Rice Today

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International Rice Research Institute

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Game of life
Farmers play games with scientists

Rice year wrap-up
Putting rice back on the map

A farm boy's tale
Rice leader heads home

Intensify to diversify
Smarter rice growing helps Cambodian farmers

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Rice Today is published by the International Rice Research Institute (IRRI), the world's leading international rice research and training center. Based in the Philippines and with offices in 11 other countries, IRRI is an autonomous, nonprofit institution focused on improving the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes, while preserving natural resources. IRRI is one of 15 centers funded through the Consultative Group on International Agricultural Research (CGIAR), an association of public and private donor agencies. For more information, visit the CGIAR Web site (www.cgiar.org).

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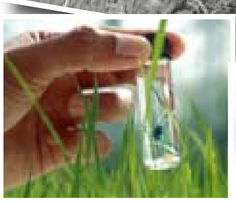
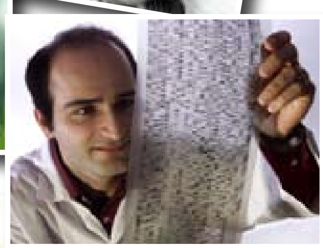
Proud to lead the way





The world was a terrifying place in 1952-53. The period saw the first use of "population explosion" in *Time* magazine and — a cruel irony — the first detonation, over the Pacific Ocean, of a hydrogen bomb. It also brought across the Pacific two senior Rockefeller Foundation agriculturalists to study how to end 2 decades of stagnating rice yields in Asia. By 1960, the population explosion was a cover story in *Time*, and the International Rice Research Institute (IRRI) was established in the Philippines to shore up global food security in the face of exponential population growth.

Along with the other midwife of the Green Revolution, the Mexico-based International Maize and Wheat Improvement Center, IRRI was a prototype for a global network of research centers that, since 1971, have found common purpose within the Consultative Group on International Agricultural Research. With more than US$400 million in annual funding from its 63 cosponsors and member states and organizations — in particular the World Bank and developed countries in North America, Europe and the Asia-Pacific — the 15-center group represents the world's largest investment in mobilizing science to generate public goods for poor farm communities.

Since IRRI's release in 1966 of the first modern rice variety, the institute has led the way in developing improved rice cultivars and other agricultural technologies to benefit Asia's 200 million rice farmers and the billions of rice consumers who depend on them for reliable, affordable supplies of their staple food. IRRI's work, on its research campus at Los Baños and across Asia in collaboration with the national partners it has nurtured, has greatly contributed to the near doubling of the Asian rice harvest since 1970.

Today, the institute combines rice-biodiversity conservation, gene discovery and plant breeding with natural resource management, integrated pest management, agricultural engineering and postharvest technologies, and social and policy studies to develop ecologically and economically sustainable strategies to reverse a troubling new stagnation in rice-yield improvement. This trend occurs in the contexts of slowing population growth and Asian farmers enjoying an average yield more than double that of their parents and grandparents at IRRI's founding. It nevertheless threatens to undermine the indispensable agricultural foundation of development, thus sabotaging the prospects of today's 600 million poor in rice-producing Asia and a large portion of the billions to be born in the several decades before the global population finally stabilizes.

People at IRRI take pride in how they, their colleagues and their predecessors going back to the shell-shocked middle of the 20th century have helped to make the world a more prosperous, safe and hopeful place. But much remains to be done to achieve the United Nations Millennium Development Goals and so alleviate hunger, want, preventable disease, ignorance, inequality and environmental degradation. With continued support, IRRI's 1,000 scientists, administrators, support staff and contract workers will contribute much more than their share.

Forging partnerships in agricultural research

Australian Government
Australian Centre for International Agricultural Research

by Peter Core

The Australian Centre for International Agricultural Research (ACIAR) contributes to the Australian Government's Official Development Assistance program by forging partnerships in agricultural research and development.

The key to ACIAR's operations and success has been partnering with agricultural research organizations, including the International Rice Research Institute (IRRI) and other Consultative Group on International Agricultural Research (CGIAR) centers, to develop solutions to the problems and barriers that limit productive and sustainable agriculture.

ACIAR works with IRRI in two ways: we provide Australia's core funding contribution to CGIAR centers, and we commission IRRI to undertake specific projects.

In 2003-04, Australia contributed US$650,000 in core funds to IRRI out of a total of $4.2 million allocated in core funding to CGIAR centers. Another $3.5 million was distributed among the centers as project-specific funding, based on the comparative research strengths each offered in addressing issues that matched Australia's regional priorities.

Project-specific funding aims to build three-way linkages by connecting the specialist research skills and knowledge of CGIAR centers with Australian and developing-country agricultural research institutes, ultimately breaking down barriers that hamper agricultural productivity.

ACIAR's annual budget of approximately $38 million is comparatively small in a global context. Our activities are therefore carefully targeted, recognizing that sustainable and environmentally benign productivity enhancements can unlock agricultural potential. This remains a proven avenue out of poverty for the rural poor — if not for today's farmers, then for their children.


ACIAR

Mr. Core is Director of the Australian Centre for International Agricultural Research.

ACIAR's project activities, and its support for IRRI and other CGIAR centers, are based on both formal and informal consultations with partner countries — an approach that reflects ACIAR's mandate to solve the problems of developing-country agriculture through partnerships in research and development.

Every 4 years, ACIAR consults with major partner countries to set broad priorities, from which more detailed annual priorities are set, and outlined in ACIAR's Annual Operational Plan. Projects, developed against these annual priorities, harness research and extension expertise to overcome obstacles to sustainable productivity increases.

By involving developing-country agricultural research institutions and, where appropriate, CGIAR centers including IRRI, projects deliver applicable results as well as build scientific capacity, creating home-grown and home-owned solutions.

ACIAR focuses on delivering these solutions in the Asia-Pacific region, home to more than half the world's population and almost two-thirds of the world's poor. Many of these poor have not benefited as much as they should have from the Green Revolution. While global food production has more than matched population growth in the past three decades, agricultural productivity among the rural poor remains low.

ACIAR works to raise productivity in a range of areas. The ACIAR-funded Seeds of Life project matches crops to growing conditions by tapping the genetic resources of five CGIAR centers, including IRRI, to introduce improved and better-suited crop varieties to the fledgling nation of East Timor.

Another sustained research effort, supported by ACIAR and led by IRRI, is developing so-called apomictic hybrid rice varieties that reproduce asexually, are high-yielding, and whose seeds are genetically identical to those of the parent plant, overcoming the high cost and inflexibility of hybrid seed production.

ACIAR-IRRI collaboration is also helping the cropping systems of Laos and Cambodia. Researchers are introducing plant breeding strategies for lowland rice, intensifying rice-based cropping systems in rainfed lowlands, developing direct-seeding technology, increasing the productivity of dry-season irrigated rice, and developing agroecological maps for Laos.

ACIAR's investment in global agricultural research and development is carefully targeted. This focus is reflected in our investment in, and support of, rice research. By working with stakeholders in setting and addressing research priorities, ACIAR ensures that benefits will continue to flow to the rural poor of the Asia-Pacific region.

IRRI has been, and remains, vital to ACIAR's efforts to deliver research results that improve the livelihoods of the people most in need.

Rice knowledge helps tsunami recovery


MARK BELL

MIRACULOUSLY UNHARMED: Sri Lankan rice farmer Mr. Farook stands at the edge of his field in the east coast town of Nintavur, from where he was swept away by the Indian Ocean tsunami on 26 December. The waves, which reached the top of the palm trees behind him, carried Mr. Farook inland for nearly a kilometer and dumped salt water and sand over his farm.

Salt-tolerant rice varieties have been shipped to communities in several countries devastated by the Indian Ocean tsunamis of December 26. The tsunamis affected more than 1 million hectares of rice growing land — an area that supplies food for at least 30 million people. The shipments, part of a coordinated response by agricultural research institutes including IRRI, aimed to quickly reestablish food production in the worst hit areas and help affected communities rapidly regain food self-sufficiency.

IRRI experts are also studying the rice production problems that farmers are encountering in the battered areas of Indonesia, India and Sri Lanka. Officials in Myanmar, Bangladesh and Thailand reported that their main rice-growing areas were mostly unaffected. The institute's Rice Knowledge Bank, an electronic repository of rice-related training and technology information, is providing essential advice on growing rice in the aftermath of the tsunami (www.knowledgebank.irri.org/TsunamisAndRice/default.htm).

The salty waters that surged into coastal rice fields destroyed crops, equipment and seed stocks, killed farm animals, and damaged storage and processing facilities. The invasion of salt water can affect rice production in several ways, including direct crop losses, soil damage via erosion or salt contamination, and storage losses.

"Many of those affected by the tsunami depended on local agriculture not just for food but also for their livelihoods, and rice obviously played a particularly important role in many regions. It's essential to the success of any recovery effort that agriculture in the region gets back on its feet as quickly as possible," IRRI Deputy Director General for Research Ren Wang said.

Dr. Wang estimated that IRRI had access to more than 40 different rice varieties that tolerate salty conditions, and could be used either immediately by farmers in suitable areas or in breeding programs to adapt to salty conditions local varieties that were already popular with farmers.

IRRI is working closely with its 14 sister centers of the Consultative Group on International Agricultural Research (CGIAR) to help tsunami-affected nations recover their agricultural productivity. Other CGIAR centers involved in the effort include four institutes based in the worst-hit countries: the International Water Management Institute in Sri Lanka, the WorldFish Center in Malaysia, the Center for International Forestry Research in Indonesia, and the International Crops Research Institute for the Semi-Arid Tropics in India.

ASEAN nations endorse IRRI 10-year, 3-point plan

IRRI has formed a major new alliance with the world's largest and most important association of rice-producing nations. The new partnership follows an invitation from the 10-nation Association of Southeast Asian Nations (ASEAN) for representatives from IRRI to attend last year's 26th Annual Meeting of the ASEAN Ministers on Agriculture and Forestry (AMAF) in Myanmar in October. Coming after ASEAN agreed to establish formal relationships with IRRI in August, the gathering endorsed a 10-year, 3-point plan presented by Myanmar that focused on three major rice production challenges facing Asia — water shortages, global warming and inadequate human resources.

The AMAF urged international donors to strengthen their support for IRRI and released a statement inviting IRRI and other concerned agencies of ASEAN "to develop a detailed blueprint for the plan and coordinate its implementation to minimize the impact of these major threats to ASEAN rice production."

The ASEAN countries are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. "Plus 3" nations China, Korea and Japan also attended the meeting.

Briefly

Establishing trust

The Global Crop Diversity Trust, set up to help conserve forever the planet's agricultural biodiversity, is now an independent international organization. To be recognized under international law, the trust required 12 signatories from five world regions. On 21 October, Sweden, as well as pledging 50 million kroners (US$7.3 million), became the required 12th signatory, joining Cape Verde, Ecuador, Egypt, Ethiopia, Jordan, Mali, Morocco, Samoa, Syria, Tonga and Togo.

New board members

Emerlinda Roman, Elizabeth Woods and Tony Fischer have been appointed to IRRI's Board of Trustees. Professor Roman became *ex officio* member when she was appointed 19th President of the University of the Philippines in February. Dr. Woods, executive director of research and development strategies at the Australian Department of Agriculture, Fisheries and Forestry, and Dr. Fischer, South Asia program adviser for the Australian Centre for International Agricultural Research, assumed their board duties on 1 January.

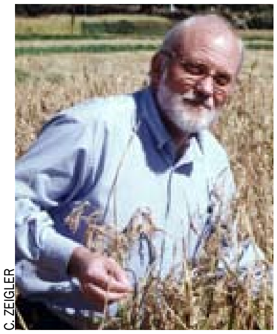
Communication innovation

Eighty scientists from organizations including the World Bank, IRRI and the Food and Agriculture Organization of the United Nations gathered on 24-26 January at the "Innovations in Communication for Rural Extension" workshop in Ho Chi Minh City, Vietnam. Supported by the U.K. Department for International Development, the workshop explored new innovations in communication to improve rural extension.

Lasting grains

IRRI has developed a farmer-friendly "super storage bag" that allows cereal grains to be safely stored for extended periods. Made from laminated, three-layer plastic, the Super bag is a liner used inside a normal storage bag. The impermeable middle layer keeps both water and oxygen out (regular

Robert Zeigler named IRRI director general



C. ZEIGLER

An internationally respected plant pathologist with more than 20 years' experience in agricultural research in the developing world has been named as IRRI's next director general. Robert Zeigler, 54, takes over from Ronald Cantrell, who retired in December (See *The tale of a Texas farm boy*, pages 18-21). The Illinois native was scheduled to assume his new duties on 1 April.

Dr. Zeigler earned his Ph.D. in plant pathology from Cornell University in 1982. After working on cassava at the International Center for Tropical Agriculture (CIAT), he spent time in Burundi as a technical adviser for the nation's maize program before returning to CIAT as a senior staff plant pathologist, ultimately taking over as the head of its rice program. In 1992, Dr. Zeigler moved to IRRI, where he led the Rainfed Lowland Rice Research Program and the Irrigated Rice Research Program. After 6 years, he left the institute to become head of the Department of Plant Pathology and director of the Plant Biotechnology Center at Kansas State University in the U.S., before working in Mexico as director of the Generation Challenge Program of the Consultative Group on International Agricultural Research. IRRI Deputy Director General for Partnerships William Padolina served as acting director general following Dr. Cantrell's departure.

DAVID JOHNSON

DURING NEPAL'S International Year of Rice celebrations on 17 December, the Minister of Agriculture and Cooperatives, Hom Nath Dahal, inaugurated the Nepal-IRRI office in Kathmandu. The National Agricultural Research Council (NARC) and IRRI exchanged a Memorandum of Agreement regarding the operation of the Nepal-IRRI office and the Nepalese version of IRRI's electronic rice training and extension service, the Rice Knowledge Bank. NARC Executive Director D. S. Pathik (*center*) is seen here signing the memorandum, as IRRI Senior Scientist Sushil Pandey (*left*) watches, along with NARC and Ministry of Agriculture senior staff.

New research Alliance to help fight poverty

IRRI and the International Maize and Wheat Improvement Center (CIMMYT by its Spanish acronym) have forged a new Alliance aimed at boosting international efforts to fight rural poverty and strengthen food security in the developing world.

Because rice, maize and wheat are all cereals, the two institutes believe that research on the crops' sustainable development and use can be better coordinated through a strong Alliance. The three staples provide 60 percent of global food needs annually, and cover more than 70 percent of the planet's productive cropping land.

The boards of trustees of IRRI and the Mexico-based CIMMYT met on 7-9 January in Shanghai, China, to identify research priorities for the new Alliance. They selected four areas — intensive crop production systems in Asia; the formation of cereals information units; training and knowledge banks for rice, maize and wheat; and climate change research directed at adapting the three crops to global changes.

The institutes' board chairs, Keijiro Otsuka of IRRI and Alexander McCalla of CIMMYT, said the Alliance will focus on mobilizing and applying science for increased impact in the developing world.

"The process should lead to a continuous evolution toward even closer integration of certain research programs to better achieve the missions of both centers," Drs. Otsuka and McCalla said in a joint statement, adding that the Alliance would enhance the institutes' partnerships with the national agricultural research systems of developing countries.

Briefly Briefly Briefly

plastic is only effective against water). The bags, which can double seed life, help farmers control grain moisture levels, maintain seed germination and viability for a much longer period, control grain pests without using chemicals, and improve grain quality.

New environmental council

The IRRI Environmental Council was established in November to ensure the long-term implementation, continued development and success of the IRRI Environmental Agenda. The council is responsible for the implementation of the Environmental Agenda — launched at the World Rice Research Conference in Japan, also in November — and will be the main advisory body for setting the institute's environmental guidelines and policies for all activities related to research, operations and interactions with the local community.

Gates money for Bangladesh

The Bangladesh Rural Advancement Committee (BRAC), founded by IRRI Board of Trustees member Fazle Hasan Abed, received the $1 million 2004 Gates Award for Global Health, funded by the Bill and Melinda Gates Foundation. BRAC is credited with improving the health and welfare of tens of millions of destitute Bangladeshis, and has become a global model for rural development groups. Dr. Abed also received the 2004 United Nations Development Program Mahbub ul Haq Award for Outstanding Contribution to Human Development, in recognition of his commitment to empowering the poor and his success in providing opportunities for women and other marginalized groups in Bangladesh.

Rice-wheat project begins

The project "Enhancing farmers' income and livelihoods through integrated crop and resource management in the rice-wheat system in South Asia," sponsored by the Asian Development Bank, commenced in Dhaka, Bangladesh, in February. The 3-year project,

IRRI researchers win best article award

The CGIAR Science and Communication Awards were presented at the annual general meeting of IRRI's parent organization, the Consultative Group on International Agricultural Research (CGIAR), held in Mexico City on 25-29 October.

The Outstanding Scientific Article award went to a team of IRRI scientists led by Marta Vasconselos (pictured at right with, *from left*, Deputy Director General for Research Ren Wang, Director General Ronald Cantrell and Director for Program Planning and Coordination Mike Jackson). The IRRI team's article, *Enhanced iron and zinc accumulation in transgenic rice with the ferritin gene* was published in *Plant Science* and shows the potential of using rice to deliver improved nutrition

OFFICIAL PHOTO

to millions of poor rice consumers. IRRI was also represented in the King Baudouin Award, won by the Rice-Wheat Consortium of the Indo-Gangetic Plains for pioneering resource-conserving technologies in South Asia's breadbasket.

Meeting highlights included Farmers' Dialogue — an innovative approach to reaching out to farmers in developing countries — and a "ministerial roundtable" where Ministers from Colombia, Côte d'Ivoire, Mexico and Venezuela, plus two private sector representatives, discussed how public-private partnerships could spur rural innovation and benefit poor farmers.

In a speech delivered by Agriculture Minister Javier Usabiaga, Mexican President Vicente Fox pledged Mexico's support for rural development and expressed confidence in the country's long-standing partnership with the CGIAR. Other speakers included CGIAR Chair Ian Johnson, World Bank Chief Economist and Vice President Francois Bourguignon, and CGIAR Science Council Chair and World Food Prize laureate Per Pinstrup-Andersen.

AILEEN DEL ROSARIO-RONDILLA

QUALITY CENTER: Plant nutrition expert Robin Graham (*right*), from the University of Adelaide, and former IRRI cereal chemist Bienvenido Juliano (*left*) cut the ribbon at the 15 December opening ceremony of IRRI's new Grain Quality and Nutrition Research Center (GQNRC) while GNQRC Head Melissa Fitzgerald and IRRI Director General Ronald Cantrell look on. The new center will help IRRI develop rice varieties of improved visual, sensory and nutritional quality. The GQNRC will also be a training hub, where scientists from national agricultural research systems can learn the most up-to-date, efficient and cost-effective methods of evaluating rice quality and nutrition. Read more in *Quality time* on pages 26-29 of *Rice Today* Vol. 3 No. 4.

Briefly Briefly Briefly

led by IRRI Senior Scientist J.K. Ladha, is designed to improve farmers' income and livelihood through technologies identified for dissemination and promotion in the rice-wheat cropping system covering the Indo-Gangetic Plains in Bangladesh, India, Nepal, and Pakistan.

Arizona *Oryza*

More than 240 rice researchers converged on the University of Arizona on 15-17 November for the 2nd International Symposium on Rice Functional Genomics. Participants presented the latest research results on the genome sequence of rice and explored ways of discovering the function of rice's 50,000 genes. IRRI attendees included bioinformatics specialist Richard Bruskiewich, plant breeder Darshan Brar and plant pathologist Hei Leung.

Regional hub for Laos

At the Lao-IRRI Rice Research and Training Project annual meeting in Vientiane on 27 January, IRRI announced that it will establish a regional hub in Laos to boost the institute's commitment to that country and regions beyond the project's auspices. National Agricultural and Forestry Research Institute officials and Ty Phommasack, vice minister of the Lao Ministry of Agriculture and Forestry, welcomed the development. The Lao-IRRI Project, which started in 1990, has substantially contributed to research infrastructure, national research capacity and national self-sufficiency in rice.

Great wall of rice

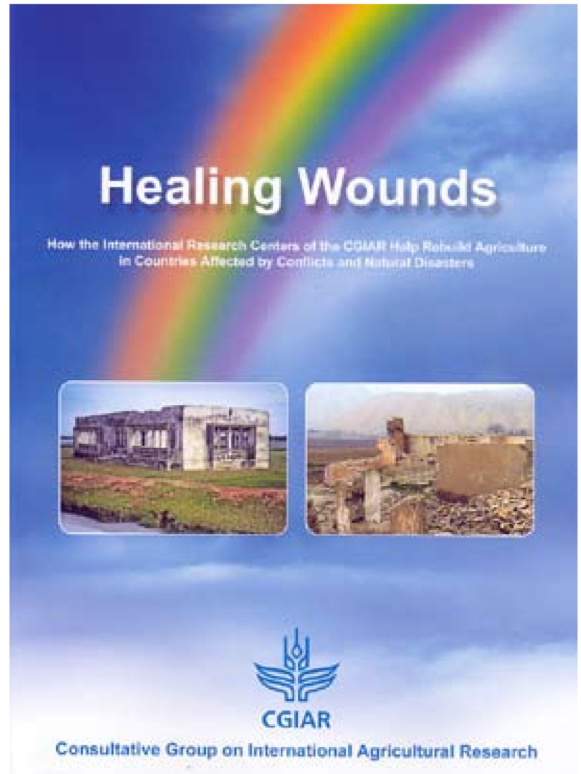
Glutinous (sticky) rice has been revealed as a secret ingredient used by ancient Chinese builders to strengthen their constructions. During recent maintenance work on the city wall of Xi'an, capital of Shaanxi province, workers found that plaster remnants on ancient bricks were difficult to remove. Chemical and physical tests showed that the plaster contained glutinous rice, which evidently helped make a better mortar.

Healing wounds

Last December's devastating tsunamis struck a double blow for many rice-growing communities. Besides the human toll, the waves brought salt and sand into coastal rice fields, destroying crops, killing farm animals, wrecking farm machinery and obliterating seed stocks. Seeds of salt-tolerant rice varieties have already been sent to Malaysia and more assistance is planned for other affected areas (see *News* on page 6).

The need to replace seeds and introduce new varieties is fueled not only by natural disaster, but also by war, which in many countries has resulted in the complete loss of varieties of rice and other crops. A new book, released by IRRI's parent organization, the Consultative Group on International Agricultural Research (CGIAR), examines its constituent centers' roles in rebuilding agriculture in countries affected by conflict and natural disasters over the past 30 years. Authored by Mark Winslow and Surendra Varma of the International Center for Agricultural Research in Dry Areas, the book, *Healing Wounds*, was featured in the January 22 edition of *New Scientist* magazine (www.newscientist.com/channel/earth/mg18524831.000).

The article, by Fred Pearce, recounts several examples of the effects of conflict on agriculture, including the rescue of Iraq's "black box." The box contained seeds from the country's main seed bank, which was destroyed following the U.S.-led invasion in 2003. There are similar tales from Afghanistan, Rwanda and the Democratic Republic of Congo. Pearce also mentions IRRI's role in the repatriation of rice varieties collected from Cambodia months before the Khmer Rouge took over (see *The burning of the rice* on page 15). But hundreds of varieties have been lost forever. Pearce quotes an IRRI study that found that in one district, the 15 most prominent and adapted deep-water rice varieties were all lost. He points out that, along with the rice, traditional knowledge about what to plant where also disappeared on a catastrophic scale.



The Cambodian experience also made the Canadian airwaves. Former IRRI scientist Harry Nesbitt was interviewed in February on the Canadian Broadcasting Corporation radio program, *The Current*, about IRRI's role in helping restore Cambodia's rice industry after the Khmer Rouge fell from power. On 10 January, the same program interviewed IRRI Senior Scientist Abdelbagi Ismail about the effect of the Indian Ocean tsunami on rice production in South and Southeast Asia. Dr. Ismail estimated that the tsunami affected more than 1 million hectares of rice land, which had previously provided food for at least 30 million people. He also discussed the short- and long-term damage to rice production. See *Healing Wounds* online at www.cgiar.org/publications/index.html.

Also...

Global warming and rice still a hot issue

A paper co-authored by IRRI scientists has made *Discover Magazine's* list of the top 100 science stories of 2004. The list, in the magazine's January issue, had *Rice yields decline with higher night temperature from global warming* at number 68. Written by a research team from IRRI, China and the United States, the study was led by IRRI crop physiologist Shaobing Peng. The paper, published in the 6 July issue of *PNAS* (www.pnas.org/cgi/content/full/101/27/9971), reported that field studies conducted at IRRI confirmed predictions from theoretical studies that global warming will make rice crops less productive.

Citing the IRRI-led study as evidence that global warming could hurt food production, a story by Robert Pore in the 23 January issue of *The Independent* reports on work by the United States' Agricultural Research Service. The study suggests that as atmospheric carbon dioxide levels rise, crops may need more nitrogen — and therefore more fertilizer — to grow.

Harvest shortfalls still a concern

Poor harvests last year, particularly in China, prompted coverage of the issue in major newspapers across the world. The *New York Times* and *Asian Wall Street Journal* are among the publications that published features suggesting causes for declining harvests and soaring prices. IRRI has warned about the threat of ongoing shortages as rice prices have undergone a 40% price increase in the past year. Website *Oryza* (www.oryza.com) reported IRRI Director General Ron Cantrell as saying that "Asia's ability to feed itself cannot be taken for granted." In addition to demand-increases from a rapidly growing population, Dr. Cantrell identified four other factors that pose threats to the supply of rice — water shortages, global warming, scarcity of rice farmers and decreasing area planted to rice.

Saving time and money in India

Regional Indian-language newspapers ran more than 20 articles on a project to develop and introduce direct-seeding technology and integrated weed management to major rice-producing areas of India. English-language national newspapers carrying the story included *The Times of India* and the *Hindustan Times*. The papers reported that IRRI weed scientist David Johnson, along with Martin Mortimer from the University of Liverpool's School of Biological Sciences, visited field trials of direct-seeding and weed management systems that could help rice farmers save water, time, labor and money.

Swiss rice

Even the Swiss have been celebrating International Year of Rice, with the news Website www.swissinfo.org visiting Ticino in December to find out about rice growing, Swiss style. Ticino's Mediterranean climate is ideal for the cultivation of the risotto rice Loto.

Reality check for rice year dinner guests

England's *Telegraph* carried on 26 November the story of a dinner hosted by Tony Hall, the U.S. ambassador to the United Nations food agencies in Rome. Hall, in an effort to remind his diplomat guests of the realities of world hunger during International Year of Rice, split diners into three groups, representing three levels of wealth. The richest third received a delicious gourmet meal, the middle class got rice and beans, while the "poor" guests were locked outside in the garden with a few handfuls of cold rice and a leaflet that "explained they were representing the 60% of the world's 6 billion people who struggle to find each meal." The leaflet also informed the bemused guests that the rice would fail to stave off their hunger. Many refused to eat and were eventually let back in for their "real" dinner.

The Vietnam News Agency looked at International Year of Rice in the context of the history of rice production in Vietnam. The report, by Huu Ngoc, stated that the rice year declaration "greatly interests Vietnam, where 80% of the population lives in rural areas and essentially survives on rice farming, and also where during the double rule of the Japanese and the French in 1945, a famine took a toll of 2 million lives."

Calling rice the "web of life in Vietnam," the story notes the country's success after the policy of *doi moi* (renewal) "was instituted in 1986 to curb a prolonged economic crisis that lasted for many years, and to revive agriculture by giving farmers the full scope of production." *Doi moi*, Ngoc adds, ended Vietnam's perennial food shortage and helped turn it into the world's third-largest rice exporter.

Washington Times reporter Takehiko Kambayashi interviewed International Rice Commission Executive Secretary Nguu Nguyen about International Year of Rice 2004. The interview, which ran in the paper's 29 October issue, covered the year's accomplishments, the reason behind devoting a year to rice, and how to increase Europe's and North America's interest in rice issues.

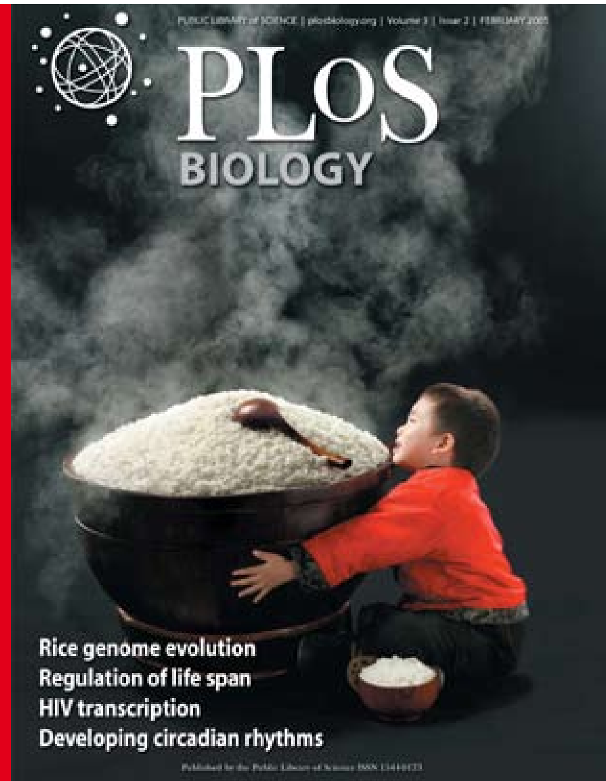


PHOTO BY LEI XU AND FANG CHEN, BEIJING INSTITUTE OF GENOMICS

PUBLIC RICE: ***PLoS Biology*, a journal published by the Public Library of Science (PLoS), focused on rice in its February 2005 issue. *The Genomes of* Oryza sativa*: A History of Duplications*, by Jun Yu, Jun Wang, Wei Lin, Songgang Li, Heng Li, *et al.*, compares the DNA sequences of the *indica* and *japonica* subspecies of rice, and reveals that duplication of genes has strongly influenced the evolution of other grass genomes. The article is accompanied by a synopsis, *Rice Genome Approaches Completion*, written to give non-experts insight into the work's significance. All works published in PLoS Biology are "open access," and freely available. See www.plosbiology.org.**

Pros and cons of genetically modified rice in China

Genetically modified (GM) rice in China has received widespread media coverage, with articles in major magazines *The Economist*, *Science* and *Newsweek*, plus a swathe of local and other international stories. Following China's Ministry of Agriculture announcement last December that the country would officially begin safety evaluation of GM rice, debate has raged about the potential benefits and risks of the commercialization of GM rice in China and elsewhere.

Some reports have surmised that, with pressure mounting on Beijing to boost domestic grain production and farmer income, China — the world's largest rice producer and consumer — could release GM rice as early as next year. The 18 November issue of *The Economist* suggests that China is ready to go GM because it consumes most of the rice it produces. The proportion of rice that China trades is small enough, says the magazine, that Chinese growers and consumers stand to gain much more than the country might lose in exports to GM-wary nations. Moreover, China is technically advanced in GM research and, according to a survey by the Center for Chinese Agricultural Policy, there is relatively high consumer support. The *Economist* article, along with a feature on China's GM-rice issues in the 20 December issue of *Newsweek* (http://msnbc.msn.com/id/6700914/site/newsweek/), proposes that if China does push ahead successfully with commercialization, it could spur other developing countries with relatively advanced research systems, such as India and Brazil, to do the same.

More recently, news agency Reuters posted a 28 February report quoting Clive James, chairman and founder of the International Service for the Acquisition of Agri-biotech Applications, a group that advocates biotechnology as a means to help end global hunger. Dr. James suggested that China could be ready to commercialize GM rice within 2 years and, once they do, it will move throughout Asia. "It's the most important food crop in the world. They've worked on this very carefully and had large-scale field trials for several years," he reportedly said.

However, following a Chinese biosafety committee meeting in December, China denied it is definitely gearing up for the commercial release of GM varieties. On 2 December, Chinese news agency Xinhua stated that there were "no genetically modified rice varieties in China being issued with safety certificates." The 10 December issue of *Science* reported Fang Xiangdong, director of the China Ministry of Agriculture's Office of Biosafety, as saying that "no application has been approved or rejected so far." The journal added that "if China does delay the introduction of GM rice, a blight-resistant GM rice variety now undergoing field trials in the Philippines could be the first in the world to win approval."

What's rich, creamy, delicious and weighs 7.5 tons?

RICEGROWERS ASSOCIATION OF AUSTRALIA INC.

Japan Today, *The Australian*, Reuters and a host of other news publications and organizations ran reports about Australian chefs and aid workers who on 26 November celebrated International Year of Rice by cooking a world-record 7.5-ton bowl of risotto.

With the Sydney Harbor Bridge in the background, the team used large paddles to stir together 1.6 tons of arborio rice, 4,400 liters of stock, 800 kg of frozen peas, 1.5 kg of saffron, 600 kg of cheese and butter, 20 kg of garlic, and 400 kg of onions and celery.

The risotto, cooked over 3 hours in a 10- by 3.6-meter steel pan, was fed to onlookers for a small donation, which went to charity group CARE Australia.

Philippine news service ABS-CBN and Australian newspaper *The Sydney Morning Herald* were among those reporting that Filipinos also put rice in the record books on December 9, when residents of Nueva Ecija, in the northern Philippines, made a 2.54-ton *Biko ng Mundo* (Rice Cake of the World).

Some 3,000 residents from 37 villages helped to prepare the *biko*, which is made by boiling glutinous (sticky) rice with coconut milk and brown sugar.

Other publications raised concerns about the environmental and human health implications of releasing GM rice. *The China Daily* said in a 13 December article that "people should not be used as guinea pigs with food they eat every day," and that the impact of genetically modified foods "on human health, the environment and biodiversity has not yet been thoroughly studied under current levels of science and technology."

Meanwhile, the Food and Agricultural Organization of the United Nations (FAO) has voiced its support for GM crops. At a conference in December, the FAO declared that biotechnology and hybrid strains could be used by rice growers to reverse falling yields. In an 8 December report, Reuters cited Mahmoud Solh, FAO director of plant protection and production, as saying, "The successful mapping of the rice genome sequence offers still further opportunities to identify and characterize the genes and biochemical pathways for increasing rice yield [...] and improving rice quality for consumer preference."

However, in another Reuters story carried by the 28 October issue of *The Manila Times*, the FAO also urged governments to act with caution before giving the go-ahead to commercial planting of GM rice. He Changchui, FAO Asia-Pacific assistant director, reportedly said that governments should undertake extensive risk assessment on food safety and study consumer sentiment before giving approval, adding that "countries intending to commercialize genetically modified rice should go through a very strict, science-based analysis."

In further GM developments, an article in the 10 February issue of *Nature* reveals that scientists from CAMBIA, a research center affiliated with Charles Sturt University in Canberra, Australia, have developed new ways to genetically modify plants. The use of *Agrobacterium* — previously thought to be the only bacteria capable of transferring genes to plants — is restricted by patent protection. The CAMBIA researchers, however, managed gene transfer using several different bacteria. CAMBIA plans to make the technology freely available through "open source" licensing, meaning that scientists will be able to use the technique without licensing costs. On the same day, *The New York Times* ran an article discussing the breakthrough and its implications.

Finally, looking at an altogether different GM rice issue, Reuters reported in February that Japanese scientists have developed GM rice that may help alleviate hay fever. A Farm Ministry official was reported as saying that the new strain of rice contains a gene that produces the allergy-causing protein. The rice "treatment" worked like other allergy therapies where a small amount of the allergy-causing substance "is released into the body to allow resistance to build up."

Intensify to diversify

Story and photography
by Leharne Fountain

Smarter rice growing gives Cambodian farmers an opportunity to try new crops and gain more income

CAMBODIAN RICE FARMER, Marie, is participating in a field trial that should enable her and her fellow farmers to grow more rice while saving money and resources that can be invested in other crops. The intensified system has some farmers growing the fast-maturing aromatic variety, Phka Rumduol (*right, above and top*). During the trial, farmers also use traditional methods and varieties (*opposite bottom and right*).

Every year since 1995, Cambodia has produced a rice surplus. It is an impressive record given the agricultural devastation wrought by the violence of the 1970s. Yet many Cambodian rice farmers still harvest yields of only 2 tons per hectare, barely enough to feed their own families. Rice is the most important source of income and employment for rural Cambodians, and the source of around three-quarters of the average Cambodian's calories. Productivity gains in rice, more than in any other crop, will therefore help reduce poverty.

One of the proven routes out of poverty is income diversification — if the rural poor can make money from a number of enterprises, not only does this provide extra income, but it also offers them a buffer when things go wrong, such as crop failure. Moreover, rice farmers perched on the edge of self-sufficiency are denied the chance to improve their lot. They are forced to devote all their energies to rice just to stave off hunger for themselves and their families. In short, better rice production opens the door to more lucrative farming.

A short drive out of the Cambodian capital Phnom Penh, Preap Visarto, head of the Plant Protection Program at the Cambodian Agricultural Research and Development Institute (CARDI), and International Rice Research Institute (IRRI) Senior Scientist Gary Jahn are conducting the Farmstead field trial, a 3-year project supported by the Australian Centre for International Agricultural Research (see *Donors corner* on page 5). Farmstead consists of around 6 hectares of rice fields in a relatively favorable rainfed environment. Standing for "Fish and Rice Management System to Enable Agricultural Diversification," the project fields are located by a canal that can provide supplemental water to nearby fields, although not enough to grow a fully irrigated dry-season rice crop.

Farmstead aims to help farmers intensify their rice production, thereby allowing the small amount of extra water, land and other resources consequently freed up to be invested in growing other crops, which can provide supplementary income for farmers. In addition, the project aims to design systems of intensification that complement, rather than hinder, ricefield fish farming, an important source of income and protein for many farm families in this region.

The trial will compare intensified fields with conventionally managed fields, focusing on yields, crop loss, profit margins and fish production.

Two rice varieties are grown in the intensified fields. Farmers first grow an IRRI-developed modern variety known as IR66, which matures in 2 months. Once IR66 is harvested, they plant a variety named Phka Rumduol, which was developed for rainfed systems by CARDI and matures in 3 months. These varieties, each planted once a year, during the rainy season, were chosen because they can be grown and harvested in synchronization with the 5-month variety, named Phka Khnhei, traditionally grown in the region. The total growing period is crucial, as sufficient water is available for only 5 months.

Other considerations were improved yield, grain quality and market value. Phka Rumduol, for instance, fetches a higher market price because of its aromatic qualities. The CARDI-designed Farmstead system also seeks to increase yields by leveling fields, improving fertilizer application and water management, and using certified seed to ensure seed quality.

Starting in 2004, the project has already delivered promising results. The intensified fields of Phka Rumduol produced significantly higher yields than traditional farmers' fields — 3.3 tons per hectare, compared with only 3 tons per hectare in fields planted to Phka Khnhei. Add to this another 3 tons per hectare from IR66, and the intensified fields are yielding more than double what they produced in the past.

Dr. Jahn and his CARDI collaborators are also measuring crop loss from pests. Small subplots within the intensified and conventional fields are either treated with pesticide or left untreated, regardless of what other management practices are carried out (see *Reason to cheer* in *Rice Today* Vol. 3 No. 4, pages 12-17).

"This will allow us to determine what level of control is required for dealing with insect pests," Dr. Jahn

THE FARMSTEAD TRIAL assesses crop loss from pests to see if the intensified farming system leads to greater damage from insects such as stem borers, which sever the rice-bearing panicles and cause "white head," so-called because the grains turn white as they die.

THE BURNING OF THE RICE

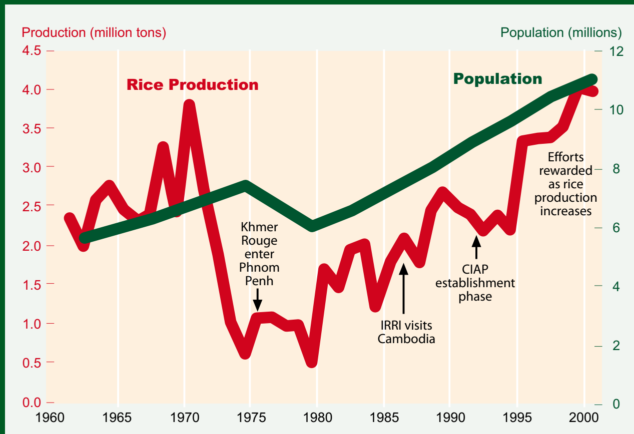
Like many aspects of normal life in the country, agriculture in Cambodia was devastated during the reign of the Khmer Rouge. But, during the International Year of Rice 2004, just a few decades since the demise of the regime, Cambodia celebrated ten years of rice self-sufficiency. This remarkable recovery began when in 1985 IRRI was invited to work with Cambodian scholars and scientists to help re-establish the country's rural economy. Supported by funding from the Australian Agency for International Development, the venture was called the Cambodia-IRRI-Australia Project (CIAP) and was led by Australian agronomist Harry Nesbitt (see Rice Today *Vol. 1 No.1, pages 14-19). Scientist Don Puckridge, a member of the IRRI team sent to Cambodia, has chronicled the events that led to the rejuvenation of Cambodia's rice production in a new book titled* The Burning of the Rice. *The following excerpt from Chapter 2 describes some of the enormous challenges faced by the CIAP team when the project began.*

"An enduring memory of Prey Veng Province was of a narrow dusty road on the bank of a canal drawn straight across the landscape. It was a typical example of Khmer Rouge changes to rice culture in which they dug canals to follow grid lines of a map without reference to the topography. A few diminishing pools of water along the bottom of the canal were a reminder of the futility of trying to keep the dry-season drought at bay. Another more fortunate canal was half full of muddy water, with a bamboo fence placed across it to trap fish as the water level dropped. Nearby were four substantial wooden houses on stilts, scattered as if they avoided associating with each other. Conical stacks of straw near each house were being undermined by bites from cattle taking respite from the dry and almost barren fields.

We stopped at a group of huts and saw an orphan girl of about sixteen years of age tending an earthen fireplace in the open, boiling sugar palm juice in a large wok to make palm sugar, a common ingredient in cooking for those who could afford it. Seeing this girl and other orphans in that place made more impact when we learnt that Prey Veng had over 34,000 widows and 10,000 orphans in a population of about 700,000. Seventy percent of the men had died under the five years of Khmer Rouge rule and sixty-five percent of the remaining population was female. Kampong Speu Province had 17,000 widows and 7,000 orphans, Kampong Chhnang Province 15,000 widows, and so on. In the sixteen to forty-five age group of Prey Veng Province, females outnumbered males by about three to one.

This disproportionate ratio of the sexes resulted in social disruption and lack of male muscle power for heavy farm work. Consequently, women were often obliged to perform tasks that were traditionally done by men, such as land preparation and application of farmyard manure and chemical fertilizer to crops. The loss of animals due to the effects of war, widespread disease and overwork took their toll as well. People without animals had to hire them, with payment usually in rice or labor, or to do the work by hand. On one occasion we even saw a young woman with a yoke over her shoulders straining to pull a plough while an old woman behind it guided the blade in the furrow.

A social survey a few years later found that such women had less access to animals and other resources, were the major borrowers of informal loans and had less access to information. Even though they may have been the only adult in the family, there was still the cultural perception that they were not farmers, but were helpers and housewives. In families without cattle or buffaloes for ploughing and raking of their fields, it was the women who were almost always the ones who repaid the labor owed as payment for borrowed draft animals. One morning of ploughing and raking was usually repaid by a full day of pulling seedlings and transplanting. Women who did not own animals also provided labor in exchange for cow manure for use as fertilizer on their fields and they were often exploited because they lacked cash or other assets."



POPULATION AND RICE PRODUCTION, CAMBODIA 1961-2000

FROM "THE BURNING OF THE RICE" PAGE 179

explains. “It is generally assumed that there will be a significant crop loss from pests. This experiment will allow us to actually measure what percentage, if any, is lost when no pesticides are used in each system.”

Initial results of the no-pesticide trials show a 7% yield drop caused by pests in the intensified fields, but no significant loss in the conventional fields, indicating that intensification may increase levels of crop loss.

“While intensification increases yields,” says Dr. Jahn, “it also appears to increase the percentage of the total yield that is lost through damage by insect pests. There’s a trade-off, and we’ll perform an economic analysis to determine whether or not it’s financially worthwhile to control pests in the intensified system.”

Harvest help

Marie is one of the participating farmers. Her farm has a total area of around 1.5 hectares, in four separate fields, all of which are involved in the Farmstead trials — some as intensified fields, others she farms using her own methods. Her husband is a teacher at the local primary school and she has four children aged 12 to 17. The day we visited, her eldest son was harvesting rice along with two hired laborers. She told us that her younger children, who were at school, also help with the harvest on Sundays.

Marie’s farm presents a typical scene. All around, rice plants lie flat, as though blown over by a strong wind. Marie explains that she flattens them herself because the Phka Khnhei she grows is tall and difficult to harvest when the plants are upright. Bundles of rice, evidence of the day’s work, form curved rows and snake in winding paths to the laborers.

Marie pays her laborers 8,000 riels, just over US$2, per 100 rice bundles. They harvest approximately 800 bundles of Phka Khnhei per field, for a total labor cost of $16 per field. She sells her rice at 400 riels ($0.11) per kilogram and, with a yield of close to 2 tons, receives around $200 income from her harvest. With

EVIDENCE OF HARD WORK — bundles of harvested rice line the fields at the end of the day.

FARMSTEAD SCIENTISTS Gary Jahn (left) and Preap Visarto (middle) ask Marie about her experiences with the field trial.

Cambodia this year suffering from drought that has destroyed a fifth of the country's wet-season crop, Marie may earn up to 600 riels per kilo. She is a long way from being wealthy but, as far as rice farmers go, Marie is doing OK. Much room for improvement remains, though, and by adopting Farmstead's intensified system she stands to gain a better, more stable income to support her family. Importantly, she will also get a chance to farm other crops.

Although the system is proving successful, Dr. Jahn says that it may need to be linked with a microcredit or livelihood improvement scheme. "The farmers really like the system and can recognize the benefits it provides, but some farmers may need initial income to implement it — extra money to buy good seed, fertilizer and labor."

The flexible approach the researchers are taking to Farmstead allows problems to be solved as they arise. One thing preventing widespread adoption of the IR66-Phka Rumduol combination is crab damage. Phka Rumduol is planted several weeks later than Phka Khnhei, leaving seedlings susceptible to attack by a particular type of crab that matures at the same time. Marie says this would prevent her from planting the two modern varieties in the lower-lying fields that the crabs inhabit. It is a dilemma for many farmers with low-lying fields in the area. In response, Mr. Visarto and Dr. Jahn plan to expand the Farmstead system to include a crab management strategy.

In its first year, Farmstead has shown that farmers have the potential to double their rice yield. Farmstead farmers, having observed the system's benefits, plan to adopt the combination of modern varieties in their fields next season. As they improve their rice production, farmers can start to diversify their crops and their income, which ultimately means a better life for them and their families.

Leharne Fountain is an Australian Youth Ambassador assigned for a year to IRRI, where her duties include serving as deputy editor of Rice Today.

The tale of a Texas farm boy

by Leharne Fountain

Ronald P. Cantrell, the Texas farm boy made good, heads home after more than 6 years at the helm of the International Rice Research Institute

If his beginnings amid the dust and dirt of a Texas farm shaped Ronald P. Cantrell's outlook on life, it was a storm in West Africa that helped define his career.

"I worked on a farming systems project and we were doing village-level studies," recalls Dr. Cantrell, who last December retired after more than 6 years as director general of the Philippines-based International Rice Research Institute (IRRI). "We had a whole array of technologies at various stages of trial in this village.

"It was the end of my second year, almost the end of the cropping season, and there was this tremendous storm. The wind just laid everything down. *Everything.* It was a complete loss of crops.

"I couldn't find any of the farmers in the fields. So I drove around and I finally found them all, sitting under a big tree, drinking beer at about 10 o'clock in the morning. I joined them and said, 'You know, I'm really sorry about what happened to your crops.' They said, 'No, no, that's all right. This happens all the time. What we're really sad about is the fact that you lost your trials, and you'll probably leave.'

"I already knew I was leaving. I told them, 'Hey — those trials, I wasn't that sure of them. I didn't know if some of them were going to be of any benefit to you or not.'

"And this village chief said to me, 'Doctor, we knew the stuff you had in those trials wasn't going to work. But, as long as you're here, that gives us hope that we'll have a link into what we know will help us in the future.'"

It may have been a humbling experience for a young researcher, but it proved priceless. Dr. Cantrell realized that his project hadn't established any linkage with the national agricultural programs. Without a conduit to the national systems to feed knowledge in where it was needed and extract local know-how and experience, there was no sustainability — no way to make lasting improvements to local farming or, ultimately, to their livelihood.

EARLY DAYS in 1998, as Robert Havener (*left*), interim director general of IRRI, hands over the reins to Ronald Cantrell.

JESSE VICTOLERO

Timely lesson

This lesson was etched in Dr. Cantrell's mind when in 1984 he joined the International Maize and Wheat Improvement Center (CIMMYT, by its Spanish acronym) in Mexico, as director of its Maize Program. CIMMYT, along with IRRI and 13 other institutes, is part of the Consultative Group on International Agricultural Research (CGIAR).

"I liked what I saw there," he explains, "because I saw an international center that was not there just to do the research. They clearly recognized that their purpose was to strengthen and complement the national programs because that's the only sustainable way."

Although the family farm provided more than mere subsistence for the Cantrells, the young Ron grew up truly poor. Two generations of family members before him had


ARIEL JAVELLANA

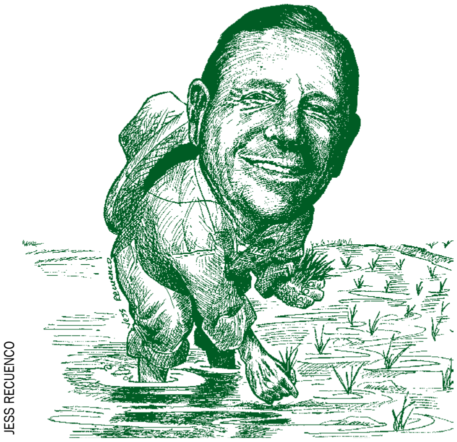
worked the land and he recalls clearly his father's feelings about his future.

"I knew one thing from my father," says Dr. Cantrell, "and that was that I was going to college. He had started farming during the Great Depression and he was convinced that his children's future should not be on the farm. He saw that the best way out of that was through an education."

Needless to say, Dr. Cantrell's rural upbringing influenced his decision to study agriculture. His family property was a combined farming ranch with both cattle and crops, and his early inclinations were toward veterinary science. "But when I switched schools from one university to another," he says, "I ended up in agronomy."

To support his studies, Dr. Cantrell found a job at an agricultural station working for a sorghum breeder. He acknowledges this as a pivotal moment in his career, but admits that it was the Vietnam War that ultimately drove him to pursue research.

"On graduation, everyone was going to Vietnam. But someone came in and explained a program where you could get an educational delay," recalls Dr. Cantrell. "I'd never considered going to graduate school. None of my family had ever gone to college before, let alone beyond. They were just delighted that I was going to finish."



JESS RECUENCO

AN INDIAN FARMER presents a token of friendship to Dr. Cantrell.

JK LADHA

After completing his Ph.D. at Purdue University in 1970, Dr. Cantrell worked as a maize breeder at the Cargill Corn Research Station in Nebraska. In 1975, he headed back to Purdue to become associate professor of agronomy, and was appointed full professor in 1981 before heading to CIMMYT 3 years later. Following his stint in Mexico, he moved to Iowa, where he spent 8 years as head of the Agronomy Department at Iowa State University. In September 1998, he returned to the CGIAR as director general of IRRI.

Having never previously worked with rice, Dr. Cantrell recalls both the trepidation and excitement he felt when he arrived at IRRI.

"It was daunting, not having worked on such an important crop before, or the environment that the crop grows in. Rice is a fascinating crop, probably the most difficult crop that I ever worked on. You try to make genetic improvements and at the same time maintain that unique taste and aroma. Some of the most sophisticated palates I know are rice eaters," he says, touching on one of rice's biggest challenges.

"Wheat is mainly processed," explains Dr. Cantrell. "In Africa, people always eat sorghum with some sauce. Same with maize, it's always eaten with something. Preserving rice's unique aroma and quality is really difficult. Rice consumers are so demanding, since they eat it alone."

As he settled into IRRI, one thing in particular jumped out at him: "I was very impressed with the staff; I thought they were of a very high quality, especially the nationally recruited staff," he recalls, referring to the Filipino researchers, managers and field workers that make up around 90% of the institute's employees. "I couldn't recall any of the other international institutes I'd seen having national staff capable of assuming the same responsibilities."

The first major issue Dr. Cantrell faced was the imminent loss of several plant breeders. "Longevity is crucial in breeding, especially for self-pollinating crops like rice; replacing people like Gurdev Khush, who had been at IRRI for over 30 years, was going to be a real challenge," he says, recalling the retirement of the former IRRI principal plant breeder and 1996 World Food Prize laureate. "But I'm delighted with the transition that's been made. We now have three people committed long term who are doing an excellent job in breeding."

Major challenges

Keijiro Otsuka, chair of the IRRI Board of Trustees, notes that Dr. Cantrell led the institute through many major challenges and decisions. A continuing decline in funding hit IRRI hard in 2002, causing painful staff cutbacks. Added to this was the growing international debate over biotechnology and how it could be used to benefit poor rice farmers and consumers. "Dr. Cantrell provided the steadying hand, strong leadership and intelligent management IRRI needed," says Dr. Otsuka.

Dr. Cantrell was a firm believer that the quality of research and the credibility of the institute rest upon the quality of the staff.

"He was never concerned about making IRRI the biggest research center, just the best," says Dave Mackill, head of Plant Breeding, Genetics and Biotechnology at IRRI. "He always focused on quality, and he convinced us to always take the high road — to do everything with a sense of purpose and not get distracted from our core research for short-term gain."

Equally important for a director general was the ability to see the big picture and remember why the institute existed in the first place — to improve the well-being of present and future generations of rice farmers and consumers. Dr. Cantrell emphasized the importance of focusing on *all* levels of food security, from the national level to the household level. He understood that simply because a country produced enough rice for its entire population, that did not mean that everybody had enough to eat.

Looming issues

Dr. Cantrell leaves IRRI at a time when many issues for rice research loom ominously on the horizon. He believes that climate change will increasingly affect all of rice-growing Asia, particularly after a recent IRRI-led study indicated that warmer temperatures may threaten rice yields. But most prominent among the challenges is the availability of fresh water.

"Of all the fresh water used in agriculture in Asia, rice uses 50%," says Dr. Cantrell. "Rice production will suffer as water becomes increasingly scarce. And we already see it happening. There's a whole realm of research centered on decreasing the need for water in growing rice."

He cautions, though, that, "With less water, there will be more weeds. Managing weed populations is going to be a huge area."

The greatest advances in the shorter term, says Dr. Cantrell, will come from closing the gap between theoretically potential rice yields and the yields that farmers actually achieve, as well as reducing large postharvest grain losses. One way to do this, he says, is simply to adapt existing technologies to local environments.

"In the next 10 years or more," he adds, looking further ahead, "tools such as biotechnology are going to do some great things to help minimize the use of chemicals, increase productivity and maximize water efficiency."

Dr. Cantrell would be the first to admit that he has received as much as he has given at IRRI. In this light, he offers some advice to Bob Zeigler, the incoming director general: "Listen to the staff. We have excellent people who know and understand the demands from our partners. Just listen and then try to create an ever-growing environment," he says, underscoring the need for both increased funding and a scientifically creative setting.

OFFICIAL PHOTO

OFFICIAL PHOTO

ARIEL JAVELLANA

ARIEL JAVELLANA

FAMOUS LIAISONS: during his 6 years at IRRI, Dr. Cantrell met with world leaders from across the globe, including (clockwise from top) His Majesty The King of Thailand Bhumibol Adulyadej, Philippine President Gloria Macapagal Arroyo, former Philippine president Joseph Estrada and former Chinese President Jiang Zemin.

The former farm boy keeps returning to one subject, an idea that cannot be emphasized strongly enough. It is the philosophy of inclusiveness that has underpinned his journey from the Texas countryside to the upper reaches of agricultural research — the need to work *with* the national agricultural research and training systems that must ultimately help people improve their lives.

"While our goal may be the elimination of poverty," he says, "we cannot do that by going and doing the job ourselves at the producer level. We can only strengthen and complement the local organizations."

A Day on the FARM

by Leharne Fountain
photography by Ariel Javellana

Home to research that helps feed the world's poor, 200 hectares of land in the northern Philippines might just be Asia's most valuable real estate

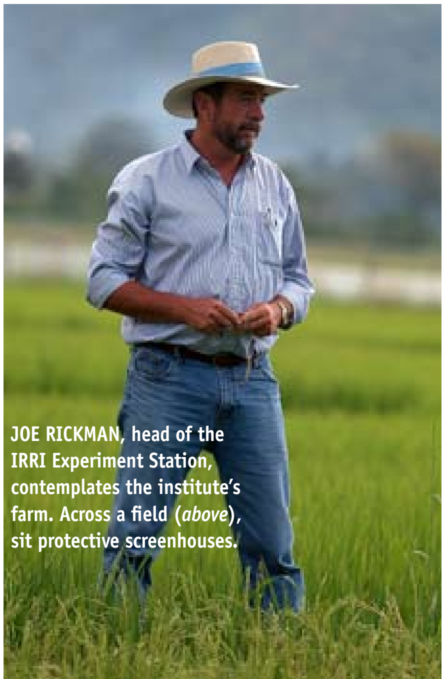
Drive 60 kilometers south of Manila and you will find a farm where, on any given day, more than 300 people are hard at work. Mechanics fix machinery, rat catchers lay traps, laborers transplant seedlings, workers dig irrigation channels — anything you might expect to find on a commercial rice farm.

But this is no ordinary piece of land.

Occupying nearly 200 hectares, the International Rice Research Institute (IRRI) Experiment Station, known simply as "the farm," is where IRRI scientists take their research out of the lab and into the wider world.

"The farm reveals the truth of our research," says Joe Rickman, head of the Experiment Station. "We can develop new technologies and breed new varieties, but if we don't test them in the field, and if we don't understand large-scale problems and farm management issues, then we've failed."

Lowland flooded rice fields make up 160 hectares and there are some 40 hectares of upland rice fields. The farm also features nearly 50 greenhouses, glasshouses and screenhouses, as well as a rice mill and a controlled-environment laboratory known as a phytotron.

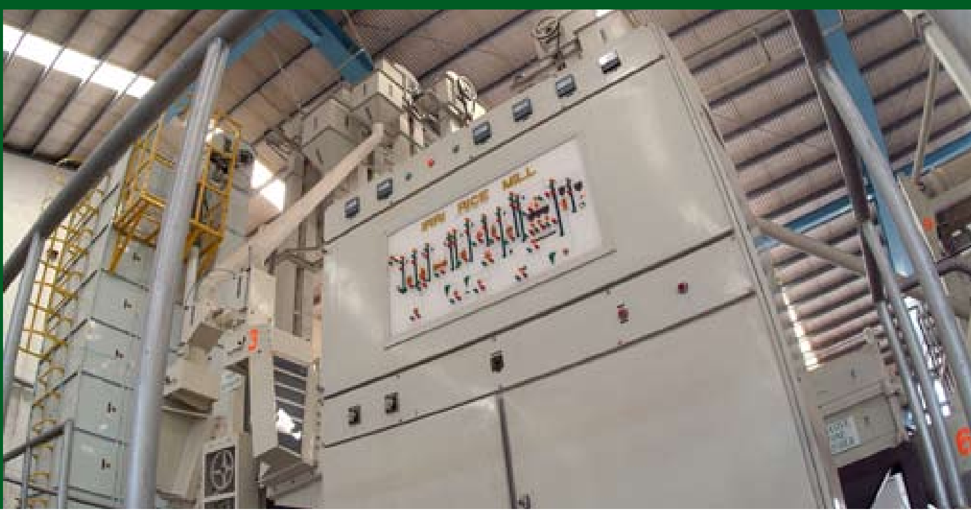


JOE RICKMAN, head of the IRRI Experiment Station, contemplates the institute's farm. Across a field (*above*), sit protective screenhouses.

So, what kind of research takes place on this prized real estate? Plant breeders, who use just less than half of the field area, are the biggest customers. IRRI's Entomology and Plant Pathology Division, Genetic Resources Center, and Crop, Soil and Water Sciences Division each use less than 10%. The Experiment Station uses the remainder to produce seeds and rice.

"In plant breeding, we look for rare plants," explains Dave Mackill, head of IRRI's Plant Breeding, Genetics and Biotechnology Division. "We take several different strains and breed them together to produce new ones. Out of a million

WORKERS HARVEST seeds among a mosaic of different varieties grown for the Genebank; (*continuing clockwise*) Soccie Almazan, curator of wild rice species, inspects wild rice in the screenhouse; wild rice variety Oryza longistaminata is the source of a gene that confers resistance to bacterial blight; the IRRI rice mill.



rice plants produced this way, only a relative handful will have the characteristics that we want."

Dr. Mackill points out that plant breeding is partly a numbers game — the more plants you can test, the greater your chances of identifying those that have the features you're looking for. But dealing with such large numbers of plants obviously requires space.

"More space means more plants," says Dr. Mackill, "and that means a greater chance of success. That's why the IRRI farm is so important."

Dr. Mackill points out that although we often don't know precisely which genes give rise to desired traits, they are expressed physically in the growing rice plants: "That's the basis of our breeding trials. We visually inspect the plants, and select the ones that show the qualities we're seeking. After several generations, we end up with a select group of several hundred, which we then grow in yield trials."

Take the quest for resistance to the rice disease bacterial blight. "It's very obvious which plants are infected and which ones aren't," says Dr. Mackill. "We select the plants that show some resistance to the disease and grow them in the next generation of the trial."

Millions of plants

Breeding trials are a serious investment of time and resources. Each may run for several generations, spanning periods of up to 5 years. Millions of plants can be sown on more than 60 hectares in each of the wet and dry seasons every year. The farm must provide more than just space, too. It also provides different environments — nutrient-deficient soils, for example — where varieties are tested for tolerance of environmental stresses.

But the farm's value reaches far beyond merely providing space for research. IRRI's International Rice Genebank holds in trust for humanity nearly 107,000 cultivated and wild varieties of rice. It is the world's most comprehensive repository of rice germplasm (seeds and the genetic material they contain).

This agricultural vault holds seeds that can help save lives, as happened when Cambodian seeds collected before the devastation of the 1970s were used to reestablish the country's ruined rice industry and help end mass starvation. Furthermore, the genebank is a source of genes that carry traits that can be harnessed to improve rice plants — from tolerance of climatic extremes of cold, heat and drought to survival in nutrient-poor soils, to pest

PLANT BREEDER Dave Mackill checks on breeding trials while a tractor levels a field using laser-leveling technology (*bottom*).

and disease resistance. And scientists access the genebank to tap into other qualities, such as nutritional value, flavor and the physical appearance of rice grains. For all that, though, where does the farm fit in?

"The genebank isn't static," explains Pola de Guzman, the genebank's curator. "We periodically test the seeds and any varieties that fall below a certain germination rate we plant out on the farm to harvest new seeds."

Multiplying genebank seed on the farm is crucial, she says, not only to ensure the viability of the current collection, but also to satisfy international seed requests, and to grow and characterize newly acquired varieties.

"We get requests for seeds from scientists and farmers all around the world," explains Ms. de Guzman. "And, as was the case for Cambodia, we supply seeds to countries that have lost their own stores through war or natural disaster."

Indeed, the genebank allowed IRRI to supply Malaysia and Sri Lanka with the seed of salt-tolerant rice varieties that will grow in areas devastated by last December's tragic tsunami (see *News*, page 6).

In any given season, thousands of different varieties from the genebank will be grown on the IRRI farm. Growing so many different types of rice, side by side, brings its own challenges. Because such large numbers of varieties are planted, those that need similar growing conditions, or have similar maturity periods, are grouped together to ease management and minimize the chance of mix-ups. Harvesting needs to be timed for optimum seed-storage potential. The farm also has a quarantine area, where all newly acquired seeds are grown, to ensure that the seed produces healthy plants and, if it is harboring disease, doesn't infect other plants.

Mini-hospital

Serving as a "mini-hospital" inside the IRRI farm complex is the screenhouse facility. This is where researchers grow varieties that are sensitive to an open-field environment, including wild species, which tend to be more difficult to grow than cultivated varieties.

"We really baby them," says Soccie Almazan, curator of the wild species. "Different wild species have very different needs. Some need partial shading and special soils because they grow in forests; others grow well in full sunlight. Some need to be submerged because they're from swamps."

Sometimes, even the screenhouse environment is too variable. Varieties that are very sensitive to environmental conditions can be grown in the controlled environment of the phytotron, where factors such as daylight hours and temperature can be manipulated.

In areas of the farm not used for research, rice is grown for production. The harvest from these fields is processed in the IRRI rice mill and distributed to staff. By-products, such as bran and broken grains, are sold. The mill also facilitates research into improving rice milling techniques.

The production areas expand and contract as research demand for land fluctuates each year. But, as Mr. Rickman explains, efficiency is fundamental.

"Although it's a research station," he says, "we try to run the farm on commercial lines. We try to make it as efficient as possible in terms of both labor and dollars and cents."

The value of the farm, though, is not in the rice produced. Its worth lies in the opportunity it provides scientists to put their research to the test — research that aims to help poor farmers produce more rice, economically and sustainably, and so improve the lives of some of the world's poorest and most vulnerable people.

In many ways, the IRRI farm is the institute itself. "Without the farm, there is no IRRI," says Mr. Rickman. "If we lost the farm, we would lose much of IRRI's value and, ultimately, our contribution to the poor."

GUY TRÉBUIL

The game of life

by François Bousquet, Tayan Raj Gurung and Guy Trébuil

A fresh approach to the challenge of sharing agricultural resources has rice farmers playing games with scientists

Imagine, for a moment, that you are a Bhutanese farmer. Farming has been in your family for generations. You manage your farm now in the same way your father, and his father, managed the land. The other farmers in your village run things in much the same way. As far as you know, it has always been thus.

Since you took the reins from your father, you have grown rice and a few other crops in high-altitude, terraced wetland irrigated by water from a nearby stream. But in the last few years things have started to go awry. You struggle to get enough water to transplant your rice on time. Farmers from a neighboring village, situated farther up the mountainside, divert almost all the stream's water into their crops. You know this isn't fair, but your hands are tied — history and culture dictate that this is the way things are done. The other village can take as much water as it likes, no matter how little is left for you and your fellow villagers.

Lately, the dearth of water has been worse than usual, and the situation has become volatile. Tempers are fraying, but nothing is changing. How do you change things so that all the people have what they need?

TAYAN RAJ GURUNG

A FARMER CLEANS the water-intake point of the Dompola village canal in west central Bhutan. Situated 1,800–2,000 meters above sea-level, Lingmuteychu watershed sports terraces of flowering rice (*top*).

This scenario is not uncommon in Bhutan. A fifth of the farming households in this small, mountainous kingdom northeast of India cite access to irrigation water as a major constraint to agricultural production. In recent years, the system of customary rights to natural resources that has served Bhutan for centuries has become bumpier as the previously unfelt influences of economic development, commercialization and globalization have distorted age-old traditions. Conflict over resources is bringing about social tensions across whole societies.

In the past few years, however, one approach has emerged that may help to quell confrontation.

Agricultural scientists François Bousquet and Guy Trébuil — seconded in 2001-04 to the International Rice Research Institute (IRRI) Social Sciences Division from the French Agricultural Research Centre for International Development (Cirad by its French acronym) — have set about implementing an innovative method for managing renewable resources in Asia.

Social factors

Drs. Bousquet and Trébuil embarked on their project knowing that there is much more to establishing successful, sustainable agricultural systems based on rice farming than simply providing technical information and technologies. Researchers sometimes ignore the social and economic factors that need to be reconciled with any new way of doing things.

According to Dr. Trébuil, it is an increasingly complex task to manage scarce and degrading common resources — such as water, land and biodiversity — in farming ecosystems. As technology permits previously isolated communities to connect, the differing views and needs of more and more stakeholders must be considered.

“However,” he says, “there has been a recent trend toward decentralizing natural resource management, which has given us a chance to reassess how agricultural scientists work in developing countries. Scientists approach problems and challenges in a particular way, but this is only one of many legitimate points of view. Managing rice-based ecosystems should be seen as a collective learning process.”

Starting in June 2001, Drs. Bousquet and Trébuil helped their colleagues from the national agricultural systems of Bhutan, Thailand, the Philippines, Vietnam and Indonesia to investigate resource management problems in rice-growing communities. To do this, they used the so-called companion modeling approach to test the effectiveness of their research methods and consequently improve them.

Companion modeling — known appropriately as ComMod, which means “convenient” in the native tongue of Drs. Trébuil and Bousquet — uses a combination of field surveys, role-playing and simple computer models that simulate different members of a community and their interactions when exploiting a common environment.

Fun and games

ComMod allows *all* the people affected by a community problem to examine it together and build a shared understanding of its nature and causes. They can then use ComMod simulations to find acceptable solutions. The trick is to ensure sustainable use and equitable distribution of resources. Easier said than done, to be sure, but it’s not all hard work. At least some of it is, quite literally, fun and games.

As well as computer simulations, ComMod makes use of role-playing games. These effectively act as simplified simulations that allow people to understand what the computer is doing when it simulates a given scenario, and how things would work if the “rules” of resource management were changed.

“Both of these low-tech games and high-tech simulations,” says Dr. Bousquet, “help researchers understand the properties of complex biological or social systems. Once we validate a new model, we can work with stakeholders to assess future scenarios and agree on collective action.”

GUY TRÉBUIL (3)

IRRIGATED RICE TERRACES (*left*) **flank the main Chu river at the bottom of the Lingmuteychu watershed. Role-playing farmers** (*above*) **from Dompola and Limbukha observe others' land use decisions, assess and compare the results of their previous decisions and cropping activities, and exchange information, water or labor. Tayan Raj Gurung** (*below left, at right*) **watches a farmer allocating his selection of crops to his fields during a May 2003 gaming session in Dompola village.**

Back to our village. In May 2003, Drs. Trébuil and Bousquet, along with fellow ComMod researcher Tayan Raj Gurung, visited Bhutan's Lingmuteychu area, a 34-square-kilometer watershed drained by the 11-km-long Limti Chu stream. Lingmuteychu features 180 hectares of terraced wetland belonging to 162 households that make up six villages. The villages access water according to a long-established "first-come, first-served" rule — meaning that a village in the upper catchment can divert any or all water from the stream. The real-life conflict that has been taking place concerns Limbukha, a higher village, and Dompola, a lower village. After the 10th day of the fifth lunar month (in June or July) of each year — a date set by local custom according to Bhutan's traditional calendar — Limbukha shares half the stream flow with Dompola at rice transplanting time. Before this date, however, Limbukha does not allow Dompola to access any water at all for growing rice.

With local agricultural officers, the research team initiated a ComMod process designed to improve communication among villagers and explore alternative methods for making decisions about sharing irrigation water between the two communities. The new scenarios were designed to help people assess the effect of their decisions on water and land use in both villages.

The process included two gaming workshops in May and December 2003, involving six farmers each from Limbukha and Dompola. The first gaming session was based on the researchers' understanding of the system; the second included players' suggestions such as an exchange of labor for water and a reduction in available cash. One gaming protocol allowed the players to swap roles, giving them a sense of what life was like in the others' shoes.

Real-life trials

Following the role-playing, Dr. Bousquet and Mr. Raj Gurung designed a computer simulation that acted as a more complex version of the games themselves. Thirty-six different scenarios simulated combinations of factors that were known to influence water allocation, including three types of social network, two rainfall patterns and six exchange protocols (exchanging labor for water, for example). Farmers and researchers together assessed the most promising and acceptable combinations, which will this year undergo real-life trials. Preliminary results suggest that a social network comprising both villages and a system in which farmers exchange water for either labor or cash may lead to more efficient water use.

The researchers point out that participants feel less threatened in role-playing scenarios or when asked to discuss the virtual results of computer simulations. The method allows nonconfrontational interaction and more effective collective learning. "The players' knowledge and understanding of water-sharing increased significantly between the two role-playing workshops," emphasizes Mr. Raj Gurung.

"The ComMod collective learning process," says Dr. Bousquet, "makes the community better-informed and more able to agree on decisions, plans and actions, which therefore have a better chance at successful implementation."

Despite — or because of — its playful appearance, the technique is having a real, positive impact on rice-producing communities in Asia. The last word is perhaps best left to one of the participants in a ComMod workshop in northeast Thailand. Following a role-playing session, Thongphun Kalayang, a farmer from Khon Kaen Province, reminded us that, "It looks like a game, but this is our life."

Dr. Trébuil, a systems agronomist, and Dr. Bousquet, are currently implementing a ComMod project at Chulalongkorn University in Bangkok. Tayan Raj Gurung works for Bhutan's Ministry of Agriculture on the Community-based natural resource management initiative.

A dry vision

by Gary Atlin

As Asia's irrigation water becomes increasingly scarce, researchers are developing rice varieties that can thrive in dry conditions

It is difficult to find an image of rice farming that is not, figuratively speaking, all wet. Pictures of green paddies with sun glinting off dark water, or of farmers plowing muddy fields with water buffalo, are bound up with our mental image of rice production.

But the irrigation water on which this picture depends is starting to run critically short. About half of all the fresh water used in Asia supports irrigated agriculture. An astonishing 90% of this flows straight into rice paddies. This already unsustainable situation is now combined with rapidly rising water demand from Asia's booming industrial sector and fast-growing cities, as well as frequent droughts. Competition for water is intensifying and, if nothing changes, will soon be out of control.

The Indian state of Tamil Nadu, for example, once farmed around 2 million hectares of rice. In 2002 and 2003, drought reduced the area of irrigated rice production to less than 300,000 hectares, and is inciting a dispute over water allocation with neighboring Karnataka. Problems like this are only getting worse — more than 12 million hectares of irrigated rice lands in South Asia alone are likely to face severe water shortage within 20 years.

In the face of this looming crisis, researchers in several countries are imagining a different picture for some of Asia's rice fields. In their vision of the future, rice crops, rather than standing in water, are grown in dry fields, like maize or soybeans.

But how to create such a rice crop? Part of the solution has existed for thousands of years. Traditional upland rice varieties (see *Highs and lows*, opposite) have been selected over hundreds of generations for their ability to grow in free-draining, "aerobic," or oxygenated — as opposed to flooded — soil conditions.

GARY ATLIN (4)

FARMERS at Tarlac, Philippines, give feedback to researchers on new IRRI aerobic rice varieties in 2003. IRRI screens thousands of potential aerobic rice varieties under stressful conditions (top) every dry season. Farmers cover aerobic rice seed (bottom) in Batangas, Philippines.

But these varieties help solve only part of the problem. Although they are deep-rooted and tolerant of drought, desirable traits in any rice variety designed for dry soils, they also suffer from low yields. Even with ample water and fertile soils, traditional upland varieties rarely yield more than 3 tons per hectare, and often produce less than half that in farmers' fields. Farmers of irrigated (lowland) rice regularly achieve yields of 5–8 tons per hectare. And, in fertile environments, upland rice is prone to lodging (falling over) under the weight of its own grain.

Rice breeders at the International Rice Research Institute (IRRI) want this to change. They are developing new varieties that combine upland rice's adaptation to dry soils with the fertilizer responsiveness and yield potential of modern high-yielding varieties. The first generation of this so-called aerobic rice has been developed by crossing irrigated high-yielding varieties with traditional upland types, and selecting the progeny under dry soil conditions — a breeding strategy pioneered by researchers at China Agricultural University in Beijing, and at the Brazilian Agricultural Research Corporation (Embrapa). The resulting varieties are direct-seeded into dry soil in nonflooded fields and managed like a high-yielding wheat or maize crop. Irrigation is applied if available and needed, but no standing water is held in the fields.

Aerobic rice has already moved off the research farm and into farmers' fields in China, Brazil and the Philippines. In northeastern China, farmers are growing aerobic varieties, developed by researchers at China Agricultural University, on about 150,000 hectares of previously irrigated rice lands, in rotation with maize, wheat and other crops. Producing 4–5 tons per hectare, these varieties use about half as much water as traditionally transplanted lowland rice — confirming that the system can be an economically attractive alternative to lowland rice production when water is limiting.

In the cool highlands of Yunnan, in southwestern China, aerobic rice cultivation is replacing environmentally destructive and low-yielding slash-and-burn agriculture. Meanwhile, farmers in Brazil's Cerrado region are growing a large commercial crop of aerobic rice under high-fertility management, producing average yields of about 4 tons per hectare.

Replicating success

The Beijing and Yunnan groups' success with temperate aerobic rice is being replicated at IRRI for the Asian tropics. The institute started breeding aerobic rice in earnest in 2001 by screening varieties from its existing breeding programs to identify any that could produce high yields when direct-seeded in aerobic soils. IRRI's upland breeding program contributed a variety, known as Apo in the Philippines, that has a yield potential of over 6 tons per

LOW-YIELDING upland rice, grown on infertile fields in the mountains of northern Laos, could be replaced by intensified aerobic rice production on flatter fields in upland valleys.

hectare in moist but nonflooded soils, and can produce 4 tons per hectare in soils so dry that conventional rice cultivars simply fail to grow.

This capacity to extract water and keep growing in very dry soils is crucial for two main reasons. First, in the regions most likely to benefit from aerobic rice, access to irrigation water can be unreliable. The extensive root systems of aerobic rice varieties help them dig deep into the soil to find the water they need to keep growing until the next irrigation.

Huge problem

The second reason is control of weeds, a huge problem in dry conditions. In a flooded rice paddy, the water layer suppresses most weeds. As soon as the water disappears, though, the weeds thrive. If ordinary lowland rice varieties face a dry spell, they may not die but they do stop growing. Weeds, however, continue to grow, and can choke an entire field in a few weeks. In dry conditions, aerobic rice seedlings push onward and upward, holding their own against the weeds. Farmers can't ignore weeds, but they do have a fighting chance to control them and still save water.

Despite its potential, aerobic rice continues to pay a yield penalty and it will be some time before it is widely adopted in irrigated areas. At IRRI and in northeastern China, experimental aerobically grown rice crops yield about 1–2 tons per hectare less than the best irrigated lowland rice crops in the same area.

But the gap is closing. IRRI researchers are developing aerobic rice with a yield potential of over 6 tons per hectare in dry soils — high enough to compete with elite tropical lowland rice varieties. Scientists are also identifying the upland rice genes that allow aerobic rice to grow well in dry soils and compete with weeds. Research is under way to tag these genes and pinpoint their locations in the rice genome. Within a few years, it may be possible to introduce a few key genes into elite lowland varieties and "convert" them into aerobic varieties.

Aerobic rice is only one weapon in the arsenal researchers are preparing to deploy against Asia's looming water crisis, but it promises to be a potent one.

Dr. Atlin is a senior plant breeder in IRRI's Plant Breeding, Genetics and Biotechnology Division.

Highs and lows

Confusingly, the terms "upland" and "lowland" refer to nonflooded and flooded fields, respectively, rather than to elevation. Upland rice fields are often found only a few hundred meters above sea level; lowland rice can be grown on bunded (walled) terraces near the tops of mountains, as it is in Banaue in the northern Philippines.

Some Asian farmers have been growing upland rice for thousands of years. Small areas of upland rice production are found in most Asian countries, and in some regions it remains an important and widespread crop.

In the hills of Thailand, Laos, southwestern China and northern Vietnam, farmers still grow hundreds of thousands of hectares of upland rice on steep mountain slopes as the cornerstone of a shifting cultivation or "slash-and-burn" system. Forests are cleared and burned to open up fields for a few seasons of cropping, then allowed to return to bush fallow for several years to restore soil fertility.

In a quite different environment, farmers in the plateau regions of several states in eastern India grow millions of hectares of upland rice on level ground and in unbunded fields, in annual rotation with pasture and other upland crops such as millet and gram.

How to find needles in haystacks

by Richard Bruskiewich

The relatively new science of bioinformatics is helping agricultural scientists accelerate research that was once prohibitively time-consuming or even impossible

Forty-five years ago, when the International Rice Research Institute (IRRI) was founded, computers were power-hungry curiosities filling large rooms in military, government and banking institutions. Only a few years before that, Cambridge University biologists James Watson and Francis Crick discovered the molecular structure of a substance called deoxyribonucleic acid, or DNA. Rotary-dial telephones and black-and-white televisions were just starting to pervade the households of the developed world.

Today, the computing power that once filled rooms now fits in the palm of a hand. Computers can serve simultaneously as a telephone, a camera and an Internet browser — the last function a completely unknown concept 4 decades ago. In step with IRRI's, and rice research's, technical progression over that time, the triple revolution of biotechnology, computing and communication has increasingly invaded the desk top, field and laboratory of the practicing agricultural scientist. This invasion shows no signs of abating. The public effort to sequence the genome — the sum total of genetic information in a given organism, encoded in its DNA — of rice has just been completed; now the race is on to decipher the meaning of what it is to be a rice plant. Foremost in this venture is the characterization of every rice gene, each of which encodes the plant's biological activities.

AL BENAVENTE (2)

THE SCREEN of IRRI's cluster grid computer displays a DNA sequence, which can be analyzed far more effectively thanks to bioinformatics specialists like Richard Bruskiewich (*top*). Four of these machines, held by IRRI and three sister institutes, are networked to create a globally distributed super-computer for high-throughput processing of information.

Playing a leading role in this work is the science of bioinformatics, which spans all three of the technical revolutions that have led science into the new millennium. Bioinformatics combines mathematics, statistics, computing science, information technology and natural sciences to capture, analyze, store, integrate and disseminate biological information. Such information is usually the product of large amounts of raw data derived from genome sequences as well as other high-throughput experiments such as analyses of how and when genes are expressed.

Although computers were first used in scientific research, including biology, as early as the 1950s, bioinformatics is relatively new. Its roots are grounded in the early 1970s in the form of algorithms — step-by-step series of instructions for solving a computer-based mathematical or symbolic problem — created to compare different DNA sequences to one another or search a database of sequences for a match. In the past 20 years, research interest in bioinformatics has exploded. More and more projects are being funded to read the complete DNA sequences of the genomes of many organisms, including humans and rice, and consequently characterize the functions of each gene.

Open and interconnected

The tools of bioinformatics generally consist of, unsurprisingly, one or more computers and specialized computer programs (somewhat more sophisticated than your average word processors). The data come from public or private databases, or are raw experimental data from the laboratory. In keeping with the spirit of bioinformatics as an open, interconnected scientific branch of learning, many of the tools and databases are available, often for free, on the Web, thereby vastly increasing the discipline's power and scope.

In the past few decades, researchers have developed a broad suite of remarkable bioinformatics applications for rice research, including many publicly available online databases. The rice genome sequencing project itself has spawned several databases that house the rice genome sequence and its associated biological functions (see, for example, the International Rice Genome Sequencing Project, a multicountry partnership led by Japan's Rice Genome Research Program, at http://rgp.dna.affrc.go.jp).

Numerous other online databases publish rice-related information. The U.S.-funded Gramene database (www.gramene.org) allows researchers to compare rice with other grasses, as does the Japanese Oryzabase (www.shigen.nig.ac.jp/rice/oryzabase). IRRI itself hosts the International Rice Information System (IRIS) at www.iris.irri.org, a repository of information on rice germplasm — rice seeds and the genetic material they contain. IRIS includes details on all of the nearly 107,000 samples housed in IRRI's International Rice Genebank, associated field data, and related information on rice genes and their functions.

Joining forces

Informatics in the broader sense has played an important role from the earliest years of IRRI's research. Modest computers were used to statistically analyze plant breeding experiments, but were later supplanted by the current generation of personal computers. About a decade ago, IRRI established limited Internet connectivity to improve communication with global collaborators and partners. Around the same time, IRRI's biometrics team joined forces with scientists from the International Maize and Wheat Improvement Center to create the International Crop Information System (www.icis.cgiar.org) software, which underlies the IRIS database.

However, it was only in the late 1990s, when the rice genome sequencing project was established and began generating sequence data, that the awesome potential of bioinformatics at IRRI became truly apparent. It would allow scientists to perform analyses that would otherwise be impossible, or would take a prohibitively long time — bioinformatics could, if you like, offer directions to the needle in the haystack. Upon realizing that bioinformatics was to play a rapidly escalating role, the institute promptly created in 2000 a bioinformatics specialist position.

IRRI's International Rice Information System is a public repository of rice germplasm information.

The bioinformatics activities of IRRI's Biometrics and Bioinformatics Unit (BBU) have since expanded in both scope and staffing. As well as adapting publicly available bioinformatics tools to crop research, the team has a wealth of exciting research under way. For example, team members are analyzing a customized database derived from the patterns of gene expression exhibited by thousands of genetically different rice plants that have been subjected to drought. Ultimately, these data may help scientists develop and identify high-yielding drought-tolerant rice varieties.

The team is also managing the field characteristics of a large collection of mutant rice plants that have had their genome deliberately mutated. The resultant change in the way a plant's genes are expressed may cause it to behave differently under certain conditions (nutrient-deficient soils, for example). This changed behavior may offer researchers clues about which genes they can use to eventually breed improved rice varieties. Much of the bioinformatics team's information is, or will be, published in IRIS.

Leading the way

Looking to the future, BBU is leading the way in developing a rice bioinformatics network that will consolidate the global resources of rice functional genomics — the science of discovering genetic structure, variation and function.

Crop research within IRRI's parent organization, the Consultative Group on International Agricultural Research (CGIAR), has become a key component in the drive to meet the United Nations Millennium Development Goals, which include eradicating extreme poverty and hunger, and reducing child mortality. Bioinformatics, which extends, streamlines and stimulates research, is crucial to this battle.

IRRI is one of 16 institutes participating in the recently inaugurated Generation Challenge Program, an initiative to use molecular biology to help boost agricultural production and, consequently, the quality of life in developing countries. The program will characterize differences in DNA sequences that confer differences in plant behavior in the field. A key task for the program's bioinformatics specialists is to build a globally distributed and integrated network of databases and tools for crop information management and analysis. Initial efforts have helped establish a network of globally integrated, shared-access, high-performance bioinformatics computing facilities in four CGIAR centers, including IRRI.

Bioinformatics at IRRI is gearing up internally, and collaborating externally, to generate millions of new data points of experimental information. The resulting data sets hold keys that will unlock new knowledge linking the agricultural performance of plants to their underlying DNA. In turn, this information will accelerate efforts to breed a new generation of stress-tolerant, nutritionally enhanced, higher-yielding crops that need fewer inputs and are better for the environment.

Dr. Bruskiewich is a senior scientist and bioinformatics specialist in IRRI's Biometrics and Bioinformatics Unit. To find out more about bioinformatics, visit the Websites of professional bioinformatics organizations such as the International Society for Computational Biology (www.iscb.org) or the Asia Pacific Bioinformatics Network (www.apbionet.org).

The year that put rice back on the map

The International Year of Rice has come and gone. The United Nations declared the rice year to draw global attention to the grain that feeds half the world and its central role in the lives of millions, if not billions, of poor people.

Did it succeed? There are clear signs that the campaign achieved its main aim of boosting public and donor awareness. Rice hit the news pages, airwaves and Websites more than any time in recent memory. The scientific community, governments and national agricultural research and training programs have forged new and important links.

The International Year of Rice Secretariat declared that, "The success of International Year of Rice 2004 has given new impetus to efforts to develop sustainable rice-based systems that will reduce hunger and poverty, and contribute to environmental conservation and a better life for present and future generations."

Read on for a sample of events from around the world. And remember — rice is, indeed, life.

LEHARNE FOUNTAIN

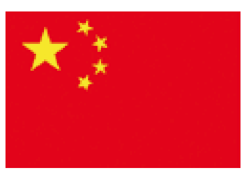
A CAMBODIAN schoolgirl enjoys International Year of Rice celebrations in Phnom Penh, Cambodia.

Cambodia

Cambodia celebrated International Year of Rice on 17 December with a colorful event at the Cambodian Agricultural Research and Development Institute (CARDI). Schoolchildren, university students, scientists, farmers and politicians enjoyed the proceedings, which included a harvesting competition in which teams threshed, winnowed and, finally, weighed their rice.

Speakers, including representatives from CARDI, IRRI, the Australian Agency for International Development and the Cambodian Ministry of Agriculture, Forestry and Fisheries, drew on Cambodia's success in overcoming the devastation of the 1970s to now be celebrating 10 years of rice self-sufficiency.

China



More than 150 rice production and environmental protection scholars, policy-makers and industry experts met at the International Conference on Sustainable Rice Production, held 15-17 October in Hangzhou, to promote sustainable development of rice under the theme "Green rice means healthy life."

Conference steering committee chair Zhai Huqu said that the three disciplines explored at the conference — policy, technology and agricultural extension — underpin sustainable production in rice cropping systems. "The success of such an undertaking is crucial if we want to meet the goals to feed the world, utilizing, but without exploiting, our precious natural resources," he said.

India

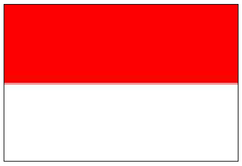
The Indian Council of Agricultural Research (ICAR) hosted the International Symposium on Rice: "From Green Revolution to Gene Revolution" on 4-6 October in Hyderabad. ICAR Director General Mangala Rai announced that the council was pushing functional genomics "to enhance productivity, reduce input costs and increase the profit margins of the producers so that we are competitive in cost, as well as quality, locally and globally."

Dr. Rai also noted that ICAR has initiated work on organic farming, with former IRRI Principal Plant Breeder Gurdev Khush adding that such farming could be adopted in limited areas for production of small quantities, but, "We can't think of feeding the entire population of India with organic agriculture."

The South Asian Association for Regional Cooperation (SAARC) Rice Expo 2004, held in Mumbai on 8-10 December, aimed to build strong trade relations between the SAARC countries — Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The expo boasted more than 15,000 attendees, including trade and industry representatives, and exporters and importers.

The year was a good one for Indian scientists, who scooped several international awards. Rice breeder S. Mallik of West Bengal's Rice Experiment Station won the Senadhira Award, which honors a leading Asian scientist working in rice research, for developing rice varieties for rain-fed lowlands. Dr. Mallik's award complemented Indian winners in four categories of the International Rice Research Notes Best Article Award (see *Wedding rice not thrown but sown* on pages 36-37 of *Rice Today* Vol. 3 No. 4).

Indonesia



Speaking on "Rice research in Indonesia: present approach and future direction" at the opening of the Rice and Rural Prosperity seminar in Jakarta on 7-8 December, Minister of Agriculture Anton Apriantono expressed support for continued cooperation between IRRI and the Indonesian national agricultural systems.

Other speakers included Food Crop Production Management Director General Jafar Hafsah ("Strategy and policy on rice production in suboptimal agroecosystem"), IRRI Social Sciences Division Head Mahabub Hossain ("Economic prosperity and the prospect of rice industry in Asia"), and U.S. Agency for International Development economist Peter Rosner ("Rice and food diversification: current status and future direction").

Achmad Suryana, director general of the Indonesian Agency for Agricultural Research and Development, hoped that the seminar, which was attended by over 120 participants, would inspire new recommendations for Indonesian rice policy.

A grainful year for development organizations

IRRI and other organizations that work towards improving lives and livelihoods were enthusiastic participants in International Year of Rice celebrations.

Food and Agriculture Organization

The Food and Agriculture Organization of the United Nations (FAO) celebrated the 25th World Food Day campaign on 16 October. The theme of "Biodiversity for Food Security" highlighted the role of biodiversity in ensuring people's sustainable access to high quality food and the efforts of researchers in developing more nutritious rice strains. World Food Day aims to heighten public awareness of, and help generate solutions to, the problem of world hunger.

The event included presentations by FAO and IRRI of the International Year of Rice International Award for Best Scientific Articles (see www.fao.org/rice2004/en/science.htm) to Youyong Zhu, President of Yunnan Agricultural University in China, and Takuji Sasaki, Director of the Genome Research Department at the National Institute of Agrobiological Sciences in Japan. The paper by Dr. Zhu and his team, *Genetic diversity and disease control in rice*, (*Nature,* Volume 406, August 2000) won first prize in the rice agronomy category. Dr. Sasaki's team's paper, *The genome sequence and structure of rice chromosome 1*, (*Nature,* Volume 420, November 2002) won first prize in the rice breeding category.

Awards were also presented to the winners of the International Year of Rice Global Photography Contest: "Rice Is Life" (see www.fao.org/rice2004/en/photog.htm), with first prizes going to Vu Nguyen from Vietnam (professional category) and Meizi Ninon Liu from China (amateur category).

Asian Development Bank

Asian Development Bank (ADB) President Tadao Chino opened the Celebrating the International Year of Rice Seminar at the bank's Manila headquarters on 16 November. IRRI Board of Trustees Chair Keijiro Otsuka, in his keynote speech on "The history, impact and role of rice research in Asian development," stressed that "the 'Second Green Revolution' holds the promise of not only solving the problems of growing water and land scarcity but also the negative legacy of the first Green Revolution."

Philippine Secretary of Agriculture Arthur Yap spoke on "Hybrid Rice in the Philippines," while IRRI Director General Ronald Cantrell presented "Research strategy for rice in the 21st Century." The conference coincided with an IRRI rice exhibit, held at ADB headquarters on 11-19 November, which focused on the impact of IRRI's ADB-funded projects.

International Rice Research Institute

Throughout International Year of Rice 2004, IRRI hosted or co-hosted 15 regional and international conferences, workshops and symposia, attended by delegates from at least 36 countries. At its headquarters in Los Baños, Philippines, the institute received more than 50,000 visitors, including farmers, school students, government officials, diplomats and representatives of donor and international organizations.

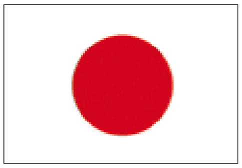
International Rice Forum participants, including 2004 World Food Prize Laureate Yuan Longpin and Indian Minister of State for Agriculture Kanti Lal Bhuria, visited IRRI on 28 November for a tour of the institute and talks with IRRI staff. IRRI extended the same hospitality to more than 120 staff from Philippine national and local government agencies on Host Country Day, 18 November. A seminar by Senator Miriam Defensor-Santiago on "The Philippines' Law on International Organizations" capped the event.

On 4 September, students from 14 public and private high schools competed in an on-the-spot painting contest based on the themes Rice is life, Rice is culture, Rice is food and Rice is environment.

AL BENAVENTE

TEAM MEMBERS from the University of the Philippines Rural High School stand beside their masterpiece after winning IRRI's International Year of Rice on-the-spot painting contest.

Japan



International Year of Rice 2004 reached its scientific climax on 5-7 November, when around 1,200 of the world's leading rice researchers, representing 42 countries, attended the World Rice Research Conference in the science city of Tsukuba. The *kagamiwari*, or breaking of the rice wine barrel, kicked off the conference reception party, at which delegates were served freshly-pounded rice cake, made traditionally by Japanese farmers.

Organized by the Japanese Ministry of Agriculture, Forestry and Fisheries, the conference was formally opened on 4 November in Tokyo before moving to Tsukuba, where scientists presented papers on four key topics: innovative technologies for boosting rice production, perspectives on the place of rice in healthy lifestyles, adaptable rice-based systems that help improve farmers' livelihood, and the role of rice in environmentally sustainable food security.

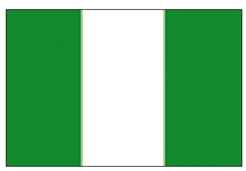
IRRI will publish the proceedings of the conference on CD with the provisional title "*Rice Is Life: Scientific Perspectives for the 21st Century*." The CD will include keynote lectures, orally-presented papers, posters and wrap-up papers by session conveners.

Nepal

The Kingdom of Nepal has pledged to celebrate National Rice Day every year on 15 Asadh (mid-July by the Nepalese calendar) to highlight the importance of rice in the lives of farmers. Hom Nath Dahal, Minister of Agriculture and Cooperatives, made the announcement in Kathmandu on 17 December, when Nepal celebrated International Year of Rice and inaugurated the Nepal-IRRI office (see *News*, page 7).

IRRI also presented a certificate of recognition and partnership to Nepal's National Agricultural Research Council "in celebration of International Year of Rice, over 3 decades of collaboration, and in recognition of its outstanding contribution to the health and food security of the people of Nepal."

Nigeria



Nigerian President Olusegun Obasanjo visited on 12 October the Tokilankwa Rice Farm in Kwali, where he inspected an exhibition of local rice products as part of Nigeria's celebration of International Year of Rice. Chief Audu Ogbeh, National Chair of the People's Democratic Party, and Mallam Adamu Bello, Minister for Agriculture, accompanied the president. The celebration demonstrated the government's commitment to boost its agricultural sector, particularly the local rice industry.

Philippines

As the nation that proposed International Year of Rice 2004, the Philippines' celebrations were some of the grandest worldwide. Apart from declaring November National Rice Awareness Month, the country hosted on 27-29 November the International Rice Forum, which was attended by over 400 delegates from across Asia and beyond. The forum brought together government leaders and some of the world's leading agricultural scientists to discuss four key issues affecting rice — production, trade, development and culture. Country presentations focused on "Efforts to reduce poverty among rice farmers." Key guests and presenters included Department of Agriculture Secretary Arthur Yap, Agriculture Ministers Fakhrul Islam Alamgir of Bangladesh and Khantilal Bhuria of India, and Asia Rice Foundation Chair Emil Javier.

The forum's International Rice Festival gave rice-producing countries, rice research and trading companies, agrochemical companies, and rice-based food manufacturers a chance to showcase their products.

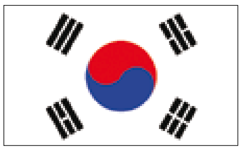
The Department of Foreign Affairs hosted on 25 October a United Nations Day reception, which focused on the International Year of Rice theme, "Rice Is Life." Foreign Affairs Secretary Alberto Romulo, reaffirmed the Philippines' commitment to the United Nations Millennium Development Goals.

The "Rice Is Life" theme also inspired a photography contest sponsored by the Asia Rice Foundation; a Philippine Postal Corporation stamp design contest for students; and *Ani* (Harvest), a special rice exhibit by the *Museo Pambata* (Children's Museum) in Manila. Dave Leprozo, Jr. won the photo contest and stamp contest winners were Maria

Elena Alegre of Antonio Regidor Elementary School in Manila, L.J. Ian B. Delgado of Antique National High School and Gary M. Manalo of Tiburcio Tancinco Memorial Institute of Technology in Calbayog City.

For a comprehensive roundup of IYR activities in the Philippines, visit www.philrice.gov.ph/newsletter/iyr.pdf.

South Korea



Two major international events marked International Year of Rice in South Korea. The International Rice Science Conference, held in Seoul on 13-15 September, boasted the theme "Rice Science for Human Welfare in the 21st Century." Heu Sang-Man, Korean Minister of Agriculture and Forestry, opened the conference and former IRRI principal plant breeder and 1996 World Food Prize Laureate Gurdev Khush delivered the keynote speech, "Feeding 5 billion people — the role of rice breeding."

The 8th annual meeting of the Council on Rice Research in Asia, held 10-12 September in Suwon, was attended by senior representatives from Asia's 15 main rice-producing countries.

"WORKING WOMEN in rice mill" is the title of the photo (*top*) taken by Md. Rashid Un Nabi of Bangladesh, who won 3rd prize in the amateur category of the FAO's International Year of Rice Global Photography Contest: "Rice Is Life" for his shot of two Bangladeshi women processing rice in a locally-made oven. The winning entry in the professional category, by Vu Nguyen of Vietnam (*above*), shows terraced fields in northern Vietnam as a farmer prepares for rice transplanting.

Vietnam

The Mekong Rice Conference in Ho Chi Minh City on 15-17 October was Vietnam's most important rice-focused event in the last decade, according to Food and Agriculture Organization of the United Nations Representative Anton Reynchner.

A special event of International Year of Rice 2004, the conference's "Rice, the Environment and Livelihoods for the Poor" theme addressed natural resource diversity and the selection of rice strains most suited to the Greater Mekong Subregion shared by Cambodia, Laos, Myanmar, Vietnam, Thailand and China's Yunnan Province. More than 170 participants from 18 countries attended.

Bui Ba Bong, Vietnamese Vice Minister of Agriculture and Rural Development, announced that by the end of 2007, at least half of Vietnam's rice farmers will have adopted the *Ba Giam Ba Tang* (Three Reductions) practices, which teach them to optimize their pesticide, fertilizer and seed use.

WHERE TO FROM HERE?

The 21st Session of the International Rice Commission is scheduled by the FAO to take place in Peru in 2006. The event will provide an opportunity to review the progress made following the International Year of Rice and look at what more needs to be done. The FAO will publish a book based on the "Rice Is Life" theme to further raise awareness of the role rice plays in food security, livelihood improvement and sustainable production. Seventeen projects on rice and rice-based systems will also receive technical guidance and support from the FAO.

As International Rice Commission Executive Secretary Nguu Nguyen put it: "For us, International Year of Rice does not end with 2004."

Hybrid rice expert bags multiple awards

IRRI

IRRI Principal Scientist **Sant Virmani** (*second from left*) has capped a stellar 2004, picking up two prestigious awards. Dr. Virmani, principal scientist in IRRI's Plant Breeding, Genetics and Biotechnology Division, received on 5 February the International Koshihikari Rice Prize at a ceremony in Fukui City, Japan. Also receiving the award was **Hae-Chune Choi**, director of the Rice Genetics and Breeding Division of the South Korean Rural Development Administration's National Institute of Crop Science. Chosen for his development of hybrid rice technology for the tropics, Dr. Virmani has helped make hybrid rice a commercial reality in several countries. The two winners each received a cash prize of 500,000 yen (US$4750).

Dr. Virmani was also one of the recipients of the Pravasi Bharatiya Samman Award at the Annual Non-Resident Indian Conference, 7-9 January in Mumbai, recognizing his contributions to hybrid rice breeding, genetics and seed production. Other winners included U.S.-based Hollywood filmmaker M. Night Shyamalan, author Vikram Seth and golfer Vijay Singh.

Partners in progress

Robert Carsky was tragically killed on 6 November by a bomb blast in Bouaké, Côte d'Ivoire. At the time of his death, Dr. Carsky was working as a cropping systems agronomist for the Africa Rice Center (WARDA) after spending 15 years with the International Institute of Tropical Agriculture. He is survived by his wife Rebecca and children Jasmine, Amado and Julien. He leaves behind a legacy of help and hope for African farmers and their families.

Sam Hsieh, IRRI Board of Trustees member from 1995-1997, passed away last April at the age of 84. He is survived by his wife Alice, daughters Wen-Tai and Wendy, and sons Wen-Ning and Wen-An.

Eugene Terry, plant pathologist and agricultural research and development specialist, has been named as Program Steering Committee Chairman of the Generation Challenge Program, replacing **Ismail Serageldin**. Dr. Terry recently served as the implementing Director of the African Agricultural Technology Foundation.

Gordon Conway, 12th president of the Rockefeller Foundation, has retired.

Laxmi Maskey has been appointed Director of Planning and Coordination of the Nepal Agricultural Research Council.

Keeping up with IRRI staff

Glenn Gregorio is one of this year's Outstanding Young Men, in the field of plant breeding and genetics, after receiving the award from young people's leadership group the Philippine Jaycees, as well as the Gerry Roxas Foundation and The Outstanding Young Men Foundation.

On 9 December, **Gelia Castillo**, IRRI consultant, received a 2004 Outstanding Filipino Award, given to pioneering Filipinos by the Philippine Jaycee Senate.

IRRI scientists **Swapan Datta, J.K. Ladha** and **Shaobing Peng** have been elected Fellows of, respectively, India's National Academy of Agricultural Sciences, the Soil Science Society of America, and the American Society of Agronomy.

Former IRRI Director for Research and Training **Mano D. Pathak** received a Research Accomplishment Award from the Leading Japanese Rice Research Group on 4 November in Tokyo, in recognition of his discovery and development of genetic resources that confer insect resistance on tropical paddy rice.

Darshan Brar, senior scientist in Plant Breeding, Genetics and Biotechnology (PBGB), has been named an honorary scientist of the Republic of Korea's Rural Development Administration for 3 years.

Arvind Kumar has joined PBGB to work on drought tolerance in rainfed rice. A plant breeder and geneticist, Dr. Kumar previously worked at Indira Gandhi Agricultural University. PBGB international research fellow **Ish Kumar** departs following successful management of the IRRI-Asian Development Bank project "Sustaining Food Security in Asia through the Development of Hybrid Rice Technology."

Suan Pheng Kam, senior scientist in IRRI's Social Sciences Division (SSD), has left IRRI after 10 years, during which she applied Geographic Information Systems to land-use planning and infrastructure, and helped establish the Consortium for Unfavorable Rice Environments. She has joined the WorldFish Center in Malaysia.

Economist **David Dawe**, senior scientist in SSD, led policy research for better understanding of farmers' nutrient management practices, as well as market dynamics and trade policies affecting the Asian rice economy. He joins the Food and Agriculture Organization of the United Nations in Bangkok after 7 years at IRRI.

Peter Fredenburg, editor of *Rice Today* and other institute publications, leaves IRRI after 3 years. He helped build an international readership that continues to grow with each issue. He has joined WRENMedia and is based in Hong Kong.

Jing-sheng Zheng has joined IRRI's Crop, Soil and Water Sciences Division (CSWS) to work on the Genetic Enhancement Project. He previously worked at the Rice Cultivation and Physiology Department at the Institute of Rice and Wheat of the Fujian Academy of Agricultural Sciences. **Yazukazu Hosen**, soil scientist, has also joined CSWS. He previously worked as a senior researcher for the Crop Production and Environment Division of the Japan International Research Center for Agricultural Sciences. Departing are CSWS postdoctoral fellows **Ramasamy Rajendran** and **Murshedul Alam**, both of whom worked on site-specific nutrient management.

Bhaha Prasad Tripathi has joined IRRI's Nepal office as an assistant scientist and assistant manager.

Leharne Fountain, IRRI's third Australian Youth Ambassador, arrived in October to work on programs for visitors and as deputy editor of *Rice Today*.

Amita Juliano, assistant scientist in IRRI's Genetic Resources Center, passed away on 1 March after a long battle with cancer. Amy, who worked at IRRI for 15 years, is survived by her husband Victor and daughter Sabrina.

Do lower rice prices help the poor?

by Mahabub Hossain
Head, IRRI Social Sciences Division

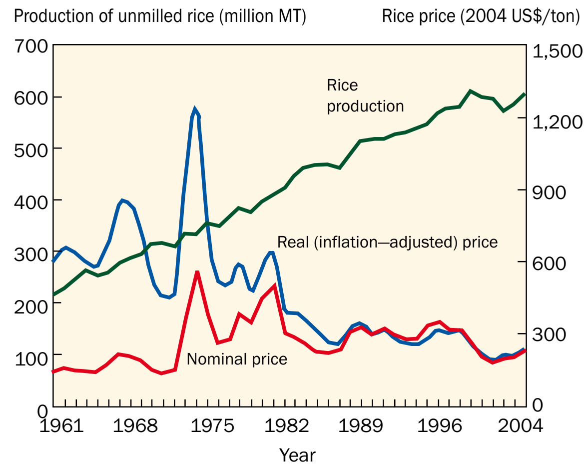


Fig. 1. Trend in rice (milled) price in the world market, 1961-2004.
Source: Production: FAOSTAT Electronic Database, FAO. 20 Dec 2004 udpate.
Rice price: relates to Thai rice 5%-broken deflated by G-5 MUV Index deflator (adjusted based on 2004 data update). Source: www.worldbank.org

Lower rice prices aren't necessarily bad news for farmers

The price of rice has consistently fallen over the last 40 years. Since the beginnings of the Green Revolution in the mid-1960s, the real (inflation-adjusted) price of rice in the world market has been more than halved while global rice production has increased (Figure 1).

This movement in price has not been smooth. An upward trend during the oil crisis in 1973-75 was followed by a sharp downturn in 1980-87 due to the rapid expansion of rice production in China and the devaluation of the Thai baht. Thailand is the world's leading rice exporter and global rice prices, which are set in U.S. dollars, are strongly tied to the baht.

Is this long-term decline in the price of developing countries' dominant food staple good or bad news for food security and poverty reduction? In low-income Asian countries, governments tend to prefer lower prices. Among the poor, there are far more net buyers of rice than net sellers. In many countries, the landless poor — who meet their entire food needs from the market — constitute one-third to one-half of the population. Add to this a large proportion of equally poor urban laborers and you have a vast majority of the poor who spend more than a third of their income on staple food.

Because people rightly place a high priority on their basic food needs, any increase in rice price means less money for other needs, such as health care and children's education. Keeping staple food prices affordable is therefore crucial to poverty reduction, good health and continued education.

But price trends raise as many questions as they answer. How do falling prices affect Asia's millions of rice farmers and farm families? What would motivate people to continue farming in the face of declining profitability? And how can prices stay low if the supply fails to keep pace with demand?

First, the world market price of rice in dollars is a poor indicator of profitability in the domestic market. For example, the exchange rate of the Thai baht fell from 21 per dollar in 1965 to 43 per dollar in 2002. Thus, Thai farmers who exported rice in 2002 effectively received more than double the price obtained by their 1965 counterparts, which compensated them for the drop in price on the world market. Indeed, an examination of the inflation-adjusted producer price of paddy (unhusked rice) in the domestic market shows a relatively small decline in price over the past few decades (Figure 2).

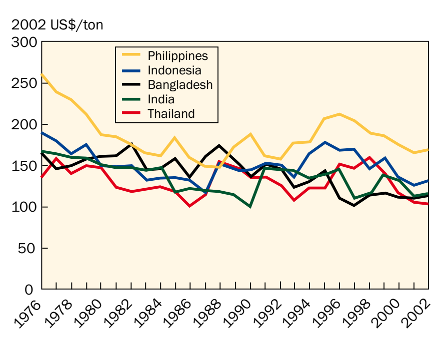
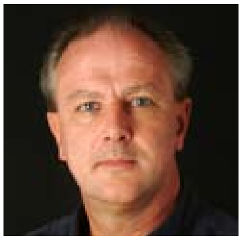


Fig. 2. Trends in producer prices (inflation-adjusted) of paddy, selected countries, 1976-2002.
Source: Paddy price: FAOSTAT Electronic Database, FAO. 20 Dec 2004 update.
Deflator: World Rice Statistics and 2004 edition of International Financial Statistics of International Monetary Fund.
Note: Nominal prices were deflated by country-specific wholesale price index converted to US$ using 2002 exchange rate

Second, lower prices do not necessarily mean lower profitability. The main factor driving the long-term decline in agricultural prices is technological progress that contributes to a drop in the unit cost of production. Despite the higher cultivation costs of modern rice varieties, their higher yields mean lower costs for farmers per ton of harvested rice. This effect is amplified by improved crop management and mechanization, which also cut production costs. These lower prices help redistribute to consumers some of the gains that farmers reap from technological progress.

Third, irrigation-induced multiple cropping has led to an increase in harvested area, further boosting production per farm household. So, even if the decline in rice price had been more than the decline in unit cost of production, farm household income would have improved because of increased production per unit of land.

Farmers in many countries continue to increase their rice production despite the decline in prices, indicating that rice farming is still economically viable. If prices fall too fast, a period of stagnation or decline in production follows, as was seen in 1998-2003. But the shortage of production leads to a rise in prices, thus restoring farmers' incentives. The last two years have seen an increasing world rice price that should offer rice farmers sufficient motivation to continue.



Ups and downs: private-sector investment in rice research

GERARD BARRY
Golden Rice Network Coordinator and Head, IRRI Intellectual Property Management Unit

Rice is, arguably, the world's most important food crop. In spite of this prominence, the private sector for many years concentrated only on developing rice crop protection products such as herbicides and insecticides. There was little investment in improving rice varieties, and low participation in the crop seed business. In the mid-1990s, however, several agricultural multinationals and some large national firms began to look seriously at investing in businesses based on rice seed.

Well before this, hybrid rice technology had moved out of China into several new regions, including the United States, India and Latin America. Its gradual validation in a number of areas — including yield and adaptability, and a sense that the business would be viable — demonstrated that returns from an investment in rice seed research were possible. Indeed, many of the companies that looked at new opportunities in rice had already had success with maize and other hybrid crops.

Several companies had also developed crop biotechnology traits, including herbicide tolerance and insect resistance in cotton, soybean and oilseed rape (canola). These traits were then developed for maize and potato, giving the developers confidence that the technology could be adapted to still more crops, including rice.

What followed was a period of aggressive expansion in investment and research in many crops, from the major row crops and commodities to vegetables and even flowers. It was also a time of large takeovers and mergers, which resulted in several traditional non-seed companies finding themselves the owners of rice seed businesses. The sale of Cargill's seed businesses to Aventis (formerly AgrEvo, now part of Bayer CropScience) and to Monsanto resulted in one such example. Many of the companies commenced significant in-house rice research with an emphasis on biotechnology. New alliances were formed with the public sector — Rhone-Poulenc (now part of Bayer CropScience), for example, became a major partner with the Institute of Molecular Agrobiology in Singapore.

Companies established new, or expanded existing, research programs for the major rice diseases (blast research at DuPont, for example). Some of the companies' targets also fit well with national research priorities. The development of herbicide-tolerant rice, for instance, would help to accelerate the adoption of direct seeding in Japan — a priority driven by the aging Japanese farm population and the eventual need for Japan to open up its market to competition from foreign rice grain.

The liberalization of the seed laws in Japan was a major driver for Japan Tobacco to seriously consider establishing rice businesses, initially in Japan, but eventually in other countries. Japan Tobacco, with a strong technological advantage in rice genetic transformation, formed a research partnership with Monsanto and ultimately established the Orynova joint venture with Zeneca. Orynova subsequently ceased operations some time after Zeneca merged with Novartis (to form Syngenta).

However, several factors then converged to stem the flow of private sector investment and research interest. The high prices paid for the various seed and technology acquisitions and the slower than expected return on investments forced companies to trim expectations and budgets, and in many cases to severely scale back investment in rice research and development. Despite the buoyant mood at the launch of the first crop biotech products, there was a growing recognition that the complexity of the new products — especially in the public and regulatory arenas — had been underestimated. Companies began to return their focus to the crops and regions in which they already had secure businesses and products.

Several factors converged to stem the flow of private sector investment in rice research, including the high prices paid for seed and technology acquisitions, and slower than expected return on investments

Today, the major corporate players in the international seed business — including Pioneer Hi-Bred, Syngenta, Advanta, Monsanto and Bayer CropScience — remain active in rice but tend to limit investment to hybrid and some varietal seed businesses or to a specific product, such as the herbicide-tolerant Clearfield™ rice of BASF. The first genetically modified rice, Bayer CropScience's herbicide-tolerant LibertyLink™, was approved for commercial release in the U.S. in 1999-2000. Last year, the UK cleared it for import for processing and animal feed, and the company is awaiting the same clearances from the European Union before launching the product.

Although it failed to meet its early promise, private-sector biotechnology research in rice is continuing. The U.S. Department of Agriculture's database of Field Test Releases indicates ongoing, and sometimes expanding, testing of a number of biotech traits. Furthermore, investment in areas such as hybrid rice development, and farming and postharvest technologies, continues to support and complement public rice research.

The use of product and company names does not represent an endorsement of these by IRRI