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Rice Today

International Rice Research Institute

April 2003, Vol. 2 No. 1

2004 declared International Year of Rice

Beijing puts rice on the table: 1,000 attend first International Rice Congress

Organized free for all: Rice Knowledge Bank materials are online

Biodiversity adds value: interplanting dresses Chinese fields in pinstripes

LOOKING UP IN LAOS

ISSN 1655-5422

5,000 liters

Growing one kilogram of rice with traditional irrigation consumes enough freshwater to fill 25 oil drums.

2003 is International Year of Freshwater

Using less water, farmers could save on irrigation, boost their earnings, and leave more water for homes, businesses and nature conservation. Rice scientists are exploring how.

Farming that feeds families
and protects the environment

Rice Science for a Better World

IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE
www.irri.org

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Rice Today
Vol. 2, No. 1

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For more information, visit the websites of the CGIAR (www.cgiar.org) or Future Harvest (www.futureharvest.org). Future Harvest is a nonprofit organization that builds awareness and supports food and environmental research for a world with less poverty, a healthier human family, well-nourished children and a better environment. Future Harvest supports research, promotes partnerships and sponsors projects that bring the results of agricultural research to rural communities, farmers and families in Africa, Latin America and Asia.

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Focusing on the neediest

by Rodney Cooke

The International Fund for Agricultural Development (IFAD) has added another chapter to its two-decade record of cooperation with IRRI to fulfill its mission of "enabling the rural poor to overcome their poverty." Last December, the specialized agency of the United Nations approved US$1.5 million for "Accelerating technology adoption to improve rural livelihoods in the rainfed Eastern Gangetic Plains," or nearly half of the three-year project's total budget of $3.5 million.

IFAD began supporting IRRI research in the mid-1980s with a focus on improving farmers' ability to achieve reliable rice harvests in agriculturally less-favored areas affected by drought, problem soils, crop disease, insect pests and weeds. In 2001, IFAD upgraded its involvement with IRRI's parent organization, the Consultative Group on International Agricultural Research, from member status to cosponsor.

Established in Rome in 1977, IFAD is a key outcome of the 1974 World Food Conference in response to the food crises of the early 1970s, mostly in the Sahelian countries of Africa. The conference resolved that "an International Fund for Agricultural Development should be established immediately to finance agricultural development projects primarily for food production in the developing countries." One insight to emerge from the conference was that food insecurity and famine were caused not so much by failures in global food production as by structural problems arising from poverty and, in particular, the concentration of the developing world's poor populations in rural areas.

IFAD PHOTO

Dr. Cooke is director of the Technical Advisory Division of IFAD.

Specific mandate

IFAD has a specific mandate to mobilize resources on concessional terms to alleviate rural poverty and hunger in developing countries. This means fostering social development, gender equity, income generation, improved nutrition, environmental sustainability and good governance, thereby enabling the rural poor to overcome poverty on their own terms. Concretely, the strategy translates into developing and strengthening the organizations of the poor to confront the issues they define as critical; increasing access to knowledge so that poor people can grasp opportunities and overcome obstacles; expanding the influence that the poor exert over public policy and institutions; and enhancing their bargaining power in the marketplace.

All of IFAD's strategic choices – in regional, country and thematic strategies; loan and grant activities; involvement in poverty reduction strategy papers; policy dialogue; and the selection of development partners – reflect these principles. IFAD's target groups are the poorest of the poor, including small farmers, the rural landless, nomadic pastoralists, coastal fisherfolk, indigenous people and, across all groups, poor rural women.

Since its establishment, IFAD has financed 628 projects in 115 countries and independent territories, to which it has committed $7.7 billion in loans and $35.4 million in grants (including three projects fully financed by grants in Rwanda, the West Bank and Gaza). Governments and other financing sources in the recipient countries – including project beneficiaries – have contributed $7.9 billion. External co-financiers have provided $6.6 billion in co-financing, of which bilateral donors contributed $1.1 billion, multilateral donors $5.2 billion, and various international and Northern NGOs $40.2 million. Sources of co-financing for the remaining $260 million remain to be confirmed. These projects have aimed to assist 49 million rural poor households, or approximately 263 million people.

The fund's current annual commitment of about $450 million derives from members' contributions (46%), reflows from past loans (49%) and investment income (5%).

IFAD's Governing Council, representing all 162 member states, elects the fund's chief executive for a four-year term, which is renewable for a second term. The current president, Lennart Båge of Sweden, was elected in February 2001. The president also serves as chairperson of the Executive Board, whose 18 members and 18 alternate members oversee the fund's operations, particularly the approval of loans and grants.

Participatory programs

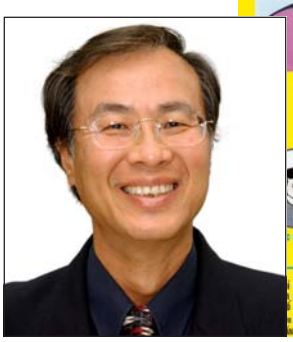
IFAD recognizes that poverty in the Asia-Pacific region is especially persistent in agriculturally less-favored areas, many of whose indigenous people suffer exploitation and human rights violations. Within a development strategy that emphasizes decentralized, participatory programs promoting regenerative agriculture and security of land tenure for farmers, IFAD aims to enhance the capability of indigenous people to tackle political and economic marginalization, reward them for environmental services, and generate social peace and security through development. As women are especially prone to poverty, IFAD strives to help them enhance their capability by tackling discrimination, ensuring equal access to resources and promoting women's representation in village institutions.

IRRI insect ecologist wins Charles A. Black Award as his collaborative team earns Vietnamese honor

The Council for Agricultural Science and Technology (CAST), an international consortium of 37 scientific and professional societies based in Washington, D.C., in January named IRRI insect ecologist K.L. Heong the recipient of the 2003 Charles A. Black Award. CAST annually honors an agricultural, environmental or food scientist's outstanding contribution to the advancement of science in the public-policy arena.

Dr. Heong and three of his partners in a project that encourages farmers to reduce their use of insecticides had earlier received the Golden Rice Award from Nguyen Van Dang, Vietnamese vice minister of agriculture. Dr. Heong's co-recipients in Cantho City on 6 December were Nguyen Huu Huan, vice director general of Vietnam's Plant Protection Department; Vo Mai, former vice director general of the department; and Monina M. Escalada, a professor in the Philippines' Visayas State College of Agriculture, now seconded to IRRI. The project team also won the prestigious 2002 St. Andrews Prize for Environment (see *Rice Today* Vol. 1, No. 2, page 5).

Primary consideration for the Charles A. Black Award goes to scientists who are actively engaged in research and who have demonstrated excellence in communicating the importance of their scientific achievements to policymakers, news media and the public. Previous recipients of the award include Calvin Qualset (2002), chairman of the program committee of the IRRI Board of Trustees, and Per Pinstrup-Anderson (1998), former director general of the International Food Policy Research Institute. Dr. Heong was scheduled to receive the award during the CAST banquet on 20 March in Arlington, Virginia, USA.



Dr. Heong and a Vietnamese "No early insecticide spray" poster.

Dr. Heong's research areas include insect ecology, pesticide toxicology, biological control, the sociology of farmer decision-making and communication. After joining IRRI in 1988, he developed, in collaboration with national scientists in Asia, participatory communication strategies to use mass media to motivate farmers to stop spraying insecticides early in the cropping cycle. The Vietnamese government honored him with the Medal for Agricultural Development in 1996, and he was the co-recipient of the Partnering Excellence Medal 2002 from Australia (see below).

Nearly a decade ago, the IRRI-led team found that a large proportion of farmers' insecticide spraying is unnecessary, especially early in the cropping cycle. Most of it targets the rice leaffolder, whose early infestations have no effect on yields. The team distilled the complex scientific details into a simple rule of thumb – "No early insecticide spray" – and used popular media, including short radio dramas, leaflets and posters, to reach farmers.

Following the media campaign in the Mekong Delta, average insecticide use fell in the test area by 53%, from 3.4 to 1.6 sprays per season, and has remained low for eight years. The team has run a similar campaign in Thailand and will soon launch another, partly supported by the St. Andrews Prize money, in Quang Ninh Province in the Red River Delta.

United Nations declares 2004 International Year of Rice

Acting on a proposal from the Philippine government, the United Nations General Assembly voted in December to declare 2004 the International Year of Rice (IYR). In its announcement, the UN noted that rice is the staple food of more than half of the world's population. It also affirmed the need to heighten international awareness of the role rice can play in alleviating poverty and malnutrition and ensuring food security.

The UN Food and Agriculture Organization and its International Rice Commission have been invited to facilitate the implementation of the IYR in collaboration with the governments of the world's rice-producing nations, the United Nations Development Programme, the Consultative Group on International Agricultural Research (of which IRRI is a member), other organizations of the UN system, and NGOs.

As *Rice Today* goes to press, no definite plans yet exist, but most rice-producing nations will likely organize special events and activities. IRRI has confirmed that, to mark the IYR, it will organize its next International Rice Research Conference in the second half of 2004, probably in Vietnam.

"The decision by the UN to declare 2004 the International Year of Rice is significant not only for the world's rice-producing nations but also for all the estimated 2.6 billion people who consume rice each day," said IRRI Director General Ronald Cantrell. "IRRI is looking forward to actively participating in many important IYR events."

IRRI shares Australian Partnering Excellence Medal 2002

Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO), represented by Grant Singleton, and the Rodent Ecology Work Group at IRRI, led by K.L. Heong of IRRI and John Copland of the Australian Centre for International Agricultural Research (ACIAR), are co-recipients of Australia's Partnering Excellence Medal 2002. The medal recognizes excellence in providing international leadership, scientific expertise and training in the ecologically based management of rodent pests in Australia and Asia, through building quality partnerships. Dr. Singleton received it in Parliament House in Canberra on 10 December.

The joint research has produced a chemical-free rodent management system, called the community trap barrier system, that can reduce rat damage by 20%. It is being adopted in several provinces in the Mekong and Red River deltas of Vietnam, in a project funded by the Australian Agency

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ARIEL JAVELLANA

Support team wins Excellence in Science Award

An IRRI research support team won the world's most prestigious award for a scientific support team in publicly funded agricultural research. The project – which has operated mainly in China but is now expanding into other countries – is called Exploiting Biodiversity for Sustainable Pest Management (see page 26). It allows farmers to boost their income while controlling a major rice disease with fewer applications of polluting chemicals.

The team received the award during the annual general meeting in Manila last October of the Consultative Group on International Agricultural Research (CGIAR), which each year presents Excellence in Science Awards. This makes two years in a row that a Filipino support team at IRRI has won the CGIAR Outstanding Scientific Support Team Award, which in 2001 went to the institute's hybrid rice breeding team. It is also the second year running that the CGIAR has cited the biodiversity project, whose paper "Genetic diversity and disease control in rice" in the journal *Nature* won the 2001 CGIAR Outstanding Scientific Article Award.

The photo shows (*from left*) project leader Tom Mew and support team members Alice Bordeos, Mel Revilla, Vivay Salazar, Nancy Castilla, Santy Culala, Abe Ona, Manny Lantin, Mayette Baraoidan, Florencio Balenson, Max Banasihan, Flavio Maghirang and Nollie Vera Cruz.

Briefly Briefly Briefly

Working CURE

Thirty scientists from South and Southeast Asia attended the Consortium for Unfavorable Rice Environments (CURE) workshop on 24-25 January at the National Agricultural Science Center in Pusa, New Delhi. Organized by R.K. Singh, IRRI liaison scientist for India, the workshop aimed to identify technologies to help "cure" unfavorable environments, select appropriate research sites and collaborating institutions, and prioritize research areas. Unfavorable environments are rainfed areas that suffer water scarcity or flooding. Most of CURE's six working groups, which are based on the major rainfed subecosystems, have held planning meetings. Deputy Director General for Research Ren Wang led a group of IRRI scientists attending the October meeting of the working group on shifting and rotational systems in Luang Prabang, Laos.

Moving in Africa

After months of civil war in its home base of Côte d'Ivoire, the CGIAR's West Africa Rice Development Association (WARDA) is continuing its management operations in that country but temporarily relocating its scientists to Bamako, Mali, where the International Crops Research Institute for the Semi-Arid Tropics, a CGIAR sister center, operates a research station. WARDA, which recently took the additional name of Africa Rice Center, reports having recovered from the genebank on the WARDA campus more than 6,000 rice seed samples, representing over 80% of the total collection.

Drought economics workshop

A workshop in Bangkok on 5-6 November studied the economic cost of drought and farmers' coping mechanisms. The project, organized by IRRI's Social Sciences Division and supported by a special grant from the Rockefeller Foundation, employs cross-country comparative analysis of three major rice-producing countries in Asia: China, India and Thailand.

Philippine honor for IRRI

The Pilipinas Shell Foundation last November recognized IRRI's contribution to the empowerment of disadvantaged farmers. The foundation cited the institute's development of salt-tolerant and tungro-resistant rice lines and the contribution they have made to the livelihood of farmers who struggle against these production constraints.

Research publication changes

International Rice Research Notes (IRRN), IRRI's biannual research journal, installed Tess Rola as its new managing editor in January, replacing Katherine Lopez. Shaobing Peng and Bas Bouman stepped down from the editorial board after more than three years and were replaced by Abdel Ismail and Renee Lafitte. J.K. Ladha continues as *IRRN* editor-in-chief.

First field test of GM rice

The first field evaluation by the Philippine Rice Research Institute (PhilRice) and IRRI of transgenic rice variety IR72 with the *Xa21* gene has shown good agronomic performance at the PhilRice station in Muñoz. IRRI developed the materials in 1998-99 and found that, under screenhouse conditions, they showed excellent protection against all races of bacterial blight in Asia.

Platform for saving water

Participants in the international workshop Water-Wise Rice Production at IRRI in April 2002 have created the International Platform for Saving Water in Rice (IPSWAR) to coordinate the efforts of agricultural researchers who are developing water-saving technologies for rice production. For more information, visit www.irri.org/irrc/water/ipswar.asp or email B.A.M. Bouman at b.bouman@cgiar.org.

New head for flood-prone rice

Mahabub Hossain is IRRI's new coordinator for improving flood-prone rice production in South Asia. This project, funded by the United Nations' International

continued from page 5

for International Development. The innovative system uses a plastic fence placed around the rice crop, which serves as bait, and cage traps placed at openings in the enclosure. Farmers who use this system need not handle dangerous rat poison or electricity. Another advantage is that rats are caught alive and can be cooked by farmers or sold commercially.

CSIRO

Members of the rodent management team in Australia (*left to right*): Dave Spratt, Lyn Hinds, Charles Krebs, Grant Singleton (*holding plaque*), Peter Brown, John Copland, Katrina Leslie, Dean Jones, Roger Pech, Jens Jacob and Steve Morton.

USAID and IRRI cosponsor food security conference

The United States Agency for International Development (USAID) and IRRI cosponsored a workshop on agriculture and food security in Asia and the Near East in Manila and Los Baños on 28 September-5 October. The workshop allowed more than 70 USAID agriculture, environment and food-aid officers across Asia and the Near East to hear from leading experts in fields ranging from agricultural research to trade competitiveness. Discussions promoted the further development and implementation of a new Asia/Near East strategy for USAID.

As the luncheon speaker on the opening day in Manila, IRRI Director General Ronald Cantrell told participants that the next Green Revolution will need the driving force of new technologies provided by research. "The new technologies must have the capacity to help millions of small-scale Asian farmers break out of their terrible poverty trap," he said. "Simultaneously, they must provide cheap rice to millions of even poorer rural rice consumers as a fuel for spurring job creation in a dynamic, diversified rural sector."

PETER FREDENBURG

Genetic Resources Center Head Ruaraidh Sackville Hamilton describes IRRI's conservation efforts during the workshop.

Workshop participants spent an entire day at IRRI's research campus in Los Baños to continue their discussions and to hear presentations from IRRI scientists in laboratories and the field.

Briefly Briefly Briefly

Fund for Agricultural Development, involves Bangladesh, India, Sri Lanka, Vietnam and Thailand.

Conference on wild rice

IRRI Genetic Resources Center Head Ruaraidh Sackville Hamilton delivered the keynote address last October at the first-ever International Conference on Wild Rice, hosted by the Green Energy Mission in Kathmandu, Nepal. Dr. Sackville Hamilton accepted on IRRI's behalf a felicitation from Badri Prasad Mandal, deputy prime minister of Nepal and the minister for agriculture and cooperatives. Discussions explored the possibility of establishing an international network for wild rice coordinated by IRRI.

New variety in Vietnam

The Vietnamese Ministry of Agriculture and Rural Development approved in August rice variety AS996, developed in part through IRRI research, for release as a national variety adapted to the acid sulfate soils that affect up to 100,000 ha of the Mekong Delta region and elsewhere.

Analytic training in Thailand

A two-week training course on multi-agent systems and geographic information systems for integrated watershed management, held in October 2002 at the Multiple Cropping Center of Chiang Mai University, attracted 24 participants from Thailand, Philippines, Vietnam, Indonesia, Bhutan, Bangladesh, Australia, Japan, France and Germany.

IRRI-Japan office closes

The end of January saw the retirement of Hiroyuki Hibino as IRRI liaison scientist in Japan and the closure of the IRRI-Japan office in Tsukuba. For now, IRRI's chief contacts in Japan are the two Japanese members of its Board of Trustees, Keijiro Otsuka and Shigemi Akita. The refocusing of the IRRI-Japan relationship emphasizes close research collaboration (see page 9), mobilization of new resource opportunities and heightened public awareness.

Rice technology transfer

The first-ever training workshop on rice technology-transfer systems in Asia brought 19 participants from 10 Asian countries to the South Korean Rural Development Administration for two weeks in September and October 2002. Participants studied worldwide trends in the rice industry, models of rice technology-transfer systems, communication strategies and project management. They also observed advanced rice-farming practices during visits to demonstration villages and progressive rice farmers.

SERGE MAGADIA

To make women more effective agents of change in agriculture, the IRRI Training Center conducted in November 2002 the first Leadership Course for Asian Women in Agricultural Research and Development. Attending were 20 participants from Bangladesh, Cambodia, China, Indonesia, Laos, Philippines and Thailand.

Rice genes go public

An international consortium set up to determine the genome, or genetic makeup, of rice announced the completion of a high-quality draft sequence of the genome on 18 December 2002. The Japanese-led International Rice Genome Sequencing Project (IRGSP) effectively completed the sequencing of 430 million bases of the rice genome, setting the stage for the accelerated development of new rice varieties to help ensure food security and improve farmers' livelihoods.

IRGSP participants include publicly funded research institutions in Japan, the United States, China, Taiwan (China), South Korea, India, Thailand, France, the United Kingdom and Brazil. With the help of three less-detailed genome-sequence drafts assembled over the past two years by private-sector researchers, the IRGSP managed to complete its definitive draft – described by IRRI Director General Ronald Cantrell as "the gold standard for all future investigations of genetic variation in crops" – six years ahead of the initial target.

Japanese Prime Minister Junichiro Koizumi congratulated the collaborators during the announcement event in Tokyo. "The publicly available, high-quality draft sequence of the rice genome is expected to trigger rapid progress in determining the function of genes in cereals," he said. "I am convinced that genome research will make far-reaching contributions to solving the constraints in sustainable food production and environmental problems."

As the first major cereal crop to be sequenced, the rice genome provides data for improving other grains, such as maize and wheat, whose larger gene sequences are collinear with that of rice.

"Decoding the rice genome is an important scientific achievement that can lead to improved nutrition and aid in efforts to eliminate hunger throughout the world," said U.S. Agriculture Secretary Ann M. Veneman at an event on the same day in Washington, D.C.

"The rice genome's sequence is crucial to our scientific understanding of the staples of life," added Rita R. Colwell, director of the National Science Foundation in the U.S.

Greatly facilitating the rice genome sequencing effort were contributions from private companies. In 2000, Monsanto independently produced a draft sequence of the rice genome and made its clones available to the IRGSP. Early last year, the Swiss agrochemical company Syngenta provided to the IRGSP a draft sequence of the japonica rice subspecies. At about the same time, the Beijing Genomics Institute in China produced a similar draft of the indica subspecies. Japonica rice is typically grown in temperate regions, while indica varieties are grown in the tropics.

These achievements spurred discussions over whether the international consortium should continue the genome project. Eventually participants decided to keep going, as they were confident that their data were usefully more accurate than the earlier drafts – 99.99% accurate. The sequence data for the entire rice genome are now in the public domain, deposited in public databases such as GenBank, EMBL and DDBJ for free access to all scientists worldwide.

Rice earned two cover stories in prestigious scientific journals last year: the 5 April edition of *Science* (see *Rice Today*, Vol. 1, No. 2, page 9) and the 21 November issue of *Nature*, in which two papers detail the complete sequences of two rice chromosomes. One research group sequenced chromosome 1 and calculated that it contains 6,756 genes; the draft version released earlier this year predicted only 4,467 genes. A second group produced a finished sequence of chromosome 4, reporting that 52% of the genes were not completely predicted by the draft sequence.

IRGSP participants

Japan: Rice Genome Research Program (a collaboration of the National Institute of Agrobiological Sciences and the Institute of the Society for Techno-innovation of Agriculture, Forestry and Fisheries). **United States**: The Institute for Genomic Research, Cold Spring Harbor Laboratory, Clemson University, Washington University in St. Louis, University of Arizona, Rutgers University, University of Wisconsin. **China**: National Center for Gene Research of the Chinese Academy of Sciences. **Taiwan (China)**: Academia Sinica Plant Genome Center. **France**: Genoscope. **South Korea**: Korea Rice Genome Research Program. **India**: Indian Initiative for Rice Genome Sequencing. **Thailand**: National Center for Genetic Engineering and Biotechnology. **Brazil**: Brazilian Rice Genome Initiative. **United Kingdom**: John Innes Center.

As rice genebank clocks a quarter century,

The International Rice Genebank at IRRI marked its 25th anniversary on 12 December last year. The world's most comprehensive storehouse of rice biodiversity holds in trust more than 108,000 samples of cultivated and wild rice seeds donated by more than 100 countries. The purpose of the genebank – which now looks forward to receiving assured, long-term support from a new funding plan – is to conserve the biodiversity of rice and make seeds available to plant breeders and other scientists around the globe.

"We protect traditional varieties so they can be used to help poor rice farmers," explains Ruaraidh Sackville Hamilton, head of IRRI's Genetic Resources Center (GRC), which runs the genebank. "We distribute seeds to any nation, provided they sign a legal agreement that they will not attempt to seek intellectual property protection on that material."

Since the mid-1980s, the GRC has distributed 250,000 seed samples. It has also restored varieties to their native place following their loss due to war (Cambodia and East Timor), natural catastrophes (Philippines) or other causes (see sidebar on page 28). "We hope to do the same for Afghanistan," Dr. Sackville Hamilton adds. "Rebuilding the country's infrastructure should include restoring Afghan biodiversity as well as introducing improved varieties."

The seeds are preserved in refrigerated, fire- and earthquake-resistant facilities on IRRI's research campus in the Philippines. Supplies for immediate exchange are kept at 2–4 ·C in vacuum-sealed aluminum cans or

Partnership opens new chapter in gene discovery

NIAS

Ronald Cantrell (*left*) and Masaki Iwabuchi.

IRRI entered into a landmark research and capacity-building agreement last month with Japan's National Institute of Agrobiological Sciences (NIAS), paving the way for the next stage of discovery revealing the genetic makeup of rice. The partnership promises to unlock the secrets of functionality in the recently sequenced genome of the world's main food grain, determining which genes strengthen plants against drought, problem soils, diseases and pests – and to do so for the benefit of poor rice farmers and consumers.

The memorandum of agreement came into force on 19 December 2002 when it was signed in Tokyo by IRRI Director General Ronald Cantrell and NIAS President Masaki Iwabuchi. It sets the terms for a five-year IRRI-NIAS collaboration designed, in the words of the agreement, "to apply genomics science and technologies to discover genes of agronomic interest, especially those involved in stress tolerance, and to build human resources that will enhance international partnerships in agricultural research and development in the developing world."

The signing came the day after the official announcement – simultaneously made in Tokyo and Washington, D.C. – that the International Rice Genome Sequencing Project (IRGSP) had completed a highly accurate sequencing of the rice genome. NIAS has led the IRGSP consortium and played a major role in the project.

The new IRRI-NIAS agreement advances the two institutes' shared vision "to make new tools and knowledge derived from rice genomics research accessible to help solve rice production problems." To this end, it will combine the expertise of NIAS as a world leader in rice genomics research, IRRI's long experience in rice biology and breeding, and the vast store of genetic resources held in trust in the International Rice Genebank at IRRI.

"There is no doubt in my mind that combining our resources to focus on this important strategic area of rice science will bring dividends in the near future," said Dr. Cantrell. "The agreement between NIAS and IRRI represents a first step in that joint endeavor. I am very pleased that we have been able to reach this agreement so quickly."

NIAS and IRRI scientists will implement the agreement through collaborative work plans updated annually or as mutually agreed. Mutual agreement and the public interest will govern joint publication of collaborative research results. NIAS and IRRI will exchange breeding materials, germplasm, clones, DNA samples, software and datasets subject to the execution of material transfer agreements and adherence to biosafety regulations, and with due recognition made to the original sources of the materials.

The two institutes also agreed that "all outcomes of NIAS-IRRI joint research activities, including all intellectual property rights, shall be jointly owned by both parties."

a new funding effort takes the long view

heat-sealed aluminum-foil packets. Long-term storage is in a vault chilled to minus 20 ·C.

Conserving biodiversity is a long-term proposition dependent, paradoxically, on year-to-year funding. The Global Conservation Trust – a partnership combining the United Nations Food and Agriculture Organization and IRRI's parent organization, the Consultative Group on International Agricultural Research – aims to provide a package of technical assistance and permanent financial backing for the world's crop-diversity collections. The trust is working to raise a minimum of $260 million from corporations, foundations and governments to establish an endowment, the interest from which will provide permanent support for genebanks around the world.

Despite recent funding cuts, the International Rice Genebank continues to operate according to accepted standards. The same cannot be said for all genebanks.

"The problem is that these storehouses of diversity are being allowed to depreciate," writes Donald Kennedy, editor-in-chief of *Science*, in an op-ed supporting the trust. "Serious underfunding prevents adequate curation. In many banks, living seeds are waiting to be duplicated while the cooling systems that protect them break down because there is no money to repair them."

Dr. Kennedy's op-ed is posted at www.washingtonpost.com/wp-dyn/articles/A3920-2003Jan2.html. To learn more about Global Conservation Trust, visit www.startwithaseed.org. For more on the International Rice Genebank, visit www.irri.org/GRC/GRChome/home.htm.

Art of rice

Dating back to at least 3000 BCE – with the first known depiction of the rice plant on a ceramic cup in China – rice has been a rich source of artistic inspiration in Asia for over five millennia. On 5 October 2003, the UCLA Fowler Museum of Cultural History will open a major exhibition in Los Angeles, California, exploring the significance of rice in Asian societies as seen through the visual arts. *The Art of Rice: Spirit and Sustenance in Asia* will feature objects ranging from ancient ceramics, gilded screens, masterful sculptures and rare textiles to contemporary paintings and popular religious depictions, such as the wood carvings of the Philippine Ifugao rice god, or *bulul* (pictured). The exhibition, which will run until April 2004, brings together the research and creativity of an international group of more than 20 curators, anthropologists and artists. For details as the opening approaches, visit www.fmch.ucla.edu/Exhibits/exhibit.htm.

CHRISTOPHER HETTEL

Beijing puts rice on the table

South Korea has become the latest country to endorse the *Beijing Declaration on Rice*, one of the key outcomes of the first-ever International Rice Congress, which took place in the Chinese capital in September 2002. Chinese President Jiang Zemin opened the congress on 16 September with a speech emphasizing the importance of international collaboration in agricultural research and committing China to a leading role.

"China has managed to feed 22 percent of the world's population with less than 10 percent of the world's arable land," President Jiang said at the opening ceremony. "At present, the 1.2 billion and more Chinese have sufficient food and clothing and, by and large, lead a well-to-do life. China has [therefore] made its contribution to world grain production and security."

More than 1,000 delegates from at least 20 countries attended the four-day event, which marked the first-ever meeting of all sectors of the international rice industry, including researchers, traders, government officials, private-sector representatives, farmers and NGO officers.

While the industry can boast of major successes in recent decades – such as famine-eradicating production increases in China, India, Vietnam and Bangladesh – it continues to struggle with major challenges such as poverty eradication, household food security and improving farmers' income.

Delegates to the congress grappled with these and a host of other issues as they met at two main events. Some 800 delegates attended the 24th International Rice Research Conference, and another 200 attended the World Rice Commerce Conference. Meanwhile, the International Rice Technology and Cultural Exhibition attracted 40 exhibitors.

Perhaps most significantly, ministers from eight of the world's major rice-producing nations – representing about half the planet's population – kicked off the congress with a special ministerial roundtable on rice on 15 September (see page 12). It was here that the *Beijing Declaration on Rice* was first proposed, with a recommendation from Thailand and several other countries that it should be more fully developed before being circulated for final endorsement. By February, the Philippines, Laos, Indonesia and South Korea had endorsed the declaration.

Historic event

"I believe the roundtable has already proven itself to have been a historic event," said Dr. Ronald P. Cantrell, director general of IRRI. "Not only did it bring together some of the world's most populous nations – such as China, India and Indonesia – to talk, for the first time, about rice. It also came at a crucial time in the history of rice with the recent sequencing of the rice genome," a monumental achievement that paves the way for researchers to decode the function of each and every rice gene.

The congress delegates were mostly from Asia, but there were also representatives from Africa (where rice production is growing rapidly), North America, Australia, Europe, and Central and South America. Among the host of other issues the congress faced were the impact of liberalization on the international rice trade (some rice cultures could be wiped out) and the terrible poverty trap that continues to ensnare millions of rice farmers.

"Profitable, sustainable rice production is essential to national and regional stability – not just in Asia, but in much of the rest of the world as well," commented Dr. Cantrell. "The delegates went to Beijing expecting to work, because we had a comprehensive research program to report on and share, as well as important trade information to analyze and dissect."

With the United Nations' decision last December to declare 2004 the International Year of Rice, plans are now under development for future congresses.

"All rice-producing nations face the same problems," Dr. Cantrell said. "For too long, rice farmers have been the most deprived and forgotten of all our food producers. It is our hope that, by bringing the rice industry together at such congresses, we will get all those involved to focus on these problems and finally resolve them to the benefit of everyone – especially poor rice farmers and consumers."

CHINESE ACADEMY OF ENGINEERING (3)

ALBERT ATKINSON

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Prime economic activity

Rice farming is one of the world's prime economic activities because it provides more sustenance to more people than any other food source and is the single largest food source for the world's poor. As the main crop grown on more than 200 million farms, it is the single largest source of income and employment for hundreds of millions of rural residents in the developing world. Because rice fields cover 11 percent of the planet's arable area, or more than 500 million ha, rice farmers also have a key role to play in environmental protection. Finally, rice is the foundation of social stability and food security for some of the world's most populous nations, including China, India, Indonesia and Nigeria.

Chinese President Jiang Zemin (*clockwise from left*) greets IRRI Board Chair Angeline Saziso Kamba, speaks at the opening ceremony of the congress, and shares a light moment with hybrid rice pioneer Prof. Yuan Longping and IRRI Director General Ronald Cantrell. Gina Zarsadias explains IRRI Training Center materials to exhibition attendees. Thai Trade Representative Prachuab Chaiyasan and IRRI Consultant Gelia Castillo check out farmers' hats at the Asia Rice Foundation display.

Asian ministers declare rice key to stability and prosperity

The first-ever International Roundtable on Rice, featuring 13 ministerial representatives from all of the world's major rice producers, has confirmed that the crop is essential to the continued health, wealth and prosperity of almost half the world's population.

The historic meeting took place in Beijing on 15 September 2002, on the eve of the first International Rice Congress.

The gathering helped set the agenda for the congress, the first time the international rice industry has ever met. The roundtable also marked the first time that high officials of the world's rice-producing nations gathered to discuss their kernel of cultural and economic commonality – rice.

A roundtable observer, Philippine National Scientist Gelia Castillo, makes a point during the ministerial discussions, as IRRI Board Member Mike Gale looks on.

In their opening statements, all the ministers spoke of the vital role rice plays in feeding their citizens and as a foundation of their cultures and, in several cases, their religions. "In Thailand, rice means life," said Prachuab Chaiyasan, the Thai trade representative and official ministerial representative to the roundtable, whose views were echoed by many other delegates.

Confirming the pivotal role of rice in keeping people fed and productive, recent research shows that rice supplies 32% of the total calories consumed by the 3.6 billion people who live in Asia. The price of rice is regularly cited as one of the most critical political factors influencing governments in the region; if prices reach unacceptable levels, instability can result.

Setting the agenda

"While rice consumers get all the political attention, it's time we realized that rice producers – or farmers – also have a key role to play in a country's economic development," said Ronald P. Cantrell, IRRI director general. "For too long, rice farmers have been trapped in poverty and deprived of technologies that farmers in other sectors take for granted. Our main aim at the International Roundtable on Rice was to start developing an agenda for the rice industry that will result in sustainable, economically thriving rice-farming communities with modern infrastructure and access to the latest technologies and expertise."

The roundtable discussions focused on the role of rice in maintaining food security and social stability, and as a common economic and cultural tie, especially in Asia.

Read all about it

Selected papers presented during the 24th International Rice Research Conference, which took place in conjunction with the rice congress, will appear soon in the book *Innovations in Rice Science for Impact and Livelihood of the Poor*. The papers include Chinese President Jiang Zemin's opening address and the latest in cutting-edge rice research presented by some of the world's most distinguished agricultural scientists:

- P.L. Timmer, University of California, San Diego, gives an overview on agriculture and poverty and highlights the need to fund rice research.
- T. Sasaki, Rice Genome Research Program of the National Institute of Agrobiological Sciences (Japan), covers genome sequencing.
- Ingo Potrykus, Institute of Plant Sciences, Swiss Federal Institute of Technology, discusses Golden Rice for developing countries.
- R. Matthews, Cranfield University, UK, looks at rice production, climate change and methane emissions.
- Peter Ooi, Food and Agriculture Organization Integrated Pest Management (IPM) Program, covers the lessons learned from rice IPM.
- Justin Lin, Beijing University, writes about the effects of the World Trade Organization agreement on China's economy and agricultural sector.
- Jun Yu and others from the Beijing Genomics Institute and Chinese Academy of Sciences discuss the Chinese super hybrid rice genome project.
- H. Hirochika, National Institute of Agrobiological Sciences (Japan), covers using retrotransposons for insertional mutagenesis in rice.
- M. Wahlqvist , Monash University (Australia), and H. Bouis, International Food Policy Research Institute, Washington, D.C., analyze biofortification.

This 800-page volume should be in the library of every rice scientist. Check IRRI's online publications catalog at www.irri.org/pubcat/pubcontents.htm for updates on availability and how to order.

"Rice is an essential part of Chinese history, culture and national identity, but it also has a key role in many other influential cultures such as in India, Japan and Indonesia," observed Song Jian, one of the honorary chairmen of the congress organizing committee.

The discussions also considered the essential roles rice research and access to new technologies play in improving the livelihoods of farm families that grow rice, who represent more than half of all farm families worldwide. IRRI's director general commented that this development was especially significant for his institute.

"Since IRRI was founded 42 years ago by the Rockefeller and Ford foundations, it has been funded mostly by Western governments," Dr. Cantrell observed. "This group includes Japan, which historically has been one of our biggest donors. But it is noteworthy that Japan is the only rice-producing nation that has significantly supported international rice research over a long period. If rice research is going to continue to benefit the poor rice farmers and consumers of the world, then rice-producing nations need to get together and provide more resources. We can't expect Western nations to support institutions like IRRI forever."

Research impact

Certainly, publicly funded rice research has impact. Over the past four decades, it has been instrumental in increasing potential yields from four to more than 10 tons per ha; in helping to more than double world rice production from 260 million to 600 million tons; in providing rice varieties that mature quickly to allow two or even three crops per year, resist various pests and diseases, need less fertilizer, and thrive under such stresses as high salinity; and in ensuring the development of more nutritious rice.

"There is no doubt that rice research has achieved a lot," Dr. Cantrell said. "However, enormous challenges remain, especially with regard to alleviating poverty. It is our hope that the Roundtable on Rice has started a process that will result in more research and new technologies that will benefit rice farmers and consumers everywhere."

Beijing Declaration

At the conclusion of the roundtable, the ministers agreed to circulate a *Beijing Declaration on Rice*, which states the following:

- Rice production is the foundation of food security and social stability for almost half the world's population (2.6 billion people). It is essential to the national stability of the 13 nations represented at the roundtable.
- Rice production and consumption are national characteristics uniting the 13 countries represented at the roundtable, which include three of the world's largest nations: China, India and Indonesia.
- The 13 nations represented at the roundtable all seek economically strong and sustainable rural communities with diversified rice production playing a key role. Such communities are also recognized as the foundation of each nation and essential to their continued national development.
- Rice research and access to new technologies are essential to the livelihoods and improved well-being of more than half the world's rural families, as well as the development of economically strong rice-based communities.
- The public sector must have a major role in such research and the development of new, freely available rice technologies. It is also essential that the public sector – in both national and international research – be guaranteed the resources it needs to play this vital role. While the private sector must also play a role, the poverty of most rice producers and consumers makes it essential that any new technologies be made easily accessible to all those who need them.
- More must be done to make the citizens – especially the young people – of the 13 nations represented at the roundtable more aware of the importance of rice to their lives and their cultures.

Roundtable on Rice

Ministerial and national representatives

Bangladesh, Dr. Mirza Fakhrul Islam Alamgir, State Minister, Ministry of Agriculture. **Cambodia**, Mr. May Sam Oeun, Secretary of State (Agriculture). **China**, Mr. Du Qinglin, Minister, Ministry of Agriculture; Mr. Liu Jiang, Vice-Chairman, State Development and Planning Commission; Mr. Zhang Baowen, Vice Minister, Ministry of Agriculture; Prof. Shen Guofang, Vice President, Chinese Academy of Engineering; Dr. Zhai Huqu, President, Chinese Academy of Agricultural Sciences. **India**, Dr. Panjab Singh, Secretary, Department of Agricultural Research and Extension; Director General, Indian Council of Agricultural Research. **Indonesia**, Prof. Dr. Ir. Bungaran Saragih, Mec., Minister, Ministry of Agriculture. **Iran**, H.E. Eng. Mahmood Hojjati, Minister, Ministry of Agriculture. **Korea (South)**, Dr. Huhn-Pal Moon, Director General, National Crop Experiment Station, Rural Development Administration. **Laos**, Mr. Viravanh Phannourath, Director General, Department of Agriculture. **Malaysia**, Cik (Ms.) Rosmah Binti Haji Jentra, Undersecretary, Ministry of Agriculture. **Myanmar**, Maj. Gen. Nyunt Tin, Minister, Ministry of Agriculture and Irrigation. **Sri Lanka**, Mr. C. Wijesundra, Deputy Director for Research, Regional Agricultural Development Center. **Thailand**, Mr. Prachuab Chaiyasan, Minister of Trade and Representative to the World Trade Organization, Prime Minister's Office. **Vietnam**, Dr. Bui Ba Bong, Vice Minister, Ministry of Agriculture and Rural Development.

IRRI representatives

Mrs. Angeline Saziso Kamba (Zimbabwe), Chair, Board of Trustees. Dr. Ronald P. Cantrell (USA), Director General. Dr. Ren Wang (China), Deputy Director General for Research. Prof. Rudy Rabbinge (Netherlands), Senator and Dean, Graduate School, Wageningen University and Research Centre; Former Chair, IRRI Board of Trustees. Dr. Emmanuel Adilson Serrão (Brazil), Director General, Embrapa Amazonia Oriental; Member, IRRI Board of Trustees. Prof. Keijiro Otsuka (Japan), Deputy Director, Graduate Program, Foundation for Advanced Studies on International Development; Member, IRRI Board of Trustees. Prof. Michael D. Gale (UK), Associate Research Director, John Innes Center; Member, IRRI Board of Trustees. Dr. Gurdev Khush (India), Plant Breeder and IRRI Consultant. Prof. Gelia T. Castillo (Philippines), Member, Board of Trustees, Philippine Rice Research Institute; Member, Philippine National Academy of Sciences; IRRI Consultant.

Other principal scientists and observers

Mr. Fazle Hasan Abed (Bangladesh), Founder and Executive Director, Bangladesh Rural Advancement Committee; Member, IRRI Board of Trustees. Mr. Li Zhendong (China), Deputy Director General, International Cooperation Division, Ministry of Agriculture. Prof. Yuan Longping (China), Director General, China National Hybrid Rice Research and Development Center. Mr. Karl Gutbrod (Germany), Head, Rice and Field Crop Strategy, Syngenta Worldwide (Switzerland). Dr. Ikuo Ando (Japan), Plant Breeder and Chief, Rice Breeding Laboratory, National Agricultural Research Center for Hokkaido Region. Dr. Muhammad Hanif (Pakistan), Agricultural Development Commissioner, Ministry of Food, Agriculture and Livestock. Dr. James Cook (USA), Member, National Academy of Sciences; Retired Chief Scientist, Department of Agriculture. Mr. Peter Kenmore (USA), International Integrated Pest Management Coordinator, United Nations Food and Agriculture Organization (Italy). Prof. C. Peter Timmer (USA), Dean, School of International Relations and Pacific Studies, University of California, San Diego. Dr. Ron Phillips (USA), Member, National Academy of Sciences.

Manila makes CGIAR history

The Philippine capital was the venue for the 2002 annual general meeting of IRRI's parent organization, marking the first time this gathering of 500 movers and shakers in publicly funded agricultural research has taken place outside of Washington, D.C. The meeting of the Consultative Group on International Agricultural Research (CGIAR) took place at the Makati Shangri-la Hotel on 30 October-1 November with the theme "Agriculture for growth and development."

IRRI and its partners in the Los Baños Science Community seized the chance to invite delegates to journey 60 km south of Manila on 28 October for a Philippines Day program and again on 29 October for IRRI Day. More than 280 visitors braved heavy rain to board the buses for IRRI Day and were rewarded by gloriously fresh weather at the institute's 252-hectare experimental farm.

"Many visitors said that IRRI Day was the best field day they had ever been to," said Mike Jackson, director for program planning and coordination. "Visitors spoke of guides' enthusiasm and good humor and of the focused presentations. Everyone did a great job."

At the exhibit ribbon-cutting in the Makati Shangri-la Hotel are (*from left*) CGIAR Chairman Ian Johnson; CGIAR Director Francisco Reifschneider (*behind*); Philippine Senate Committee on Agriculture and Food Chair Ramon Magsaysay, Jr.; Patricia El-Ashry; Crawford lecturer Mohamed El-Ashry; and then-Secretary Leonardo Montemayor of the Philippine Department of Agriculture. (*Insets, clockwise from left*) Imelda Revilla, spokesperson for the award-winning scientific support team at IRRI; Odin Knudsen, senior advisor on environmentally and socially sustainable development to the vice president of the World Bank; Mr. Johnson addresses the meeting; Dr. Reifschneider escorts Philippine Vice-President Theofisto Guingona from the hall following his speech.

2002 CGIAR Science Award winners and team reps (*from left*): Fred Pearce (Outstanding Journalism), Christopher Barr of CIFOR (Outstanding Communications), Bruce Campbell of CIFOR (Outstanding Scientific Article), Imelda Revilla of IRRI (Outstanding Scientific Support Team), Jagdish Kumar of ICRISAT (King Baudouin Award), Marilyn Louise Warburton of CIMMYT (Promising Young Scientist), Tushaar Shah of IWMI (Outstanding Scientist), Ruth Meinzen-Dick of IFPRI (Outstanding Partnership).

(*Left*) Dr. Reifschneider and Sen. Magsaysay at the IRRI exhibit; (*right, from left*) IRRI Board Chair Angeline Kamba, South African CGIAR Exco Member Bongiwe Njobe, WARDA Director General Kanayo Nwanze, Future Harvest Executive Director Judith Symonds, and South Africa National Department of Agriculture Deputy Director-General Njabulo Nduli.

ARIEL JAVELLANA, AILEEN DEL ROSARIO, PETER FREDENBURG, MIKE JACKSON

IRRI Day guides (*from left*) Josephine Narciso, Carlos Casal, Reycel Maghirang, Alvaro Pamplona, Criselda Ramos, Lina Torrizo, Renato Reaño, Christina Casanova, Jessica Rey, Carlos Huelma, Blesilda Albano, Jose Roxas, Reymunda Labuguen, Tamerlane Mark Nas, Sylvia Avance, Lilia Molina, Ailene Garcia, Ofelia Namuco, Estela Pasuquin, Ma. Theresa Tenorio, Leonor Herradura and Joel Janiya. Not pictured: Ma. Zenaida Borra, Eleah Lucas and Ma. Angeles Quilloy.

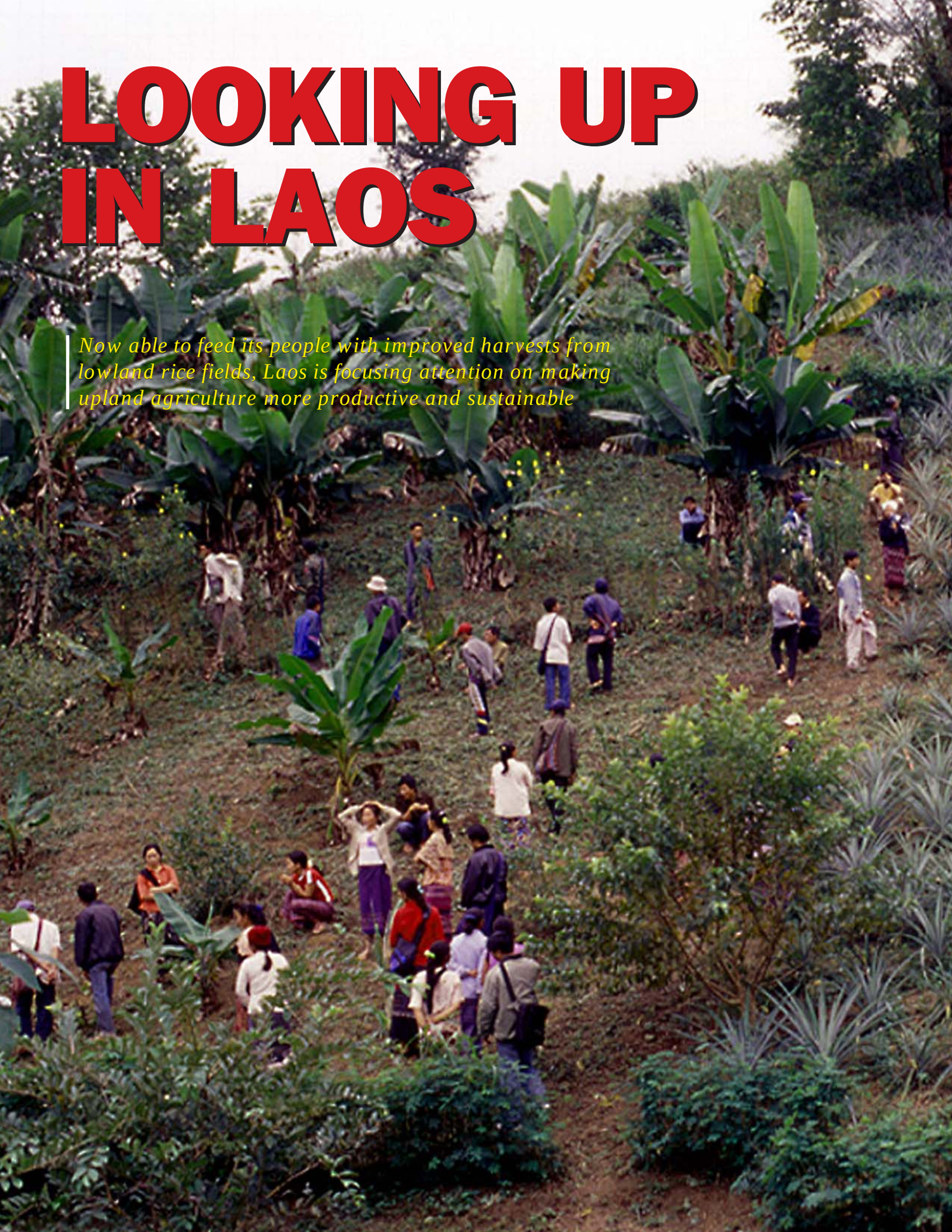
Plant physiologist Renee Lafitte (*above*) makes a presentation as Emile Frison, subsequently IPGRI director general designate, looks on; entomologist K.L. Heong (*below*) presents; among the visitors are Peter J. Matlon (*right, white shirt*), Rockefeller Foundation deputy director for food security, and Doug Wholey (*standing, blue shirt*), agronomist in the IFAD Technical Advisory Division.

Plant pathologists Nollie Vera Cruz (*above left, from left*) and Nancy Castilla presenting; one of the 10 tractor-and-wagon rigs (*above*) that took visitors around to the presentation sites; (*inset*) IRRI Director General Ronald Cantrell; (*below, from left*) Dr. Cantrell with CGIAR Director Francisco Reifschneider, CGIAR Chairman Ian Johnson and WorldFish Center Director General Meryl Williams.

At Philippines Day: (*left, from left*) WorldFish Center Philippine Project Leader Boris Fabres, then Philippine Agriculture Secretary Leonardo Montemayor, Dr. Reifschneider, Mr. Johnson; (*below left, from left*) IRRI Spokesperson Duncan Macintosh with IFPRI Media Relations Head Michael Rubinstein; (*below, from left*) Dr. Reifschneider, Odin Knudsen of the World Bank, Dr. Cantrell, Mr. Johnson, IRRI Board Chair Angeline Kamba, Philippine Representative to the CGIAR Eliseo Ponce, and Ramon Razal, dean of the College of Forestry, University of the Philippines Los Baños; (*below right*) Sec. and Monica Montemayor with Dr. Ponce.

LOOKING UP IN LAOS

Now able to feed its people with improved harvests from lowland rice fields, Laos is focusing attention on making upland agriculture more productive and sustainable



BRUCE LINQUIST

Phath and Mai Khong's garden experiences a minor population explosion during a farmers' field day showcasing this and several other participatory research sites along the Ou River in northern Laos. Phath (*below*) addresses the visitors regarding her fruit-tree nursery. Perennial crops are a sustainable alternative to the slash-and-burn system (*above*) that population growth and the resulting shorter fallows have rendered obsolete.

Phath Kantannam and her husband, Mai Khong, started their garden a little more than two years ago. It has since matured into a roadside slice of Eden amid the hardscrabble hills that crowd the Ou River north of Luang Prabang. The garden's mango, lichee, lemon and star apple trees do not yet bear fruit, but among the annual and intermediate cash crops already earning the couple a modest income are chili, eggplant, banana and pineapple. Hedgerows of leucaena and stylo legumes planted to control erosion on this single hectare of sloping land also provide fodder for pigs. A few small stream-fed ponds at the bottom of the vale nurture fish that the couple share with their children and grandchildren. Phath and Mai Khong recently started marketing saplings from their fruit-tree nursery and experimentally raising frogs to sell as food.

Unlike biblical Eden, this garden is no paradise of innocent leisure. Phath and Mai Khong devote long hours of hard labor to tending and expanding it. They are lucky to have the time, and they owe their good fortune to another hectare of land, inherited from Phath's mother, on the other side of the river.

That plot consists of several bunded (embanked) rainfed paddies that reliably produce the 2.5 tons of rice that the family of six consumes each year. Unlike most of their neighbors, the couple need not resort to growing upland rice (a dryland crop like wheat) on hillsides cleared by slash-and-burn. Their rice needs readily secured, they devote their spare time and energy – and their upland garden – to improving their livelihood.

PETER FREDENBURG (10)

"We hardly ever have to weed the lowland rice," says Mai Khong,

Farmers weed upland rice, an activity that absorbs up to half of the crop's labor demand; (*continuing clockwise*) participatory research finds Dr. Linquist (*left*) and Mr. Bounthanh (*second from left*) learning how farmers dry indigo, boys sitting on the sidelines during an extension visit, and farmers sharing experiences in a field-day discussion group; Ms. Chay (*right*), the biodiversity specialist, inspects a rice sample taken from a farmer's storehouse; rice is plentiful in a market in Vientiane since Laos achieved national rice self-sufficiency.

citing the most time-consuming chore in upland rice production. "We use that time to work in the garden."

The couple's story illustrates the happy corollary to a maxim of life in the Lao highlands: "Without rice, you can't do anything." Because they *have* rice, they can pursue a wealth of options. And what is good for the family is good for the nation. Now that Laos grows about as much rice as it needs at the national level, it can devote more resources to tackling persistent regional rice deficits, especially in the north, and to addressing the other economic, environmental and social challenges that face its 5.3 million people.

"Laos was never in modern history self-sufficient in rice until 1999," says Karl Goeppert, IRRI representative to the Lao People's Democratic Republic and head of the Lao-IRRI Project. "Rice prices for consumers have since come down and are now similar to prices in neighboring countries."

The Lao-IRRI Project is a collaboration teaming IRRI with the Lao National Agricultural and Forestry Research Institute. Since the project's launch in 1991, the Swiss Agency for Development and Cooperation has faithfully supported it with a commitment so far totaling US$14.5 million. In the same period, the Lao rice harvest has grown by more than half. Almost all of that gain has been in the lowlands, where adoption of modern, high-yielding varieties has ballooned from 5% to more than 80%.

"One of the most striking features of rice production in Laos during the second half of the 1990s was the rapid expansion of the irrigated area," comments Kouang Douangsila, head of the National Rice Research Program and Lao-IRRI project coordinator. Since 1995, the irrigated area has grown by eightfold to 100,000 ha, now accounting for almost a fifth of total lowland rice area. Irrigated dry-season fields, all of which are planted to modern varieties, have strongly contributed to the growing harvest.

"Several ADB irrigation projects are still being completed," Mr. Kouang continues, referring to

BRUCE LINQUIST

the Asian Development Bank. "But after that there will be no point to irrigating more lowlands. As a landlocked country between Thailand and Vietnam, both of which are major rice exporters, Laos will never have an economic incentive to produce a big surplus. The ADB and other donors are correct to orient new investment toward small irrigation projects in the mountains and so improve rice self-sufficiency in those remote communities."

Leading Lao-IRRI's intensified focus on upland sustainability is Bruce Linquist, an IRRI upland agronomist who in 2000 moved from the project's headquarters in the Lao capital of Vientiane to a new regional outpost in the scenic former capital of Luang Prabang, tucked beside the Mekong River in the mountains of northern Laos. The garden of Phath and Mai Khong is one result of this new focus – an ongoing, multifaceted experiment in farmer participatory research to test and disseminate strategies to improve rice cultivation and diversify livelihoods in the north.

Dr. Linquist works closely with Bounthanh Keoboualapha, head of the Northern Agriculture and Forestry Research Center at nearby Huay Khot, who explains why the traditional slash-and-burn system still generally practiced in the region no longer meets people's needs.

Shortened fallows

"Shifting agriculture has traditionally depended on long fallow periods to maintain soil fertility and control weeds," Mr. Bounthanh says. "The need for more farmland to feed a growing population has led to widespread deforestation, and in many places it has forced farmers to shorten fallows to only two years. As a result, erosion gets worse. And weeds get much worse because scrubby or grassy fallows leave lots of weed seeds on the ground, and a lot of them survive because the fire that clears the scrub or grass doesn't burn very hot."

Today, adequately weeding a hectare of upland rice takes 162 person-days, or up to half of the crop's total labor investment. Whereas the traditional strength of the extensive slash-and-burn system was that it exploited ample land availability to optimize small communities' meager labor resources, today's onerous weeding requirements permit farmers only marginal returns. In addition, shorter fallows and the resulting decline in soil fertility have depressed upland rice yields for the past decade. Leaving aside compelling environmental reasons to phase out slash-and-burn agriculture, modern conditions have brought upland Lao farmers to the critical point where it is profitable for them to shift to more intensive land-use systems.

Fruit trees and other perennial cash crops are ideal for minimizing hillside erosion and associated environmental ills caused by farming fragile highlands. However, rutted or nonexistent roads make hauling these crops to market a nonstarter for

farmers in remote areas. These farmers face a similar problem bringing home such bulky agricultural inputs as fertilizer – or supplementary supplies of rice.

Sadly, Lao attainment of national rice self-sufficiency does not directly solve the problem of local rice shortages in remote mountain communities. And, as mountain folk say, "Without rice, you can't do anything."

This is why the Lao-IRRI Project stresses improving rice productivity wherever possible. Montane lowlands – which are bunded paddies, either rainfed or irrigated, on valley bottoms or stepped terraces cut into hillsides (see the inside back cover) – are solidly sustainable systems that offer strong potential for intensification.

"For every hectare of montane lowland that produces one more ton of rice than it did, farmers can reduce by 2 ha the upland area used for slash-and-burn rice," says Dr. Linquist. "Newly terracing 1 ha of rainfed lowland paddy can lead to a 7 ha reduction in upland rice area. Irrigate that hectare so you can grow a second crop in the dry season, and you free 14 ha of upland for cash crops or reforestation."

Establishing montane lowlands is not always an option, though, especially for the poorest of the rural poor. Lao-IRRI is therefore helping these farmers identify upland rice varieties that perform well under short-fallow conditions, fallow species that restore soil fertility quickly, and other ways to make upland rice-based cropping systems more productive and profitable.

Lao-IRRI not only strives to help farmers build a sustainable future for rice farming in Laos. It also actively safeguards the country's distinguished rice heritage. An early priority was to collect samples of the myriad traditional rice varieties still grown in the country. Because Laos lies within the center of origin of cultivated rice, its rice biodiversity is uniquely rich and significant.

From 1995 to 2000, collectors gathered 13,193 samples of cultivated rice, which Lao farmers identified with 3,160 distinct variety names. Also collected were 237 samples of wild and weedy rice types. The project established a genebank for the short- and medium-term storage of this germplasm at the National Agricultural Research Center near Vientiane, which multiplies pure seed for distribution to farmers.

Biodiversity backup

As reported by Chay Bounphanousay, the center's head of biodiversity, power outages lasting as long as a week have sometimes turned the facility's cold-storage vault into an oven, rendering some accessions sterile. Fortunately, a second set of Lao accessions resides in the International Rice Genebank at IRRI (see page 8). Small as Laos is, the country's contribution of more than 13,000 accessions to the International Rice Genebank is second in size only to India's 18,000 accessions and half-again as large as third-place Indonesia's 8,500.

Lao-IRRI is actively evaluating hundreds of traditional Lao rice varieties for yield, disease resistance and other characteristics. And the project encourages farmers to continue to plant traditional varieties alongside modern ones. Lao farmers typically grow each season several rice varieties displaying various characteristics, in particular varieties that mature at different rates. This allows farmers to smooth peaks in labor demand. It is also a hedge against drought, as late-maturing varieties may recover from an early drought and early varieties may escape a late drought altogether.

Finally, farmers who endure an annual rice deficit – the number of months of which is the Lao measure of rural poverty – cherish early varieties for hastening the return of homegrown rice to the family table. Even today,

Farmers file out of a participatory research site during a field day and, Phath among them (*below*), taste traditional rice varieties from a "mother-baby trial." A shop in Luang Prabang (*left*) displays paper lanterns made from local paper mulberry (along with dried strips of the bark), a popular fallow crop.

85% of Lao rice is consumed on the farm where it is grown.

In the highlands of northern Laos, the Lao-IRRI Project capitalizes on the country's rice biodiversity by introducing superior traditional upland varieties to areas where they are not grown. In so-called "mother-baby trials," participating farmers run "baby trials" in which they try out a candidate variety, while in the researcher-assisted "mother trial" all of the test varieties are grown side by side to facilitate comparison. Farmers rate the varieties according to agronomic and eating-quality criteria to guide the project's decisions on which ones to promote. The project both depends on the genebank near Vientiane for candidate seeds and complements its conservation effort by keeping worthy traditional varieties alive in farmers' fields.

Active collaboration

Also tapping biodiversity, the project plans this year to carry forward a successful experiment in southwestern China in which farmers control a fungal disease by interplanting high-value but disease-susceptible traditional varieties with modern, disease-resistant hybrid rice (see page 26).

Lao-IRRI is active in a collaboration led by the Lao National Agricultural and Forestry Research Institute that brings together, with other partners, four of the 16 Future Harvest centers of the Consultative Group on International Agricultural Research (CGIAR): IRRI, the Kenya-based World Agroforestry Centre (formerly the International Centre for Research in Agroforestry [ICRAF]), the Colombia-based International Center for Tropical Agriculture (Spanish acronym CIAT), and the Sri Lanka-based International Water Management Institute (IWMI).

The tasks of the Integrated Upland Agricultural Research Project (IUARP) are to develop, test and refine a methodology for integrated participatory upland agricultural research, while reinforcing the research capacity of national partners; to develop sustainable livelihood systems as alternatives to slash-and-burn; and to enhance development, decision-making and leadership capacity within the target communities.

"The IUARP is an on-the-ground collaboration to integrate participatory activities aimed at developing improved livelihood systems," summarizes Dr. Linquist. "It's also a model of CGIAR center collaboration."

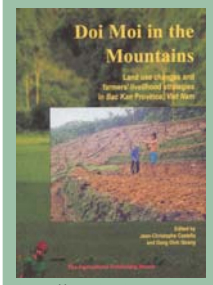
In several villages along the Ou River, the project and its organizations work with cooperating farmers like Phath and Mai Khong to establish experimental and demonstration sites to test and disseminate strategies for improving rice cultivation and for diversifying crop, livestock and fishery options. Interplanting, to cite only one strategy applicable in a range of environments, pairs rattan with teak or paper mulberry, for example, and pineapple with legume hedgerows. Experimental improved fallow crops to plant in rotation with upland rice offer benefits in addition to controlling erosion.

"A good fallow species should improve or maintain soil fertility," explains Dr. Linquist. "It should be easy to establish and grow, and it shouldn't compete with rice. Importantly, it should offer an economic benefit that can be realized in the short term. We've found that the legume crotalaria, for example, is a good nitrogen fixer and biomass producer. But, if there isn't another use for it, farmers aren't interested.

"Participatory research takes a lot of time and effort in the first couple of years," he concludes. "But the effort pays off because you earn farmers' trust and their willingness to collaborate. And, finally, you achieve more rapid adoption of sustainable technologies."

Upland analysis

Rural communities in the mountains of northern Vietnam are among the poorest in the land. They have benefited the least from the *doi moi* (renovation) reforms that since 1986 have transformed a nation of chronic food shortages into one of the world's leading exporters of rice, coffee, rubber, tea and other agricultural products. The Mountain Agrarian Systems Program (SAM by its French acronym) has since 1998 been studying how farmers in remote Bac Kan Province adjust to the rapid policy and institutional changes brought by the *doi moi* reforms and how to help them prosper through sustainable adaptations to their rice-based cropping systems (see *Rice Today*, Vol. 1, No. 1, pages 20-25).



Castella JC, Quang DD, editors. 2002. *Doi Moi in the Mountains. Land use changes and farmers' livelihood strategies in Bac Kan Province, Viet Nam*. Hanoi, Vietnam: The Agricultural Publishing House. 283 pages.

SAM researchers and collaborators have now published a volume of studies resulting from their interdisciplinary work in Bac Kan. The research provides a foundation for understanding the successes and failures of past policies and projects, and for targeting the groups most in need of development assistance today.

Available in English and Vietnamese from Institut de Recherche pour le Développement (bougeard@paris.ird.fr; www.ird.fr/us) or IRRI (irripub@cgiar.org; www.irri.org).

Organized free for all

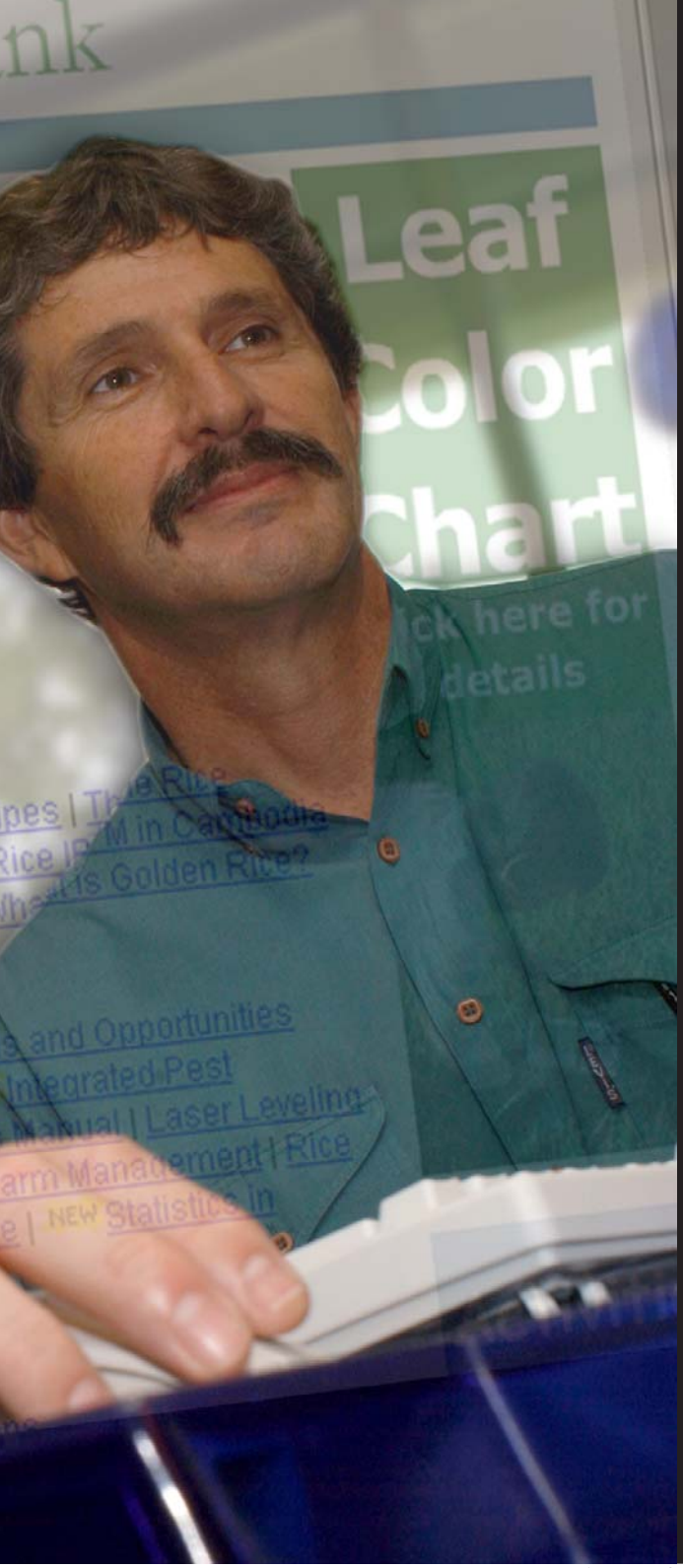
The new Rice Knowledge Bank lays the benefits of more than four decades of research at your fingertips

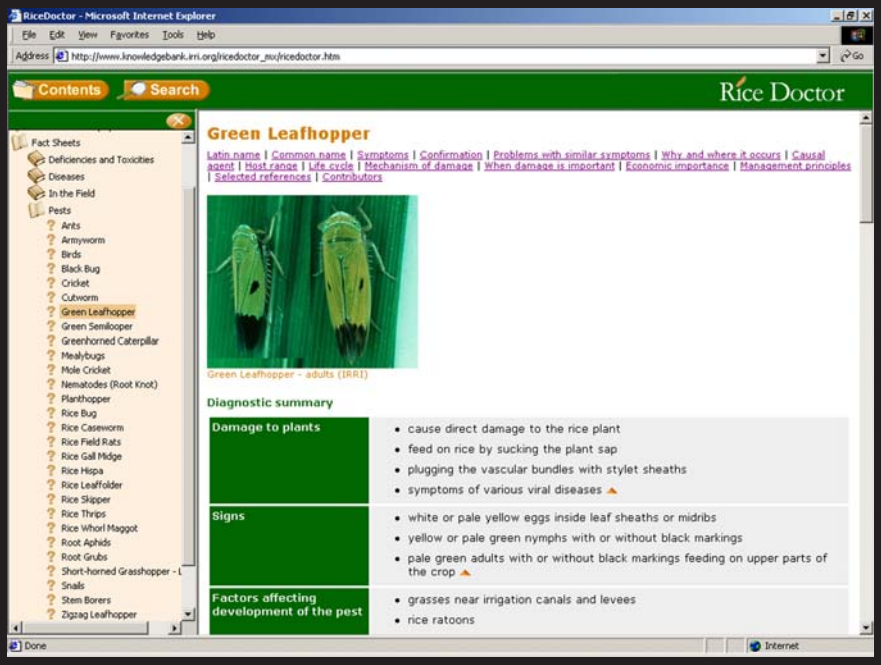
It was one of those magic moments when Rajat M. Nag wished he had a camera. Bubbling with enthusiasm, two youngsters were taking delight in demonstrating the basics of computer use to their parents. But for Mr. Nag, who is director general of the Mekong Department of the Asian Development Bank, this heart-warming scene went way beyond cute.

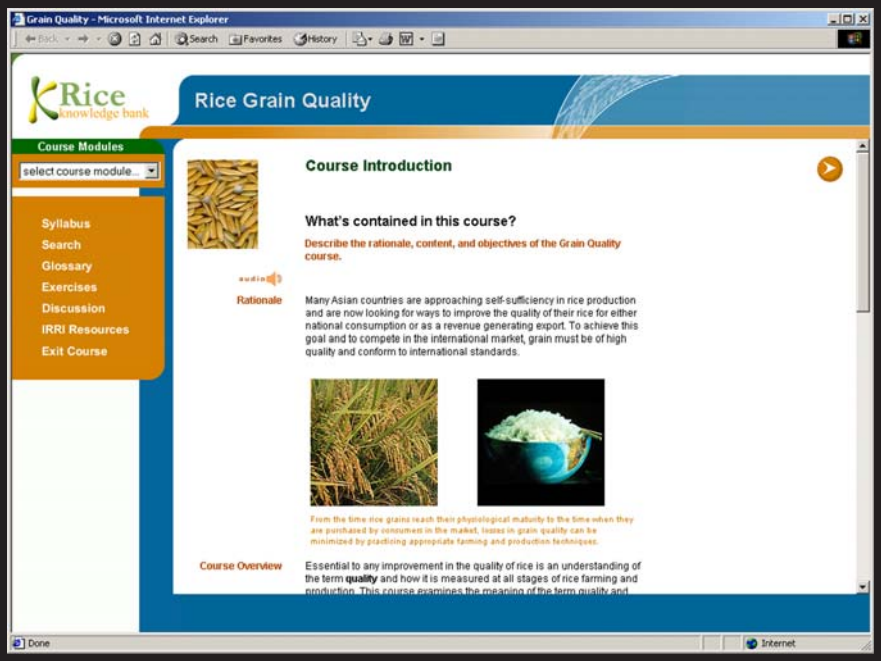
The room was not a comfortable, well-appointed den, but one of the cramped, spartan Internet cafés that dot the roadside in the impoverished rice-growing expanses of northeastern Thailand. What intrigued Mr. Nag most was what the kids had up. Not for them the digital mayhem of the latest computer game. On their screen were pages from *Rice Doctor*, a diagnostic program developed by IRRI scientists to help rice farmers manage the pests and diseases that attack their crops. The kids were translating the relevant pages of *Rice Doctor* into Thai for their parents.

Farmers will benefit

"I loved hearing this story," says Mark Bell, the head of the Training Center at IRRI. "It demonstrates that, although very few poor rice farmers







Easy access: training and courseware specialist Albert Atkinson demonstrates how to use the Rice Knowledge Bank to Mark Bell, head of the IRRI Training Center. Content created by IRRI scientists and others is structured so that material residing within one of the bank's six major categories can be cross-referenced and combined with items from other areas.

ARIEL JAVELLANA/JUAN LAZARO

can use a computer or have access to one, if you make information available on the Internet, chances are many farmers will benefit in some way."

To be sure, rice knowledge rarely flows this directly from IRRI to farmers. The institute focuses its training and other knowledge-dissemination efforts on the staff members of national agricultural research and extension systems (NARES) and other partners that run extension services. In other words, IRRI trains trainers, who then adapt institute research methods and recommendations to local conditions and relay them to farmers. That said, one of the hardest challenges in agricultural development remains, as always, the timely and effective transfer of technologies from the research laboratory to farmers' fields.

All too often, new technologies are successfully developed only to fail to reach those who need them most – the farmers – because of poor communication. Even worse, potentially valuable technologies that languish unused can become forgotten and permanently lost. Meanwhile, NGOs have begun to play an important role in extension, but few have the resources or expertise to

develop their own technologies. Only with access to technologies developed by scientists in institutes like IRRI can they hope to achieve impact.

Into the yawning gap between research and impact has stepped the Rice Knowledge Bank. This is the world's first comprehensive, digital library of training materials on rice farming and one of the first digital extension services for those who work with poor farmers. What is more, the wealth of information on rice production and training in the Rice Knowledge Bank – which, of course, includes *Rice Doctor* – continues to grow with new contributions made by scientists and educators from IRRI and elsewhere.

ALBERT ATKINSON

The reach of cyberspace: Internet storefronts (*above*) in Coimbatore, Tamil Nadu, India; the IRRI Training Center's e-Learning for Development course created a far-flung learning community for two weeks in August and September 2002, in which 27 students from 14 countries (*map below*) completed the course at home.

Scientists' participation

IRRI training materials have always been notable for their quality and focus, thanks to a tradition of scientists actively participating in training. What is new about the Rice Knowledge Bank is that it provides all this in a breakthrough format that sets a new standard in organizing material for easy retrieval. Borrowing the latest and best ideas from private-sector work in this area, the Rice Knowledge Bank offers government extension officers and NGO staffers – and anyone else who logs on – unprecedented access to rice knowledge and training information.

IRRI aims to make this dynamic Internet portal the world's central repository of rice knowledge and training materials. The knowledge bank has made a good start by capturing much of IRRI's 42 years of rice research in digital form, which allows it to be shared, searched and used in any part of the world with Internet connectivity. For areas where the Internet is inaccessible, the Rice Knowledge Bank is built to run on CD-ROM. From either source, users can easily call up the material in a form ready-formatted for printing, using a concept known as single-source publishing.

Content in the Rice Knowledge Bank falls into six categories or areas: 1) e-Learning Courses, 2) Field Diagnosis and Practices, 3) Fact Sheets, 4) Reference Materials, 5) Rice Biological Databases, and 6) Training Materials. Within each area, content is structured as reusable, or shared, learning and information objects, meaning that objects residing within one area can be cross-referenced and combined with items from other areas. For example, the Rice Grain Quality course, which is located within e-Learning Courses, uses any number of objects from other areas, such as various reference materials and the decision-support tool *TropRice*, which resides in Field Diagnosis and Practices.

At the institute level, scientists are now using the Rice Knowledge Bank to prepare materials for traditional classroom courses. Rather than reinvent the wheel, they search the bank for their topic, see what has already been written and then make necessary adjustments. When their

course is complete, they upload the revised materials into the Training Materials area, where it is stored for use during the next training. This can save hours of preparation time and ensure that training messages are delivered consistently.

New dimension

"The Training Materials site is receiving materials developed by many IRRI scientists and their partners," says Albert Dean Atkinson, the IRRI training and courseware specialist who leads the ongoing development of the Rice Knowledge Bank. "These include people from CAB International, the University of Queensland and the Royal Agricultural College of Cirencester. We also capture and store input from students and instructors where it can be searched and accessed.

"With regard to the systematic management and delivery of knowledge, this adds an exciting new dimension to IRRI – and to the CGIAR in general," adds Dr. Atkinson, referring to the Consultative Group on International Agricultural Research, IRRI's parent organization.

The possibilities made evident by the Rice Knowledge Bank have spurred the development of digital extension as a discipline of its own. IRRI is now offering digital extension workshops for NARES, NGOs and farmers themselves. The workshops focus on how to use the Rice Knowledge Bank to build capacity that allows participants to make better-informed rice-production decisions for themselves or their constituents.

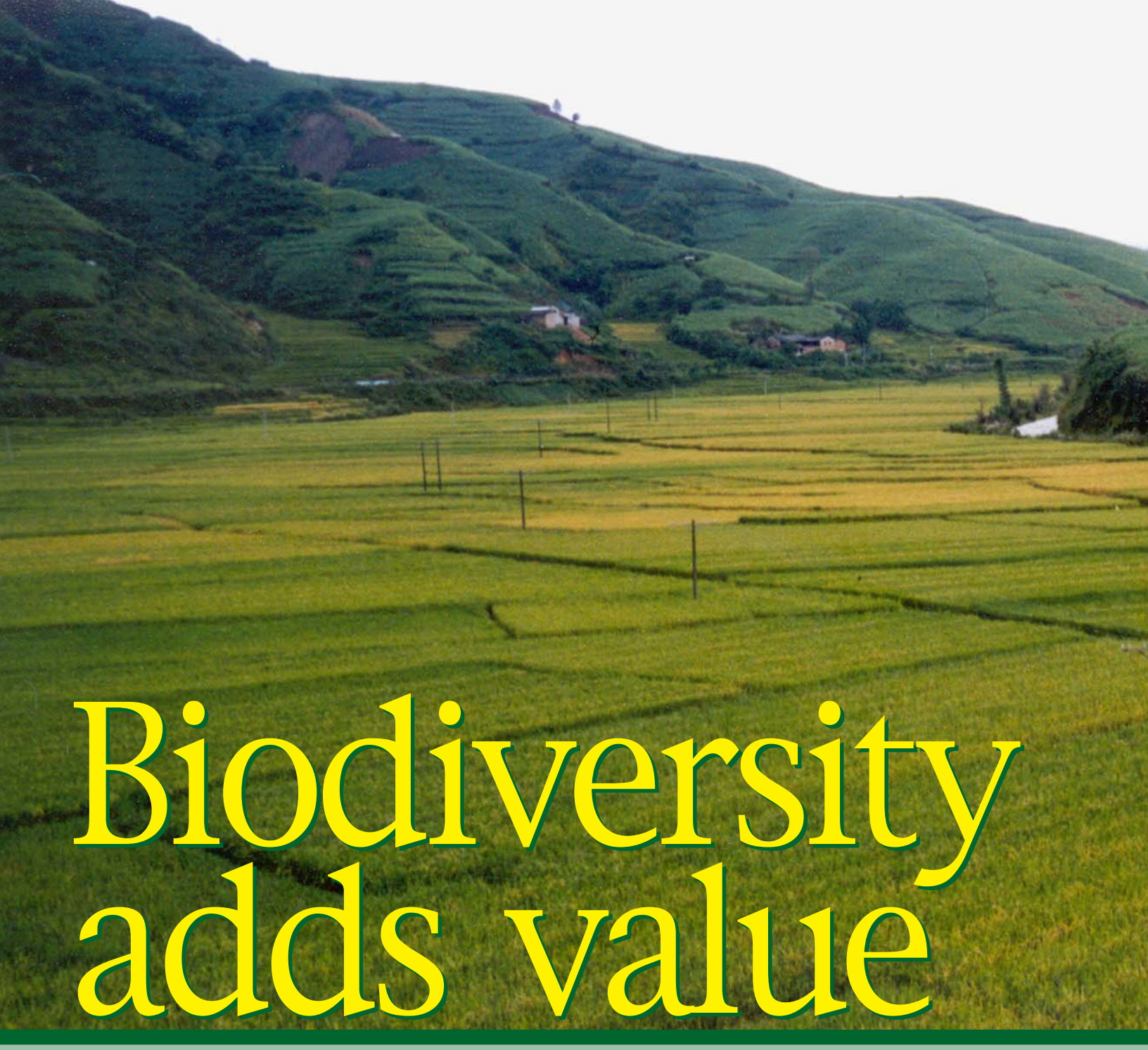
"The Rice Knowledge Bank will be a big help to our organization because it is very informative," comments Anita V. Antonio, a workshop participant from the Philippine Rice Research Institute. "It will readily assist our extension workers in the field who are attending to the different problems of rice farmers, especially in the area of principles and practices of farm management."

Visit the Rice Knowledge Bank at www.knowledgebank.irri.org.

Banking on IRRI

Twenty-five years ago last December, the International Rice Genebank at IRRI opened cold-storage facilities that now hold in trust more than 108,000 samples of rice biodiversity donated by more than 100 countries (see page 8). Last year, IRRI launched the Rice Knowledge Bank, the dynamic Internet portal that aims to become the world's central repository of rice knowledge and training materials.

This year, the new IRRI Image Bank is offering online the world's most comprehensive library of photography related to rice research and farming. Visit the IRRI Image Bank at http://rice-photos.irri.org and read about it in the next issue of *Rice Today*.



Biodiversity adds value

Crop biodiversity has a key role to play in helping farmers improve their livelihoods while protecting the environment and their health. This is emerging from the latest rice research on the benefits of planting traditional rice varieties either alongside or in place of the modern, high-yielding varieties normally grown today by most of the world's 200 million rice farmers. Many of these traditional varieties command a higher price because of their popularity with consumers but are rarely grown because of their low yields, susceptibility to disease or other drawbacks.

In what *The New York Times* described as a "stunning success" and "one of the largest agricultural experiments ever," an IRRI-led team of scientists working in the south-western Chinese province of Yunnan found a way to use biodiversity to improve control of a major rice disease despite reduced pesticide applications. By planting different types of rice alongside each other, researchers found they could almost completely control rice blast, a fungal disease that can cost the rice industry millions of dollars per year.

Maximum effect

Exploiting biodiversity to protect crops is hardly new to some farmers in Yunnan and elsewhere. What is new is how researchers used cutting-edge science in their collaboration

The practice of interplanting high-value but disease-susceptible traditional rice varieties with disease-resistant hybrids is dressing the rice lands of southwest China in pinstripes. Farmers (*right*) transplant several rows of hybrids between previously transplanted rows of a traditional variety.

ZHU YOUYONG (2)

with farmers to determine how to use this strategy to maximum effect.

Thousands of farmers in Yunnan have now embraced the technique because it improves yield and income while reducing their reliance on chemicals. The strategy calls for farmers to interplant one row of glutinous rice – which commands a high price but is susceptible to blast – between four to six rows of blast-resistant hybrid rice in a repeating pattern.

Simple as this description of the technique sounds, refining interplanting to make it profitable has been a challenge. The project coordinator, Tom Mew, who is also the head of IRRI's Entomology and Plant Pathology Division, has dedicated decades to working with farmers to control the pests and diseases that can devastate their crops.

ARIEL JAVELLANA (2)

Several rows of hybrid rice control blast disease in the taller traditional glutinous varieties, which are popular with consumers and earn farmers extra income.

Dr. Mew and his team reasoned that planting a wide area with a single variety of rice, as has been done in the Red River Valley of Yunnan, invited epidemic outbreaks of such diseases as blast. The pathogen adapted to the defenses of one plant and then was able to attack the remainder of the crop. But a crop that exhibited biodiversity would surround the pathogen with dissimilar plants, making it harder for the disease to spread.

"Our challenge was to simulate through varietal deployment on actual rice farms a situation similar to natural diversity and achieve the resistance to pests or diseases that such diversity supplies," Dr. Mew said. "We focused on interplanting rice, or growing different varieties in the same field."

Improved income

An experiment in 1997 covering a few hectares indicated that interplanting could achieve 92–99% control of rice blast while boosting yields by 0.5–1 ton per ha, allowing farmers to improve their income through both higher production and reduced costs. The following year, cooperating farmers interplanted 812 ha with hybrid and glutinous rice. They sprayed the crop with fungicide only once. Yields reached 9 tons of hybrid rice and nearly 1 ton of high-value glutinous rice per hectare. Even more impressive was that the incidence of blast in glutinous rice fell to 5% within the interplanted crop, from a common level of 55% in monoculture, and the yield loss dropped from 28% to nothing at all.

In 1999, the interplanted area expanded to 3,342 ha, and cooperating farmers reported that the technique was providing them with an average of US$281 more income per hectare. By the end of 2001, about 60% of rice farm households in the indica rice area of Yunnan had adopted interplanting of rice varieties, and the area under mixtures had expanded to 106,000 ha. Last year, rice interplanting covered an area of more than 200,000 ha in 101 counties of Yunnan.

The IRRI-Yunnan research team plans to extend the approach to other provinces in southwest China and to other rice-producing countries, including the Philippines, Indonesia, Laos and Vietnam.

Philippine homecoming

Recent projects in IRRI's host country, the Philippines, have seen traditional rice varieties successfully reintroduced in areas where they had been lost.

On the southern island of Mindanao, IRRI is conducting an on-farm participatory trial with about 50 farmers testing some 20 improved and traditional upland rice varieties. The farmers have so far commented favorably on two traditional upland varieties, *Azucena* and *Dinorado*, rating the IRRI-supplied seed above both their own traditional material and modern varieties.

Dinorado.

The farmers had lost most of their own seed for *Azucena* and *Dinorado* following a shift out of upland rice into maize, and the seed that remained with them had become badly mixed with other varieties. Farmers supplied with new stocks of pure seed from the International Rice Genebank at IRRI (see page 8) said they wanted to plant the varieties again next year, as they grew well and commanded a good price.

Another project, in 2001 in the Cagayan Valley of the northern Philippines, saw researchers introduce to local farmers a system of double cropping that included the traditional variety *Wag-wag*, which had all but disappeared from local farms. Farmers said the strengths of the system were increased profitability, reduced input costs, a better market price, and the potential for adding crops other than rice, such as mung bean, in the wet season.

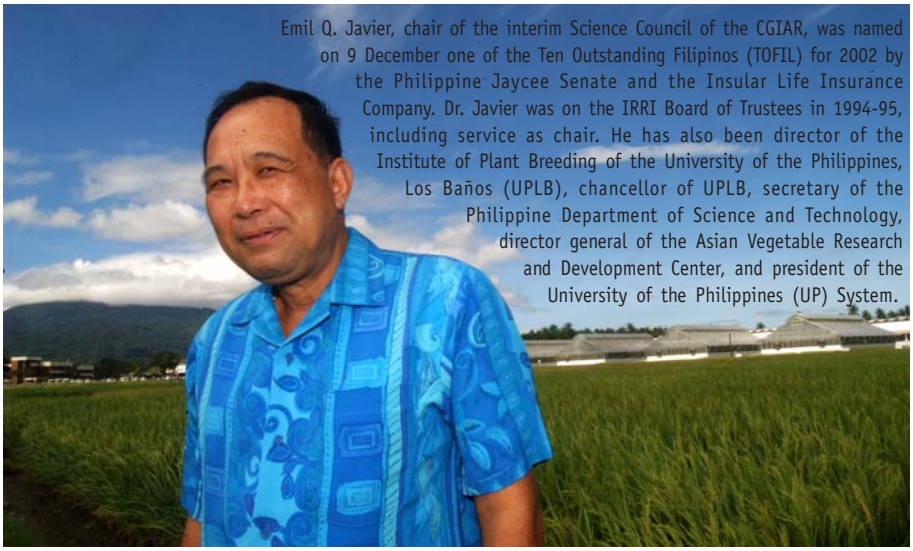
IRRI and the Philippine Rice Research Institute had earlier distributed in the Cagayan Valley two tons of rice seeds of 20 modern and eight traditional varieties. This was to assist farmers who lost their seed stocks when crops failed because of El Niño of 1997 and Typhoon Loleng in 1998.

New head for IPGRI

Emile Frison is the director general designate of the Rome-based International Plant Genetic Resources Institute (IPGRI), one of IRRI's sister Future Harvest centers of the Consultative Group on International Agricultural Research (CGIAR). IPGRI's mandate is to use crop diversity to advance sustainable development. Dr. Frison, a Belgian national, is currently director of the International Network for the Improvement of Banana and Plantain, one of IPGRI's three programs.

Dr. Frison has spent most of his career in international agricultural research, including 18 years of work related to plant genetic resources. He joined IPGRI in 1987 and a decade later launched the Global Program for *Musa* Improvement, which brought together researchers and growers with an interest in bananas and plantains. In 2002, he launched the Global Consortium on *Musa* Genomics, whose goal is to decode the genetic sequence of the banana and use it to improve the varieties available to smallholder farmers.

Dr. Frison will take over as director general on 1 August, when Geoffrey Hawtin finishes his term.



ARIEL JAVELLANA

Emil Q. Javier, chair of the interim Science Council of the CGIAR, was named on 9 December one of the Ten Outstanding Filipinos (TOFIL) for 2002 by the Philippine Jaycee Senate and the Insular Life Insurance Company. Dr. Javier was on the IRRI Board of Trustees in 1994-95, including service as chair. He has also been director of the Institute of Plant Breeding of the University of the Philippines, Los Baños (UPLB), chancellor of UPLB, secretary of the Philippine Department of Science and Technology, director general of the Asian Vegetable Research and Development Center, and president of the University of the Philippines (UP) System.

Swaminathan heads Pugwash Movement

M.S. Swaminathan, former director general of IRRI (1982-88), has been elected president of the prestigious Pugwash Movement. The first Indian to head the movement, he will hold the position for five years from his installation in August 2002.

Dr. Swaminathan is also a UNESCO-Cousteau professor of eco-technology and chairman of the Swaminathan Research Foundation, a non-profit Chennai-based organization that promotes sustainable development.

The Pugwash movement started in 1957 as a global conscience-keeper. "Pugwash deals mainly with the use and abuse of science," explains Dr. Swaminathan. "The question is, How can science be a powerful instrument for human well-being and happiness, and not become an element of human destruction?"

He added, "The choice of an agricultural scientist is significant at a time when children are being sold in a country like Afghanistan for wheat."

Partners on the move

Enrica Porcari, an Italian national, in September became the CGIAR chief information officer (CIO). Ms. Porcari brings to this newly created position in Penang, Malaysia, extensive knowledge and experience regarding information technology related to development, having worked as chief of telecommunications and ICT field services at the United Nations Food and Agriculture Organization's World Food Program, and as coordinator of CGNET services to CGIAR centers. Until recently, she was also a fellow at the Reuters Digital Vision Fellowship Program at Stanford University. As CIO, Ms. Porcari leads the development and implementation of the CGIAR's information-technology and knowledge-management strategies.

John Donough Heber Keatinge in October became the new deputy director general for research at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). An Irish national, Dr. Keatinge previously served at the International Institute of Tropical Agriculture (IITA) in Nigeria as assistant to the director general for resource mobilization. He was also director of IITA's Resource and Crop Management Division from 1999 to 2002. Dr. Keatinge has over 25 years' experience as a systems agronomist and more than 100 scientific papers to his credit.

Rajesh Agrawal in October became the new director of finance at ICRISAT. Prof. Agrawal was previously associate professor at the Indian Institute of Management in Ahmedabad, Gujarat. He has extensive teaching, research and consulting experience in finance, management, accounting and tax planning, and has authored several research papers and books on accounting systems. He replaces Kwame Akuffo-Akoto, who is now IRRI's director of finance.

Mangala Rai is the new director general of the Indian Council of Agricultural Research and secretary of the Department of Agricultural Research and Education. A breeder by training who specialized in seed production and issues related to intellectual property rights, Dr. Rai succeeds Panjab Singh, who retired on 31 December.

Ruben L. Villareal on 31 December completed his three-year term as director of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). The officer in charge of SEARCA is Djoko Suprapto, deputy director for graduate scholarship and research and development, pending the appointment of a new director.

Pierre Roger traded microbiology for painting and music after 35 years of service at the Institut de Recherche pour le Développement in France, most recently as director of research. Though retired, Dr. Roger is still involved in preparing book chapters and teaching. He served at IRRI as a soil microbiologist in 1979-91, from which time this picture dates. Dr. Roger's new email address is the euphonic p.roger@wanadoo.fr.

Awards recognize achievements

Calvin Qualset, IRRI Board of Trustees member and founding director of the Genetic Resources Conservation Program of the University of California's Division of Agriculture and Natural Resources, received the 2002 William L. Brown Award for Excellence in Genetic Resources Conservation. The Missouri Botanical Garden, in collaboration with the Donald Danforth Plant Science Center, Washington University in St. Louis and the World Agriculture Forum, sponsored a symposium on 5 November in St. Louis to honor Dr. Qualset's accomplishments.

Tom Mew, plant pathologist and head of IRRI's Entomology and Plant Pathology Division, received the Friendship Award 2002 from the government of Jiangsu Province, China. The award, presented in Nanjing on 20 October, recognizes Dr. Mew's contribution to protecting rice from diseases, especially the biological control of bacterial blight and sheath blight in Jiangsu. Dr. Mew and collaborators from the Jiangsu Academy of Agri-sciences isolated the non-pathogenic bacteria *B916*, which suppresses seedborne fungal pathogens. This technology has recently been applied on more than 340,000 ha in Jiangsu.

Sant Singh Virmani, plant breeder and deputy head of IRRI Plant Breeding, Genetics and Biochemistry, received the Third World Network of Scientific Organizations Award in Agriculture for 2000 in New Delhi on 21 October 2002, at a ceremony delayed by the 9/11 terror attacks. Dr. Virmani received the award during the 7th General Assembly of the Third World Network of Scientific Organizations. At a 12 November luncheon of the Crop Science Society of America in Indianapolis, Indiana, Dr. Virmani received the 2002 International Service in Crop Science Award for his work in developing and disseminating hybrid rice in the tropics.

J.K. Ladha, IRRI soil fertility and plant nutrition specialist, was made a Fellow of the American Society of Agronomy at a concurrent event in Indianapolis.

B. Mishra, project director of the Directorate of Rice Research, Hyderabad, India, received the 2002 Senadhira Rice Research Award in September at the International Rice Congress in Beijing (see page 10). The award – which commemorates Dharmawansa Senadhira, leader of IRRI's research program on flood-prone rice until his death in 1998 – recognizes Dr. Mishra's outstanding contributions to salinity-tolerance rice-breeding research and development in India. More than 30 salt-tolerant rice varieties developed by Dr. Mishra are now broadly cultivated in salt-affected inland, coastal and sodic areas of India.

Virendra Pal Singh, an agronomist with 30 years' service to IRRI, has left the institute to establish the South Asia Office of the World Agroforestry Center. During a workshop in January, N.I. Bhuiyan (*right*), Bangladesh Rice Research Institute director of research, presented a plaque to Dr. Singh, as wife Mercedita Pal Singh looked on. R.K Singh, IRRI liaison scientist for India, commended Dr. Singh for his contributions to the rainfed rice systems of eastern India.

Former IRRI principal plant breeder Gurdev S. Khush (*left*) was named an adopted and distinguished son of Laguna Province, Philippines, for his leadership of IRRI's rice breeding program. Laguna Governor Teresita Lazaro and officers of the Laguna provincial government presented the award to Dr. Khush on 9 September in Sta. Cruz.

Keeping up with IRRI staff

Guy Kirk, former soil chemist in IRRI Crop, Soil and Water Sciences (CSWS), on 1 February started as professor of soil systems and head of the Soil Systems Group at the National Soil Resources Institute (NSRI) at Cranfield University, United Kingdom. Established in August 2001, NSRI brings together various groups with expertise in soil and land resources. Dr. Kirk is also putting the final touches on *The chemistry of submerged soils*, a book based primarily on his 13-year body of work at IRRI.

Muhammed Alam in September joined CSWS to conduct research on site-specific nutrient management and integrated pest management practices.

Ravindra Kumar in September joined CSWS to develop and validate physiologically based protocols suitable for the mass screening of rice breeding lines for drought tolerance and to compile data on certain drought-tolerance mapping populations.

Stephan M. Haefele in February joined CSWS as a soil scientist/agronomist under the supervision of To Phuc Tuong.

Hum Nath Bhandari in September joined the Social Sciences Division (SSD) with responsibility for analyzing farm-level data collected for studying drought-coping mechanisms of rainfed rice farmers in eastern India, northeast Thailand and southern China.

Manik Lal Bose in July joined SSD to assist Mahabub Hossain in conducting dialogues and workshops with Bangladeshi partners. He also analyzes and interprets interview and survey data on rural livelihoods and changes in the rural economy.

Mohammed Zainul Abedin in January joined SSD as an international research fellow under the supervision of Dr. Hossain.

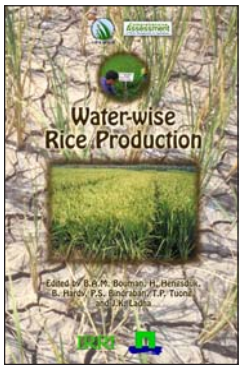
Devendra K. Dwivedi in July joined Plant Breeding, Genetics and Biochemistry (PBGB) with responsibility for developing significantly improved IR64 lines suitable for the rainfed environments of eastern India.

Ish Kumar in August joined PBGB to help manage an international network on hybrid rice, to develop hybrid rice technology using two- and three-line breeding systems, and to improve grain quality in hybrids.

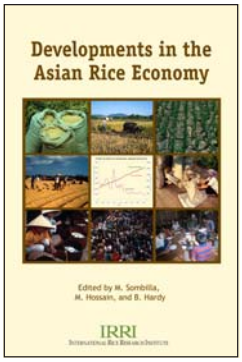
Rhoda Lantin is the new manager of the Analytical Services Laboratory, overseeing the operations of the plant and soil analysis, mass spectrometer, radioisotope and organic analysis laboratories.

NEW BOOKS

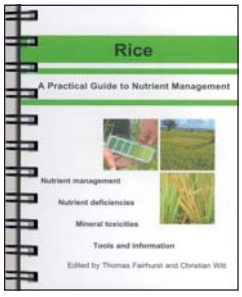
In recent months, IRRI has added seven new titles to its inventory of more than 100 books and publications currently available on rice research and related topics. Check the IRRI online publications catalog at www.irri.org/pubcat/pubcontents.htm for pricing and ordering information on these and other titles and for announcements that new books are becoming available.



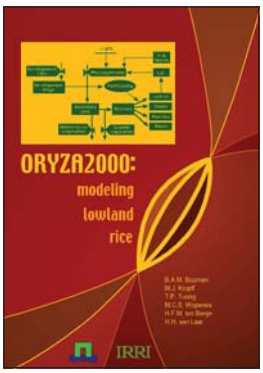
Water-wise Rice Production (edited by B.A.M. Bouman et al; 356 pages) explores ways to grow rice using less water to safeguard food security and preserve precious water resources. This book, which reviews progress made in developing water-saving technologies for rice production, has sections on intermittent irrigation, the system of rice intensification, aerobic rice, rice-wheat, physiology and breeding, and irrigation systems. An accompanying CD contains information on technology transfer for water savings in the Philippines.



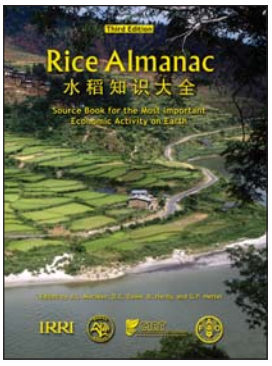
Developments in the Asian Rice Economy (edited by M. Sombilla et al; 436 pages) covers emerging trends in rice supply and demand. Government policy-makers and farmers can use the information provided to understand how trends in rice supply, demand and trade change with economic growth, political development and demographic changes. Country studies cover China, India, Indonesia, Bangladesh, Thailand, Vietnam, Philippines, Sri Lanka and Malaysia.



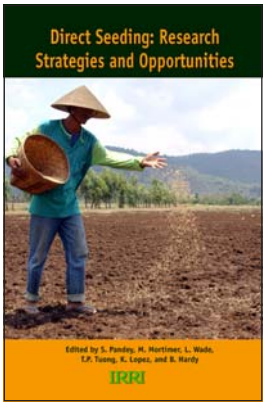
Rice: A Practical Guide to Nutrient Management (edited by T. Fairhurst and C. Witt and co-published with the Potash & Phosphate Institute [PPI]; 140 pages) is a pocket-sized guidebook for managing nutrients and detecting nutrient deficiency and toxicity symptoms in rice grown in tropical and subtropical regions. A companion to *Rice: Nutrient Disorders and Nutrient Management* (also co-published by IRRI and PPI), this guide refines and simplifies site-specific nutrient management (SSNM) concepts for practitioners. The SSNM approach has been successfully evaluated in a wide range of farmers' fields in Asia and is now well positioned for wider-scale evaluation and adaptation by Asian farmers.



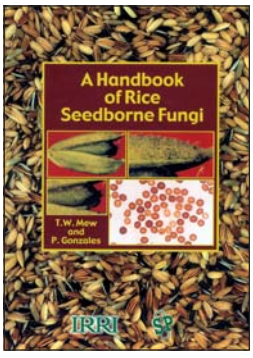
ORYZA2000: Modeling Lowland Rice (by B.A.M. Bouman et al and co-published with the Wageningen University and Research Centre [WUR]; 235 pages) is the successor to a series of lowland rice growth simulation models developed by IRRI and WUR in the 1990s. Besides scientific and programming updates, *ORYZA2000* contains new features that allow a more explicit simulation of crop management options, such as irrigation and nitrogen fertilizer management. It can also be used in application-oriented research such as the design of crop ideotypes and the analysis of yield gaps. Full documentation of the model, calibration programs, and three sets of example data input files are provided on an accompanying CD.



Rice Almanac, third edition (edited by J.L. Maclean et al; co-published with the International Center for Tropical Agriculture, West Africa Rice Development Association, and Food and Agriculture Organization; 253 pages) has become a standard source book for the most important economic activity on earth. It brings together general information about rice and data about rice production worldwide. The third edition has been fully updated and expanded to include 64 countries – from Afghanistan to Venezuela. There are also discussions on international issues important to rice such as the looming water crisis, global climate change and biotechnology.



Direct Seeding: Research Strategies and Opportunities (edited by S. Pandey et al; 383 pages) demonstrates how Asian rice systems are undergoing various types of change in response to economic factors and technological opportunities in farming. For example, there has been a shift from transplanting to direct-seeding methods for rice establishment. The rising cost of labor has provided economic incentives for direct seeding, and the availability of short-duration rice varieties and chemical weed-control methods has made such a shift profitable. Papers in this book review past patterns of changes in crop establishment and factors explaining such patterns, assess the likely future patterns of change in crop establishment in various ecosystems and regions, and identify strategic research issues for improving rice productivity by manipulating crop-establishment methods and related factors.



A Handbook of Rice Seedborne Fungi (by T.W. Mew and P. Gonzales; 83 pages) focuses on the important seedborne fungi that cause diseases of rice foliage, stem, leaf sheath, root, grain and inflorescence. It provides information on more than 50 species that have been detected in rice seeds during routine testing and analysis. The information, which can be used for teaching and as a reference when conducting seed health testing in different laboratories, should be used in conjunction with available information on local rice-growing conditions.

EVENTS

FOOD FOR PEACE

The congress "From the Green Revolution to the Gene Revolution" will take place in Bologna, Italy, on 28-31 May. Scheduled speakers and their topics include: N. Borlaug, Texas A&M University (Feeding a world of 10 billion people: our 21st century challenge); M. Swaminathan, The Swaminathan Foundation (Towards an evergreen revolution); G. Khush, University of California, Davis, and former IRRI principal plant breeder (Green revolution: the way forward); M. Gale, John Innes Centre and IRRI board member (Comparative mapping in cereals); J. Bennett, IRRI senior molecular biologist (Proteomics: what problems can we tackle in crop improvement?); I. Potrykus, Swiss Federal Institute of Technology (Golden crops and iron fortification). For details, visit www.avenuemedia.it/linkCONG/Green-Gene/prog.html.

RURAL DEVELOPMENT TRAINING

The International Centre for development oriented Research in Agriculture (ICRA) training in interdisciplinary team work for participatory rural development takes place in English, 12 Jan.-23 July 2004, in Wageningen, Netherlands; in French, 19 Jan.-30 July 2004, in Montpellier, France. PhD/MSc degree (formation universitaire, Bac+5) required; age under 40 (for fellowships). Deadline: 1 July 2003. For details: (English) secretariat.icra@wur.nl; (French) icra@agropolis.fr. Web: www.icra-edu.org.

PESTICIDE FORUM

The 7th International HCH and Pesticides Forum, on 5-7 June in Kiev, Ukraine, is a technical forum that aims to find solutions to the problems arising from the production and application of HCH (hexachlorocyclohexane) and other pesticides. For details contact Valentyna Pildisnyuk (pidlis@carrier.kiev.ua) or visit www.hchforum.com/index.php.

BIOTHAILAND 2003

The National Center for Genetic Engineering and Biotechnology (BIOTEC) will organize BioThailand 2003: Technology for Life on 17-20 July in Pattaya, Thailand. It will feature a trade show, business partnering and scientific meetings. For details email biothailand2003@ biotec.or.th or visit http://biothailand.biotec.or.th.

PLANT BREEDING SYMPOSIUM

The Arnel R. Hallauer International Symposium on Plant Breeding will take place on 17-22 August in Mexico City. For information contact Julien de Meyer, j.demeyer@cgiar.org. Web: www.cimmyt.cgiar.org/Research/Maize/symposium/breeding_0803.htm.

MODERN RICE FARMING

The International Conference on Modern Rice Farming will take place on 14-16 October at Alor Setar, Kedah Darul Aman, Malaysia. Co-organized by the Malaysian Agricultural Research and Development Institute, IRRI, Muda Agricultural Development Authority and Malaysian Plant Protection Society, the conference will consider a broad range of topics, from land leveling to marketing. For details visit www.mardi.my.

CONFERENCES, MEETINGS AND WORKSHOPS

Date	Event	Venue	Contact
30 Apr-2 May	2nd International Conference on Water Resources Management 2003	Las Palmas, Gran Canaria, UK	shobbs@wessex.ac.uk; www.wessex.ac.uk/conferences/2003/waterresources2003/pp.html
30 May-2 Jun	Empowering women through info. and knowledge: from oral traditions to ICT	Pune, India	http://gendwaar.gen.in; harsha_parekh@vsnl.com
4-6 Jun	ECOSUD 2003: Fourth International Conference on Ecosystems and Sustainable Development	Siena, Italy	shobbs@wessex.ac.uk; www.wessex.ac.uk/conferences/2003/ecosud03/index.html
1-6 Jun	Mechanisms of Cell Signalling	Hong Kong	grc@grcmail.grc.uri.edu
5-7 Jun	Int'l Conference on Regional Climate Change and Agriculture	Raipur, India	e-mail: asastri@yahoo.com
2-6 Jun	Nitrogen Fertilizer Production Technology Workshop	Belgium	hrd@ifdc.org; hrdu@ifdc.org; www.ifdc.org
15-27 Jun	Agroecology, IPM and Sustainable Agriculture	East Lansing, Michigan, USA	kmaredia@msu.edu
16-21 Jun	7th International Congress of Plant Molecular Biology	Barcelona, Spain	congress@aopc.es; www.ispmb2003.com
29 Jun-3 Jul	11th Int'l Conference on Intelligent Systems for Molecular Biology	Brisbane, Australia	www.iscb.org/ismb2003/index.shtml
29 Jun-3 Jul	7th International Conference on Productivity, Public Goods and Public Policy	Ravello, Italy	icabr@economia.uniroma2.it; www.economia.uniroma2.it/conferenze/icabr2003
29 Jun-3 Jul	1st FEMS Congress of European Microbiologists	Cankarjev Dom, Ljubljana, Slovenia	www.fems-microbiology.org/congress2003.htm
6-11 Jul	15th International Plant Protection Congress	Beijing, China	ippc2003@ipmchina.net; www.ipmchina.cn.net/ippc/index.htm
6-12 Jul	XIX International Congress of Genetics	Melbourne, Australia	P.Batterham@unimelb.edu.au
13-18 Jul	Internship in Intellectual Property Rights Technology Transfer, Use and Management	East Lansing, Michigan, USA	kmaredia@msu.edu
19-23 Jul	BioChE-03	Boulder, Colorado, USA	bhconf@poly.edu; www.engconfintl.org/3am.html
27-30 Jul	2003 International Annual Meeting, Am. Soc. of Agricultural Engineers	Las Vegas, Nevada, USA	http://www.asae.org/meetings/am2003/index.html
27 Jul-1 Aug	Ensuring a Safe Food Supply for the Global Community	East Lansing, Michigan, USA	kmaredia@msu.edu
29 Jul-1 Aug	InforAg 2003: 6th Information Agriculture Conference	Indianapolis, Indiana, USA	www.farmresearch.com/infoag
9-13 Aug	American Phytopathological Society Annual Meeting	Charlotte, North Carolina, USA	aps@scisoc.org; www.scisoc.org
19-22 Aug	ICAS 3rd International Convention of Asia Scholars	Singapore	icas3sec@nus.edu.sg; www.fas.nus.edu.sg/icas3
7-9 Sep	2003 World Fertilizer Conference	Boston, Massachusetts, USA	vbrown@tfi.org; www.tfi.org
15-19 Sep	Phosphate Fertilizer Production Technology Workshop	Belgium	hrd@ifdc.org; hrdu@ifdc.org; www.ifdc.org
23 Sep-2 Oct	ComBio 2003	Victoria, Australia	asbmb@bigpond.net.au
1-3 Oct	International Conference on Sustainable Planning & Development	Skiathos, Greece	www.wessex.ac.uk/conferences/2003/planning03/index.html
12-15 Oct	2003 International Conference on Agriculture Science and Technology	Houston, Texas, USA	OCMS@tamu.edu
13-24 Oct	Fertilizer Marketing Management	Vietnam	hrd@ifdc.org; hrdu@ifdc.org; www.ifdc.org
26-30 Oct	Entomological Society of America Annual Meeting	Cincinnati, Ohio, USA	esa@entsoc.org; www.entsoc.org

2003 IRRI GROUP TRAINING COURSES (SELECTED TENTATIVE LISTING)

Course/Venue	Duration (wk)	Target Date	Coordinator(s)/ Asst. Coordinator
Rodent Management	3	19 May-6 June	G. Singleton/K. Heong
Two-Week Rice Production Training Course	2	Aug	V. Balasubramanian
Water Management, for Philippines only	1	13-17 Oct	B. Bouman
Genetic Engineering and Nutrition Improvement in Rice	1	May	S. Datta
Rice Breeding Course	2	11-29 Aug	G. Atlin
Scientific Writing and Presentation	1	12-16 May	A. Arboleda
Intensive English 1 Course (after office hours)	12	7 Jul-26 Sep	A. Arboleda
Intensive English 2 Course (after office hours)	3	10-28 Nov	A. Arboleda
Intro to SAS Version 8 for Windows	1	2-6 June	G. McLaren/V. Bartolome
Intro to IRIS for Plant Breeders Training	1	11-15 Aug	G. McLaren/V. Bartolome
Advanced Experimental Design	1	10-14 Nov	G. McLaren/V. Bartolome

For details, email IRRI-Training@cgiar.org.

Fight poverty where it lives

by David Dawe

The most recent World Food Summit, in 1996, set the target of halving by 2015 the number of people who go to bed hungry. Such rapid progress will require poverty reduction worldwide, but especially in Asia. Despite substantial progress in many Asian countries over the past few decades (Figure 1), Asia is still home to most of the world's poor.

The number of poor in rice-producing Asia[1] is nearly three times that of sub-Saharan Africa, the second largest locus of poverty (Figure 2). To some extent, Asia has more poor people than Africa simply because its population is much larger. Yet some key indicators suggest that the incidence of poverty is worse in large parts of Asia than in sub-Saharan Africa. For example, stunting, wasting and underweight all afflict a larger proportion of children in south-central Asia (dominated by India, Pakistan and Bangladesh) than in sub-Saharan Africa (Figure 3). Illuminating a similar picture of the status of women, the proportion of severely underweight adult women is much higher in Bangladesh and Nepal than in Chad or Madagascar, the two countries in sub-Saharan Africa with the highest prevalence of underweight adult women (Figure 4).

It seems that well-publicized progress toward alleviating hunger and poverty in much of Asia has blinded many donors – and the public at large – to the poverty that remains in the world's largest continent. Certainly the level of official development assistance (ODA) provided per poor person in rice-producing Asia is much lower than in sub-Saharan Africa (Figure 2). This conclusion holds even excluding from the calculations India and China, who by sheer size arguably threaten to skew the results. Adjusting the figures to take into account how a lot of ODA for Africa is in the form of grants, while that for Asia is more often in the form of loans, shows sub-Saharan Africa receiving four times as much aid per poor person as does rice-producing Asia.

Africa urgently needs donor funds. But, in their zeal to set Africa aright, donors should not forget that both the incidence of poverty and its absolute numbers remain very high in Asia. It will be impossible to achieve broad progress in global poverty alleviation unless Asia receives due attention.

For more rice facts, visit www.riceweb.org/ricestat/index.htm.

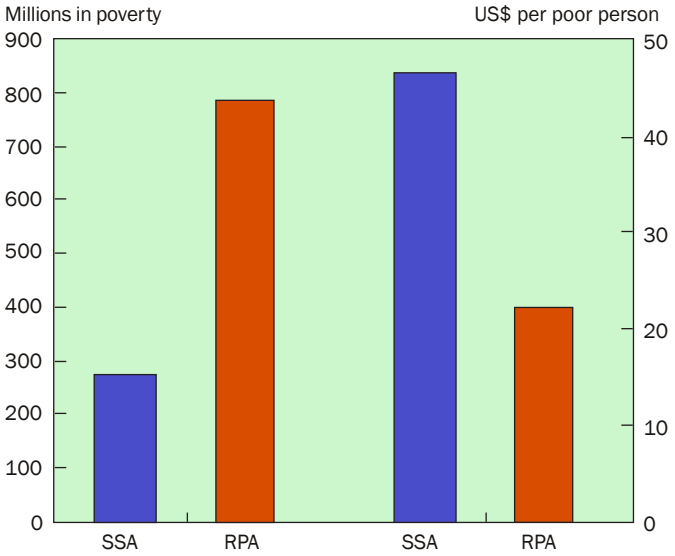


Fig. 2. Number of people living in poverty and official development assistance per person in rice-producing Asia (RPA) and sub-Saharan Africa (SSA).

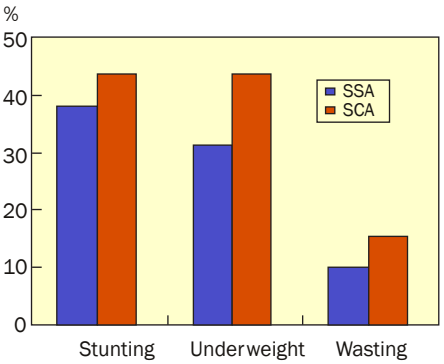


Fig. 3. Percentage of children suffering from stunting, underweight and wasting, year 2000, in sub-Saharan Africa (SSA) and south-central Asia (SCA).

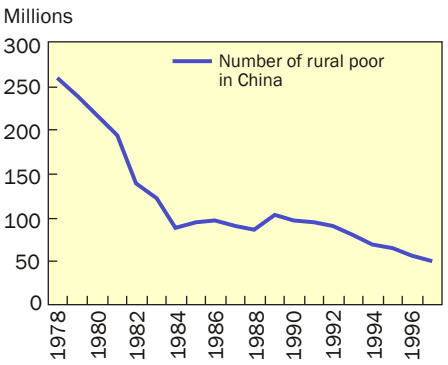


Fig. 1. Number of rural poor in China, 1978-97.

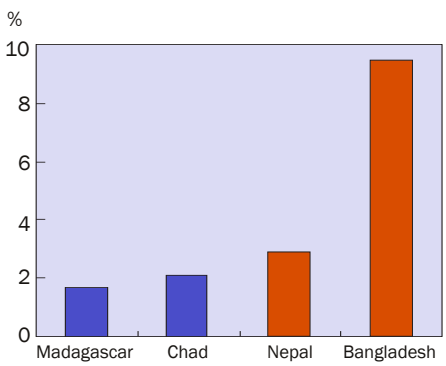


Fig. 4. Percentage of women (age 20–49) who are severely underweight.

[1]Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Laos, Korea (North), Malaysia, Myanmar, Nepal, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

grain of truth

Biotech won't soon replace "conventional" breeding

DAVID J. MACKILL
IRRI Plant Breeder

A defining moment in the history of biology was the elucidation of the laws of genetics by Gregor Mendel, whose work was rediscovered and became widely known in 1900. Ranking in the same category a century later must be the announcement of complete genome sequences, notably of humans and the plant *Arabidopsis*. Rice has now joined this exalted company with the announcement on 18 December 2002 of the completion of a high-quality draft sequence of the rice genome.

Rice geneticists labored for most of the 20th century to identify and map rice genes. The work hastened immensely with the advent of molecular markers in the 1990s. However, these painstaking efforts resulted in a map location for perhaps a few hundred major genes and a similar number of genetic loci controlling quantitative traits, only a handful of which were characterized at the DNA level. Suddenly, we now possess detailed sequences of an estimated 50,000 genes that regulate the rice plant's development.

Parallel to this stunning progress in molecular biology are similar advances in our ability to introduce genes into plants directly as DNA. The area planted to transgenic crops rose from nil in 1995 to over 50 million ha in 2001, mostly in North America. Transgenic rice is under evaluation in several countries, and we should expect commercial products to become available within a few years.

One question these trends frequently raise is, "What is the future of conventional plant breeding?" First, let me point out that "conventional plant breeding" is a misnomer. Plant breeders continually reevaluate their approaches and have adopted a wide range of tools to make their breeding efforts more efficient. For the sake of discussion, we will define conventional plant breeding as hybridization without inserting transgenes, followed by field selection.

It is true that in the early days of the biotechnology revolution one heard such comments as, "In the future, we'll produce new plant varieties in the lab, with no need for field work." However, even the staunchest advocates of the new biology would now dispute this misguided idea. A basic fact of applied genetic engineering is that all transgenic manipulation involves conventionally bred varieties. A transgenic plant is nothing more than a conventionally bred one with a novel gene inserted into it. While the inserted gene may add a very important feature, it remains a small part of the genetic makeup that determines the overall attributes of the plant.

We expect that the complete genome sequence of rice will greatly improve our ability to breed new rice varieties. Our ultimate goal is to identify the function of each gene and subsequently the most favorable alleles (versions) of those genes, which we can then combine into superior rice varieties. In the future, this technology will allow us to trace all genes in our rice breeding populations. As it becomes cheaper and more widely available, it should allow us to select the best plants from the breeding populations without extensive field tests. Breeders will be able to produce elite breeding lines by directly selecting for specific combinations of alleles at the molecular level. However, these elite lines will still require thorough evaluation by breeders, other agricultural scientists and, finally, farmers.

A basic fact of applied genetic engineering is that all transgenic manipulation involves conventionally bred varieties

The challenges for rice breeders are immense. We have a long way to go before solving the problem of abiotic stress tolerance, for drought in particular. In the future, rice consumers will want varieties that are not only tastier but also more nutritious. Also assuming a more important role will be such environmental concerns as durable pest resistance, more efficient nutrient uptake, and the cultivars' response to global climate change and pollution. Genetic engineering and genomic tools will complement these rice breeding efforts. While we may not anticipate breakthroughs on a par with the yield gains of the Green Revolution semidwarfs of the 1960s, we can certainly expect incremental progress on many fronts.

One could argue that at some point we will be able to create optimum genotypes entirely in the laboratory. This is an intriguing possibility, but I expect to see demand for several more generations of scientists versed in the classical methods of plant breeding. These breeders will have a range of new tools to facilitate their work, but they should not forget how to make crosses and grow field nurseries.

How rice grows

ARIEL JAVELLANA

Irrigated rice grows in bunded (embanked) fields with assured water supplies and reliable drainage, allowing farmers to maintain shallow flooding of their fields until the crop is nearly mature. The focus of innovation during the Green Revolution, this highly productive system, permitting up to three rice crops per year in tropical lowlands, provides more than three-quarters of the world's rice and is therefore central to global food security.

IRRI

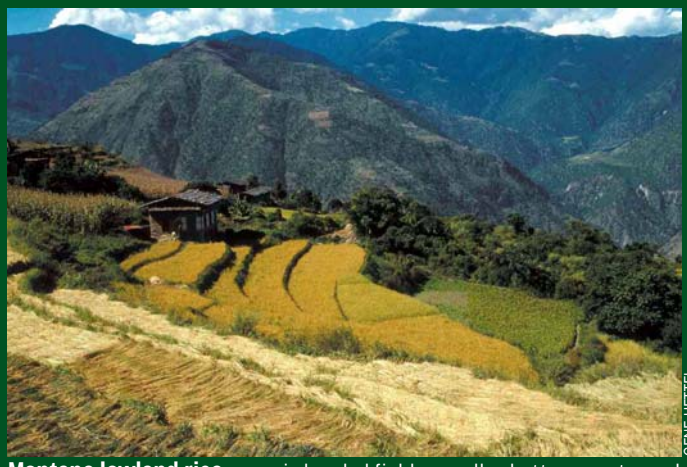
Flood-prone rice areas present a range of growing conditions in both coastal and inland environments that support more than 100 million Asians, despite high risks and low yields. Some rice varieties tolerate being submerged for several days. Deepwater rice elongates or floats to survive long inundations. Coastal areas subject to tidal surges require rice varieties that tolerate high salt levels. Minerals that accumulate in waterlogged soils often render them infertile.

BAS BOUMAN

Aerobic rice grows as a dryland crop much like wheat, usually direct-seeded in lowlands or favorable uplands that are rainfed or have supplementary irrigation. With suitable varieties and properly managed inputs, farmers can achieve yields approaching those of conventionally irrigated fields. Aerobic rice is widely planted in rotation with pasture or soybean in Brazil and is increasingly being adopted in China.

GUY TREBUIL

Rainfed lowland rice grows in bunded fields flooded by rainfall during at least part of the cropping season. Farmers typically grow one rice crop per year, followed by a minor crop if the remaining wet season permits. Some rainfed lowland areas are favorable and reliably productive, but most are prone to drought or flooding or both. Toxic soils, weed pressure, insect pests and diseases are common problems.



GENE HETTEL

Montane lowland rice grows in bunded fields on valley bottoms or stepped terraces cut into hillsides. This system, either rainfed or irrigated, is the preferred way to grow rice in the mountains, but limited availability of suitable land means that many farmers don't have access to enough lowland area to feed their families. Typically, these farmers also grow upland rice to reduce or eliminate their rice deficit.

IRRI

Upland rice grows as a rainfed dryland crop in permanent fields — which can be sustainable if rotated with other crops — or in shifting slash-and-burn systems that become unsustainable, especially on hillsides, as population pressure shortens the fallow periods needed for soil regeneration. With few inputs, upland rice yields are very low but nevertheless critical to the household food security of some of the poorest people in Asia.

Note: Rice systems fall into categories in line with the categorizer's focus — to a plant breeder according to conditions affecting rice plants and to an agricultural economist according to farmers' livelihood options. The categories included here are intended to be broadly informative, not definitive or exhaustive.

NEW

Rice-photos.irri.org

The Rice Image Bank of the International Rice Research Institute

is now available on the Web at http://rice-photos.irri.org.

View more than 5,000 images of landscapes, farmers, children, events, markets, research, and life in general – in Asia and elsewhere!