



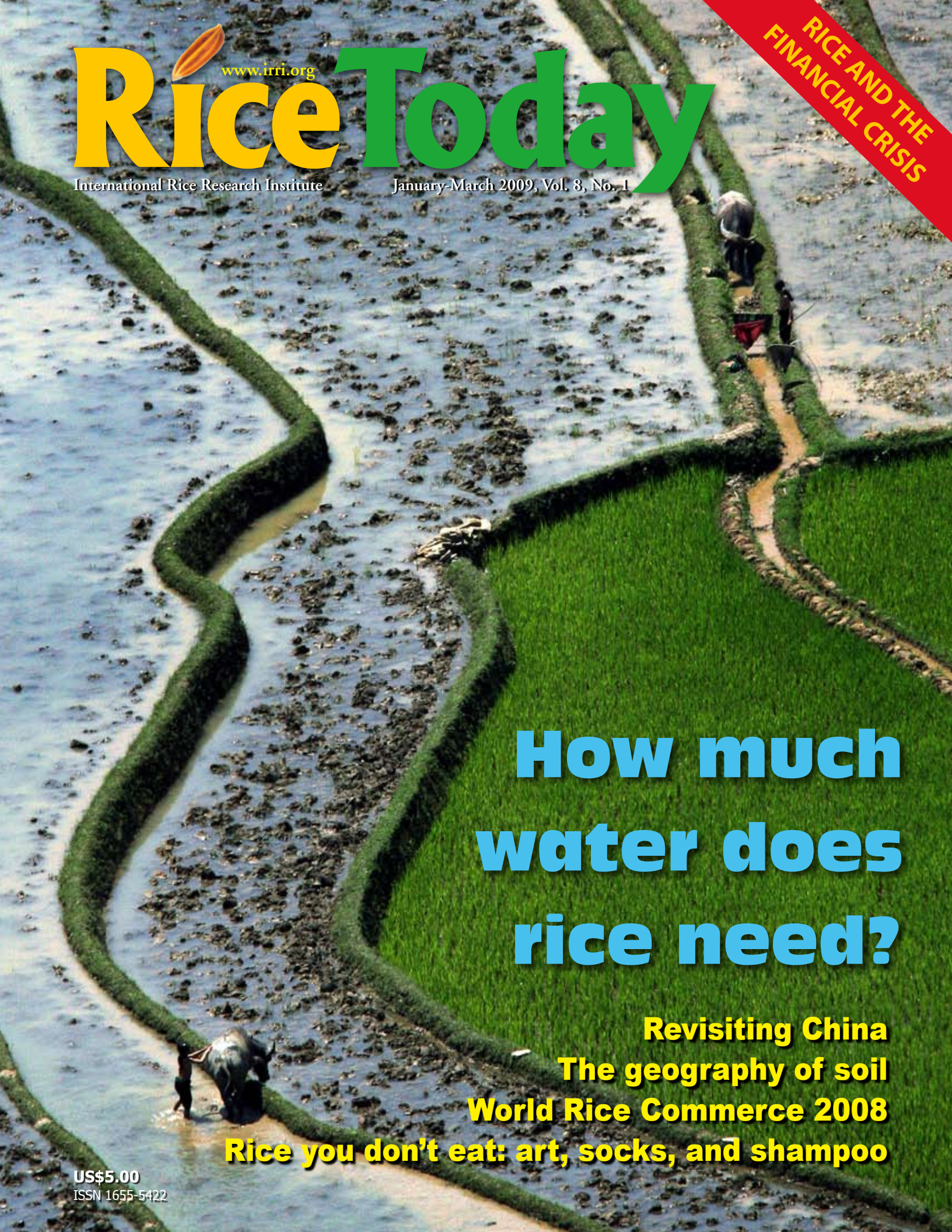
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Rice Today

International Rice Research Institute

January-March 2009, Vol. 8, No. 1

**RICE AND THE
FINANCIAL CRISIS**



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**Revisiting China
The geography of soil
World Rice Commerce 2008
Rice you don't eat: art, socks, and shampoo**

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Terraces and channels intertwine to feed water to rice in paddies in Vietnam.

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HIDDEN TREASURE



Everyone loves treasures. Perhaps they love the idea of undiscovered wealth. Or maybe it's the excitement of the search. Whether you are a sailor on the great seas or a rice scientist painstakingly searching for a gene that will increase yields, this truth holds. The unknown holds much more allure than the known and it is the journey to the treasure, as much as the destination, that thrills.

A Chinese proverb describes the true treasures of the world: "The precious things are not pearls and jade but the five grains, of which rice is the first." Unlike pearls or jade, grains are a treasure with an infinite value, reproducing and renewing themselves virtually forever. It is a beauty that changes the way that wealth is defined.

So why would the great thinkers of old say that rice is the first of these great treasures? Coming from a Midwestern U.S. farm growing other grains and especially wheat (a fragment of lingering pride forces me to mention that wheat is one of the other great treasures in the proverb), the significance of rice in Asia has found its way to my intellect. The dominant staple in Asia as well as in several other regions, rice, simply put, feeds more people than any other food. Rice also has cultural and political aspects sufficiently momentous to alter the fate of a nation. One cannot talk about the history or economics of Asia without understanding this key factor. Even Socrates made it clear that an understanding of agricultural concerns was a requirement for a country's leader.

The present situation reinforces my decision to be involved with *Rice Today* as publisher. The valuation of rice, for one, has been lost as populations continue to rise at the same time that yield growth rates for rice and other major crops are flattening. Research dollars have decreased dramatically and, for at least 15 years now, have lagged behind what is required for the pipeline of improved technologies to flow fast enough to allow producers to stay ahead of the game.

With history showing a lag between research investment and results of 10 years or more, the lack of adequate investment over the last 15 years is just now beginning to hurt—and it will plague us for years to come. One of my key goals is to continue highlighting the need for a well-funded plan that can generate results. We must aggressively challenge the notion that research and planning are unnecessary, that we will achieve food security by accidentally stumbling upon hidden treasures. Agriculture, rice, and concern for tomorrow's children—those who will inherit our legacy—are the passions that drive this effort to build on *Rice Today's* status as a global messenger for the importance of rice, food security, the work being done now, and the road ahead.

The true hidden treasures of this world are in the seeds planted beyond the seeing eye, working to deliver our promise to future generations. Though out of sight, the value of these treasures should never be hidden from heart or mind.


Jeremy Zwinger

Mr. Zwinger and The Rice Trader will take over as publisher of Rice Today from the magazine's April–June 2009 issue.

NOTE FROM THE EDITOR

Dear *Rice Today* readers,

This issue of the magazine will be my last as editor. Over the past 4 years, I have learned far more about rice—its science, its history, its economy, its culture, and its traditions—than I ever dreamed I would know. I sincerely hope that *Rice Today* has also helped you learn more about the grain that feeds half the world. Thank you for your time, your interest, and your feedback.

All the best,

Adam Barclay

Southeast Asian nations endorse Rice Action Plan

The world's biggest rice-exporting and -importing nations have endorsed a new Rice Action Plan targeting many of the problems that triggered 2008's rice price crisis.

At a meeting of the ten-nation Association of Southeast Asian Nations (ASEAN) in Hanoi, Vietnam, in November, ministers of agriculture unanimously endorsed a seven-point action plan presented by the International Rice Research Institute (IRRI). ASEAN includes the world's two largest rice exporters, Thailand and Vietnam, and several importing nations, including the Philippines, the world's largest importer.

The endorsement, announced at the 30th annual meeting of the ASEAN Ministers of Agriculture and Forestry, it was presented as part of a comprehensive food security strategy being developed for the region, home to more than 500 million rice consumers, including some of Asia's poorest.

"The message is very clear," IRRI Director General Robert Zeigler said. "We have the scientific expertise, knowledge, and partnerships to grow the rice Asia needs, and now—with this endorsement by these nations—we have strong political support. The only things missing are the financial resources needed to implement this."

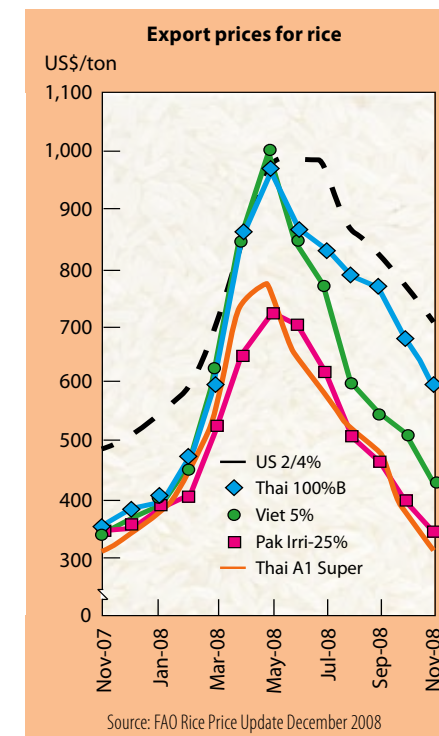
Dr. Zeigler told the ministers that IRRI needs an additional US\$15 million a year for the next 10 years to adequately support the ASEAN Rice Action Plan. "At a time of

trillion-dollar bailouts for the global financial sector, \$15 million a year is barely the annual bonus of a former Wall Street executive," he said.

The Rice Action Plan was developed by IRRI earlier this year during the rice price crisis in consultation with its partners around the region. It includes the following measures:

1. Bring about an agronomic revolution to reduce existing yield gaps
2. Accelerate the delivery of new postharvest technologies to reduce losses
3. Accelerate the introduction and adoption of higher-yielding rice varieties
4. Strengthen and upgrade breeding pipelines for developing new varieties and hybrids
5. Accelerate research on the world's thousands of rice varieties so scientists can use the vast reservoir of untapped genetic resources they contain
6. Develop a new generation of rice scientists and researchers for the public and private sectors
7. Provide rice policy support.

Although in the last quarter of 2008 rice prices continued to slide from earlier spikes, prices remained well above those of less than 2 years ago. Recent estimates by the Food and Agriculture Organization of the United Nations show the 2008 food crisis has reversed a declining trend in the global proportion of undernourished people. The



percentage has risen from a record low of 16% in 2003-05 to about 17%.

There are also concerns that the global financial crisis could increase demand for rice and put further pressure on production as farmers struggle to access credit for inputs such as fertilizer and people increase consumption of staples in preference to higher-priced, more nutritious foods such as meats and vegetables.

For more on the impacts of the financial crisis on rice production and food security, see *Rice and the global financial crisis* on page 40. For more information on the Rice Action Plan, including detailed budgets, please visit <http://solutions.irri.org>.

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Vietnam to host International Rice Congress

Vietnam will host the 3rd International Rice Congress (IRC2010) in Hanoi in 2010. The world's largest gathering focused on rice, the event will also mark the 50th anniversary of the International Rice Research Institute (IRRI).

The decision was announced in a joint statement by Minister Cao Due Phat of Vietnam's Ministry of Agriculture and Rural Development (MARD) and IRRI Director General Robert Zeigler in Hanoi on 24 October.

The IRC2010 theme—*The Future of Rice*—will aim to increase public and private support to help

poor rice farmers and consumers.

Dr. Zeigler said he was very pleased that IRC2010 would be held in Hanoi considering Vietnam's success with rice production over the past 2 decades. "Vietnam's rice industry is outstanding and MARD's commitment to research and the best science is an example for others to follow," he said.

IRC2010 will incorporate the 28th International Rice Research Conference, 3rd World Rice Commerce Conference, 3rd International Rice Technology and Cultural Expo, and the 50th anniversary celebration of IRRI.

A global voice for the global grain

The voice of rice—the grain that feeds half the world—has become even stronger with the new partnership between IRRI and The Rice Trader, Inc. (TRT), publisher of the world's premier publication on rice trade issues.

For 7 years, *Rice Today* has kept the world informed about developments in rice research to help millions of poor farmers improve their rice production and pull themselves out of poverty. For 18 years, TRT has brought its subscribers crucial information on world rice trading through its publication *The Rice Trader*, a weekly summary of market and data analysis. Now, at a time when rice issues are capturing major global attention more, the two

organizations are joining forces.

Jeremy Zwinger, president of TRT, and Achim Dobermann, IRRI deputy director general for research, announced the new partnership at a signing ceremony at World Rice Commerce 2008 in Chiang Mai, Thailand, 20-22 October.

The Rice Trader Inc. will publish *Rice Today*, adding new content and resources that will showcase the vital partnership between research and trade. IRRI's continued role in *Rice Today*, blended with TRT's commercial focus, will take a world-class publication to new heights.

The first issue of *Rice Today* to be published under the new arrangement will be Vol. 8, No. 2, April–June 2009. Existing subscribers will continue to receive the magazine.



The theme for this 2-day event is "How is the regional business evolving amid volatile supplies & changing climate?"

Key issues to be covered will include global grains market outlook & where it is heading; can the biofuels mandate roll back with rising food prices?; agriculture policy & investment outlook; will the center of commodity exchange shift to Asia?; commodity price risk management; freight markets & impact on grains movement.

The contact person is Hafizah Adam (hafizah@cmtsp.com.sg; +65 63469218)

For more information: www.cmtevents.com/aboutevent.aspx?ev=090206&

Pest outbreaks in India



Brown planthopper (BPH) outbreaks were observed in several rice-growing areas in northern India in 2008, causing significant damage, especially to high-value Basmati rice. The fly-like brown insect pierces the soft tissue of plants to extract sap, damaging the plant and making it susceptible to viral infestation.

According to Zubair Ahmad from the Department of Zoology of Aligarh Muslim University in Uttar Pradesh State, recent abnormal weather patterns may have contributed to the unusual outbreaks of BPH, along with insecticide misuse.

"Indiscriminate use of pesticides has disrupted the action of naturally occurring biological control agents," said Dr. Ahmad. "The pesticides kill off the natural enemies of BPH, allowing subsequent cohorts of BPH a predator-free period in which to develop. Because their populations develop more quickly than the predators, outbreaks occur, causing devastating losses."

Also in late 2008, more than 33,000 hectares of rice fields in the Mekong Delta region were infested with BPH. Severe BPH outbreaks have caused problems in several countries in recent years, including major producers China and Vietnam.

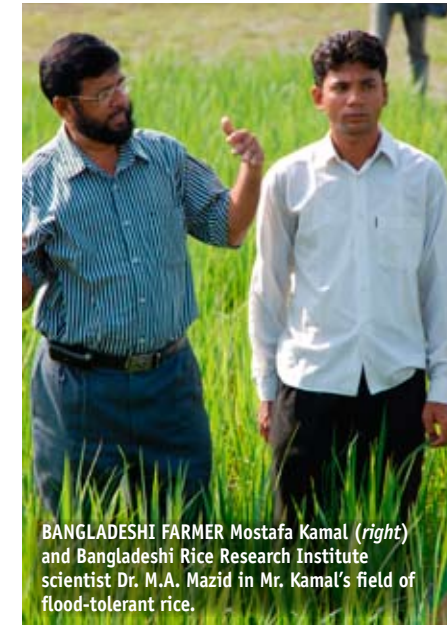
Waterproof rice set to make waves in South Asia

"Waterproof" versions of popular varieties of rice, which can withstand 2 weeks' complete submergence, have passed tests in farmers' fields with flying colors. Several varieties are now close to release by national and state seed certification agencies in Bangladesh and India, where farmers suffer major crop losses because of flooding of up to 4 million tons of rice per year—enough to feed 30 million people.

The flood-tolerant varieties are effectively identical to their susceptible counterparts, but recover after severe flooding to yield well.

A 1-9 November tour of research stations and farms in Bangladesh and India led by David Mackill, senior rice breeder at IRRI, marked the successful completion of a project, *From genes to farmers' fields: enhancing and stabilizing productivity of rice in submergence-prone environments*, funded for the past 5 years by Germany's Federal Ministry for Economic Cooperation and Development (BMZ).

The new varieties were made possible following the identification of a gene responsible for most of the tolerance. Pamela Ronald, a University of California (UC) at Davis



BANGLADESHI FARMER Mostafa Kamal (right) and Bangladeshi Rice Research Institute scientist Dr. M.A. Mazid in Mr. Kamal's field of flood-tolerant rice.

professor, worked with Kenong Xu to isolate the gene, dubbed *Sub1A*.

Julia Bailey-Serres, a geneticist from UC Riverside investigating how *Sub1A* confers flood tolerance, said that the gene effectively makes the plant dormant during submergence, allowing it to conserve energy until the floodwaters recede.

On 5 December, Drs. Mackill, Bailey-Serres, and Ronald were honored for their work by the U.S.

Department of Agriculture with its prestigious 2008 National Research Initiative Discovery Award.

Several national organizations, including the Bangladesh Rice Research Institute and India's Central Rice Research Institute and Narendra Dev University of Agriculture and Technology have collaborated closely on the project.

"The potential for impact is huge," said Dr. Mackill. "In Bangladesh, for example, 20% of the rice land is flood prone and the country typically suffers several major floods each year. Submergence-tolerant varieties could make major inroads into Bangladesh's annual rice shortfall and substantially reduce its import needs."

Because the *Sub1* varieties were developed through "precision breeding"—known as marker-assisted selection—they are not genetically modified organisms and are not subject to the regulatory testing that can delay release for several years.

Once *Sub1* varieties are released, the key will be dissemination to smallholder farmers in flood-prone areas. IRRI is leading this initiative through grants from the Bill & Melinda Gates Foundation and Japan's Ministry of Foreign Affairs.

BRIEFLY

Indonesia project launched

Improving rice productivity in South and Southeast Sulawesi, an IRRI-led project funded by the Australian Centre for International Agricultural Research, was launched with a stakeholder meeting and planning workshop in Maros, South Sulawesi, on 16-17 October. The project aims to boost rice production in the two provinces and contribute to the national plan to increase Indonesia's rice production by 5% per year from 2007 to 2010. The initiative will help increase production through optimization of rice productivity, the use of high-quality rice seeds, as well as training for and advice from extension workers, who

are responsible for disseminating technologies and information to farmers.

Rice-for-oil deal a first

In a first for global trade, Thailand indicated in October that it planned to barter rice for oil with Iran. The Food and Agriculture Organization of the United Nations said such government-to-government deals were likely to increase in number as lack of credit for trade becomes a factor. Thailand is the world's largest rice exporter, controlling a third of the global market, while Iran is one of the top 10 importers. In 2007, Iran bought some 600,000 tons of rice from Thailand.

Brunei rice expansion

The Brunei Department of Agriculture has identified 3,000 hectares of low-lying land with good potential to be developed into large-scale rice fields. The country aims to increase local rice production to 20% of national requirements by 2010 and 60% by 2015. As well as expanding rice area, the Department plans to improve infrastructure and promote the adoption of high-yielding rice varieties. Annual per-capita rice consumption in Brunei is estimated at around 80 kg per person. In 2007, national production was just under 1,000 tons, or around 3% of requirements. Imports cost the country around US\$34 million.

Letter

To the Editor:

Thank you for 4 years of *Rice Today*. It has been a fantastic resource for teaching undergraduate environmental health students. I have used articles in case studies in areas ranging from environmental health equity and the social determinants of health, resource allocation within and between countries, and the transfer of science research to practice. One particular article, *Fear and loathing drive needless insecticide use* (*Rice Today* Vol. 3, No. 2) gets a guernsey each year with my second-year environmental chemistry students as I use it as the basis for one of their assignments. And, of course, there are the great centerfolds.

Dr. Kirstin Ross
Lecturer, Environmental Health
Department of Environmental Health
School of Medicine
Flinders University
South Australia

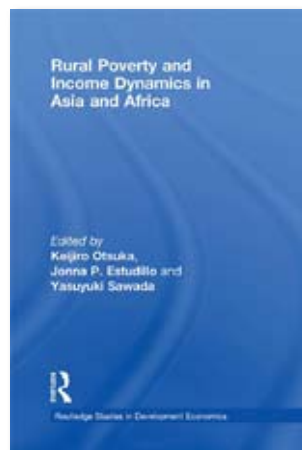
NEW BOOKS

www.irri.org/publications

Rural poverty and income dynamics in Asia and Africa

Edited by Keijiro Otsuka, Jonna Estudillo, and Yasuyuki Sawada; published by Routledge; 256 pages.

Although there is much interest in poverty reduction, there are few agreed-upon strategies to effectively reduce poverty. In this new book, the editors have gathered together evidence on poverty dynamics, based on data from the Philippines, Thailand, Bangladesh, India, and sub-Saharan Africa. The major finding is that rural households in sub-Saharan Africa are beginning to experience the same pattern of structural change in income composition and poverty reduction that Asian households have experienced over the past 25 years. The book explores how the spread of the Green Revolution triggered the subsequent transformation of rural economies, including poverty reduction through the adoption of modern rice technology—and subsequent higher rates of education for children—and the gradual diversification of income sources away from farm to nonfarm activities. The editors contend that the Asian experience provides valuable lessons for sub-Saharan Africa. For ordering information, visit <http://tinyurl.com/6kh62s> or Amazon.com.



TRAINING COURSES AT IRRI

BASIC EXPERIMENTAL DESIGN AND DATA ANALYSIS USING CROPSTAT

IRRI Training Center, Los Baños, Philippines, 2-6 February 2009

The course acquaints researchers with principles of experimental design (particularly for rice research), analysis of variance, and regression and correlation analysis. It also introduces CropStat, a computer-based statistical package for experimental data analysis. For more details, contact Dr. Thomas Metz (t.metz@cgiar.org) or Dr. Noel Magor (IRRITraining@cgiar.org).

LEADERSHIP COURSE FOR ASIAN WOMEN IN AGRICULTURE R&D AND EXTENSION

IRRI Training Center, Los Baños, Philippines, 2-13 March 2009

Topics include Asian women in the workplace; mainstreaming gender concerns in the workplace; leadership and management; personality development; developing work-related knowledge and skills; and relating to others.

For more details, contact Dr. Thelma Paris (t.paris@cgiar.org) or Dr. Noel Magor (IRRITraining@cgiar.org).

ECOLOGICAL MANAGEMENT OF RODENTS, WEEDS, & RICE DISEASES—BIOLOGICAL & SOCIAL DIMENSIONS

IRRI Training Center, Los Baños, Philippines, 16-27 March 2009

The themes for the course are ecologically-based pest management with an emphasis on rodents and weeds; applying social science knowledge in decision analysis of pest and disease problems; farmer participatory research. Presenters at the course include Emeritus Professor Charles Krebs, Dr. Grant Singleton, Dr. David Johnson, Dr. Serge Savary, Dr. Flor Palis, and Dr. K.L. Heong.

For more details, contact Dr. Grant Singleton (g.singleton@cgiar.org).

RICE: RESEARCH TO PRODUCTION

IRRI Training Center, Los Baños, Philippines, 18 May-5 June 2009

The course aims to create a new generation of plant scientists that understand the importance of innovative plant science in addressing global problems. Topics include an understanding of the basics of rice production in Asia; germplasm exchange and intellectual property; the research issues of IRRI and its developing partners; hands-on skills for rice breeding, molecular genetics, and genomics; structuring effective international collaboration; and working effectively as part of the international research community.

For more details, contact Dr. Hei Leung (h.leung@cgiar.org) or Dr. Noel Magor (IRRITraining@cgiar.org).

2009 GLOBAL RICE SCIENCE SCHOLARSHIPS

Qualified students from developing countries about to conduct their PhD research are invited to apply for Global Rice Science Scholarships at IRRI. The 3-year scholarships are for PhD thesis-only research.

- One scholarship supported by Pioneer Overseas Corporation for applicants from India, Bangladesh, Vietnam, Indonesia, or the Philippines. This scholarship will emphasize rice breeding coupled with entomology, physiology, or biotechnology.
- Three scholarships for applicants from India, Bangladesh, Nepal, or Pakistan, to conduct research as part of the Cereal Systems Initiative for South Asia. Priority given to students whose research focuses on rice breeding, soil and water management, systems agronomy and modeling, and/or plant pathology with emphasis on host plant resistance and leaf pathology.

Applications close 28 February 2009

For more information, please contact IRRITraining@cgiar.org or visit www.irri.training.org.

PEOPLE

Awards and recognition

Bui Chi Buu, director general of the Institute of Agricultural Science for Southern Vietnam, received the Senadhira Rice Research Award for 2008 for his outstanding contributions to the development of popular rice varieties in Vietnam. Dr. Buu (pictured below), who received the award at IRRI headquarters on 3 December, has enjoyed a distinguished career in rice breeding, during which he has emphasized grain-quality improvement, salt tolerance, and resistance to pests and diseases such as blast fungus, bacterial blight, and brown planthopper. His efforts have led to the certification of many popular rice varieties grown by farmers throughout the Mekong Delta. The award is named after **Dharmawansa Senadhira**, one of IRRI's most successful rice breeders, who died tragically in a road accident in Bangladesh in 1998.



BUI Chi Buu

IASV

J.K. Ladha, International Rice Research Institute (IRRI) representative for India, and **S.K. De Datta**, former IRRI agronomist, have been named American Association for the Advancement of Science (AAAS) fellows. In 2008, 486 members, who are due to be honored at the 2009 AAAS Annual Meeting in Chicago in February, were awarded because of their scientifically or socially distinguished efforts to advance science or its applications. Dr. Ladha received his award “for distinguished contributions to

international agriculture through his research, training, and extension activities in sustainable management of natural resources for increasing food security and environmental quality.” Dr. De Datta, now at Virginia Polytechnic Institute and State University, was honored “for distinguished contributions to global food security, the green revolution, and environmental stewardship in a global context.”

Another Vietnamese researcher, **Vo-Tong Xuan**, became the first recipient of the **Dioscoro L. Umali** Achievement Award in Agricultural Development. Dr. Xuan, professor of agronomy, former IRRI researcher, and former rector of An Giang University, was recognized for his significant role in invigorating the rice industry in Vietnam and sharing his expertise in Africa. This regional award is aimed at promoting agriculture by recognizing exemplary individuals who have advanced agricultural development in Southeast Asia. The award is named after the late Dr. Umali, a National Scientist of the Philippines, former assistant director-general of the UN Food and Agriculture Organization, and former consultant to IRRI.

IRRI Senior Scientist **T.P. Tuong** (below right with Tai Cheol Kim, Professor, Chungnam National University, Korea) received the International Society of Paddy and Water Environment Engineering (PAWEES) Award 2008 for his outstanding work on natural resource management that has had impact on poor people and on protecting the environment, especially in acid soils and coastal areas. Dr. Tuong, who received the award at



PAWEES

the PAWEES 2008 International Conference on 27-29 October in Taiwan, was also recognized for his innovative integrated strategies for increasing water-use efficiency and combating water scarcity, which have influenced the agenda of research programs globally.

Also in Taiwan, IRRI Senior Scientist **Hei Leung** (below right with NCHU president Jei-Fu Shaw) was recognized as a Chair Professor on Molecular Breeding in the Department of Agronomy at National Chung Hsing University, where he presented a lecture in October.



NCHU

The IRRI-led **International Network for Genetic Evaluation of Rice** (INGER) was named the 2008 winner of the Consultative Group on International Agricultural Research (CGIAR) award for Outstanding Scientific Support Team. The award was presented on 2 December at the CGIAR Annual General Meeting in Maputo, Mozambique. A global partnership of national and international centers, INGER facilitates the exchange and evaluation of elite rice breeding materials worldwide. It is coordinated globally at IRRI by Edilberto Redoña and a team including **Connie Toledo, Cel Laza, Franco Nazareno, Glenn Alejar, Virgilio Ancheta, Jose Angeles, Fe Danglay, Cenon Lanao, Nestor Leron, Virgilio Magat, Jose Marasigan, Honorio Oboza, Renato Pizon, Allan Salabsabin, Ernesto Sumague, and Joseph Vicente**. The recognition comes with a US\$10,000 cash prize.

Keeping up with IRRI staff

IRRI Director General **Robert Zeigler** has accepted a second 5-year contract, beginning in 2010. IRRI Board of Trustees Chair **Elizabeth Woods** said that the Board members were “impressed and pleased by the enthusiasm and talent that Bob Zeigler has brought to IRRI,” adding that, “We can now be confident of strong leadership to take IRRI forward into what will be exciting times.”

Kyu-Seong Lee, former IRRI researcher seconded from Korea’s Rural Development Administration (RDA), has been appointed as the director of the Reclaimed Land Agricultural Research Division, Department of Rice and Winter Cereal Crops, National Institute of Crop Science, RDA.

Susana Poletti and **Ramaiah Venuprasad**, postdoctoral fellows in IRRI’s Plant Breeding, Genetics, and Biotechnology Division,

departed the Institute in October. Dr. Poletti generated and analyzed transgenic plants for biofortification and gene expression measurement. Dr. Venuprasad worked on the development of drought-tolerant rice. **Adam Barclay**, managing editor of *Rice Today*, science writer and editor, and, from May 2008, IRRI spokesperson and media relations manager, left the Institute in December.

Kay Sumfleth joined as a visiting research fellow working on geographic information systems to identify regional heat-stress hotspots and analyze climate change impacts in major rice-growing areas. **Madonna Casimero** joined IRRI’s Irrigated Rice Research Consortium as a project scientist to work on farmer participatory research and development, do benchmarking, identify pathways for the dissemination of rice production technologies, and analyze the factors influencing adoption by farmers.

The Institute welcomed three new postdoctoral fellows: **Amelia Henry** has joined the project “Stress-tolerant rice for poor farmers in South Asia”; **Suk-Man Kim** will map tungro resistance genes; and **Dong-Jin Kang** has joined the Crop and Environmental Sciences Division.

Obituary

Sukumar Mallik, 52, rice breeder at the Rice Experiment Station in Chinsurah, West Bengal, India, died tragically of a heart attack on 17 November. Dr. Mallik, a close colleague and friend of many IRRI staff and winner of the 2004 Senadhira Rice Research Award, contributed enormously to the development of varieties for flood-prone areas. He had recently played a leadership role in the seed multiplication, evaluation, and dissemination of *Sub1* varieties in West Bengal and other Indian states. He is survived by his wife, Supti, and 2-year-old son, Argha.

SPECIAL REPORT

by V. Subramanian

WORLD RICE COMMERCE 2008: PRICE VOLATILITY SET TO CONTINUE

Last October’s World Rice Commerce conference heralded a coming together of often disparate sections of the rice industry—*Rice Today* reports

“Sustained price volatility” was the conclusion at the 7th World Rice Commerce 2008 Conference held in Chiang Mai, Thailand, on 20-22 October.

Addressing business concerns facing the rice industry, the event brought together representatives from export giants Thailand, Vietnam, India, Pakistan, and the United States, who joined key market participants (including the National Food Authority of the Philippines and Perum Bulog of Indonesia) and a panel of experts representing the world’s most prominent traders. Participants analyzed the skyrocketing market prices witnessed up to May 2008 and the slide down since, and tried to glimpse the future.

Stability was key as participants recognized sustainable supply, growing demand, and a stable price as the foundations necessary to build a rice industry that can ably overcome food security concerns and offer an affordable staple for some of the world’s poorest people. However, current record crops in Southeast Asia, India, and China conspired with a seemingly elastic demand (that is, demand decreases as price increases) to lower prices and raise concerns about long-term stability of supply. In short, if prices continue to bounce around as they have for the past year or so, future plantings are likely to expand and contract accordingly.

Commenting on the events leading up to the May highs in



LIEN DAI of the Vietnam Food Association (left) with V. Subramanian.

dilemma,” said Ms. Apiradi, emphasizing the need for stability and a price that also takes into account farmers’ living conditions.

Food security and maintaining production

Mulyo Siddik of the East Asia Emergency Rice Reserve highlighted the challenges in maintaining production (such as its susceptibility to weather and other uncontrollable factors), with production failure resulting in consequences reaching beyond food security to national security. A long-term strategy was seen as vital in supporting price

stabilization, encouraging production, and enhancing yield. Dr. Mulyo said that this must be combined with long-term reserves to prevent unnecessary price volatility and consequent production responses.

Reluctance from buyers expecting even lower prices unveiled a major flaw in the balance between the needs at destination (demand) markets and at origins (exporters). This imbalance threatens to disrupt supply and add to the already daunting long-term challenge facing policymakers and research organizations in delivering sufficient rice to the world.

Solutions for the long run

Achim Dobermann, deputy director general for research at the International Rice Research Institute, revealed that, “A 50% increase in rice prices may throw 30-100 million people in Asia back

RiceToday around the world



1. KASRA, KUROSH, Bitu, Kiara, and Karissa Avendaño (right to left) find *Rice Today* much more compelling than Hong Kong Disneyland.



2. A GOLDEN GATE for a golden grain; Emmy Ballesfin with *Rice Today* in San Francisco, California, USA.

3. DISNEY ON RICE: Marina Bennight (left), Doreen Salon (center), and Kelsie Aggen with *Rice Today* in Walt Disney World in Florida, USA.



4. NOT LOOKING for Condoleezza: Anna Duluc (left) and Lanie Orsulak with *Rice Today* at the United States Capitol.

5. GLORIA HARDY (left), Sofia Hardy (center), and Clara Ayerbe with *Rice Today* in Cali, Colombia, during a Colombian Independence Day (20 July) march.

into poverty.” With rice yield growth running below population growth since 1992, Dr. Dobermann described the industry’s urgent need to fix a problem that is not new, and that reached a global audience only after export prices surpassed US\$1,000 per ton in May 2008. According to Dr. Dobermann, a “generation gap” underscores a shortage of young rice scientists as the world grapples to meet the target of raising global rice production by 8–9 million tons per year between now and 2020.

The voice of trade

While there was an uncomfortable agreement that the record plantings seen in 2008 were a result of farmers being motivated by the high prices of April–May 2008 along with some very favorable weather conditions, Jeremy Zwinger, president of The Rice Trader, cited several factors that could throw markets into a period of sustained volatility. The key concerns are overconfidence by governments and those in charge of food and farm policy in assuming that lower prices mean “crisis solved” combined with the psychological impact of the current fall in prices, rising input costs, a growing global population (meaning increasing demand), and the fact that very little changed fundamentally in rice markets. Many of the issues raised by the 2008 price shock—such as insufficient water availability, population growth, increasing demand, the need for improved varieties, improved tolerance of extreme weather, and the need for long-term availability and affordability in the face of an expanding population—have been around for 15 years or more.

Robert Papanos, editor of *The Rice Trader*, pointed to just how easy it was for demand to overwhelm supply. Unreliable and often questionable production statistics, inefficiencies in the methodology of crop surveys, high fertilizer prices, and continued weather problems even during the current harvests offered a glimpse at just how tight supply and demand are right now, making volatility unavoidable.



ROBERT PAPANOS, Achim Dobermann, Jeremy Zwinger, and V. Subramanian following the announcement that *Rice Today* and *The Rice Trader* were teaming up (see *A global voice for the global grain* on page 6).



VIJAY SETIA, president of the All India Rice Exporters Association (left photo), speaks. Rut Subniran, vice president of the Thai Rice Millers’ Association and chairman of the executive board of Patum Rice Mill and Granary Public Company Ltd. (left in right photo), and Korbsook Iamsuri, secretary general of the Thai Rice Exporters’ Association and CEO of the Kamolkij Group of Companies, preside over a discussion panel.



Mr. Papanos also reflected on high-priced stocks held currently by traders and the impact of the credit crunch as important short-term elements that will affect buying patterns as buyers increasingly face a “hand-to-mouth” situation created by the credit situation.

The road ahead reveals an urgent need for research to increase yields and develop strong postharvest and crop-management solutions that get more from current rice varieties, as well as for efforts to get policy right and keep farmers in rice production at a time of tight supply and demand and volatile prices. Demand is expected to arrive in “spurts” as demand and supply perform an

awkward dance to discover price.

If there are positives to emerge from the craziness of 2008, they include across-the-board recognition that long-term strategies are required and agreement among farmers, traders, researchers, and policymakers that production and price stability are crucial for the rice industry’s livelihood—along with that of the billions of people who depend on the grain for their sustenance.

Mr. Subramanian is vice president for Asia of *The Rice Trader*. He can be contacted at subra@thericetrader.com.

THE RICE TRADER (3)



SHORT EDUCATIONAL rice videos are shown and discussed in rural villages by mobile cinema units.

The best agricultural research in the world won’t help a single farmer if it stays on the shelf. To ensure that good science gets real-world results, the Africa Rice Center (WARDA) and partners have developed educational tools as part of a Rice Rural Learning Campaign to communicate relevant science and to stimulate learning all along the path from field to market. By promoting better access to scientific results, the campaign is helping African rice farmers and processors improve both rice productivity and marketing opportunities.

The campaign aims to trigger rural learning by enhancing rural communities’ awareness of promising rice technologies developed by WARDA and partners related to land, water, crop, and postharvest management. By linking video with mass media, the initiative stimulates local adaptation of the technologies, nurtures local ownership, and builds on existing capacities and networks.

In 2005, WARDA, in collaboration with UK-based Countrywise Communication, trained a team in Benin to produce farmer learning videos. In 2007, WARDA also taught partners to produce rural radio scripts, which, as well as teaching about rice production, also advertise video distribution points.

By 2008, 20 educational radio and video programs had been produced. WARDA distributed the videos to 80 partners in 28 African countries, who in turn shared them with over 300 local organizations. Canada-based Farm Radio International distributed radio scripts on rice technologies to more than 300 rural radio stations across Africa, and monitored their use.

MAKING SCIENCE WORK

by Paul Van Mele

A communication campaign designed to link rice production with relevant science promises to help African farmers and processors boost their productivity

Partners translated the videos and radio programs into, respectively, 20 more than 40 local languages. The two media were creatively combined to reinforce the messages.

By strengthening 380 organizations, the videos helped train more than 2,500 trainers and benefit more than 100,000 rice farmers and processors across Africa. The radio programs’ potential audience constituted millions of farmers.

The Rice Rural Learning Campaign, which is funded by the International Fund for Agricultural Development, the Government of Japan, and the Bill & Melinda Gates Foundation, has already enjoyed much success. In Guinea, for example, the nongovernmental organization Association pour la Promotion Economique de Kindia (APEK) trained thousands of farmers using campaign videos before reinforcing the lessons through Radio Guinée Maritime, which aired interviews with farmers about what they had learned. The resulting radio program reached up to 800,000 people. Gambian TV also broadcast the

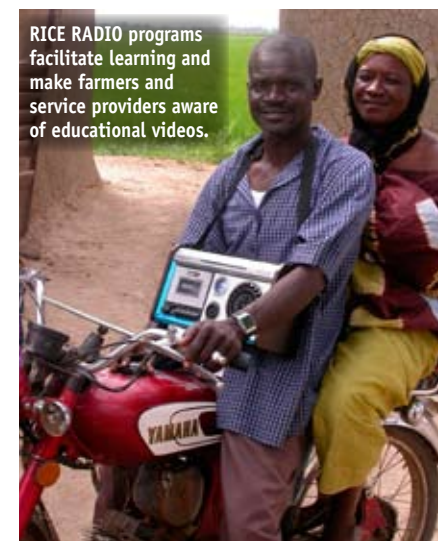
videos in Mandinka (The Gambia’s main language) in 2007 and 2008.

To revive agriculture in war-torn villages in northern Uganda, the Agricultural Productivity Enhancement Program showed the videos to more than 7,000 farmers living in refugee camps. In addition, Sasakawa Global 2000 distributed local-language copies to extension (training, education, and technology dissemination) services and farmer associations and also engaged policymakers, a TV station, and a farmers’ newspaper.

In Benin, mobile cinema vans reached more than 50,000 farmers. Interactive programs on rural radios and a question-and-answer service helped promote the videos and make use of audience feedback.

To assess the videos’ impact, 200 women were surveyed in Benin. After watching a video on parboiling rice, over 90% cleaned and dried their rice properly (compared with 20% in a group who did not watch the video), and 42% adopted improved rice parboiling (compared with 5% in the nonvideo group). Not only did rice quality improve, allowing the women to obtain a higher price, but they also learned to work better as a group.

The Rice Rural Learning Campaign creatively combines educational video with mass media. The initiative has already mobilized a vast network of local actors to the benefit of African rural communities, and is set to continue this success in the years to come.



PAUL VAN MELE, WARDA

Dr. Van Mele is program leader, Learning and Innovation Systems, at WARDA. To see rice videos, visit www.warda.org/warda/guide-video.asp.

Sowing the seeds of art

by Yoko Hani
© Japan Times



THIS FAMOUS Edo-Period print, originally created between 1823 and 1829 by Katsushika Hokusai, is spectacularly reproduced (below and opposite) in rice at Inakadate Village in 2007.

When is a paddy not a paddy? When it's a canvas, of course. In Japan's Aomori Prefecture, rice is far more than mere food.

Mysterious crop circles of incredible complexity that appear overnight, or a baseball park as in the 1989 film *Field of dreams*—who knows what you might come across in your local rural idyll these days?

But travel some 600 kilometers north of Tokyo, then take a drive off the beaten track. There, in a village in verdant Aomori Prefecture, who would ever expect to find exquisite Edo Period artworks sprouting amid a swaying green sea of enormous rice paddies?

It's neither a dream, nor a supernatural mystery, nor fiction.

Instead, by precisely planting four varieties of rice with differently colored leaves in fields their ancestors have farmed for centuries, the people of Inakadate Village in 2007 grew remarkable reproductions of famous woodblock prints by Katsushika Hokusai (1760-1849). And this is no cheap gimmick—the images from the artist's *Fugaku Sanjurokkei* (36 views of Mount Fuji) on the 15,000-square-meter paddies are nothing if not spectacular in both their scale and detail—even as every day brings them nearer to annihilation in the September harvest.

From ground level, the artistic paddies spread out before the Inakadate Village office building

are, like crop circles that occur in England, invisible. However, by scaling a 22-meter-high mock castle tower that overlooks the fields, visitors are rewarded with a view that takes their breath away. The spectacle also boosts the local economy, with hundreds of thousands of visitors now drawn to the village of 8,700 people each year.

“People who see this for the first time often ask me if we made this by painting colors on green rice plants,” says Akio Nakayama, who leads the rice-paddy art project, while viewing the multicolored rice fields from the village office. Mr. Nakayama, an official in the office's industries section, has been working on the art project for more than 10 years.

“This year's [2007's] Hokusai design was very challenging,” he

says. “We weren't sure if we could really pull it off—but we did.”

Inakadate Village started to create rice-paddy art in 1993 as a local revitalization project. No one will take credit for the idea, which seems to have just grown out of village committee meetings.

In the first 9 years, the village office workers and local farmers grew a simple design of Mount Iwaki in Aomori Prefecture every year, accompanied by the words “Inakadate, a village of rice culture.” Then, by planting rice varieties with different leaf colors on about 2,500 square meters of rice paddies, they quite literally brought their designs to life.

But, as time went by, the locals' horizons widened and the pictures they tried to transform

into fields of art became ever more complicated. Not surprisingly, over the years, more and more people also began to pay attention to their extraordinary endeavors.

Then, in 2005, after agreements between landowners allowed the creation of enormous, 15,000-square-meter rice paddies, the villagers painstakingly plotted their planting on paper plans and created huge-scale reproductions of Edo Period *ukiyo-e* works by Sharaku and Utamaro.



INAKADATE VILLAGE OFFICE ©



That year, around 130,000 visitors sought out this beautiful backwater to marvel at the arable artwork.

In 2006, another revolution occurred in this creative corner of the northernmost prefecture of Honshu, the largest of Japan's islands, when the organizers for the first time used computers to precisely plot the planting of the four differently colored rice varieties. The result was an astonishing set of reproductions of paintings by the famous *Fujin Raijin Zu Byobu* (*Wind God and Thunder God screens*) by the early Edo Period artist Tawaraya Sotatsu. Around 200,000 visitors came to Inakadate to view the images.

"I feel happy to see many people come to see our rice paddies because, here in Inakadate Village, rice and people's lives are very closely connected," Mr. Nakayama says, noting that the idea came out of the village's ancient history of rice cultivation.

"In 1981, when we did construction work for a new road, we dug up some rice paddies that archaeologists dated as being about 2,000 years old. That impressed us local people a lot, because we realized how long people have been growing rice in this place. So then we thought that we had to do something involving rice to revitalize this area."

From that germ of an idea sprang the paddy-art project, which has come to involve not only local farmers but also many of their friends and neighbors.

Now, the project starts in April each year, when the pictures to be planted in Inakadate Village's rice paddies are decided upon at local meetings. After that, six staff at the village office make an elaborate plan of how to plant different colors of rice to create the image. They calculate and plot the precise areas where each different color of rice needs to be planted in the paddies, and produce a printout of the design that at first just looks like a mass of dots.

Each year, the six village office workers spend several weeks of their own private time, working until late at night, to complete the planting



IN 2005, Inakadate replicated *ukiyo-e* works (a style of Japanese woodblock printing and painting produced between the 17th and the 20th centuries) by Sharaku and Utamaro.



IN 2006, the Inakadate villagers reproduced *Fujin Raijin Zu Byobu* (*Wind God and Thunder God screens*) originally created by the early Edo-Period artist Tawaraya Sotatsu.

plan. Their calculations are not just simple painting-by-numbers layouts, but include sophisticated use of perspective so that the paddy pictures appear perfectly proportioned when viewed from the observation point.

"Using computers has greatly shortened the time it takes to calculate the position of one dot on the rice paddies," Mr. Nakayama says. "At the same time, it has made it possible to calculate many more dots to draw

the picture more precisely."

The 2007 Hokusai design included 6,100 dots, compared with 1,500 dots in 2005. "If we have more dots for a picture, we can reproduce the original more precisely on the rice paddies," says Mr. Nakayama.

Dots on a printout are all very well—but the most sensitive and difficult task is digging reed sticks into the bare spring paddies at exactly the right points so that those who plant the rice know where to

position each of the four varieties. This year, five groups of six village-office staff dug 6,100 reed sticks into the ground, then strung plastic tape between them to create the areas—some large, some as small as one square meter—in which to plant the rice varieties. Altogether, the task took three full, backbreaking days.

Then, on 27 May 2007, 700 people helped plant the rice. Divided into teams, they used four kinds of rice: two traditional varieties named *ki ine* (yellow rice) and *murasaki ine* (purple rice) that grow into yellow- and brown-leafed plants, respectively, and also more modern *beni miyako* (red miyako) and *tsugaru roman*, an Aomori variety with a fresh green color.

Then, nature took control of the artwork as the seedlings grew, transforming them in varying hues into Hokusai's famous wave.

Mr. Nakayama says that late July is the best time to enjoy the art. Referring to 2007's image, he explains why, and in doing so offers a sense of the work's intricacy.

"In August," he says, "the lengths of each kind of rice are different due

to their different growth rates. We cannot clearly see the drops falling off the waves, as the yellow rice for the drops is shorter than *tsugaru roman*. So [by August], the drops have begun to sink into the green background."

The number of visitors flocking to Inakadate to view the paddy-artists' amazing, living creations keeps on rising.

"Oh, it's so busy," says Mr. Nakayama. "Visitors have to wait in line for about an hour to go up the observatory, and staff are busy talking to them. But I feel that our efforts are being rewarded when I see so many people enjoying the art."

At the end of September, Inakadate braces itself for another influx of people. Then, as the cool breezes of autumn bathe the land, visitors arrive to take part in the annual harvest. In 2006, around 900 people from across the country harvested about 2 tons of *tsugaru roman* rice, which was given to those who took part and to those who helped with the spring planting.

The 2008 effort, Inakadate's 16th since the custom began in 1993, featured images of Daikoku

(god of wealth) and Ebisu (god of fishers and merchants). An accompanying image of the logo of Japan Airlines—which sponsored the event in 2008—also provided a dose of controversy. Part way through the season, the logo was removed following complaints by the owner of the fields that it contradicted the community nature of the tradition.

Following the harvest, as one year's transient beauty is cut down, Mr. Nakayama and other Inakadate officials turn their minds to the next year's artistic crop. These days, they also host seminars at the request of other farming communities around Japan on the practical details of creating rice-paddy art.

Mr. Nakayama expects that the spectacle will continue to grow.

"One thing's for sure," he says. "We have more ambitious plans for our rice-paddy art every year."

Yoko Hani is a staff writer at the Japan Times. Edited version reprinted with permission from the Japan Times.



INAKADATE'S 2008 effort featured images of *Daikoku* (god of wealth; left) and *Ebisu* (god of fishers and merchants).

RICE ON THE CUTTING EDGE

by Yothin Konboon

SOMETIMES THE BEST INVENTIONS ARE ACCIDENTAL. IN NORTHEASTERN THAILAND, FARMERS ARE ADOPTING A WEED-CONTROL METHOD FIRST TAUGHT TO THEM BY THEIR ANIMALS.

If performed correctly, the practice of planting rice by broadcasting rice seeds directly into unflooded soil offers several advantages over the usual practice of transplanting seedlings into flooded fields. Farmers can save time and labor, less water is required to establish the crop, and dry direct-seeded rice suffers less from early-season drought. These are important advantages, especially in rainfed rice, and dry direct seeding is gaining popularity in a number of areas across Asia. According to the Thai Office of Agricultural Economics, around 38% of rainfed rice (reliant on rain with no irrigation infrastructure) in northeastern Thailand in 2005 was planted to dry direct-seeded rice, and this figure is growing.

The main problem with direct-seeded rice is weed control. Transplanting seedlings gives rice a head start over weeds, and a continuous layer of water suppresses weed growth. In northeastern Thailand, the methods used to control weeds differ from place to place. Some farmers follow official agriculture department recommendations while others develop their own methods.

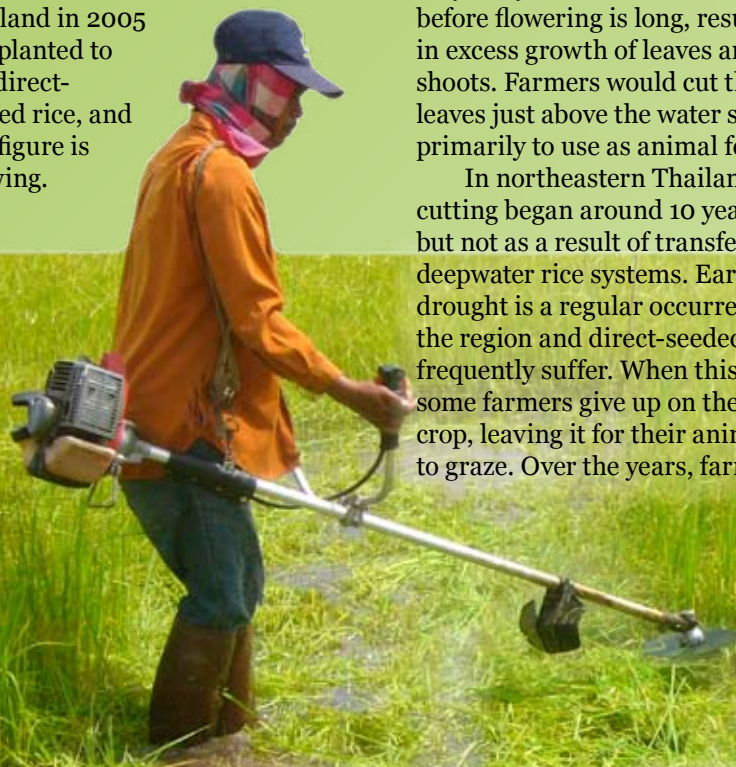
One of the most promising farmer-initiated controls is rice cutting, a method first studied in 1998 in deepwater rice by Thai researcher Tawee Kuptkarnjanakul. Because deepwater rice is planted very early in the season, the period before flowering is long, resulting in excess growth of leaves and shoots. Farmers would cut the leaves just above the water surface primarily to use as animal feed.

In northeastern Thailand, rice cutting began around 10 years ago, but not as a result of transfer from deepwater rice systems. Early-season drought is a regular occurrence in the region and direct-seeded crops frequently suffer. When this occurs, some farmers give up on their crop, leaving it for their animals to graze. Over the years, farmers

have discovered that, when the rains finally resume, the grazed crop recovers well and ends up yielding a reasonable harvest.

After a few years of trial and error, farmers in different areas developed their own rice-cutting methods, which all include cutting down weeds as well as rice early in the season. In some places, cutting is done primarily to reduce weed competition; in others, it is to improve soil fertility. The practice is spreading through farmer-to-farmer communication, media campaigns, and extension workers (the people responsible for technology dissemination). However, farmers' and researchers' understanding of the benefits of rice cutting, and the conditions under which it succeeds or fails, is still very limited. Therefore, Thailand's Ubon Ratchathani Rice Research Center (URRC)—with assistance from the Consortium for Unfavorable Rice Environments (CURE), a group of national and international institutions led by the International Rice Research Institute—has recently conducted farm surveys to study and test this technology.

Farmers who practice rice cutting say that it boosts their rice yields substantially, with some claiming that it also improves soil fertility. They tend to use the method with tall, photosensitive rice varieties—that is, varieties that flower in October independent of the sowing date—including Thailand's famous jasmine rice. Once the rice crop has been established, it is managed as usual until late July–early August when the rice cutting is conducted. This leaves around 50 days before



CUTTING RICE with a swing grass mower can help control weeds.



A FARMER GROUP discusses the rice-cutting method.

the development of the panicle (the panicle bears the grain later on). The cutting time is crucial for success. Cut too early and it has no effect on weed and rice growth because the plants are too small. Cut too late and the rice plant may not recover sufficiently to produce a good yield.

Using a swing grass mower (see photo, *opposite*), farmers cut rice and weeds at a height of around 5 cm above ground. Thus, the water level in the field should not rise much higher than that. In fields where deeper water levels occur regularly, the water will suppress weeds adequately without the need for cutting. If the rice plants are cut much higher than 5 cm, the stimulating effect on the number of stems (which carry panicles later) does not occur. Therefore, the method works best in middle terraces where the water level is low enough for optimum cutting but sufficient to allow good crop growth after cutting. The practice is not recommended on upper and lower terraces.

The uses of the cuttings differ from farm to farm. Some farmers leave the residues in the field for soil mulching and to recycle plant nutrients. Others use the cuttings as animal feed. A few days after cutting, farmers usually apply

fertilizer to boost crop growth and promote the decomposition of residues. By 10–15 days after cutting, the rice crop has regrown to the same height as before the cutting.

To evaluate the effect of rice cutting, URRC conducted on-farm trials in 2007–08, targeting farmers who had not previously practiced rice cutting. Two treatments—rice cutting in dry-seeded broadcast rice and the normal farmer practice of dry-seeded broadcast rice—were compared in 23 farmer fields. Initial results showed that rice cutting was effective in suppressing weeds and average rice yields improved by 12% over the no-cutting treatment. However, variation was considerable from farm to farm and some farmers had no yield increase.

Discussions among farmers and researchers revealed several other benefits aside from increased yield: reduced weed competition also lowered the labor needs for weeding, fewer pest problems occurred because of a less dense and more aerated crop canopy, and harvesting was easier because of the more uniform plant height and flowering time.

In conclusion, rice cutting can help increase the productivity of rainfed rice in northeastern Thailand and, importantly, can be integrated

THE AUTHOR with a swing grass mower.



into the existing rice production system. Especially in areas with poor soils and severe weed problems, rice cutting offers new opportunities to sustain and improve productivity and farmer livelihoods, as well as to benefit the environment. And, finally, rice cutting provides a great example of how farmers' knowledge and modern research can combine to stimulate new insights into rice production systems.

Dr. Konboon is an agronomist at URRC in Thailand.



Dedicated scientists—a child's inspiration

During the summer of 2006, Usha Rani Palaniswamy returned with her father, K.M. Palaniswamy, to the International Rice Research Institute (IRRI) for the first time in 35 years. In 1968, as a young child, Dr. Palaniswamy moved from India to Institute headquarters in Los Baños, Philippines, when her father was assigned to IRRI's Statistics Department. Fondly recalling those days through the mind and eyes of a child, she relates how the experience influenced her future career in science. When interviewed, she was an assistant professor of plant physiology at the University of Connecticut. Today, she is chair of the Division of Natural Sciences and Mathematics at Excelsior College in Albany, New York. She also pays loving tribute to her father, who at age 78 died tragically in a road accident in India on 5 December 2007, a little over a year after his own Pioneer Interview (see box) during the same 2006 IRRI visit. She is the co-author (with her father) of A handbook of statistics for teaching and research in plant and crop science and more recently of Asian crops and human dietetics.

Growing up

During my stay at IRRI, I really grew up. Coming from India [Tamil Nadu Agricultural University where my father was based], I had the opportunity to interact with new cultures that I found to be friendly and warm. We were greeted with great smiles and were most fortunate to make some very good friends during our stay.

Although I was only 10 years old, I had the opportunity to observe many dedicated scientists at work. I was impressed with that dedication, exemplified by my own dad who was out of the house all day working very hard. In one way or another, all the scientists focused on one plant—a single crop, rice, which is the most important one in the whole world. I thought a lot about plants then. Plants play such important roles in our lives in many different ways besides just giving us food. It was for these reasons, the dedication of the IRRI scientists and the importance of plants, that I decided

to become a scientist myself—specifically, a horticulturist.

IRRI provided our entire family with a unique opportunity to interrelate with new cultures and to learn about the world and the people in it. I look back at my time at IRRI and see it as one of the greatest periods of my life. I really matured as I had interactions with not only the great culture of the Philippines but also other cultures that were part of IRRI's international community, including Koreans, Thais, and even Indians from different states in my home country whom I would not have had the opportunity to meet if my dad had left us in Tamil Nadu.

Warm local culture

I fondly remember the large trees with white flowers at IRRI headquarters and the green grass on which we would have picnics and share our snacks in the evening with my dad and his colleagues [see photo, below]. We would come to IRRI on the bus and enjoy the fountain, the lights, and the cool



HAPPY DAYS at IRRI circa 1970: Usha Palaniswamy (with white headband and glasses) enjoys snacks with her father Kodiveri (to her left), mother Indrani (in front of her), her three siblings (from center to right in back row) Meera Devi, Vijayaraghavan, and Rajeswari, Statistics Department research assistant Rosalinda Alicbusan Graham (second from left in back row), husband Bill, and family friend Verna Estaphia (left foreground).

air-conditioned lounge. We came for the movies screened in the Chandler Hall Auditorium and were greatly appreciative of the gifts that we little kids would get at Christmas time.

The local people with whom we interacted were so kind. As Hindus, we never really appreciated Christianity or celebrated Christmas before coming to the Philippines. We stayed at the Gonzales Compound outside of IRRI and the landlady would knock on our door and offer us rice and different desserts. Since my mom is a vegetarian, our hosts made a point of offering us many vegetables and fruits that were growing in their gardens. We had great appreciation for the local culture, which is so very warm and friendly. I look back on this all with fond memories, enjoying it all.

A model for research

I returned to IRRI [in 2006] to look into including the Institute as a model of successful agricultural research outside the United States in a curricular development and innovation project I'm working on [funded by the U.S. Department of Agriculture/Cooperative State Research, Education, and Extension Service – International Science and Education Competitive Grants Program]. I hope to inspire young students to become agricultural scientists just as I once was years ago by my IRRI experience. IRRI can truly be an educational model to show that real-world issues and problems can be solved through science and research.

Agriculture is the most basic of professions that has touched the lives of people since time immemorial, since antiquity. That will continue and it is very important that we keep the younger generation excited about agriculture and that they consider agriculture as a desirable career option. My effort here is to incorporate IRRI's techniques in my curriculum design and university teaching. Many universities in the United States should be very excited about research that's happening overseas and making students

Excerpt from K.M. Palaniswamy's Pioneer Interview: On IRRI's fastidious but accommodating director

During my stay at IRRI, I had several occasions to accompany Dr. Robert Chandler [IRRI director general, 1960-72] in and around the Institute. I observed that he had a keen interest in keeping the IRRI grounds very clean and neat. Once, when I was walking with him in the cafeteria, he saw a cigarette butt on the floor. He bent down, picked it up, and carried it all the way to a waste bin. It was very surprising to see a person of his stature cleaning up the area. But it was a memorable lesson [teaching by example] for all of us watching.

One very important event I remember was the moon landing by the American astronauts on 20 July 1969. At that time, Dr. Chandler opened the lounge so all the staff from IRRI and the University of the Philippines at Los Baños could watch the landing on the TV. Everyone was silent and watched very keenly. When the landing was over, we expressed our joy and happiness with smiles all around. It was a great event in history that, thanks to Dr. Chandler's accommodating forethought, we all had a chance to witness.



aware of it, as well as thinking about playing an important collaborative role in alleviating poverty through scientific efforts in agriculture.

A tribute to dad

My dad—my inspiration and role model in my life—was very passionate about rice. We both shared fervor for the plant sciences. He enjoyed watching farmers working in their fields in the early morning. As I have been living outside of India for a long time (in the United Arab Emirates since 1982 and the U.S. since 1994), I had not had much time with him. So, I took advantage of our summer 2006 excursion to IRRI.

We went out for morning walks and watched the workers in the IRRI rice plots. His face would light up immediately as he would smell the air and start talking about the importance of agriculture in the human experience. During his scholar days at IRRI and the nearby University of the Philippines at Los Baños, he studied under Dr. Kwanchai Gomez, IRRI's chief statistician [see Figures, fake guns, and fund-raising, on pages 16-19 of Rice Today Vol. 7, No. 4]. So, it was no surprise that, even 35 years later, he was quick to point out the importance of statistical methods in field experiments. He

could immediately pick out an off-type in a plot and say how important it is to rogue a plot [remove infected or undesirable individuals from a pure population] that is being used for producing good seed or obtaining good experimental results.

Dad was a self-made man who raised all his children to be scholars. He continued to learn and obtained his PhD. He held several key positions as department head of physical sciences at Tamil Nadu Agricultural University; professor of statistics at Khartoum University, Sudan; and an expert with the United Nations Economic Commission for Western Asia in Iraq.

Since retirement, he was working on a book, *Guidelines for rice researchers in the estimation of some plant parameters*. I contributed some of the chapters and hope to complete it soon in his memory.

He was in excellent health so his passing, due to the road accident in Coimbatore, was all too sudden for any of us to grasp as being real.

Go to www.irri.org/publications/today/Pioneer_Interviews.asp for this and other Pioneer Interviews as IRRI approaches its 50th anniversary in 2010.



Rice in the Dragon's shadow: CHINA 1976



by Randy Barker

The political turmoil of the 1970s formed the backdrop to the first visits of International Rice Research Institute staff to China. Agricultural economist Randy Barker, one of the team of scientists who ventured to the world's largest rice producer, recounts the experience.

The first person-to-person contact between the International Rice Research Institute (IRRI) and China occurred in 1974. On that occasion, IRRI Director General Nyle Brady joined a delegation of plant scientists for a 1-month tour during which he provided China with seeds of IRRI-developed rice varieties. In March and April 1976, a team of eight Chinese agricultural scientists visited IRRI twice. With the success of these visits, the Chinese government invited an IRRI team to China in July 1976. However, Chinese Chairman Mao Zedong's illness—which resulted in his death on 9 September—forced the trip's postponement until October.

The seven of us who made the journey (see map, page 26) represented a good mix of nationalities and disciplines: Nyle Brady (director general, United States), Mano D. Pathak (entomologist, India), Shu Huang Ou (plant pathologist, China), Shouichi Yoshida (plant physiologist, Japan), Gurdev Khush (plant breeder, India), Surajit K. De Datta (agronomist, India), and I (economist, United States).

Beijing, 7-12 October

We took the train from Hong Kong to Guangzhou (Canton) on 7 October, changing trains at the Chinese border before flying to Beijing. Unbeknownst to us at the time, the infamous Gang of Four had been arrested in a coup d'état on 6 October. The Gang of Four was a leftist political faction composed of four Chinese Communist

party officials, including Mao's wife, Jiang Qing. The other members were Zhang Chunqiao, Yao Wenyuan, and Wang Hongwen. They were charged with a series of treasonous "counter-revolutionary" crimes. What we witnessed, however, in the meetings, the entertainment, the confessions on the wall, even the drab gray-blue look-alike clothes that people wore, was still a part of the soon-to-end Cultural Revolution (1966-76).

The route that we followed in China was the same as that assigned to professionals and tourists alike—Beijing, Nanjing, Shanghai, and Guangzhou. Our visit was a combination of professional activities, meetings, and sightseeing. We visited research institutions and communes, were briefed by staff at the National Academy of Agriculture and Forestry Science, and held discussions with agricultural scientists.

One of the most surprising visits was to the Institute of Microbiology,



THE AUTHOR (left) around the time of the 1976 China visit and Nyle Brady, IRRI director general 1973-81.

where they collected species of fungi. We were ushered into a room with drawers full of species that had been collected over time. Our interpreter pulled open a drawer randomly to show us what was inside. The fungus in the drawer had been collected and classified by S.H. Ou from 1934 to 1936 while he was working at the Institute of Agricultural Science in Jiangsu Province. You can imagine Ou's excitement. Other drawers were opened up and two or three also contained

species that Ou had collected.

We had our first glimpse of agriculture at the Double-Bridge Commune 25 km east of Beijing. The population of 40,000 was situated on 90 square kilometers, including 3,600 hectares under cultivation. There were six production brigades and 62 production teams—a structure that to me seemed comparable with that of the U.S. army. The main crops were wheat, rice, vegetables, and fruits. Livestock included dairy, pigs, ducks, and fishponds. Vegetable, fruit, and livestock products were shipped to nearby Beijing. At harvest time, the factories were required to provide labor to the commune free of charge.

From Beijing, we took the night train to Nanjing. Except for us, the only other passengers on the train were soldiers. At the time, movement in China was strictly controlled. Most people were assigned to communes and given ration cards for food. Grain was rationed—about 15 kg per month for city folk and double that for a person doing hard work in the commune. There was almost no opportunity for civilians to travel. At 6 a.m., we were woken by loudspeakers blaring words of wisdom from Mao Zedong. Later in the morning, we passed

through Anhui Province, historically one of the poorest areas in China and the setting for Pearl Buck's book *The Good Earth*.

Nanjing, 13-15 October

In Nanjing, we visited the Soils Institute of the Chinese Academy of Sciences, which had been protected from the Cultural Revolution. Staff members there were particularly proud of their library, which contained some foreign publications. This raises an interesting point: it seems that before and during the



FORMER IRRI STAFF who made the 1976 trip to China (left to right): rice breeder Gurdev Khush, entomologist Mano Pathak, and plant pathologist S.H. Ou.



THE IRRI TEAM with some of their Chinese hosts at Tai Lake, Wuxi, on 17 October 1976. Front row: S.K. De Datta (far left), S.H. Ou (third from left), then-IRRI Director General Nyle Brady (center), Randy Barker (fourth from right), and Mano Pathak (third from right). Back row: Gurdev Khush (left) and plant physiologist Shouichi Yoshida (right).

Cultural Revolution, agricultural research in general was protected. For example, semidwarf rice varieties (which resisted lodging, or falling over, just like the first Green Revolution semi-dwarf variety IR8, bred by IRRI) were first bred in China (including Taiwan) in the late 1950s and early 1960s using different parents. We now know that the Chinese and IRRI semidwarfs all have the same dwarfing gene. The Chinese also developed and released hybrid rice in the 1970s, using IRRI varieties IR24 and IR26 as fertility restorer parents. Hybrid rice varieties would soon cover around half of the country's rice area.

Basic research was conducted at the provincial and county level with extension of research findings carrying down to the commune, brigade, and production team level. We visited Jiangsu Academy of Agricultural Sciences (JAAS), which had a staff of 600 and 67 hectares of experimental fields. This was the same institute where S.H. Ou had worked before leaving mainland China for Taiwan. I photographed Ou sitting in his old office chair (see photo on page 24).

Also at JAAS, we met a "model farmer," Mr. Chen, who was carrying

out research. He was selected as a "national hero" in 1954 when he achieved a record rice yield. He used a system of nutrient management called "three yellows and three blacks," which referred to the green and yellow coloring of the various stages of growth. In a technique similar to that employed with IRRI's leaf color chart today, farmers made crop management decisions according to the colors of the plant.

Wuxi, 16-18 October

We took the train from Nanjing to Wuxi on the morning of the 16th. I had brought along a copy of John Lossing Buck's seminal work *Land Utilization in China*. I read the pages where he described the area we were traveling through, the lower Yangtze River Basin. As I looked out the window, the cropping patterns seemed much as Buck had described them. Buck was the husband of Pearl Buck and together they taught at the University of Nanking from 1920 to 1933. From 1929 to 1933, Buck organized a survey of 38,256 farm families in 22 provinces, which provided the materials for the book. The three-volume book was first published by the University of Nanking in 1937. His demarcation

of the agricultural regions of China remains basically the same today.

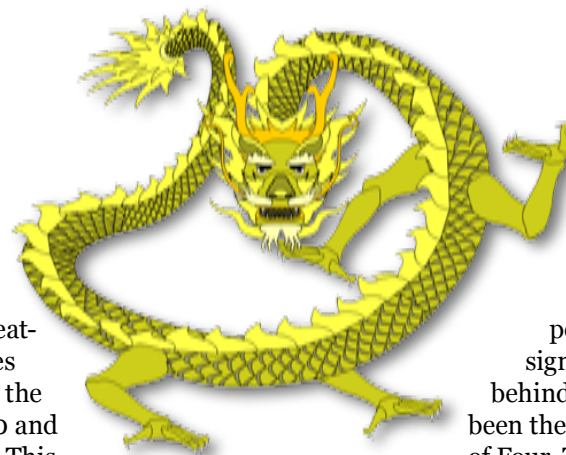
We visited two communes near Wuxi, where the main annual cropping pattern was wheat-rice. These two communes had a plan for developing the land, which began in 1970 and was to extend up to 1985. This involved an enormous amount of human labor to move soil, dig and straighten irrigation and drainage canals, and level land. The land was originally divided into about 15 fields per hectare, but, when we were there, each hectare was just a single field. The irrigation water was piped underground.

One evening, we attended a Chinese movie. It was much like an American melodrama. At one point, a Chinese and a Vietnamese naval ship were approaching each other. It was easy to make out the villains by their sinister looks. A peasant on the Chinese ship was about to fire at the Vietnamese ship when the party secretary put a hand on his arm and said, "We don't shoot until they shoot first."

My most vivid memories were of two events, one peaceful and one not so peaceful. First, we took a boat trip on the famous Tai Lake (see photo on page 25), and I can remember sitting on the lake's edge watching the sun set. Second, and even more memorable, on the day we arrived in Wuxi, S.H. Ou and Shouichi Yoshida read signs on the wall and told us that something big was afoot. This was the beginning of the mass movement against the Gang of Four. On the morning of the 18th, on the way to the railroad station, we passed demonstrators parading in the streets carrying signs condemning the Gang of Four. Our interpreters said very little. But I was sitting next to one of our interpreters, Mr. Huang, who was obviously pleased. As he put it, "The masses know what is best."

Shanghai, 18-21 October

After visiting a doll factory, we boarded the train for Shanghai at



about 10:15 a.m., arriving two hours later. The whole city was buzzing with demonstrators. Signs on every wall denounced the Gang of Four. Crowds of people were either reading the signs or forming ranks to march behind red banners. Shanghai had been the headquarters for the Gang of Four. The demonstration was very well organized and a great victory for the people (meaning Deng Xiaoping, about whom I will say more later).

We were asked to stay in our hotel except when escorted by our hosts, and to take no photos. However, we were able to hold discussions with scientists and make visits to two communes. We learned quite a bit more about the accounting system and taxation procedures—commune, brigade, production team—much of which carried over into today's farm and village structure with the dismantling of the commune system.

One evening, members of S.H. Ou's family came to visit him. He met them in the lobby, which he felt was safer than meeting in his room. When I asked him later what the family thought of the demonstrations, he said: "We didn't discuss this, only family matters."

Guangzhou, 21-26 October

On the 21st, we flew from Shanghai to Guangzhou, where authorities were preparing a celebration of the people's victory over the Gang of Four. To avoid the crowds, we were taken to a hotel at the Zhonghua hot springs.

We were briefed at the Guangdong Provincial Academy of Agricultural Sciences by a rice specialist, Lao Yanhai, who had been to IRRI. A main focus of plant breeding was on the three-crop system of rice, which they claimed would yield 16 tons or more per hectare per year over three crops. They were even trying to introduce a fourth annual crop, rice followed by wheat, soybeans, or rapeseed. The breeding stressed early maturity, resistance to insects and disease, and high yield.

At this point, I want to digress

and point out that each briefing was preceded by a short political speech. One of the Chinese scientists began his talk as follows:

"Since the liberation, under the guidance of Mao Zedong, following the movement to deepen the criticism of Deng Xiaoping, the rightist revolutionary, following the principle of learning from Dazhai, and carrying on our work in a self-reliant way, we reformed the cropping system to grow three crops of rice."

It was quite a mouthful. Later, I asked our Mr. Huang if Deng Xiaoping was wrong in his agricultural policy. He answered that Deng had the wrong attitude about Dazhai. Dazhai was a brigade in Shanxi Province that had, as the saying goes, "pulled itself up by its bootstraps," although some said they received a lot of help from the government. Everywhere we went, there were big red banners proclaiming: "In agriculture learn from Dazhai." Apparently, Deng Xiaoping felt there should be more emphasis on economic development rather than taking the concept of self-reliance, as expressed in Dazhai, to the extreme.

Deng Xiaoping, of course, having outmaneuvered the Gang of Four, would soon become de facto leader of China, replacing his long-time friend, Zhou Enlai, who died of cancer in January 1976. Although he never held office as the head of state or the head of government, Deng served as de facto leader from 1978 to the early 1990s. Under his leadership, China established an open market economy and abolished the communes in favor of small family farms. The increase in productivity was dramatic and, a decade later in the late 1980s, Vietnam would follow the Chinese policy, also boosting productivity remarkably.

One evening, we were taken to see an "opera." This was not the kind of Chinese opera that we were familiar with. Instead, it was a play in which the Communists were fighting the Nationalists. At one point, it seemed that the Nationalists had the Communists

pinned down. "Go over to the next hill and get the Party Secretary! He will tell us what to do."

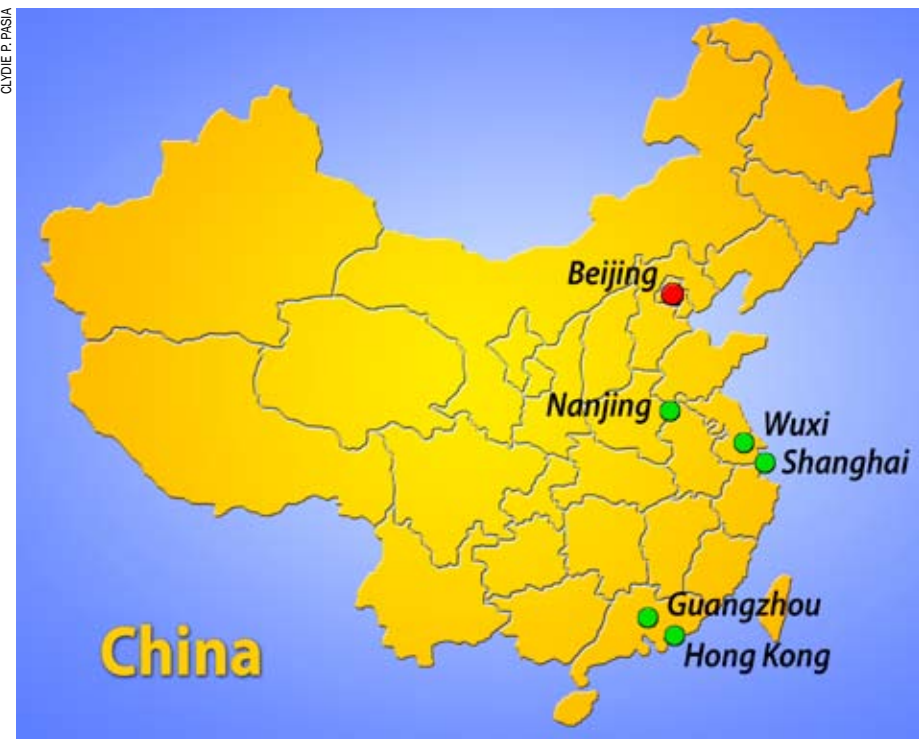
At all of the major stops, we handed out publications and rice varieties and received publications in return. We also brought hand-operated fertilizer placement machines. In 1976, as in 2008, there was a worldwide energy and fertilizer shortage. IRRI was experimenting with methods of placement to improve fertilizer-use efficiency.

On the next to last day of our tour, we visited the Syn Hwa People's Commune about 40 km northwest of Guangzhou. S.K. De Datta and I were at a brigade research station. I said to S.K., "You see that implement over in the corner? That looks just like our fertilizer placement machine." We began asking questions, and learned in our discussions that deep placement had been widely practiced in southern China since the late 1960s. Shouichi Yoshida told us that a Japanese team discussed this method with the Chinese in the mid-1960s. His uncle had helped to popularize the method in Japan during World War II.

Homeward bound

On the 25th, Nyle Brady left for Hong Kong and then Washington, D.C. On the morning of the 27th, the rest of us boarded the train for Hong Kong and left as we had come. The trip marked the beginning of dramatic changes in China and of a close relationship between China and IRRI. Back at IRRI, we met the staff at the guesthouse to report on our trip and later published a report in English and Chinese (with a red cover), *Rice research and production in China: an IRRI team's view*, which detailed our observations. 🍚

Dr. Barker headed the Department of Agricultural Economics at IRRI from 1966 to 1978. In 2007-08, he returned to IRRI as acting head of the Social Sciences Division. He extends his thanks to those who made the trip with him and others for their useful comments.



How much water does rice use?

by Bas Bouman

Rice Today examines this often-asked (and often poorly answered) question

Many people ask the question, “How much water does it take to produce 1 kg of rice?” The answer to this question lies in the definition of “water use” and of “rice.” We can identify three types of water “use”—through transpiration, evaporation, and a combination of seepage and percolation—at, respectively, three scales of rice—the plant, the crop, and the field.

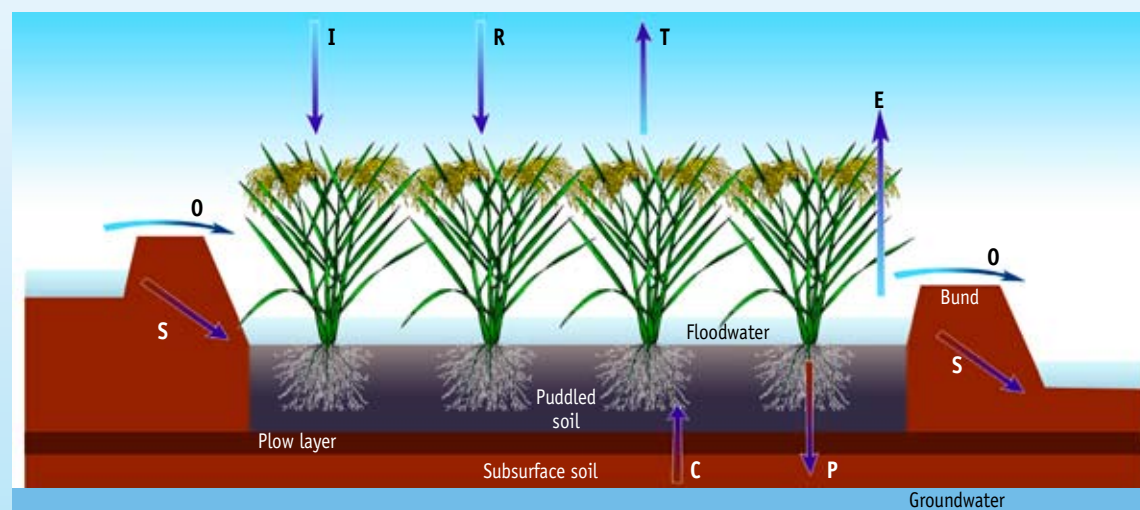
The **rice plant** “uses” water through the process of transpiration, which cools the plant and drives the upward sap flow—which carries essential nutrients—from roots to leaves. This is a “real” water use, since once the plant has taken up water and released it to the atmosphere through transpiration, that amount of water is no longer available for reuse by that same plant in the same growth cycle. Transpired water enters the

global water cycle and will eventually return to the earth as rain or snow.

The **rice crop** comprises the plants and underlying soil. Besides transpiration from the plants, water leaves the crop from the soil underneath through evaporation. Like transpiration, evaporated water is “lost” and cannot be used again by that same crop in the same growth cycle. This combined water use by a rice crop is called “evapotranspiration.”

In **rice fields**, water is often ponded to ensure there is plenty for the crop to take up. Besides

evapotranspiration, outflows of water from a field occur through seepage and percolation: sideward and downward water flows through the soil and bunds out of the field. For an individual farmer, these are real losses as well, and she considers the total combined outflows by evapotranspiration, seepage, and percolation as water use by her rice field (see figure). The farmer needs to ensure sufficient irrigation (to complement rainwater if rainfall is insufficient) to match all these outflows. At a larger spatial scale, however, seepage and percolation



WATER BALANCE of a puddled rice field: C = capillary rise; E = evaporation; I = irrigation; O = over-bund flow; P = percolation; R = rainfall; S = seepage; T = transpiration.

flows from one field enter the groundwater or creeks and drains, from where other farmers may reuse the water to irrigate other fields. This is in contrast to the water losses by evapotranspiration, which cannot be recaptured.

Rice plant water use (by transpiration)

Pot experiments and greenhouse studies carried out at the International Rice Research Institute (IRRI) have shown that rice plants growing under a range of water applications transpired 500–1,000 liters of water to produce 1 kg of rough (unmilled) rice.¹ This is at the high end of comparable cereals such as wheat and barley.

Rice crop water use (by evapotranspiration)

The estimated water use by evapotranspiration of all rice fields in the world is some 859 cubic kilometers per year.² With a global rough rice production of around 600 million tons, it takes an average of 1,432 liters of evapotranspired water to produce 1 kg of rough rice. This is roughly the same as the world-average water use of wheat, but higher than that of maize and barley (see Table 1).

The variability in water use

Table 1. World-average water use by evapotranspiration of major nonrice grain crops (liters of water per kg of grain).

Source	Wheat	Maize	Barley
Falkenmark and Rockström, 2004 ³	1,480	1,150	1,000
Chapagain and Hoekstra, 2004 ⁴	1,300	900	–

Table 2. Liters of evapotranspired water needed to produce 1 kg of rough rice.

Source	Minimum	Medium	Maximum
Zwart and Bastiaansen, 2004 ⁵	625	909	1,667

¹ Haefele SM, Siopongco JDLC, Boling AA, Bouman BAM, Tuong TP. 2008. Transpiration efficiency of rice (*Oryza sativa* L.). Field Crops Research. (In press.)
² Mom R. 2007. A high spatial resolution analysis of the water footprint of global rice consumption. Master thesis, University of Twente, Enschede, Netherlands.
³ Falkenmark M, Rockström J. 2004. Balancing water for humans and nature: the new approach in ecohydrology. Earthscan, London, UK. 247 p.
⁴ Chapagain AK, Hoekstra AY. 2004. Water footprint of nations. Value of water research report series No. 16. Delft (Netherlands): UNESCO-IHE. 76 p.
⁵ Zwart SJ, Bastiaansen WGM. 2004. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. Agric. Water Management 69:115-133.

Table 3. Total global water use (cubic kilometers of water per year).

Source	Chapagain and Hoekstra, 2004 ⁴	Falkenmark and Rockström, 2004 ³
Total	7,450	8,160
Food	6,390	7,200
Industry	716	780
Domestic	344	180

by evapotranspiration by rice crops is large. Table 2 summarizes experimental data from well-managed lowland field experiments with rice.

By comparison with total global water use, Table 3 puts the world rice water use by evapotranspiration into perspective. Producing the world’s rice accounts for 12–13% of the amount of evapotranspired water used to produce all of the world’s food (food crops and grass and fodder for livestock).

Rice field water use (to account for evapotranspiration plus seepage and percolation)

On average, about 2,500 liters of water need to be supplied (by rainfall and/or irrigation) to a rice field to produce 1 kg of rough rice. These 2,500 liters account for all the outflows of evapotranspiration, seepage, and percolation. This average number is derived from

a large number of experimental data at the individual field level across Asia. Variability is large, ranging from around 800 liters to more than 5,000 liters. This variability is caused by crop management (such as variety planted, fertilization

regime used, and pest and disease controls adopted), weather, and soil properties. At the field level, water inputs to rice fields are 2–3 times those of other major cereals.

Although rice’s water productivity in terms of evapotranspiration is similar to that of comparable cereals such as wheat, rice requires more water at the field level than other grain crops because of high outflows—in the forms of seepage and percolation—from the field. However, because these outflows can often be captured and reused downstream, rice’s water-use efficiency at the level of irrigation systems (which comprise many fields) may be higher than that at the field level. Nevertheless, around one-quarter to one-third of the world’s developed freshwater resources are used to irrigate rice (which, it must be remembered, is the staple food for almost half the world’s population).

Rice production must be viewed in the light of the emerging water crisis, as climate-change-induced shifts in rainfall patterns combine with the diversion of irrigation water for urban and industrial uses. As agricultural water scarcity increases, there is a growing need for water-saving technologies such as aerobic rice (varieties that grow well in unflooded fields; see *High and dry* on pages 28-33 of *Rice Today* Vol. 6, No. 4) and more efficient irrigation regimes such as alternate wetting and drying (see *The big squeeze* on pages 26-31 of *Rice Today* Vol. 7, No. 2).

Dr. Bouman is a senior water scientist and head of the Crop and Environmental Sciences Division at IRRI.

Soil quality in rainfed lowland rice

by Stephan Haefele and Robert Hijmans

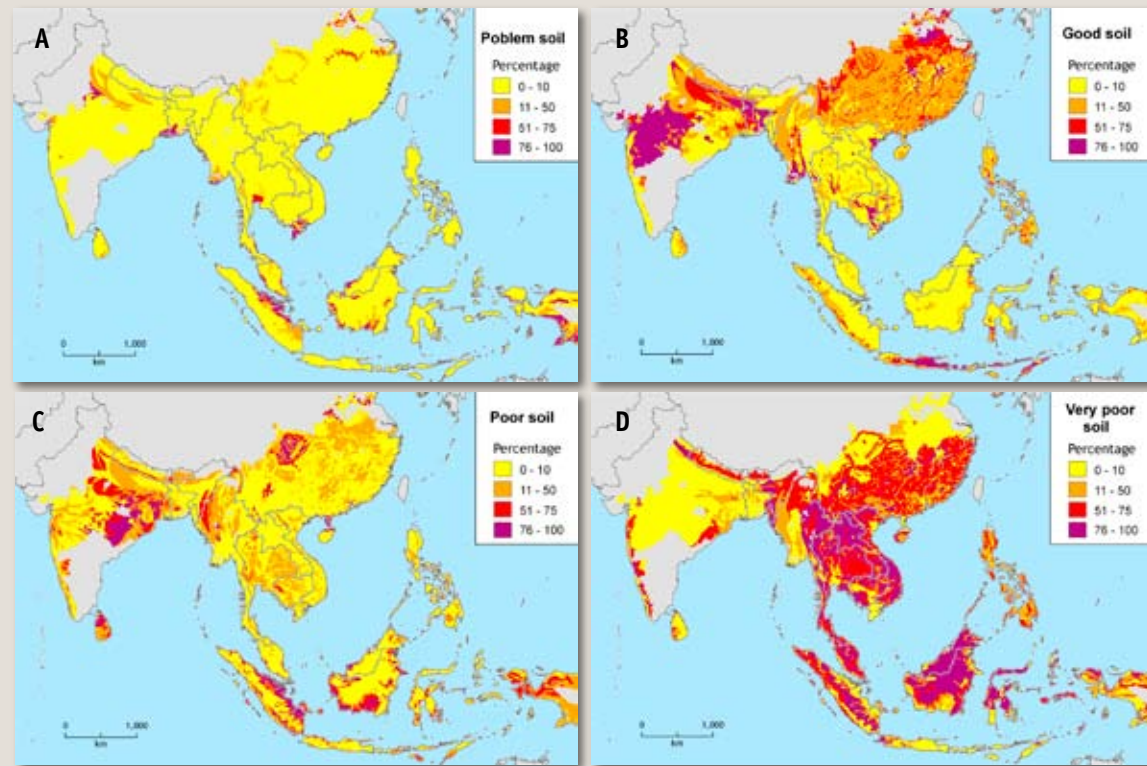
Rainfed lowland rice agroecosystems are characterized by fields that are flooded for at least part of the growing season, but that are not irrigated. Asia has about 46 million hectares of rainfed lowland rice, constituting almost 30% of the global rice area. Rice production in these ecosystems—often hampered by drought, submergence, and problem soils—is associated with low productivity, and with a high incidence of poverty.

Recent technological advances, such as the development of stress-tolerant rice varieties and improved crop-management options, can help boost yields substantially. However, such benefits depend strongly on the quality and availability of natural resources, particularly soil and water. Here, we present maps that help characterize soil quality and soil-related constraints in rainfed lowland rice ecosystems (excluding deepwater rice) in Asia.^{1,2}

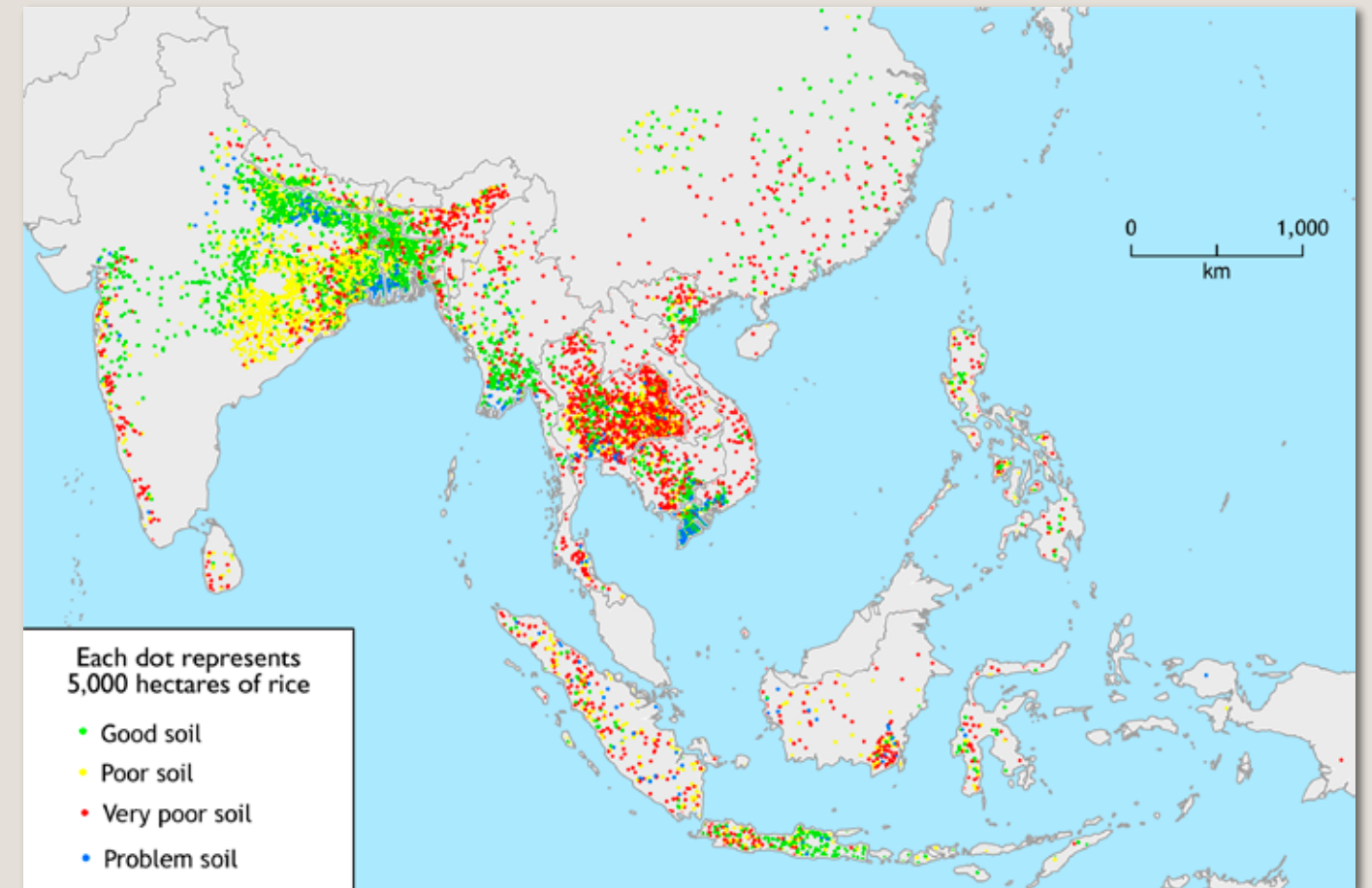
We transformed the data of the *Soil map of the world*³ by creating four soil quality groups.⁴ The first two groups—“good” and “poor” soils—do not have major soil chemical constraints but differ in their degree of weathering (the physical and chemical breakdown of soil over time) and, therefore, their indigenous soil fertility (the amount of nutrients the soil can supply). The third group—“very poor”—represents highly weathered soils that are likely to have multiple soil chemical

constraints to crop growth (such as acidity, severe phosphorus deficiency, and iron and aluminum toxicities). The last group—“problem soils”—combines the most frequently cited soil problems, including acid-sulfate, peat, saline, and alkaline soils, which partly cause low fertility, and partly cause soil chemical toxicity.

Although not widespread, problem soils are locally important, especially in northern India (sodic soils); in some coastal lowlands of Bangladesh, Myanmar, Thailand,



Map 1. Soil quality in areas where rainfed lowland rice is grown in Asia.



Map 2. Distribution of rainfed lowland rice soil quality area in Asia. Each dot is colored to represent the assumed dominant soil class.

and Vietnam (saline and acid-sulfate soils); and in coastal regions of Borneo, Sumatra, and New Guinea (acid-sulfate and organic soils) (Map 1A). Fertile soils without major constraints are relatively widespread in India, Bangladesh, western Myanmar, Java, Cambodia, northern China, and Korea (Map 1B). Poor soils without major constraints are frequent in eastern India, Sri Lanka, coastal lowlands of Borneo and Sumatra, and New Guinea (Map 1C). Very poor soils with considerable soil constraints are particularly common in the eastern parts of Myanmar, most of Thailand, Laos, Vietnam, Malaysia, Borneo, Sumatra,

and Cambodia (Map 1D). In India, very poor soils are mostly limited to the west coast and to mountainous regions in the north and northeast.

We overlaid the soil groups with the distribution of rainfed lowland rice area (Map 2).^{5,6,7} The results show that only about one-third of rainfed lowland rice is grown on relatively fertile soils, slightly less than one-third grows on soils with low indigenous soil fertility, and slightly more than one-third is produced on soils with considerable soil constraints often combined with very low soil fertility. Rainfed lowland rice in Southeast Asia is much more likely to be on poor soils with various

soil constraints compared with South and East Asia. About 7% of rainfed rice is grown on problem soils such as acid-sulfate or saline soils.

Soil quality is a major constraint contributing to the low productivity of rainfed lowland rice ecosystems. However, spatial variation should not be ignored: farmers growing rainfed lowland rice in Southeast Asia are much more likely to encounter very poor soils with various soil constraints than farmers in South and East/Northeast Asia.

Dr. Haefele, a soil scientist, and Dr. Hijmans, a geographer, work at IRRI.

¹Our approach is based on that of Garrity DP, Oldeman LR, Morris RA. 1986. Rainfed lowland rice ecosystems: characterization and distribution. In: Progress in rainfed lowland rice. International Rice Research Institute (IRRI), Los Baños, Philippines. p 3-23.

²For more details, see Haefele SM, Hijmans RJ. 2007. Soil quality in rice-based rainfed lowlands of Asia: characterization and distribution. In: Aggarwal PK, Ladha JK, Singh RK, Devakumar C, Hardy B, editors. Science, technology, and trade for peace and prosperity. Proceedings of the 26th International Rice Research Conference, 9-12 October 2006, New Delhi, India. IRRI, ICAR, and NAAS. p 297-308.

³Food and Agriculture Organization of the United Nations: The digital soil map of the world. An updated version is available from www.iiasa.ac.at/Research/LUC/luco7/External-World-soil-database/HTML/index.html.

⁴To do this, we simplified the Fertility Capability Soil Classification (FCC) system, which classifies soil types into agronomically relevant groups. See Sanchez PA, Palm CA, Buol SW. 2003. Fertility capability soil classification: a tool to help assess soil quality in the tropics. *Geoderma* 114:157-185.

⁵See *The where and how of rice* on pages 19-21 of *Rice Today* Vol. 6, No. 3.

⁶This type of analysis is hampered by the spatial resolution of soil data. The digital soil map of the world was updated recently but it does not include detailed soil data that are available nationally, but even these data suffer from large variability within mapping units. In the future, this will probably be addressed by predictive spatial modeling of soil properties.

⁷Soil characteristics can be strongly modified by local geomorphology and hydrology. Integration of soil characteristics with land properties such as slope and climate is a next step we want to take in the characterization of Asia's rainfed lowland rice ecosystems.

Love at first site

by Florencia Palis and Greta Gabinete

One Filipino farmer's experience with a better way of managing his crop's fertilizer needs could inspire change across the nation's rice fields

The global food crisis of 2008 hit Asia particularly hard. The price of rice, Asia's predominant staple food, rose faster and farther than almost any other food, placing enormous pressure on millions of poor consumers who spend a substantial portion of their income on the grain.

And, despite higher prices, farmers, too, face formidable challenges to make rice production profitable. With fertilizer prices skyrocketing, farmers more than ever need to be creative, resourceful, and adaptive in their nutrient management.

This is the story of Johnny Tejada, a 46-year-old Filipino rice farmer who took the risk of deviating from the traditional way of applying fertilizer. Mr. Tejada adopted a relatively new practice known as site-specific nutrient management (SSNM), which allows farmers to "feed" rice with nutrients as and when needed (see figure on page 34). Non-SSNM fertilizer recommendations available to Mr. Tejada prescribed

higher rates of some nutrient sources and did not provide such detailed guidelines on the optimal distribution and timing of nutrients during the growing season.

According to Roland Buresh, soil scientist at the International Rice Research Institute (IRRI) and one of the lead developers of SSNM, the approach helps rice farmers "to increase their profit by optimally supplying their crop with essential nutrients." Moreover, by applying need-based nitrogen (N), phosphorus (P), and potassium (K) fertilizer, farmers can not only boost their income, they can also reduce the incidence of pests and diseases.

Mr. Tejada owns 1.3 hectares of land in Iloilo Province, Philippines. One of the top five rice-producing provinces in the country, Iloilo (pronounced "Ilo-ilo") is the rice granary of the central Philippines. Mr. Tejada's municipality of Tigbauan, a 30-minute drive from Iloilo City, is composed of 52 villages with a total population of 57,000.

Ninety percent of the municipality's approximately 9,000 hectares are devoted to agriculture, with about 4,550 hectares planted to rice and an average farm size of 0.5 hectare.

"Life is tough nowadays," says Mr. Tejada. "The gasoline cost is so high that it shoots up the cost of preparing the land for rice cultivation. Fertilizer inputs are so expensive."

In 2007, the price of urea (N) fertilizer was 850 Philippine pesos (US\$17.50); as of October 2008, it was PhP 1,950 (\$40). NPK fertilizer was PhP 700 (\$14.40) in 2007, but PhP 1,840 (\$39) as of October 2008.

Filipino farmers consider fertilizers as "vitamins," helping to protect plants against illness or disease, and as "food," essential for fast and healthy plant growth. Without fertilizers, farmers believe plants to be malnourished. Because farmers associate healthy plants with greenness, these beliefs have led many Filipino farmers to associate fertilizers predominantly with N. Thus, because N is responsible for



LORELEI DELA CRUZ

FILIPINO FARMER Johnny Tejada tends his rice crop in Iloilo.

Amount of fertilizer applied (in bags per hectare and kg of nutrient per hectare) before and after use of SSNM by Johnny Tejada, 2007 wet season. DAS = days after sowing.

	Before SSNM			After SSNM			
	1st (20 DAS)	2nd (40 DAS)	Total bags	1st (12 DAS)	2nd (28 DAS)	3rd (38 DAS)	Total bags
Urea	2	2	4	0	1.5	1.5	3
14-14-14*	1	1	2	3	0	0	3
Total bags applied	3	3	6	3	1.5	1.5	6

	Before SSNM			After SSNM			
	1st (20 DAS)	2nd (40 DAS)	Total nutrients	1st (12 DAS)	2nd (28 DAS)	3rd (38 DAS)	Total nutrients
N	53	53	106	21	35	35	91
P ₂ O ₅	7	7	14	21	0	0	21
K ₂ O	7	7	14	21	0	0	21

*14-14-14 is a typical NPK fertilizer used in the Philippines.

a rice plant's greenness, farmers often give extra attention to urea applications.

Direct sowing of rice seed, rather than transplanting of seedlings, is common in Iloilo. Planting time for the wet season is usually in May–July, depending on adequate rainfall, and harvest is in August–October. The dry season is from October–November to February–March.

In May 2007, IRRI scientists led by Dr. Buresh in collaboration with Greta Gabinete, a soil scientist at West Visayas State University in Iloilo, established a small SSNM demonstration in Mr. Tejada's and a neighboring rice field. The neighboring farmer, who was also an agricultural technician, told Mr. Tejada that SSNM validation experiments had worked in other villages. While the experiment was being conducted, recounts Mr. Tejada, he quietly imitated the SSNM practice on the remaining 1.2 hectares of his field. It was a risk, but he decided, one worth taking given the rising prices of fertilizers and the increasing cost of living.

Like most Iloilo farmers, Mr. Tejada used to apply fertilizer twice per season, at 20 and 40 days after sowing (DAS) in both the wet and the dry season. Per hectare, he would apply two 50-kg bags of urea (each bag contains 23 kg N) and one 50-kg bag of 14-14-14 NPK (containing 7 kg each of N, P₂O₅, and K₂O; this is a typical NPK fertilizer used in the Philippines) at both 20 DAS and 40 DAS, giving a per-hectare total of

106 kg N, 14 kg P₂O₅, and 14 kg K₂O. His normal yield in each season was 4–5 tons per hectare of unmilled rice grain (at 14% moisture content).

"SSNM has really helped me a lot," says Mr. Tejada. "When I practiced SSNM in the 2007 wet and dry seasons, my yield increased markedly. Since then, I have continued practicing SSNM."

The increase in yield was verified by a field technician who harvested grain from Mr. Tejada's crop in both seasons. The wet-season yield of air-dried, unmilled grain increased from 4.1 tons per hectare with the original fertilizer practice to 6 tons per hectare with SSNM. In the dry season, the yield rose from 4.6 to 6.5 tons per hectare.



CYNIE P. PASA

With SSNM, Mr. Tejada applied fertilizer three times, instead of his usual two applications. His first application was at 12 DAS using three bags of 14-14-14 NPK. His second and third applications were at 28 and 38 DAS using 1.5 bags of urea per hectare for each application. Before and during SSNM, he used a total of six bags of fertilizer per hectare, but the nutrient composition and timing of the applications differed (see table, left).

It is instructive to hear what Mr. Tejada has to say about SSNM in his own words.

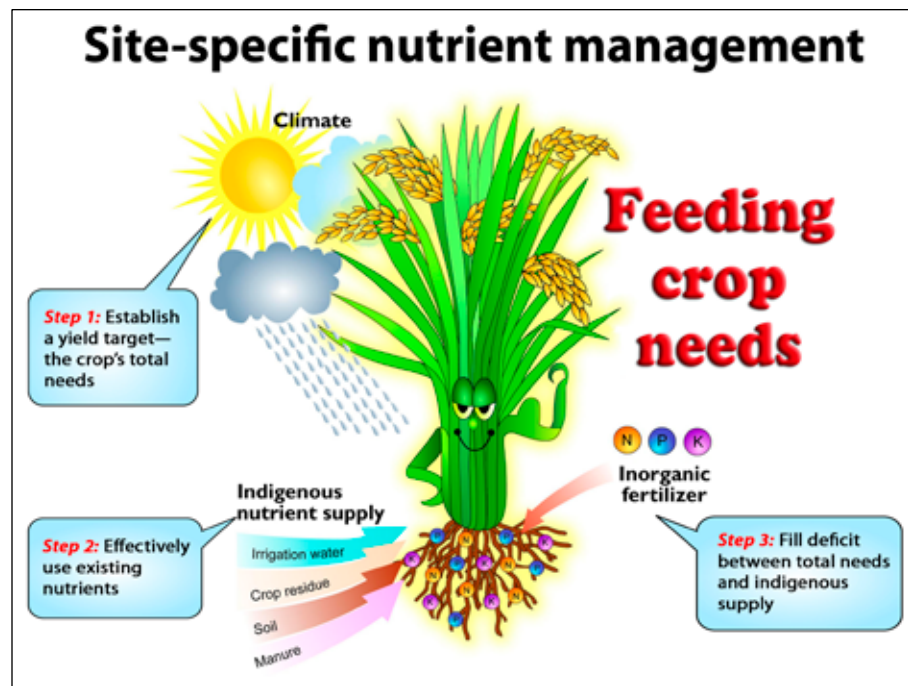
When I first practiced SSNM in the 2007 wet season, I couldn't sleep well for around 10 days after my first fertilizer application. My rice plants weren't green and they were not growing well compared with those in other farmers' fields, though the growth and color of the leaves were similar to those in the neighboring SSNM demo plot and the experimental plot in my field. Before I slept, I kept wondering why it seemed that there was no fertilizer response by my rice crop. I was really anxious that my crop might fail. For those 10 days, I was uneasy and kept moving around the rice fields in the village, comparing the growth of the rice plants.

But, 10 days after the second fertilizer application, I was amazed. By then, the growth stand of my rice crop was far better than that in farmers' fields not practicing SSNM. My stems were so hard and the roots were so deeply rooted. Also, my plants were not infested with pests and diseases and did not lodge [fall over]. Many of those plants that had accelerated growth and bright green leaves after the first fertilizer application lodged long before harvest and were infested with pests and diseases. I realized that SSNM enabled the rice crop to take a balanced "diet" before urea was supplied.

Mr. Tejada harvested again in the second week of August 2008, achieving a good yield of just over 6 tons per hectare. He also reported that many of his neighboring farmers have begun to follow SSNM.

When my neighboring farmers saw the good performance of my crop after my second fertilizer application, they began to ask me what SSNM is about. At the same time, they monitored my field. We farmers normally discuss many things on the farm, especially when it comes to our rice crop. My constant interaction with the researchers doing experiments in my rice field, and with the agricultural technician, enriched me with knowledge about SSNM that I happily shared with my co-farmers during our "huntahan," or spontaneous farm discussion. After the 2007 wet-season harvest, it was known in my village that my yield was high, increasing from 120 to 184 bags of unmilled grain. This made my neighbors eager to imitate me in using SSNM.

Dr. Palis is an anthropologist in IIRRI's Social Sciences Division. Dr. Gabinete is a professor at West Visayas State University. For more information on SSNM, see



About site-specific nutrient management

The concept of site-specific nutrient management (SSNM) for rice was developed in the mid-1990s and has been systematically transformed and refined since 2000 in collaboration with national agricultural research and extension agencies through the Productivity and Sustainability Work Group of the Irrigated Rice Research Consortium.

Research identified a mismatch between the timing used by farmers to apply nitrogen (N) fertilizer and the growth stages at which the rice plant needs supplementary N. This lack of synchrony between N supply and plant N need resulted in luxuriant vegetative growth and crop architecture favorable to diseases and insect pests. This was further confounded by insufficient use of potassium (K). SSNM provides farmers with guidelines for managing N, phosphorus (P), and K that fit local conditions and are easily understood by farmers and extension workers (responsible for disseminating agricultural technologies to farmers). Crucially, SSNM ensures that farmers obtain good returns on their cash investment in fertilizers.

The rolling out of SSNM is extremely timely in light of the 2008 rice crisis and high fertilizer prices. The Philippine government has incorporated SSNM into the national agricultural program, in line with the country's Rice Self-Sufficiency

Plan. The dissemination of SSNM will be facilitated by the development of new Nutrient Manager for Rice software that enables extension workers and farmers to rapidly develop nutrient-management guidelines for specific fields based on a farmer's response to about ten easy-to-answer multiple-choice questions (see Management made easy on pages 32-33 of Rice Today Vol. 7, No. 4).

In Iloilo Province, SSNM is now being piloted by extension workers in 20 municipalities. Nutrient Manager for Rice was field-tested in mid-2008, and was released on CD in the local language in September 2008. The adoption of SSNM in the Philippines may have started with Johnny Tejada, but, with government support in mobilizing extension workers, we hope that SSNM will be adopted by tens of thousands of Filipino farmers.

The process that systematically established the scientific basis for SSNM, evaluated and refined SSNM in farmers' fields through partnerships across Asia, and is now disseminating improved nutrient management for rice across Asia was made possible through more than a decade of support from the Swiss Agency for Development and Cooperation, the International Fertilizer Industry Association (IFI), and the International Plant Nutrition Institute.

www.irri.org/irrc/ssnm.

Adapted with permission from e-ipc: International Fertilizer Correspondent (No. 17, Sept. 2008),

the quarterly correspondence of the International Potash Institute (see www.ipipotash.org/publications/detail.php?i=260).



FURUYA TAKASHI

Maybe I was hallucinating but I thought I saw a pair of socks among a sea of products in the rice exhibit at the Second International Symposium on Rice and Disease Prevention in Wakayama, Japan. Upon closer inspection, my surprise was verified. It was indeed a pair of socks, made partly from rice bran.

Taking a step back and looking at the room that lay before me, I was totally dumbstruck. So many products were made completely or partially from rice.

Aside from its obvious uses for food—including flour for cakes, noodles, and other snacks—rice and its derivatives can be used to make cosmetic products, shampoo, and soaps for people, pets, and clothes.

Rice bran oil, which constitutes about 5% of the bran, is extracted and processed into healthy cooking and salad oil. Bran oil doesn't burn easily and has a better percentage of unsaturated fats than olive oil.

Rice can be incorporated into energy drinks and added to supplementary drinks for

More than meets your rice

by Paul Hilario

Rice Today ventures to Japan to find an astonishing range of rice products, most of which you wouldn't want to eat

cows to prevent calcium deficit disorders after calving.

Remarkably, rice can also be used in making packaging foam and paint, and is used in offset printing to make the process more environmentally friendly.

The derivatives of rice bran—including oryzanol, inositol, phytic acid, and ferulic acid—are the key ingredients in many of these products.

Oryzanol is a mixture of substances that includes ferulic acid and sterols and is widely used in the U.S. in sports supplements. It has been approved in Japan for the treatment of several conditions, including menopausal symptoms, mild anxiety, upset stomach, and high cholesterol.

Inositol is a sweet and naturally occurring nutrient found in different foods but mostly in cereals with high bran content. Its main role in the body is to prevent the collection of fats in the liver and help in the conversion of nutrients into energy to maintain a good metabolism. It also supports healthy hair growth.

Phytic acid is used as a chelating agent (a substance whose molecules bind to metal ions, removing them from solutions) in manufacturing and printing processes.

Ferulic acid, an antioxidant, acts against free radicals, which are implicated in DNA damage, cancer, and accelerated cell aging. Ferulic acid is also used in topical creams designed to protect the skin.

Standing amid the myriad rice products displayed at the Wakayama exhibit, it was easy to think that the income farmers get from selling plain old rice grain is miniscule compared with the cost of rice-based socks, drinks, creams, and the like. But rice will always be first and foremost a staple food—a hungry person would rather have a plate of food than the silky hair promised by rice shampoo.

Though, if I ever find myself penniless and famished, I could always eat my rice-bran socks.

Mr. Hilario is the curator of the Riceworld Museum and Learning Center at the International Rice Research Institute.



PAUL HILARIO (2)



WILLIAM STA. CLARA

SEAL OF APPROVAL

by Philippe Villers and Martin Gummert

HERMETIC STORAGE OF RICE IS BECOMING INCREASINGLY POPULAR ACROSS ASIA, AND FOR GOOD REASON—AS WELL AS BEING TRANSPORTABLE, IT IS BETTER THAN AIR-CONDITIONED STORAGE AND ALMOST AS GOOD AS A COLD ROOM, AT A FRACTION OF THE COST OF EITHER

The wax seals found on ancient Greek and Roman jars known as amphoras tell us that hermetic storage has been used to preserve grains for more than 2,500 years. Today, hermetic storage using modern materials has become widely available. In the last 2 years, one of the world's largest seed companies, Bayer CropScience, successfully shifted from traditional warehouse storage to hermetic storage for its hybrid rice seeds. Bayer is now able to eliminate live insects and maintain the full germination potential of hybrid rice seed beyond 9 months. Other organizations have followed Bayer's lead.

How does hermetic storage work? Studies dating back to the 1930s show that properly dried seeds can be preserved for a very long time, regardless of temperatures, as long as the moisture level remains constant and a low oxygen-high carbon dioxide atmosphere is maintained. In a sealed container, such an atmosphere is created through the natural respiration of the seeds and any insects present. The combined effect generally lowers the oxygen level to below 3% within days. Maintaining the modified atmosphere inhibits the generation of molds and

their mycotoxin by-products (toxins produced by a fungus). Insects in all life stages die in a matter of days due to a lack of oxygen when stored in hermetic environments at room temperature or above.

For more than 6 years, the International Rice Research Institute (IRRI), through its Grain Quality, Nutrition, and Postharvest Center, has evaluated and disseminated hermetic storage technology in collaboration with national agricultural organizations, farmers, and rice millers. Thanks to these efforts, hermetic storage for smallholder and subsistence farmers is expanding worldwide.

Studies conducted by IRRI confirm and quantify the efficacy of hermetic storage versus alternative methods in maintaining germination potential of rice for periods up to 18 months. Hermetic storage systems rapidly reduce the number of live insects, which are able to survive in nonhermetic air-conditioned storage at 20°C, though not in cold-room storage at 8°C (Table 1). Large commercial hermetic systems and smaller hermetic systems offered similar control.

Similar results were found in Bangladesh, Cambodia, and Vietnam.

Table 1. Number of live insects per 1 kg of grain.

Months	Open storage	Air-con	Cold room	Hermetic (5 tons)
0	3.2	8.4	8.4	8.8
3	135	1.6	0	0
6	114	3	0	0.4
9	54	3.4	0	0.4
12	27	9	0	2.2

Source: DeBruin T. A user's introduction to hermetic storage – how it works. (Unpublished - GrainPro document #SL2322TDB0506-4), GrainPro, Inc., Concord, Mass., USA. Data from Philippines (2002).

In Cambodia, the germination for hermetically stored seeds was 90% after 6 months and 63% after 12 months. In comparison, seed stored in traditional systems had germination of 51% and 8%, respectively. In Vietnam, seeds stored in traditional woven plastic bags had 0% germination after 7 months while the same seed stored in the hermetic systems had 53% germination. In Cambodia, when oxygen levels increased above 9%, insect numbers also increased. The highest number of live insects recorded was a disastrous 332 per kg in an open storage system.

In 2006, the Philippine Bureau of Postharvest Research and Extension (PBPRE) and the Philippine Rice Research Institute (PhilRice) studied storage of the high-performance hybrid rice variety Mestizo 1.

Table 2 shows germination rates using different storage technologies. Studies on rice seeds in Bangladesh and Cambodia (100–398 days), on maize seed in Mexico, Thailand, and Bangladesh (90–280 days), and on barley and wheat in Cyprus and Israel (120–900 days) showed hermetic storage seed germination of 81–95% after 90 days.^{1,2} Another study from Vietnam on peanut seeds showed 98% germination after 8 months versus 4% when stored unprotected.³

It is also important to recall that hybrid seeds not only are more expensive than conventional farmer-grown seeds but also are more delicate and prone to damage. A continuing shift to high-yield hybrid seeds makes effective storage all the more crucial, since without high germination rates and maintenance of vigor, these “high-value” seeds have no value to the farmer. The PBPRE–PhilRice study showed that by month 6 of storage, hermetic methods are economically favorable to the other 3 methods (Table 3).

Table 2. Mean % germination rate of Mestizo 1 hybrid paddy (unmilled) seeds stored using different storage technologies.

Storage method	Storage time after harvest (months)			
	0	3	6	9
Hermetic	96.2	96.5	93.3	86.2
Cold room	96.8	97.6	93.0	89.6
Air-conditioned	94.3	94.8	88.1	85.8
Control (unprotected)	92.9	92.9	76.4	74.7

Source for Tables 2 and 3: Savio GC. Preservation of Mestizo Rice (PSB Rc72H) using hermetic and low temperature storage techniques, presented at the International Working Conference on Stored Products Protection (IWCSPP), São Paulo, Brazil, p. 3.

Table 3. Cost comparison (Philippines) using four storage methods for preserving Mestizo 1 hybrid paddy seeds (all values in US dollars; \$1 = 50 Philippine pesos).

Costs	3 months' storage				6 months' storage			
	Control	Her-metic	Cold room	Air-con	Control	Her-metic	Cold room	Air-con
Investment	82,250	1,744	12,820	16,230	82,250	1,744	12,820	16,230
Operating expenses	24,991	504	3,548	3,820	31,086	504	4,196	3,950
Per 20-kg bag	2.50	2.52	3.55	2.55	3.11	2.52	4.20	2.63

Investment and operating expenses based on: control 10,000 bags; hermetic 200 bags; cold room 1,000 bags; air-conditioned 1,500 bags.

Conventional storage was found adequate only up to 3 months.

Effective hermetic storage requires reasonably priced hermetic containers, now possible with modern specialized materials. Most widely used at the moment is the SuperGrainbag™ liner, a 60-kg-capacity, 0.078-mm-thick co-extruded plastic composed of polyethylene protective layers on the outside and a proprietary gas barrier in the middle (photo, *opposite left*). This plastic has extremely low permeability to water vapor and oxygen (typically 8 grams per square meter per 24 hours for water vapor and as low as 3 cubic cm per square meter per 24 hours for oxygen).

Cocoon™ is another form of hermetic storage (photo, *opposite center*). It is made from a special grade of 0.83-mm polyvinylchloride (PVC) with a permeability to oxygen of 55 cubic centimeters per square meter per 24 hours and to water vapor of 8 grams per square meter per 24 hours. Available in capacities

of 5 to 1,000 tons, the Cocoon™ protects seeds in jute or polypropylene bags during storage.

The TransSafeliner™ offers hermetic storage for seeds during transport (photo, *opposite right*). It acts as a hermetic liner for standard 20-foot- or 40-foot-long shipping containers, allowing

safe intercontinental transport.

Through the efforts of IRRI and its national partners, hermetic rice seed storage is now being used successfully in Bangladesh, Cambodia, India, Indonesia, Laos, Myanmar, the Philippines, and Thailand.

Hermetic storage of paddy (unmilled) and milled rice is also gaining popularity. IRRI reports that grain quality, as measured by head rice yield and the number of broken kernels, is higher for hermetically stored paddy rice than for traditionally stored rice. In Cambodia, head rice yields for hermetically stored grain were 10% higher than for traditional open storage over 12-months period. (Head rice yields are the percentage of head rice—whole grains and broken kernels that are at least 75–80% whole—obtained from paddy after milling.) In Vietnam in 2003, hermetic storage resulted in a 4.5% reduction in the number of broken kernels after 6 months.

The current revival of hermetic storage, using high-performance plastics, has made possible relatively inexpensive storage of rice seeds, paddy, milled rice, brown rice, maize, wheat, and pulses for both human and animal consumption. As the benefits of hermetic storage become more widely known, use of the technology is likely to grow throughout Asia and beyond. Sometimes it takes a few thousand years for a good idea to take hold. 🌾

Dr. Villers is president of U.S.-based postharvest technology company GrainPro, Inc. Mr. Gummert is a postharvest expert at IRRI.

The use of commercial product or company names in this article does not imply endorsement by IRRI.



¹ DeBruin T. 2005. Innovations in seed storage methods. Published in *Asian seed and planting material*. Philippines, January.
² Villers P, De Bruin T, Navarro S. 2004. Advances in hermetic storage as a methyl bromide replacement. 4th CAF Conference, Brisbane, Australia, February.
³ Villers P, De Bruin T, Navarro S. 2006. Development and applications of the hermetic storage technology. Published in Proceedings of the 9th International Working Conference on Stored Products Protections (IWCSPP), São Paulo, Brazil, October.

Buy a house on a hill

by John Sheehy

As Earth's climate changes, so does the way we approach agriculture. The head of the International Rice Research Institute's applied photosynthesis laboratory offers his observations on the current state of play.

The variability of the climate requires a corresponding variability in those who live in it, whether animal or plant; and all future planning, all development of skills for increasing food supplies and raising living standards, must take account of the possibility of drastic change and the certainty of continuing fluctuations, and thus be so far as possible geared to the worst rather than the best in prevailing circumstances.—Crispin Tickell (1977), *Climatic Change and World Affairs*

Climate change is a favored subject among disputatious individuals. About its cause, proof of who is right and who is wrong is certain not to emerge between dinner and breakfast.

The wonderful opera, “life,” is staged on Earth amidst the splendid scenery that is the biosphere. Astonishingly, it is the orchestra of living organisms—harmonizing the laws of physics and chemistry, with the aid of energy from the Sun—that has built the edifice of the current biosphere, across geological time.

New members of the orchestra have taken their places after rigorous natural selection, from the wide range of applicants proposed by mutation in the process of evolution. Some fear that the more recent human members have abandoned the score and, like modern jazz musicians, are improvising. The fear is that the resulting cacophonous pollution will surely destroy the current show. Humans will take their place, somewhat like dinosaurs, in sedimentary layers to be excavated millions of years hence by the highly evolved and curious inheritors of Earth. Some will ask, “Why did they become extinct?” Some will answer, “Global warming.” Others will say, “Rubbish!”

Special interest groups, dispassionate scientists, and lunatics (repent, the end is nigh!) often have contrasting opinions about future climates and the fate of humankind. Geologists, atmospheric chemists, astronomers, oceanographers, physicists, botanists, ecologists, economists, meteorologists, and

agronomists have been assembled to construct predictions relating to climate change under the umbrella of the United Nations Intergovernmental Panel on Climate Change. Like the laborers constructing the Tower of Babel, they are almost mutually incomprehensible. Nonetheless, a sort of scientific pidgin has emerged and although lacking in precision is surprisingly useful when employed in a number of special reports.

In his Gaia theory, James Lovelock attempted to integrate knowledge from all branches of science into a theory of Earth as a living organism. However, as yet there is no universally accepted theory of climate and what forces it to change and so many aspects of climate change remain speculative affairs.

I used to think that climate was the integral of weather averaged over somewhat arbitrary periods called seasons and that topography

needlessly complicated the correlation between latitude and warmth. As a student, I was taught that sunshine hours, rainfall, windspeed, and maximum and minimum temperatures were the raw materials of weather. Nowadays, smog, ozone, oxides of nitrogen, hydroxyls, acid rain, UV levels, atmospheric particulates, carbon dioxide, methane, sulfur, chlorofluorocarbons, and a cornucopia of other things must be added to the mixture from which climate is made.

The debate about the contribution of humans to climate change has stimulated much scientific activity. As a consequence, we have a much better understanding of past climates. One of the most fascinating studies has been that of the Vostok ice core in Antarctica. Gases, dust, and pollen are trapped annually in falling snow and then entombed in the polar ice. Drilling an ice core 3,623 meters



RESEARCH AT IRRI aims to mitigate, as well as develop rice varieties that are adapted to, the effects of climate change.

JOSE RAYMOND PAVALIGAN (2)



WILLIAM STA. CLARA (2)

EXTREME WEATHER events such as floods and typhoons are predicted to become more frequent.

deep, an international team extracted a record of the climate for the past 400,000 years. Present-day levels of the greenhouse gases carbon dioxide (around 385 parts per million) and methane (1,700 parts per billion by volume) are unprecedented during the past 420,000 years: previous maximum values were 280 parts per million and 773 parts per billion.

A picture of the periodic nature of the glacial and interglacial periods emerged, as well as the correlation between components of the climate changing more or less in phase. Four glacial periods, each lasting about 100,000 years, were separated by relatively brief warm interglacial periods.

Without energy from the Sun and the atmosphere, there could be no climate or life. The eccentricity of Earth's orbit around the Sun varies, Earth tilts and wobbles on its axis, and these factors influence the amount and distribution of solar energy incident over land and sea on the surface of the planet. Such factors are grouped together and called orbital forcers of climate change. Cores of marine sediments are used to analyze past climates up to 180 million years ago and, on this time scale, tectonic events become part of the climate-forcing factors.

To understand greenhouse gas forcing of climate requires a small digression. At a “stable” average environmental temperature, the radiation entering Earth's atmosphere equals the amount leaving. Increasing concentrations of greenhouse gases in the atmosphere absorb more

of the infrared radiation. To re-establish the zero-sum radiation balance, the emission of long-wave infrared radiation has to increase. To achieve this, temperatures must rise and thus either force or amplify climate change. On top of this, some of the changes in past climates have yet to be explained.

The Vostok record shows that, in the absence of the billions of humans inhabiting the planet, the next phase of global climate change would be a gradual drift into an ice age. The break from glacial to interglacial periods has been accompanied by increases in the concentrations of greenhouse gases. Modern humans ascended from caves to skyscrapers during the past 20,000 years of the most recent warming period.

The prospect of ice sheets grinding down through North America and Europe will be a chilling one for my progeny. But my problem is global warming. The evidence suggests that the world is getting warmer and it would be most odd if increasing concentrations of greenhouse gases and other anthropogenic gaseous emissions were not playing a significant, albeit somewhat obscure, role.

The key question, of course, is, What will happen? Will it suddenly get 6°C hotter? Will the polar caps partly melt, causing sea levels to rise by several meters? Will the future course of climate change be altered irreversibly by the activities of humankind? I don't know—but neither does anyone else.

Weather disasters could become

the normal human experience over the coming century. When extreme variation in the weather makes climate a variable, agriculture ceases to be an industry and becomes a desperate struggle for survival.

What is the International Rice Research Institute (IRRI) doing? IRRI has a long history of climate research and, over the past few years, has scaled up its activities in that area, including the establishment of the Rice and Climate Change Consortium. The Institute is ramping up its development of rice varieties that are flood, drought, and salt tolerant, fast growing, and high yielding, and crop management practices that are robust and flexible.

The development of technologies and skills for increasing food supplies and raising living standards must take account of the likelihood of drastic changes in the weather. A significant part of IRRI's agenda must focus on how to cope with the worst of expected future circumstances rather than the best of prevailing circumstances. A substantial part of the Institute's experimental farm should be dedicated to that end. A Climate Change Disaster Center would allow us to test our concepts and train our partners for the worst. Varieties that can provide food in a hotter, more CO₂-rich and uncertain world of violent weather extremes have become, and must continue to be, a priority.

By the way, does anyone have a hectare of land at about 200 meters above sea level in the tropics for sale?

RICE AND THE GLOBAL FINANCIAL CRISIS

by Samarendu Mohanty Head, IRRI Social Sciences Division

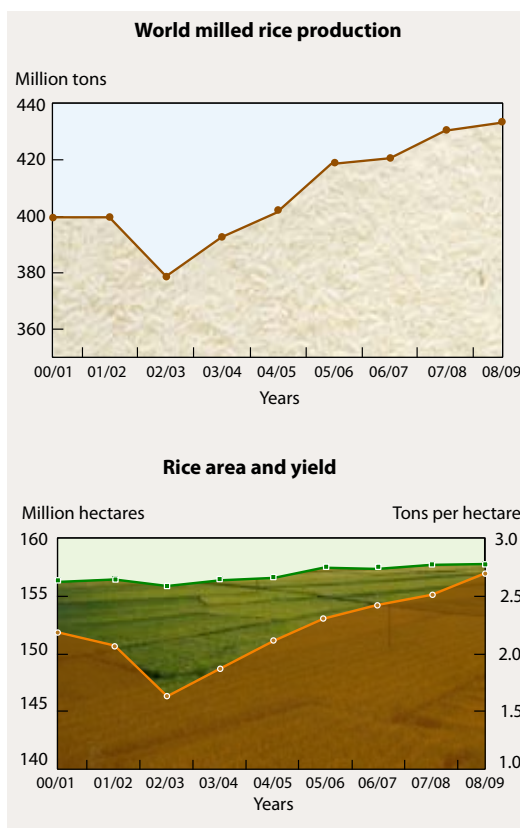
WHAT ARE THE SHORT- AND LONG-TERM IMPACTS ON RICE PRODUCTION AND FOOD SECURITY?

In the October–December 2008 issue of *Rice Today*, I wrote an article (*Rice crisis: the aftermath*, pages 40–41) highlighting the 2008–09 supply and demand situation and the long-term challenges to meeting future demand growth. Soon after that article went to press, the calamitous global financial crisis and attendant fall in commodity prices cast a dark shadow over the agricultural situation, despite the drop in crop prices. Since reaching their peak earlier this year, wheat and rice prices have fallen steeply. The price for 100% grade B Thai rice fell to \$575 per ton in late October 2008 from a whopping \$1,080 per ton in April 2008, a result of record production and economic slowdown. It is important to remember, however, that current rice export prices remain around double those of mid-2007. Following crude oil and agricultural commodities, fertilizer prices, particularly for urea and ammonia, also plummeted toward the end of 2008 after reaching record highs in September.

Short-term impact

The meltdown of commodity prices may have caught off-guard many farmers who in late 2008 harvested a lower-priced crop produced with high-priced inputs (such as seeds and fertilizer). Burned once, these farmers will likely play safe and reduce input use for their 2009 crops. The credit crunch will also make it difficult for farmers around the world to secure credit for purchasing inputs. Signs of this trend have already emerged.

Already, the Philippines has lowered its 2009 rice production estimate by almost 4% because of lower input use as farmers struggle to secure credit to buy inputs. Similar news from other rice-producing



countries is likely in the near term.

Production uncertainty due to tight credit and declining rice prices combined with strong demand growth points to another rise in rice prices in the coming months. Price volatility will remain high.

Long-term effects

The recent crisis in the rice market helped expose recent fundamental imbalances in supply and demand. In five of the last seven years, rice consumption has exceeded production, resulting in frequent dipping into buffer stocks to cover the shortfall. The recent rise and fall in rice prices reaffirms the high degree of price volatility arising out of historic low levels of global rice stocks.

The world has produced a record rice crop in each of the last 4 years with most of the increase coming

from area expansion rather than yield growth (see figures). A slowdown in rice yield growth has been occurring since the early 1990s. The neglect of agricultural research and infrastructure development since the early 1980s has started to bite. The recent crisis turned the world's attention back to agriculture, but the credit crunch is likely to further tighten funding for infrastructure improvements and research and development activities.

Making matters worse, the economic slowdown may increase the demand for rice in developing countries as falling income forces poor people to switch back to less expensive staples. Consumption projections may therefore rise above earlier estimates of around 90 million tons per year of additional rough (unmilled) rice by 2020.

Time to act

The supply and demand situation simply does not add up for rice. Current rice area is at a historic high and it is foolish to assume that additional area can keep coming to meet future demand. If the yield growth rate does not improve, we can expect rice prices to continue to rise, and at a faster pace than that seen since prices started moving up in 2000.

The solution lies in revitalizing rice yield growth through higher investment in research and infrastructure development. The International Rice Research Institute's nine-point plan for short- and long-term interventions outlines the sort of urgent action that donors, international organizations, and national governments need to take to improve yield now and in the future (see http://solutions.irri.org/images/the_rice_crisis.pdf).

INVESTING IN THE FUTURE

by Sushil Pandey, Mark W. Rosegrant, Timothy Sulser, and Humnath Bhandari

HOW WILL FUTURE INVESTMENT IN AGRICULTURE AFFECT RICE PRICES?

Rice is a staple crop of Asia, which is home to almost 700 million poor people with income of less than a dollar a day. A confluence of several long- and short-term factors led to a skyrocketing price of rice in early 2008.

Keeping the price of rice affordable for the poor is critically important for poverty reduction. The share of rice in total expenditure of poor households is estimated at 30–50%. Any substantial rise in the price of rice, therefore, is equivalent to a substantial drop in real income.

Using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT)¹ to make long-term projections, we estimated rice prices out to 2025 and 2050 under three alternative scenarios of investments in and policy options for agricultural research and development. These were compared with a reference scenario representing “business as usual” (see figure).

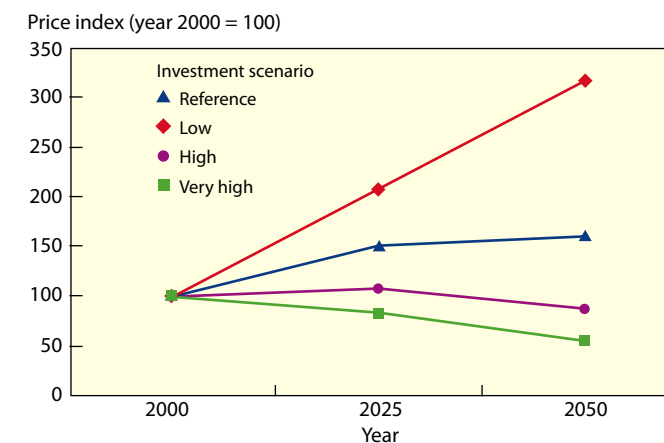
The *Low* scenario presents a pessimistic view of future developments in agricultural production around the world and a further reduction in already declining rates of investment in agricultural research and development. In contrast, the optimistic *High* scenario has governments and other agencies prioritizing agricultural investments to improve productivity, particularly in the developing world. The *Very high* scenario augments the improved *High* situation with increased

investments in yield improvements, intensification of existing agricultural systems, increased investment in irrigation infrastructure, as well as higher investment in other poverty- and malnutrition-reducing strategies.

Under the *Business as usual* reference scenario, the price of rice will increase almost 50% by 2025, and will continue to increase, although at a slower pace, from 2025 to 2050. The *Low* scenario is extremely unfavorable. Were this scenario to become reality, rice prices in 2050 would be nearly double the projected reference scenario prices and triple the 2000 starting price. The more optimistic scenarios are much more promising. By 2050, rice prices would actually decline relative to the starting year. The *High* scenario would see rice prices about half those of the projected reference value. The *Very high* scenario would result in 2050 prices of roughly a third of the reference scenario prices.

In short, rice prices will be lower in 2050 relative to 2000 only if investments in agricultural technology, research, and development are boosted substantially (the *High* and *Very high* scenarios). Such investments are necessary rice productivity to increase rapidly enough to keep prices down.

The underlying cause of the current rice crisis is a long-term imbalance between demand and supply: production growth has



TRENDS IN RICE price under reference (business-as-usual) and three alternative policy scenarios, 2000–50. These long-term projections do not factor in short-term supply shocks and trade restrictions of the kind that prompted price spikes in early 2008.

Source: IFPRI IMPACT model projection, April 2008

failed to keep pace with demand growth. As the root of the problem is on the supply side, the long-term solution will require measures to boost production. These measures can be grouped into two categories: stimulating investments in research, technology, and infrastructure, and policy reforms.

Although rice prices have dropped from their peak in May 2008, they are still high relative to 2007 levels and are likely to remain too high for millions of poor. The task ahead is challenging but not insurmountable and requires a substantial boost for agricultural research, which remains highly underinvested. Increased investments together with policy reforms that make rice markets more efficient will provide the ultimate solution to the rice crisis.

Drs. Pandey and Bhandari are agricultural economists at IRRI. Drs. Rosegrant and Sulser are agricultural economists at the International Food Policy Research Institute. This article is based on Rice price crisis: causes, impacts, and solutions, a paper presented at the 6th International Conference of the Asian Society of Agricultural Economists, Manila, Philippines, 28–30 August 2008.

¹Rosegrant MW, Msangi S, Ringler C, Sulser TB, Zhu T, Cline SA. 2008. International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT): Model Description. Washington, D.C. (USA): International Food Policy Research Institute.



Food security & fertilizer

BY CHRISTIAN WITT

Food security is back on the global agenda. With the recent food crisis, public attention has returned to issues of availability and affordability, particularly for the urban and rural poor. Responses to the accelerating changes in food stocks and prices in recent months ranged from interventions at the policy level to calls for longer term strategies, including greater investment in agricultural research to safeguard food security in the future.

Although consumer rice prices have dropped somewhat since the peaks of mid-2008, they remain higher than those of 2 years ago and the crisis is by no means over. Yield forecasts for the immediate future are promising, but rice supply remains tight and is likely to remain so in the coming years.

Meanwhile, at the farm level, growers find themselves facing higher production costs (especially for fertilizer and fuel) and higher but more volatile farm-gate prices for their produce. This poses problems to rice farmers with typically low cash flows. As fertilizer prices increase, cutting costs by reducing the use of one or more fertilizer nutrients might appeal to farmers and policy-makers—but it's a risky strategy.

Crop yield is directly related to the amount of nutrients taken up by a crop, and fertilizers supply a significant portion of the nutrients required to achieve high and profitable yield. Food security cannot be achieved without the effective use of fertilizer nutrients in combination with other nutrient sources such as residues and manures available on-farm. At some point, less fertilizer means lower yield unless the innovative, yield-building nutrient management strategies developed over the past 10 years become common practice. The time is now for the public and

Anyone with access to the new tools can develop strategies for yield improvement



private sector to step up and make this knowledge available to farmers.

But won't fertilizer prices plummet soon to previous levels? Current fertilizer prices are the result of an until-recently very tight global fertilizer market that follows the basic principles of supply and demand. The demand for agricultural products—and thus fertilizer—has been increasing for years, driven by population growth and increasingly diversified diets as income in developing countries has grown. This development has been further accelerated by the recent investment boost in the biofuel sector.

The International Rice Research Institute forecast a significant increase in future rice demand back in the early 1990s, at a time when food stocks were high and rice prices low. As food stocks melted away with accelerating demand, investment in agricultural research slowly dwindled. And, just as one cannot switch research on and off within a year, it takes massive capital and several years to increase fertilizer production capacity. As a result, fertilizer capacity growth has not kept pace with demand.

With production capacity currently at or near record levels, the International Fertilizer Industry Association warned in mid 2008 that fertilizer markets will remain tight for at least 3 years. Fertilizer supply has eased in recent months as many farmers are reluctant to invest in their crops given the global economic recession and volatile prices for commodities and fertilizer. As economies recover, however, significant investment in infrastructure and opening of new plants and mines will be required

to meet future fertilizer demand.

It currently appears that the cost for fertilizer and other inputs will remain relatively high in most farming environments. Farmers will thus have to optimize their production systems considering the global market prices of inputs and particularly fertilizer.

What gives me hope for the near future is that there is still room for yield improvement at the farm level in Asia's key rice-producing areas. What gives me even more hope is that, in the last 10 years, we have transformed complex science into robust scientific principles. These have formed the basis for a new generation of user-friendly tools and associated communication strategies in nutrient management. Examples include the leaf color chart, which helps farmers optimize their nitrogen application, and the new country-specific Nutrient Manager Software recently developed by IRRI and its partners in Asia.

The process of developing locally adapted fertilizer strategies combined with locally available nutrient sources has been demystified. One does not need a laboratory to do this. One does not even need an expert. Today, anyone with access to the new tools can develop individual, site-specific strategies for yield improvement and effective input use, in real time and on the spot.

This information is increasingly being made available to farmers with promising examples of uptake by the public sector, industry, and nongovernmental organizations. More and more, these groups must share their experiences and intensify their learning alliances if farmers are to reap the full benefits of the knowledge we now have.

Dr. Witt is director of the Southeast Asia Program of the International Plant Nutrition Institute.



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The International Rice Genetics Symposium, now in its 6th series, is one of the world's biggest and most important rice research conferences. Adding to its scope and significance, this event will be held in conjunction with the 7th International Symposium of Rice Functional Genomics. The 4-day event, under the patronage of HRH Princess Sirindhorn of Thailand, builds on the excitement generated by rapid advances in rice genomics and its potential benefits to food security and the international rice industry. More than 700 top international scientists and researchers from around the world are expected to attend.

The symposium comes at a key time for the international rice industry, which is under unprecedented pressure caused by record high prices and major production challenges. It provides an important forum for reviewing the latest advances in rice research, how recent breakthroughs could affect global food security, and in-depth discussion and exchange of information on classical genetics and genomics. This major event will showcase the latest developments in the field, including research on breeding, mapping of genes and quantitative trait loci, identification and cloning of candidate genes for biotic and abiotic stresses, gene expression, and genomic databases and mutant induction for functional genomics.

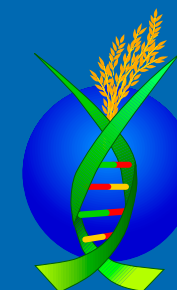
The program will include plenary and concurrent sessions, evening workshops, satellite meetings, and a post-meeting field tour to the International Rice Research Institute (IRRI) in Los Baños.

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Contact IRRI at rg6@cgiar.org for more information.

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