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Putting the lid on pesticides
Making upland farms sustainable
Replanting Cambodia's killing fields
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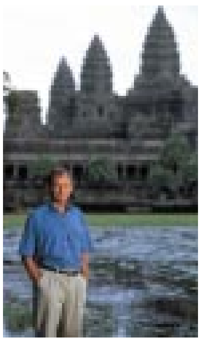

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Rice Today is published by the International Rice Research Institute (IRRI), the world's leading international rice research and training center. Based in the Philippines and with offices in 11 other countries, IRRI is an autonomous, nonprofit institution focused on improving the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes, while preserving natural resources. IRRI is one of 16 Future Harvest centers funded by the Consultative Group on International Agricultural Research (CGIAR), an association of public and private donor agencies.

For more information, visit the websites of the CGIAR (www.cgiar.org) and Future Harvest (www.futureharvest.org), a nonprofit organization that builds awareness and supports food and environmental research.

Forward in India

About 150 people from the Indian Council of Agricultural Research (ICAR), the Indian Agricultural Research Institute (IARI), agricultural universities, IRRI and its sister CGIAR centers, and the press attended the inauguration of the IRRI-India Office on 15 February in New Delhi. Located at the National Agriculture Science Center, the new office joins those of other CGIAR centers and is in close proximity to IARI, the National Bureau of Plant Genetic Resources, the National Academy for Agricultural Sciences, and the National Seeds Development Corporation.

On the same day, the ICAR-IRRI Work Plan 2001-2004 meeting took place at the IARI Library. Under the new work plan, 33 ongoing projects will continue, and eight new projects will begin. The research covers the full spectrum of biotechnology, field delivery and impact assessment. The photo shows ICAR Director General Panjab Singh (*seated left)* and IRRI Director General Ronald Cantrell signing the work plan agreement. Observing are (*from left*) R.K. Singh, IRRI liaison scientist; B.N. Singh, director of India's Central Rice Research Institute; K.N. Choudhary, ICAR protocol officer; Mahabub Hossain, IRRI Social Sciences Division head; Ren Wang, IRRI deputy director general for Research; Mark Bell, IRRI International Programs Management Office head; and J.P. Noor, IRRI-India finance and administration officer.

Seed Health Unit is gatekeeper for all IRRI rice seed

The Seed Health Unit (SHU) is the sole entry and exit point for all rice seeds going to and from IRRI. SHU processes seeds for phytosanitary certification and post-entry clearance as accredited by the Philippine Plant Quarantine Service for rice seed health testing.

For incoming seeds, SHU checks the phytosanitary certificate from the country of origin, the Philippine import permit, and the seed export permit from the country of origin, including the seed list. In addition, SHU checks for an incoming material transfer agreement (MTA) or a letter stating the terms and conditions of the seed donation.

Vegetative plant parts, seeds of wild rice, and genetically modified organisms, however, require a specific import permit (for one shipment only). For rice seeds, IRRI is issued and maintains an import permit valid for six months, and copies are available from SHU.

For outgoing seeds, the required documents include the seed list, the import permit (if the importing country requires one), the phytosanitary certificate, and the appropriate MTA. If the seeds are to be sent to a destination within the Philippines and, therefore, do not require a phytosanitary certificate, SHU will attach the appropriate MTA and record the disbursement in the database. Seeds completely processed for shipment with all necessary documentation are mailed by SHU.

Internally, seed releases to IRRI staff must be accompanied by an appropriate MTA. Seeds released by IRRI staff to their collaborating research partners must also be accompanied by an appropriate MTA.

Vietnamese president pays second visit to IRRI

IRRI welcomed Vietnamese President Tran Duc Luong to its campus at Los Baños on 15 November. This was President Tran Duc Luong's second visit to the institute, illustrating the strong ties between IRRI and one of its most important national partners.

In 1978, when a recently reunited Vietnam signed its first memorandum of agreement with IRRI, the country produced 10 million tons of rice. By 2000, this figure had climbed to 33 million tons, an increase of 230 percent in 23 years. Vietnam regained self-sufficiency in rice in 1989 and has since established itself as the world's second largest rice exporter. Rice is Vietnam's second most important export, accounting for a tenth of total exports by value.

The role that IRRI has played in the return to health of Vietnam's rice-based agricultural sector is indicated by the country's high rate of adoption of modern varieties. More than 60% of Vietnam's total rice area, and 90% of its irrigated rice area, is planted to IRRI-originated varieties.

But the adoption of modern varieties tells only part of the story of IRRI-Vietnam collaboration. At least equally important is how the relationship has matured and deepened, to the benefit of both sides, and how it promises to become even more valuable in the future.

Today, IRRI has 34 internationally recruited scientists working on projects in Vietnam, reflecting a level of activity surpassed only in India and the Philippines. Among the many projects are integrated pest management (see page 10) and eco-regional integrated natural resource management (see page 20).

President Tran Duc Luong (*left*) inspects IRRI's long-term continuous-cropping experiment with Vice Prime Minister Nguyen Cong Tan and IRRI Director General Ronald Cantrell.

Seed health in Bangladesh

During a policy dialogue at the Center for Integrated Rural Development in Asia and the Pacific in Dhaka on 8 January, Mahabub Hossain delivered the keynote speech, *The rice seed delivery system in Bangladesh: institutional and policy issues*. Dr. Hossain stated that a more efficient seed delivery system, coupled with active participation by the private and public sectors and farmers' organizations, would further increase rice productivity in the country. Aldas Janaiah of IRRI and Prof. Muazzam Husain and Firdousi Naher of the Bangladesh Rural Advancement Committee co-authored the address.

The Center for Policy Dialogue (CPD) organized the program in collaboration with IRRI's Poverty Elimination Through Rice Research Assistance (PETRRA) project. CPD Chairman Rehman Sobhan presided. Former Agriculture Secretary A.M.S. Shawkat Ali and CPD Executive Director Debapriya Bhattacharya also spoke. The event attracted high officials in government and the Bangladesh Rice Research Institute (BRRI), as well as donors, diplomats and journalists.

Later the same day, S.B. Siddique, BRRI director general, cut the ribbon to officially open the Seed Pathology Laboratory. Among those attending were Tom Mew, IRRI seed health coordinator; N.I. Bhuiyan, BRRI director for research; Noel P. Magor, PETRRA manager and head of the IRRI Bangladesh Office; and M.A. Taher Miah, coordinator of the Seed Health Project, Bangladesh.

IRRI Library wins award

The Philippine Association of Academic and Research Libraries (PAARL) has named the IRRI Library winner of its Outstanding Academic/Research Library Award for 2001. The award was presented during the PAARL general assembly in Manila on 25 January.

PAARL recognized the IRRI Library for its commitment to Philippine academic and research librarianship, innovativeness and responsiveness to the demands of the times, and for the institute's involvement in information networking and linkages.

Library and Documentation Services Manager Mila Ramos said advances in information and communication technology during the last five years "were manifested in the Library's various operations: its computerized library system, web page, electronic document delivery, comprehensive databases, cataloging of internet resources, electronic reference, and e-acquisitions."

Philippine president unveils online course

Philippine President Gloria Macapagal-Arroyo unveiled the first modules of the Rice Production Training series online during a visit to IRRI on 2 August 2001. After being taught to thousands of rice researchers, government officials and farmers in classrooms for almost three decades, the first electronic modules of the series were released during her visit.

The ceremony was seen as especially appropriate by those who recalled that it was the father of President Macapagal-Arroyo, former Philippine President Diosdado Macapagal, who formally inaugurated IRRI in 1962 and so launched the very first Rice Production Training course soon after.

"We were honored to have the president perform this simple ceremony," Director General Ronald Cantrell said. "While it was a relatively simple ceremony, the potential impact of this training material should be enormous."

President Arroyo also visited the International Rice Genebank and was introduced to several of IRRI's research projects during her brief visit.

Letter to Readers,

Just a few words to tell you about the new publication you're reading right now. This year, IRRI launched a biannual magazine dedicated to exploring the world of rice science and its impact on global food security, poverty alleviation and environmental protection.

We decided to replace our annual report with this magazine because the new format will allow us to focus less on IRRI as an institution and more on developments and issues affecting rice farmers today. We hope you find this first issue of *Rice Today* informative, illuminating and enjoyable. Let us know what you think. Contact information is on the Contents page.

Ronald P. Cantrell
IRRI Director General

IRRI-Korea Office inaugurated

The IRRI-Korea Office (IKO) was formally inaugurated on 14 December, marking the culmination of almost two years of consultations between the Rural Development Administration (RDA) of South Korea and IRRI. The event was a milestone in the 37-year partnership between IRRI and Korea. The IKO is unique among IRRI country offices, as its maintenance and operating costs — including personnel costs — are fully covered by the RDA. The IKO will support collaborative research activities, particularly on improving temperate japonica rice germplasm for high yield and resistance to stresses. The photo shows (*from left*) former RDA Administrator and incoming IRRI Board of Trustees Member E.J. Lee, IRRI Deputy Director General for Partnerships William Padolina, RDA Administrator K.Y. Suh, National Crop Experiment Station Director General S.D. Kim, and IKO Representative K.K. Jena.

Zimbabwean is new BOT chair

Angeline Kamba in January began her three-year term as chair of the IRRI Board of Trustees. Ms. Kamba was elected during last April's board meeting at the institute's research campus in Los Baños, Philippines. The first woman, and the first African, to chair IRRI's governing body, Ms. Kamba succeeds Sjarifudin Baharsjah of Indonesia.

The energetic and charismatic Ms. Kamba brings to the job a wealth of administrative and international experience. A librarian by training, she has served the government of Zimbabwe as public service commissioner, director of the National Archives (which led to a term as vice president of the International Council on Archives), and Zimbabwean representative on UNESCO's Intergovernmental Council for the General Information Program, of which she became chair. She is a member and patron of the Southern African Association for Research into Culture and Development and president of Riders for Health, a British-registered charity focused on delivering health services in Africa. She was recently appointed chair of the Board of Trustees of the Harare (Zimbabwe) International Festival of the Arts.

In the international arena, she has served on the board of CAB International, an intergovernmental organization that provides information services in support of agriculture, public health, environment and forestry. She is on the Advisory Editorial Board of Information Development, an international journal that covers current developments in the provision, management and use of information throughout the world, with particular emphasis on the information needs and problems of developing countries. Significantly, she served as a member of the UN/UNESCO World Commission on Culture and Development,

Angeline Kamba in Nepal with IRRI scholar A.P. Regmi.

which was chaired by the former UN Secretary-General Javier Pérez de Cuéllar.

In addition to her strong administrative skills and extensive international contacts and experience, Ms. Kamba's qualifications include her superb talents as an engaging communicator.

Benito Vergara proclaimed National Scientist

The Philippine Department of Science and Technology and the National Academy of Science and Technology in September 2001 awarded Benito Vergara, former plant physiologist and director for administration of IRRI, the rank and title of National Scientist. The honor recognizes his scientific and technological achievements on the physiology of the rice plant and his efforts to bring rice science and technology closer to the popular consciousness.

Dr. Vergara worked extensively on the flowering response of rice to photoperiod and on screening procedures for cold tolerance, as well as developing and streamlining a breeding methodology, termed "rapid generation advance," for breeding photoperiod-insensitive and cold-tolerant rice varieties. He also studied flood tolerance, growth duration, ratooning, tillering, flowering and grain yield.

He popularized the scientific basis of modern rice culture through his widely published and translated *A farmer's primer on growing rice*. Further, he helped design and put together the Philippine Science Heritage Center and IRRI Riceworld.

Collaborators on the move

Zhai Huqu last year became president of the **Chinese Academy of Agricultural Sciences** (CAAS). Before joining CAAS in August 2001, he was the president of Nanjing Agricultural University. Prof. Zhai, whose research interests focus mainly on genetic crop breeding, biometrics, experimental design, and quantitative genetics, has published more than 40 papers. In recognition of his outstanding contributions to agricultural education and research, he was awarded a special subsidy issued by the State Council in 1993 and was named a promising young scientist by the Ministry of Agriculture in 1997.

In January, **Sutep Limthongkul** became deputy director general of the **Thai Department of Agriculture**. Dr. Limthongkul forged a close working relationship with IRRI during his more than five years as the director of Thailand's Rice Research Institute. He earlier served as director of the Pathum Thani Rice Research Center.

Panjab Singh was named director general of the **Indian Council of Agricultural Research** in October 2001. Dr. Singh was formerly the director of the Indian Agricultural Research Institute in New Delhi. Prior to that, he served as vice chancellor of Jawaharlal Nehru Agricultural University and director of the Indian Grassland and Fodder Research Institute. He is an experienced administrator and research manager.

S. B. Siddique became the new director general of the **Bangladesh Rice Research Institute** (BRRI) in December. He was previously director of Agriculture of the Bangladesh Jute Research Institute. Dr. Siddique earlier served BRRI as director of Administration and head of Agronomy.

IRRI bags two CGIAR awards

IRRI was the only center in the Consultative Group on International Agricultural Research (CGIAR) to win two Excellence in Science Awards during the CGIAR's 2001 Annual General Meeting in Washington, DC. The institute's hybrid rice breeding team won the award for the Outstanding Scientific Support Team, and the paper *Genetic diversity and disease control in rice* was chosen as the Outstanding Scientific Article.

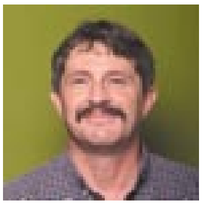
Led by Plant Breeding, Genetics and Biochemistry Deputy Head Sant Virmani (*third from right*), the hybrid rice breeding team includes (*left to right*) Reynaldo dela Cueva, Luisito Caracuel, Juan Alzona, Julito Talay, Alejandro Manio, Oscar Gonzales, Carlos Casal, Jr., Leonida Nazarea and Rodolfo Toledo.

The winning scientific paper, published in the 17 August 2000 issue of the prestigious journal *Nature*, was coauthored by Zhu Youyong, Chen Hairu, Fan Jinghua, Wang Yungyue, Li Yan, Chen Jianbing, Fan Jinxiang, Yang Shisheng, Hu Lingping, Hei Leung, Tom Mew, Paul Teng, Wang Zonghua and Christopher Mundt.

Sant Virmani is AAAS Fellow

Sant S. Virmani, deputy head of IRRI's Plant Breeding, Genetics and Biochemistry Division, has been elected a Fellow of the American Association for the Advancement of Science (AAAS) for his "tremendous contributions to hybrid rice breeding, genetics and seed production, which are significant steps toward global food security." Dr. Virmani received a certificate and a rosette during the AAAS Fellows Forum in Boston on 16 February. The AAAS Council elects members whose "efforts on behalf of the advancement of science or its applications are scientifically or socially distinguished." Dr. Virmani is also a Fellow of the National Academy of Agricultural Sciences, India (1995), American Society of Agronomy (1999), Crop Science Society of the Philippines (2001) and Crop Science Society of America (2001).

Keeping up with IRRI staff



Mark Bell, head of the International Programs Management Office (IPMO), has been named head of the Training Center, while maintaining his responsibilities in IPMO. Dr. Bell started at IRRI in 1994 as head of the Central Research Farm, became head of the Experiment Station and Agricultural Engineering Division in 1997, and moved to IPMO in 2000. At the Training Center, he replaces **Paul Marcotte**, who left in March to become director of international programs at the University of California, Davis.

To Phuc Tuong, who became deputy head of Crop, Soil and Water Sciences (CSWS) in January, has been tapped to become acting head of CSWS on 1 May. As acting head of IRRI's largest division, Dr. Tuong will automatically become a member of the institute's Management Committee.

Dr. Tuong joined IRRI in 1991 as a water management engineer and is currently the team leader of Project 5 (Enhancing Water Productivity in Rice-Based Production Systems) in IRRI's current Medium Term Plan. Outgoing CSWS Head **James Hill** is returning to the University of California, Davis.

J.K. Ladha, soil nutritionist in Crop, Soil and Water Sciences, took over the editorship of *International Rice Research Notes* (*IRRN*) from **Mike Cohen**, the first editor-in-chief of the journal since its revamp in 1998, who is leaving after eight years at IRRI.

Dr. Ladha first joined IRRI as a postdoctoral fellow starting in 1980, working his way up to soil nutritionist in 1999. His current responsibility is rice-wheat research in South Asia. He is regional editor of *Biology and fertility of soils* and sits on the editorial board of *Nutrient cycling in agroecosystems* (Netherlands), *Japanese journal of soil science and plant nutrition*, and *Indian journal of microbiology*.

Hamid Miah is the new IRRI liaison scientist for activities in Bangladesh not included under the program Poverty Elimination Through Rice Research Assistance (PETRRA). Dr. Miah is a former director general of the Bangladesh Rice Research Institute (BRRI).

Prior to BRRI, he served as acting director general of the Bangladesh Jute Research Institute and director for Crops of the Bangladesh Agricultural Research Council. He is a Fellow of the Bangladesh Academy of Sciences and the current president of the Entomological Society of Bangladesh. **Noel Magor** continues to be the IRRI representative for Bangladesh and PETTRA project manager.

Matthias Wissuwa has joined the Crop, Soil and Water Sciences Division as an international research fellow. Dr. Wissuwa, a German national, was a Science and Technology Agency Fellow and a European Union Science and Technology Fellow at the National Institute of Agro-Environmental Sciences in Tsukuba, Japan.

Kazuko Morooka, librarian, resigned in October after 30 years with IRRI. Mrs. Morooka joined the IRRI library office as an indexer in 1971. She became a library supervisor in 1988 and a librarian in 1995. She served IRRI by collecting, translating and filing rice literature from Japan. Mrs. Morooka planned to begin work on a PhD in information processing.

Borlaug wins NAS medal

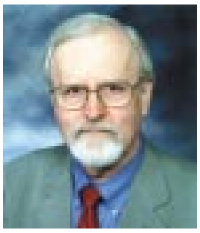
The U.S. National Academy of Sciences (NAS) announced in January the awarding of its prestigious Public Welfare Medal to agricultural scientist Norman E. Borlaug, founder of the International Maize and Wheat Improvement Center (CIMMYT).

Many hail Dr. Borlaug as the father of the Green Revolution, whose dwarf varieties of wheat saved millions of lives in Latin America, Africa and Asia — as well as spurred the development of modern varieties of rice. A forester and plant pathologist by training, Dr. Borlaug began working on the first dwarf wheat hybrid in the 1940s in Washington State. In 1944, he took his improved wheat to Mexico, where he organized the Cooperative Wheat Research and Production Program, a joint venture of the Mexican government and the Rockefeller Foundation, and the precursor to CIMMYT. Dr. Borlaug won the Nobel Prize in 1970.

World Food Prize for IFPRI DG

The World Food Prize Foundation awarded Per Pinstrup-Andersen, director general of the International Food Policy Research Institute (IFPRI), the 2001 World Food Prize for his contribution to agricultural research, food policy, and the well-being of poor farmers and consumers worldwide. The prize includes a $250,000 cash award.

Dr. Pinstrup-Andersen has led IFPRI for nearly a decade. Under his leadership, IFPRI has undertaken groundbreaking research projects, including efforts to encourage the breeding of staple crops for higher nutrition, improve the effectiveness of food for education efforts, and develop computer models to determine the effects of government policies on child malnutrition. He has been the driving force behind the 2020 Vision Initiative, a global effort to encourage world leaders to focus on food security issues in the 21st century.



Von Braun is named IFPRI DG

The Board of Trustees of the International Food Policy Research Institute (IFPRI) in December appointed Joachim von Braun to succeed Per Pinstrup-Andersen as director general, effective 1 September 2002. Prof. von Braun is the director of the Center for Development Research (ZEF), which he helped to found in 1997 at the University of Bonn, Germany. He heads the Department of Economics and Technical Change and is a professor in the Institute for Agricultural Policy.

Prof. von Braun's association with IFPRI includes seven years as a research fellow and three years as director of the Food Consumption and Nutrition Division. He is currently the president of the International Agricultural Economics Association and a member of the CGIAR's Technical Advisory Committee.

CIP names new research head

Pamela Anderson, a highly regarded entomologist and ecologist, has been appointed deputy director general for Research of the International Potato Center (CIP). She will join the

CIP directors' team on 1 June. Dr. Anderson comes to CIP from the Centro Internacional de Agricultura Tropical (CIAT), where she was a senior scientist. At CIAT, she led and coordinated the CGIAR's successful Whitefly Project, under the umbrella of the Systemwide Program for Integrated Pest Managment.

Dr. Anderson, a U.S. citizen, is a leading expert on emerging plant diseases.

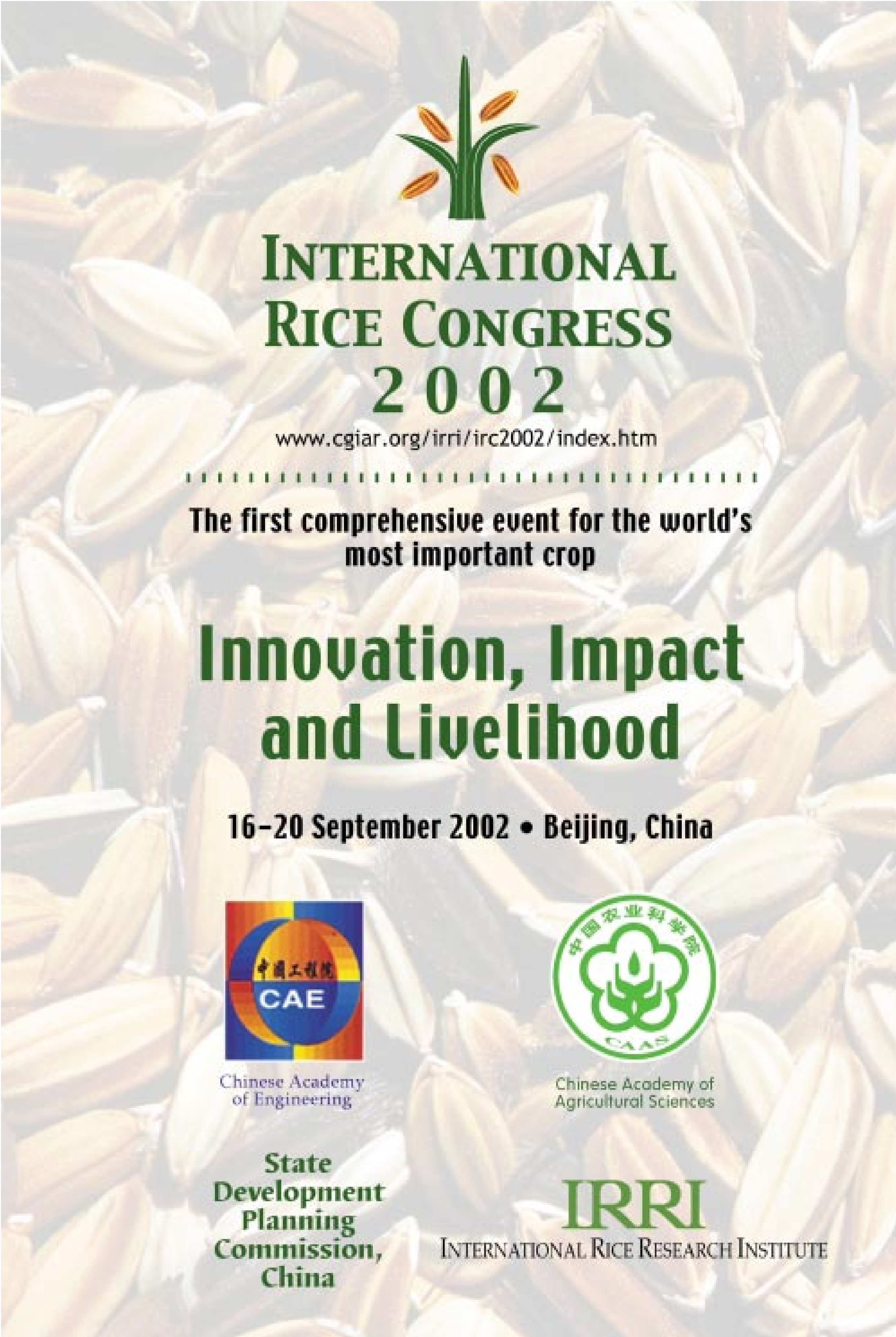
New head of Internal Audit

John Fitzsimon is the CGIAR's new head of Internal Audit for 2002-2004. He replaces Hock-Chye Ong, who returned to the World Bank at the end of January.

Mr. Fitzsimon has more than 20 years' experience in auditing and management. For the last 11 years, he has been with the World Bank, where he served as financial management advisor to the vice president for South Asia and as a senior auditor with the Internal Auditing Department.

CIAT staff perish in crash

Two scientists of the International Center for Tropical Agriculture (CIAT), Chusa Ginés, coordinator of the Cassava Biotechnology Network (CBN), and Verónica Mera, research associate of CBN, lost their lives in an airline accident in January. The plane crashed in the mountainous region close to the frontier between Colombia and Ecuador, leaving no survivors.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Pesticide misuse

Stemming the overuse of pesticides has become an urgent issue in many rice-growing countries

IRRI scientists have developed some unusual but highly successful approaches to the problem of pesticide misuse. They're working against a background of official and scientific reports that continue to outline a horror story of misuse, widespread sickness among farmers, and exploitation of inadequate government controls. The damage is compounded because many pesticides commonly available in Asia are classified by the World Health Organization as extremely hazardous, and their use is either banned or severely restricted in the developed world.

Repeated calls have been made for a tightening of regulatory controls and increased farmer education. These days, such calls tend to be based on economic issues, rather than the more obvious environmental costs of pesticide use.

For instance, a report prepared for the Institute of Agricultural Economics in Hanover, Germany, estimates that nearly 40,000 farmers in Thailand suffer from various degrees of pesticide poisoning every year, and that their associated health costs amount to more than US$300,000. It goes on to estimate that the external costs of pesticide use in Thailand, including health, monitoring, research, regulation and extension, amount to as much as $127.7 million per year.

A similar report called *The impact of pesticides on farmer health: a medical and economic analysis in the Philippines* (Pingali, P.L. et al., 1995) claims that the value of crops lost to pests when pesticides aren't used is invariably lower than the cost of treating diseases caused by their use (see Grain of truth, page 30). It says that the health costs incurred by farmers exposed to pesticides are 61% higher than those of farmers who are not exposed.

The Thai report details the proliferation of trade names for agricultural chemicals sold in the kingdom. One chemical is marketed under 296 different trade names, and another under 274. As the report points out, this makes transparency for users, and monitoring and control by government agencies, nearly impossible.

The effects on the Thai environment are equally dramatic. Studies have shown pesticide residues in more than 90% of samples of soil, river sediment, fish and shellfish. Seventy-three percent of tangerines tested in one survey contained pesticide residues, and more than a third of all vegetables were contaminated with organophosphorus insecticides.

Against this backdrop, an IRRI team is helping to introduce to Thailand an education program that has already proved to be very successful in Vietnam. Under the banner of the Rice Integrated Pest Management Network, the campaign reduced insecticide use in Vietnam's Mekong Delta by an estimated 72%. What's more, the number of farmers who believed that insecticides would bring higher yields fell from 83% before the campaign to just 13% afterwards.

As in Vietnam, the new Thailand campaign uses cartoon characters, billboards, and information handouts. Probably most effective is a series of humorous radio segments in which local actors play out brief comedies, using rustic situations and solid scientific facts, to make their audience laugh. The premise is that farmers' perceptions, rather than economic rationale, are used in most pest-management decisions.

"We want to motivate farmers to think of the benefits of not using pesticides," says IRRI entomologist K.L. Heong. "Most of the farmers in the project area spray their rice crops three or four times. In fact, some of them are not even using insecticides against insects. They're using them to kill snails, because they believe they've got no other option. Pesticide use is regarded as a big problem in the Thai countryside. We are trying to reduce it by one half."

Dr. Heong is helping local researchers develop the anti-pesticide campaign, which is centered on the town of Singburi, in Thailand's central rice bowl.

Breakthrough in biological control

An innovative way to keep disease in check promises to help clean up China's rice industry

Rice farmers in China are at the forefront of a ten-year international scientific effort to reduce the amount of chemicals being dumped on the planet's millions of hectares of rice paddies. As 13% of the world's total harvested crop area is planted to rice, any success in helping rice farmers reduce the inappropriate use of pesticides promises to have a major impact on the environment, especially in Asia. The situation is of special concern in China, where the excessive use of farm chemicals has been a major problem for many years.

While scientific efforts to help rice farmers cut back on pesticide use have been underway for more than decade, progress in China has received fresh impetus from the country's entry into the World Trade Organization (WTO) and Beijing's determination to ensure that its agricultural sector is internationally competitive. The resulting commercialization of research products developed by China's agricultural research institutes has led to the successful development of a new type of biological control agent for two rice diseases that can cause serious crop losses.

The new biological control agent, called Wenquning, is one of the first products sent into field trials by the Jiangsu Academy of Agricultural Sciences (JAAS). Last year, thousands of farms covering almost 70,000 ha in Jiangsu — one of China's most important rice growing provinces — used Wenquning to protect their crops from crippling sheath blight disease.

"Initial results showed that Wenquning was very effective in controlling the disease, so farmers didn't have to use the same amounts of fungicides they normally do to protect their crops," said Chen Zhiyi, of the Institute of Plant Protection Research at the Jiangsu Academy. Dr. Chen and her team had earlier registered Wenquning with the Jiangsu authorities for use as a crop protection agent. This was an important step taken by the institute to have Wenquning recognized as their product.

Biological control agents

Biological control agents are naturally occurring predators on such crop pests as locusts or rabbits. Scientists have struggled for many years to find suitable biological control agents for rice diseases. Researchers from IRRI initiated a collaborative project on biological control (funded first by the Asian Development Bank and then by the Belgian government) with scientists from the JAAS in 1990. The team quickly turned their attention to microbial biological control agents found in the rice ecosystem.

They eventually identified a bacterium they called *Bacillus subtilis B-916*, which was found to act as a type of microbial biological control agent against the dreaded sheath blight disease. After many years of tests and research into how the bacterium worked, the scientists from IRRI and the JAAS were only recently ready to share it with local farmers. After settling on the name Wenquning, the researchers started large-scale field tests in 1994.

"Perhaps the most gratifying thing after so many years of work was to see how quickly this new technology was adopted by farmers," said Tom Mew, senior IRRI plant pathologist and the head of the project. "Every year since we started the trials with farmers, the area being tested has doubled in size, and we are now at the point where we can't produce enough Wenquning to keep up with demand."

The product's success has also given confidence to academy researchers to commercialize other research products they have developed. "When they first learned that their research would not be funded in the same way as in the past, they were worried about how their work would be supported," Dr. Mew reported. "Now it's clear that if they can continue to develop products like Wenquning from their research, then they can be confident of their future."

Exciting prospects

The IRRI-Jiangsu research team has found that Wenquning also works well against another yield-devastating disease called rice false smut. "This is really good news because it shows how effective bacteria can be as biological control agents used on rice," Dr. Mew said. "Another important aspect is that farmers were using fungicides containing heavy metals to combat false smut, and now they can stop this dangerous practice."

Another exciting prospect arises from preliminary evidence that biological control agents like Wenquning may play an important role in helping to break down pesticides in the soil. "It's too early to say for sure if the bacterium will do this consistently," Dr. Mew cautioned. "But if it can, this would quickly become one of Wenquning's most attractive features."

Farmers like Zhu Guangwei, whose one hectare of rice near Fungshen town in Danyang City was included in the Wenquning trials, may not really understand the science behind the new breakthrough. But, like other rice farmers, Mr. Zhu certainly understands the dangers posed by pesticides.

"To be able to provide poor rice farmers with something that not only saves them money by reducing their reliance on expensive chemicals, but also protects their health and improves the environment is something the whole team is very proud of," Dr. Mew said.

The final word on Wenquning comes from Jing Liu Ming, the director of the Danyang City Agricultural Bureau and the person responsible for overseeing rice production in the districts where many of the research trials took place. An avid backer of IRRI-Jiangsu research, Mr. Jing praised such resulting technologies as Wenquning for preparing the Danyang rice industry for WTO membership.

"We've all been told by the government to get ready for China's entry into the WTO," Mr. Jing said. "To do this, we must produce internationally competitive goods. So we need to develop a cleaner, greener rice industry that produces rice free of harmful chemicals."

Mix and interplant

More farmers in China are interplanting rice varieties to control disease — and now the ecologically sound approach is spreading to other crops

Large-scale field experiments have shown that within-field varietal diversification is a highly effective approach to controlling blast disease in rice. This result was reported in August 2000 in the prestigious journal *Nature* (406: 718-722) by scientists from IRRI and collaborating institutions in China. They found that interplanting disease-susceptible glutinous rice with resistant hybrid rice reduced the severity of rice blast by 94% and improved the yield of the highly valued glutinous variety by 89%.

The simplicity and effectiveness of this approach has since attracted great interest from farmers and policy makers alike. Indeed, it is changing the rice landscape of the southwestern province of Yunnan and has extended to other provinces in China, as the alternating rows of short and tall rice varieties become a prominent feature of many rice fields.

As of last year, mixed planting of rice varieties to control blast and improve yield had expanded to 100,000 ha in Yunnan. Such rapid adoption can be attributed to a systematic extension campaign involving county and village officials, researchers, and extension workers. The extension network ensures not only that farmers are trained but also that seeds are available at planting time.

As the interplanted area increased, so did the number of varieties used in mixture. In lieu of glutinous rice, farmers began planting 26 other high-quality but blast-susceptible traditional rice varieties as the susceptible interplant between rows of hybrid rice, with equally good results. This suggests that many valuable traditional varieties that are no longer grown because of their susceptibility to disease can now be brought back into production through this ecologically sound approach to crop management.

Ten other provinces in China have evaluated the technology for possible large-scale implementation. In 2001, Sichuan Province, which has more than 2.3 million ha under rice, evaluated the technique in more than 3,000 ha. Because of a prolonged drought in Sichuan last year, blast incidence was generally low even in susceptible checks. However, the yield in mixture planting was 0.5 to 1.0 ton per ha higher than in hybrid rice alone. Monocultured glutinous rice plants lodged after a rainstorm, while those grown in mixture escaped lodging. An expansion area of close to 70,000 ha is planned for this year.

Exploiting genetic diversity in rice production has been part of an on-going collaborative project between IRRI and Yunnan Agricultural University since 1997. Since last year, the scientists have extended the idea of diversification to control the diseases and insect pests of other major crops in Yunnan, particularly wheat and broad bean.

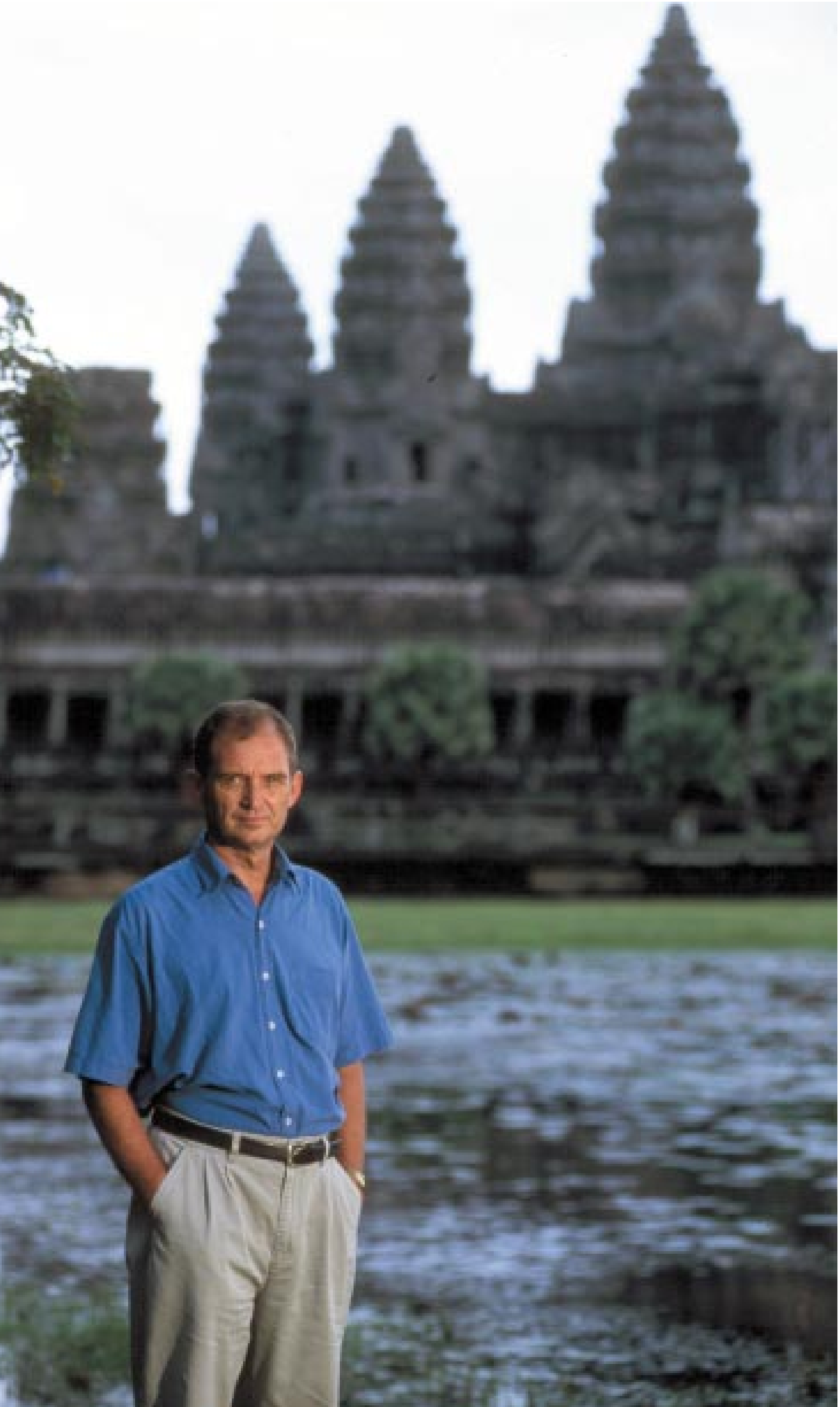
As part of a rice-wheat cropping system, wheat is planted during winter on over 250,000 ha in Yunnan. Wheat stripe rust, caused by *Puccinia triticana*, is a major constraint to production, causing yield losses as high as 15-20%. Broad bean is an important cash crop planted during the same season as wheat, but bean yield is often compromised by serious root and stem damage caused by maggots of the bean fly (*Ophiomyia phaseoli*). Researchers intercropped wheat and broad bean by planting wheat in blocks of 1 m × 20 m and then planting two rows of broad bean between blocks. This intercropping design reduced the incidence of wheat rust by 19-27%, and damage due to bean fly maggots decreased to minimal. The intercrop registered a 24-26% yield advantage over the monocrop at all sites. Rhizobial nodule formation in intercropped broad bean was also significantly higher than in the monoculture crop.

Scientists are forming an extensive network of researchers and extension personnel in Yunnan to disseminate this technology to farmers. Meanwhile, diversification as a means to sustain productivity has spread to other rice growing countries. Field trials to evaluate how effectively varietal mixtures reduce the severity of tungro disease are underway in the Philippines. Vietnam will try the concept out on rice blast, which is becoming a serious problem in the Mekong Delta and central Vietnam due to resistance breakdown in commonly grown varieties.

A farmer harvests an interplanted crop.

Towering *legacies*

by Brad Collis



From the killing fields to improving yields — how a team of dedicated scientists and extension workers has helped farmers restore Cambodian agriculture

On a rooftop overlooking Phnom Penh, two Australians pulled the stopper from a bottle of Russian champagne and proposed a toast. It was a poignant snapshot, the surrounding buildings blackened by mildew and war, and the brown-puddled streets devoid of life.

The year was 1988. The champagne was warm, the toast somber. The two men, Harry Nesbitt and Glenn Denning, were poised at the start of an arduous journey that would challenge their courage, endurance and ingenuity beyond anything a couple of agricultural scientists could reasonably anticipate. The task demanded of them was to revive the ancient rice culture of the Khmers, to breathe life back into the killing fields.

As the pair sat in the heavy tropical silence, they felt the full weight of their burden. Cambodia was isolated from the Western world — a country where people starved, landmines killed and maimed desperate farmers, and the Khmer

Glenn Denning (*left*) and plant breeder Ram Chaudhary, two of the trailblazers of the Cambodia-IRRI-Australia project, pause for a snapshot in 1991.

Rouges, driven from the capital eight years earlier by the Vietnamese army, still posed a threat from their jungle redoubts.

Almost all knowledge of traditional rice farming practices had been lost — the varieties and their traits, soil characteristics, irrigation and drainage, plant breeding, cultivation techniques and pest management. The country's trained agriculturists had either been murdered or forced to flee. Farmers had suffered forced relocation and now worked unfamiliar soils and terrain. To cap it off, most of the seed of traditional Cambodian rice varieties had been eaten, and many farmers were now struggling with unsuitable Chinese varieties introduced by the Khmer Rouge.

The story of Drs. Nesbitt and Denning (in particular of Dr. Nesbitt, who would be the long-term man on the ground) celebrates the rebuilders, the heroes that the chronicles of war rarely mention. Late last year, Dr. Nesbitt recalled the champagne toast and the high ideals and naïve hopes that infused the moment.

"It wasn't until a few days later, when we started to look around, that we realised what we had got ourselves into," he said. "Villages had been razed, and traditional village life was all but extinguished. You'd drive down narrow dirt tracks past rows of cement steps rising from the jungle floor to an empty sky — the houses all gone. People were dying from hunger, and what they had been through was still staring them in the face. Human bones were stacked in the center of most of the major towns. A quarter of the population — anyone educated or skilled or who had worked with Westerners — was killed by the Khmer Rouge under Pol Pot."

The recovery plan was for Dr. Nesbitt to begin an urgent rice-production program using Cambodian seed collected before the war and stored in the International Rice Genebank at IRRI. At the same time, he would start training a local support team. Dr. Denning's job was to direct relevant scientific work at IRRI headquarters in the Philippines. As there was no time to breed new rice varieties, it was a case of identifying the best traditional varieties, planting them out, and selecting the highest-yielding plants from each crop. This work would progress in tandem with longer-term efforts.

"We basically had to build a whole new farming infrastructure, including a system of national agricultural research for the Cambodians to take over later," Dr. Nesbitt explained. "This meant training people up to PhD level. But the most urgent priority of all was to raise basic household food production."

The ambitious program, later named the Cambodian-IRRI-Australia Project (CIAP), was funded by the Australian Agency for International Development in defiance of the U.S., which was still hostile to Cambodia and opposed to Australian activities there. This left Dr. Nesbitt

Harry Nesbitt pitches in during construction, in 1990, of one of the earliest post-war irrigation canals and (*opposite*) poses last year before the towers of Angkor Wat.

on his own, with no peace-keeping force to watch his back as he set about rebuilding Cambodian agriculture, from its bloody paddy fields up.

The effort required large measures of practical science, humor and courage. When the first plant-breeding trials were run on disputed land, a grenade attack wrecked the CIAP office, rifle shots pierced Dr. Nesbitt's house, and a price was put on his head. ("We would clean up and move on, trying not to think about another attack," he recalled.) One of the project's first locally trained agricultural technicians died when the CIAP Toyota Hi-lux was ambushed and machine-gunned by the Khmer Rouge.

Day-to-day living was a trial. "For the first four months, I was constantly ill," said Dr. Nesbitt. "Living conditions were grim. The few eating places that had opened were filthy. We worked long hours for six days, and Sunday was 'survival day,' spent scouring the city for food and basics like soap, detergent and toilet paper."

Yet Dr. Nesbitt never considered giving up. Even in 1997, when most of Cambodia's expatriate population fled during a coup attempt, Dr. Nesbitt stayed, bolstering the morale of his staff and demonstrating to all Khmer stakeholders, in the most emphatic way possible, that he would remain on the job until it was done.

When Dr. Nesbitt arrived in Cambodia in November 1988 (with his pregnant Canadian wife, Betty), 65% of the Cambodian population were women, and almost half of these were under the age of 16. Rice production, which by the end of the Khmer Rouge reign in 1979 had plummeted by 84% in five years, was still abysmally low, as was the area of farmland brought back into production. A country that had been one of Southeast Asia's leading rice exporters in the late 1960s was now a wasteland, scarred by thousands of kilometers of slave-built irrigation canals that were useless because the agricultural engineers who might have ensured functionality had been murdered.

Race against time

With the help of the government's Department of Agronomy, Dr. Nesbitt assembled a small team of local trainees and started trials. He focussed on the Cambodian rice varieties that IRRI assessed as most promising — and on IR66, a modern variety bred by the institute for high yield and quick maturity, allowing two crops per year.

While testing the varieties to determine how best to manage them under various Cambodian soil and climatic conditions, the CIAP team started introducing farmers to modern fertilizers and their appropriate application, irrigation, new harvest and post-harvest technologies, and integrated pest management. The team was expanded to include a prominent Indian plant breeder, Ram Chaudhary, and American anthropologist Richard Lando (who had to pass for Dutch). It was a race against time, keeping bellies full while engendering an agricultural revolution that made many farmers anxious, wary as they had become of sudden change.

Drs. Nesbitt and Denning immersed themselves in people's personal stories, to understand their state of mind. "When people started to tell you a bit about themselves, the constant refrain was, 'I'm the only one left,' and you began to realise how fragile the place was," Dr. Nesbitt recalled. "We made a point of going to Chung Eck, the killing fields near Phnom Penh, to try to understand better how people felt. The open graves were still littered with bones, fragments of clothing, teeth. It was sickening, but

CIAP workers investigate insect infestation levels in rice fields. Dr. Nesbitt (*top*) surveys a crop.

it helped us appreciate why people might be frightened of more change, and why we needed to assure them we'd be staying for the long haul. This was neither the place nor the time for quick fixes. Aside from everything else, some part of the country would always be in drought or flood or ravaged by crop disease."

The formula for kick-starting Cambodia's economic and social recovery was to lift rice production from subsistence to sustenance and finally to surplus. This would lay the foundation upon which the CIAP team could help Khmers start building a more diversified agricultural economy.

Key to success was the introduction of high-yielding rice varieties, the best of which required irrigation. This meant educating farmers accustomed to rainfed conditions and once again mobilising the population to construct irrigation canals. Typically 20 to 30 km long, the canals were built under a food-for-work program that attracted thousands of willing hands. Payment was 1 kg of rice per cubic meter of soil removed in a basket. One of the first canal-building projects attracted a labor force of 30,000.

By this stage, the CIAP team was garnering support from a number of other international government and nongovernmental organisations, in particular World Vision, the German Agency for Technical Cooperation (GTZ), the Canadian International Development Agency (CIDA), Catholic Relief Services and OXFAM, which funded the technical expertise for canal construction.

"While this was happening, we were still playing around with varietal improvements, nutrient and water management, and green-manuring, as well as phosphate fertilizers — and pretty much realizing that we had no idea," said Dr. Nesbitt. "There was just no information anywhere on the constraints to rice production in Cambodia — soils, environmental and social factors such as gender issues. We had to start from scratch and expand the program to include soil specialists, agricultural engineers and sociologists."

Chan Phaloeun (*second from left*) interviews a farm family. Ms. Phaloeun survived a Khmer Rouge labor camp and near death by starvation, later worked with CIAP, and was named deputy director of the new Cambodian Agricultural Research and Development Institute.

Long-term aspiration

Not long after Drs. Nesbitt and Chaudhary started working together, they were joined by two young local graduates of Russian universities. Chan Phaloeun and Men Sarom personified the Cambodian government's long-term aspiration to set up its own agricultural research institute.

Ms. Phaloeun, who was assigned to work with Dr. Nesbitt, had only just survived the Khmer Rouges labor camp where her father, a pharmacist, had committed suicide after becoming too ill to work. Four years of punishing labor on a starvation diet of rice porridge caused the then 17-year-old Ms. Phaloeun to succumb to malaria. With 11 other dying teenagers, she was removed from the camp and abandoned in a village. Ms. Phaloeun was the only survivor.

"I remember the villagers deciding not to feed me, because I would be dead in a few days anyway," she said. "But I asked for some rice and fish. I said, if I was going to die, the food would make it easier. As soon as I started eating proper food, I began to recover, but I was still close to dying for a long time. It was six months before I could stand on my feet."

Ms. Phaloeun's experience of near-death from starvation stayed with her, making her acutely sensitive to the suffering caused by hunger and poverty, despite having been raised in middle-class comfort. Helping farmers improve food production became a quest. The chance to work with Dr. Nesbitt appeared as a dream.

Chance to learn

"In 1988, you were only allowed to study in Russian or Vietnamese," she explained. "This was a chance to learn English and how to do proper scientific research. I was very excited, especially when Harry and I started driving to the provinces to find farmers to work with us. We had the only car, so it was always full of people. I was proud to be a part of the project and to be learning and helping with such important work.

"In the beginning, farmers were only interested in filling their stomachs," she continued. "Their priority was to stay alive. We knew we had to meet this basic need before they could be encouraged to experiment. Our other task was to plan a long-term research program and set up training courses for farmers and agriculturists. For example, farmers didn't know how to purify seed — to select seed from only the highest-yielding plants. We showed them how to choose seed plants at the early tillering stage, by recognising the yield indicators in the panicle.

"We also taught farmers how and when to apply fertilizer. Some fertilizers were chemical, like urea, but many farmers couldn't afford this, so we introduced green manure, nitrogen-fixing legumes that could be grown and dug into the soil with bullock manure."

By 1994, the CIAP team had grown into a sizeable force of international specialists. Their combined efforts — among them a simple soil-assessment technique developed especially for Cambodia by a scientist from the University of Western Australia, farmer schools run by the UN Food and Agriculture Organization, the promotion of integrated pest management by the Commonwealth Scientific and Industrial Research Organization — brought ever-stronger signs of recovery.

A farmer winnows rice. In the seven years since Dr. Nesbitt's arrival in Cambodia, the country has gone from suffering a severe rice deficit to producing a small surplus. Dr. Nesbitt (*below*) consults with farmers (*left*) and CARDI Extension Officer Kep Poch.

The following year, just seven years after Drs. Nesbitt and Denning grimaced over warm Russian champagne, Cambodia achieved a small rice surplus. This didn't mean that everyone had enough to eat, but it was a foundation upon which the country could begin to build a viable economy.

The gains have been modest for some farmers. In Svay Rieng District, a widow whose husband was murdered by Pol Pot forces has managed to improve production on her small farm just enough to pay for two daughters' weddings, buy a secondhand battery-powered television and, critically, pay her medical bills without resorting to selling her farm. For others, the new technologies have opened future prospects that a few years ago would have been inconceivable.

Ouk Chor, a community leader in the village of Tongke in Takeo Province, held off until 1998 before taking the plunge and asking the CIAP team for help. "We were all hungry," he said. "There was never enough rice. So we decided to risk the new varieties and learn about fertilizers and irrigation. As a result, we've doubled the harvest. We're growing two, sometimes three, crops per year. The village is making money from the surplus, and we're considering diversifying into melons and mung beans. In 1998, we could only think of how hungry we were. Now we're building a business."

In the mid-1990s, rice yields on the 2.4 ha family farm of Sam Vesha in Svay Rieng District were low, and the future looked bleak. The young Mr. Vesha convinced his father to let him take over, and five years later his rice yields have grown from 800 kg to 2 tons per hectare. This has allowed him to convert some of his land to commercial fish ponds and horticulture, which generate an annual income of about US$250 — a sizeable sum in Cambodia. He is keen to try planting high-value aromatic rice for export.

Symbol of hope

Mr. Vesha remains a rare exception to the country's endemic poverty, but agricultural extension workers regard him as a symbol of hope for Cambodia's future, a member of a new generation unfettered by the past and eager to grasp new opportunities.

In 1998, Men Sarom completed his PhD in plant breeding at the University of Western Australia and returned to his homeland as preparations progressed to replace CIAP with the new Cambodian Agricultural Research and Development Institute (CARDI). Dr. Sarom is now the institute's first director, and Ms. Phaloeun is his deputy.

Formally inaugurated in November 2000, CARDI promises to open the door to Cambodia's full economic recovery. Rice production has already increased by 70% since the start of the CIAP program. Now agriculture is diversifying, and living conditions are improving immeasurably. The rice surpluses since 1995 have been sustained, allowing the start of a small export trade.

Last December, Harry Nesbitt, the man who more than any other helped make this possible, finally packed his bags for home. As CARDI's labors were just beginning, his work was done.

During his years in Cambodia, Dr. Nesbitt keenly studied ancient Khmer civilisation, which from the 9th century was an early developer of sophisticated rice irrigation systems. The spectacular Angkor Wat temple was the centerpiece of an extraordinary complex that once irrigated an estimated 500 sq km, laying the foundation for Cambodia's golden age.

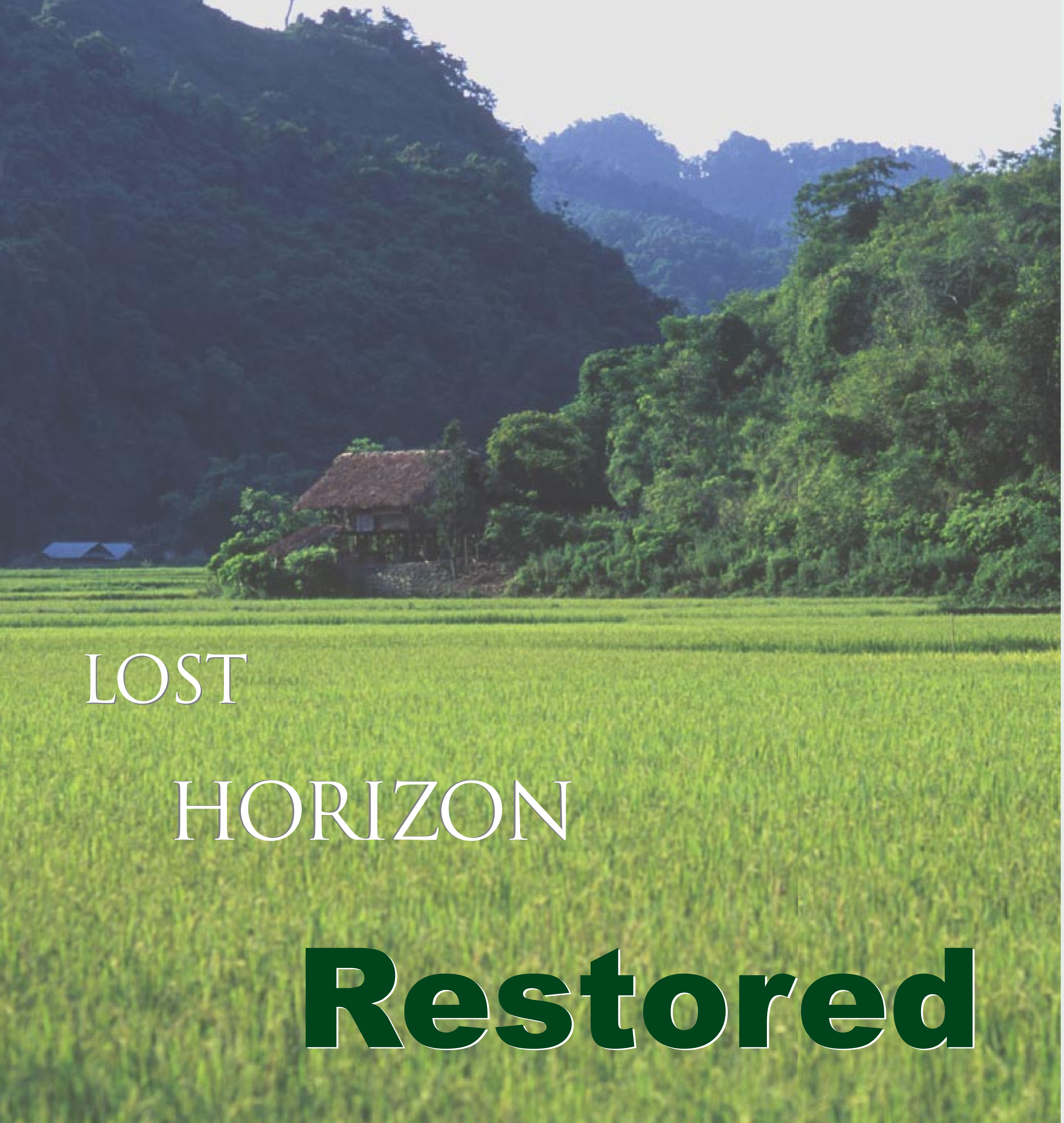
Today, thanks to the efforts of Harry Nesbitt and his collaborators, CARDI and its Khmer stakeholders are well along the way toward restoring the indispensable agricultural basis for building prosperity in Cambodia.

The energetic and optimistic Sam Vesha, who turned his 2.4 ha family farm into a diversified enterprise with an annual income of US$250 (a sizable sum in Cambodia), represents Cambodians' best efforts to climb out of poverty.

IRRI staff members in Cambodia under CIAP

Ram Chet Chaudhary, plant breeder, Dec 1988–Apr 1993. **Peter G. Cox**, agricultural economist, Jan 1998–Jan 2001. **Lorelei V. Domingo**, administrative assistant, Nov 1994–Dec 2001. **Gary Jahn**, crop protection specialist, Feb 1995–Jul 2000. **Edwin L. Javier**, plant breeder, Dec 1993–Dec 1998. **Margaret Ann Jingco**, administrative officer, Feb 1989–Sep 1996. **Ravindra C. Joshi**, crop protection specialist, Aug 1993–Aug 1994. **Richard P. Lando**, anthropologist, Jan 1989–Mar 1991. **D. P. Mishra**, post-doctoral fellow (plant breeding), Mar 1993–Mar 1994. **Harold John Nesbitt**, farming systems agronomist and project manager, Nov 1988–Dec 2001. **Joseph F. Rickman**, agricultural engineer, Apr–Jul 1994 (consultant), Jan 1995–Jul 2000. **Vinoy N. Sahai**, post-doctoral fellow (plant breeding), Aug 1990–Dec 1992. **G. S. Sidhu**, project scientist (plant breeding), Feb 1994–Jan 1998. **Peter F. White**, soil scientist, Oct 1992–Jun 1999.

The Crawford Fund arranged for Brad Collis to visit Cambodia to research and photograph this article, which is adapted from one that appeared in The Weekend Australian Magazine.



LOST HORIZON Restored

As the UN marks the International Year of Mountains, innovative research techniques help make upland agriculture sustainable

Water buffalo and wiry farmers muscle plows through flooded rice paddies. Houses of rough planks and thatch cluster along a road that skirts the valley, tracing the line along which flat, intensively cultivated bottomland abruptly yields to steep hillsides displaying a patchwork of forest and upland fields. This scene in the northern Vietnamese province of Bac Kan, on the outskirts of Ba Be National Park, appears to exist outside of time, a classic image of tranquil, eternal Asia.

Appearances deceive. In recent decades, the way of life in rural Bac Kan has been buffeted by abrupt social transformations and squeezed by rapid population growth. Unable to grow enough food in their fertile but narrow valleys, farmers have increasingly resorted to tilling the surrounding hillsides. Runaway deforestation, soil erosion and loss of biodiversity now threaten to erase any hope that the people of Bac Kan will ever succeed in lifting themselves out poverty.

Since the 1960s, the Green Revolution has brought unprecedented gains in rice yields, allowing most Asian countries to attain self-sufficiency in this essential grain, even as their populations exploded. However, almost all of the gains so far achieved by IRRI and its partners have come in the irrigated lowlands, which produce 75% of the world's rice. Today, agricultural scientists are focusing more of their attention on fragile upland ecosystems. They aim to alleviate the grinding poverty that persists in these difficult environments and reverse the tide of environmental destruction that endangers the world's last vestiges of pristine wilderness, such as Vietnam's Ba Be National Park.

"A farm family's first priority is their own food security, which means growing enough rice to feed themselves from one harvest to the next," explains Jean-Christophe Castella, a specialist in agricultural production systems who works with IRRI. "They'll try to get rice sufficiency from the lowlands — which here in the mountains means the valley bottom. If their needs aren't covered, and they have labor available, they'll crop the uplands."

The catch is that upland fields don't last. After a few harvests of maize or upland rice (a dry-field crop like wheat), the soil is typically capable of supporting only the root crop cassava, then nothing. "Cassava is derided as a soil killer, because nothing can follow it," says Dr. Castella, adding that farmers must then clear new fields. "But cassava grows in infertile soil and is a good risk reducer, because you can harvest it in two years to feed the pigs, if the maize fails."

Dr. Castella heads a research project in Bac Kan that brings together IRRI, the Vietnam Agricultural Science Institute (VASI), Institut de Recherche pour le Developpement (IRD) and Centre de Coopération Internationale

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The Samba method

Ecosystems won't wait to be saved. Change often outpaces the efforts of scientists to improve upland agriculture, and many square kilometers of forest have disappeared while researchers studied how to preserve them. This is one key reason the Mountain Agrarian Systems program developed the Samba method.

The method is a board game in which several farmer-players try to improve their livelihoods within the game by making the same sort of farm-management choices they face in real life. These include what to plant where, when to clear a new field, and whether or not to buy or sell a buffalo. Individual players draw cards defining their virtual farm household's initial conditions: how much paddy land their families own, how many mouths they have to feed, and how much labor they can muster.

Facilitator/researchers leave the rules, especially social ones, for the farmers themselves to work out in the course of play. As in real life, there is no single winner. Families fare well or badly depending on their strategy, how effectively they cooperate, and how vulnerable they are to such "chance" (facilitator-decided) factors as bad weather or livestock epidemics.

It takes a day to run the game to seven or eight cycles, or "years." Researchers spend the next three days interviewing participants to learn more about the strategies they adopted, meanwhile programming a computer model of how the game progressed. On the fifth day, researchers present the model to farmers for validation and to spur further discussion.

"The process is both a research tool and a training method," explains Dr. Castella. "It overcomes the problem of confidence between researchers and stakeholders. We and the farmers share a common experience — the game — which allows us to discuss and compare strategies and determine how closely the game resembles real life."

The Samba method also allows farmers to experiment with strategies, and to see the cumulative environmental impact of their decisions, without facing real-world consequences.

"The overexploitation of natural resources is commonly studied as biophysical phenomena, but the underlying causes and consequences are largely socioeconomic and institutional/political in nature," Dr. Castella observes. "A problem in integrated natural resource management is that research tends to be site specific. The challenge remains to make it capable of benefiting lots of farmers across large areas within reasonable time frames. The Samba method helps, because it's much faster than conducting anthropological surveys, and it can be used in different situations."

Trinh Thi Xuyen (*top*), Ma Ngoc Bich and Hoang Van Phoc follow up a Samba method exercise in Gnoc Phai, Bac Kan. SAM staffer Hoang Lan Anh (*below right*) facilitates a game.

en Recherche Agronomique pour le Développement (CIRAD). The aim of the Mountain Agrarian Systems program (shortened to its French acronym, SAM) is to help farmers progress from shifting, slash-and-burn agriculture toward sustainable, intensive systems that can improve their food security and livelihoods while preserving upland forests.

As this urgent need spans the highlands of Asia, Africa and Latin America, Dr. Castella and his colleagues are developing research methodologies that are broadly applicable to a range of local situations (see box at left "The Samba method"). At the same time, in partnership with other national and international research and development organizations, SAM is assembling a basket of solutions specific to Bac Kan, where lowland rice paddies provide only two-thirds of residents' basic caloric needs.

Filling the gaps

"The shortages occur in May and September, just before the rice harvests," Dr. Castella explains. "To fill the gaps, farmers rely on upland rice, maize and sweet potatoes. Agricultural researchers tend to think that upland rice and lowland rice are completely different systems, but here we see them side by side. And what happens in the lowland fields affects what happens in the uplands. When we understand the history of how the farming system developed, we can better see how we can make it sustainable."

Historically, people of the Tày ethnic group occupied the valleys and grew rainfed lowland rice. Tribal Dao people lived on the hillsides, where they practiced shifting agriculture and grew upland rice. In this subsistence economy, the Tày and Dao had little contact with each other or the outside world.

Lowland rice (*inset*) and upland rice in Gnoc Phai. The hillside in the foreground is in its first season, so seedlings are transplanted to take advantage of strong tillering. The hillside behind is in its second or third season and is already too depleted to support strong tillering, so seed is broadcast to achieve denser planting.

In 1960, the Vietnamese government collectivized agriculture in the area and banned cultivation on the slopes. The Dao moved to the lowlands, where they lived together with the Tày and newly arrived Kinh (mainstream Vietnamese) migrants. By late in the 1970s, lowland fields could no longer feed the growing population, so farmers began illegally clearing upland patches. Decollectivization brought two rounds of lowland reallocations, in 1982 based on how many mouths each family had to feed, and in 1986 according to how much labor families could muster. Then in 1991 the Tày reclaimed the ancestral lands they had contributed to the cooperatives, forcing other farmers back into the now-degraded uplands.

By this time, all accessible uplands even marginally suitable for agriculture had been exploited. As fallow periods shortened to two or three years, instead of the two decades or more that was typical before 1960, declining fertility and soil erosion became serious problems. Despite the ruggedness of the terrain, forest cover shrank from 80% in 1985 to 50% in 1998.

"We face a diversity of situations and systems, so we have to offer a diversity of solutions," says Dr. Castella. "More broadly, we need to stop denying diversity, but rather use it to our advantage. And we need to integrate social aspects from the beginning"

"The old slash-and-burn system has become unsustainable due to population pressure," says Dr. Castella, adding that the government's decision in 1993 to distribute forested uplands to individual households further rendered shifting cultivation unworkable. "The idea is to go from a shifting system to an intensive one. This will allow farmers to produce more food on less land. But to do this, we need to boost the fertility of existing farmland and reduce erosion. Our strategy is to combine increased productivity in the valley bottom with stabilization of hillside agriculture through eco-agriculture and improved fallow management."

One technique being studied by the VASI-CIRAD component of SAM Project — slow-burn trenches — mimics in existing fields the fertility-enhancing power of burning forest cover. Farmers bury shredded bamboo in trenches (for the trial plots, SAM salvages scraps from a local chopsticks factory) and set fire to the trenches, which smolder for two days. The process

Mountain Agrarian Systems head Jean-Christophe Castella (*second from right*), SAM interpreter/secretary Hoang Lan Anh (*third from right*), Dang Dinh Quang (*right*), Dr. Castella's counterpart in the Vietnam Agricultural Science Institute's Agrarian Systems Department, and SAM agronomist Hoang Hai Bac (*fifth from right*), interview Nguyen Van Quach, headman of Pac Cop village in Phong Huan, Bac Kan.

reduces soil acidity and aluminum toxicity and renders phosphorous in the soil more available to crops. It is a good first step toward reviving almost sterile soils in land-scarce areas.

SAM is also evaluating sustainable erosion-control techniques, such as planting contour lines of legume hedgerows or grass, or leaving strips of natural vegetation. The legumes are an effective nitrogen-fixing green manure, and both legumes and grass provide fodder for farm animals. Another option is sowing a cover crop that does double duty reducing erosion and providing mulch for upland rice, maize or cassava — combined, on slopes steeper than 35°, with mini-terraces for each row of the food crop. The mulch spectacularly boosts yields while sharply reducing the need to weed, a time-consuming chore that falls mostly to women and children.

"We face a diversity of situations and systems, so we have to offer a diversity of solutions," says Dr. Castella. "More broadly, we need to stop denying diversity, but rather use it to our advantage. And we need to integrate social aspects from the beginning."

Modern trends

Publicly funded agricultural research is sometimes derided as scientists handing down from their ivory towers "solutions" that are irrelevant to the problems of poor farmers. This caricature has never been wholly accurate or fair, and modern trends make it even less so.

"We are now using problem-driven delivery, rather than solution-driven delivery," explains Dr. Castella, citing a key principle of an emerging framework — called eco-regional integrated natural resource management (INRM) — for tackling agricultural challenges. By working closely with farmers and policy-makers, and by facilitating a mutual learning process, eco-regional INRM addresses issues linking agriculture and natural resource management beyond the field scale. It also aims to bridge the gap between this bottom-up approach and the top-down view of planners and policy-makers. Eco-regional INRM taps the full range of scientific assets that can be brought to bear, from laboratory-bound disciplines like biotechnology to such "soft sciences" as sociology. It also harnesses tools that facilitate the integration of diverse findings into analyzable packages (see box opposite "Geographic information systems").

Using this process, SAM researchers have discovered that the fundamental constraint to intensifying and diversifying upland agriculture in Bac Kan is not what most observers would guess. It is neither vegetable nor mineral, but animal.

"Success depends on developing better livestock management systems," Dr. Castella explains. "Rapid social and policy changes have so far prevented this from happening."

In Bac Kan, water buffalo provide most of the traction for land preparation. They are idle for much of the year but valued as "living capital" to sell in time of need. The upland-dwelling Dao assign a child or elder to keep buffalo

When not providing traction for land preparation, water buffalo are often left to graze unattended in the forests and meadows of the uplands, where they compact the soil and invade farmers' fields. Free-grazing animals are a major constraint to forest regeneration and agricultural intensification in Bac Kan

away from crops, as fencing a temporary field would be an impractical investment. However, since decollectivization and the distribution of buffalo to individual households in the early 1990s, the valley-dwelling Tày have allowed their buffalo to graze unattended in upland meadows and forests, where they often invade the fields of the Dao. In addition to causing crop loses and communal discord, the heavy buffalo compact the soils of the forests and meadows in which they graze.

"Free-grazing animals are a major constraint to forest regeneration, as well as to agricultural intensification," Dr. Castella observes.

Yet, if given the chance, agricultural intensification can solve the problem by supplying the fodder — cut from soil-stabilizing hedgerows and stands of grass — required for keeping buffalo corralled. Intensification thereby smoothes the way for further intensification, illustrating how the holistic eco-regional INRM approach, combining technological and social innovations, can replace the vicious cycle of environmental degradation with a virtuous cycle of self-reinforcing sustainability.

Ideally, most upland areas, in Bac Kan and around the world, would be preserved as wilderness, sustainably exploited for forest products. Accessible and suitable hillsides may be devoted to such perennial cash crops as fruit. The trick is to get from here to there, from how the uplands are used today to how they would be used best.

"After people cover their rice needs, they invest in livestock and fruit to sell," Dr. Castella says. "This is where access to market kicks in. Livestock is better if the way to market is long or difficult, because animals can walk and you have to carry fruit. For sustainability, though, fruit is the ultimate goal. But you can't get there all at once. You have to go through securing food needs first."

Geographic information systems

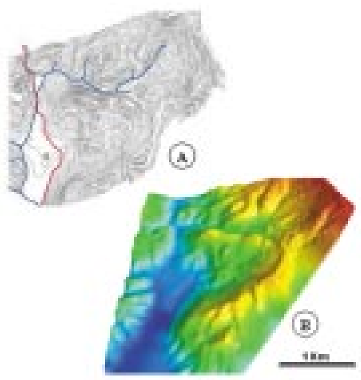
Eco-regional integrated natural resource management can be even more difficult to comprehend than it is to say. The volume and complexity of the data that go into an eco-regional INRM study — combining elements from an array of scientific disciplines — make synthesizing results almost as a great a challenge as communicating conclusions to nonscientists.

A valuable tool for such interdisciplinary studies is map-making with geographic information systems (GIS), which allows scientists to layer wide-ranging data into compact, analyzable packages.

"GIS is a computer-based technology for integrating maps and data, both biophysical and socio-economic, from various sources," explains Suan Pheng Kam, IRRI's GIS specialist. Combining aerial photography, satellite images, existing statistical data, and field interviews on a single map can reveal patterns of interconnection that may otherwise escape the notice of researchers.

"GIS also makes it easier for scientists to present the results of complex models to local authorities," adds Dr. Kam. "This allows them to understand how their decisions affect what farmers can do with their land, water and other resources."

In Bac Kan, the Mountain Agrarian Systems program is experimenting with sketch maps and 3-D modeling, developed with the participation of farmers, to forge village- and watershed-level GIS tools that are easier to read than conventional maps. The goal is to find a common spatial language for scientists, farmers and other local stakeholders.



Farmers cooperating with the VASI-CIRAD component of the SAM project in Gnoc Phai try direct seeding of upland rice through dead mulch. This method controls erosion and spectacularly boosts yields while sharply reducing the need to weed, a time-consuming chore that falls mostly to women and children.

FAIR shares

The Council for Partnership on Rice Research in Asia sets a new code of conduct for rice variety exchange

The world's major rice-producing nations have adopted an informal code of conduct governing the exchange of varieties and germplasm. The aim is to ensure their continued access to new rice varieties, thereby protecting the livelihoods and food security of their citizens.

The move follows decisions by a number of rice-producing nations to introduce plant variety protection (PVP) legislation aimed at defending their biological resources, including unique rice varieties. It also comes amid growing concern expressed by many people that not enough is being done to protect the biological resources of the developing world.

However, rice scientists are concerned that restrictions imposed as a result of new PVP and intellectual property rights (IPR) legislation, if not properly handled, may restrict the free exchange of genetic material, or seeds, needed by scientists to develop improved rice varieties for farmers. This is because PVP and IPR laws could, for the first time, introduce into the Asian rice industry the concept of exclusive ownership.

While the idea of one company owning a popular variety is well established in crops such as wheat and maize, this is still relatively unknown in most Asian countries, where even newly developed varieties are nearly always made freely available to all farmers. However, with the increasing use of biotechnology and the implementation of the World Trade Organization's (WTO) new rules and regulations, such traditions must either adapt or die.

The issue of PVP and IPR legislation was at the top of the agenda of the fifth annual meeting of the Council for Partnership on Rice Research in Asia (CORRA), an informal group sponsored by IRRI. Last November's CORRA meeting in Bangkok attracted senior rice research representatives from the world's 15 top rice-producing nations.

The director of Indonesia's Central Research Institute for Food Crops, Andi Hasanuddin, said that while it was important for every country to be able to protect its unique biological resources as effectively as possible, it was also important to allow the appropriate sharing of rice germplasm so that new varieties could be developed for the benefit of farmers everywhere. At the Bangkok meeting, Dr. Hasanuddin represented CORRA Chairman Joko Budianto, who is also from Indonesia.

RESPONSE TO CHALLENGES

Dr. Hasanuddin said that, in response to the challenges facing rice researchers, the CORRA meeting had agreed to adopt an informal code of conduct for the exchange and sharing of rice varieties. For more than 20 years, a scientific network known as the International Network for the Genetic Evaluation of Rice (INGER) has been the backbone of a large and successful program that has allowed scientists and researchers around the world to freely exchange rice varieties. The new code of conduct will be applied to INGER and its operations in order to expand the gains already made. The key points are listed in the box opposite.

Noting that it would be difficult to enforce the code, Dr. Hasanuddin stressed that it was important to establish a set of basic standards for germplasm exchange, because of the heightened value countries were placing on their rice varieties. INGER, formerly known as the International Rice Testing Program (IRTP), was created in 1975 as an informal partnership among the national agricultural research and extension systems (NARES) of the world's main rice-producing nations. It also includes several international agricultural research centers (IARCs), such as IRRI, and focuses exclusively on rice germplasm exchange and utilization.

INGER's mandate is to facilitate the unrestricted, free and safe multilateral exchange and utilization of rice germplasm, as well as the free sharing of INGER's genetic materials and related information. INGER is also expected to address specifically the needs and priorities of the NARES and to promote the exchange of germplasm among them and the IARCs.

MAXIMIZING RESOURCES

Since the network's foundation, INGER breeding materials have been used to develop more than 570 rice varieties released in 62 countries. In many cases, access to INGER's elite breeding materials has allowed nations to save up to five years in developing varieties through their own breeding programs, thereby maximizing their utilization of precious financial and human resources. While most rice-producing nations have benefited from INGER, it is the poorest countries — those with the least developed research capacity — that have benefited the most. These include nations such as Cambodia, Vietnam and Myanmar.

Under the new code, INGER's broad policies and direction will be guided by an INGER Advisory Council made up mostly of CORRA representatives. A Technical Advisory Committee composed of selected IRRI and NARES representatives will provide additional guidance on technical matters. Above all, the code requires INGER to be transparent in all its activities.

IRRI Deputy Director General for Research Ren Wang (*left*) consults with R.S. Paroda, executive secretary of the Asia-Pacific Association of Agricultural Research Associations; Shankar Nath Shukla (*back to camera*), assistant director general of the Indian Council for Agricultural Research; and Zhai Huqu, president of the Chinese Academy of Agricultural Sciences, during a break at the fifth annual CORRA meeting.

COUNCIL FOR PARTNERSHIP ON RICE RESEARCH IN ASIA

POINT BY POINT

THE ROLE OF NARES

- The NARES will continue to provide outstanding varieties and breeding materials for worldwide exchange.
- The NARES will designate institutions for germplasm exchange and lead research institutions in implementing the INGER program in their respective countries.
- The NARES will designate a national INGER coordinator who will be the key contact person for variety nominations, consolidated nursery requests (types of nursery, number of sets, testing sites, cooperators), and processing import permit requirements.
- In implementing the INGER program, the NARES may decide to work with private breeding institutions in their respective countries.

INGER-DISTRIBUTED GERMPLASM

- The types of materials that can be nominated by the NARES and IARCs to INGER nurseries are traditional and released varieties, advanced breeding lines, and segregating populations.
- Hybrids can be accepted by INGER only if the inbred parents are also nominated for testing.
- Genetically modified rice populations will be accepted for evaluation only when INGER's NARES partners have the necessary facilities and guidelines for testing.
- INGER will accept materials from private breeding institutions nominated by the NARES.
- All materials nominated to INGER nurseries shall be accompanied by a material transfer agreement (MTA).
- All material distributed by INGER shall be accompanied by an MTA for FAO-designated germplasm and/or an MTA for non-designated germplasm, regardless of the seeds' source country or institution.
- Outstanding entries in nurseries will be stored in the International Rice Genebank at IRRI. They will be available for seed distribution when needed. They may or may not be designated to the FAO, according to the decision of the country that provided the materials concerned.

UTILIZING INGER-DEVELOPED RICE VARIETIES

- Any entry in the INGER nursery may be released as a variety or used as a parent in hybridization, provided that the national program doing so simply inform IRRI and acknowledge the origin and seed source of the selected materials.
- The naming of an INGER variety to be released in a country should be made in consultation with the variety source.
- For FAO-designated accessions, a recipient may not obtain intellectual property rights (IPR) on the germplasm or related information.
- For non-designated germplasm, the source of the materials reserves the right to allow or refuse permission for a recipient to seek any form of IPR on the material or related information.
- INGER will document the utilization of INGER genetic materials by the NARES.

INTERNATIONAL RICE COMMISSION 20TH SESSION IN JULY

The 20th session of the International Rice Commission (IRC) will be held at the headquarters of the United Nations Economic and Social Commission for Asia and the Pacific (UN/ESCAP) in Bangkok, Thailand, 23 to 25 July. Those interested in promoting sustainable rice production for food security are welcome to participate. Registration is at the venue on 23 July.

Every four years, the IRC organizes a session to review the emerging issues and recent achievements in scientific, technical and socio-economic matters relating to sustainable rice production and rice-based farming systems.

The main theme of the 20th session is "Rice for food security." Papers and reports belonging to the following sub-themes will be presented and discussed: issues and challenges in rice technological development for sustainable food security; rice in the world's trade; progress in rice genetic improvement for food security; progress in integrated management for sustainable rice production; regional strategies on rice production: Africa, Asia and the Pacific, and Latin America and the Caribbean; country presentation.

For inquiries contact:
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00100 Rome, Italy
Email: dat.tran@fao.org;
Fax: +39-06-57056347

INT'L SYMPOSIUM ON HYBRID RICE

The 4th International Symposium on Hybrid Rice is set for 14-17 May in Hanoi. The theme is "Hybrid vigor in rice for food security, poverty alleviation and environmental protection." Papers will be presented on aspects of technology generation and dissemination, and seed production. International and bilateral collaboration and policy issues will be discussed.

WILD RICE IN KATHMANDU NOW SET FOR 21-27 OCT 2002

The International Conference on Wild Rice (ICWR), which was originally scheduled for 4-10 November 2001 in Kathmandu, Nepal, was postponed because of the 11 September terrorist attacks. The organizational committee of the ICWR has rescheduled the conference for 21-27 October 2002 in Kathmandu.

Conferences, meetings and workshops at IRRI and elsewhere in 2002

Date	Event	Venue	Contact
3-5 April	IRRI Board of Trustees Meeting	IRRI Headquarters, Philippines	G.MacNeil@cgiar.org
8-12 April	Water-wise Practices in Rice Production	IRRI Headquarters, Philippines	B.Bouman@cgiar.org
8-12 April	International Crop Information System Development Workshop	Brisbane, Australia	G.McLaren@cgiar.org
14-17 May	4th International Symposium on Hybrid Rice	Hanoi, Vietnam	S.S.Virmani@cgiar.org
27-31 May	Progress Toward Developing Resilient Crops for Drought-Prone Areas	IRRI Headquarters, Philippines	R.Lafitte@cgiar.org
8-12 July	2nd International Rice Meeting	Havana, Cuba	M.M. Tamargo mireya@palco.cu
11-13 September	IRRI Board of Trustees Program Committee Meeting	Beijing, China	T.Mew@cgiar.org
16-20 September	1st International Rice Congress	Beijing, China	T.Mew@cgiar.org
22-25 September	1st International Symposium on Genomics and Crop Genetic Improvement	Wuhan, China	Q. Zhang croplab@mail.hzau.edu.cn
21-27 October	International Conference on Wild Rice	Kathmandu, Nepal	G.L. Shrestha gemnepal@info.com.np gyanlal@hotmail.com
28 October-1 November	Annual General Meeting of the CGIAR	Washington, DC.	

2002 IRRI group training courses (tentative listing)

Course/Venue	Duration (wks)	Target date	Coordinator/ Co-coordinator
Headquarters Courses			
Genetic Engineering and Nutrition in Rice (IRRI)	1	20-27 Apr	S. Datta
Intro to SAS Version 8 for Windows (IRRI)	1	6-10 May	G. McLaren/V. Bartolome
Scientific Writing and Presentation (IRRI)	2	13-24 May	S. Arboleda
Intro to IRRIStat (IRRI)	1	3-7 Jun	G. McLaren/V. Bartolome
Research Project Formulation and Implementation: Leadership Skills (IRRI)	3	3-21 Jun	R. Cuyno/R. Luna
Instructional Video Production (IRRI)	4	24 Jun-19 Jul	T. Clabita/D. Gavino
Two-Week Rice Production Training Course, 2nd offering (IRRI)	2	22 Jul-2 Aug	O. Garcia
Rice Breeder's Course (IRRI)	3	5-23 Aug	G. Atlin
Unbalanced Data Analysis (IRRI)	1	12-16 Aug	G. McLaren/V. Bartolome
ICIS Training (IRRI)	1	26-30 Aug	G. McLaren/V. Bartolome
IT Applications in Training and Delivery (IRRI)	2	9-20 Sep	A. Atkinson
Participatory Rural Appraisal (IRRI)	2	TBA	TBA
Leadership Course for Asian Women (IRRI)	2	Oct	M. Quiamco/T. Paris
Regional/In-country			
Training of Trainers (India)	4	15 Apr-10 May	G. Zarsadias/V. Bala
Rice Production Research (Thailand)	8	22 Apr-14 Jun	S. Phumiphon/O. Garcia
Integrated Pest Management (India)	3	June	TBA
Multi-Agents Systems for Natural Resources Management (Thailand)	2	22-26 Apr (Bangkok) 14-25 Oct (Chiang Mai)	F. Bousquet/G. Trebuil

TBA - To be arranged. Notes: Schedules are subject to change. For inquiries: inquiry@irri.exch.cgiar.org; Fax: (63-2) 891-1292; Mailing Address: DAPO Box 7777, Metro Manila, Philippines

Food security as economic stimulus

The benefits of the Green Revolution spread beyond the farm and the dinner table

In the years following World War II, there was growing concern about the food problem in Asia. The population was growing at close to 3% per annum, and the potential for further expanding cultivated area was limited. Attention focused on the need to increase the yield of rice, Asians' primary dietary staple, to avert widespread famine.

Success by IRRI and other Asian scientists in developing new rice varieties (in parallel with work in wheat by the International Maize and Wheat Improvement Center), coupled with the widespread use of ever cheaper forms of chemical fertilizer (see figure 1) and a rapid expansion in irrigated area, launched the Green Revolution. Growth in the Asian rice area slowed to almost nothing by the mid-1980s, and the high yields achieved by using fertilizer-responsive semidwarf varieties have accounted for almost all of the growth in Asian rice production since their introduction in the late 1960s (see figure 2). Consumers have benefited as rice prices have stayed well below their highs of the early 1970s (see figure 3).

The food security achieved by the Green Revolution was a critical first step in Asia's transition from an agricultural to an industrial society. In the 1960s, agriculture occupied two-thirds of the labor force and produced one-third of the gross domestic product (GDP) in most Asian countries. As those economies grew, agriculture became an ever smaller portion of the economy, both nationally (see table 1) and at the farm level (see figure 4) — thereby freeing capital, labor and land for investment in industry and services.

Adapted from Barker R, Dawe D. 2001. The Asian rice economy in transition. In: Rockwood WG, editor. Rice research and production in the 21st century: symposium honoring Robert F. Chandler, Jr. Los Baños (Philippines): International Rice Research Institute. p 45-77.

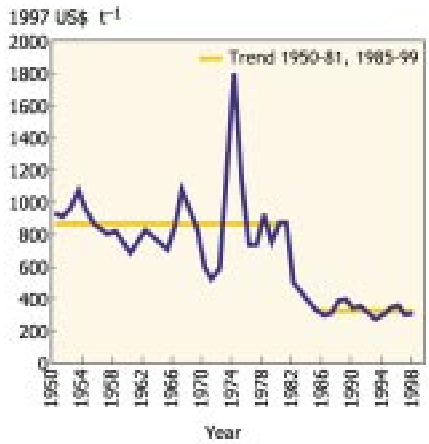


Figure 3. Real world rice prices (FOB Bangkok).

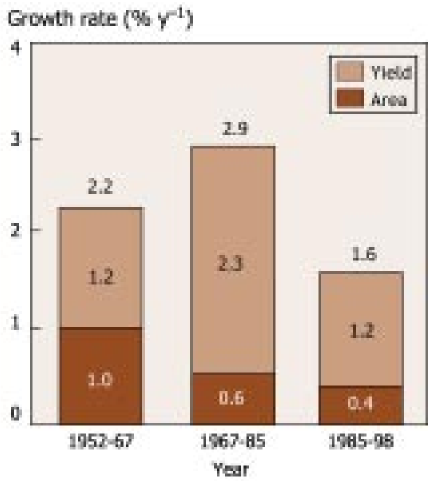


Figure 2. Changes by area and yield toward production growth in Asia, 1952-67 to 1985-98.

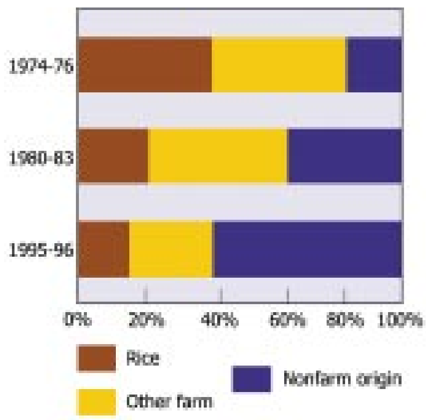


Figure 4. Changes in source of rural household incomes in a village in Laguna, Philippines (adapted from Hayami and Kikuchi 2000).

Figure 1. Relationship between world prize of urea and total fertilizer consumption in Asia, 1961-96.

Table 1. GDP and labor force in agriculture—1960s and 1990s.[a]

Region/country	GDP in agriculture (%)		Labor force in agriculture (%)	
	1960s	1990s	1960s	1990s
East Asia				
China	40	21	82	70
South Korea	37	7	66	18
Taiwan	28	3	56	10
Southeast Asia				
Indonesia	54	17	75	57
Malaysia	30	13	60	25
Philippines	26	22	62	43
Thailand	40	11	84	64
Vietnam	–	40	–	70
South Asia				
Bangladesh	53	31	86	61
India	47	26	75	62
Sri Lanka	28	23	56	47

[a]Sources: World Bank, World Development Reports, and Council of Agriculture, Taiwan.

DAVID DAWE
Agricultural Economist

THE 2nd GREEN REVOLUTION

The first Green Revolution substantially increased rice production in the Philippines, using a package of new seeds, fertilizer and irrigation. In his book *The Doubly Green Revolution: Food for all in the 21st century*, Gordon Conway calls for a second Green Revolution that stresses environmental protection. Few realize that this revolution is well underway in the Philippines.

The most damaging environmental consequence of intensive farm production in the past 30 years has been farmers' widespread use of pesticides, especially insecticides. Insecticide use exploded because of both supply and demand factors. On the demand side, farmers worried that their larger and more frequent harvests would attract insect pests. This fear, along with aggressive marketing by pesticide producers, led farmers to spray ever-increasing quantities of these chemicals on their crops.

On the supply side, advances in the chemical industry produced highly affordable pesticides. Many observers mistakenly view pesticides as expensive inputs that destroy farmers' profit margins. The fact is that pesticide costs, even in intensive production, absorb only a small share of the total value of the rice crop. Farmer surveys conducted for five years in eight rice bowls in China, India, Indonesia, Thailand, Vietnam and the Philippines found that total pesticide costs accounted for less than 3% of the gross value of production, on average across the sites. In the Philippines, the share was just 2%.

> FILIPINO FARMERS INTELLIGENTLY CHOOSE TO USE INSECTICIDES CAREFULLY, IF AT ALL. THIS IS A HEARTENING TREND

There are, however, many hidden costs. Indiscriminate use of pesticides kills insect pests' natural predators, such as spiders, causing an ecological imbalance that can actually contribute to pest outbreaks instead of preventing them. Probably the most egregious example of this phenomenon occurred on the Indonesian island of Java in the 1980s, when excessive pesticide use decimated the insect populations that preyed on the brown planthopper. The planthopper's short breeding cycle then allowed it to breed unchecked by predators.

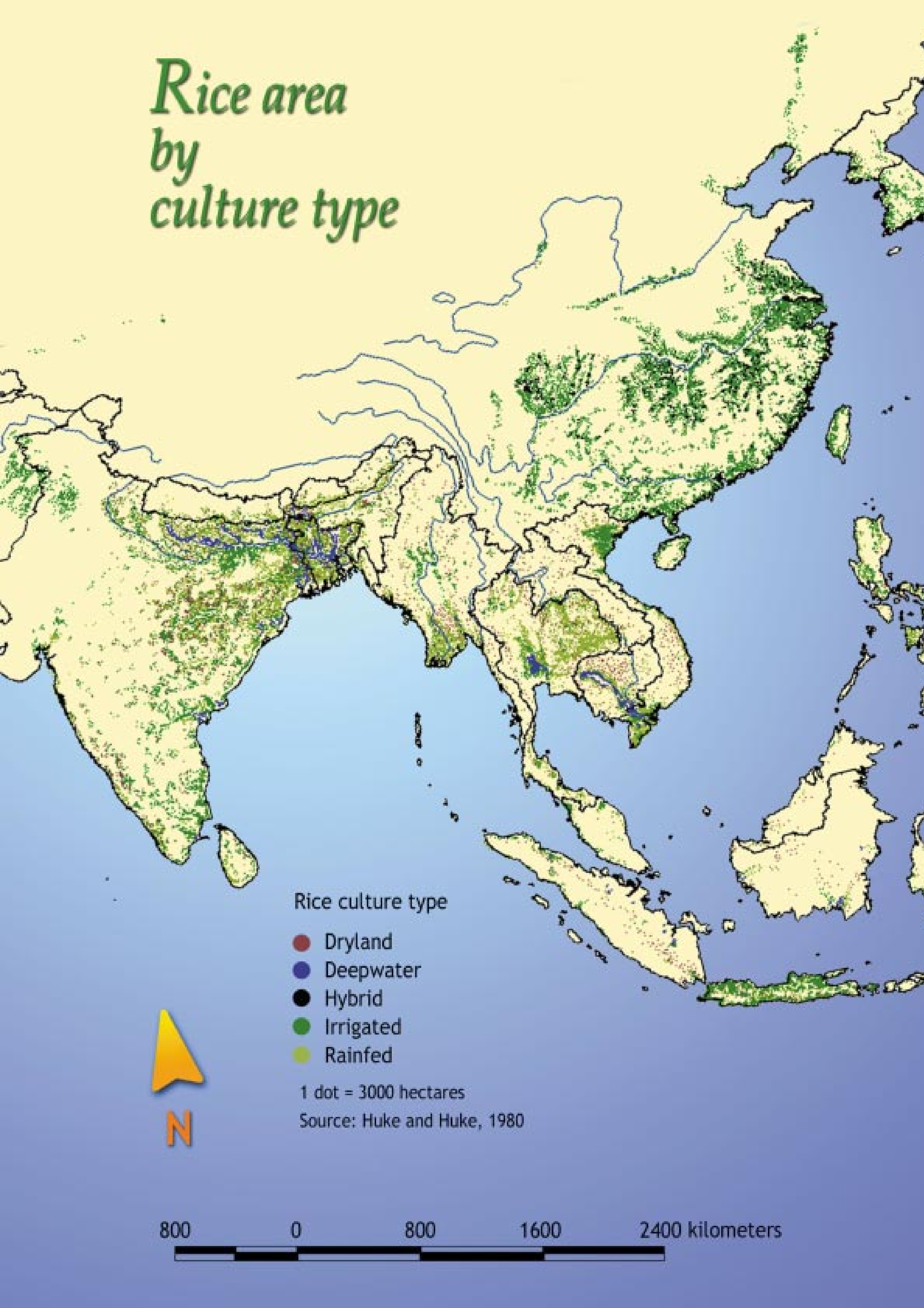
Worse, excessive pesticide use has damaged the health of farmers and consumers. Because of poor training and/or lack of money for buying proper pesticide application equipment, farmers are directly exposed to chemicals that injure their eyes, skin, respiratory tract and nervous system. Studies by Agnes Rola of the University of the Philippines Los Baños (UPLB) and Prabhu Pingali, formerly of IRRI, showed that the costs to farmers' health outweighed the benefits gained from pesticides. Furthermore, farmers sometimes apply pesticides very close to harvest, which endangers the health of consumers.

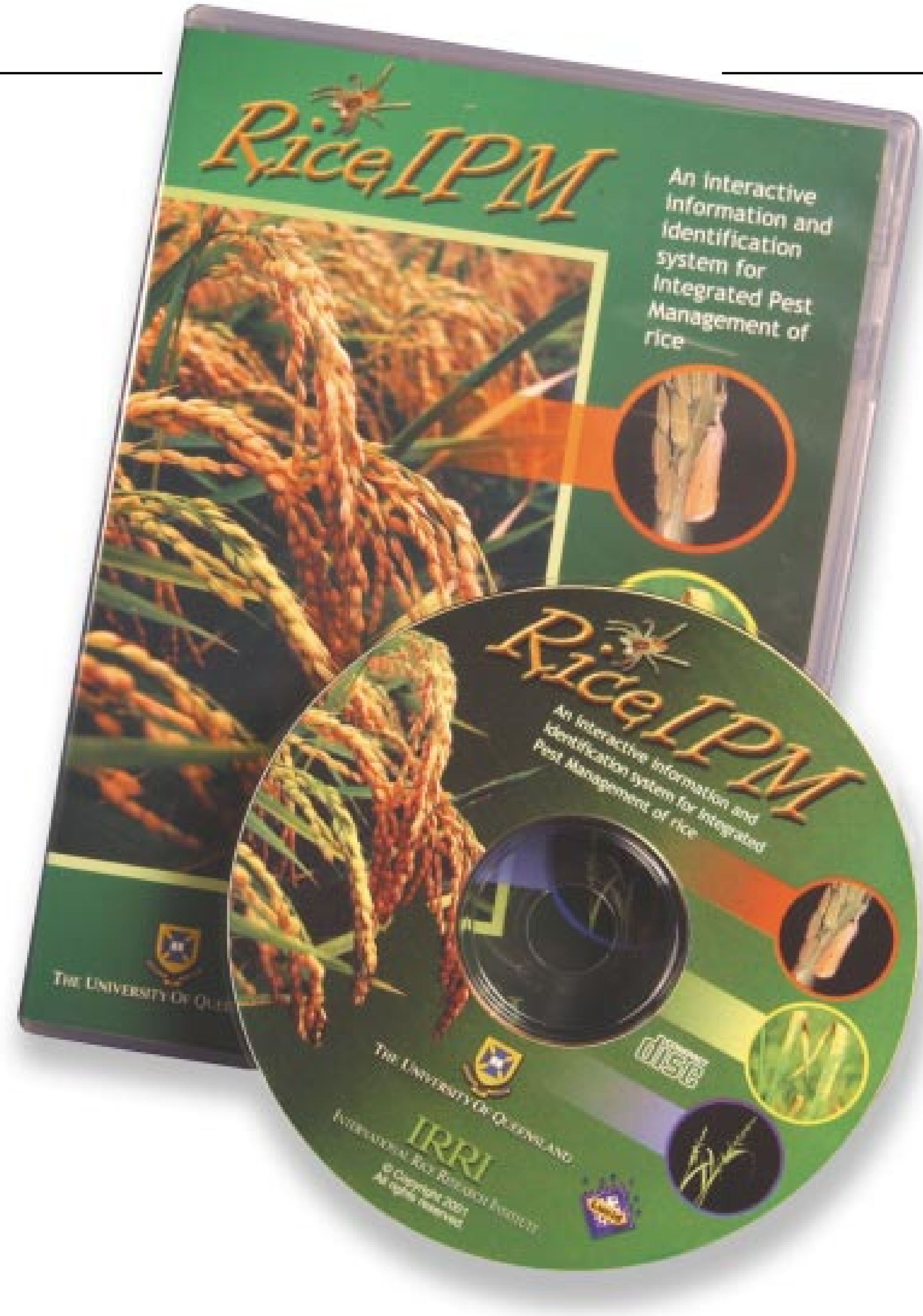
Yet there are grounds for optimism, especially in the Philippines. The above-mentioned survey found that farmers in Central Luzon applied by far the lowest levels of insecticides in any of the areas surveyed. The next lowest users, farmers in Tamil Nadu, India, used 60% more insecticides than the Filipinos. The highest users were farmers in Zhejiang, China, who applied more than 20 times as much active ingredient as the Central Luzon farmers.

The low level of insecticide use in the Philippines is the culmination of a declining trend that began slowly in the mid-1980s and accelerated in the 1990s. Among farmers surveyed in Central Luzon, the quantity of insecticide active ingredient applied per hectare increased ten-fold from 1966 to 1979, from less than 0.1 kg/ha to nearly 1.0 kg/ha. But by the middle of the 1990s, this figure had been cut in half. Since then, use has declined even more, and levels of insecticide use are now slightly *below* what they were before the first Green Revolution began. In contrast, recent data from China show that per hectare pesticide costs in rice cultivation increased steadily from 1980 to 1998.

Two main factors appear to account for low insecticide use by Filipino rice farmers. First, education campaigns based on research findings from entomologists at UPLB, the Philippine Rice Research Institute, IRRI and other organizations appear to have enjoyed some success in convincing farmers of the dangers of insecticide use. Second, insecticide prices are relatively high in the Philippines – double prices in Thailand, Vietnam and Tamil Nadu, and six times China's subsidized prices. That said, remember that pesticide costs are a relatively low 2% of total farm revenues for irrigated farms in Central Luzon – revenues that, by the way, are higher than in the rice bowls of neighboring countries. Thus, Filipino farmers can afford insecticides, but they intelligently choose to use them carefully, if at all.

This is a heartening trend, but much remains to be done. Many farmers still overuse insecticides, which still damage water supplies and the environment. More farmers must learn to differentiate harmful, harmless and beneficial insects, and about the damage pesticides do to the environment and their own personal health. The second Green Revolution against insecticide overuse in the Philippines is not yet won. But the good fight is underway, and substantial progress is being made.


Rice area by culture type
Rice culture type
Dryland
Deepwater
Hybrid
Irrigated
Rainfed
1 dot = 3000 hectares
Source: Huke and Huke, 1980
N
800
0
800
1600
2400 kilometers



Developed jointly by the International Rice Research Institute (IRRI) and the Centre for Pest Information Technology & Transfer (CPITT) at the University of Queensland, ***RiceIPM*** is an interactive training and resource package for researchers, advisers, and students. Focusing on tropical rice, this CD provides a comprehensive source of information and training material for improving the management of rice pests, including insect pests, diseases, and weeds.

A major feature of this knowledge management tool is that users can navigate through the content in any way they want to meet their own, specific information and learning needs. The combination of videos, images, hypertext links, and interactive keys provides a unique way of accessing the wealth of material contained on the CD. For instance:

- A diagnostics key assists users to shortlist the likely causes of observed rice disorders.
- A series of interactive, multimedia Lucid keys provide help to users in identifying insects found in rice.
- A customized search engine provides a rapid means of directing the user to specific topics to be found on the CD.
- The CD provides links to web sites that provide further information on specific topics.

The content of the CD—structured according to the competency standards required for proficient integrated pest management—has been researched and developed by an international team of IPM specialists from various countries in Southeast Asia and IRRI based in the Philippines.

RiceIPM contains sections on pest ecology; crop checking; fact sheets on major insect pests, rats, diseases, weeds, nutrient deficiency and toxicity; crop growth and pest damage; pest management options and decision-making and economics. A separate section of the CD provides material for researchers and advisers on various aspects of implementing IPM, including farmer field schools, multimedia campaigns, and stakeholder workshops. Other components include frequently asked questions, a multiple-choice quiz, a “slide-tape” tutorial on biological control, and an information sources section, including references, rice statistics, and glossary.