are much less affected by such recurring disasters. In addition, the Philippines' rice sector has high labor costs that must be reduced—without reducing wages—in order to increase productivity.

So, what would happen if rice trade were liberalized? Would it mean that the Philippines might end up importing even more rice? To look at the consequences of such a policy decision in the Philippines—and other countries for that matter— PhilRice and the International Rice Research

Rice is an intregral part of life, history, and culture in the Philippines.

Institute (IRRI), with the support of the Bureau of Agricultural Research (BAR) of the Department of Agriculture of the Philippines, conducted a 3-year study of the issues involved. BAR's support enabled the research team of Dr. Dawe, who was then still stationed in the Philippines as an IRRI economist, Piedad Moya, senior associate scientist in IRRI's Social Sciences Division, and Cheryll Casiwan, economist with the Socioeconomics Division of PhilRice, to bring together agricultural experts from many other Philippine organizations, such as the Bureau of Agricultural Statistics, the National Food Authority, and state colleges and universities.

Trade liberalization, although a term used widely today, is often not properly understood. "It does not necessarily mean more imports for all commodities in all situations," explains Ms. Moya. "What it does mean is that the price for a specific commodity inside the country (the domestic price) becomes the same as the price for that same commodity outside the country (the world price), after taking account of the exchange rate and any necessary transportation costs."

Generally speaking, for any commodity that is tradable across international borders, the domestic price will naturally tend to equal the world price unless the government intervenes with trade restrictions. If domestic prices are higher than world prices, private traders will try to profit by importing from abroad, buying low, and selling high. This process will continue until the additional supply of imports lowers domestic prices and erases those profits. The reverse will happen if world prices are higher than domestic prices: private traders will profit by exporting.

For rice in the Philippines, only the government has the legal authority to arrange imports. "Because the government is currently limiting the quantity of imports each year," says Ms. Moya, "the law of supply and demand suggests that domestic prices will rise, and, in fact, they have."

It is not widely known, even in the Philippines, that Filipino farmers receive much higher prices for their *palay* (rice at harvest before the husk is removed) than do farmers in neighboring developing countries. Further, farm prices for rice have increased during the past 10 years much faster than for other key agricultural commodities such as corn. Not surprisingly then, the very high prices received by Filipino farmers translate into very high rice prices paid by poor consumers. The large gap between world prices and domestic rice prices not only harms consumers, it also creates opportunities for corruption that would disappear if the price differential were much smaller.

During the past few years, the Philippines has imported about 10% of its consumption requirements. According to May 2006 press reports, the projected rice import total for 2006 will amount to around 1.4 million metric tons. Because palay and rice prices are higher in the Philippines than on world markets (sometimes nearly double world prices), the researchers' analyses show that rice trade liberalization would most likely mean more rice imports than this.

"Lower palay and rice prices due to increased imports would, of course, hurt palay farmers," says Dr. Dawe, "especially those with large surpluses to sell. Many palay farmers are poor, but many are not, and most of the benefits of high prices accrue to the larger, better-off farmers because they have the most surplus to sell. However, there is no doubt that some small, poor palay farmers would be hurt by trade liberalization."

PHOTOGRAPHY BY ARIEL JAVELLANA, GENE HETTEL, AND JOSE RAYMOND PANALIGAN

On the other hand, the research suggests that lower prices resulting from increased imports would benefit the many poor consumers who spend more than 20% of their income on rice alone. "These consumers consist of fishers, landless laborers, corn farmers, and the urban poor—in fact, most poor people in the Philippines are not rice farmers," Dr. Dawe points out.

In a trade liberalization scenario that results in more rice imports, Filipino farmers would need to either become more competitive in rice production or explore alternative crops. "One promising way to improve competitiveness is through the use of hybrid rice, a new technology that could increase yields and profits in areas and seasons that are suitable for its cultivation," says Ms. Casiwan. "PhilRice is conducting considerable hybrid rice research that will, we hope, provide farmers with this additional option."

Progressive rice farmers can and are exploring growing other crops. "The choice of alternative crops will vary from province to province and some of these alternatives are even more profitable than rice and would make farmers wealthier," says Ms. Casiwan. "But these crops are also often riskier to plant than rice, and the government and private sector will need to work together to reduce the effects of this risk on farmers." (See *Opportunities beyond growing rice* on pages 22–23, for a farmer's perspective on the role of crop diversification in the Philippines.)

Rice farmers who switch crops will not lose their household rice security. "They can still choose to plant some rice if liberalization occurs," says Ms. Casiwan. "Only a small portion of their land—about 0.15 hectare of double-cropped land for a family of five—is necessary to feed their own family."

As the study found, trade liberalization will have both positive and negative effects. So, PhilRice's Dr. Sebastian and IRRI Director General Robert Zeigler urge that any relaxation of government import restrictions that does occur in an effort, for example, to benefit poor consumers should be done gradually, not all at once. In the foreword to the book that details the results of this research, *Why does the Philippines import rice?* (see box at *right*), they write that "Gradual changes make it easier for all members of society to adjust their lives to changed circumstances. Any analyst with a dose of humility must admit to being less than perfect, and a gradual approach to reform would allow an assessment of changes before full reform is implemented."

"In thinking about the future of rice policy in the Philippines or any country for that matter, it is important to keep a balanced perspective," says Dr. Dawe. "Rice is what many farmers grow, but it is also what nearly all consumers eat. In many cases, farmers have more flexibility to switch crops than consumers—especially poor ones—do to switch their staple food."

Although self-sufficiency can be a laudable goal, it can cause great harm if it is pursued at all costs, without regard for the welfare of the poor. Self-sufficiency pursued through improvements in productivity and competitiveness is much less likely to have negative side-effects, and is a target worth pursuing. Indeed, in one recent story in the Philippine press, National Food Authority Administrator Gregorio Tan Jr. is quoted as saying, "If we can be self-sufficient in a competitive manner, then well and good."

It is important that policymakers reach decisions with as much information as possible. The PhilRice-IRRI research team has endeavored to provide that information so that decisions can be made to help the millions of Filipinos living in poverty—rice producers and consumers alike.

Why Does the Philippines Import Rice? Meeting the challenge of trade liberalization

A book edited by David C. Dawe, Piedad F. Moya, and Cheryll B. Casiwan and published by IRRI and PhilRice.

Emanating from a 3-year joint PhilRice-IRRI study, this book attempts to answer the question on the cover, and then proceeds to the even more difficult issue of what would happen if rice trade were liberalized and the Philippines began to import more rice. Although written by experts on the rice economy and some of the country's young economists, this book is intended for a general lay audience. The reader need not be familiar with complex concepts and jargon in economics or mathematics in order to understand the arguments presented. All that is necessary is an open mind and a willingness to think carefully.

The primary goal of this book is to be educational. For example, the Philippines imports rice because it is an island nation; Filipino farmers receive high rice prices; farm laborers, not rice farmers, do the bulk of the work producing the nation's rice; and most of the poorest people in the Philippines are not rice farmers. If readers retain just some of these facts about the rice sector in the Philippines, and discuss them with friends and colleagues, then the publication will have been successful.

For more information about purchasing this book, access IRRI's online publications catalog at www.irri.org.

Ariel Javellana

A different kind of rice landscape—hills and valleys of sacks waiting to be unloaded from a ship docked at Manila, Philippines.

Opportunities beyond growing rice—a farmer's perspective

If rice trade liberalization were to occur and result in more rice imports, one potentially viable option for rice farmers would be to plant alternative crops. Soils, climate, and the degree of economic development vary throughout the different provinces of the Philippines. Because of these differences, rice production systems are different, and so are the alternative crops that could be grown if trade liberalization made rice less profitable for farmers. Here, Florentino M. Santiago, a progressive Filipino farmer from Central Luzon in the Philippines, offers his thoughts on diversification.

Growing up on a farm, Santiago, Jr., 36, has always known the language of agriculture. As a young boy, he watched his father toil on the farm so he could send him and his eight siblings to school. The only child who studied agriculture in school, Santiago now works as a PhilRice farmer-consultant. The Talavera, Nueva Ecija, native is committed to proving that there is indeed money in farming.

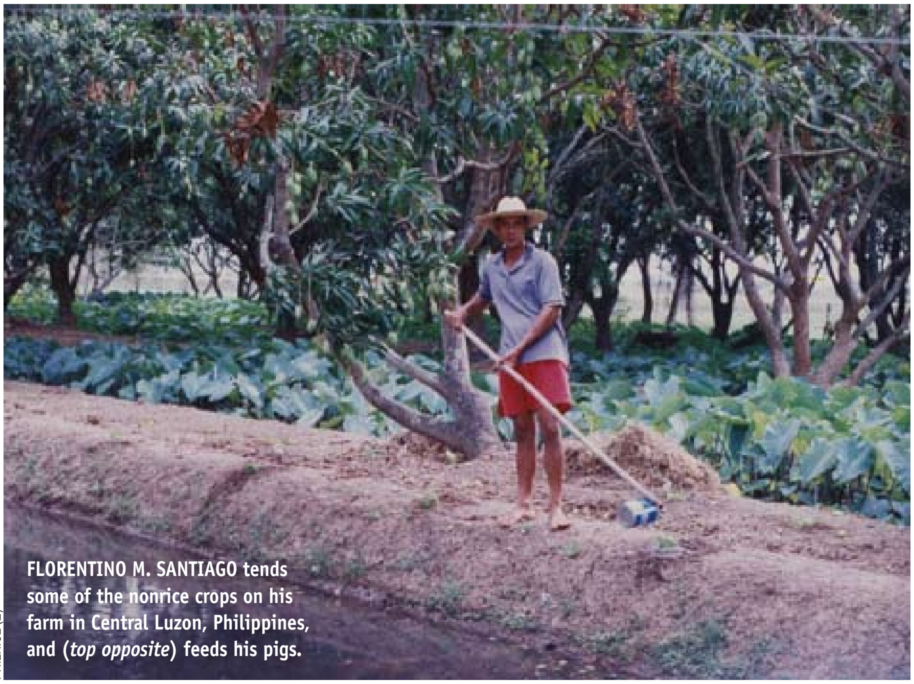
Santiago's ambition has always been to become a professional farmer and a role model to the farming community. He felt a need to influence traditional farmers when he realized their dire need for modern technologies. He practices land-use planning and uses every space on his farm to obtain higher income. Since income from rice is not enough to meet the basic needs of his family, he intercrops *gabi* (taro), vegetables, and mango trees on his 3.25-hectare farm and has also ventured into fish culture. To minimize his expenses on chemical fertilizers, he uses indigenous materials available on the farm—animal waste, rice straw, and other organic materials. He attends training and seminars conducted by different government and nongovernment agencies to augment his practical experience in farming.

The rice yield on his farm normally reaches 5.8 tons per hectare. Planting only rice will give him an annual gross income of about 150,000 Philippine pesos (US$2,900). With 300 mango trees planted along the dikes around his rice farm, he is earning an additional income of $1,750 per year. Annual profit from gabi is higher at $2,900. Fish harvests give him an extra $580, while his vegetable produce adds $390 to his household income. Thus, adopting an integrated farming system by devoting 2.25 hectares for rice cultivation and allocating small portions of his land to fish and other crops more than doubled his annual gross income to at least $6,600.

Diversifying his farm increased his family income and reduced the risk in relying solely on rice farming. Moreover, diversification benefits the environment as it helps improve soil conditions and forces farmers to reduce their chemical applications on the farm. However, "Diversification does not mean abandoning rice," he says cautiously, "but simply using prudent land-use planning."

For rice farmers, Santiago sees diversification as one safety net for rice trade liberalization. "Unfortunately, our farmers have not been prepared well for this possibility," he says. "I see capital, or lack of it, as one deterrent to diversification for most farmers. Usually, it is simply because they are not aware of where to get additional money or they are afraid to take risks."

In Nueva Ecija, where a distinct dry season exists, pumps—which may cost a farmer at least $680—are needed to irrigate farms after the



PHILRICE (2)

FLORENTINO M. SANTIAGO tends some of the nonrice crops on his farm in Central Luzon, Philippines, and (*top opposite*) feeds his pigs.

wet season. Restructuring of land to suit other crops also seems to be a stumbling block for farmers. Santiago quickly points out, however, that municipal government offices have heavy equipment that can be rented at a minimal fee to restructure lots. Farmers also need to invest some time to learn about the crops suited for cultivation considering the soil type and climate. Because his farm soil is mostly heavy clay, Santiago is mindful that he cannot plant onion, so he opted for other vegetables such as *sitao* (cowpea), *talong* (eggplant), and gabi. Another important issue is the high labor requirement for planting vegetables compared with planting rice alone.

In cases in which farmers do not diversify, Santiago asserts that farmers are either indolent or ignorant. He stresses the importance of farmers' initiative in increasing their household income through diversification. "I firmly believe that farmers themselves should make the first move in obtaining their inputs and capital needs and not depend on the government to supply them with those needs," he says. "The role of the government and the extension service should be in making sure technologies and opportunities reach farmers."

His competence as a skilled farmer manager was first recognized in 1998. From then on, Santiago has consistently been honored as one of the outstanding rice farmers in Central Luzon. Although focused on farming, he is active in community affairs and development, serving as chairman of a cooperative and of an agrarian reform council in his *barangay* (district). He still

dreams of expanding his farm because he sees opportunities in farming that would eventually make him a peso millionaire.

Adapted from Chapter 16 of *Why Does the Philippines Import Rice?*

Trade liberalization:
an agricultural economist's perspective

Rice Today recently discussed the issue of rice trade liberalization with David Dawe, Bangkok-based economist for the Food and Agriculture Organization of the United Nations and former International Rice Research Institute economist.

***Rice Today:* What effects can trade reforms have on reducing poverty?**

Dr. Dawe: The effects of trade reforms on poverty and food security are complex and will vary depending on social structure (e.g., the proportion of landlessness in the rural population, inequality of land ownership), infrastructure, the specific commodity involved (e.g., whether it is preferentially consumed by the poor or well-to-do, whether it is being imported or exported in any particular country), and many other factors. This complexity means that analyses of specific countries and commodities are highly valuable, although some generic lessons can be gleaned from the studies described in *Trade liberalization, poverty and food security*, a part of the new publication from the FAO Regional Office for Asia and the Pacific, *The State of Food and Agriculture in Asia and the Pacific*.

***Rice Today:* If any country decided to import more rice, in part, to benefit poor consumers, can today's world market be trusted to provide those supplies?**

Dr. Dawe: In the mid-1970s, the answer was uncertain. Today, however, the world rice market has fundamentally changed. World rice production is more stable because of more irrigation and high-yielding varieties with pest and disease resistance.

ARIEL JAVELLANA (2)

In addition, more exporting countries are commercially oriented—the health of their own domestic rice economies depends on being reliable suppliers to the world market. As proof, the world market has successfully weathered two recent events that did not turn into crises—the massive El Niño of 1998 and China's rice imports in 2004 and 2005. Today, although price fluctuations still occur on the world market, rice prices are more stable than ever before, and they are more stable than world prices for other cereal grains. So, the world rice market can be trusted once again, just as it could in the 1950s.

Rice Today: **What about price stability when opening to external markets?**

Dr. Dawe: Trade can play an important role in ensuring price stability, as in the case of Bangladesh during the "flood of the century" in 1998 that caused a drop in rice production. The government eliminated tariffs on rice imports during the crisis and the increased supplies brought in from India by private traders kept domestic prices stable. In addition to trade, government storage also has a role to play in ensuring price stability, but the costs of food reserves are often much higher than the benefits. Tariffs that vary in response to changing world prices and domestic harvests (either according to a predetermined schedule or on an ad hoc basis) may be a more cost-effective mechanism for stabilizing domestic prices. This is a more feasible option today than it was in the 1970s, because of the increased stability in the world rice market mentioned earlier. Such tariffs should be imposed only for key commodities, confined to a low level, and used to moderate price fluctuations, not provide protection for an extended length of time.

Rice Today: **What is your take on rice exporters trying to form an organization of rice-exporting countries that would lead to a cartel of rice exporters just like in oil?**

Dr. Dawe: First of all, rice is very different from oil in that production comes from millions of small farmers acting independently, as opposed to a few oil wells controlled by a government planner. This makes it difficult to control surplus production if a cartel is successful in raising prices. Second, rice is a perishable commodity, unlike oil. Thus, when surpluses accumulate, and governments try to keep prices high by holding these surpluses off the market, they will suffer large financial losses as the rice deteriorates in storage. Third, rice exporters have been trying to form this cartel for many years without success, as the interests of the exporters are very diverse. While some countries may try to increase world prices on their own by holding back their rice stocks, other nations are happy to provide more opportunities for their farmers to export at any time. In other words, enforcement is a problem, as with all cartels. Fourth, oil prices are high today because of recent increases in demand and the prospects of further increases in demand from India and China, as well as political instability in the Middle East. In contrast, rice demand is increasing relatively slowly as wealthy and middle-class Asian consumers diversify their diets away from staple foods in favor of meats, dairy products, vegetable oils, and fruits. Because of all these factors, it will be difficult for a rice exporters' cartel to increase prices by more than a small amount.

For more information on this topic, see *Trade liberalization, poverty and food security* in the new publication from the FAO Regional Office for Asia and the Pacific, *The State of Food and Agriculture in Asia and the Pacific*. The publication can be obtained online at www.fao.org/world/regional/rap/publication.asp or by sending an email to david.dawe@fao.org.

A rice future *for Asia*

Thai and Filipino high school students come together to help ensure the rice industry's future in Asia, sparking new friendships—and friendly rivalries—along the way

JOSE RAYMOND PANALIGAN

Rice and agriculture are still fundamental to the economic development of most Asian nations, not to mention their cultural and social identities. The rice industry has been a foundation of the Asian way of life for generations. In much of Asia, rice plays a central role in politics, society, and culture, and directly or indirectly employs more people than any other sector.

A healthy rice industry, especially in Asia's poorer countries, is crucial to the livelihoods of rice producers and consumers alike. Farmers need to achieve good yields without harming the environment so that they can make a good living while providing the rice-eating public with a high-quality, affordable staple. Underpinning this, a strong rice research sector can help reduce costs, improve production, and ensure environmental sustainability. Indeed, rice research has been a key to productivity and livelihood gains over the last four decades.

But, in recent years, one major problem has emerged that threatens to halt this progress: the young people of Asia don't want to work in the industry. And they have support—many existing rice farmers, having experienced for themselves the unforgiving life that often defines farming for a living, are encouraging their children to leave the land for careers in burgeoning urban and industrial sectors. Even fewer young Asians are choosing careers in rice science, despite its vital importance to the region.

However, an innovative project launched in April in Thailand and the Philippines marks the start of a major new effort to encourage young Asians to consider a future in rice.

"It's a sad fact of life in modern Asia that many young people in the region don't think of rice as offering an exciting or promising career, so they focus on other industries and other careers," says Robert Zeigler, director general of the International Rice Research Institute (IRRI).

On 24–28 April 2006, IRRI, together with the Thai Rice Foundation under Royal Patronage and Philippine Rice Research Institute (PhilRice), hosted 19 high school students, aged 16–18, from Thailand and the Philippines at a "rice camp," designed to boost their interest in rice and science.

The nine Filipinos and ten Thais—all from rice-farming families, they were selected because of their interest in, or knowledge of, rice—spent 5 days at IRRI's

These photos show the Filipino and Thai students enjoying activities—not all of them centered on rice—at the rice camp.

Philippine headquarters learning about the latest rice research and, more importantly, how rice research can provide a brighter future for rice production and, consequently, peoples' livelihoods in Asia.

Dr. Zeigler emphasizes that, if the rice industry is to continue to develop in Asia, the rice industry must attract the region's best and brightest young people. "We want them to understand that rice research is not some sleepy little scientific backwater, but is, in fact, right on the cutting edge of international scientific activity," he says. "The recent sequencing of the rice genome attracted enormous international attention, especially among the scientific community, yet most young Asians still don't know it even happened, let alone understand its implications for the food they eat each day."

During their 5 days at IRRI, the students, who were accompanied by their teachers, tried their hand at several laboratory techniques such as extracting DNA from a rice plant and inserting a gene into the rice genome. It wasn't all air-conditioned labs, though—they also had the chance to get their hands dirty, preparing a field for rice transplanting.

One of the camp's biggest successes was the camaraderie that blossomed among the students. Despite sharing little language, the young Thais and Filipinos struck up friendships that look set to last well beyond the 5-day camp. IRRI has created a Web site where the students can communicate and post photos.

PHOTOGRAPHY BY JOSE RAYMOND PANALIGAN, LAURO ATIENZA, AND CHRISANTO QUINTANA

The future of rice in Asia?

The following students participated in the rice camp at IRRI:

Thailand
Supawan Fukkearw
Suwassa Semsil
Boontawee Kuhana
Leenlada Monpo
Narumol Nookong
Sasiwimon Saengaawang
Santad Klaithin
Weerasak Megwee
Preeda Lunlee
Anon Chaiyasatr

Philippines
Faye Victoria Casimero
Joana Joyce Gadiano
Evelita Cara
Pamela Cunanan
Jeniffer Pascual
Romarc Corpuz
Mc Christian Julius Macaranas II
Michael John Albert Malig
Carlos Miguel Jr.

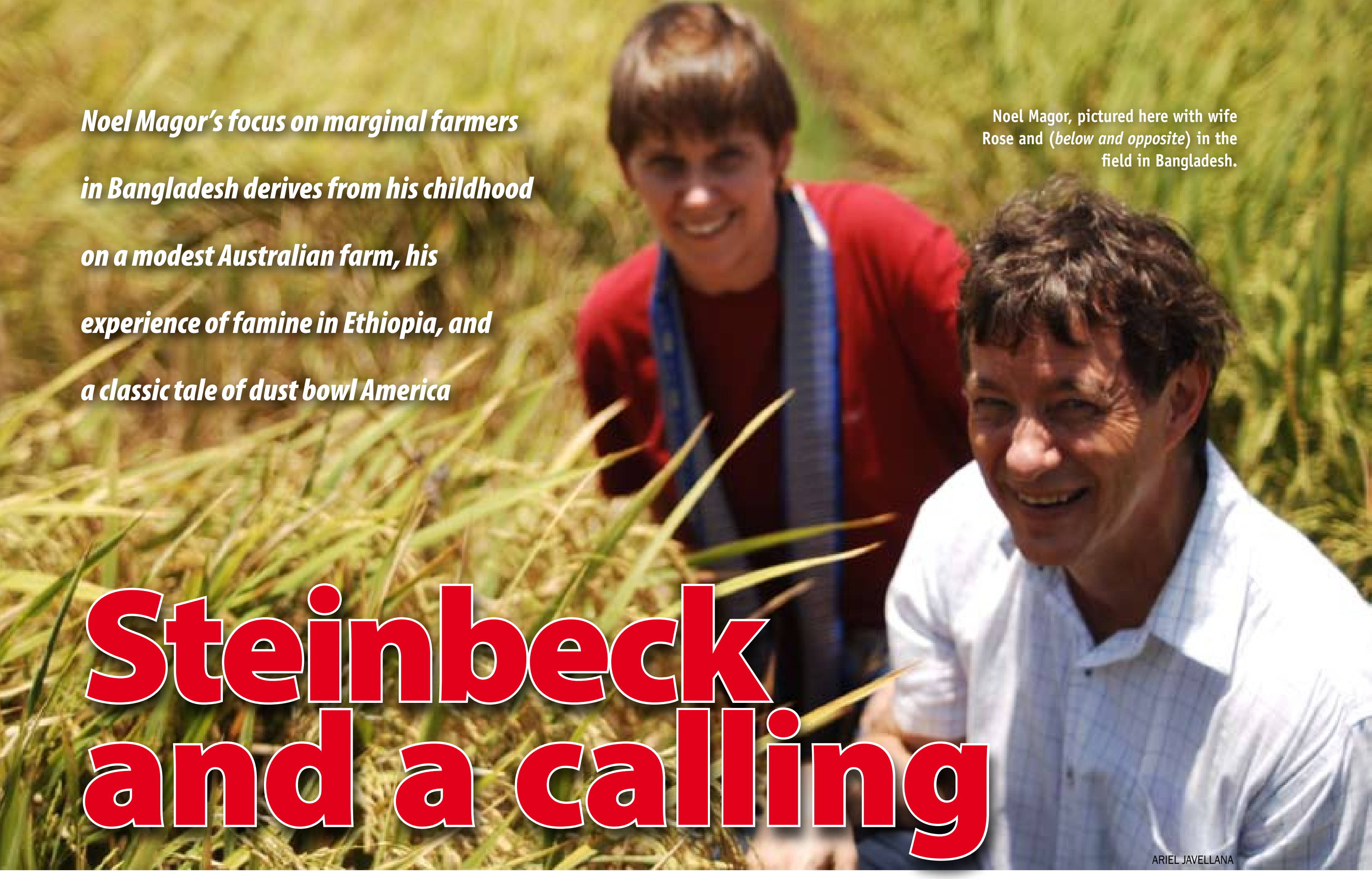
According to IRRI Spokesperson Duncan Macintosh, the chance to mix with people from different cultures also provided some comic moments.

"At dinner one night," recounts Macintosh, "one of the Filipino boys boldly challenged one of the Thai boys to a chili-eating competition. After gulping down three chilies in the time it took the Thai lad to eat one, the Filipino proclaimed victory—prematurely, as it turned out. Within a minute or so, the Filipino had turned red and tears were streaming down his face as he guzzled water. Meanwhile, the Thai student calmly ate his second, then third, then fourth, then fifth chili. The rest of the students were in stitches."

Macintosh added that the Filipinos got their revenge later, when they challenged the Thais to eat Filipino *balut*. While the Filipinos savored the delicacy, the Thais gagged and spluttered on the fertilized duck egg with a nearly-developed embryo inside.

Kwanchai Gomez, executive director of the Thai Rice Foundation, expressed hope that the students returned home with a new sense of excitement about rice and its potential both in science and in the future development of Asia.

"Rice has played a vital role in Thailand's economic development, not to mention its history and culture," says Dr. Gomez. "The challenge is to try to translate this into a sense of excitement and interest amongst young people in Thailand and all over Asia."



Noel Magor's focus on marginal farmers in Bangladesh derives from his childhood on a modest Australian farm, his experience of famine in Ethiopia, and a classic tale of dust bowl America

Noel Magor, pictured here with wife Rose and (*below and opposite*) in the field in Bangladesh.

ARIEL JAVELLANA

Steinbeck and a calling

by Rebecca Khelseau-Carsky

Growing up on his father's almond and poultry farm in Australia, Noel Magor knew from early childhood that he would pursue a career in agriculture. His father, one of 10 children, had grown up on the modest 3-hectare farm that his grandfather had struggled to keep. Yet, with the conviction that fair play and hard work lead to success, Noel's father succeeded in expanding the family farm to 12 hectares. What Dr. Magor remembers most clearly today is how his father repeatedly won competitions with his chickens and produced beautiful almonds using green manure and irrigation.

What young Noel probably did not realize in his early childhood was that other influences would set him on a particular career path leading to distant lands. From his secondary school days, he felt an awareness of social issues brewing within him. John Steinbeck's novel *The Grapes of Wrath* profoundly affected his thinking. Reading at the age of 16 about indebted farmers in the American Midwest losing their land, and of the hardships suffered by migrant farm laborers, sparked in him an interest in social justice—an interest that later became a commitment.

Proof of that commitment began in 1974. Upon completing a bachelor's degree in agricultural science at Adelaide University, Noel set off to Wollo Province in northern Ethiopia, where a devastating famine had struck the year before. As a volunteer, he assessed how the famine affected village families and sought ways to rehabilitate the most destitute by providing grain through food-for-work projects and by distributing seed.

Twelve months of living and working under primitive conditions left Noel determined to alleviate hunger and poverty. It also brought alive Steinbeck's narrative on the struggles of the working class. "Some things affect you inside," he recalls. "I believe that my reflections on *The Grapes of Wrath*, and my growing awareness of social justice issues, prompted me to move into development work."

Measured by his achievements, Dr. Magor's decision was an answer to a calling. In 1977, simultaneously serving as agricultural service head,

PETRRA (2)

extension coordinator, and acting project director of the Kamalganj Project of HEED Bangladesh, a nongovernmental organization (NGO), he started working to empower marginal farmers. Never expecting to pursue graduate studies or maintain a long-term connection with Bangladesh, he did both to support his commitment to alleviating their plight. He returned briefly to Australia to earn a master's degree in tropical agronomy from Sydney University and a PhD in politics from Adelaide University.

Dr. Magor explains why he chose to enhance his scientific and agricultural background with a degree in politics: "I was interested in the importance of agriculture for poverty reduction. I needed to know what was happening to marginal farmers, as they seemed to be a group missed by NGOs, who keep their focus on poor households not dependent on agriculture, and by government, which concentrates on bigger farmers. The politics department of the university provided the best perspective for exploring that."

Choosing marginal farmers in Bangladesh as his thesis topic, he demonstrated that marginal farm households—those able to grow enough rice to feed themselves for only 3–5 months of the year—were rapidly becoming landless. On the other hand, small farm households—those able to provision themselves with rice for 6–8 months of the year—were very resilient and incrementally increased their landholdings. Establishing eight key principles for success in creating an environment for uplifting and empowering poor households, he pioneered a shift in research focus toward the farming systems of marginal farmers.

Dr. Magor's inclusive approach toward alleviating poverty found eloquent expression in the project Poverty Elimination Through Rice Research Assistance (PETRRA), which he set up and managed for the International Rice Research Institute (IRRI), a center of the Consultative Group on International Agricultural Research (CGIAR). Funded by the United Kingdom's Department for International Development, PETRRA greatly enhanced IRRI's working partnership with the Bangladesh Rice Research Institute, the Ministry of Agriculture, and poor farm households in Bangladesh. The project also exemplified a philosophy that Dr. Magor had nurtured over the years that combines a poverty focus, gender equity, participation, and partnership in a regional, in-country framework.

On top of developing appropriate technologies endorsed by farmers and new methods of extension and knowledge delivery, Dr. Magor has found time to learn Bangla to facilitate his immersion in the world of Bangladeshi farmers. That the PETRRA Web site and newsletter appeared in both English and Bangla reflects his determination to develop more effective means of communication and so spread awareness of agricultural development's contribution to poverty reduction.

"With a strong enough will, we can relieve hunger by mobilizing science, social organizations, governments, and farmers," he says. "I credit the CGIAR system with helping to focus science and technology on marshalling the efforts of different organizations to achieve poverty reduction. But we'll never really know the full extent of what we've contributed."

Reprinted from Scientists of the CGIAR, *published by the Consultative Group on International Agricultural Research.*

Eliminating poverty in Bangladesh

Poverty Elimination Through Rice Research Assistance (PETRRA), a five-year project funded by the Department for International Development of the United Kingdom and managed by IRRI in close partnership with the Bangladesh Rice Research Institute (BRRI), the Bangladesh Ministry of Agriculture, and—most importantly—the resource-poor rice farmers of Bangladesh, ended in August 2004.

The project improved the well-being of resource-poor farm households by identifying, developing, and validating improved technology and service delivery methods, so fostering the development of a demand-led research system. PETRRA developed clear strategies and policy support documents that enhanced the research and delivery methods used among the 45 partner organizations representing national, international, private, and nongovernmental organizations (NGOs), and universities. PETRRA projects were implemented in 551 villages throughout 38 districts with more than 11,000 farmers, of whom about 40% were women.

The PETRRA Web site (www.petra-irri.org) makes available the experiences of researchers, extension persons, and farmers and so spreads awareness of agricultural development's contribution to poverty reduction. The Bangladesh Rice Knowledge Bank (www.knowledgebank-brri.org) gives extension workers and farmers up-to-date information, in Bangla, on rice production and training.

In light of PETRRA's success, the European Union is funding the Food Security for Sustainable Household Livelihoods project (www.foshol.org)—coordinated by IRRI and key NGOs and now under way—to deliver PETRRA technologies across Bangladesh, where around half the population lives below the poverty line of US$1 per day, most of them in rural areas. The project target is to reach at least 50,000 food-insecure households.

Cambodian researchers are set to increase their understanding of rice diseases as part of a project that could help lift the country off the lower rungs of Asia's rice yield ladder

Pest by pest step by step

by Rowena McNaughton

Cambodia's per hectare rice yield is one of the lowest in Asia. This is a significant problem in a country where more than 80% of the population is reliant on agriculture for its primary source of income and where rice constitutes 90% of total agricultural output. Rice is also by far the country's most important staple food, with the average Cambodian obtaining three-quarters of his or her calories from rice and consuming 160 kg of the grain per year.

Within the problem of low yields, however, lies a great opportunity. In November 2005, the Cambodian Ministry of Agriculture, Forestry, and Fisheries reported that the national average rice yield was 2.1 tons per hectare—an improvement on previous years but, according to researchers from the Cambodian Agricultural Research and Development Institute (CARDI), simply not high enough. In neighboring Vietnam, for example, the average yield stands at 4.1 tons per hectare.

"There is no doubt that, in Cambodia, diseases of rice contribute to low productivity by reducing yield and grain quality," Preap Visarto, head of CARDI's Plant Protection Program, explains. Improved understanding and management of pests can help pull Cambodia's low yields up to levels comparable with those of other countries in the region.

One of Cambodia's few plant pathologists, Ny Vuthy, adds that, until recently, there has been little technical and diagnostic interest in disease, with most scientific pest research focusing exclusively on insects.

"Most farmers can't identify diseases, and therefore do not know how to treat and manage

CARDI (5)

HIN SARITH, research assistant in CARDI's Soil and Water Department, and a field worker check on plants in a CARDI greenhouse. Thun Vathany (*top left*), research assistant in CARDI's Plant Breeding Department, tests the disease resistance of CARDI-developed orchard germplasm. *Top right*, a Cambodian Agricultural University student performs fieldwork at CARDI.

the increasing outbreaks that are occurring," says Dr. Vuthy. "They don't understand why their rice crops are dying, and many falsely believe that, because of Cambodia's tropical climate, disease is a problem of other countries."

But, since farmers have adopted modern techniques, both fertilizer and irrigation rates have increased. Dr. Visarto explains that inappropriate use of both has raised nitrogen levels and therefore contributed to increased outbreaks of disease.

"It is a critical time in rice research," he says. "Previously unseen diseases and pests are now becoming a problem. Blast in particular has been striking at alarming rates throughout Cambodia. In some areas, 65% of the rice crops have been damaged by blast. The outbreak has been quick and farmers do not know how to respond."

To date, general plant pathology issues have been overlooked mainly because of the lack of local expertise. Without the required knowledge and consequent correct identification of diseases, "an understanding of their importance and, ultimately, their management in rice are impossible," explains Dr. Vuthy.

To develop Cambodia's expertise in rice diseases and their management, researchers at CARDI are collaborating with Australian researchers at the New South Wales Department of Primary Industries and Charles Sturt University in a project funded by the Australian Centre for International Agricultural Research, *Improving understanding and management of rice pathogens in Cambodia*. The project will also help the Australian rice industry through better understanding of exotic diseases that could threaten Australian crops.

Several past projects in Cambodia have looked at disease identification, but the new project is the first to adopt a diagnostic approach to disease prevention—running tests to, step by step, rule out possible disease causes—and will also help set up Cambodia's first-ever disease herbarium (a collection of diseased plants) and collection of rice pathogens.

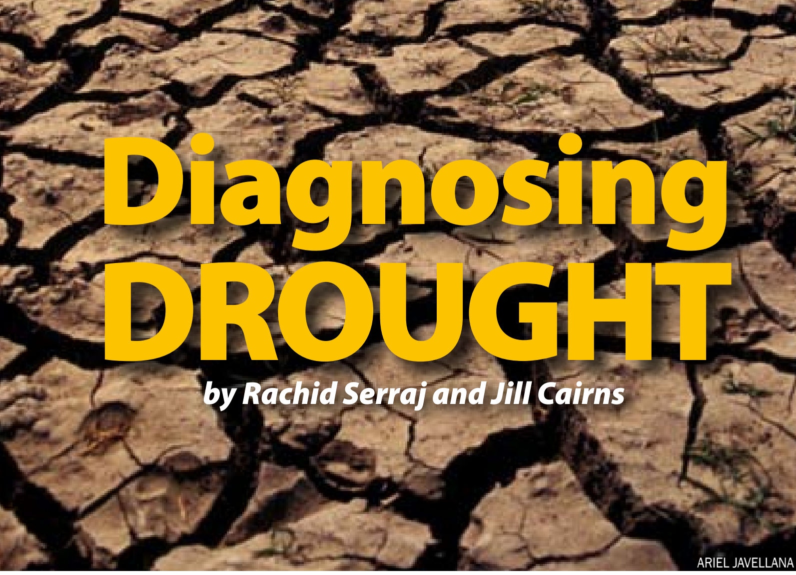
FARMERS participate at a workshop in Kompong Cham Province. CARDI plant pathologist Ny Vuthy (*below*) at his desk.

"One of the goals of the new project is to train Cambodian researchers to create and develop local knowledge and expertise in general plant pathology and rice pathology in particular," says Dr. Vuthy, who adds that being the only plant pathologist at CARDI and one of the few in Cambodia "has been difficult."

Drs. Vuthy and Visarto are scheduled to travel to Australia throughout 2006 to undertake intensive pathology training on the identification of important Cambodian diseases and pathogens. Under the project aims, development of the Cambodian agricultural research system is as important as the research itself. In this light, CARDI staff will be trained in not only plant pathology techniques but also research design and reporting.

There are more than 50 important diseases of rice in Asia and other tropical and temperate rice-growing areas, all of which can lower yields and increase production costs. However, very little is known about the distribution, prevalence, and importance of these diseases in Cambodian conditions. An increased understanding of rice disease and management—especially among Cambodian researchers themselves—is a significant step toward improved rice production.

Rowena McNaughton worked at CARDI in 2005-06 as an Australian Youth Ambassador for Development.



Diagnosing DROUGHT

by Rachid Serraj and Jill Cairns

ARIEL JAVELLANA

HAMLYN JONES takes a thermal image of drought-stressed rice while Mauro Centritto (*below*) measures the photosynthesis rate of plants in the same field.

Improved methods of measuring how rice plants respond to drought in the field are helping scientists discover how and why some varieties tolerate water shortages better than others—knowledge that will ultimately help farmers withstand the cruel vagaries of the weather

The International Rice Research Institute (IRRI) has highlighted drought as one of the major challenges to be tackled in its future research. Drought is a more complex phenomenon than most other stresses, such as salinity, submergence, pests, and diseases. It can occur at any point during crop production and for any length of time, affecting a large array of physiological, biochemical, and molecular processes. These complexities, along with the uncertainty in drought timing, intensity, and duration, have posed a major challenge for agricultural scientists. Despite drought having been a focus of agricultural research for several decades, progress in delivering drought-adapted rice varieties and technologies has been relatively slow.

The past few years have seen something of a revolution in genomics—the science of understanding DNA sequence structure, variation, and function, and the relationships among these. Rice research, in particular, has benefited from the sequencing of the entire rice genome (see *The gene revolution* on pages 14–18 of *Rice Today* Vol. 5, No. 1). The emergence of new information and technologies is making it quicker, easier, and cheaper to decipher the complex genetic networks of drought resistance in rice. However, the physiological characterization, or phenotyping, of plants has not, until now, advanced at the same pace. If scientists are to better understand and exploit the wealth of available genetic information, they need detailed knowledge of the biological effects of drought stress at both the cellular and whole-plant levels.

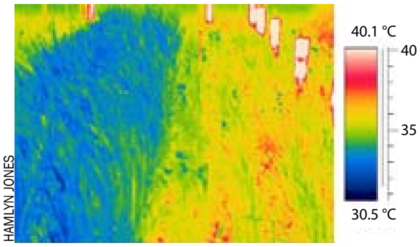
By subjecting plants to different irrigation regimes and thus different levels and intensities of drought stress (see *Playing rain-god* on page 33), scientists can investigate drought-resistant traits and genes (or regions of the genome) and the potential value of different varieties. In the 2006 dry season alone, IRRI scientists examined the drought response of more than 14,500 rice lines and varieties—including traditional and exotic rice varieties that potentially harbor a wealth of valuable genes—at the institute's Philippine headquarters. Each line needed to be carefully monitored for its response to drought in the field, so that the resultant data could be combined with existing genetic information, allowing researchers to ultimately select the best candidates for breeding programs for drought resistance. It is a daunting task. Even a simple 1-minute description of each line would take 14,500 minutes—more than 30 work days, and only a fraction of what is required to obtain sufficient data for an in-depth study.

JOSE RAYMOND PANALIGAN (3)

Researchers are developing new methods that allow many lines to be quickly but reliably evaluated. For example, infrared thermal imaging—using an infrared camera to measure plant temperature—is an innovative method of gaining precise information on the stress experienced by plants and their subsequent response or adaptation. Leaf temperature is a sensitive indicator of plant stress level. Plants cool down by losing water through small pores, known as stomata, on their leaves. In dry periods, plants conserve water by closing their stomata, which consequently raises internal plant temperature. Leaf temperature is thus related to the stress level of the plant.

Infrared thermometer guns have long been used to measure the temperature of individual leaves. As early as the 1980s, former IRRI crop physiologist John O'Toole used this method to screen rice varieties for reproductive-stage drought avoidance. He found that mean canopy temperatures increased dramatically from 28 to 37 degrees Celsius during a drought stress period, and that the lines that had previously responded best to drought consistently remained coolest under stress.

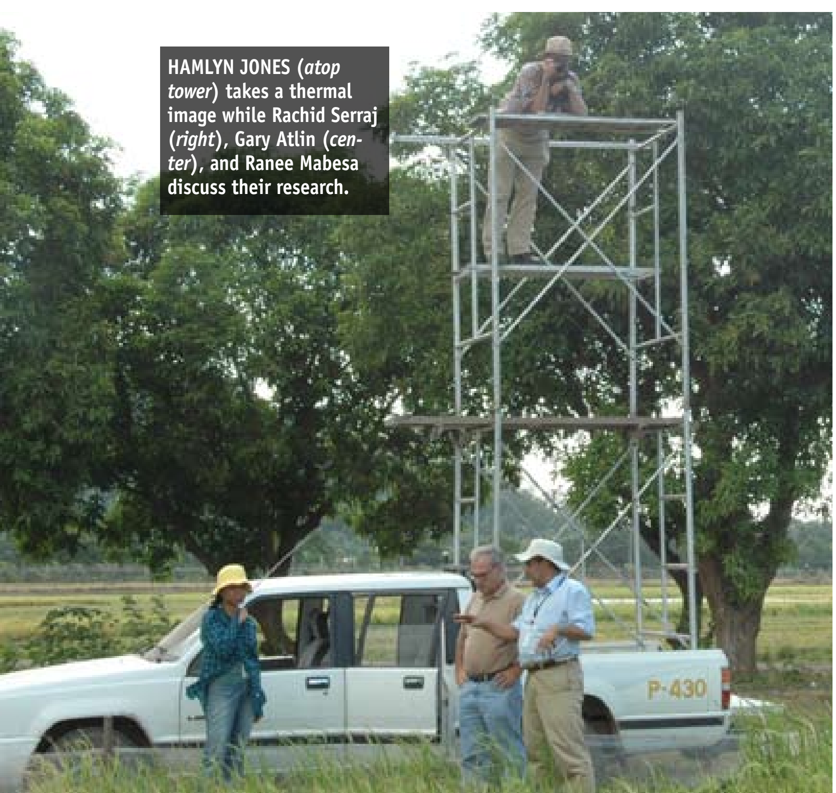
Despite these promising results, using an infrared gun on single plants can result in high plant-to-plant variation and thus have limited scope as an efficient and reproducible screening method. However, recent technological progress in infrared thermal imagery has revived interest in using canopy temperature as a screening tool, especially if scaled up to plot or field levels. Infrared cameras can now



A THERMAL IMAGE of drought-stressed rice (*right; mostly yellow*) and irrigated rice (*left*) in an IRRI field.

be used to detect whole-plant, or even whole-plot, temperature within seconds. While this technique can be applied very quickly on a large scale, more detailed measurements are required to fully understand the effect of drought stress.

As part of a project funded by the Rockefeller Foundation, Hamlyn Jones, from Dundee University in Scotland, and Mauro Centritto, from the Consiglio Nazionale delle Ricerche (National Research Council) in Rome, recently worked with IRRI's drought physiology group on scaling up field screening procedures from single plants or leaves to plot and field levels. While taking a series of infrared thermal images from atop a 6-meter scaffolding tower placed above rice plants under various drought stress treatments (see photo *below*), the team of scientists measured other indicators of drought stress such as above-ground biomass production, plant water status, photosynthesis, and leaf gas exchange through stomata. Combining this information with temperature measurements will provide a more detailed picture of the effects of stress on individual lines.



HAMLYN JONES (*atop tower*) takes a thermal image while Rachid Serraj (*right*), Gary Atlin (*center*), and Ranee Mabesa discuss their research.

As periods of water shortage during a plant's reproductive stage can severely reduce yield, the researchers also took measurements during and after flowering to understand what the exact cause of this reduction is, and to determine what causes certain varieties to yield more than others under drought stress. Early results are gradually revealing the physiological processes that underpin the rice plant's response to drought.

Further improving the efficiency and accuracy of screening will allow enhanced integration of newly developed genomics tools with corresponding methods of phenotyping. Such advances will help scientists unravel the mysteries of drought and ultimately develop rice varieties that can withstand severe water shortage, thus helping the millions of farmers who are afflicted each and every season.

Drs. Serraj and Cairns are senior crop physiologist and postdoctoral fellow, respectively, in IRRI's Crop and Environmental Sciences Division.

Playing rain-god

To investigate how rice varieties respond to drought conditions, scientists subject plants to different irrigation regimes and thus different levels and intensities of drought stress. Methods of irrigation include:

Soil drying. By exposing drained paddy fields to soil drying periods during both dry and wet seasons, researchers can simulate intermittent dry-spells in rainfed lowlands. This system has been used by IRRI drought breeder Gary Atlin to screen large collections of breeding lines and rice hybrids and to identify several donor parents for drought resistance breeding.

Sprinkler irrigation. This is used in upland fields to compare plant performance under well-watered aerobic conditions and drought conditions. It also allows drought of varying severity to be simulated at specific plant growth stages.

Drip irrigation. This uses drip tapes to apply water to individual rice plots, thus allowing variable drought stress periods. Drip irrigation is the preferred method for screening varieties with major differences in flowering time—by initiating the stress period at different times, researchers can target a specific growth stage for each variety.

Line-source sprinkler irrigation. This is used to generate a differential gradient of soil moisture varying from well watered to extremely dry, thus allowing comparisons of the effects of different levels of drought stress on the same plots at the same time.

AN INTERMEDIATE EGRET flies over rice fields.

Balanced on a Wing

Although seemingly at odds, rice production and biodiversity conservation can exist together—the trick is to find the right balance

Story and photos by Greg Fanslow

You might see something strange if you go bird watching near the small town of Candaba in the middle of the Philippine island of Luzon—next to rice fields and a dusty road, with no water in sight, are houses perched on stilts with boats stored underneath. This area is a cultivated floodplain and it's the quintessential place between land and water—an area defined by its potential both in terms of agricultural productivity and as a habitat for a profusion of wildlife.

Almost every wet season, about a third of Candaba's 18,000 hectares of farmland are flooded up to several meters by the Pampanga River. This is in some ways a vestige of floodplain landscapes that used to be much more widespread in Asia. However, as demand for rice has increased, many areas like this—with soils that are potentially good for agriculture, but usually too wet—have gradually been appropriated for rice production.

It is a scene repeated again and again in the planet's rice-producing areas. From an agronomist's perspective, wetland conversion exemplifies the application of human ingenuity to optimize nature's fickle resources for enhanced food production. And, satellite imagery shows us that, over the past 30 years, human ingenuity has been hard at work converting Candaba marsh into a homogeneous landscape of agricultural terrain (see maps on page 14).

Bringing floodplain wetlands into agricultural production generally requires flood control and drainage to manage water levels. These hydrologic modifications, along with plowing, land leveling, and bunding, radically alter the ecology of the system and tend to eliminate nonproductive native vegetation. From a wildlife conservation perspective, converting wetlands to agricultural fields too often represents habitat simplification to favor the needs of just one species—the crop—and creates nonoptimal circumstances for other species and ecosystem functions.

While at first the arguments over high levels of food production versus

AT THE EDGE of Candaba marsh, near the Pampanga River, a truck drives past a flood gauge designed to measure depths more than 4 meters above ground level.

maintaining biodiversity may seem hopelessly at odds, International Rice Research Institute (IRRI) ecologist K.L. Heong maintains that these debates are mainly a problem of semantics and the scale at which we think about agricultural systems.

"If we say that our goal is to optimize natural resources to maximize only grain production or only the number of bird species, for example," says Dr. Heong, "we perceive the world quite differently than if we say we want to optimize the totality of services that humanity derives from an ecosystem over many generations. Once the discussion expands to include a larger basket of environmental services over long time scales, there is usually much less misunderstanding."

Understanding the "totality" of almost anything is a daunting undertaking, particularly the totality of a landscape, but Dr. Heong points out the value of indicator organisms for this kind of task—particularly the kind with feathers.

According to Dr. Heong, there are two compelling things about birds that make them useful for understanding how human activities influence ecosystems. First, birds are widely cherished and, compared with less cherished groups of organisms (such as insects), many people have some knowledge about how the abundance and species composition of birds have changed with time. Second, birds are a very diverse group, with many species that specialize on particular resources within the overall environment. This specialization means that changes in abundance of a particular species can give us clues to specific things that have changed in the overall environment.

Tim Fisher, a prominent Philippines-based naturalist and co-author of the authoritative *Guide to Birds of the Philippines*, has observed declining numbers of bird species in Candaba and other parts of the Philippines for nearly 30 years. Fisher points out that the major threat to bird abundance seems to be the loss of native vegetation that accompanies the development of homogeneous agricultural areas.

While there can be large numbers of birds in rice fields, there generally aren't nearly as many species as exist in undisturbed wetlands. According to Fisher, "The very abundant species we see tend to be the ones that are lucky enough to have an ecological niche that overlaps with some aspect of the rice system. Such species might do extraordinarily well because the system has essentially been optimized for them as well."

However, Fisher warns that "while rice fields provide excellent feeding habitat for many of the seasonal migrants to the region, there are very limited breeding opportunities for resident species on field margins and almost no birds actually breed in rice fields."

As well as being affected by the amount of land that is brought into cultivation, local bird species are also affected by the amount of time during the year that the land is cultivated. "Early in the conversion process," says Fisher, "there is usually just one crop per year with a long fallow period when native vegetation can recover and birds may be able to breed in overgrown areas. However, as water control becomes more effective and cropping cycles are added, the periods when native vegetation can recover are drastically reduced." (See *The calculus of conservation*, page 36, for more on the response of birds to specific environmental changes.)

The streaked reed-warbler (*Acrocephalus sorghophilus*) is a rare species seen as quite sensitive to wetland conversion. Breeding in China and wintering in reed-beds in the Philippines, this small bird is now rarely observed in Candaba marsh and is generally regarded as in decline.

On the other hand, changing conditions can favor species that were previously alien to the landscape. The Eurasian tree sparrow (*Passer montanus*), for example, is a ubiquitous rice pest that can eat large amounts of grain, and which now thrives in extraordinarily high numbers in rice-growing areas throughout the Philippines.

Despite these examples, much can be done. Take Candaba, for instance. Candaba City Mayor Jerry Pelayo has established a 72-hectare bird sanctuary adjacent to Candaba marsh. The sanctuary attracts some 500 local and foreign visitors each year, boosting the local economy through increased employment and tourism. Although an isolated sanctuary is unlikely to significantly help species that require very large areas, a number of species do appear to have benefited from the mayor's efforts. Perhaps the most notable is the Philippine swamphen

IN THE HEART of Candaba marsh, about 8 meters above the fields they work in, farm workers camp on one of the major levees that holds back seasonal floods.

(*Porphyrio pulverulentus*). Common in the past, the swamphen became rare as wetlands were lost, but now breeds successfully and is a familiar site in the Candaba sanctuary.

In addition to preserving biodiversity for bird lovers, there are myriad other human benefits from wetlands. According to the secretariat of the Ramsar Convention on Wetlands, other services provided by healthy wetlands include protecting downstream areas by storing floodwaters during the wet season, recharging aquifers, and releasing the stored water during the dry season. Wetlands also act as biological filters by retaining and processing nutrients and pollutants. Wetlands are also critical habitat for many fisheries. For a complete list of environmental services, see Barbier et al 1997 (www.ramsar.org/lib/lib_valuation_e.htm).

According to Thomas Brooks, senior director of the Center for Applied Biodiversity Science at Conservation International in Washington, D.C., in the U.S., it works both ways—while humans receive benefits from wetlands, the wetlands must be managed appropriately by humans.

A PURPLE HERON prowls the bund of a rice field in a once-marshy area.

"While we must restore wetland habitat to effectively conserve bird biodiversity," explains Dr. Brooks, "this alone won't be effective unless the rice systems in the same landscape are managed in a manner that maintains appropriate flow of water into the areas within the system that are important to wildlife."

Can high food production coexist along with biodiversity? "Why not?" asks Ruaraidh Sackville Hamilton, leader of the T.T. Chang Genetic Resources Center at IRRI. "Although agricultural intensification during the 20th century was based on reducing biodiversity, it is not at all clear that increasing biodiversity per se would reduce productivity. In theory, judicious selection of the appropriate components of a biodiverse system can increase productivity by enhancing beneficial processes like the activity of natural enemies of diseases and pests, and increase the stability of production by buffering the impacts of climatic uncertainty."

"It's a false dichotomy," says Thomas Brooks. "The most authoritative study on this (Balmford et al 2002, *Science* Vol. 297, p 950–953) shows that, if the value of all environmental services is considered, conservation areas are generally worth 100 times the opportunity costs of establishing them."

Further highlighting the potential for a win-win solution, Sackville Hamilton turns the issue on its head and adds that "when you look at very extensive wetlands, they are actually rather homogeneous at the landscape level and it's quite possible that when agriculture is introduced to the landscape in patches, it can actually increase the overall biodiversity of the system."

The real issue, it seems, is to carefully find the right balance.

Greg Fanslow is an environmental consultant at IRRI.

The calculus of conservation

by Jonas Rune

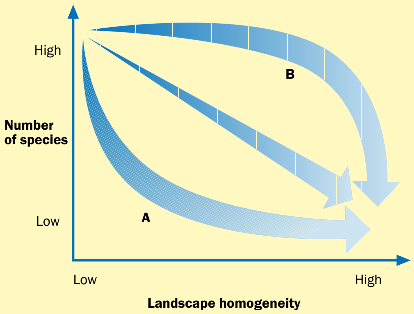
The figure to the right shows a theoretical model of species richness (for birds, for example) as a function of landscape homogeneity (the variation of types of habitat in the landscape). The more intense the farming, usually the more homogeneous the landscape and the fewer native species can be expected. This does not necessarily mean that the *number* of birds will be lower, as we may see a rise in the abundance of invasive species (species that expand rapidly when they are introduced from another region or when environmental conditions change).

The shape of the curve depends on what species and habitats make up the ecosystem. The more specific environmental demands a species has, the sooner it will disappear when its environment changes.

Case A presents an example where most native species disappear quite early in the land conversion process. An example of this would be converting forest to rice fields, where most of the forest species are lost very quickly because their niches don't overlap with the rice system. In case B, species richness is sustained much longer. An example here could be rice farming in an existing wetland, where more species may be able to use the new habitat and patches of natural habitat still remain.

The relationship between wetlands and birds is shaped by many factors, so it is difficult to determine the exact shape of the curve, but this conceptual model provides an idea of how much effort is needed to restore biodiversity. Case A, for example, would require the system to be restored to close to its original condition—a very large effort. In case B, however, even small measures can have significant positive effects.

An understanding of how species react to land use gives us a clearer idea about which areas are likely to experience the maximum benefit from our restorative efforts.



Potential relationships between degree of landscape homogeneity (variation of types of habitat in the landscape) and the number of species able to use an area.

Jonas Rune is a Philippines-based biologist.

Do rice prices affect malnutrition in the poor?

by Debbie Templeton
Economic impact specialist, IRRI Social Sciences Division

Cheaper rice can help break the cycle of poverty and malnutrition

ARIEL JAVELLANA (2)

At least 840 million people worldwide do not have enough food to meet their daily energy needs. In addition, more than three times this number—including many who do have enough food to avert day-to-day hunger—suffer from micronutrient deficiencies because their staple foods contain negligible amounts of essential micronutrients such as zinc, iron, iodine, and vitamin A.

Micronutrient deficiency results in low cognitive development and increased susceptibility to disease, and contributes to maternal mortality during childbirth. The enormity of this problem is staggering, with large numbers of women and children in sub-Saharan Africa, the Caribbean, and South and Southeast Asia at high risk. For example, over half of all women and children in South and Southeast Asia suffer from anemia, to which iron deficiency is a major contributor, and malnutrition-based disease contributes to more than half the deaths of children below preschool age.

The basic cause of malnutrition is poverty because the poor lack the resources to produce or purchase nutrient-dense foods such as meat, fruit, and vegetables. In turn, malnutrition perpetuates poverty as it directly reduces the productive ability of those afflicted.

Rice is the staple food of around half the world's population, providing 50–80% of the energy intake of the poor in South and Southeast Asian countries. Rice therefore offers a tremendous opportunity for breaking the savage poverty-malnutrition cycle. While the relative benefits of nutritional supplement and fortification programs and of biofortification of the rice grain (developing varieties that contain increased levels of micronutrients) are well documented, little research has explicitly examined the link between the price of rice and the nutritional status of rice producers and consumers.

We know that the decline in the inflation-adjusted price of rice due to productivity gains was the major contributing factor behind the progress in poverty reduction in Asia over the last two decades (see *Do lower rice prices help the poor?* on page 37 of *Rice Today* Vol. 4, No. 2). We also know that a large share of the income of poor households in Asia is used to purchase food, with the greatest proportion going toward the purchase of rice. The ability of a household to purchase food depends on income and on the price of food. Therefore, if households respond to a change in the price of rice by reducing the quantity or changing the composition of their total food basket, the household's nutritional status could be affected.

Between 1992 and 2000, the Nutritional Surveillance Project collected data on more than 81,000 rural Bangladeshi children aged 6–59 months. These data were used to examine the association between household rice expenditure and child nutritional status.[1] An analysis of the relationship between the price of rice and the number of children found to be underweight indicated that, while rice consumption remained fairly static, expenditure on rice increased with price rises, leaving less income to purchase the nonrice foods that would deliver the vitamins and minerals essential for healthy growth. Furthermore, higher rice prices are correlated with the number of underweight children aged 6–59 months.

The major implication of this study is that factors that lead to a fall in the price of rice can have a positive impact on both poverty levels and the nutritional well-being of children because not only will they have more to eat, their diets will also contain a higher proportion of nutrient-rich foods. At the same time, lower rice prices must be accompanied by strategies to help rice-farming families who may be adversely affected (also see *Do lower rice prices help the poor?*).

[1]Torlesse H, Kiess L, Bloem MW. 2003. Association of household rice expenditure with child nutritional status indicates a role for macroeconomic food policy in combating malnutrition. J. Nutr. 133:1320-1325.

Sarah Johnson

Are we at risk from metal contamination in rice?

The simple answer to the question posed by the title is "no"—because most rice is not dangerous. On closer inspection, though, we find that some rice-cropping systems are more likely than others to take up metals that are toxic to humans. Such metals may be a natural part of the local environment or present in industrial pollution.

Who is most at risk from contaminated rice? Nutritionally deficient people are more likely than well-nourished people to experience harmful effects from eating rice containing higher-than-average levels of metals. As the most impoverished people are the most likely to be malnourished, they too are the most vulnerable.

Which metals are dangerous? The risk of long-term exposure to low levels of metals is difficult to confirm. All of the potentially toxic metals are naturally present in the environment in trace amounts and are ingested with food, water, and air. Human bodies have the ability to deal with these background levels. The World Health Organization has established guidelines on allowable consumption of various toxins.

The most impoverished people—and hence the most likely to be malnourished—are the most at risk

How important is food in exposure to metals? Some toxic metals, such as chromium, mercury, and lead, are considered very low risk as plant food contaminants because plants can't absorb them. Other metals, such as copper and zinc, are needed in small quantities by plants and humans, and become toxic to plants before they reach high enough concentrations to be toxic to humans. The metals that pose the biggest risk are those that chemically mimic plant nutrients and can therefore be absorbed by plants at high enough concentrations to threaten human consumers.

Is rice riskier than other food? Arsenic is of more concern in rice than in other grain crops because flooded soil conditions make arsenate, which mimics the plant nutrient phosphate, more available to plants. However, far more arsenic accumulates in leaves than in grain, and experiments have so far failed to measure arsenic concentrations above published safe limits in rice grain, even in very contaminated soil.

Sources of arsenic contamination in rice fields include geologic soil materials that are naturally high in arsenic, irrigation with contaminated water, residual arsenical pesticides used on cotton, or application of poultry manure from chickens treated with arsenical antiparasite food additives. In Bangladesh, which has widespread geologic arsenic contamination, the many documented cases of arsenic poisoning have been caused by consumption of contaminated drinking water, not food.

Cadmium, which chemically mimics the plant micronutrient zinc, is less likely to be found in rice grain than in other grains because it is less available to plants under flooded conditions. However, because cadmium is very toxic, it is important to monitor any effects that trends in rice production may have on grain cadmium content. In water-scarce areas, for example, water-saving irrigation strategies may increase cadmium uptake. Sources of cadmium in rice fields include urban sewage sludge applied to soil, runoff from mining operations, and, to a much lesser extent, phosphate fertilizer.

What are scientists doing? Researchers have a four-pronged approach to minimizing the content of metals in rice grains: identifying which geographical areas have elevated risk and testing soil and plant samples; identifying the rice varieties that take up the least metal or convert the toxin to less toxic forms when grown in high-risk areas; developing irrigation, fertilization, and residue management strategies that help to minimize metal uptake by plants; and recommending growth of nonrice crops where the risk is too high for rice.

What can farmers do? Farmers who think their farm may be in a high-risk category should contact their local extension office and arrange to have soil and grain samples tested. If a contaminant is present, there may be a recommended approach for their area—more suitable varieties or irrigation techniques, for example.

What can policymakers do? As well as determining allowable levels of contaminants in food, policymakers can implement food and soil-testing programs in suspected risk areas, monitor land use and cleanup of contaminated sites, and build capacity for monitoring and solving contamination problems.

How do I know my rice is safe? Most people are extremely unlikely to consume sufficient contaminated rice to cause health problems. The people most at risk are those who live on contaminated sites and eat primarily the rice produced on their own land, those who have additional sources of contamination besides rice, and those who are nutritionally deficient. Many of these people do not have access to the necessary information. It is our job to identify and inform them.

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The premier international event for the food that feeds almost half the planet