Rice Science for a Better World

Annual Report of the Director General, 2004-05

IRRI

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IRRI
International Rice Research Institute
www.irri.org

The International Rice Research Institute (IRRI) was established in 1960 by the Ford and Rockefeller Foundations with the help and approval of the Government of the Philippines. Today, IRRI is one of the 15 nonprofit international research centers supported by the Consultative Group on International Agricultural Research (CGIAR – www.cgiar.org).

IRRI receives support from several CGIAR members, including the World Bank, European Union, Asian Development Bank, International Fund for Agricultural Development, International Development Research Centre, Rockefeller Foundation, Food and Agriculture Organization of the United Nations, and agencies of the following countries: Australia, Austria, Belgium, Brazil, Canada, Denmark, France, Germany, India, Iran, Japan, Malaysia, Netherlands, Norway, People's Republic of China, Republic of Korea, Republic of the Philippines, Spain, Sweden, Switzerland, Thailand, United Kingdom, United States, and Vietnam.

The responsibility for this publication rests with the International Rice Research Institute.

Mailing address: DAPO Box 7777, Metro Manila, Philippines
Phone: +63 (2) 580-5600
Fax: +63 (2) 580-5699
Email: irri@cgiar.org
Home page: www.irri.org.
Riceweb: www.riceweb.org
Rice Knowledge Bank: www.knowledgebank.irri.org
Courier address: Suite 1009, Pacific Bank Building
6776 Ayala Avenue, Makati City, Philippines
Tel. +63 (2) 891-1236, 891-1174, 891-1258, 891-1303

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Production team
Writers: Jay Maclean, Gene Hettel
Editors: Tess Rola, Bill Hardy, Gene Hettel
Design and layout: George Reyes, Mannie Panisales

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Volume 15, March 2005

An update from William Padolina
ACTING DIRECTOR GENERAL

RESEARCH PROGRESS IN 2004

As we have pointed out to audiences on every continent during the International Year of Rice just concluded, IRRI has a major role to play in achieving many of the United Nations Millennium Development Goals (www.undp.org/mdg)—especially goal #1—the eradication of extreme poverty and hunger. Rice is so central to the lives of most Asians that any solution to global poverty and hunger must include research that helps poor Asian farmers reduce their risks and earn a decent profit while growing rice that is still affordable to poor consumers.

To meet this challenge, IRRI's research and related activities are grouped into 12 projects under four programs, covering genetic resources, enhancing rice productivity and sustainability in favorable environments, improving productivity and livelihood for fragile environments, and strengthening linkages between research and development. The work is guided by and implemented through two research consortia—one for irrigated areas and the other for the less favorable environments—consisting of scientists from IRRI and national agricultural research and extension systems (NARES). Much was accomplished in 2004.

On genetic resources, the International Rice Genebank continues to maintain, document, and share germplasm of rice and biofertilizers. The total number of accessions at the end of 2004 was 106,865, of which the core collection, a subset of samples representing the range of rice varieties and ecosystems, was about 10%. More than 300 "nursery" sets of germplasm were distributed and 400 outstanding lines from the International Network for Genetic Evaluation of Rice (INGER) were sent to requestors in seven countries.

The search for a gene that allows plants to perform well in phosphorus-deficient soils has been narrowed down to two candidates. We found inheritance of brown planthopper resistance to be controlled by a single dominant gene; we are already sharing resistant plants with national programs. A single gene may also control tungro virus resistance, whereas a network of genes appears to confer broad resistance to some biotic stresses and tolerance for abiotic stresses in some varieties.

On improving productivity, rice varieties with improved tolerance and resistance continue to be developed in collaboration with national partners for release to farmers. Several lines of IRRI's new plant type with resistance to blast, bacterial leaf blight, tungro, and brown planthopper became available. Other lines that tolerate low temperature also became available. Lines that combine high yield and improved drought tolerance are being tested in farmers' fields in India as are salt-tolerant lines in Bangladesh. Rice yield under moderate to severe lowland drought stress was finally confirmed to be a heritable trait.

Collaboration between IRRI and the Thailand Department of Agriculture has resulted in two new varieties of the popular Thai jasmine rice with superior performance in areas where drought and blast fungus affect yields, such as northeastern Thailand. One variety is proposed for release in 2005 and should be rapidly adopted by farmers in that area. This work can now be used to speed up the development of high-quality and high-yielding varieties in other areas.

Lines of japonica rice adapted to the tropics have been developed; they give yields comparable with those of indica, and—according to a consumer panel—have the japonica grain quality and palatability.

A conclusion from IRRI's work on aerobic rice is that it is useful as an alternative crop in rainfed lowland systems with unreliable rainfall. The aerobic rice systems we tested use half or less of the water needed for flooded lowland systems, although they yield 20–30% less; the cause and prevention of yield decline remain major research challenges.

New hybrid rice lines with superior grain quality became available in 2004 and will be used extensively in future hybrids. Yields of lines tested in drought-prone rainfed lowlands in India were at least 1 ton per hectare higher than those of varieties presently in use. Other lines with superior salinity tolerance have been identified. IRRI scientists obtained unprecedented hybrid seed yields of more than 2 tons per hectare in 2004 using improved management methods.

For micronutrient enrichment, IRRI distributed rice varieties possessing elevated levels of iron for evaluation in several countries to confirm the iron content and its distribution in the grain. Also developed were varieties that incorporate genes from other plants for beta-carotene synthesis (for vitamin A) and increased protein and iron content in milled grain. These transgenic plants are being tested at IRRI to obtain the most suitable lines.

Several nursery and nutrient management practices that improve rice plant survival or yield were either developed or confirmed in 2004, including improved dry-seeding practices in rainfed areas, more efficient nutrient management and low seeding rates in flood-prone areas, covers for cold-affected plant nurseries, and calcium and phosphorus addition to soils and zinc oxide root dipping in saline areas.

Major improvements in the management of new plant type lines were made: seedlings should be transplanted early—between 7 and 14 days rather than after 20—which produces more tillers and dry matter and, hence, better yield.

We have developed a simple rule-of-thumb for using alternate wetting and drying instead of flooding rice fields when water is moderately scarce: re-irrigate the field when ponded water levels have dropped to 15–20 cm below the soil surface. This technique saves about 20% of the water used without affecting yield.

Weed management, rodent management, laser leveling of land, milling techniques, mechanized direct-seeding methods, and grain storage bags are some of the other aspects of the rice farming spectrum that have seen progress in 2004 by IRRI and collaborators.

On linkages between research and development, use of the Rice Knowledge Bank continues to grow, with more than 400,000 users by the end of 2004. IRRI, with NARES, used a variety of means to familiarize farmers with new technologies: posters and publications, an improved leaf color chart, radio programs, and slogans (such as the "3 reductions"—of pesticides, fertilizers,

and seeding rate—which has become national policy in Vietnam). Many training courses, covering not only research and extension but also English, leadership, scientific writing, and presentation skills, were given at IRRI and in-country during 2004. More than 14,000 people have received training at IRRI to date.

More details of our research progress and achievements during 2004 can be found beginning on page 13.

INTERNATIONAL YEAR OF RICE 2004

The 2004 International Year of Rice (IYR) afforded IRRI and its staff a unique opportunity to emphasize the importance of rice production and research to a worldwide audience. From the first celebration of the IYR at the ASEAN Secretariat in Jakarta on 13 January and the official launching at the FAO Rice Conference in Rome, 12-13 February, through to the culminating World Rice Research Conference (WRRC), in Tsukuba, Japan, 4-7 November, IRRI staff members traveled the globe to proclaim that "rice is life" and to mobilize the international community to face the most pressing issues confronting the global rice sector, from local farming practices to international trade.

In Rome, IRRI Director General **Ronald Cantrell** pointed out that "a country can achieve 'national' food security, but still have a large part of its population not enjoying 'household' food security, which is providing poor families with enough income to lead healthy, active lives." And later in Tsukuba, he added that "the world's poor will achieve household food security only when—in addition to being available in sufficient quantity—the food is of ample quality as well." Certainly, rice researchers have a major role to play in achieving this.

At the WRRC alone, more than 40 IRRI scientists and researchers participated in the 4-day event. Overall, the conference attracted more than 1,200 delegates from 15 countries, making it one of the largest rice research gatherings in the Institute's 44-year history. At Rome and Tsukuba and at 22 additional international and national conferences and workshops in between, IRRI either displayed major rice exhibits with staff on-site or supplied materials for local setup.

A full schedule of IYR events in the Philippines started with the Crop Science Society of the Philippines 35th Anniversary and Annual Scientific Conference in Davao, 8-12 March, and culminated with an International Rice Forum, Festival, and Exhibit at the Philippine Trade Training Center in Manila, 27-29 November.

At IRRI headquarters in Los Baños, we arranged programs for the visits, interviews, and filming by media representatives from all over the world—from Canada to Australia, Finland to Singapore, and the United States to France. For more details on IRRI's extensive IYR activities, see under "Visitors and Information Services" beginning on page 102.

SIXTH EPMR REPORT WRITTEN, REVIEWED, AND APPROVED

During the week of 15-19 March, the arrival of the Sixth External Program and Management Review (EPMR) Panel, chaired by **Richard Flavell**, chief scientific officer of Ceres Inc. (photo below), signaled the culmination of many months of preparation and the main phase of this important activity. In addition to Prof. Flavell, the panel members were **John Griffith**, retired specialist in finance and general management; **Huhn-Pal Moon**, vice administrator, Rural Development Administration, Korea; **Dr. Ann Hamblin**, director, Agricultural Production and Natural Resources, Bureau of Rural Sciences, Canberra; **Martin Kropff**, professor of weed science, Wageningen Agricultural University, Netherlands;

and **Ammar Siamwalla,** former president, Thailand Development Research Institute.

When turning over the report to the Board of Trustees (BOT), Dr. Flavell said the panel was delighted to be able to deliver a very positive evaluation of IRRI's performance and the Institute's future. He urged all IRRI staff to "celebrate" the Institute's achievements and to be proud to work at such an important and successful organization. He added that, while some research areas might need some fine-tuning, overall, the panel had given IRRI a very strong and favorable endorsement. The panel's encouraging report was reviewed by the BOT during its meeting at IRRI headquarters, 31 March-2 April, and was later approved during the CGIAR Annual General Meeting in Mexico City, 27-29 October.

FUNDING

In general, IRRI's finances improved in 2004, thus providing a better environment for our researchers to do their work. Total donor funding was US$32.6 million—about 20% above the previous year's US$27.1 million (see page 51 for a listing of individual donor grants). The increase can be attributed to modest new grants, currency exchange gains, and elevated expenditures in restricted and Challenge Program projects.

We are now in a position—from 2005 onward—to maintain annual balanced budgets. One major development was the decision by DFID (the UK's Department for International Development) to both nearly double and reclassify its attributed grants as unrestricted. Some donors increased their unrestricted grants by modest amounts.

DIRECTOR GENERAL TRANSITION

During its spring meeting, the BOT regretfully accepted the resignation of Director General **Ronald Cantrell**, who announced his departure effective 31 December 2004 due to health and family reasons. Dr. Cantrell joined IRRI on 1998 at a time when strong leadership was truly needed. He revived IRRI with his strong scientific, intellectual, and managerial talents.

As part of a farewell program on 13 December, Dr. and Mrs. Cantrell unveiled the dedication plaque of the *Ronald P. Cantrell Building*, formerly CPS 1 and 2, which houses Communication and Publications Services and Information Technology Services (photo at upper right). The plaque, which eloquently sums up Dr. Cantrell's 6+ years at IRRI, reads: *"The Trustees of the International Rice Research Institute have named this building in honor of Ronald P. Cantrell, Director General, 1998-2004, in recognition of his strong leadership and intelligent management at a time when this combination of talents was urgently needed. He secured a place for the Institute on the cutting-edge of information and communication technology and the new science of functional genomics ushered in with the sequencing of the rice genome. He also oversaw the continued development of innovative, sustainable rice production systems for both irrigated and unfavorable environments and articulated the importance of household food security for millions of poor rice farmers and consumers."*

As soon as Dr. Cantrell announced his resignation in March, the process was set in motion to find his successor. The Institute was very fortunate to have had a shortlist of world-class candidates for the position and thanks all those who applied and especially those who took part in the interview process.

On 3 February 2005, the Institute named **Robert (Bob) Zeigler** as the next director general (photo below). An internationally respected plant pathologist with more than 20 years' experience in agricultural research in the developing world, the Urbana, Illinois, native assumes his new duties on 1 April 2005. Among his many important positions in the developing world, Dr. Zeigler

worked at IRRI as a plant pathologist from 1992 to 1998, during which he led the Rainfed Lowland Rice Research Program (1992-96) and the Irrigated Rice Research Program (1996-98).

BOT MEMBERSHIP TRANSITION

The Institute welcomed two new members of the Board of Trustees for 2005-07 terms, both from Australia: **Elizabeth Jean Woods** (top right), executive director of research and development strategy at the Australian Department of Primary Industries and Fisheries, and **Ralph Anthony "Tony" Fischer**, ACIAR's South Asia program advisor. Also joining the Board as an ex officio member, when she became the 19th president of the University of the Philippines (UP) on 9 February 2005, was **Emerlinda R. Roman**.

We bade farewell to ex officio member **Francisco Nemenzo** (1999-2005), outgoing UP president, and to **Calvin Qualset** (United States, 1999-2004) and **Emanuel Adilson S. Serrão** (Brazil, 1999-2004).

IRRI-CIMMYT ALLIANCE

As of this writing in early 2005, IRRI and CIMMYT (International Maize and Wheat Improvement Center) had announced details of a new IRRI-CIMMYT Alliance aimed at boosting international efforts to fight rural poverty and strengthen food security in the developing world. The Alliance will especially focus on harnessing science to provide the world's millions of poor farmers with improved access to new technologies that will make them more productive and help lift them out of poverty, as well as developing sustainable solutions to the developing world's urgent need for reliable food supplies, particularly involving the three major cereals: rice, wheat, and maize.

To recap, in April 2003, the BOTs of IRRI and CIMMYT agreed to explore opportunities for closer collaboration. In September 2003, the Rockefeller Foundation was asked to provide leadership for the process of exploring various options for an alliance. In November 2003, **Gordon Conway**, president of the Rockefeller Foundation, proposed establishing an Oversight Committee and a Working Group to examine the feasibility of closer ties between IRRI and CIMMYT. In 2004, the Working Group was formed and visited IRRI and CIMMYT headquarters and other relevant locations, as it prepared a report for submission to the Oversight Committee, which met in Bellagio, Italy, in September 2004.

The IRRI and CIMMYT BOTs met in a joint session in Shanghai, China, on 7-9 January 2005 to review the Working Group and Oversight Committee recommendations and to map out details of the new Alliance. The two boards identified four research priorities as potential first programs of the new Alliance, each with a single leader and integrated budget: (1) intensive crop production systems in Asia, (2) cereals information units, (3) training and knowledge banks for the three crops, (4) and climate change research directed at the three crops. Once these four initial Alliance programs are further considered by the staff of both centers and approved by each Board of Trustees later in 2005, other programs will also be considered. To further maximize the operational efficiency of the two centers, the IRRI-CIMMYT Alliance will also consider sharing a range of support services.

As of this writing, IRRI and CIMMYT have named joint working groups to draft implementation plans for the four priority research programs and shared services in consultation with stakeholders. The BOTs of both institutions will review these plans in September-October 2005. A joint committee on governance and management has also been formed.

IRRI'S ENVIRONMENTAL AGENDA

To assure that environmental sustainability will always be central to our research projects, as well as to our day-to-day operations at our research campus headquarters in the Philippines, IRRI has codified its longstanding commitment to environmental protection and sustainable rice production. As part of the World Rice Research Conference mentioned above, Dr. Cantrell formally launched IRRI's Environmental Agenda (IEA).

"To take the environmental approach in this more holistic way, to consciously commit to conserving the environment and achieving sustainable development, and to package it in this way, we think, is something unique among the Future Harvest Centers of the CGIAR," said Dr. Cantrell during the WRRC launch. He went on to say: "The bottom line is that farmers across the rice-producing world need to join the Doubly Green Revolution to grow more rice more efficiently. Smart research, carefully managed according to the environmental principles now enshrined in our *Environmental Agenda*, will keep us on target as we work to help the world's rice farmers grow their crop in an environmentally sustainable way."

On 22 November, Dr. Cantrell announced the establishment of a 16-member IRRI Environmental Council (IEC), with the mandate to provide a mechanism to ensure the long-term implementation, continued development, and evolution as well as success of the IEA. New Director General Robert Zeigler will serve as the IEC chair. A publication, which provides details of the IEA, can be downloaded at www.irri.org/docs/IRRIEnvironmentalAgenda.pdf.

ASEAN ESTABLISHES FORMAL TIES WITH IRRI

In the most important new strategic initiative during 2004, the 10-nation Association of Southeast Asian Nations (ASEAN) agreed to establish formal ASEAN-IRRI relations. The move marks the beginning of the first-ever official ties between IRRI and the world's largest formal grouping of rice-producing nations. ASEAN consists of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam but also meets with other nations in the region via special collaborative mechanisms such as the ASEAN Plus Three grouping—China, Japan, and Korea.

The decision to accept IRRI as an official partner was made by a special meeting of ASEAN Senior Officials (SOM) for agriculture and forestry on 11-13 August in Kunching, Sarawak, Malaysia. IRRI representatives later attended the next SOM and a meeting of ASEAN Ministers of Agriculture and Forestry (AMAF) in Myanmar in October that included a meeting of all the ASEAN Ministers of Agriculture Plus Three.

We look forward very much to working with the nations of ASEAN to further develop this important new alliance, which is sure to greatly benefit the region's rice farmers and consumers. Not only does this powerful new partnership bring together two important institutions in Asia, but also it does so at a crucial time for the ASEAN rice industry. We must help farmers reduce their costs and increase their productivity.

KING OF THAILAND UPDATED ON IRRI'S WORK

IRRI BOT Chair **Keijiro Otsuka**, Director General **Ron Cantrell**, and IRRI Spokesperson **Duncan Macintosh** paid a courtesy visit to His Majesty the King of Thailand, **Bhumibol Adulyadej** (photo above), on 25 August. The Thai Minister of Agriculture, **Mr. Somsak Thepsutin**, and the Permanent Secretary of the Thai Ministry of Agriculture and

Cooperatives, **Mr. Banphot Hongthong**, accompanied them. The audience lasted for almost 2 ½ hours, instead of the scheduled 30 minutes, with the discussions covering such topics as postharvest losses and storage of rice. His Majesty stated that "IRRI was doing good and important work and that the Ministry should do all it could to help."

IRRI RESPONDS TO TYPHOON AND TSUNAMI DISASTERS

Late 2004 was a particularly bad time for natural disasters in the Philippines and Asian nations rimming the Indian Ocean. On 7 December, IRRI transported more than 300 bags of relief goods and supplies to Infanta, one of the isolated Philippine municipalities in Quezon Province hardest hit by devastating landslides caused by typhoons Unding, Violeta, Winnie, and Yoyong, in response to an appeal made by Infanta Integrated Community Development Assistance, Inc. (ICDAI). Our Community Relations Office (CRO), the central coordinating point for relief operations, received general cash donations from the IRRI community.

The CRO installed drop boxes for cash donations around the Institute. Donations in kind such as those coming from the Rotary Club of West Bay and other individuals were deposited at IRRI for packaging by volunteer staff coordinated by the Society of IRRI Nonresearch Professionals (SINoP), with assistance from the IRRI-Philippine Institute of Certified Public Accountants (PICPA) chapter. Volunteers worked over the weekend to pack and prepare the relief bags (photo above). IRRI provided transport to ferry the donations to where they were needed.

In the wake of the tragic tsunami disaster to hit Asia on 26 December, IRRI received urgent requests from Malaysia and Sri Lanka for seeds of saline-tolerant rice varieties that would grow in the devastated areas. In our International Rice Genebank, we were able to identify varieties that can grow and produce grain under saline soil conditions.

IRRI researchers studied the rice production problems in the battered areas of Indonesia and India and a two-person team visited Sri Lanka in February. The Institute is also using the Internet via the Rice Knowledge Bank (www.knowledgebank.irri.org/TsunamisAndRice/) to provide essential information on growing rice in the aftermath of the tsunami to anyone working with rice farmers, anywhere, and at any time.

2004 STRATEGIC INITIATIVE FUNDING

In August, DDG-R **Ren Wang** announced that the Institute had set aside $100,000 from the 2004 core research program budget to carry on IRRI's Strategic Initiative Fund (SIF). This fund was established in 2003 to bridge gaps in areas of geographic/agropolitical priority, such as projects on capacity-building activities in a rice-producing developing country that are not given priority by donors and/or are of scientific and technical potential and priority, such as the development of a new technology. In 2003, IRRI supported four projects involving aerobic rice, physiological studies and others, with activities in Myanmar, Central Asia, and the Caucasus region.

Based on discussions with the senior research managers' group and some consultation with the national programs, two proposals were approved for funding using SIF support in 2004. These were *Induced plant responses: a potential approach for managing insect pests* by **Yolanda Chen** and **K.L. Heong** ($45,000 for 2004-06), an activity placed under Program 2, Project 4; and *Household food security and economic transitions in uplands: a cross-country comparative analysis in the Greater Mekong Subregion* by **Sushil Pandey** ($40,000 for 2004-06), placed under Program 3, Project 8.

IRRI OPENS GRAIN QUALITY AND NUTRITION RESEARCH CENTER

IRRI officially opened its new Grain Quality and Nutrition Research Center (GQNRC) on 15 December 2004. Director General **Ronald Cantrell** (2nd from left in top photo of the next page) led the ribbon-cutting ceremony, with consultant **Robin Graham** (right) and **Bienvenido Juliano**, PhilRice consultant and former long-time cereal chemist at IRRI (left). GQNRC

Head **Melissa Fitzgerald** (center) gave the opening remarks, which were followed by a laboratory tour and afternoon tea to celebrate.

The GQNRC will contribute to IRRI's objectives of releasing rice varieties of superior visual, sensory, and nutritional quality by evaluating breeder lines, conducting relevant research, collaborating with other research groups, and training other NARES in the best, newest, and most efficient and cost-effective methods of evaluating rice quality and nutrition.

UPDATE ON IRRI STAFFING

Changes in responsibility. In August 2004, **K.L. Heong**, project team leader (PTL) for Project 4 (*Managing resources under intensive rice-based systems*), replaced **Suan Pheng Kam** as PTL for Project 8 (*Natural resource management for rainfed lowland and upland rice ecosystems*). **David Johnson**, senior weed scientist, replaced Dr. Heong as PTL of Project 4. CSWS Head **T.P. Tuong** was concurrently appointed as the new PTL for Project 11 (*Ecoregional approaches for integrated natural resource management and livelihood improvement*). At the Institute's Annual Program Review in November, it was agreed that Project 11 would be merged into Project 8, effective 3 January 2005, with Dr. Heong having the overall responsibility of managing Project 8, including outputs/activities transferred from Project 11. Likewise, all administrative matters concerning Project 11 are now under Project 8.

On 24 February 2005, **Gary Jahn**, senior scientist in EPPD, became leader of the Lao IRRI Rice Research and Training Project (LIRRTP), replacing **Bruce Linquist.**

Also in January 2005, **John Bennett** was named new PTL for Project 7 *(Genetic enhancement for improving productivity and human health in fragile environments)* and deputy head of PBGB and **Darshan Brar** was named the new PTL for Project 3 *(Genetic enhancement for yield, grain quality, and stress resistance)*. This came about because Principal Scientist **Sant Singh Virmani** will be retiring from IRRI in July 2005. To enable him to focus on scientific issues in the development and use of hybrid rice technology during his remaining time at the Institute, he was relieved of his responsibilities as Project 3 leader and PBGB deputy head.

Departures and arrivals since the last DG Report. In addition to the departure of Dr. Cantrell in December 2004 and pending arrival of Dr. Zeigler on 1 April 2005, we bade farewell to a number of IRRI staff, who have either retired or resigned to take on new assignments, and welcomed several new staff members.

After 29 years of service to the Institute, **Tom Mew**, IRRI principal scientist, EPPD head, Program 3 leader, head of the Seed Health Unit (SHU), and coordinator of the Consortium for Unfavorable Rice Environments (CURE), retired from IRRI on 5 August. Dr. Mew was honored in a tribute organized by EPPD. Part of the program was a mini-symposium on *Sustainable Crop and Disease Management,* which presented highlights of Dr. Mew's research on seed health (SHIP Project in Bangladesh), management of bacterial blight, exploiting biodiversity for disease management, and biological control of rice diseases. During the symposium, the activities of SHU on rice seed health testing at IRRI were presented. **Suan Pheng Kam**, SSD, presented *CURE: the Mew prescription for the fragile rainfed environments*. **Gelia Castillo**, IRRI consultant, gave the keynote address and presented Dr. Mew with *10 lessons from life*. She described Dr. Mew as a dreamer and a positive thinker. "For the millions of Asians for whom rice is life, science best serves its human purpose and what better scientists have served this human purpose than a scientist like Dr. Mew and his kind at IRRI," said Dr. Castillo. The photo below shows Dr. Mew with his wife, Tita, and daughters Aiyling (left) and Jialing (right).

Thanda Wai, intellectual property rights specialist (2001-04), departed in March and was replaced by **Gerard F. Barry**, who is also the Golden Rice Network coordinator.

Ram Kathin Singh, liaison scientist for India, who served the IRRI-India office for 9 years, retired in June 2004. He was replaced by **Jagdish K. Ladha**, who also continued his other duties as senior scientist, soil science, in CSWS and coordinator of the Rice-Wheat Consortium.

Karl Goeppert, IRRI representative and team leader of the LIRRTP, departed for Christian Relief Services in Baltimore (USA) on 12 May. He was briefly replaced as team leader by IRRI senior scientist and upland agronomist **Bruce Linquist**, who himself departed for the University of California, Davis in February 2005 after serving IRRI in Laos for 8 years. **Ho-Yeong Kim**, a senior scientist in PBGB who joined IRRI in 2001, also left in May 2004.

Albert Atkinson, training and courseware specialist, departed on 15 May for the Asian Development Bank after spending nearly 3 years developing IRRI's Rice Knowledge Bank (www.knowledgebank.irri.org).

Guy F. Trébuil and **François Bousquet**, CIRAD scientists seconded to SSD since 2001, completed their assignments in IRRI's Bangkok office in June 2004. Also in June, **Conrad Stevens**, molecular biologist/molecular pathologist for the PETTRA Project (2001-04), left after completing his assignment.

In September and October, the following staff departed IRRI for other positions in Japan: **Yosimichi Fukuta** (1999-2004) and **Seiji Yanagihara** (2000-04), senior scientists, plant breeding, PBGB, and **Takuhito Nozoe**, senior scientist, agronomy, CSWS (2000-04).

In November 2004, **Suan Pheng Kam**, geographic information systems specialist (1994-2004), and **David Dawe**, senior scientist, agricultural economics (1997-2004), both resigned from SSD. Dr. Kam returned to her home country, Malaysia, where she joined the WorldFish Center, and Dr. Dawe moved to Bangkok to be an economist at FAO. Also, **Peter Fredenburg**, writer/editor, VIS, and managing editor of *Rice Today* (2001-04), departed in December after completing his assignment.

In April 2005, **Swapan K. Datta** (1993-2005) and **Karabi Datta** (1996-2005), senior scientists, plant biotechnology in PBGB, will leave after completing their assignments.

Renee Lafitte, senior scientist, physiology, CSWS (1997-2005), has resigned effective in April. **Mark Bell**, currently head of both IPMO and the TC, has resigned effective in July 2005 after more than 10 years at IRRI in various positions.

Joining IRRI in 2004 were **Melissa Anne Fitzgerald,** an international research fellow in charge of the new Grain Quality and Nutrition Research Center; **Hung-Goo Hwang**, senior scientist in PBGB; **Yasukazu Hosen**, soil scientist in CSWS; and **Glenn Gregorio**, scientist and rice breeder for Africa in PBGB. Also joining PBGB during the first quarter of 2005 are **Nobuya Kobayashi**, scientist, plant breeding, and **Sigrid Heuer**, scientist, molecular biology. **Deborah Templeton,** scientist, social science/economics joined SSD in March. **Kumi Yasunobu**, an IRS seconded from JIRCAS, will join SSD in May 2005.

A complete listing of staff arrivals and departures in 2004, which includes international research and postdoctoral fellows, begins on page 85.

AWARDS AND HONORS

CGIAR Outstanding Scientific Article. A team of IRRI scientists won the 2004 CGIAR Science Award for Outstanding Scientific Article for their article *Enhanced iron and zinc accumulation in transgenic rice with the ferritin gene*, published in *Plant Science*. The team was composed of **Marta Vasconselos**, **Karabi Datta**, **Norman Oliva**, **Mohammad Khalekuzzaman**, **Lina Torrizo**, **Sellapan Krishnan**, **Margarida Olibeira**, **Fumyuki Goto**, and **Swapan K. Datta**.

King Baudouin Award. Also during the 2004 CGIAR annual general meeting in Mexico City, the Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC) received the CGIAR King Baudouin Award. The award recognized the RWC's seminal role in charting a course toward more ecologically friendly, higher producing agriculture among the poor in Asia. The RWC includes the national agricultural systems of Bangladesh, India, Nepal, and Pakistan; research centers **IRRI**, CIMMYT, ICRISAT, CIP, IWMI, and AVRDC; and various advanced research institutions.

Koshihikari Rice Prize. In recognition of his contributions to hybrid rice breeding, genetics, and seed production, IRRI Principal Scientist **Sant Singh Virmani** (second from left in photo at upper left of next page) was chosen as one of two 2004 recipients of the Koshi-

hikari International Rice Prize. Dr. Virmani, who has been working at IRRI on hybrid rice since the early 1970s, shared the award with Dr. Hae-Chune Choi (second from right in photo), a prominent rice breeder in Korea and director of the Rice Genetics & Breeding Division, National Institute of Crop Science, RDA. The award ceremony was held on 5 February 2005 at the International Activities Plaza in Fukui City, Japan. During the event, both winners gave seminars about their research and each received a cash prize of 500,000 yen. On 9 January 2005, the Government of India named Dr. Virmani as one of the recipients of the Pravasi Bharatiya Samman Award, which recognizes the contributions made by nonresident Indians (Pravasi Bharatiya) to the development of India and the world in general.

Three major awards for Glenn Gregorio. **Glenn Gregorio** (photo, upper right), international research fellow in PBGB at the beginning of the year and later appointed scientist and rice breeder for Africa in PBGB, received the 2004 Achievement Award for Crop Science Research from the Crop Science Society of the Philippines (CSSP) during its annual scientific conference in Davao City in March. In June, The National Academy of Science and Technology, Philippines, named Dr. Gregorio the 2004 Outstanding Young Scientist (OYS) in the field of genetics. Then in December, the Philippine Jaycees, Gerry Roxas Foundation, and the TOYM (The Outstanding Young Men) Foundation named Dr. Gregorio as one of this year's 10 recipients of the TOYM award in the field of plant breeding and genetics.

SSSA and ASA fellows. Senior CSWS scientists **J.K. Ladha**, soil science, and **Shaobing Peng**, crop physiology, were named fellows of the Soil Science Society of America (SSSA) and the American Society of Agronomy (ASA), respectively.

As in every year, numerous other IRS and NRS received various awards and honors. See the complete listing beginning on page 61.

SIGNIFICANT ACTIVITIES AND EVENTS SINCE THE LAST DG REPORT

19th RDA-IRRI Collaborative Research and Training Workplan Meeting. In April, eight scientists from the Rural Development Administration (RDA) and the IRRI-Korea Office (IKO) met with their counterparts at IRRI. The meeting ended with a signing of the 2004-05 collaborative workplan between RDA and IRRI. The Korea (RDA)-IRRI collaboration is unique and we would like to acknowledge the invaluable support of RDA in establishing the IKO and its increasing financial support to the partnership with IRRI.

RKB enhancement. In May, Bangladesh, China, and Nepal added their country-specific sites to the Rice Knowledge Bank (RKB, www.knowledgebank.irri.org). Offering country-specific information and materials in local languages, these country sites are exciting new dimensions to the RKB. An example of the significance of these sites was illustrated in May when the *Tropical Field Problems* manual in Bahasa on the Indonesian site had the highest number of downloads on the entire RKB facility. These sites are developed through collaborative efforts of IRRI and NARES partners. Cambodia, India, Lao PDR, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, and Vietnam also have a presence on the RKB.

PETRRA closing celebration held in Dhaka. The PETRRA (Poverty Elimination through Rice Research Assistance) Project, in partnership with the Bangladesh Rice Research Institute

(BRRI) and funded by DFID (Department for International Development), UK, organized a 1-day closing program in Dhaka on 13 July. The program celebrated the success of the 5-year PETRRA Project and stimulated a dialogue on *Agricultural Technology and Innovations for the Poor* to exchange views on how to sustain the innovations of the project in the existing system. One of the great PETRRA successes was the Livelihood Improvement Through Ecology (LITE) subproject, which closed in June with two farmer field days and a workshop. Using LITE recommendations, farmers have been able to significantly reduce their insecticide and fertilizer use while increasing their incomes.

IRRI strengthens ties with DPR Korea. To assess the rice R&D needs of the Democratic People's Republic of Korea (DPRK) and to explore possible opportunities for technical cooperation with and assistance from IRRI, the Academy of Agricultural Sciences (AAS) invited IRRI scientists to visit the DPRK on 20-24 July. The IRRI delegation was composed of DDG-R **Ren Wang**; **K.K. Jena**, PBGB senior scientist and IRRI representative to Korea; **Kaijun Zhao**, IRRI liaison scientist in China; and **Jojo Lapitan**, Training Center and IPMO senior manager.

IRRI BOT chair visits UNIC-Tokyo exhibit. On 9 August, IRRI BOT Chair **Keijiro Otsuka** (left in photo above) visited the United Nations Information Centre (UNIC)-Tokyo summer exhibition at the Gallery of the UN House in Shibuya-ku. The exhibit featured various displays on rice to celebrate the IYR2004 and the recently published

Japanese translation of IRRI's own *Graindell* book for children. Dr. Otsuka met with UNIC-Tokyo Director Akio Nomura (right in photo) to discuss various issues on rice and other UN-related matters. Dr. Otsuka commended IRRI's IYR exhibit and *Graindell* teams for their hard work and efforts to promote rice and IRRI to Japanese children and other audiences.

CCER panel reports on IRRI staffing patterns. The center-commissioned external review (CCER) team of **Peter Hobbs**, **Vo-Tong Xuan**, and **Nimal Ranaweera** gave their summary report to management on 8 October. During their 2-week review, the team visited Australia, Bangladesh, Cambodia, India, Indonesia, Laos, the Philippines, and Thailand and spoke with many IRRI staff members and NARES partners. In addition, the panel members themselves came as representatives of Sri Lanka and Vietnam. Additional input for the review came from participants of the International Crop Science Congress in Australia, 75 IRRI staff members who participated in an online survey via our intranet portal, and CORRA (Council for Partnerships on Rice Research in Asia) members. Management is reviewing the team's recommendations on what the Institute's future staffing pattern at headquarters and in partner countries should be.

As we have just concluded a very rewarding International Year of Rice 2004 and enter 2005—our 45th anniversary—the Institute is at a pivotal time in its history, as many of the topics I have just covered illustrate. IRRI continues doing its part to help achieve the UN's Millennium Development Goals by conducting smart research, the details of which follow, carefully managed according to the environmental principles now enshrined in our *Environmental Agenda*. This will keep us on target as we work with our NARES partners to help the world's rice farmers grow their crop in an environmentally sustainable way.

William G. Padolina
Acting Director General

Program 1

Genetic resources conservation, evaluation, and gene discovery

This program includes IRRI's work on collection, conservation, documentation, and exchange of germplasm (plant seeds and tissues), which has as its bottom line sustaining biodiversity and making it—and the related knowledge—available worldwide toward improving rice productivity and production. The program also aims to understand the biological functions encoded in the genes, taking advantage of investments made in the private sector to document the rice genome. Through these activities, IRRI is playing a key role in improving public access to rice genetic information. IRRI is in a unique

position to undertake this important task on behalf of publicly funded rice researchers, and of the poor rice farmers and consumers they serve, because the institute possesses an excellent capacity to produce genetic resources, the expertise necessary for identifying important traits, and an extensive collaborative network to evaluate newly found traits in diverse environments.

There are two projects. One deals with all aspects of maintaining the germplasm and the other seeks to understand the functioning of the rice genome.

PROJECT 1

Germplasm conservation, characterization, documentation, and exchange

Since its foundation, IRRI has been at the forefront of international efforts to collect and conserve the genetic resources of rice. The world's largest rice germplasm collection is held in trust in the International Rice Genebank at IRRI (along with a collection of biofertilizer germplasm, including *Azolla*, blue-green algae, and nitrogen-fixing bacteria). Plant breeders and researchers worldwide use these genetic resources to develop new rice varieties. Effective use requires characterization (Output 1), evaluation (Output 2), and information access (Output 3).

Output 1: Rice and biofertilizer genetic resources conserved and characterized

Ensuring the long-term preservation of the collections in the International Rice Genebank (IRG) is an ongoing commitment. During 2004, samples of more than 13,000 accessions were sent to the National Center for Genetic Resources Preservation (NCGRP) in Fort Collins, Colorado, USA. These samples bring the safety duplication of the IRG collection up to date. They are not accessed or distributed from NCGRP but are held as a black-box safety duplication in case of a catastrophe at IRRI. It remains only to continue this duplication with newly processed accessions. Some 5,000 new accessions were added to the base collection in 2004 and 3,000 accessions underwent seed rejuvenation. The total number of accessions at the end of 2004 was 106,865, of which the core collection, a subset of samples representing the range of rice varieties and ecosystems, was about 10%. Rejuvenation, characterization, and viability monitoring continue as core activities.

A bank of freeze-dried leaf tissue samples has been established for the core collection of 11,000 cultivated (*Oryza sativa*) rice varieties and 1,500 non-*sativa* accessions. Of these, DNA was extracted and stored from 2,000 and 700, respectively. This DNA is being used for molecular characterization to ensure wide sample coverage of the collection, to understand the phylogenetic structure of the collection, and ultimately to locate novel alleles (versions

of genes) affecting important traits for plant breeding.

A collection of more than 3,000 accessions showing diverse reactions to drought stress has been identified from the IRG core collection and by nominations from partners in the Generation Challenge Program. The partners—IRRI, Centro Internacional de Agricultura Tropical (CIAT), Africa Rice Center (WARDA), Cornell University, Chinese Academy of Agricultural Sciences, and Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)—are collaborating to determine patterns of alleles or genetic fingerprints, using markers distributed across the genome for these accessions. This will be one of the largest sets of rice accessions characterized to this level for determining population structure.

By studying molecular variation at the sites of genes identified as being involved in drought response and other important traits, we will go on to identify sources of new alleles for plant breeding. In 2004, new equipment allowed us to undertake EcoTILLING, an application of TILLING (Targeting Induced Local Lesions IN Genomes) designed to detect small variations in gene sequences in natural populations. Using this method, we discovered variants of two genes involved in the regulation of drought response. Short DNA sequences (primers) have been developed for 48 candidate genes for stress tolerance and quality, and we expect to discover novel variants of these genes in the same way.

Some 200 accessions with excellent grain quality are being screened for salinity tolerance. Accessions showing good tolerance will be used in breeding programs to produce new varieties that will have an important benefit for farmers in saline areas.

Work has continued on pinning down the identity of 4,453 wild rice accessions using both molecular and morphological techniques. Some of the accessions were found to have been misidentified. The work in 2004 involved tissue sampling (2,812 accessions), determining chromosome numbers (1,345), DNA extraction (943), field characterization (380), and inter- and intraspecific hybridization.

Output 2: Rice germplasm exchanged and evaluated internationally

Exchange and dissemination of improved rice germplasm through the International Network for Genetic Evaluation of Rice (INGER) are the most visible features of IRRI's collaboration with the national agricultural research and extension systems (NARES) and other international centers. In 2004, we assembled and distributed more than 300 "nursery" sets to 28 countries. Also, we sent 400 outstanding INGER lines to requestors in seven countries. Four irrigated lowland varieties are showing promise in East Timor.

The system of germplasm exchange through INGER was reviewed during the year, as a result of which the NARES' roles have been broadened with regard to prioritization of requests, in-country multiplication of germplasm, and charging arrangements. This will increase the efficiency of the overall system.

Output 3: International Rice Information System developed and used by rice breeders and researchers

A major strategy of the International Rice Information System (IRIS) is to consolidate existing IRRI germplasm-related databases, including those for genetic resources, breeding, and INGER, into a single system that can be easily searched via the Internet. Activities in 2004 focused on the

International Rice Genebank Collection Information System (IRGCIS): combining various tables to consolidate all available knowledge on each germplasm. One benefit has been discovering gaps and inconsistencies in the data. These are now being addressed. The work was slowed by technical problems in making the wide range of data accessible through the system's information portal, which is based on the generic International Crop Information System (ICIS).

Location data on IRG accessions are being reviewed and reorganized to provide comprehensive and accurate site information for use in research, management, and decision making. The bulk of this work was done in 2004 and the data management system will be launched in the first quarter of 2005.

Improvements were made to the way in which we describe plant phenotypes in IRIS. With more precise definitions, we can compare different lines more exactly. The initial work was done on IR64 rice mutants (Project 2, Output 4) and this will be extended to general crop types.

Project leader

Graham McLaren, senior scientist, biometrics, and head, Biometrics and Bioinformatics Unit, g.mclaren@cgiar.org

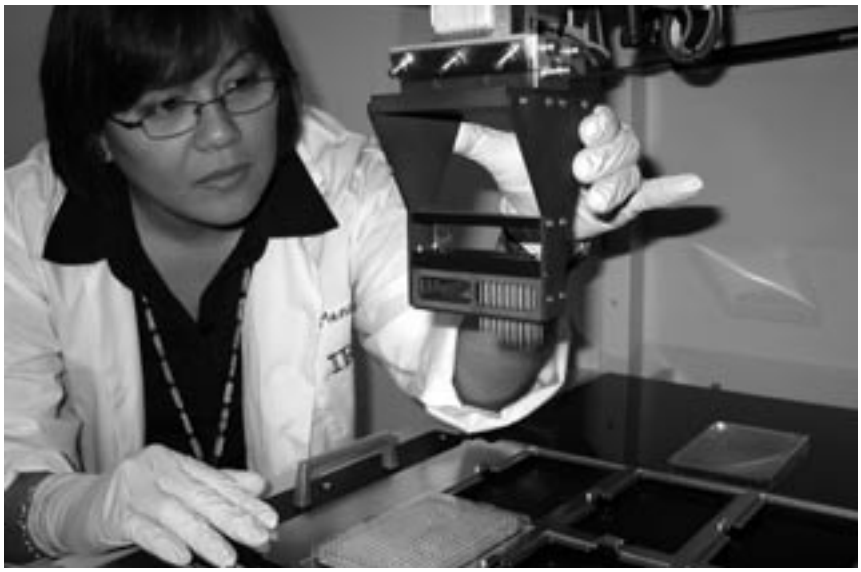
PROJECT 2

Functional genomics

Genomics, the science of deciphering DNA sequence structure, variation, and function in totality, will become the engine that drives discovery of plant traits that contribute to solving intractable problems in crop production. Through genomics, we will discover every rice gene, the functional diversity of the various versions of these genes in the gene pool, and the overall architecture of genetic and physiological (including biochemical) systems in rice. This knowledge will lead to new strategies for genetic improvement that will allow farmers to grow rice more efficiently and profitably.

The draft rice genome sequence became available late in 2002 through the efforts of the International Rice Genome Sequencing Project and private-sector contributions. Fully exploiting this wealth of information provided by *structural genomics* will not be possible until we understand the biological functions encoded by the sequenced DNA. We therefore pursue a parallel effort in *functional genomics*, developing the genetic resources that we need to discover which biological functions belong to specific DNA sequences.

The strategy is to combine the information provided by structural genomics with discoveries gleaned from specially manufactured genetic resources (such as mutants in which certain genes are disabled) and well-characterized germplasm, using innovative research techniques developed for this purpose. By creating genetic resources for trait discovery, IRRI is well placed to use genomic databases and to promote public access to these resources to the rice-growing world.



Output 1: Genetic resources—mutants, near-isogenic lines, and mapping populations—developed and characterized for genome-wide assignment of biological functions to DNA sequences

IRRI scientists are developing genetic resources at both the plant and molecular levels. Analysis at the plant level in 2004 revealed that inheritance of resistance to brown planthopper in an IR64 rice mutant (D518) is controlled by a single dominant gene. The resistant mutant line was shared with national agricultural research and extension systems (NARES) to evaluate its field performance.

A single recessive gene may control tungro virus resistance, according to first- and second-generation trials of another IR64 mutant. Third-generation data are being evaluated to confirm this mechanism.

Two lines highly tolerant of salt stress were identified from among 3,000 screened IR64 mutant lines. A few lines with moderate tolerance for and greater sensitivity to salt stress were also found. All these lines will be useful for genetic analysis of the altered response.

Screening of 752 lines for sheath blight resistance showed 21 promising lines and these are now being genotyped at the Chinese Academy of Agricultural Sciences.

We confirmed the superior performance of six mutant lines in chronic drought. They showed stable and heritable improvement in drought tolerance. The mutant lines were produced by disabling some genes and are thus potential tools for investigating the importance of negative regulators of plant physiology. We will try to identify the genetic location of the mutation and the physiology of drought tolerance.

At the molecular level, TILLING (Targeting Induced Local Lesions IN Genomes) is now used to screen DNA

samples. We have produced a DNA pool from 2,800 chemically induced mutants for detecting changes in blast resistance, tolerance for various stresses, and grain quality in a group of 20 genes. NARES personnel were trained in the technique at a workshop in February 2004 (Output 6).

A recessive gene conferring resistance to tungro virus was mapped on chromosome 7 using near-isogenic rice lines (lines that differ in only a few chromosomal segments). Molecular markers flanking this gene can now be used in selection for tungro resistance in breeding lines. We will next validate its usefulness in other tungro-resistant varieties.

As of December 2004, the IR64 rice mutant stocks consisted of 43,000 lines, of which 24,000 have been distributed since the establishment of the mutant bank.

Output 2: High-throughput gene array facilities established for genotyping and expression analysis of desirable agronomic traits

The Gene Array and Molecular Marker Application (GAMMA) Laboratory provides a regional facility in South and Southeast Asia to apply gene array techniques and serve as a training ground for many NARES partners. The facility supported the completion in 2004 of studies on drought response and comparative studies on salinity tolerance between barley and rice. Using gene chips that contain arrays of short DNA sequences (oligo chips) representing the rice genome, the expression—through their color under fluorescence—of thousands of genes is monitored to identify genes relevant to stress tolerance. We expect that the facility will continue to support gene array applications and produce diagnostic gene chip arrays for use by the research community.

The mechanism of broad-spectrum resistance to blast and bacterial blight and abiotic stress is being studied at the GAMMA Laboratory in collaboration with the Beijing Genomics Institute and Japan's National Institute of Agrobiological Sciences. In this case, the expression profiles of the genes revealed that a network of defense genes confers broad resistance. Importantly, the system is a model for investigating other complex traits, and we will continue to seek new applications.

Output 3: Candidate genes, favorable alleles, and metabolic pathways for tolerance for abiotic and biotic stresses and for nutritional enhancement identified

The most significant work in this area in 2004 was progress in locating an important gene (*Pup1*) related to phosphorus uptake. After extensive genetic recombination and phenotype analysis, we have narrowed the search down to two candidate genes that are potentially responsible for the trait. Identification of the gene will help us understand the mechanism of tolerance for phosphorus deficiency and eventually produce varieties that will perform well in phosphorus-deficient conditions that affect most upland rice areas.

Another significant finding in 2004 was that drought stress before flowering affects the nature of grain proteins at maturity. This was one result of improvement in our technique of analyzing pollen and grain proteins. We also found candidate genes that control aspects of pollen release (dehiscence). Next, we will investigate how drought affects grain quality and attempt to confirm the roles of the candidate genes controlling dehiscence.

Finally, we identified 13 genetic markers with gene expression patterns correlated to response to drought stress and their map locations coincide with positions on the chromosomes known to contribute to drought tolerance, bringing us closer to developing tolerant varieties. However, the drought response was found to be cultivar-specific. Also, different genes seem to be involved in responding to gradual and

acute drought stress. The next steps are to verify molecular variation in candidate genes associated with functional variation in germplasm and well-defined pedigrees.

Output 4: Databases and bioinformatics support for functional genomics developed

In 2004, the Biometrics and Bioinformatics Unit team made steady progress in database development and enhanced bioinformatics support.

First, with funds from both the Generation Challenge Program and from IRRI core resources, a new high-performance "cluster" (multiprocessing) computing facility was purchased and commissioned. This new facility now forms a key resource for efficient large-scale processing of DNA sequence and gene expression data for both IRRI researchers and their global collaborators.

Second, the International Rice Information System (IRIS, www.iris.irri.org) continues to be developed as a central, integrated source of rice germplasm and genome information at IRRI and for the international rice community. A significant feature of this system is that it is based on a World Wide Web interface and a protocol for distributed computing called "web services" that enables cross-linking of diverse global plant databases.

Third, a new version of the IR64 rice mutant database was released in 2004. The new database includes descriptions of more than 3,000 mutant lines, following precise definitions of biological concepts and their interrelationships, or ontology, that will help with biological interpretation and database searches.

The informatics team will continue analysis and publication of IRRI functional genomics information, such as the IR64 drought-stress cDNA library and associated gene expression array data.

Output 5: An international working group established to provide a public resource platform and broaden access to genetic resources and genomic technologies

In pursuit of the goal of providing a public resource platform, the International Rice Functional Genomics Consortium (IRFGC) was established in January 2003. One essential output in 2004 was a collective paper documenting the mutant resources in 12 laboratories and institutions, an essential step toward sharing these resources. We have formed a network through the Generation Challenge Program to identify useful phenotypes from these stocks. In this network, about 10 institutions are expected to share their expertise and facilities.

A network of eight U.S. universities and research institutions to work on biotic and abiotic stress has been formed by IRRI using funds of the USAID Linkage Program. In addition, the U.S. Department of Agriculture is supporting two projects that contribute to the objectives of the IRFGC, on TILLING and gene expression analysis of rice disease mutants. The alliance of independently funded but synergistic projects will help accelerate the discovery of agronomically important genes.

The Consortium held the Second International Symposium on Rice Functional Genomics in Arizona, November 2004. IRRI is organizing the third international symposium in this series to be held in conjunction with the Fifth International Rice Genetics Symposium in Manila in November 2005.

Output 6: Resources and information disseminated to NARES through the Asian Rice Biotechnology Network (ARBN) and training workshops

For resource dissemination, IRRI continues to distribute gene collections for target traits; these are used for analysis and training purposes. In 2004, we distributed 1,767 clones of candidate genes for host defense to NARES in China and Indonesia and to collaborators from the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD) in France. Also, more than 1,000 defense gene clones were sent for analysis to collaborators at Kansas State University in the U.S. and the Institut de recherche pour le développement (IRD) in France.

The GAMMA laboratory was used by 33 NARES researchers and students from eight countries. The laboratory will continue to be upgraded and will provide tools to serve the needs of NARES scientists.

For information dissemination and training, a workshop on Applying Genomic Technologies to Identify Induced and Natural Variation in Stress-Response Genes was held at IRRI in February 2004 to extend functional genomics technologies. The workshop involved 36 participants from NARES and 11 in-house participants. An ARBN workshop on Advances in Marker-aided Selection will be held at IRRI in February 2005.

Project leader

Hei Leung, senior scientist, plant pathology, h.leung@cgiar.org

Program 2

Enhancing productivity and sustainability of favorable environments

The major factor that has contributed to poverty alleviation is the reduced unit cost of production and the downward trend in real prices of food. Low food prices benefited the urban laboring class and the rural landless and marginal farmers who are net buyers of food from the market. As a result, the food entitlement of the poor improved substantially. Rapid adoption of improved technologies in the favorable irrigated environment contributed to this achievement. This environment accounts for nearly 45% of the rice land and 55% of the rice harvested area (in most of the irrigated area in the tropics,

two rice crops are grown versus a single rice crop in rainfed land) and contributes to about 75% of total rice production.

Because of its importance, we must continue to focus on the favorable environment as the major source of rice supply to meet the growing demand from the expanded urban population and rural landless. The challenges are how to sustain the high yields already achieved in this ecosystem and whether modern science can be used to explore possibilities of a further increase in yield potential. As the irrigated rice production system intensifies with growing population pressure on limited natural resources, technological options must be developed to maintain soil fertility and manage pest pressure. Extending the area under high-yielding modern rice varieties by developing irrigation infrastructure will no longer be possible for many countries because of the looming water crisis. Farmers need assistance from rice scientists on how to grow rice with less water and how to operate irrigation systems more efficiently. At the same time, varieties with higher yield potential, multiple resistance to diseases and insects, tolerance for problem soils, superior grain quality, and higher micronutrient content must be available. Micronutrient deficiencies, especially of iron, zinc, and vitamin A, afflict millions of poor Asians—people who receive most of their nutrition from rice and so would be healthier if the rice they consumed contained more of these micronutrients. At the same time, rising living standards in most of Asia are fueling demand for high-quality rice. Thus, IRRI is investing resources to enhance its grain quality research.

PROJECT 3

Genetic enhancement for yield, grain quality, and stress resistance

As population growth continues to boost demand for rice, production growth in the irrigated ecosystem is approaching a plateau. In this favorable ecosystem, which produces 75% of the world's rice, the adoption of improved varieties offering a yield potential of 10 tons per hectare is almost complete. Meanwhile, the irrigated rice area is shrinking, irrigation water is being diverted for other uses, agricultural labor is moving to industry, and concern is rising about the overuse and misuse of pesticides and fertilizers. Taken together, these developments mean that farmers have to learn to produce more rice using less land, water, labor, and chemical support.

To meet the challenges of raising the size of the rice harvest while improving grain quality to make rice tastier and more effective against the "hidden hunger" of micronutrient deficiency, we need varieties with higher yield potential, multiple resistance to diseases and insects, tolerance for problem soils, superior grain quality, and higher micronutrient content.

This project uses conventional breeding and biotechnological approaches to develop new plant type cultivars and rice hybrids with 15–20% higher yield than existing high-yielding

varieties. Opportunities exist to develop even higher yielding rice cultivars and hybrids. IRRI undertakes molecular breeding to incorporate yield-enhancing genes from exotic and wild species into cultivars that are useful as such and as parents of superior hybrids. We also use conventional and genetic-engineering approaches to improve the pest resistance of varieties and hybrids. To increase the durability of resistance, several genes are pyramided through molecular marker-aided selection.

Finally, conventional breeding and genetic engineering are used to enhance the palatability and nutrition of rice varieties, including higher content of such micronutrients as iron, zinc, and provitamin A.

The ultimate aim of the project is to develop rice varieties and hybrids that combine all these desirable features. At the same time, we develop agronomic management practices for new plant types and hybrids and study their economic impact.

Output 1: Germplasm possessing high yield, multiple resistance, and superior grain quality developed

Several new plant type lines with resistance to blast and bacterial leaf blight and with field resistance to tungro and brown planthopper became available in 2004. These will be shared with national agricultural research and extension systems (NARES). Meanwhile, we will develop these lines further by incorporating improved grain quality.

Two IRRI-bred elite indica lines for irrigated areas were released as varieties in the Philippines. They will broaden the gene pool of varieties available to farmers. One (IR61979-138-1-3-2-3) was released as Angelica for areas with low solar radiation and high precipitation; the other (IR68305-18-1-1) was released as Matatag 3 for tungro hot spots in the country.

Elite lines with the superior grain quality of japonica rice and higher yield level of indica rice are now available, after 10 years of breeding. Some lines were tested by consumer panels, which confirmed their grain quality and palatability. Next, we will test these new japonica/indica derivative lines in different tropical locations through INGER and study the physiological basis of their adaptation to tropical conditions.

Two lines, one a new plant type, were found to be tolerant of low temperature and should prove useful for breeding varieties for the boro season and for tropical highlands. We intend to test them in the boro season in Bangladesh and in Banaue, Philippines, and cross them with local elite lines to develop recombinant progenies possessing cold tolerance.

We have made major improvements in the management of new plant type lines. First, seedlings should be transplanted between 7 and 14 days rather than after 20. The effect is to produce more tillers and dry matter and, hence, better yield. Second, their seeding rate, as for indica varieties, can be targeted to 50 kilograms per hectare in direct seeding. Higher rates do not improve yield.

Stem borer larvae were observed to feed on panicles during the rice plant's booting stage and cut the stem by the seventh day. Hence, we will screen varieties for resistance during this critical stage. This will first require developing a diet for rearing stem borers to be used for varietal screening.

Output 2: Rice hybrids developed that possess stronger heterosis, improved grain quality, and multiple resistance to diseases and insects

During 2004, hybrid rice cultivation in some tropical countries (Bangladesh, India, Indonesia, the Philippines, and Vietnam) increased significantly and covered about 1.4 million hectares. IRRI has been active in developing parental lines and hybrids for different tropical rice environments.

Some male sterile lines (both cytoplasmic, CMS, and thermosensitive genic, TGMS) with acceptable grain

quality were developed during the year. They will be shared with NARES to improve further the quality of hybrids. We have also found some hybrids with salt tolerance for potential use in moderately saline areas. These will be validated in multilocation trials.

Three activities in 2004 promised to lower production costs for farmers using hybrid rice. First, we developed, using a CMS line (IR79156A), a technology—early nitrogen application and wider spacing of the pollen parents—to produce more than 2 tons per hectare of hybrid seed, which should lower seed costs. We will validate the technology and are using the IR79156A line extensively in making future hybrids.

Second, IRRI scientists developed new nursery management guidelines for hybrid rice cultivation: transplanting at 7 days, which gives more tillers than when transplanting later (usually 21 days); and reducing the number of hills per square meter to 25 from the usually recommended 50. We need to evaluate this technology with a wide range of hybrids. Third, two hybrids were shown to perform better than nonhybrid rice under direct seeding, even at the low seeding rate of 25 kilograms per hectare, rather than the usual 50—potentially further reducing the costs of such hybrids to farmers. We will follow up this research by varying the seeding rates for other hybrids.

Project leader

Sant Virmani, principal scientist, plant breeding;
Darshan Brar, senior scientist, plant breeding,
from February 2005, d.brar@cgiar.org

PROJECT 4

Managing resources under intensive rice-based systems

Favorable irrigated environments that are highly productive and sustainable, or potentially so, produce nearly three-quarters of the world's rice. The two major intensive rice production systems in Asia are double cropping of rice and rice rotated with wheat. The doubling of rice production in Asia over the past 30 years has arisen largely from the increasingly bountiful harvests in these systems brought about by improved rice varieties, expanded irrigation, and higher rates of fertilizer use.

Stagnating yield growth in recent years, however, suggests that it may be difficult to grow enough rice to satisfy the future nutritional needs of a growing population of urban poor and rural landless, especially when combined with postharvest losses and labor scarcity in many areas. Meanwhile, farmers' misuse or overuse of pesticides and fertilizers—and their profligate use of water—causes environmental worries.

Current irrigated yields, averaging 5 tons per hectare, are well below the estimated potential yield of 8 tons per hectare of existing rice cultivars. Farmers need new knowledge, techniques, and practices to bridge this yield gap. Knowledge is key to ensuring that larger harvests go hand-in-hand with improved profitability, while minimizing environmental impact both within and beyond the rice ecosystem.

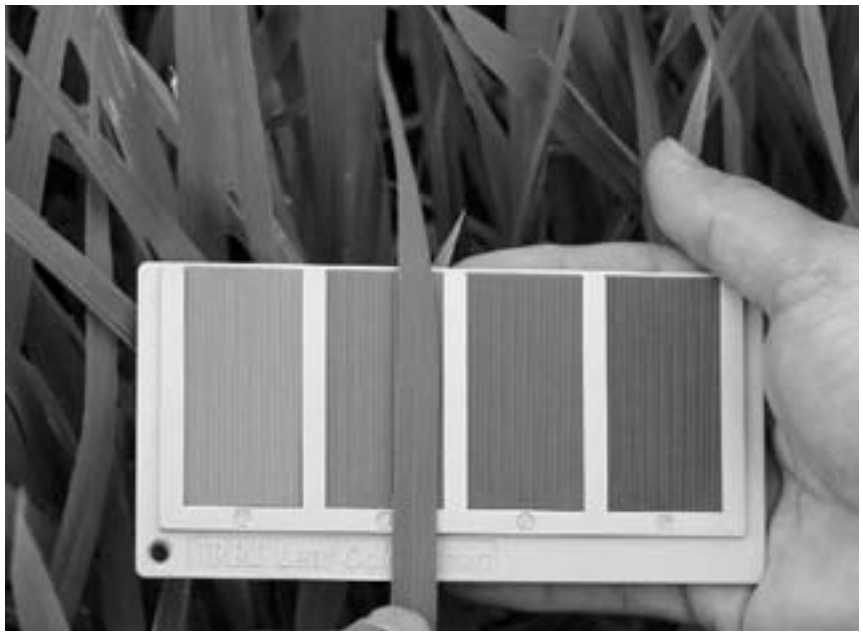
New knowledge-based technologies and machinery that are environmentally sound, socially acceptable, and profitable to farmers can enhance and sustain the productivity of favorable environments. These technologies must integrate management of soil, water, and complexes of weeds, pests, and diseases, with particular attention to conserving biodiversity and environmental health. Fully developing these technologies requires research on crop physiology, nutrient cycling, pest ecology, the rice crop in its environs, and mechanization systems. Understanding farmers' management approach and the limitations they face will enhance the development and adoption of improved technologies.

Output 1: Crop and soil management practices and strategies developed and deployed for sustaining productivity, enhancing profitability, and minimizing environmental impact in intensive systems

Site-specific nutrient management (SSNM)—tailoring fertilizer use for individual fields and seasons—is now well

recognized as an international public good across Asia. In 2004, we demonstrated SSNM in farmers' fields at five sites in China, and undertook farmer participatory research on its effects at four sites there. At all the research sites, SSNM increased the efficiency of nitrogen use by producing similar or higher grain yield than usually experienced in the area, while requiring lower nitrogen inputs than those normally used by farmers.

A new four-panel leaf color chart (photo at right) was developed and calibrated for use throughout Asia. It provides a high-quality, standardized tool for nitrogen management. About 90,000 were distributed in 2004 and another 100,000 will be distributed early in 2005. Other research by national agricultural research and extension systems (NARES) in Asia and by IRRI over the past four years has confirmed that a real-time and fixed-time approach to nitrogen management with the color chart are equally effective.



Beyond nitrogen use per se, SSNM was found in collaborative research with NARES in northern Vietnam to reduce sheath blight and bacterial leaf blight as well as to increase yields in farmers' fields. This provides not only further evidence of an association between incorrect levels of fertilizer application and rice diseases but also a way to reduce pesticide use. Collaborative agroeconomic research showed economic gains by using more potassium on farms in the New Cauvery Delta, India. In the Red River Delta, Vietnam, similar research led to recommendations for SSNM for five major rice soils.

Economic analysis at sites in southern Vietnam, southern India, and Central Luzon, Philippines, showed that, compared with farmers' usual practices, SSNM had negligible effects on costs but increased net benefits through increased rice yields. The omission-plot method used in this research is gaining prominence as a way to find the correct balance of phosphorus and potassium fertilization. Use of the method in Bangladesh revealed variation within and across villages in the resulting recommendations for phosphorus and potassium fertilization. We will do more evaluations of these local variations and what they mean for developing phosphorus and potassium recommendation "domains."

We updated overall recommendations for SSNM in some 20 rice-growing areas in 2004 and, with NARES, held workshops and training courses on SSNM in six countries toward building research–extension–private-sector partnerships for further dissemination of the practices to farmers.

SSNM is a component of integrated crop management (ICM). Farmer cooperators in India and the Philippines had yield increases of more than 1 ton per hectare and additional profit of more than US$100 per hectare using site-specific ICM options that we developed in 2004. Understandably, there is great interest in ICM. The next activities will be to expand its evaluation to other parts

of India and the Philippines, as well as to Myanmar, and develop ICM options for boro rice in West Bengal (India) and for irrigated rice in East Timor.

A preliminary study of the effect of some ICM components, including the use of mechanical weeding and using younger seedlings than usual, demonstrated their individual benefits. The results provide clues as to why application of ICM gives increased crop vigor, tillering, and yields. The work will continue at several sites in collaboration with NARES.

Output 2: Improved pest management practices to increase productivity and conserve and enhance the environment developed and deployed

Suppression of tungro disease by planting tungro-resistant and -susceptible rice varieties together as seed mixtures was confirmed in farmers' fields in the southern Philippines. An additional finding was that the mixture gives higher yields than a monoculture of either variety. We will expand trials to other tungro-endemic areas, but we can now recommend mixed planting as an alternative tungro disease control to insecticide use and synchronized planting of fields.

Zizania is a wild relative of cultivated rice. We found that, when planted around rice fields, it serves as an alternate host for natural enemies of rice pests and reduces crop loss. It is now widely grown in Zhejiang Province of China. The shoots are eaten as a vegetable; consequently, pesticide spraying has decreased.

The media have turned out to be effective in reducing insecticide use among rice farmers in Sing Buri Province of Thailand and in the Mekong and Red River deltas of Vietnam. A campaign using leaflets, posters, and radio and TV dramas has resulted in a

22% reduction in spraying in Sing Buri. Monitoring shows that about 70% of the farmers are aware of the campaign in the two Vietnamese deltas. The approach is a promising one because most NARES have the infrastructure to undertake such campaigns. We will continue to follow the effects of the present experiment.

In the Philippines, insecticide use has declined substantially over the past 20 years, in part because of activities of extension agents and insecticide price increases. IRRI is investigating the role that farmer field schools may have played in this decline.

Rice plants can apparently suppress weeds by rapid early growth. We are field-testing a wide range of cultivars to assess to what extent superior early growth has a weed-suppressing effect. Next, we will select those with differences in their competitiveness and grow them in different conditions to establish their ability to suppress weed growth. Potential is good in areas with weed problems to use this trait to complement other integrated pest management practices.

Flood irrigation is the most important means of weed control in transplanted rice, but, in direct-seeded systems, weeds are able to germinate at the same time as rice and survive. With managed flooding, however, field and screenhouse trials suggest that the rates of herbicide application can be reduced significantly. IRRI scientists are continuing this work with a range of flooding regimes and weed species to develop these integrated approaches.

Output 3: Mechanization systems developed that improve the efficiency and sustainability of rice production

Fifty-kilogram airtight "super bags," the product of trials of rice grain storage methods over the past 2 years by IRRI in collaboration with NARES in Bhutan, Cambodia, Indonesia, Lao PDR, Myanmar, and Vietnam, control insects without chemicals, double seed life, and maintain constant moisture content. They are still being field-tested and are expected to be commercialized in 2005. Rodent management using the super bags was field-tested by collaborators in Cambodia who were trained in their use the previous year. Further tests are planned in Myanmar and Lao PDR in 2005.

We have been comparing the economic and environmental impact of different rice cropping systems at IRRI (see also Project 5, Output 1). Puddled systems—transplanted or direct-seeded—were the most efficient users of water and had the lowest labor requirements. Yields were similar with dry direct seeding, whereas the system of rice intensification (SRI) gave only 60% of transplanted system yields in the dry season and 50% in the wet season. We will make further comparisons of these systems, including water-saving treatments.

IRRI scientists have been examining with NARES the effects of weed growth on crop establishment, fallow, and cropping systems in experiments in India and the Philippines. Weed growth and species composition are affected by changes in crop management practices.

A database of these interactions is being developed and the researchers expect to create decision frameworks for crop and weed management over the next 2 years.

Research into equipment and techniques to enhance crop production in 2004 included development of laser land-leveling equipment for Vietnam. The laser-controlled system is much more efficient and accurate than a water-based leveling system. Field demonstrations are under way and these will continue in 2005. In IRRI's fields, we are evaluating the use of narrow steel wheels for four-wheel tractors in saturated fields. The equipment is for mechanized direct seeding, which would improve crop establishment and weed management. Associated with this is a prototype direct-seed drill that we are evaluating for puddled soils. Used with the tractor, it will combine the benefits of a puddled seedbed with mechanized direct seeding. Direct seeding into dry seedbeds is also being investigated, using our prototype zero-till machine. Trials of these three innovations will continue at IRRI in 2005.

Output 4: Resource-use efficiency in the rice-wheat system increased

IRRI's investigation of ways to improve yields and sustainability of the important rice-wheat cropping system (photo above) in the Indo-Gangetic Plains of India focused in 2004 on the interactions among tillage, nutrients, weed management, and water use in the rice crop. IRRI and NARES scientists found that direct seeding with zero tillage made cultivation costs lower than when transplanting rice and gave substantial water savings. Weed growth is the most severe constraint in direct seeding and we have identified integrated weed management approaches for possible adoption by farmers. On-farm trials are being conducted to further evaluate and develop direct-seeding strategies.

We have been evaluating and promoting the use of the leaf color chart to manage nitrogen in several rice varieties in many rice-wheat farming locations in India, Nepal, and Pakistan. We also worked with the private sector and Punjab Agricultural University in India to promote the technology and will continue to disseminate it throughout South Asia.

Sustaining or enhancing soil quality requires a way to measure relevant soil properties and develop indices of fertility so that changes over time can be quantified. A laboratory and greenhouse experiment in which a crop was grown in 18 soils from five countries showed losses in carbon, nitrogen, and potassium, whereas available phosphorus increased. The study has shown a simple way to assess sustainable levels of soil fertility and this will lead to different on-farm management strategies.

Project leader

Kong Luen Heong, senior scientist, entomology/IPM specialist, and deputy head, Entomology and Plant Pathology Division; David Johnson, senior scientist, weed science, from August 2004, d.johnson@cgiar.org

PROJECT 5

Enhancing water productivity in rice-based production systems

Food security in Asia depends heavily on irrigated rice, a system that is a major consumer of freshwater resources. In Asia, irrigated agriculture uses 90% of total diverted fresh water, and about half of that irrigates rice. A semiaquatic plant typically grown in continuously flooded paddies, lowland rice requires substantially more water to produce a given amount of grain than does any other major crop.

Meanwhile, irrigated agriculture faces stiffening competition from industrial and domestic water users. This situation is aggravated by dramatically rising costs in recent decades for developing irrigation systems. Declining water supplies, emerging water markets (in India and Bangladesh, for example), and rising water costs (either charges by volume or the power outlay for pumping groundwater) are increasingly forcing rice farmers to use less water. Farmers urgently need new irrigated rice-based systems and technologies that save water by improving water productivity in terms of the grain produced with a given volume of water.

Substantial progress has already rewarded efforts to develop water-saving irrigation techniques, such as reducing losses to percolation and seepage by allowing the soil to dry out to some extent before reapplying irrigation water. Investigation in this area will continue, but combating the looming water crisis requires exploring more radical changes in crop management techniques. These include cultivating rice in saturated soil on raised beds or, as in the case of aerobic rice, as an irrigated upland crop.

Saving water in the field is economically important for farmers but may have little effect on the hydrology of the irrigation system or basin. This is because the water "lost" from a field may be recovered for irrigation further downstream. Interactions among different components of the water balance in an irrigation system require us to look beyond the field level as we strive to develop socially acceptable and economically viable irrigated rice-based systems that save water.

Output 1: Strategies for enhancing water productivity at the farm level developed

Research continued on three technologies for saving water—alternate wetting and drying, aerobic rice (photo at right), and raised beds—and was extended from China and the Philippines to include India. Also, nitrogen management and row spacing as well as water management were included in 2004.

Alternate wetting and drying is useful under moderate water scarcity and shallow groundwater depths. Up to 20% of the water can be saved without affecting yield and the same fertilizer recommendations as for flooded rice can be followed. The water savings are mainly realized through a reduction in seepage and percolation losses, whereas evapotranspiration losses are hardly affected. We developed a simple threshold for water management that will maintain high rice yields: re-irrigate the paddy field when ponded water levels have dropped to 15–20 centimeters below the soil surface. We organized a 1-week training course on water-saving technologies and gave it to a total of 100 water managers and professionals during 2004. Also, extension materials for farmers were developed and disseminated. We will continue the experiments in 2005 to determine the interaction effects of nitrogen and water, the feasi-

bility of using leaf color charts, and the physiological basis for performance; also, we will attempt to obtain yield stability when the soil water level is as much as 30 centimeters below the soil surface. National agricultural research and extension systems (NARES) partners started to provide training on the technologies and will continue this in the future. Impact assessment began in 2004 and will be taken further in 2005.

Aerobic rice is useful when rice fields cannot be flooded at all. Our results suggest that it is also useful as an alternative in rainfed lowland systems with unreliable rainfall. The aerobic rice systems tested use half or less of the water needed for flooded lowland systems, but yield 20–30% less. The aerobic rice yield potential is about 6 tons per hectare. In the Philippines, yields of best-bet varieties were stable in the wet season but highly variable in the dry season. Low yields may be due to nematodes, micronutrient imbalances, or other, as yet unknown, factors. We obtained direct evidence of yield decline in continuous aerobic systems by comparing first- and seventh-season yields in plots in the same fields at the same time (the control plots contained flooded rice for the first six seasons). The yield of the first-season crop was up to 68% higher than that of the seventh. We are continuing this work to investigate and overcome dry-season growth problems and the yield decline in continuous aerobic rice systems.

Raised beds seem to be attractive only when they are stable—a difficulty in itself—and used by different crops in rotation in a permanent setup of the beds. Yields and water savings are of the same order of magnitude as in systems based on alternate wetting and drying on flat land.

We have demonstrated in large field experiments at IRRI that the best seeding methods are puddled transplanting and puddled direct wet seeding. They give higher yields and economic returns as well as more efficient use of water than other systems—nonpuddled, dry direct seeding; the system of rice intensification (SRI); and raised-bed systems. Labor use in SRI is nearly double that of puddled transplanting systems.

Output 2: Interactions among the hierarchical scales of irrigation systems investigated and strategies identified for translating water savings at the farm scale into savings at the scale of irrigation systems

We can now study water-saving technologies for rice production by modeling them, potentially saving much research time and costly experimentation. The crop growth model ORYZA2000 was validated against data sets from field experiments in China, Indonesia, and the Philippines. Standard procedures for model evaluation were designed and applied. ORYZA2000 was found to predict crop growth and development, water and nitrogen dynamics, yield, and water use sufficiently accurately under water-short conditions to enable its use for exploratory studies on water-saving technologies. We trained 50 students from the China Agricultural University, Beijing, and various Chinese NARES counterparts on the model. Using ORYZA2000, we can now assess the effects at the irrigation-system level of different ways of saving water in rice fields. Irrigation managers can use the model to improve the management of their systems. For this purpose, we will set up functioning models for specific irrigation systems and apply them interactively with system managers.

We also examined the role of ponds at one of the pilot sites in China and found that these ponds do not seem to encourage water savings. On the contrary, they form backup supplies in the event of irrigation supply failure. However, they can also be used for other crops to augment overall farm production.

Project leader

To Phuc Tuong, head, Crop, Soil, and Water Sciences Division; Bas Bouman, senior scientist, water science, from May 2004, b.bouman@cgiar.org

PROJECT 6

Irrigated Rice Research Consortium

An estimated 2.2 billion Asian rice farmers and consumers depend on the productivity of irrigated rice systems for their livelihoods and/or food security. The Irrigated Rice Research Consortium (IRRC) provides a framework for partnership combining IRRI and national agricultural research and extension systems (NARES) that facilitates and strengthens NARES' research and technology delivery in these systems. The IRRC is active in every major Asian country that grows irrigated rice and includes on its steering committee policymakers from Bangladesh, China, India, Indonesia, Malaysia, the Philippines, and Vietnam, thereby ensuring support from local governments and NARES. The IRRC also seeks partnerships with nongovernmental organizations and the private sector to identify solutions to farmers' problems and to help in their adoption.

The IRRC is organized in workgroups composed of interdisciplinary teams of research and extension workers at sites in three or more countries. The workgroups are designed to identify and address important problems of productivity and sustainability, which are reflected in their names: Nutrient Management or Reaching Toward Optimal Productivity, Water Saving, Hybrid Rice, Weed Ecology, Rodent Ecology, and Postharvest. The workgroups are coupled to an overarching Achieving Impact workgroup, which provides farmer participatory appraisals and monitors and evaluates adoption and impact.

Output: Regional and NARES-driven multidisciplinary research and extension partnerships strengthened and new technologies for irrigated rice adopted

Completion of phase II (2001-04) of the IRRC provides an opportunity to summarize some of its accomplishments:

- Site-specific nutrient management, including the leaf color chart, was promoted by the Reaching Toward Optimal Productivity workgroup among partners in about 20 major rice-growing areas in eight countries.
- A low-cost moisture meter, a milling chart, and sealed storage systems (photo below) were developed and promoted through the Postharvest workgroup in partnership with stakeholders in five countries.
- Development and promotion of cost-effective weed management practices that integrate herbicides and mechanical weeding were facilitated by the Weed Ecology workgroup in partnership with NARES and nongovernmental organizations in nine countries.
- Development of controlled irrigation with alternate wetting and drying of soil to save water was catalyzed by the Water Saving workgroup in partnerships in three countries. This

technology is ready for large-scale evaluation and promotion.

- The Hybrid Rice Network, through its many activities conducted in collaboration with NARES, contributed significantly to expanding the hybrid rice area in tropical countries from 700,000 hectares in 2001 to 1.4 million hectares in 2004.
- Community trap-barrier systems to control rats without chemicals were assessed for adoption by the Rodent Ecology workgroup through partnerships in five countries.

The IRRC external review report of October 2003 recommended that the IRRC be continued for a third phase (2005-08). A series of planning workshops was undertaken with NARES during 2004 to develop the phase III proposal, and funding for the phase was secured. During the third phase, the IRRC should reach its goal of providing an international platform and effective mechanism for research-extension partnerships with the target of enhancing knowledge-intensive crop management on-farm in the irrigated rice-based systems of Asia. The next steps are to recruit a coordinator, establish a new steering committee, and finalize documentation and action plans.

In 2004, farmers taking part in national initiatives in Indonesia to integrate various farming technologies increased their overall profit by more than $100 per hectare. There were similar successes in Vietnam, integrating innovations that resulted from previous research. Phase III will build on these successes.

Project leader

Roland Buresh, senior scientist, soil science, and program leader, Enhancing Productivity and Sustainability of Favorable Environments, r.buresh@cgiar.org

Program 3

Improving productivity and livelihood for fragile environments

More than 700 million of Asia's poor obtain 50–80% of their calories from rice grown in unfavorable rice environments—infertile uplands, rainfed lowlands subject to frequent droughts and submergence, and deepwater and coastal areas that suffer from flooding, strong winds, salinity, and other soil-related problems. Farmers in these fragile environments face drought and submergence, diverse pests and diseases, and poor soils. They minimize risk by limiting inputs, but this results in low yields—less than 2 tons per hectare compared with more than 5.5 tons per hectare in favorable

irrigated lowlands. The benefits from rice science in these conditions have so far not been as great as those in the favorable environments. Because rice farming (the production of staple food) is the major economic activity at low levels of income, these ecosystems are characterized by low farm income and high incidence of poverty. These ecosystems account for about 55% of the rice lands and are home to the vast majority of the rural poor in Asia. New, higher yielding varieties that are tolerant of drought, submergence, and problem soils must also be comparable in quality with traditional varieties if farmers are to adopt them.

Stress-tolerant, better yielding varieties, along with efficient crop management practices, will help reduce the risk in rice cultivation that contributes to socioeconomic inequity and will help increase yield and farm income. The probability for success in research for

building tolerance for abiotic stresses into better yielding varieties was low in the past, leading to inadequate allocation of research resources to solve these problems. But, with recent advances in molecular biology for tagging and characterizing genes and their transfer to other species, the probability of success in this area appears bright. The environments are diverse and their domains vary across countries; hence, this research must be done in partnership with the national agricultural research and extension systems (NARES), drawing on local scientific expertise and farmers' indigenous knowledge. IRRI coordinates the Consortium for Unfavorable Rice Environments (CURE, Project 9) to develop and implement the research agenda to tackle problems in the unfavorable rice environments. The consortium places emphasis on developing and delivering technologies and knowledge to farmers, and working with them to adapt these to suit specific needs, conditions, and livelihood strategies.

The research and related activities are grouped into three projects, on genetic enhancement, natural resource management, and the activities of CURE, respectively.

PROJECT 7

Genetic enhancement for improving productivity and human health in fragile environments

The modern rice varieties developed for irrigated systems do not adapt well to unfavorable ecosystems and farmers obtain low and unstable yields and limited gains in profits when they adopt them. Risk reducers that offer more promise include enhanced seedling vigor, heightened tolerance or avoidance (through early maturity) of drought and submergence, improved ability to grow in soils with toxic levels of salt, iron, or aluminum or deficient in phosphorus or zinc, and strengthened resistance to pests and diseases, especially the blast fungus. The goal of Project 7 is to develop rice varieties that combine these traits with high and stable yields and consumer-preferred grain type.

Improving the efficiency and value of rice production in fragile areas promises immense gains in food security, human nutrition, poverty reduction, and environmental protection. In addition to providing more calories from higher yields, improved varieties have the potential to offer enhanced levels of vitamin A, lysine, iron, and zinc. Because rice is prominent in the Asian diet, inexpensive, and easily stored, it is an ideal vehicle for enhancing nutrition among the poor.

In recent decades, researchers have discovered potential answers to many of these problems and aspirations in the genes of cultivated and wild rice. Scientific advances in biochemistry, physiology, and biotechnology have already produced promising genetic material and clear breeding strategies that can now be tapped for genetic enhancement of varieties for fragile environments. High levels of iron, zinc, and provitamin A, and tolerance for drought, submergence, phosphorus deficiency, and saline soils, are traits with good prospects for breeding into different rice cultivars.

IRRI is uniquely positioned to bridge, on the one hand, the upstream research done in advanced research institutes and the private sector in industrialized countries and, on the other, the downstream research by NARES in developing countries to create varieties for rice farmers in highly diverse rainfed ecosystems.

Boosting the impact of this project are NARES-IRRI breeding networks, farmer participatory selection that recognizes the central role of women, and linkages with the International Network for Genetic Evaluation of Rice (in Project 1) and the Consortium for Unfavorable Rice Environments (in Project 9). The Asian Rice Biotechnology Network (in Project 2) facilitates the development and dissemination to NARES of germplasm and databases and the training of NARES scientists in new breeding, selection, and evaluation techniques. Animal and human nutritional studies on the bioavailability and food safety of micronutrient-rich rice are in progress.

Output 1: Superior germplasm for rainfed lowlands developed

A high-quality, blast-resistant version of the popular and highly valued Thai jasmine rice (KDML 105) with short duration, developed by IRRI in collaboration with the Thailand Department of Agriculture, was proposed for release in Thailand in 2005 (Output 6). This variety significantly reduces the risk of blast disease, which is endemic in northeastern Thailand. Also, its early maturity permits the crop to escape late-season drought, and will help small farmers in drought-prone areas to stabilize their yields. The new variety is likely to be rapidly adopted by farmers in affected areas. Equally important, the methodology serves as a model for developing high-quality, resistant varieties elsewhere.

Other blast-resistant lines that differ in only one gene (monogenic lines) are being evaluated in Thailand and the Philippines. These monogenic lines, which are useful for identifying different strains of blast disease and the genes that confer resistance, have been

distributed to more than 30 institutions in 15 countries for identification of the blast strains and application in breeding.

We are developing superior rice hybrids for farmers in moderately drought-prone lowlands. So far, we have produced (cytoplasmic male) sterile lines for breeding hybrids for drought-prone rainfed lowlands. Results from India suggest that yields are at least 1 ton per hectare higher than with varieties presently in use. The sterile lines will next be crossed with elite lines adapted to rainfed lowlands to produce suitable hybrids.

Rice yield under moderate to severe lowland drought stress is a heritable trait. This finding, the result of years of trials at IRRI and the Indira Gandhi Agricultural University, Raipur, India, will enable breeders to confidently apply selection techniques that will lead to the development of varieties combining high yield and improved drought tolerance in farmers' fields. Thirty-seven useful lines have been identified using these techniques and their superiority has been confirmed in tests in India. Next, we will apply the approach to IRRI's lowland rice populations and support national programs in institutionalizing drought screening in managed-stress conditions for cultivar development.

Output 2: Superior germplasm for flood-prone areas and infertile lowlands developed

Evaluation of salt-tolerant lines selected by farmers in a participatory rice breeding project in Bangladesh continued. Four selected lines for the boro season in coastal wetlands were compared in farmers' fields to decide which varieties to release and seeds were submitted to the Seed Certification Agency. The evaluation will continue in the aman season. Other breeding lines were being evaluated for salt tolerance in India. We will continue to send material to all participants in the Challenge Program on Water and Food for testing at each site and to other collaborators in research networks.

Research begun in 2003 on the mechanisms of submergence tolerance is now bearing fruit. Tolerance involves vigor, quick germination, higher activity of the enzyme amylase, and the generation of higher levels of ethylene. The findings mean that new fast screening techniques can be established based on these target traits. We now have 27 tolerant lines that show far greater survival (more than 60%) than do nontolerant varieties (9% for IR64). We will continue to look for any other physiological traits that may be involved. Work on marker-aided selection to speed up the incorporation of submergence into high-yielding varieties is also ongoing.

A key mechanism of tolerance for zinc deficiency in rice was identified: plant roots produce organic acids that make zinc more available for uptake. Existing mapping populations show variation in this trait, so we can rapidly move to map the regions on the chromosomes that control organic acid production. A new greenhouse screening method that simulates zinc-deficient field conditions now allows large-scale screening for traits associated with tolerance as well as a means for rapid phenotyping to identify the genes or groups of genes concerned.

Output 3: Superior germplasm for infertile uplands developed

The search for genetic markers involved in upland drought tolerance has not led to the identification of a few genes with large effects. Thus, tolerance in these populations is probably controlled by many genes and selection of phenotypes remains the best approach to improving upland drought tolerance in the short term, while we continue to seek the underlying genetic basis. Indeed, from trials at IRRI in 2004, we now know that yield under this kind of stress is a heritable trait (as found in lowland stress). Two promising high-quality, short-duration lines, developed by direct screening under drought conditions, are currently being evaluated in drought-prone areas of eastern India. An IRRI-India drought breeding network based on direct selection for yield under stress is beginning.

In seeking better breeding strategies for low-input upland systems, our analyses of trials from India and Lao PDR have shown that, contrary to expectation, improved upland cultivars perform better than traditional varieties under low-input and high-input management. However, because trial results exhibit high variability, extensive testing in different environments will be needed to make yield gains.

IRRI scientists successfully incorporated five candidate genes for blast resistance into selected elite lines. High levels of resistance to seedling and neck blast were demonstrated by these lines in an area of high disease pressure in Almora, India. Success of the technique means that we can combine several chromosomal regions, each providing a different type of resistance, in different varieties to provide partial blast resistance in blast-prone areas. Markers for tracking effective versions of genes (alleles) on small regions of the chromosomes in advanced breeding lines are now available. Next, we need to track and recombine these alleles in additional populations.

IRRI scientists made progress during the year on two major upland problems for rice farmers—phosphorus deficiency and blast. Lines that we confirmed in 2003 to have superior phosphorus uptake (with the gene concerned [*Pup1*] finely mapped; see Project 2, Output 3) were crossed with blast-resistant lines. Third-generation data are now being analyzed. We will screen blast-resistant lines for incorporation of the *Pup1* gene and evaluate selected materials in further generations until the lines are stable, when field testing can begin. Combining quantitative blast resistance and tolerance for phosphorus deficiency with tolerance for drought will be the next task.

Output 4: Aerobic rice germplasm for water-scarce tropical environments developed

We now have a composite picture of aerobic adaptation: rapid growth in the vegetative stage; and maintenance of panicle elongation, spikelet fertility, and harvest index under moderate stress in the reproductive stage. The work involved deriving lines with high aerobic adaptation by crossing the elite aerobic variety Apo with various lowland varieties, followed by four seasons of selection for yield under aerobic conditions. Advanced backcross lines are also being developed and their genotypes determined. Next, we will assess allele frequencies in the aerobic-adapted progeny of aerobic × irrigated crosses to identify the chromosomal regions that confer an advantage in aerobic rice systems.

Elite aerobic lines from upland × lowland crosses are being evaluated by breeding networks in Yunnan Province of China, India, Lao PDR, and the Philippines.

Hybrid rice is showing potential in aerobic conditions also. We plan to evaluate large numbers of rice hybrids under aerobic rice environments.

Output 5: Micronutrient-enriched rice to combat malnutrition in fragile environments developed

The year has been a busy and productive one in joint IRRI-NARES micronutrient research. IRRI distributed 10 elite iron-dense lines for evaluation by NARES in five countries (Bangladesh,

China, Indonesia, the Philippines, and Vietnam). NARES partners also identified elite lines with enhanced iron content, which will be shared among them and IRRI for evaluation. The evaluations are to confirm the elevated iron content and its distribution in the grain. (An earlier IRRI study, in which 300 women consumed high-iron rice, showed that the iron was bioavailable; the diet improved blood iron levels in nonanemic women.)

Transgenic rice plants that incorporate genes for beta-carotene synthesis and for enhanced levels of iron and protein in milled grain are now in place at IRRI. We are investigating varietal differences in expression of the incorporated genes, how these genes affect yield, and the effect of fertilizer on their expression. Although there has been concern about the use of such plants in some countries, they are well accepted in others. We will also continue to develop farmer-preferred cultivars incorporating these traits.

Output 6: NARES-IRRI partnerships in rice breeding enhanced

There is a need to integrate effective, low-cost methods of plant varietal selection (PVS) into breeding programs. Involving farmers is key to this. We found, for example, in experiments in India and the Philippines, that farmers' preharvest yield ratings and postharvest reports were similar to researchers' quantitative data. Farmers' experience, as both producers and end users, adds value to field trials. In collaboration with NARES, we produced a draft manual of PVS techniques to expand awareness of them among NARES. The techniques have already been incorporated in the Indian rainfed shuttle breeding networks and in the Lao PDR upland and rainfed lowland programs. Training materials on PVS will be upgraded for the NARES and we will continue to promote the methods in breeding programs.

Ideally, all the shuttle breeding groups collaborating with IRRI should use the International Rice Information System (IRIS), both to trace pedigree and evaluation information and to input their data for sharing with all users of the system. Breeders are enthusiastic to use the system. However, coordinating data input remains problematic, an issue we are now examining.

To complement IRIS, we produced software in 2004, now freely available, for the design of field trials in low-input and drought-stress environments. The previous lack of convenient software precluded the design and analysis of sophisticated trials needed for an efficient breeding program in these environments. We will provide training in use of the software.

The Eastern Indian Rainfed Lowland Shuttle Breeding Network (EIRLSBN) is a collaborative NARES-IRRI network of rainfed rice breeding programs targeting flood-prone lowlands in eastern India. The network produced two varieties developed by the Narendra Deva University of Agriculture and Technology (Faizabad, Uttar Pradesh) and derived from IRRI crosses, which were recommended for release in 2004. One of them, NDR 8002 (IR67493-M2), was recommended for national release by the All-India Coordinated Rice Improvement Project (AICRIP), and the other, NDR 96005 (IR66363-10-M-1-1-1-1), was recommended for release by the state of Uttar Pradesh. In addition to these releases, 41 lines developed by this network were under advanced national AICRIP testing in 2004.

In Thailand, collaboration between IRRI and the Department of Agriculture resulted in the development of two short-duration, blast-resistant jasmine rice varieties. These varieties were evaluated by farmers across northeastern Thailand in a large-scale IRRI-Department of Agriculture participatory varietal selection program in 2003 and 2004, funded in part by the Rockefeller Foundation. The short-duration varieties performed very well in the severe drought conditions of 2004 in the Khon Kaen area, and one is proposed for release to farmers in 2005. Responsibility for the advanced backcross program for short-duration jasmine rice was transferred to the national breeding program, which will also oversee the participatory testing and release of blast-resistant varieties of longer duration.

Project leader

Renee Lafitte, senior scientist and consultant, crop physiology; John Bennett, senior scientist, molecular biology, from February 2005, j.bennett@cgiar.org

PROJECT 8

Natural resource management for rainfed lowland and upland rice ecosystems

The farm families who live and work in unfavorable rice environments are among the poorest people in the world. Rice yields in these difficult ecosystems, where 80 million families farm a total of 60 million hectares, are low and unstable. Erratic water supplies, crop diseases and pests, and problem soils cause risk that discourages farmers from investing in improved rice-production and resource-management techniques. Unsustainable farm practices degrade the natural resource base, condemning communities to ever-deepening poverty. Many inhabitants of these areas, especially the highlands, belong to socially and politically marginalized ethnic minorities. Project 8 seeks to overcome these problems by improving crop and natural resource management practices.

Output 1: Crop and natural resource management practices for improved livelihood in rainfed lowlands developed and evaluated

Ways to improve yield and sustainability in direct-seeded rice areas of Karnataka, India, were identified. The suggested resource management practices could help to improve the livelihoods of poor farmers. The state agricultural department is keen to demonstrate the practices, which may result in more farmers changing from transplanting to the direct-seeding method. We will investigate whether improvements can be made in Sri Lanka, where nearly all rice is farmed by this method, and in areas with similar agroclimatic conditions in other parts of South Asia.

Improved nutrient management strategies developed at IRRI for flood-prone areas were tested successfully at sites in Bangladesh and India, where yields improved by more than 1 ton per hectare. Low seeding rates (75 grams per square meter) in nurseries resulted in seedlings better capable of surviving flooding than those seeded at the normal rate (150 grams per square meter).

Survival of seedlings in the cold temperatures of the early boro season in Bangladesh was enhanced by placing nurseries under polyethylene covers, and further improved when combined with other improved nursery and nutrient management regimes.

In salt-affected areas, the earlier finding that application of excess calcium and phosphorus substantially improves seedling survival and growth was confirmed; the two nutrients act synergistically. We found that zinc oxide root dipping in saline areas improved grain yield by more than 1 ton per hectare, a finding that will next be tested in farmers' fields in collaboration with the Narendra Deva University of Agriculture and Technology (Faizabad, Uttar Pradesh).

IRRI's crop model ORYZA2000 has been evaluated for the first time in

rainfed conditions, using a standard procedure that we developed. The model worked satisfactorily in a wide range of rainfed lowland rice conditions in Central Java. Although some parameters are yet to be incorporated, we can begin to use the model to explore management options to improve rainfed rice productivity and stability.

Nutrient management recommendations for rainfed lowlands in Lao PDR were evaluated on-farm. We found that fertilizers have considerable potential to increase productivity but farmers lack knowledge on their use. Production of a poster to help farmers make decisions on where and when to use fertilizers has been delayed. An evaluation of nutrient recommendations in northeastern Thailand's rainfed lowlands showed that there seemed to be little potential for gain with the varieties in use there and a re-evaluation of the research strategy is needed.

Output 2: Crop and natural resource management practices for improved livelihood in upland rice systems developed and evaluated

The widespread *bolon* system in Bangladesh (photo above), which involves double transplanting of rice to avoid submergence in heavy flooding, is expensive in terms of labor and has low productivity. Research is continuing on the reasons for low productivity, socioeconomic issues, and overcoming constraints to improving the system. One result to date is an improved bolon system using tillers for double transplanting in second lowland fields and single transplanting on higher lands.

Management options suitable for smallholders in upland areas infested with the perennial grass *Imperata cylindrica* are being explored through field experiments. Options include sowing various legumes and forage grass, combined with flattening the *Imperata* with a drum or plank to allow the replacement species to establish. The use of a herbicide (glyphosate) was included as an option in the experiment to provide a comparison. The trial was established in the wet season of 2004. However, seed shortages meant that a replicated design was not possible and this is planned for 2005. Initial results suggest that the use of one legume (pigeon pea) may be an attractive option for farmers and that glyphosate addition prior to rice provides excellent control of the weed with very little regrowth. The work on improved fallow species builds on previous studies in Laos.

Project leader

Suan Pheng Kam, senior scientist, GIS specialist; Kong Luen Heong, senior scientist, entomology/IPM specialist, and deputy head, Entomology and Plant Pathology Division, from August 2004, k.heong@cgiar.org

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PROJECT 9

Consortium for Unfavorable Rice Environments (CURE)

In unfavorable rice environments that produce low rice yields, poverty and population density are high in both rural and urban areas. Rice productivity gains have so far been meager because of variable and difficult conditions and the absence of a well-structured strategic research approach to address key constraints. The continuing challenge in unfavorable rice environments is to increase and stabilize rice productivity, and so improve farmers' household food security and livelihood, while sustaining the resource base. Success demands that we work with our partners in the national agricultural research and extension systems (NARES) at sites representing these highly diverse environments and use a multidisciplinary approach to technology development and dissemination.

The Consortium for Unfavorable Rice Environments (CURE) is the framework to address these concerns and to foster cooperation in research and development between NARES and IRRI, who jointly identify strategic problems through collaborative research at NARES sites. CURE came about in 2002 with the restructuring and consolidation of the Rainfed Lowland Rice Research Consortium and the Upland Rice Research Consortium into a single entity. NARES in CURE at its establishment were from Bangladesh, India, Indonesia, Lao PDR, the Philippines, Thailand, and Vietnam. The research activities are described in projects 7 and 8.

Working groups' progress

NARES membership in the consortium formally expanded to 10 countries in 2004, with the inclusion of Cambodia, Myanmar, and Nepal. The steering committee, at its third meeting, held at the Ubon Rice Research Center, Thailand, 2-3 June, reviewed research progress and issues raised by the six working groups, each of which focuses on one of the unfavorable rice environments.

Drought-prone lowlands. Rice farmers in these areas generally still use old technologies rather than new ones recommended by national programs. Researchers conducted participatory varietal selection in order to select farmer-preferred rice varieties. Preference analysis was conducted with men and women farmers, and agronomic data were collected. Experiments conducted in Thailand during 2003-04 resulted in the development of the first short-duration KDML backcross derivatives, now handed over to the national program.

Submergence-prone lowlands. There has been enough crop-establishment research in this environment. Ways to scale up adoption of research findings and to identify new priority research areas are now needed.

Salt-affected environments. The main progress here has been in develop-

ing criteria for identifying representative sites for future research. Participatory varietal selection methods were used for screening advanced lines to identify farmer-preferred varieties for coastal areas in Bangladesh and eastern India. Experiments have also yielded nursery and crop establishment techniques that make seedlings more robust to withstand salinity stress, which is most severe at the start of the growing season.

Shifting rotational upland systems. Seed production was found to be important in ensuring seed availability for upland farmers. A case study on intensive upland rice systems in Yunnan Province of China was conducted to learn ways to improve productivity and livelihoods for upland systems in the Greater Mekong Subregion. In Lao PDR, IRRI social scientists organized training on socioeconomic and policy analysis, involving lectures, hands-on exercises, and case studies.

Drought-prone plateau uplands. After several years of trials, promising varieties of aerobic rice were identified for adoption in lands at the upland-lowland interface.

Intensive uplands with long rainy season. In Indonesia, interplanting experiments were conducted with susceptible and resistant traditional and improved varieties to reduce the yield losses from blast and reduce the use of pesticides for blast control. The results suggested that neck blast on the susceptible variety could be reduced more effectively by mixing seeds rather than by interplanting in rows.

Special research projects

New proposals for special projects under CURE were approved by donors for funding on the development of technologies to improve rice productivity in salt-affected areas of the Indo-Gangetic, Mekong, and Nile river basins (under the Challenge Program on Water and Food); technology validation and accelerating the adoption of technologies to improve livelihoods on the rainfed Gangetic Plains (funded by the International Fund for Agricultural Development, IFAD); and comparative analysis of food security and economic transition in uplands of the Greater Mekong and Hindu-Kush Himalayan subregions (funded by IFAD).

Project leader

Twng Wah Mew, principal scientist, plant pathology; program leader, Improving Productivity and Livelihood for Fragile Environments; and coordinator, CURE; Mahabub Hossain, head, Social Sciences Division, economist, and program leader, Improving Productivity and Livelihood for Fragile Environments, from June 2004, m.hossain@cgiar.org

Program 4

Strengthening linkages between research and development

Members of the Consultative Group on International Agricultural Research (CGIAR) are now asking centers to disseminate new knowledge and technologies more actively by assisting national and international agencies engaged in socioeconomic development. CGIAR members and civil society are also asking the centers to move further to adopt an interactive process of research planning, combining top-down and bottom-up approaches for a better assessment of the technology needs of farmers, the priorities of rice research, the probability of research success in

solving emerging problems, and feedback on farmers' criteria for evaluation of scientific knowledge in the context of farmers' traditional knowledge. Such an approach may help improve efficiency in the allocation of research resources, thus reducing the risk that many technologies and scientific outputs will remain on the shelf or be used only for academic purposes.

This program incorporates some of the ongoing socioeconomic research on understanding rural livelihoods, assessing technology needs of farmers, and validating technologies through farmer participatory experiments, in response to this change in direction suggested for the CGIAR system. The program contains three projects. The first deals with research prioritization and impact assessment based on understanding farmers' needs and livelihood strategies, and interactions among technologies, infrastructure, and institutions. The second applies ecoregional approaches at selected sites to demonstrate the use of systems models for improving rural livelihoods through efficient management of natural resources. The third aims at understanding the pathways of technology dissemination, and validating and adapting promising technologies through farmer participatory research to be conducted in partnership with nongovernmental organizations, the private sector, and other extension agencies. This will involve developing and adopting innovative ways and tools to assess needs and opportunities, disseminate information, and manage knowledge.

PROJECT 10

Understanding rural livelihood systems for rice research prioritization and impact assessment

International agricultural research supported by the Consultative Group on International Agricultural Research aims to ensure sustainable food security and alleviate poverty by improving farm efficiency while protecting the environment. Planning and prioritizing rice research require a deep understanding of people's access to and use of natural resources and other forms of capital—physical, financial, human, and social—and their interactions with government agencies, nongovernmental organizations, and institutions that influence their livelihood strategies. We must understand farmers' current practices, how components of farming systems and livelihood strategies interact, and farmers' criteria for evaluating scientific knowledge before we can assess how effective specific interventions are likely to be. Information and databases on biophysical, socioeconomic, and policy variables—and an understanding of constraints to farmers' adoption of improved technologies

in different agroecosystems—can help in formulating better research strategies and policies.

Research managers and policymakers must evaluate how technologies affect the well-being of various socioeconomic groups, poverty rates, and natural resource use in order to assess progress toward meeting the objectives of rice research. Knowing what factors drive decisions at the household level—as well as the larger trends in changing patterns of production, consumption, and trade; input use and pricing policies; and overall socioeconomic conditions—can shed light on emerging rice supply-and-demand balances, competition for resources by alternative economic activities, and constraints to growth in rice production. Finally, this knowledge can reveal how best to balance research on productivity enhancement and natural resource management in various countries and ecosystems.

Output 1: Rice-sector analysis conducted and a rice statistics database maintained and shared with national agricultural research and extension systems

In 2004, two sectoral studies were completed. The first, on trade liberalization in the Philippines, showed that wholesale and retail rice prices will fall under liberalization, as will the price received by farmers, but offset by a reduction in production costs. Based on our data on about 2,500 rice farm households in various regions of the Philippines, the effect of the price fall will differ by region and by ecosystem. Some regions can tolerate a bigger fall in rice prices—say, more than 30–40%—and still remain competitive (i.e., generate positive net profits for farmers), whereas some cannot. However, even if rice is still competitive under trade liberalization, it might not be the most competitive crop available and farmers might choose to grow other crops instead. A report will be prepared giving a detailed analysis and options for farmers in dealing with price liberalization.

The second study, a comparison of rice marketing in the Philippines and Thailand, revealed that rice marketing costs in the Philippines are higher than in Thailand, mainly because of higher interest rates in the financial system. Rice marketing margins are substantially greater in the Philippines than in Thailand despite many similarities between the two systems and despite findings by many analysts that Philippine rice marketing is competitive. Higher marketing margins in the Philippines appear to be due to too many marketing agents: it takes about 18 traders and millers in the Philippines to transport, store, and mill 90,000 tons of paddy, whereas in Thailand a similar task is the responsibility of just one miller. Results of the study were made available to policymakers and the general public in book form, through posters, and in conferences and seminars. We hope to expand the scope of the study to include areas of Vietnam.

The food security situation in Bangladesh, Indonesia, and Thailand was assessed in a study commissioned by the Food and Agriculture Organization (FAO) of the United Nations. The reports indicate that, despite improvements in food security at the national level, poor households with limited livelihood options are still food and nutrition insecure. In addition to investments in health, sanitation, and education needed to improve the earning capacity of such households, further investments in agricultural research, irrigation development, and

marketing systems development are needed to improve household-level food security.

We also finished compiling a database on gender-sensitive rural development in the Philippines. This will be posted on the IRRI Web site and will be useful for policymaking at the national level.

Output 2: Rural livelihood systems studied and the interface among technology, infrastructure, and institutions analyzed

An international workshop was held on the impact of migration on livelihood, rice farming efficiency, and gender roles. Labor out-migration was seen to be more prevalent in rainfed than in partially irrigated rice ecosystems in eastern India, Indonesia, and the Philippines. Migration was found to have a positive effect on rice productivity through reinvestment of earnings from migration in rice production. Women's role has begun to shift from unpaid family worker to decision maker as they have started to make farm-related decisions.

A project began on the impact of labor migration/off-farm employment in mixed farming systems in Australia, the Philippines, Thailand, and Vietnam. A coordination meeting was held at IRRI to develop a suitable methodology and data-collection protocols.

The Cuu Long Rice Research Institute and IRRI made a collaborative study on the impact of row-seeder technology on female labor in southern Vietnam. The study showed the advantages of using a plastic row seeder over broadcasting rice. However, more than half of the poor women from farming households who worked as wage laborers in hand-weeding and gap filling were displaced by the plastic row seeder. Poor landless women fared worst because of the lack of alternative job opportunities and incurred debts.

We completed a study on the socioeconomics of integrated crop-animal systems in rainfed rice areas and submitted the draft report to the CGIAR System-Wide Livestock Program. Although crop-livestock interactions tend to weaken somewhat with economic growth, substantial opportunities exist in Asia for improving farmers' livelihoods through more productive crop-animal systems.

Output 3: Constraints to adoption of improved rice technologies assessed

The adoption rate of improved rice varieties in the uplands of Indonesia was less than 10%, according to a sample survey of farmers in western Java and southern Sumatra. Nonavailability of improved seeds and their susceptibility to blast were found to be the major constraints to adoption.

In eastern India, a similar study showed that, although the adoption of modern varieties in rainfed areas has increased over time, the productivity increase has been small, with a yield difference between modern and traditional varieties in several locations of only 0.2–0.6 tons per hectare. Adoption

of improved varieties developed mainly for irrigated areas in rainfed areas and the limited use of fertilizers in the risky rainfed areas were found to be the main reasons for low productivity gain. Varieties more suited to the unstable hydrology of rainfed environments are needed.

Output 4: Impact of rice research on poverty alleviation and sustainable management of natural resources assessed

The impact of changes in the rural economy of Bangladesh in the 1990s was analyzed and the results prepared for publication. The findings show that the major driver of the growth in rural income was the expansion of nonfarm economic activities, particularly trade and services. Agricultural income has grown slowly, and income from rice cultivation has declined in absolute terms because of diversification into nonrice crops and noncrop agricultural activities, as well as deterioration in the terms of trade for rice farming. However, land and labor productivity in rice farming has increased because of the movement of resources from rice farming to other agricultural activities and to the nonfarm sector. Farm size has continued to decline despite rapid rural-urban migration. Large and medium landowners are renting land to landless households and engaging in more remunerative nonfarm activities. Thus, the scope for improving income for landless and marginal landowning households through diffusion of improved agricultural technology has increased. The incidence of poverty has declined by about 1% per year. But, income distribution has become more unequal because the income from trade and services is more unequally distributed than income from rice cultivation, and the share of trade and services in total rural income has grown. These findings were presented in a series of policy dialogues conducted by the Poverty Elimination Through Rice Research Assistance (PETRRA) project (Project 12, Output 1) on the role of agriculture in poverty alleviation.

A study on poverty mapping in Bangladesh showed that the areas with highest incidence of poverty were the depressed basins in the greater Sylhet region, northwestern districts, and coastal inlands. Land ownership and tenancy were the major determinants of poverty. Results of this study were discussed in a policy dialogue in Bangladesh.

Project leader

Mahabub Hossain, head, Social Sciences Division, economist, and program leader, Improving Productivity and Livelihood for Fragile Environments; Sushil Pandey, senior scientist, agricultural economics, deputy head, Social Sciences Division, and program leader, Strengthening Linkages Between Research and Development, from June 2004, s.pandey@cgiar.org

PROJECT 11

Enhancing ecological sustainability and improving livelihoods through ecoregional approaches to integrated natural resource management

Farmers' dependence on a healthy natural resource base links the goals of ensuring food security, alleviating poverty, and protecting the environment. Research to help farmers use resources more efficiently at the field level must go hand-in-hand with broader concerns regarding resource allocation at the agroecosystem level. Recognizing this, the CGIAR in 1995 asked IRRI to convene the Ecoregional Initiative for the Humid and Subhumid Tropics of Asia, one of eight ecoregional programs tackling complex natural resource management (NRM) issues at the regional scale.

Project 11 aims to improve rural livelihoods by enhancing the sustainability of their supporting ecosystem. We adopt a systems perspective, drawing on diverse expertise to tackle the many dimensions of NRM integration across disciplines, geographic and time scales, and the research-development-policy continuum. The research challenges are to generate integrated natural resource management (INRM) knowledge (including the tools to use it) and to promote its free exchange among researchers, policymakers, and users of natural resources.

While building upon NRM research at low levels of integration (field/farm), we develop additional tools for modeling and analyzing interactions at different levels of biological, physical, and social organization. Successful INRM empowers stakeholders at all levels to make informed resource-management choices by improving their knowledge and their ability to articulate objectives and negotiate demands. As our role is to facilitate this empowerment, we stress developing research and operational methods, and involving stakeholders in the process, as much as we do the delivered research products.

The research is conducted in pilot regions representing the various agroecosystems where rice is a major crop, with emphasis on less-productive, fragile environments. Within each pilot region, IRRI establishes strategic partnerships with national and international institutions that fill complementary roles along the research-development continuum.

Output: Ecoregional concept for integrated natural resource management adopted and systems approaches for improving livelihoods and sustaining natural resources applied

Participatory companion modeling research in northeastern Thailand and Bhutan provided many insights into farmers' decision-making processes concerning resource management issues in rainfed systems. As a result, a project by the Japan International Research Center for Agricultural Sciences (JIRCAS) is adopting a similar approach in the same area of Thailand to investigate water management issues. IRRI will help the project team develop a case study. We gave several courses on aspects of companion modeling in Thailand and provided support to other national agricultural research and extension systems (NARES), especially in the Philippines, to develop applications of the modeling. Four videos were made that describe companion modeling experiments in action in Thailand and Bhutan, to be used for training NARES colleagues. In addition, Chulalongkorn University, Bangkok, is adding a new option based on companion modeling in its agricultural technology PhD program. A final participatory modeling workshop will be held early in 2005 at the Rice Research Institute in Bangkok.

Integrated natural resource management options in the Vietnamese highlands were evaluated in 2004 through multilocation trials by scientists from IRRI and the Vietnam

Agricultural Science Institute. A knowledge base on INRM, created from the results of this work, is now available in English, French, and Vietnamese. It is available in book form, on CD-ROM, and on the Internet (www.knowledgebank.irri.org/sam/home_en.html). It was publicized on radio and television in Vietnam. The Northern Mountainous Agricultural Research Centre is currently applying the ecoregional and systems approaches promoted in the knowledge base. We hope that farmers in the northern highlands of Vietnam will adopt the recommendations.

An interprovincial water management alliance was established in Ca Mau Peninsula, Vietnam, to exchange information on management of salinity control sluices in neighboring provinces, with a view to improving salinity control. It is the first time such an alliance has been made among neighboring provinces there. In continuation of this alliance, a project on Coastal Resource Management for Improving Livelihoods was approved by the CGIAR Challenge Program on Water and Food. A workshop was held in March and activities began in Vietnam and Bangladesh in June. An international conference on coastal land resource management will be held in Vietnam in March 2005.

Project leader

Suan Pheng Kam, senior scientist, GIS specialist; T.P. Tuong, head, Crop, Soil, and Water Sciences Division, from August 2004, t.tuong@cgiar.org

PROJECT 12

Facilitating rice research for impact

Improved rice technologies can help raise farmers' incomes, reduce farm drudgery, and protect the environment. However, as technologies grow more complex, they become increasingly difficult to present to farmers for their consideration. Reaching hundreds of millions of rice farmers with knowledge-based technologies is an enormous challenge. This project meets the challenge by asking the "what, who, and how" of dissemination: What are the problems and opportunities facing farmers and researchers? Who are the target groups and partners in dissemination? How do we distill and present the message? In addressing these questions, we ensure that research is focused and relevant, and that national partners have the skills to develop, distill, and deliver research products. We achieve the necessary understanding of dissemination pathways and knowledge-assimilation patterns by analyzing problems and opportunities and by identifying, validating, adapting, and promoting potentially useful technologies through farmer participatory experiments.

Feedback from farmers allows us to maintain research relevance and efficiency. Integral to this process are partnerships with national agricultural research and extension systems (NARES), nongovernmental organizations, and private-sector specialists. Required throughout is focused training for NARES partners on both research and delivery methodologies to bridge the gap between technology development and its use.

Output 1: Develop strategies and devices for enhanced dissemination of information and knowledge-based technologies

Poverty Elimination Through Rice Research Assistance (PETRRA), a five-year project funded by the Department for International Development of the United Kingdom and managed by IRRI in close partnership with the Bangladesh Rice Research Institute (BRRI), the Bangladesh Ministry of Agriculture, and—most important—the resource-poor rice farmers of Bangladesh, ended in August 2004. The end-of-project evaluation indicated that the project achieved its purpose by fostering the development of a demand-led research system. PETRRA developed clear strategies and policy support documents that enhanced the research and delivery methods used among the 47 partner organizations representing national and international institutions, universities, nongovernmental organizations (NGOs), and private organizations. PETRRA projects were implemented in 551 villages in 38 districts with more than 11,000 farmers, of whom about 40% were women.

PETRRA was considered so successful that the European Community developed a project with IRRI and key NGOs to deliver PETRRA technologies across Bangladesh. The project target is to reach at least 50,000 farmers, but, ultimately, our goal is to reach all 13 million farm households in the country.

The project's "focal area forum" achieved acceptance—beyond expectation—as a way to bring regional partners together for validating and scaling up technologies. This was viewed by the State Minister of Agriculture as a major practical step toward coordinated regional research. The structure could

be reinforced by linking regional IRRI activities to the forum and to the European Community's food security work in the region.

A seed network was established linking farmers and breeders through private and NGO seed producers, involving more than 50 local partners. It was seen as a major advance by BRRI, although funding remains a problem. The network will seek to link with the European Community work. A validation model that works in farmers' fields with resource-poor men and women was validated by BRRI. Farmers tested the treatments in their fields under their conditions and then shared lessons learned with their neighbors. The project established a network of 45 within-country regional and national NGOs and government and private-sector agents for technology dissemination. The work confirmed that women should be included in all extension and research activities because they are responsible for many of the household seed-quality management steps.

A Checklist for Creating Impact was updated and used in training courses. NARES partners are using the checklist in the field in Sri Lanka and the Philippines.

Use and development of the Rice Knowledge Bank continued to grow. The site, which was created in 2002, has had more than 400,000 users to date. New materials were deposited in the knowledge bank in 2004 for courses on management, project design, team building, scientific writing, time management, and presentation skills. New fact sheets were added on a range of technical innovations. The Bangladesh Rice Knowledge Bank was improved; training material was included that covers PETRRA recommendations. For Indonesia, part of the database was translated into Bahasa. Rice Knowledge Bank site-use statistics showed that the Indonesian site has been remarkably successful in compiling high-demand materials. Other sites established in China, Lao PDR, Myanmar, Nepal, the Philippines, and Vietnam are being monitored for future improvements. We will continue to help develop NARES' capacity to access and use the Rice Knowledge Bank for training and extension purposes. The sites will be developed with key partners to meet local needs in local languages.

Ham radio was found to be an effective medium for dissemination of information and feedback between farmers and researchers in a five-village experiment in Tamil Nadu, India. Useful interactions were broadcast on local radio and published in newspapers to reach a larger audience. The approach has good potential in other rice-growing countries.

Training and extension materials on integrated crop management were created during interactive training workshop sessions in Indonesia. These materials can be used for future training to promote integrated crop management elsewhere in Indonesia and can be adapted to the needs of other countries.

Guidelines for validating technologies and scaling up were made for an IRRI project in the rainfed eastern Gangetic Plains. The methodology is still being tested at seven locations in India and Bangladesh by research teams trained on the guidelines, but success is already apparent in some areas, where technology adoption is accelerating.

IRRI helped form the Philippine Rice Postproduction Consortium, which held a national meeting in March 2004 and which is seen as a useful example for postharvest organizations in other countries.

Output 2: Validate technologies and methodologies for matching priority needs with available options through farmer participatory experiments and partnerships

Making Indonesian rice farmers familiar with the benefits of some newly released varieties is being promoted by IRRI in collaboration with NARES through publications and posters on integrated crop management and use of the leaf color chart, and through a

national extension program. A "how to" manual on integrated crop management is in preparation. In India, nitrogen management using the leaf color chart was promoted with the private sector in Haryana and was made a recommendation of Punjab Agricultural University.

Direct seeding to replace the traditional beushening (broadcasting seed and cross-plowing after several weeks to control weeds and improve nutrient uptake) in Chhattisghar is being assisted by IRRI. Expansion of the program, led by the Bangladesh Department of Extension, is being planned. Also, a national program to integrate crop and resource management, based on recent IRRI-developed technologies that include direct seeding, has been drafted.

Insecticides do not increase rice yields in rainfed or irrigated conditions in Bangladesh. Studies under the Livelihood Improvement Through Ecology (LITE) project, an activity of PETRRA, showed that insecticide and nitrogen management practices in Bangladesh reduce the diversity of the natural enemies of rice pests and that mixed cropping systems help in natural biological control of the pests. As a result, insecticide use fell by 90% in six trial villages through scaling-up activities. Word of mouth led to a 20% reduction in six nontarget villages. NGOs are scaling up use of the LITE technique, monitored by IRRI.

In Vietnam, a similar approach, called in local language the "3 reductions, 3 gains"—involving reductions in seeding rate and fertilizer and pesticide use—has been well received and has already become provincial policy in at least four Mekong Delta provinces. The agricultural minister stated that it would be a national policy beginning in the 2004-05 crop season. IRRI's role has been both catalytic and direct: working with local partners to develop and validate the technologies and then working with partners to conceptualize and develop the delivery program. We will conduct a nationwide impact survey and join the World Bank in an economic analysis of the benefits.

Output 3: Develop human capital of NARES

In-country training in 2004 was given on impact assessment (Indonesia, Vietnam), integrated crop management (India), integrated pest management (India, Iran, Malaysia, Vietnam), modern production technology (Central Asian Caucasus), ORYZA2000 model (China), project management (Bhutan), research management (Lao PDR), rice from seed to market (Uzbekistan), Rice Knowledge Bank (China, Indonesia, Lao PDR), survey data processing and analysis (Indonesia), rice milling (Bangladesh), scaling-up frameworks (Philippines), scientific writing and presentation skills (India, Indonesia, Myanmar), and technology promotion and communication technology (Sri Lanka). In many cases, IRRI staff led the training, but, in other cases, IRRI staff joined local trainers to deliver the courses.

Courses at IRRI headquarters in 2004 were given on Developing Integrated Nutrient Management Options for Delivery; Grain Quality and Management; a two-part Rice Production Training Course; Planning Rice Breeding Programs for Impact; Hybrid Rice and Seed Production; Ecological Methods on Biodiversity Research, Genetic Engineering, Food Safety, and Awareness; Scientific Writing and Presentation Skills; Intensive English (two courses); Leadership for Asian Women in Agricultural Research and Development; Modular Public Speaking and Presentation Skills; and Basic Experimental Designs and Data Analysis.

The Rice Production Training Course has been updated with more interactive components than before and the latest information and technologies. This course has become very popular with NARES in Asia and Africa. We will continue to hold it annually.

All course materials are now automatically captured in the Rice Knowledge Bank. This innovation means that all those who can benefit from such materials have free and easy access to help them develop their own training courses.

Project leader

Mark Bell, head, Training Center and International Programs Management Office, m.bell@cgiar.org

Financial Support and Special-funded Projects that Started in 2004

Summary of financial support to IRRI research agenda, 2004 (in US$'000).

Asian Development Bank	563
Australia	818
Belgium	98
Brazil	5
Canada	
Canadian International Development Agency	1,197
International Development Research Centre	9
China	140
CGIAR Challenge Programs	1,877
Denmark	458
European Commission	1,972
Food and Agriculture Organization of the United Nations	122
France	728
Germany	
Federal Ministry for Economic Cooperation	301
Federal Ministry for Economic Cooperation/German Agency for Technical Cooperation	1,017
India	150
International Fund for Agricultural Development	547
Iran	102
Japan	4,199
Korea	722
Netherlands	409
Norway	294
Philippines	101
Rockefeller Foundation	717
Spain	25
Sweden	557
Switzerland	2,581
Thailand	58
United Kingdom	6,205
United States of America	
Unites States Agency for International Development	4,205
United States Department of Agriculture	161
Vietnam	15
World Bank	1,940
Others	343
TOTAL	**32,636**

- **ARC Seibersdorf Research GmbH (ARC)**
  - Comparative genomics for gene discovery (Austria-IRRI collaboration) (DPPC2004-28), EUR90,000, 2004/05/20–2007/05/19

- **Asian Development Bank (ADB)**
  - Integrating and mobilizing rice knowledge to improve and stabilize crop productivity to achieve household food security in diverse and less favorable rainfed areas of Asia (DPPC2003-42), USD900,000, 2004/01/01–2006/12/06

- **Australian Centre for International Agricultural Research (ACIAR)**
  - Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems (DPPC2001-06), AUD496,764, 2004/07/01–2007/06/30

- **Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development) (BMZ)**
  - From genes to farmers' fields: enhancing and stabilizing productivity of rice in submergence-prone environments (DPPC2002-45), EUR700,000, 2004/01/01–2006/12/31

- Applying genetic diversity and genomic tools to benefit rice farmers at risk from drought (DPPC2003-41), EUR500,000, 2004/02/01–2007/01/31

- **Bureau of Agricultural Research–Department of Agriculture, Philippines (BAR–DA)**
  - Developing new plant types for direct seeding rice production systems in the Philippines (DPPC2003-69), USD90,000, 2004/05/20–2007/05/19

- **Canadian International Development Agency (CIDA)**
  - Developing efficient methods for detecting genes enhancing rice drought tolerance (CCLF) (DPPC2003-78), CAD150,000, 2004/04/01–2007/03/31

- **Cereals Comparative Genomics Initiative (CCGI)**
  - The Global Comparative Cereal Crop (GLOC3) Network: an information system to link genotype to phenotype comparatively across diverse cereal crops (DPPC2003-09), USD30,000, 2004/03/01–2005/02/28
  - Identification and functional validation of genes conditioning broad-spectrum disease resistance in rice and pearl millet (DPPC2003-10), USD200,000, 2004/03/01–2005/02/28

- **Challenge Program on Water and Food (CPWF)**
  - Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River basins (PN 7) (DPPC 2003-21), USD1,353,411, 2004/06/15–2008/06/14
  - Developing a system of temperate and tropical aerobic rice (STAR) in Asia (PN 16) (DPPC2003-24), USD884,572 , 2004/10/01–2007/09/30
  - Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments (CRESMIL) (PN 10) (DPPC2003-29), USD962,450 , 2004/06/01–2007/05/31
  - Challenge Program on Water and Food: Theme 1 Leadership (DPPC2003-87), USD135,000, 2004/01/01–

- **Comprehensive Assessment of Water Management in Agriculture–System-wide Initiative on Water Management (CA-SWIM)**
  - Increasing water productivity by managing land-water interface: effective water control for solving conflicts (CA-SWIM II Project) (DPPC2002-55), USD88,656, 2004/05/24–2005/09/23

- **Department of Agriculture, Sri Lanka (DOASL)**
  - Improving the productivity of the Sri Lankan rice granaries through effective technology promotion and delivery systems using information and communication technology (ICT) (DPPC2003-80), USD75,000, 2004/04/21–2007/04/20

- **European Commission (EC)**
  - Coordinating NGO interventions for improving small and marginal farmer households' livelihood and food security in Bangladesh (DPPC2003-71), EUR1,496,881, 2004/07/01–2008/12/31

- **Generation Challenge Program: Cultivating Plant Diversity for the Resource Poor (Generation)**
  - Generation Challenge Program (1st round of commissioned research) (DPPC2003-88), USD883,180, 2004/01/01–2004/12/31
  - Generation Challenge Program (Sub-Program 2 Leadership) (DPPC2003-85), USD100,000, 2004/02/04–

- **Global Crop Diversity Trust (GCDT)**
  - A pilot project to develop an accession-level information resource (DPPC2004-60), USD23,000, 2004/11/01–2005/04/30

- **Grain Biotech Australia PTY LTD (GBA)**
  - GBA-IRRI collaborative project 'Further development of the International Crop Information System (ICIS)' (DPPC2004-34), USD60,000, 2004/08/01–2007/07/31

- **HarvestPlus**
  - Assessing the potential of biofortification to address micronutrient malnutrition in rice-based cropping systems of South and Southeast Asia (Impact and Policy Analysis for HarvestPlus) (DPPC2004-16)

USD90,000, 2004/04/26–2005/02/28
- Micronutrient-dense rice to reduce malnutrition (DPPC2003-70), USD374,827, 2004/01/01–

- **HTSPE Limited**
  - Innovations in communications for rural extension workshop (consultancy service on the Programme of Advisory and Support Services to DFID) (DPPC2004-47), USD100,000, 2004/09/01–2005/06/01

- **Information and Communications Technology-Knowledge Management Initiative (ICT-KM)**
  - Advanced research networking for the CGIAR (DPPC2003-82), USD111,600, 2004/08/01–2005/07/31
  - Consortium for Spatial Information (CSI) Sub-Projects 1 and 2 (Sub-Project 1-Rice Supply and Demand System (RSDS) and Land Use Evaluation Tool/Raster GIS Toolbox [LUSE]/Sub-Project 2-Meta-data inventory and on-line meta-data server) (DPPC2004-20), USD19,800, 2004/06/01–2005/05/31

- **Ministry of Foreign Affairs–Japan (MOFA-Japan)**
  - Development of integrated rice cultivation system under water-saving conditions (Japan Government-IRRI Collaborative Project Phase V) (DPPC2004-19), USD339,830, 2004/10/01–2009/09/30

- **Monsanto Fund**
  - Improving the analytical capability of IRRI in support of the nutritional improvement of rice grains and the dissemination of modern nutritional information to underserved Asian populations (DPPC2004-11), USD220,000, 2004/06/23–2007/06/22

- **Philippine Rice Research Institute (PhilRice)**
  - Hybrid nucleus and breeder seed production (PhilRice-UPLB-IRRI) (DPPC2003-73), PHP150,000, 2004/01/16–2008/01/15

- **Rockefeller Foundation (RF)**
  - Marker-aided breeding for development of drought-tolerant IR64 lines (support for Dr. Devendra Dwivedi) (DPPC2004-46), USD60,000, 2004/07/01–2005/09/30
  - Detecting alleles conferring improved reproductive-stage drought tolerance in rainfed rice (DPPC2004-01), USD275,616, 2004/04/01–2006/03/31

- **Rural Development Administration, Korea (RDA)**
  - RDA-IRRI collaborative project on 'Molecular characterization and allele mining of Korean rice germplasm and extension to the IRRI core collection' (DPPC2004-36), USD40,000, 2004/09/01–2006/08/31
  - Development of water-saving technology for increasing water productivity in rice cultivation (DPPC2004-12), USD48,000, 2004/04/01–2006/12/31
  - RDA-IRRI Cooperative Research Projects (2004-2005) (DPPC2004-29), USD140,000, 2004/04/20–2005/12/31

- **Sarmap**
  - IRRI-Sarmap collaborative research on Internet Rice Information Services Phase 2 (DPPC2004-08), USD10,000, 2004/03/24–2004/12/31

- **SunRice**
  - Glycemic index studies of rice-extending to resistant starch (DPPC2004-35), USD13,250, 2004/04/01–2005/03/31

- **United States Agency for International Development (USAID)**
  - USAID Linkage Program to Strengthen the International Rice Functional Genomics Consortium (DPPC2004-49), USD640,000, 2004/06/01–2006/05/31

- **United States Department of Agriculture (USDA)**
  - Tilling and ecotilling resources for japonica and indica rice (DPPC2003-50), USD90,200, 2004/04/01–2007/03/31

- **University of Queensland (UQ)**
  - A simulation study on water availability in rainfed lowland and rice ecosystem (support for Dr. Mitsuro Tsubo) (DPPC2004-14), USD140,000, 2004/04/16–2006/12/31

Challenge Programs: Projects Managed by IRRI

- **Challenge Program on Water and Food (CPWF)**
  - International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
    - Enhancing rainwater and nutrient use efficiency for improved crop productivity, farm income and rural livelihoods in the Volta Basin-CPWF Theme 1 (PN 5) (DPPC DPPC2004-37), USD1,500,568, 2004/06/15–2009/06/19
  - Savanna Agricultural Research Institute (SARI)
    - Empowering farming communities in northern Ghana with strategic innovations and productive resources in dry-land farming-CPWF Theme 1 (DPPC2004-38), USD957,070, 2004/06/15–2009/06/14
  - International Center for Agricultural Research in the Dry Areas (ICARDA)
    - Improving on-farm agricultural water productivity in the Karkheh River Basin -CPWF Theme 1 (PN 8) (DPPC2004-44), USD1,150,000, 2004/09/01–2008/08/31
    - Improving water productivity of cereals and food legumes at Atbara River Basin of Eritrea-CPWF Theme 1 (PN 2) (DPPC2004-39), USD1,284,252, 2004/07/15–2009/07/14

Subprojects under the USAID Linkage Program to Strengthen the International Rice Functional Genomics Consortium

- **Noble Foundation**
  - Subproject 1: Use and optimization of virus-induced gene silencing in rice (DPPC2004-50), USD80,000, 2004/06/01–2006/05/31
- **Colorado State University**
  - Subproject 2: Validating functions of candidate defense genes for broad-spectrum disease resistance (DPPC2004-51), USD80,000, 2004/08/01–2006/05/31
- **Ohio State University**
  - Subproject 3: Elucidating the function of novel ubiquitination-related E3 ligase genes in the defense response to rice pathogens (DPPC2004-52), USD80,000, 2004/06/01–2006/05/31
- **University of California-Davis**
  - Subproject 4: Molecular and genomic characterization of submergence tolerance in rice (DPPC2004-53), USD80,000, 2004/06/01–2006/05/31
- **University of California-Riverside**
  - Subproject 5: Molecular and genomic characterization of submergence tolerance in rice (DPPC2004-54), USD80,000, 2004/06/01–2006/05/31
  - Subproject 6: Genomic comparisons between barley and rice in relation to salt adaptation and heritable salt tolerance (DPPC2004-55), USD80,000, 2004/06/01–2006/05/31
- **University of Arkansas**
  - Subproject 7: Functional analysis of drought-associated regulatory genes and high throughput RNA interference in rice (DPPC2004-56), USD80,000, 2004/06/01–2006/05/31
- **Purdue University**
  - Subproject 8: Allelic function in wild, indica, and japonica rices (DPPC2004-57), USD80,000, 2004/06/01–2006/05/31

Memoranda of agreement: Partner institutions IRRI entered into agreements with in 2004

Australia

- New South Wales Agriculture (NSWA). Memorandum of Agreement between NSWA and IRRI for an International Research Fellow to work in the Grain Quality and Nutrition Research Center. 20-04-2004 – 19-04-2007.
- School of Land and Food Sciences, University of Queensland (SLFS, UQ). Letter of Agreement between SLFS, UQ and IRRI for the project *A simulation study on water availability in rainfed lowland rice ecosystem*. 16-04-2004 – 31-12-2006.
- Grain Biotech Australia PTY LTD (GBA). Project Agreement between GBA and IRRI for the project *Further development of the International Crop Information System (ICIS) in collaboration with GBA* (DPPC2004-34). 01-08-2004 – 31-07-2007.
- Curtin University of Technology (CUT). Research Agreement between CUT and IRRI for the ACIAR-funded project *Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems* (DPPC2001-06). 01-09-2004 – 31-08-2007.

Bangladesh

- Bangladesh Rice Research Institute (BRRI). Letter of Agreement between BRRI and IRRI for the project *Micronutrient-dense rice to reduce malnutrition* under the HarvestPlus Challenge Program (DPPC2003-70). 10-06-2004 – 31-12-200.
- European Community, Dhaka, Bangladesh (EC). European Community Contribution Agreement with IRRI for the implementation of the project *Coordinating NGO interventions for improving small and marginal farmer households' livelihood and food security in Bangladesh* (DPPC2003-71).
- BRRI. Memorandum of Understanding between BRRI and IRRI *for scientific and technical cooperation in research on rice and rice-based cropping systems*. 01-12-2003 – 30-11-2009.
- BRRI. Research Agreement between BRRI and IRRI for the CPWF-funded project *Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10)* (DPPC2003-29). 01-06-2004 – 31-05-2007.
- Health, Education, and Economic Development (HEED). Research Agreement between HEED and IRRI for the CPWF-funded project *Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10)* (DPPC2003-29). 01-06-2004 – 31-05-2007.
- SocioConsult Limited. Research Agreement between SocioConsult Limited and IRRI for the CPWF-funded project *Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10)* (DPPC2003-29). 01-06-2004 – 31-05-2007.
- Bangladesh Fisheries Research Institute (BFRI). Research Agreement between BFRI and IRRI for the CPWF-funded project *Managing water and land*

resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10) (DPPC2003-29). 01-06-2004 – 31-05-2007.

- BRRI. Research Agreement between BRRI and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.

Canada

- University of Alberta. Collaborative Research Grant Agreement between IRRI and the Governors of the University of Alberta for the CIDA-funded project *Developing efficient methods for detecting genes enhancing rice drought tolerance* (DPPC2003-78). 01-09-2004 – 31-03-2007.

China

- Ministry of Agriculture of the People's Republic of China. Letter of Agreement extending the Memorandum of Understanding for scientific and technical collaboration in research and training on rice and rice-based farming system between the Ministry of Agriculture of the People's Republic of China and IRRI. 27-04-2004 – 26-04-2010.
- Rice Research Institute, Guangdong Academy of Agricultural Sciences (RRI, GAAS). Amendment No. 3 to the Memorandum of Agreement between IRRI and RRI, GAAS extending the effectivity until 31 December 2004 for the project *Evaluation of fertilizer nitrogen strategies for rice* under the *Reaching Towards Optimum Productivity* (RTOP) workgroup of IRRC (DPPC2000-10).
- Yangzhou University (YU). Agreement between YU and IRRI for the BMZ-funded project *Managing crop residues for healthy soils in rice ecosystem* (DPPC2001-11). 06-06-2004 – 31-03-2006.
- Huazhong Agricultural University (HAU). Agreement between HAU and IRRI for the BMZ-funded project *Managing crop residues for healthy soils in rice ecosystem* (DPPC2001-11). 28-05-2004 – 31-03-2006.
- HAU. Agreement between HAU and IRRI for the BMZ-funded project *Managing crop residues for healthy soils in rice ecosystem* (DPPC2001-11). 01-06-2004 – 31-03-2006.
- China National Rice Research Institute (CNRRI). Addendum to the Memorandum of Agreement between CNRRI and IRRI for collaboration in the area of agricultural research and weed management in particular, for the SDC-funded project *Weed Ecology Working Group* under the *Irrigated Rice Research Consortium (IRRC), Phase 2* (DPPC2001-03).

Colombia

- Centro Internacional de Agricultura Tropical (CIAT) and the International Food Policy Research Institute (IFPRI). Agreement between CIAT-IFPRI (on behalf of the donors to the HarvestPlus Program) and IRRI for the project *Assessing the potential of biofortification to address micronutrient malnutrition in rice-based cropping systems of South and Southeast Asia* (Impact and Policy Analysis for HarvestPlus) (DPPC2004-16). 26-04-2004 – 28-02-2005.

Dubai

- International Center for Biosaline Agriculture (ICBA). Research Agreement between ICBA and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.

France

- Institut de recherche pour le developpement (IRD). Amendment No. 3 for year 2004 to the Protocol of Agreement between IRD and IRRI relative to Dr. Georges Reversat's secondment to IRRI.

Germany

- Deutsche Gessellschaft für Technische Zusammenarbeit (GTZ) GmbH. Agreement between GTZ and IRRI for the BMZ-funded project *From genes to farmers' fields: enhancing and stabilizing productivity of rice in submergence-prone environments* (DPPC2002-45). 01-01-2004 – 31-12-2006.
- GTZ GmbH. Agreement between GTZ and IRRI for the BMZ-funded project *Applying genetic diversity and genomic tools to benefit rice farmers at risk from drought* (DPPC2003-41). 01-02-2004 – 31-01-2007.
- University of Bayreuth. Amendment No. 1 to the Memorandum of Agreement between the University of Bayreuth and IRRI extending the BMZ-funded project *Applying genetic diversity and genomic tools to benefit rice farmers at risk from drought* (DPPC2003-41). 01-02-2004 – 31-01-2007.

India

- International Center for Research for the Semi-Arid Tropics (ICRISAT). Letter of Agreement between ICRISAT and IRRI on collaboration in IFAD-supported project *Accelerating technology adoption to improve rural livelihoods on the rainfed Gangetic Plains* (DPPC2002-27). 30-08-2004 – 31-12-2006.
- ICRISAT. Letter of Agreement between ICRISAT and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.
- Narendra Deva University of Agriculture and Technology (NDUAT). Research Agreement between NDUAT and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.
- Central Soil Salinity Research Institute (CSSRI). Research Agreement between CSSRI and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.
- Central Rice Research Institute (CRRI). Research Agreement between CRRI and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.
- Indira Gandhi Agricultural University (IGAU). Letter of Agreement between IGAU and IRRI on collaboration in *Changes in agriculture and livelihoods in rainfed system: a case study of Chhattisgarh, India*. 01-12-2004 – 31-03-2006.

Indonesia

- Indonesian Center for Agricultural Post Harvest Research and Research and Development (ICAPRD). Agreement between ICAPRD and IRRI for the project *Post Harvest Systems Development* under *IRRC Phase 2: Postharvest Workgroup* (DPPC2001-03). 18-05-2004 – 31-12-2004.

Iran

- Rice Research Institute of Iran (RRII). Research Agreement between RRII and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.

Italy

- Global Crop Diversity Trust (GCDT), a Foundation for Food Security. Letter of Agreement between GCDT and IRRI for the project *A pilot project to develop an accession-level information resource for rice* (DPPC2004-60). 01-11-2004 – 31-05-2005.

Japan

- National Institute of Crop Science (NICS). Letter of Agreement between NICS and IRRI on research collaboration in *Application of carbon isotopic ratio in developing rice cultivars with high productivity*. 17-03-2004 – 16-03-2007.
- The Agriculture, Forestry, and Fisheries Research Council Secretariat of the Ministry of Agriculture, Forestry, and Fisheries of Japan (MAFF/AFFRC). Memorandum of Cooperation between MAFF/AFFRC and IRRI *to develop, distribute and promote mirroring systems for improving access to and sharing of Internet-based information in Japan and in other countries in the Asian region*. 15-04-2004.
- National Graduate Institute for Policy Studies (GRIPS). Terms of Agreement for joint research between GRIPS and IRRI to jointly undertake household-level research projects in the Philippines as part of the Central Luzon Loop Survey (DPPC2003-81). 05-2004 – 10-2004.

Kenya

- International Center for Research on Agroforestry (ICRAF). Letter of Agreement between ICRAF and IRRI for the project *Accelerating technology adoption to improve rural livelihoods in the rainfed Eastern Gangetic Plains* (DPPC2002-27). 16-04-2004 – 31-12-2006.
- International Livestock Research Institute (ILRI). Letter of Agreement between ILRI and IRRI for ILRI-led project under CPWF-Theme 1 -*Increasing water-use efficiency for food production through better livestock management: the Nile River Basin* (DPPC2003-87). 15-05-2004 – 14-08-2004.

Korea

- Honam Agricultural Research Institute (HARI). Agreement on cooperative research project between HARI of NICS, Rural Development Administration (RDA)

and IRRI for the project *Development of water-saving technology for increasing water productivity in rice cultivation* (DPPC2004-12). 01-04-2004 – 31-12-2006.

- National Institute of Agricultural Biotechnology (NIAB) of the RDA. Agreement on cooperative research between IRRI and NIAB for the project *Molecular characterization and allele mining of Korean rice germplasm and extension to the IRRI core collection* (DPPC2004-36). 01-09-2004 – 31-08-2006.

Malaysia

- WorldFish Center (WorldFish). Memorandum of Agreement between WorldFish and IRRI for the CA-SWIM2 project *Increasing water productivity by managing land-water interface: effective water control for solving conflicts among agriculture-fisheries-aquaculture in coastal zone* (DPPC2002-55). 24-05-2004 – 23-09-2005.

Myanmar

- Yezin Agricultural University (YAU). Memorandum of Agreement between YAU and IRRI for collaboration in agricultural research and training. 27-02-2004 – 26-02-2007.

Nepal

- Nepal Agricultural Research Council (NARC). Memorandum of Agreement between NARC and IRRI for collaboration in agricultural research and training – *Nepal-IRRI Information and Communication Technology Project*. 13-02-2004 – 12-02-2007.

Netherlands

- Nunza B.V. Addendum on the 2002 Project Agreement between Nunza B.V. and IRRI for the project *Further development of the International Crop Information Systems* (DPPC2001-69), extending the duration of the project until 31-03-2006.

Philippines

- Philippine Rice Research Institute (PhilRice). Amendment to the Letter of Agreement between PhilRice and IRRI for the USDA-funded project *Participatory assessment of social and economic impacts of biotechnology* (DPPC2001-49), extending the duration of the project until 31-03-2004.
- PhilRice. Letter of Agreement between PhilRice and IRRI for the project *Micronutrient-dense rice to reduce malnutrition* under the HarvestPlus Challenge Program (DPPC2003-70). 07-07-2004 – 31-12-2004.
- Department of Agriculture, Bureau of Agricultural Research (DA-BAR). Memorandum of Agreement between DA-BAR and IRRI for the project *Developing new plant types for direct seeding rice production systems* (DPPC2003-69). 20-05-2004 – 19-05-2007.
- University of the Philippines Los Baños Foundation, Inc. (UPLBFI). Memorandum of Agreement between IRRI and UPLBFI for the collaborative project *Extent of infestation of lowland* Cyperus rotundus*, its tolerance and basis for adaptation to flooding*, which is a part of the IRRC weed ecology group (DPPC2001-03). 16-12-2004.

Sri Lanka

- International Water Management Institute (IWMI). 2004 Letter of Agreement between IWMI and IRRI for CPWF-Theme 1: IRRI leadership (DPPC2003-87).
- IWMI. Memorandum of Understanding between IWMI, IRRI, CIAT, IFPRI, and ICLARM re: Centers' responsibilities in regard to the management and implementation of research projects funded by the *Challenge Program on Water and Food (CPWF)* (DPPC2003-86). 30-04-2004.
- IWMI. Memorandum of Agreement between IWMI and IRRI for implementing research activities for the *Consortium for Spatial Information (CSI) Project* under the CGIAR ICT-KM Program (DPPC2004-20). 05-06-2004 – 04-06-2005.
- IWMI. Amendment No. 1 to the Letter of Agreement between IWMI and IRRI for the implementation of the activity *Theme 1 Leadership* to be carried out under the CPWF in 2004.
- IWMI. Letter of Agreement between IWMI (on behalf of the CPWF and IRRI for a grant to support the project *Development of technologies to harness the productivity of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 14-06-2004 – 15-06-2008.
- IWMI. Letter of Agreement between IWMI (on behalf of the CPWF and IRRI for a grant to support the project *Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10)* (DPPC2003-29). 01-06-2004 – 31-05-2007.
- IWMI. Research Agreement between IWMI and IRRI for the CPWF-funded project *Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10)* (DPPC2003-29). 01-06-2004 – 31-05-2007.

Switzerland

- Sarmap. Letter of Agreement between Sarmap and IRRI for the project *Collaborative research on Internet Rice Information Services Phase 2* (DPPC2004-08). 24-03-2004 – 31-12-2004.
- Swiss Agency for Development and Cooperation (SDC). Amendment to the Memorandum of Agreement between SDC and IRRI extending the project *Rice mutant bank and resource platform for functional genomics* until 31 01-2006 (DPPC2001-24).

Thailand

- Ubon Ratchathani Rice Research Center. Letter of Agreement between Ubon Ratchathani Rice Research Center and IRRI for the RF-funded project *Detecting alleles conferring improved reproductive-stage drought tolerance in rainfed rice* (DPPC2004-01). 06-09-2004 – 31-03-2006.
- Faculty of Agriculture, Khon Kaen University (KKU). Research Agreement between KKU and IRRI for the ACIAR-funded project *Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems* (DPPC2001-06). 01-09-2004 – 31-08-2007.

USA

- Perlegen Sciences, Inc. Memorandum of Understanding between Perlegen Sciences, Inc. and IRRI for collaboration in genome sequencing of multiple rice varieties. 06-09-2004 – 05-09-2009.
- The Agricultural Research Service (ARS), U.S. Department of Agriculture. Nonfunded Cooperative Agreement between IRRI and ARC regarding *IRRI Rice Germplasm Storage and Conservation*. 04-05-2004 – 03-05-2009.
- University of Hawaii at Manoa. Subgrant Amendment No. 1 between University of Hawaii and IRRI increasing the funding for the project *Testing, comparing, and adapting NuMass: the nutrient management support system* (DPPC2003-72).
- University of Hawaii at Manoa. Subgrant Amendment No. 2 between University of Hawaii and IRRI increasing the funding for the project *Testing, comparing, and adapting NuMass: the nutrient management support system* (DPPC2003-72).
- International Science and Technology Practice and Policy Center (InSTePP). Memorandum of Agreement between InSTePP and IRRI for promoting research and policy research activities. 06-09-2004 – 05-09-2009.
- Noble Foundation, Ardmore, Oklahoma. Letter of Agreement between the Noble Foundation and IRRI for the USAID-funded project *Use and optimization of virus induced gene silencing (VIGS)* (DPPC2004-50). 01-06-2004 – 31-05-2006.
- University of California, Davis (UCD). Letter of Agreement between UCD and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.
- UCD. Letter of Agreement between the Regents of the UCD and IRRI for the USAID-funded project *Molecular and genomic characterization of submergence tolerance in rice* (DPPC2004-53). 01-06-2004 – 31-05-2006.
- University of California, Riverside, California (UCR). Letter of Agreement between the Regents of the UCR and IRRI for the USAID-funded project *Molecular and genomic characterization of submergence tolerance in rice* (DPPC2004-54). 01-06-2004 – 31-05-2006.
- UCR. Letter of Agreement between the Regents of the UCR and IRRI for the USAID-funded project *Genomic comparisons between barley and rice in relation to salt adaptation and heritable salt tolerance* (DPPC2004-55). 01-06-2004 – 31-05-2006.
- University of Arkansas, Fayetteville, Arkansas. Letter of Agreement between University of Arkansas and IRRI for the USAID-funded project *Functional analysis of drought-associated regulatory genes and high throughput RNA interference in rice* (DPPC2004-56). 01-06-2004 – 31-05-2006.
- Kansas State University, Manhattan (KSU). Amendment No. 1 to the Memorandum of Agreement between KSU and IRRI regarding transfer of funds for the project *Cereals Comparative Genomics Initiative (CCGI)* (DPP2003-02).
- KSU. Subaward Agreement (S04094) between KSU and IRRI for the CCGI-USAID project *The Global Comparative Cereal Crop ("gloc3") Network: an information system to link genotype to phenotype comparatively across diverse cereal crops* (DPPC2003-09). 01-03-2004 – 28-02-2005.
- KSU. Subaward Agreement, Modification No. 1 (S04094.01) between KSU and IRRI extending the period for the CCGI-USAID project *The Global Comparative Cereal Crop ("gloc3") Network: an information system to link genotype to phenotype comparatively across diverse cereal crops* (DPPC2003-09).' 01-03-2004 – 30-09-2005.

- KSU. Subaward Agreement (S04095) between KSU and IRRI for the CCGI-USAID project *Identification and functional validation of genes conditioning broad-spectrum disease resistance in rice and pearl millet* (DPPC2003-10). 01-03-2004 – 28-02-2005.
- KSU. Subaward Agreement, Modification No. 1 (S04095.01) between KSU and IRRI extending the period for the CCGI-USAID project *Identification and functional validation of genes conditioning broad-spectrum disease resistance in rice and pearl millet* (DPPC2003-10). 01-03-2004 – 30-09-2005.
- Monsanto Fund, St. Louis, Missouri. Letter of Agreement between Monsanto Fund and IRRI for the project *Improving the analytical capability of IRRI in support of the nutritional improvement of rice grains and the dissemination of modern nutritional information to underserved Asian populations* (DPPC2004-11). 23-06-2004 – 24-06-2007.
- Ohio State University Research Foundation, Columbus, Ohio (OSURF). Letter of Agreement between OSURF and IRRI for the USAID-funded project *Elucidating the function of novel ubiquitination-related E3 ligase genes in the defense response to rice pathogens* (DPPC2004-52). 01-06-2004 – 31-05-2006.
- University of Washington, Seattle, Washington. Subcontract between University of Washington and IRRI for the USDA-funded project *Tilling and ecotilling resources of japonica and indica rice* (DPPC2003-50). 01-04-2004 – 31-03-2007.
- Pennsylvania State University (PSU). Amendment No. 4 to the Memorandum of Agreement between PSU and IRRI for the USAID-funded project *IPM Implementation of Vietnamese Farms in the Mekong Delta Project* (DPPC1997-12).
- Purdue University. Letter of Agreement between Purdue University and IRRI for the USAID-funded project *Allelic function in wild, indica, and japonica rice* (DPPC2004-57). 01-06-2004 – 31-05-2006.
- Colorado State University (CSU). Letter of Agreement between the Board of Governors of the CSU System and IRRI for the USAID-funded project *Validating functions of candidate defense genes for broad-spectrum disease resistance* (DPPC2004-51). 01-08-2004 – 31-05-2006.

Vietnam

- Voice of Ho Chi Minh (VOH). Memorandum of Agreement between VOH and IRRI for the RF-funded project *Using entertainment-education (EE) approach to motivate rice farmers reduce pesticide use in Mekong Basin* (DPPC2002-30). 01-03-2004 – 28-02-2005.
- Nong-Lam University, Thu-Duc District, Ho Chi Minh City. Agreement between IRRI and Nong-Lam University for the project *Rice Post Harvest Systems Development* under the *Irrigated Rice Research Consortium (IRRC), Phase 2: Postharvest Workgroup* (DPPC2001-03). 14-09-2004 – 31-12-2004.
- Cuu Long Rice Research Institute (CLRRI). Research Agreement between CLRRI and IRRI for the CPWF-funded project *Development of technologies to harness the productivity potential of salt-affected areas of the Indo-Gangetic, Mekong, and Nile River Basins (PN7)* (DPPC2003-21). 01-06-2004 – 31-05-2008.
- CLRRI. Research Agreement between CLRRI and IRRI for the ACIAR-funded project *Impact of migration and/or off-farm employment on roles of women and appropriate technologies in Asian and Australian mixed farming systems* (DPPC2001-06). 01-09-2004 – 31-08-2007.
- Cantho University (CTU). Research Agreement between CTU and IRRI for the CPWF-funded project *Managing water and land resources for sustainable livelihoods at the interface between fresh and saline water environments in Vietnam and Bangladesh (PN10)* (DPPC2003-29). 01-06-2004 – 31-05-2007.

Honors, awards, and appointments for IRS, NRS, and BOT in 2004

Fazle Hasan Abed, BOT member

- On behalf of the Bangladesh Rural Advancement Committee (BRAC), which he founded, received the $1 million Gates Award for Global Health, September.
- Received the 2004 United Nations Development Programme Mahbub ul Haq Award for Outstanding Contribution to Human Development in recognition of his commitment to empowering the poor and his success in expanding choices and providing opportunities for women and other marginalized groups in Bangladesh.

Mark Bell, head, Training Center and IPMO

- Received an Appreciation and Partnership Award for his strong and continuous support for IRRI-Myanmar collaborative programs through capacity building, Ministry of Agriculture and Irrigation, Myanmar.

Roland Buresh, senior scientist, soil science, CSWS

- Received an Appreciation and Partnership Award for his excellent technical support to nutrient management through site-specific nutrient management, Ministry of Agriculture and Irrigation, Myanmar.

Ronald P. Cantrell, director general

- Received Medal for Agriculture and Rural Development in recognition of his contributions to agricultural development and research over the years, from the Vietnamese Ministry of Agriculture and Rural Development, Hanoi, May.
- Named honorary professor by the Chinese Academy of Agricultural Sciences, Beijing, July.
- Presented with a resolution in recognition of his valuable contributions in uplifting the lives of the residents of the municipality of Bay, Laguna, Philippines, Sangguniang Bayan of Bay, November.
- Presented with Resolution No. 691 recognizing his contributions to Laguna through IRRI's community projects, Provincial Office of Laguna, Sta. Cruz, Philippines, December.
- Presented a Plaque of Appreciation for his support to the "development of a rice research and development program for the Philippine national agricultural research system and for playing a proactive role in the various activities of the Los Baños Science Community Foundation, Inc., Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines, December.
- Participated in a ceremony during which CPS 1 and 2, which houses Communication and Publications Services and Information Technology Services, was formally renamed the Ronald P. Cantrell Building with a plaque mounted on the building that reads: "The Trustees of the International Rice Research Institute have named this building in honor of Ronald P. Cantrell, Director General, 1998-2004, in recognition of his strong leadership and intelligent management at a time when this combination of talents was urgently needed. He secured a place for the Institute on the cutting-edge of information and com-

munication technology and the new science of functional genomics ushered in with the sequencing of the rice genome. He also oversaw the continued development of innovative, sustainable rice production systems for both irrigated and unfavorable environments and articulated the importance of household food security for millions of poor rice farmers and consumers. Dedicated this 13th day of December 2004."

A.R. Castañeda, B.A.M. Bouman, S. Peng, and **R.M. Visperas,** CSWS

- Won the Best Paper Award, Soil and Water Management Category, for *Testing of aerobic rice in the Philippines; results of field experiments at IRRI,* 54th Annual Philippine Agricultural Engineering National Convention, Central Luzon State University, Muñoz, Nueva Ecija, April.

Gelia Castillo, consultant

- Received one of five 2004 Outstanding Filipino Awards given to pioneering Filipinos, Philippine Jaycee Senate, Manila, December.

Swapan K. Datta, senior scientist, plant biotechnology, PBGB

- Elected member of the International Advisory Committee of the International Association for Plant Tissue Culture and Biotechnology.
- Named associate editor of *Transgenic Research*, Springer/Kluwer International Publications.
- Elected Fellow of India's Academy of Agricultural Science, December.

S.K. De Datta, former IRRI agronomist and principal scientist (1966-91)

- Received a Presidential Citation Award from President Gloria Macapagal Arroyo for his contributions toward eradicating hunger through improved agricultural productivity and food security, particularly for the production of rice, 17th PhilRice National Research and Development Conference, Manila, April.

Glenn Gregorio, international research fellow; scientist and rice breeder for Africa, PBGB

- Received the 2004 Achievement Award for Crop Science Research from the Crop Science Society of the Philippines, Davao City, March.
- Named 2004 Outstanding Young Scientist in the field of genetics, National Academy of Science and Technology, Philippines, June.
- Appointed honorary scientist of the Rural Development Administration of Korea.
- Received one of Ten Outstanding Young Men (TOYM) Awards in the field of plant breeding and genetics, from the Philippine Jaycees, Gerry Roxas Foundation, and the TOYM Foundation, Manila, December.

Gene Hettel and **Aurora Ammayao**, CPS

- Won the Outstanding Professional Skill in Writing Award and Gold Award for their book chapter, *Let's hope the bile is good*, Association of Communication Excellence in Agriculture, Natural Resources, and Life and Human Sciences, Lake Tahoe, Nevada, USA, June.

Ariel Javellana (CPS), **Christian Concepcion** (CPS), and **Duncan Macintosh** (VIS)

- Won the Gold Award for IRRI's International Year of Rice poster set, Association of Communication Excellence in Agriculture, Natural Resources, and Life and Human Sciences, Lake Tahoe, Nevada, USA, June.

Edwin Javier, senior scientist, plant breeding, PBGB and INGER coordinator

- Received an Appreciation and Partnership Award for his continuous collaboration with Myanmar through activities involving the International Network for Genetic Evaluation of Rice, Ministry of Agriculture and Irrigation, Myanmar.

Gurdev Khush, former IRRI principal plant breeder, PBGB

- Received the Khwarizmi International Award for Agriculture, Teheran, February.

Ish Kumar, international research fellow, PBGB

- Presented a Plaque of Recognition for being responsible for the development of Mestizo hybrid rice and contributions to the Filipino people, Bayer Crop Science, Manila, November.

J.K. Ladha, senior scientist, soil science, CSWS

- Elected Fellow of the Soil Science Society of America, November.

Juan Lazaro IV, **Ariel Javellana**, and **Gene Hettel**, CPS

- Won a Bronze Award for an IRRI image bank advertisement, Association of Communication Excellence in Agriculture, Natural Resources, and Life and Human Sciences, Lake Tahoe, Nevada, USA, June.

Dave Mackill, Sant Virmani, Gary Atlin, Edwin Javier, Yolanda Chen, Melissa Fitzgerald, Ish Kumar, Mods Amante, Roger Cabunagan, Julio Chavez, Leody Ebron, Tony Evangelista, Cel Laza, Vit Lopena, Rhulyx Mendoza, Neil Monroy, Mark Nas, Varoy Pamplona, Ed Redona, Dory Resurreccion, Benny Romena, Tess Sta Cruz, Noli Vera Cruz, and **Jeannie Yanoria**

- Received a plaque of recognition for the Philippine release of two new rice varieties for the irrigated lowlands—NSIC Rc118 also known as *Matatag 3* and NSIC Rc122 or *Angelica*, National Seed Industry Council (NSIC), the Philippine Rice Research Institute, and the Rice Technical Working Group, April.

Tom Mew, principal scientist, EPPD

- Presented a Certificate of Appreciation in recognition of his contributions to rice pathology, Rural Development Administration, Republic of Korea, Seoul, April.
- Presented a Certificate of Recognition for his outstanding contributions to improving rice farmers' seed health practices for pest management and crop production in Bangladesh, Bangladesh Rice Research Institute, May.

Tamerlane Mark Nas, researcher, PBGB

- Received the 2004 Gamma Sigma Delta Honor Society of Agriculture Best MS Thesis Award (for *Pyramiding of thermosensitive genetic male sterility [TGMS] genes and molecular characterization of a candidate TGMS locus in rice),* University of the Philippines Los Baños.

F. Palis, P.A.A. Cenas, B.A.M. Bouman, R.M. Lampayan, A.T. Lactaoen, T.M. Norte, V.R. Vicmudo, M. Hossain, and **G.T. Castillo**

- Won the best paper on education and extension, Crop Science Society of the Philippines, Davao City, March.

A. Pamplona, **R. Maghirang**, **C.N. Neeraja**, **E. Ella**, **A. Ismail**, and **D. Mackill**

- Received the best poster award for *Submergence tolerance deployed to widely grown rainfed rice varieties through marker-assisted backcrossing, International Symposium on Rice: From Green Revolution to Gene Revolution*, Hyderabad, India, October.

Mano D. Pathak, former IRRI director for research and training (1962-89)

- Received *Research Accomplishment Award* in recognition of his discovery and development of genetic resources that confer insect resistance on tropical paddy rice, Leading Japanese Rice Research Group, Tokyo, Japan, November.

Shaobing Peng, senior scientist, crop physiology, CSWS

- Elected Fellow of the American Society of Agronomy, November.

N. Ruaraidh Sackville Hamilton, head, Genetic Resources Center

- Named chair of the Inter-Center Working Group on Genetic Resources.

M. Vasconselos, **K. Datta**, **N. Oliva**, **M. Khalekuzzaman**, **L. Torrizo**, **S. Krishnan**, **M. Olibeira**, **F. Goto**, and **S.K. Datta**

- Won the 2004 CGIAR Science Award for Outstanding Scientific Article, *Enhanced iron and zinc accumulation in transgenic rice with the ferritin gene*, published in *Plant Science,* Mexico City, October.

Sant Singh Virmani, principal scientist, PBGB

- Won the Koshihikari International Rice Prize in recognition of his contributions to hybrid rice breeding, genetics, and seed production; Fukui City, Japan, announced in November 2004, presented in February 2005.
- Received a Plaque of Recognition for being responsible for the development of Mestizo hybrid rice and contributions to the Filipino people, Bayer Crop Science, Manila, November.

M.G. Yandoc, **G. Santos**, **V. Alarcon**, **J. Ibabao**, and **G. Hettel**, CPS

- Won a Silver Award for the electronic IRRI Bulletin, Association of Communication Excellence in Agriculture, Natural Resources, and Life and Human Sciences, Lake Tahoe, Nevada, USA, June.

Kaijun Zhao, liaison scientist for China, IPMO

- Elected Fellow of the Beijing Society for Plant Pathology.

Publications and seminars in 2004

(through 31 January 2005)

Journal articles (refereed)

Crop management, agronomy, and physiology

Belder P, Bouman BAM, Spiertz JHJ, Cabangon R, Guoan L, Quilang EJP, Li Yuanhua, Tuong TP. 2004. Effect of water and nitrogen management on water use and yield of irrigated rice. Agric. Water Manage. 65:193-210.

Boissau S, Hoang LA. Castella JC. 2004. The SAMBA role play game in northern Vietnam. An innovative approach to participatory natural resource management. Mountain Res. Dev. 24(2):101-105.

Boling, A, Tuong TP, Jatmiko SY, Burac MA. 2004. Yield constraints of rainfed lowland rice in Central Java, Indonesia. Field Crops Res. 90(2/3):351-360.

Castella JC, Dang DQ, Thevenot P. 2004. Toward new modes of governance of the research-development continuum to facilitate the dissemination of agricultural innovations in a mountainous province of northern Vietnam. Int. J. Agric. Resour. Gov. Ecol. 3(1/2):77-94.

Castella JC, Tran TH, Eguienta YK. 2004. Participatory analysis for community-based livestock management in Vietnam. Participatory Learning Action, 50.

Castella JC. Tran QH, Husson O, Vu HN, D DQ. 2004. Appartenance ethnique, acces aux ressources foncieres, et strategies paysannes dans une zone de montagne au nord du Vietnam. Cahiers Agric. 13(5):403-411.

Das KK, Sarkar RK, Ismail AM. 2004. Elongation ability and non-structural carbohydrate levels in relation to submergence tolerance in rice. Plant Sci. 168:131-136.

Dey M, Complainvill A, Charon C, Kondorosi A, Crespi M, Datta SK. 2004. Phytohormonal responses in enod40-overexpressing plants of *Medicago truncatula* and rice. Physiol. Plant. 120:132-139.

Erout A, Castella JC. 2004. Riz d'en bas–riz d'en haut: elements structurant des systemes de production agricole d'une province de montagne au nord du Vietnam. Cahiers Agric. 13(5):413-420.

Haefele SM, Johnson DE, M'Bodj D, Wopereis MCS, Miezan KM. 2004. Field screening of diverse rice genotypes for weed competitiveness in irrigated lowland ecosystems. Field Crops Res. 88:29-46.

Huang J, Peng S. 2004. Comparison and standardization among chlorophyll meters in their readings on rice leaves. Plant Prod. Sci. 7(1):97-99.

Huang J, Peng S. 2004. Influence of storage methods on total nitrogen analysis in rice leaves. Commun. Soil Sci. Plant Anal. 35(5&6):879-888.

Husson O, Castella JC, Ha DT, Naudin K. 2004. Diagnostic agronomique des facteurs limitants le rendement du riz pluvial dans les zones de montagne au nord du Vietnam. Cahiers Agric. 13(5):421-428.

Johnson DE, Wopereis MCS, Mbodj D, Diallo S, Powers S, Haefele SM. 2004. Timing of weed management and yield losses due to weeds in irrigated rice in the Sahel. Field Crops Res. 85(1):31-42.

Johnson DE, Wopereis MCS, Mbodj D, Diallo S, Powers S, Haefele SM. 2004. Timing of weed management and yield losses due to weeds in irrigated rice in the Sahel. Field Crops Res. 85(1):31-42.

Laza RC, Peng S, Akita S, Saka H. 2004. Effect of panicle size on grain yield of IRRI-released indica rice cultivars in the wet season. Plant Prod. Sci. 7(3):271-276.

Peng S, Huang J, Sheehy JE, Laza RC, Visperas RM, Zhong X, Centeno GS, Khush GS, Cassman KG. 2004. Rice yields decline with higher night temperature from global warming. Proc. Natl. Acad. Sci. (USA) 101(27):9971-9975.

Ranathunge K, Kotula L, Steudle E, Lafitte R. 2004 . Water permeability and reflection coefficient of the outer part of young rice roots are differently affected by closure of water channels (aquaporins) or blockage of apoplastic pores. J. Exp. Bot. 55:433-447.

Scopel E, Macena da Silva FA, Corbeels M, Affholder F, Maraux F. 2004. Modelling crop residue mulching effects on water use and production of maize under semi-arid and humid tropical conditions. Agronomie 24:383-395.

Segda Z, Haefele SM, Wopereis MCS, Sedogo MP, Guinko S. 2004. Agro-economic characterization of irrigated rice at Bagré, Burkina Faso. Agron. J. 96(5):1314-1322.

Sheehy JE, Mitchell PL, Ferrer AB. 2004. Bi-phasic growth patterns in rice. Ann. Bot. 94(6):811-817.

Sheehy JE, Mnzava M, Cassman KG, Mitchell PL, Pablico P, Robles RP, Samonte HP, Lales JS, Ferrer AB. 2004. Temporal origin of nitrogen in the grain of irrigated rice in the dry season: the outcome of uptake, cycling, senescence and competition studied using a ^{15}N-point placement technique. Field Crops Res. 89:337-348.

Sheehy JE, Mnzava M, Cassman KG, Mitchell PL, Pablico P, Robles RP, Ferrer AB. 2004. Uptake of nitrogen by rice studied with a point-placement technique. Plant Soil 259:259-265.

Sheehy JE, Peng S, Dobermann A, Mitchell PL, Ferrer A, Jianchang Yang, Yingbin Zou, Xuhua Zhong, Jianliang Huang. 2004. Fantastic yields in the system of rice intensification: fact or fallacy? Field Crops Res. 88:1-8.

Wassmann R, Hien NX, Hoan CT, Tuong TP. 2004. Sea level rise affecting the Vietnamese Mekong Delta: water elevation in the flood season and implications for rice production. Clim. Change 66(1/2):89-107.

Witt C, Dobermann A, Buresh R, Abdulrachman S, Gines HC, Nagarajan R, Ramanathan S, Tan PS, Wang GH. 2004. Long-term phosphorus and potassium strategies in irrigated rice. Better Crops 88(4):32-35.

Diseases and their management

Elazegui FA, Castilla NP, Dalisay TU, Mew TW. 2004. Causal agent of red stripe disease of rice. Plant Dis. 88:1310-1317.

Mew TW, Leung H, Savary S, Vera Cruz CM, Leach JE. 2004. Looking ahead in rice disease research and management. Crit. Rev. Plant Sci. 23(2):103-127.

Genomics, bioinformatics, and molecular biology

Biradar SK, Sundaram RM, Thirumurugan T, Bentur JS, Amudhan S, Shenoy VV, Mishra B, Bennett J. 2004. Identification of flanking SSR markers for a major rice gall midge resistance gene *Gm1* and their validation. Theor. Appl. Genet. (epub ahead of print).

Bruskiewich R. 2004. Guest editor preface: Plant and Animal Genome (PAG) Meeting Bioinformatics Session Paper Competition. Bioinformatics 20(2):139.

Cui K, Peng S, Ying Y, Yu S, Xu C. 2004. Molecular dissection of the relationships among tiller number, plant height and heading date in rice. Plant Prod. Sci. 7(3): 309-318.

Hirochika H, Guiderdoni E, An G, Hsing YI, Eun MY, Han CD, Upadhyaya N, Ramachandran S, Zhang Q, Pereira A, Sundaresan V, Leung H. 2004. Rice mutant sources for gene discovery. Plant Mol. Biol. 54:325-334.

Juretic N, Bureau TE, Bruskiewich RM. 2004. Transposable element annotation of the rice. Bioinformatics 20(2):155-160.

Latha R, Rubia L, Bennett J, Swaminathan MS. 2004. Allele mining for stress tolerance genes in *Oryza* species and related germplasm. Mol. Biotechnol. 27:101-108.

Leung H, An G. 2004. Rice functional genomics: large-scale gene discovery and applications to crop improvement. Adv. Agron. 82:55-111.

Liu B, Zhang S, Zhu X, Yang Q, Wu S, Mei M, Mauleon R, Leach J, Mew T, Leung H. 2004. Candidate defense genes as predictors of quantitative blast resistance in rice. Mol. Plant-Microbe Interact. 17(10):1146-1152.

Liu G, Wang L, Zhou Z, Leung H, Wang GL, He C. 2004. Physical mapping of a rice lesion mimic gene, *Spl1*, to a 70-kb segment of rice chromosome 12. Mol. Genet. Genomics 272:108-115.

Ueda A, Kathiresan A, Inada M, Narita Y, Nakamura T, Shi W, Takabe T, Bennett J. 2004. Osmotic stress in barley regulates expression of a different set of genes than salt stress does. J. Exp. Bot. 55:2213-2218.

Wang GL, Wu C, Zeng L, He C, Baraoidan M, Goes da Silva F, Williams CE, Ronald PC, Leung H. 2004. Isolation and characterization of rice mutants compromised in *Xa21*-mediated resistance to *X. oryzae* pv. *oryzae*. Theor. Appl. Genet. 108:379-384.

Zeng LR, Qu S, Bordeos A, Yang C, Baraoidan M, Yan H, Xie Q, Nahm BH, Leung H, Wang GL. 2004. *Spotted leaf11*, a negative regulator of plant cell death and defense, encodes a U-box/armadillo repeat protein endowed with E3 ubiquitin ligase activity. Plant Cell 16:2795-2808.

Pests and their management

Escalada MM, Heong KL. 2004. A participatory exercise for modifying rice farmers' beliefs and practices in stem borer loss assessment. Crop Prot. 23: 11-17.

Jahn GC, Domingo I, Almazan, MLP, Pacia J. 2004. Effect of rice bug *Leptocorisa oratorius* (Hemiptera: Alydidae) on rice yield, grain quality and seed viability. J. Econ. Entomol. 97(6): 1923-1927.

Lu ZX, Heong KL, Yu XP, Hu C. 2004. Effects of plant nitrogen on fitness of the brown planthopper, *Nilaparvata lugens* Stal. in rice. J. Asia Pacific Entomol. 7:97-104.

Willocquet L, Elazegui FA, Castilla N, Fernandez L, Fischer KS, Peng S, Teng PS, Srivastava RK, Singh HM, Zhu D, Savary S. 2004. Research priorities for rice disease and pest management in tropical Asia: a simulation analysis of yield losses and management efficiencies. Phytopathology 94:672-682.

Plant breeding, genetics, and transgenics

Cho YC, Baek MK, Suh Jp, Kwon SJ, Choi IS, Kim YG, Han SS, Choi HC, Hwang HG. 2004. Mapping of quantitative resistance to leaf blast in Japonica resistance rice, Suweon 365. Korean J. Breed 36:125-132.

Cho YC, Choi IS, Baek MK, Yanoria Mary JT, Suh JP, Roh JH, Kim YG, Jena KK, Choi HC, Hwang, HG. 2004. Analysis of resistance genes to blast (*Magnaporthe grisea*) in the japonica rice cultivar, Ilpumbyeo. Korean J. Breed. 36(2):81-89.

Chye ML, Zhao KJ, He ZM, Ramalingam S, Fung KL. 2004. An agglutinating chitinase with two chitin-binding domains confers fungal protection in transgenic potato. Planta (epub ahead of print).

Fan YL, Zhao KJ. 2004. Progress in the development of large DNA fragment cloning vectors [in Chinese]. China Biotechnol. 24(3):12-16.

He GM, Sun CQ, Fu YC, Fu Q, Zhao KJ, Wang CL, Zhang Q, Ling ZZ, Wang XK. 2004. Pyramiding of senescence-inhibition *IPT* gene and *Xa23* for resistance to bacterial blight in rice (*Oryza sativa* L.) [in Chinese]. Acta Genet. Sin. 31(8):836-841.

Hwang HG, Kwon SJ, Cho YC, Ahn SN, Suh JP, Moon HP. 2004. Genetic diversity of high quality rice cultivars based on SSR markers linked to blast resistance genes. Korean J. Crop Sci. 49(3):251-255.

Jeung JU, Kang KH, Suh JP, Hwang HG, Choi HC, Jena KK. 2004. Line evaluation of specific allele tagging: practical and proper application of DNA marker technologies. Korean J. Breed. 36(1):139-146.

Khush GS, Angeles E, Virk PS, Brar DS. 2004. Breeding rice for resistance to tungro virus at IRRI. SABRAO J. 36(2):101-106.

Lafitte HR, Price A, Courtois B. 2004. Yield response to water deficit in an upland rice mapping population: associations among traits and genetic markers. Theor. Appl. Genet. 109:1237-1246.

Liu L, Lafitte HR, Guan D. 2004. Wild *Oryza* species as potential sources of drought-adaptive traits. Euphytica 138:149-161.

Narayanan NN, Baisakh N, Oliva NP, Vera Cruz, CM, Gnanamanickam SS, Datta K, Datta SK. 2004. Molecular breeding: marker-assisted selection combined with biolistic transformation for blast and bacterial blight resistance in Indica rice (cv CO 39). Mol. Breed. 14:61-71.

Nozoe T, Rodriguez R, Agbisit R. 2004. Effects of waterlogging during fallow season on the growth of paddy rice under double cropping system in the tropics. Jpn. J. Soil Sci. Plant Nutr. 75:161-167.

Nozoe T, Rodriguez R, Agbisit R. 2004. Phosphorus deficiency of paddy rice originated in the soil drying in fallow season. Jpn. J. Trop. Agric. 48(1):7-8.

Rodriguez R, Nozoe T, Yanagihara S, Fukuta Y, Agbisit R. 2004. Physiological evaluation of tolerance of elite rice breeding lines for iron (Fe) toxicity using Fe-excluding power. Philipp. J. Crop Sci. 29 (1):161.

Suh JP, Cho YC, Jeong EG, Choi IS, Choi YH, Baek MK, Yea JD, Ahn SN, Kim YG, Hwang HG. 2004. SSR analysis of heterosis for cold tolerance in rice. Korean J. Breed. 36(3):157-164.

Suh JP, Choi YH, Kim KJ, Cho YC, Kwon SJ, Jeong UP, Jeung JU, Choi LS, Kim YG, Choi HC, Hwang HG. 2004. Genetic diversity, japonica rice, SSR marker, QTLs and grain quality. Korean J. Breed. 36(1):20-30.

Suh JP, Choi YH, Kim KJ, Cho YC, Kwon,SJ, Jeong JU, Choi IS, Kim YG, Choi HC, Hwang HG. 2004. Genetic diversity and QTLs for grain quality in japonica rice. Korean J. Breed. 36(1):31-37.

Tang CM, Chye ML, Ramalingam S, Ouyang SW, Zhao KJ, Ubhayasekera W, Mowbray SL. 2004. Functional analyses of the chitin-binding domains and the catalytic domain of *Brassica juncea* chitinase BjCHI1. Plant Mol. Biol. 56(2):285-298.

Vitte C, Lamy F, Ishii T, Brar DS, Panaud O. 2004. Genomic paleontology provides evidence for two distinct origins of Asian rice (*Oryza sativa* L.). Mol. Gen. Genomics 272:504-511.

Wang CL, Zhao BY, Zang Q, Zhao KJ, Xin QD. 2004. Identification of a new rice germplasm with resistance to bacterial blight and the breeding of a near-isogenic line [in Chinese]. J. Plant Genet. Resour. 5(1):26-30.

Wu JL, Sinha PK, Variar M, Zheng KL, Leach JL, Courtois B, Leung H. 2004. Association between molecular markers and blast resistance in an advanced backcross population of rice. Theor. Appl. Genet. 108:1024-1032.

Wu XF, Zhao KJ, Chen YQ. 2004. The motifs of plant inducible promoters [in Chinese]. China Biotechnol. 24(12):14-21.

Xu KN, Deb R, Mackill DJ. 2004. A microsatellite marker and codominant PCR-based marker for marker-assisted selection of submergence tolerance in rice. Crop Sci. 44:248-253.

Zeng L, Kwon T-R, Liu X, Wilson C, Grieve CM, Gregorio GB. 2004. Genetic diversity analyzed by microsatellite markers among rice (*Oryza sativa* L.) genotypes with different adaptation to saline soils. Plant Sci. 166:1275-1285.

Zhou YL, Fan JJ, Zeng CZ, Liu XZ, Wang S, Zhao KJ. 2004. Preliminary analysis of genetic diversity and population structure of *Ustilaginoidea virens* [in Chinese]. Acta Phytopathol. Sin. 34(5):442-448.

Socioeconomics and policy

Abedullah, Pandey S. 2004. Risk and fertilizer use in the rainfed rice ecosystem of Tarlac, Philippines. J. Agric. Appl. Econ. 36(1):241-250.

Balisacan A, Fuwa N. 2004. Going beyond cross-country averages: growth, inequality, and poverty in the Philippines. World Dev. 32(11): 1891-1907.

Cantrell RP, Hettel GP, Barry GF, Sackville Hamilton R. 2004. Impact of intellectual property on nonprofit research institutions and the develop countries they serve. Minnesota J. Law Sci. Technol. 6(1). www.mjlst.umn.edu.

Datta SK. 2004. Rice biotechnology: a need for developing countries. AgBioForum 7:30-34.

Dawe D, Frolking S, Li CS. 2004. Trends in rice-wheat area in China. Field Crops Res. 87(1):89-95.

Hossain M. 2004. Rural non-farm economy in Bangladesh: evidence from household surveys. Econ. Pol. Weekly 34(36):4053-4058.

Huang Q, Dawe D, Huang J, Rozelle S, Wang J. 2004. Irrigation, income and poverty in rural China. Austr. J. Agric. Resour. Econ.

Moya P, Hong Lin, Dawe D, Chen Chongde. 2004. The impact of on-farm water saving irrigation techniques on rice productivity and profitability in Zhange Irrigation System, Hubei, China. Paddy Water Environ 2:207-215.

Roetter RP, Hoanh CT, Laborte AG, Van Keulen H, Van Ittersum MK, Dreiser C, Van Diepen CA, de Ridder N, van Laar HH. 2004. Integration of systems network (SysNet) tools for regional land use scenario analysis in Asia. Environ. Modelling Software 20:291-307.

Sommut W, Bose ML, Singh VP, Hossain M. 2004. Agriculture and livelihoods in the flood-prone ecosystem in Thailand. Kasetsart J. (Soc. Sci.) 25:69-84.

Van Ittersum MK, Roetter RP, Van Keulen H, de Ridder N, Hoanh CT, Laborte AG, Aggarwal PK, Ismail AB, Tawang A. 2004. A systems network (SysNet) approach for interactively evaluating strategic land use options at sub-national scale in South and Southeast Asia. Land Use Policy 21:101-113.

Soils and nutrient management

Alam M, Ladha JK. 2004. Optimizing phosphorus fertilization in an intensive vegetable-rice cropping system. Biol. Fertil. Soils 277-283.

Haefele SM, Johnson DE, M'Bodj D, Wopereis MCS, Miezan KM. 2004. Field screening of diverse rice genotypes for weed competitiveness in irrigated lowland ecosystems. Field Crop Res. 88:29-46.

Haefele SM, Wopereis MCS, Ndiaye MK, Kropff MJ. 2003. A framework to improve fertilizer recommendations for irrigated rice in West Africa. Agric. Syst. 76(1):313-335.

Haefele SM, Wopereis MCS, Schloebohm A, Wiechmann H. 2004. Long-term fertility experiments for irrigated rice in the West African sahel: effect on soil characteristics. Field Crops Res. 85(1):61-77.

Shukla AK, Ladha JK, Singh VK, Dwivedi BS, Gupta RK, Sharma SK, Balasubramanian V, Singh Y, Padre AT, Yadav RL. 2004. Calibrating the leaf color chart for N management in different genotypes of rice and wheat in a system perspective. Agron. J. 96:1606-1621.

Tirol-Padre, A, Ladha JK. 2004. Assessing the reliability of permanganate-oxidizable carbon as an index of soil labile carbon. Soil Sci. Soc. Agron. J. 68:969-978.

Wassman R, Neue HU, Ladha JK, Aulakh MS. 2004. Mitigating greenhouse gas emissions from rice-wheat cropping systems in Asia. Environ. Dev. Sustainability 6:65-90.

Yadvinder-Singh, Bijay-Singh, Ladha JK, Khind CS, Gupta RK, Meelu OP, Pasuquin E. 2004. Long-term effects of organic inputs on yield and soil fertility in the rice-wheat rotation. Soil Sci. Soc. Agron. J. 68:845-853.

Yadvinder-Singh, Bijay-Singh, Ladha JK, Khind CS, Khera TS, Bueno C. 2004. Effects of residue decomposition on productivity and soil fertility in a rice-wheat rotation. Soil Sci. Soc. Agron. J. 68:854-864.

Water management

Belder P, Bouman BAM, Cabangon R, Lu Guoan, Quilang EJP, Li Yuanhua, Spiertz JHJ, Tuong TP. 2004. Effect of water-saving irrigation on rice yield and water use in

typical lowland conditions in Asia. Agric. Water Manage. 65:193-210.

Tabbal DF, Bouman BAM, Bhuiyan SI, Sibayan EB. 2004. Improving lodging resistance of direct wet-seeded rice. Philipp. J. Crop Sci. 27(2): 55-64.

Books

Crop management, agronomy, and physiology

Bhuiyan SI, Abedin MZ, Singh VP, Hardy B, editors. 2004. Rice research and development in the flood-prone ecosystem. Proceedings of the international workshop on flood-prone rice systems, 9-11 Jan 2001, Gazipur, Bangladesh. Los Baños (Philippines): International Rice Research Institute. 283 p.

Caton BP, Mortimer M, Hill JE. 2004. A practical field guide to weeds of rice in Asia. Los Baños (Philippines): International Rice Research Institute. 116 p.

Pests and their management

Heinrichs EA, Barrion AT, Hettel GP. 2004. Rice-feeding insects and selected natural enemies in West Africa: biology, ecology, identification. Los Baños (Philippines): International Rice Research Institute and Abidjan (Côte d'Ivoire): WARDA—The Africa Rice Center. 242 p.

Socioeconomics and policy

Trebuil G, Hossain M. 2004. Le Riz: Enjeux ecologiques et economiques. Belin: Paris.

Book chapters

Crop management, agronomy, and physiology

Buresh RJ, Peng S, Huang J, Yang J, Wang G, Zhong X, Zou Y. 2004. Rice systems in China with high nitrogen inputs. In: AR Mosier, JK Syers Freney JR, editors. Agriculture and the nitrogen cycle: assessing the impacts of fertilizer use on food production and the environment. Washington, D.C. (USA): Island Press. p 143-153.

Buresh RJ, Rowe EC, Livesley SJ, Cadisch G, Mafongoya P. 2004. Opportunities for capture of deep soil nutrients. In: van Noordwijk M, Cadisch G, Ong C, editors. Below-ground interactions in tropical agroecosystems--concepts and models with multiple plant components. Wallingford (UK):CABI Publishing. p 109-125.

Peng S, Ismail A. 2004. Physiological basis of yield and environmental adaptation in rice. In: Nguyen HT, Blum A, editors. Physiology and biotechnology integration for plant breeding. New York: Marcel Dekker, Inc. p 83-140.

Wade LJ, Samson BK, Siopongco J, Egdane J, Ismail AM, Bennett J, Salekdeh H, Ghareyazie B, McLaren CG, Kamoshita A, Yano K, Yamauchi A. 2004. Progress in drought avoidance of rainfed lowland. In: Water in agriculture. Proceedings of a CARDI International Conference: Research on Water in Agricultural Production in Asia for the 21st Century, Nov 2003, Cambodia, Canberra ACIAR. pp 215-223.

Witt C, Buresh RJ, Balasubramanian V, Dawe D, Dobermann A. 2004. Principles and promotion of site-specific nutrient management. In: Dobermann A, Witt C, Dawe D, editors. Increasing productivity in intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc., and Los Baños (Philippines): International Rice Research Institute. p 397-410.

Witt C, Haefele SM, 2004. Paddy soils: characteristics, productivity, and management. In: Hillel, D. editor. Encyclopedia of soils in the environment. ISBN 0-12-348530-4. Oxford, UK: Elsevier Ltd. p 141-150.

Genomics, bioinformatics, and molecular biology

Koo B, Pardey PG, Jackson MT. 2004. IRRI genebank. In: Koo B, Pardey PG, Wright BD, editors. Saving seeds: the economics of conserving crop genetic resources ex situ in the Future Harvest centres of the CGIAR. Wallingford (UK): CABI Publishing. p 89-103.

Plant breeding, genetics, and transgenics

Ashikari M, Matsuoka M, Datta SK. 2004. Transgenic rice plants. In: Curtis IS, editor. Transgenic crops of the world—essential protocols. The Netherlands. p 3-18.

Baisakh N, Datta SK. 2004. Metabolic pathway engineering for nutrition enrichment. In: Daniell H, Chase CD, editors. Molecular biology and biotechnology of plant organelles. The Netherlands: Springer. p 527-542.

Brar DS, Dhaliwal HS. 2004. Chromosome manipulations for crop improvement. In: Jain HK, Kharkwal MC, editors. Plant breeding: Mendelian to molecular approaches. New Delhi (India): Nargosa Publ. Co. p 65-96.

Elahi CMF, Seraj ZI, Rasul NM, Das KC, Biswas K, Salam MA, Gomosta AR, Tumimbang E, Adorada D, Gregorio GB, Bennett J. 2004. Breeding rice for salinity tolerance using the Pokkali allele: finding a linked DNA marker. In: Islam AS, editor. In vitro culture, transformation and molecular markers for crop improvement. USA: Science Publishers, Inc. p 157-170.

Mackill DJ, McNally KL. 2004. A model crop species: molecular markers in rice. In: Lörz H, Wenzel G, editors. Molecular marker systems in plant breeding and crop improvement. Vol 55. Biotechnology in agriculture and forestry. Heidelberg: Springer Verlag. p 39-54.

Virmani SS, Pandey MP, Singh IS, Xu WJ. 2004. Classical and molecular concepts of heterosis. In: Jain HK, Kharkwal MC, editors. Plant breeding: Mendelian to molecular approaches. New Delhi: Narosa Publishing House and The Netherlands: Kluwer Academic Publishers. p 407-418.

Socioeconomics and policy

Balisacan A, Fuwa N, Debuque M. 2004. The political economy of Philippine rural development since the 1960s. In: Akiyama, T, Larson, D, editors. Rural development and agricultural growth in Indonesia, the Philippines, and Thailand. Canberra (Australia): Asia Pacific Press. p 220-296.

Dawe D. 2004. Trends in sustainability and farm level productivity in intensive Asian rice-based cropping systems. In: Dobermann A, Witt C, Dawe D, editors. Increasing the productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc. Los Baños (Philippines): International Rice Research Institute. p 59-72.

Dawe D, Dobermann A, Witt C, Abdulrachman S, Gines HC, Nagarajan R, Satawathananont S, Son TT, Tan PS, Wang GH. 2004. Nutrient management in the rice soils of Asia and potential of site-specific nutrient management. In: Dobermann A, Witt C, Dawe D, editors. Increasing the productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc. and Los Baños (Philippines): International Rice Research Institute. p 337-358.

Dobermann A, Simbahan GC, Moya PF, Adviento MAA, Tiongco M, Witt C, Dawe D. 2004. Methodology for socioeconomic and agronomic on-farm research in the RTDP project. In: Dobermann A, Witt C, Dawe D, editors. Increasing the productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc. and Los Baños (Philippines): International Rice Research Institute. p 11-27.

Hossain M, Abedin Z. 2004. Rice research and development in the flood-prone ecosystem: an overview. In: Bhuiyan SI, Abedin MZ, Singh VP, Hardy B. editors. Rice research and development in the flood-prone ecosystem. Proceedings of the international workshop on flood-prone rice systems, 9-11 Jan 2003, Gazipur, Bangladesh. Los Baños (Philippines): International Rice Research Institute. p 77-107.

Hossain M, Bose ML, Chowdhury A. 2004. Changes in agriculture and the economy in the flood-prone environment in Bangladesh, 1988-2000: insights from a repeat survey of 16 villages. In: Bhiuyan SI, Abedin MZ, Singh VP, Hardy B. editors. Rice research and development in the flood-prone ecosystem. Proceedings of the international workshop on flood-prone rice systems, Gazipur, Bangladesh, 9-11 Jan 2003. Los Baños (Philippines): International Rice Research Institute. p 13-31.

Moya PF, Dawe D, Pabale D, Tiongco M, Chien NV, Devajaran S, Djatiharti A, Lai NX, Niyomvit L, Ping HX, Redondo G, Wardana P. 2004. The economics of intensively irrigated rice in Asia. In: Dobermann A, Witt C, Dawe D, editors. Increasing the productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc. and Los Baños (Philippines): International Rice Research Institute. p 29-58.

Witt C, Buresh RJ, Balasubramanian V, Dawe D, Dobermann A. 2004. Principles and promotion of site-specific nutrient management. In: Dobermann A, Witt C, Dawe D, editors. Increasing the productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc. and Los Baños (Philippines): International Rice Research Institute. p 397-410.

Soils and nutrient management

Balasubramanian V, Alves B, Aulak MS, Bekunda M, Cai Z, Drinkwater L, Mugendi D, van Kessel C, Oenema O. 2004. Crop, environmental and management factors affecting fertilizer nitrogen use efficiency. In: Mosier AR, Syers JK, and Freney Jr., editors. Agriculture and the nitrogen cycle: assessing the impacts of fertilizer use efficiency on food production and the environment. SCOPE Series. Vol. 65. Washington: Island Press. p 19-33.

Haefele SM, Wopereis MCS. 2004. Combining field and simulation studies to improve fertilizer recommendations for irrigated rice in the Senegal river valley. In: Doberman A, Witt C, Dawe D, editors. Increasing productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers, Inc. and Los Baños (Philippines): International Rice Research Institute. p 265-286.

Krupnik TJ, Six J, Ladha JK, Paine MJ, van Kessel C. 2004. An assessment of fertilizer nitrogen recovery efficiency by grain crops across scales. In: Mosier AR, Syers JK, Freney JR, editors. An assessment of fertilizer nitrogen recovery efficiency by grain crops. Agriculture and the nitrogen cycle: assessing the impacts of fertilizer use on food production and the environment. SCOPE 65. Paris, France. p 193–207.

Witt C, Buresh RJ, Balasubramanian V, Dawe D, Dobermann A. 2004. Principles and promotion of site-specific

nutrient management. In: Doberman A, Witt C, Dawe D, editors. Increasing productivity of intensive rice systems through site-specific nutrient management. Enfield, NH (USA): Science Publishers Inc. and Los Baños, (Philippines): International Rice Research Institute. p 397-410.

Yadvinder-Singh, Ladha JK. 2004. Principles and practices of no-tillage systems in rice-wheat systems of Indo-Gangetic plains. In: Lal R, Hobbs P, Uphoff N, Morris D, editors. Sustainable agriculture and the rice-wheat systems. Mercel and Dekker. p 167-207.

Conference and workshop posters

Crop management, agronomy, and physiology

Buresh RJ, Larazo W, Samson MI, Laureles E, Thuy NH, Gines HC, Pampolino M, Alberto M. 2004. Sustainable soil and nutrient management of lowland rice ecosystems: experiences from long-term experiments. Poster presented at the Mekong Rice Research Conference, 15-17 Oct 2004, Ho Chi Minh City, Vietnam.

Castillo EG, Tuong TP, Inubushi K, Abdelbagi I. 2004. Rice responses to salinity: comparative effects of osmotic and ionic stresses. Poster presented at the 6th International Conference on Soil with Low pH, 1-5 Aug 2004, Sendai, Japan.

Castillo EG, Tuong TP, Inubushi K, Abdelbagi I. 2004. The importance of osmotic component of salinity stress in rice. Poster presented at the World Rice Research Conference, 4-7 Nov 2004, Tsukuba, Japan.

Centeno HG, Pascual ZP, Ferrer AB, Sheehy JE. 204. The changing rice environment in the Philippines. Poster presented at the 35th CSSP Annual Scientific Conference, 8-12 Mar 2004, Davao City, Philippines.

Chandrasekaran B, Sivakumar DS, Chelliah N, Rajendran R, Ramanathan S, Balasubramanian V. 2004. Evaluation and up-scaling of integrated crop management in Cauvery Delta of Tamil Nadu, India. Poster paper presented at the World Rice Research Conference, 4-7 Nov 2004, Tsukuba, Japan.

Deomano E, Wade L, Harnpichitvitaya D, Amarante S, Tahere S, Bartolome V, McLaren CG. 2004. GxE interaction and characterization of rainfed lowland (RL) environments with DHL's and reference lines. Poster presented at the 17th Annual Scientific Conference of the Federation of Crop Science Societies of the Philippines, 21-26 Apr 2004, Aklan State University, Banga, Aklan.

Haefele SM, Sipaseuth N, Konboon Y, Patil SK, Naklang K, Mazid MA. Harnpichitvitaya D, Siopongco J, Amarante ST, Wihardjaka A, Sengar SS, Singh G, Wade LJ. 2004. Internal nutrient efficiencies of rainfed lowland rice in drought prone environments of subtropical Asia. Poster presented at the World Rice Research Conference, 5-7 Nov 2004, Tsukuba, Japan.

Laza RC, Peng S, Huang J, Sheehy JE, Visperas RM, Zhong X, Centeno GS. 2004. Rice yields decline with higher nighttime temperature from global warming. Philipp. J. Crop Sci. 29 (suppl. 1):79.

Pirdashti H, Sarvestani ZT, Mematzadeh G, Ismail AM. 2004. Study of water stress effects in different growth stages on yield and yield components of different rice (*Oryza sativa* L.) cultivars. In: Proceedings of the 4th International Crop Science Congress, 26 Sep–1 Oct 2004, Brisbane, Australia. Handbook and abstracts. p 133.

Sheehy JE, Pablico PP, Mnzava M, Robles RP, Ferrer AB, Elmido AV. 2004. Nitrogen: uptake, distribution, and use of N for grain estimated using a point-placement technique. Poster presented at the 35th CSSP Annual Scientific Conference, 8-12 Mar 2004, Davao City, Philippines.

Siopongco J, Sekiya K, Yamauchi A, Egdane J, Ismail AM, Wade L. 2004. Evidence of root signals in rainfed lowland rice. In: Proceedings of the Japan Society for Root Research, 12 Jun 2004, Chubu University, Kasugai City, Aichi, Japan. Root Res. 13(2):81.

Tang Q, Zhong X, Peng S, Buresh RJ, Castilla N. 2004. Effect of canopy microclimate on sheath blight infestation and yield loss in irrigated rice. Philipp. J. Crop Sci. 29 (suppl. 1):85.

Thapa B, Ismail AM. 2004. Seedling tolerance to salt stress as affected by genotype and nutrient management. In: Proceedings of the International Rice Science Conference, 13-15 Sep 2004, Seoul, Korea. p 81.

Visperas RM, Peng S, Bouman BAM, Castañeda AR. 2004. Yield decline in continuous aerobic rice system. Philip. J. Crop Sci. 29 (supplement 1):78.

Wissuwa M, Gamat G, Ismail AM, Yanagihara S. 2004. Using component QTL mapping to unravel the genetic and physiological complexity of tolerance to Zn deficiency. Poster presented at the World Rice Research Conference, 5-7 Nov 2004, Tsukuba, Japan.

Witt C, Cabrera-Pasuquin JMCA, Kam SP, Casiwan C, Gines HC, Dobermann A. 2004. Developing recommendation domains for site-specific nutrient mangement in irrigated rice. Poster presented at the 35th Annual Scientific Conference of the Crop Science Society of the Philippines, 8-12 Mar 2004, Davao City, Philippines.

Genetic resources

Almazan MSR, Banaticla MCN, Hamilton NRS. 2004. Conserving wild rice before it's too late. Poster presented at the World Wild Rice Forum, 8 Aug 2004, Osaka, Japan.

Eusebio W, Cosico A, McLaren CG, Serioso-Capilit GL, Mackill D. 2004. Origin of germplasm used in IRRI crosses and distribution of IRRI breeding lines between 1993 and 2002. Poster presented at the 17th Annual Scientific Conference of the Federation of Crop Science Societies of the Philippines, 21-26 Apr 2004, Aklan State University, Banga, Aklan.

Wu JL, Wang HH, Liu B, Carrillo G, Vera Cruz C, McNally K, Leung H. 2004. Identifying and tracing allelic variations of defense response genes in advanced backcross and segregating populations for blast resistance in rice. Crop Functional Genomics Symposium, Jeju, Korea, 6-10 Apr 2004. Poster abstract GM-54.

Genomics, bioinformatics, and molecular biology

Bruskiewich RM, Portugal AM, Cosico AB, Despacio-Reyes G, Ulat VJM, Pimentel CI, Ulat MT, Mansueto L, Gregorio S, Eusebio W, Mendoza MJ, Sallan MAB, Sison L, Herrera RQ, Constantino WVE, Mauleon R, Sylvester AG, Sackville-Hamilton R, Leung H, McNally KL, Metz T, McLaren CG. 2004. Bioinformatics for rice functional genomics at IRRI. Rice Functional Genomics Symposium, Tucson, Arizona. Poster abstract 7.

Han SS, Cho YC, Kim YH, Han JH, Choi SH, Lee SW, Leach JE, McNally K, Choi IR, Vera Cruz C, Leung H. 2004. Association genetics to identify broad-spectrum resistance against blast disease in Korean rice germplasm. Crop Functional Genomics Symposium, 6-10 Apr 2004, Jeju, Korea. Poster abstract GM-61.

Hussain J, McNally K, and Lafitte RH. 2004. Identification of SSR markers linked to candidate genes for drought tolerance in rice. Rockefeller Foundation's Workshop on Resilient Crops for Water-limited Environments, 24-28 May 2004, Cuernavaca, Mexico. Poster abstract.

McNally KL, Vera Cruz C, Leung H. 2004. Relating molecular variation to function in rice germplasm, mutants and breeding populations. Rice Functional Genomics Symposium, Tucson, Arizona. Poster abstract 50.

McNally KL, Wang H, Naredo ME, Carillo G, Till BJ, Greene EA, Henikoff S, Comai L, Vera Cruz C, Leung H. 2004. EcoTILLING stress tolerance genes in cultivated and wild rice. Rice Functional Genomics Symposium, Tucson, Arizona. Poster abstract 68.

Wang HH, Naredo MEB, Wu JL, Till BJ, Greene EA, Comai L, Henikoff S, Leung H, McNally KL. 2004. EcoTILLING candidate genes for drought tolerance in rice. Rockefeller Foundation's Workshop on Resilient Crops for Water-limited Environments, 24-28 May 2004, Cuernavara, Mexico. Poster abstract.

Wissuwa M, Gatdula K, Ismail AM, Yano M. 2004. Candidate gene characterization at the Pup1 locus: a major QTL increasing tolerance to phosphorus deficiency in rice. Poster presented at the World Rice Research Conference, 5-7 Nov 2004, Tsukuba, Japan.

Xie Y, Aquino C, Fournier A, Juliano A, Macatangay M, Zhu Y, Leung H, McNally KL. 2004. Evaluating the diversity of IRGC germplasm and traditional varieties used for mixed planting in China by application of Diversity Array Technology™. Plant, Animal & Microbe Genome XII, 10-14 Jan 2004, San Diego, CA. Poster abstract P355.

Plant breeding, genetics, and transgenics

Afza R, Zapata-Arias FJ, Adorada DL, Mendoza RD, Gregorio GB. 2004. Salt-tolerant IR29 mutants caught in action. Philipp. J. Crop Sci. 29 (suppl. 1):62 (abstr.).

Atlin GN, Laza C, Amante M, Lafitte HR. 2004. Agronomic performance of tropical aerobic, irrigated, and traditional upland rice varieties in three hydrological environments at IRRI. Poster presented at the 4th International Crop Science Congress, Brisbane, Australia.

Begum S, Ona A, Virk P, Vera Cruz CM. 2004. Basmati-derived rice: introgression of effective bacterial blight resistance genes, analysis of physiochemical traits and mapping for grain quality. International Rice Science Conference, Korea, 13-15 Sep 2004, Seoul, Korea (abstr.).

Gregorio GB, Sison CB, Mendoza RD, Adorada DL, Tumimbang EB, Cabuslay GS, Sattari M. 2004. High-iron rice: genetic variability of iron content in the grain. Philipp. J. Crop Sci. 29: (suppl. 1):18.

Hwang HG, Suh JP, Cho YC, Kwon SJ, Choi IS, Hong HC, Kim YG, Kim MK, Choi HC. 2004. QTL analysis for eating quality in japonica rice. Poster presented at the World Rice Research Conference, Tokyo and Tsukuba, Japan.

Islam MM, Gregorio GB, Barrion AA, Mendoza RD, Adorada DL. 2004. Screening technique for salinity tolerance at reproductive stage in rice. Philipp. J. Crop Sci. 29 (suppl. 1):55.

Maghirang R, Neeraja CN, Pamplona A, Mackill DJ, 2004. Marker-assisted approach toward developing submergence-tolerant rice. Poster paper presented at the 8th National Genetics Symposium, 21-22 Oct 2004, International Rice Research Institute, Los Baños, Laguna, Philippines.

Nas TM, Sattari M, Sanchez DL, Casal CS Jr., Toledo RS, Virmani SS. 2004. Use of molecular markers in hybrid rice breeding at IRRI. Poster paper presented at the 8th National Genetics Symposium, 21-22 Oct 2004, International Rice Research Institute, Los Baños, Laguna, Philippines.

Pamplona A, Maghirang R, Neeraja CN, Ella E, Ismail A, Mackill DJ. 2004. Submergence tolerance deployed to widely grown rainfed rice varieties through marker-assisted backcrossing. Poster paper presented at the 8th National Genetics Symposium, 21-22 Oct 2004, International Rice Research Institute, Los Baños, Laguna, Philippines.

Pamplona A, Maghirang R, Neeraja CN, Ella E, Ismail AM, Mackill D. 2004. Submergence tolerance deployed to widely grown rainfed rice varieties through marker-assisted backcrossing. In: Proceedings of the International Symposium on Rice: From Green Revolution to Gene Revolution, 4-6 Oct 2004, Hyderabad, India. p 254.

Singh PK, Sahu RK, Virk PS, Khush GS. 2004. Genetic basis of heterosis in two crosses between tropical japonica and indica rices. International Symposium on Rainfed Rice Ecosystems: Perspective and Potential, 11-13 Oct 2004, Raipur, India. p 9 (abstr.).

Singh PK, Sahu RK, Virk PS, Khush GS. 2004. Triple test cross analysis of a cross between tropical japonica and indica rices. Poster presented at the International Symposium on Rainfed Rice Ecosystems: Perspective and Potential, 11-13 Oct 2004, Raipur, India. p 10 (abstr.).

Tumimbang EB, Niones JM Adorada DL, Gregorio GB, Elahi F, Seraj ZI. 2004. Getting closer to the salt tolerance gene. Philipp. J. Crop Sci. 29 (suppl. 1): 64.

Zaidem ML, Mendoza RD, Tumimbang EB, Duka IM, Gregorio GB. 2004. Is salinity tolerance the same in all stages of rice? Philipp. J. Crop Sci. 29: (suppl. 1):61.

Soils and nutrient management

Balasubramanian V. 2004. Efficient N management technologies for irrigated rice in Asia. Poster presented at the 4th International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia.

Water management

Castañeda AR, Bouman BAM, Peng S, Visperas RM. 2004. Mitigating water scarcity through an aerobic system of rice production. Philipp. J. Crop Sci. 29 (suppl. 1):11.

Conference workshop papers – presented

Crop management, agronomy, and physiology

Affholder F, Madeira Neto J, Scopel E. 2004. Yield gap assessment and diagnosis in Brazil using a crop model. Paper presented at the Crop Science for a Better World, IV International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia.

Cabrera-Pasuquin JMCA, Witt C, Mutters R. 2004. A new standardized leaf color chart for efficient N management in irrigated rice. Paper presented at the 35th Annual Scientific Conference of the Crop Science Society of the Philippines, 8-12 Mar 2004, Davao City, Philipilippines. Philipp. J. Crop Sci. 29 (suppl.): 46.

Castella JC, Kam SP, Verburg PH. 2004. Using models of land use/cover change as support to public policies in northern Vietnam: combined use of LUPAS, CLUE and SAMBA-GIS modeling frameworks. Contribution to the International Workshop on Integrated Assessment of the Land System: the Future of Land Use, 28-30 Oct 2004, Institute for Environmental Studies, Amsterdam, The Netherlands.

Corbeels M, Macena da Silva FA, Affholder F, Scopel E. 2004. Modelling a millet cover crop and subsequent maize production in the tropical cerrados of Brazil. Paper presented at the Congress of the European Society of Agronomy, 11-15 Jul 2004, Copenhagen, Denmark.

Dobermann A, Buresh RJ, Peng S, Witt C, Wang G, Huang J, Yang J, Zhong X, Zou Y. 2004. Strategies for increasing nitrogen use efficiency in irrigated rice systems of China. Paper presented at the International Conference on Resource Management for Sustainable Intensive Agriculture Systems - Promoting Environmentally-friendly Agricultural Production, 5-7 Apr 2004, Beijing, People's Republic of China.

Ella E, Ismail AM. 2004. High nitrogen reduces seedling survival after submergence in rice. Paper presented at the International Symposium on Rice: From Green Revolution to Gene Revolution, 4-6 Oct 2004, Hyderabad, India.

Flores NR, Ismail AM, Dionisio-Sese M. 2004. Gas exchange and water status of contrasting rice (*Oryza sativa* L.) cultivars as affected by salt stress. Abstract of papers at the 18th Scientific Conference of the Federation of Crop Science Societies of the Philippines (CSSP). Philipp. J. Crop Sci. 29 (supp. 1):25.

Gines HC, Witt C, Buresh RJ, Alam MM, Balasubramanian V, Sebastian LS. 2004. Site-specific nutrient management (SSNM) for rice: recommendations and guidelines for Philippine rice farmers. Paper presented at the 35th An-

nual Scientific Conference of the Crop Science Society of the Philippines, 8-12 Mar 2004, Davao City, Philippines. Philipp. J. Crop Sci. 29 (suppl.): 47.

Haefele SM, Atlin G, Kam SP, Johnson DE. 2004. Improving farmers' livelihood in rainfed rice-based lowlands of Asia. Paper presented at the Deutscher Tropentag 2004, Humboldt University, 5-7 Oct 2004, Berlin, Germany. www.tropentag.de/2004/abstracts/full/128.pdf.

Haefele, SM, Atlin G, Kam, SP, Johnson DE. 2004. Improving farmers' livelihood in rainfed rice-based lowlands of Asia. Paper presented at the Deutscher Tropentag 2004, Humboldt University, 5-7 Oct 2004, Berlin, Germany. www.tropentag.de/2004/abstracts/full/128.pdf.

McLaren CG. 2004. Target populations of environments for drought-prone conditions. Invited paper for the GCP Workshop on Phenotyping Methods and Water Deficit, 5-9 Jul 2004, Montpellier, France.

Pampolino MF, Buresh R, Witt C, Balasubramanian V. 2004. Site-specific nutrient management: a plant-based approach for developing fertilizer recommendations for rice. Paper presented at the 35th Annual Scientific Conference of the Crop Science Society of the Philippines, 8-12 Mar 2004, Davao City, Philippines. Philipp. J. Crop Sci. 29 (suppl.):114.

Sheehy JE, Pablico PP, Mnzava M, Robles RP, Ferrer A, Elmido AV. 2004. ^{15}N point-placement technique: a new technique for investigating uptake, distribution, and losses of nitrogen in irrigated rice. Paper presented at the 35th CSSP Annual Scientific Conference, 8-12 Mar 2004, Davao City, Philippines.

Tuong TP. 2004. Integrated approach for increasing water productivity in rice-based systems in Asia. Invited paper presented at the First Steering Meeting of the International Network for Water Ecosystem in Paddy Fields, 1-2 Nov 2004, Ministry of Agriculture, Forestry and Fishery, Tokyo, Japan.

Tuong TP. 2004. Sustainable resource management for agriculture and fisheries: a case study in the Mekong River Delta. Invited paper presented at the symposium on integrated water and fishery resources management, Philippines, 20-22 Sep 2004, Philippine Council for Aquatic and Marine Research and Development, Los Baños, Laguna.

Tuong TP. 2004. Technologies for efficient utilization of water in rice production. Invited paper for the International Rice Science Conference, 13-15 Sep 2004, Rural Development Administration, Seoul, Korea.

Wang, R, Buresh RJ, Kam SP. 2004. Rice farming - its potential for sustainable resource use. Paper presented at the FAO-Japan Conference on Sustainable Use of Agricultural Resources and Environmental Management with Focus on the Role of Rice Farming, Jan 2004, Tokyo, Japan.

Diseases and their management

Mew TW. 2004. Four decades of bacterial blight of rice research. Paper presented at the First International Conference on Bacterial Blight of Rice, 17-19 Mar 2004, Tsukuba International Congress Center, Ibaraki, Japan (abstr.).

Genetic resources

McNally KL. 2004. Candidate gene trees: ortholog or paralog? Paper presented at the Generation Challenge Program Annual Meeting, 21-24 Sep 2004, Brisbane, Australia.

McNally KL. 2004. Discovering SNPs in stress genes: linking SP2 to SP1. Paper presented at the Generation Challenge Program Annual Meeting, 21-24 Sep 2004, Brisbane, Australia.

Genomics, bioinformatics, and molecular biology

Choi IR, Kwak DY, Yamada H, Lee BC, Satoh K, Ooka H, Muhsin M, Cabauatan PQ, Yang SJ, Leung H, Kikuchi K. 2004. Comparative analysis of gene expression profiles from rice plants in response to infection with rice tungro spherical virus. Paper presented at the Crop Functional Genomics Symposium, 7-10 Apr 2004, Jeju, Korea.

Han SS, Cho YC, Kim YH, Han JH, Choi SH, Lee SW, Leach JE, McNally K, Choi IR, Vera Cruz C, Leung H. 2004. Association genetics to identify broad-spectrum resistance against blast disease in Korean rice germplasm. Paper presented at the Crop Functional Genomics Symposium, 7-10 Apr 2004, Jeju, Korea (abstr.).

Leung H, Wu JL, Liu B, Zeng LR, Bordeos A, Baraoidan M, Madamba S, Wang GL, Leach J, McNally K, Choi IR, Vera Cruz C. 2004. Identification of broad-spectrum disease resistance through mutational and gene expression analyses. Paper presented at the Crop Functional Genomics Symposium, 7-10 Apr 2004, Jeju, Korea (abstr.).

Pests and their management

Chen YH, Bernal C. 2004. Examining the origins of insect pests: influence of rice domestication on key pests and natural enemies. Paper presented at the 22nd International Entomological Congress, 15-21 Aug 2004, Brisbane Australia.

Choi IR, Cabunagan RC, Mew TW. 2004. Effects of pure and mixed plantings of resistant and susceptible rice variet-

ies on rice tungro disease incidence in an endemic region of the Philippines. Paper presented at the International Rice Science Conference, 13-15 Sep 2004, Seoul, Korea.

Hossain M, Diaz C, Elazegui F, Mew. T. 2004. Ouality of rice seeds in Bangladesh and effects of yield and pest pressures: results of farmer participatory experiments. Paper presented at the final workshop on Seed Health Improvement sub-project (SHIP) of PETRRA, BARC, 7 Jul 2004, Dhaka, Bangladesh.

Plant breeding, genetics, and transgenics

Gregorio GB. 2004. Challenges in rice breeding for unfavorable areas. Invited paper presented at the Mekong Rice Conference, 15-17 Oct 2004, Ho Chi Minh, Vietnam.

Gregorio GB. 2004. Designing crops with enhanced micronutrient for human health. Invited paper presented at the 31st Philippine Society for Biochemistry and Molecular Biology, 3-4 Dec 2004, Dumaguete, Negros Oriental, Philippines.

Gregorio GB. 2004. Designing crops with enhanced micronutrient for human health. Invited paper presented at the International Symposium on Trace Elements and Health-Trace Elements in Agroecosystem and Health, 10-13 Oct 2004, Hangzhou, China.

Jeung JU, Lee JH, Choi HC, Brar DS, Jena KK. 2004. Identification and fine mapping of a gene conferring resistance to brown planthopper (BPH) in japonica rice improvement. Paper presented at the International Rice Science Conference, 13-15 Sep 2004, Seoul, Korea. p. 65.

Micallef S, McLaren CG, Ulat MT, DeLacy I. 2004. Global wheat information system. Paper presented at the Annual Meeting of the Australian Wheat Breeders Association, 21-24 Sep 2004, Hyatt Hotel, Canberra, ACT, Australia.

Nozoe T, Rodriguez R, Agbisit R. 2004. Effects of water managements in fallow on the growth of rice. Abstracts of the Annual Meeting of the Japanese Society of Soil Science and Plant Nutrition. p 16 (abstr.).

Sanchez AC, 2004. Nuclear protein binding to ethanol-sensitive region (ESR)-1 of the *Nos2* gene: putative role for POU family members. Invited paper presented at the 8th National Genetics Symposium, 21-22 Oct 2004, International Rice Research Institute. Los Baños, Laguna, Philippines.

Virk PS. 2004. Breeding for aromatic/nutritious rices. Paper presented at the workshop Germplasm Enhancement and Water and Nurient Management Strategies for Efficient Rice Production in Iran, 7-11 Aug 2004, Rice Research Institute, Mazandaran, Iran.

Virk PS. 2004. Germplasm screening, identification of genotypes and introgression to elite varieties. Paper presented at the workshop on Crop Biofortification for Alleviating Micronutrient Malnutrition, 23-24 Aug 2004, DBT and MSSRF, Chennai, India.

Virk PS. 2004. Issues in breeding. Paper presented at the Third Annual Meeting, 'Breeding for iron-dense rice: a low-cost, sustainable approach to reducing iron deficiency anemia in Asia,' 7-9 Jun 2004, Bogor, Indonesia.

Virk PS. 2004. Rice breeding at IRRI. Paper presented at the workshop From Seed to Market: a Systems Approach to Rice Improvement in Central Asia, 9-11 Sep 2004, Tashkent, Uzbekistan.

Virk PS. 2004. Varietal selection for water-saving technology. Paper presented at the workshop Germplasm Enhancement and Water and Nutrient Management Strategies for Efficient Rice Production in Iran, 7-11 Aug 2004, Rice Research Institute, Mazandaran, Iran.

Virk PS. 2004. Research on enhancing the nutritional value of rice. Paper presented at CORRA's 8th Annual Meeting, 10-12 Sep 2004, Suwon, Korea.

Wang CL, Fan YL, Zeng CZ, Qiao F, Zhang Q, Liu YG, Zhu LH, Liu PQ, Zhao KJ. 2004. *Xa23*, an elite rice bacteria blight resistance gene, was physically mapped with a 12-kb fragment from *Oryza rufipogon*. In: Plant genomics in China V, 19-22 Aug 2004, Wuhan, China. p 152 (abstr.).

Socioeconomics and policy

Paris T. 2004. Accelerating the adoption of rice varieties suitable for rainfed rice environments through farmer participatory research. IRRI's experience and lessons learned. Paper presented at the International Symposium on Agronomic Research for Local People-oriented Technology Development in Rainfed Rice Fields in Thailand, 19 Mar 2004, Field Production Science Center and Thai Research Exchange Group and Graduate School of Agricultural and Life Sciences, The University of Tokyo.

Conference workshop papers – proceedings

Crop management, agronomy, and physiology

Boling A, Burac MA, Tuong TP, Bouman BAM, Jatmiko SY, van Laar HH. 2004. Simulating the effect of climate, agrohydrology and management on rainfed rice production in Central Java, Indonesia. Philipp. J. Crop Sci. suppl. 29(1):S27.

Boling A, Tuong TP, Bouman BAM, Jatmiko SY, Murty MVR, van Laar HH, van Keulen H. 2004. Increasing rainfed rice productivity in Central Java, Indonesia: a modeling approach. In: Fischer T, et al, editors. New directions for

a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia.

Boling A, Tuong TP, Bouman BAM, Jatmiko SY, Murty MVR, van Laar HH. 2004. Increasing rainfed rice productivity in Central Java, Indonesia: a modeling approach. In: New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep–1 Oct 2004, Brisbane, Australia. Published on CD-ROM. www.regional.org.au/au/cs.

Burac MA, Boling, Tuong TP. 2004. Water-use efficiency of rice under drought spells. Philipp. J. Crop Sci. suppl. 29(1):S82.

Buresh RJ, Witt C, Peng S, Balasubramanian V, Alam MM, Ladha JK. 2004. Site-specific nitrogen management for rice in Asia. In: Annual meeting abstracts. Madison, WI (USA): ASA-CSSA-SSSA.

Buresh RJ, Witt C, Peng S, Mamaril CP. 2004. The evolving integrated nutrient management systems in rice. In: Redoña ED, Castro ZP, Llanto G, editors. Rice integrated crop management: towards a RiceCheck system in the Philippines. Proceedings of the First National Workshop on Rice Integrated Crop Management, 4-5 May 2004, PhilRice, Science City of Muñoz, Nueva Ecija, Philippines. Science City of Muñoz (Philippines): Philippine Rice Research Institute. p 65-78.

Cabangon R, Tuong TP. 2004. Bed-planting of rice to increase water productivity: effects of raised-bed configuration and water management. Philipp. J. Crop Sci. suppl. 29(1): S29.

Cantrell RP, Hettel GP. 2004. The doubly green revolution in Rice. In: Proceedings of the World Food Prize Symposium: Rice, Biofortification, and Enhanced Nutrition, 14-15 Oct 2004. Des Moines (USA): World Food Prize Foundation. www.worldfoodprize.org/Symposium/04presentations/cantrell.pdf.

Castañeda AR, Bouman BAM, Peng SB, Visperas RM. 2004. Testing of aerobic rice in the Philippines: results of field experiments at IRRI. In: Proceedings of the 54th Philippine Agricultural Engineering Annual National Convention, 19-22 Apr 2004, Central Luzon State University, Muñoz, Philippines. p 145-161.

Castillo E, Tuong TP, Inubushi K, Ismail AM. 2004. Rice responses to salinity: comparative effects of osmotic and ionic stresses. In: Proceedings of the 16th International Conference on Soil with Low pH, 1-5 Aug 2004, Sendai, Japan.

Hoanh CT, Tuong TP, Khiem NT, Nhan NV. 2004. Management of conflicts in rice-fishery production in the coastal zone of the Mekong River Delta and impacts on rural livelihood. In: Proceedings of the Mekong Rice Conference, 15-17 Oct 2004, Ho Chi Minh, Vietnam. Vietnam: Ministry of Agriculture and Rural Development.

Hoanh CT, Tuong TP, Phong ND, Kam SP. 2004. Managing conflicting demands on water quality for shrimp and rice production: lessons from the Mekong River Delta. In: Annual meeting abstracts [CD-ROM]. Madison WI: ASA, CSSA, and SSSA.

Ismail AM, Ella E, Holt D, Mackill D. 2004. Tolerance for flooding during germination and vegetative stages in rice: some recent developments. In: Proceedings of the 8th Conference of the International Society for Plant Anaerobiosis, 20-24 Sep 2004, Perth, W. Australia. p 45.

Johnson SE, Angeles OR, Peng N, Wang K, Alberto MCR, Larazo W, Buresh RJ. 2004. Intermittent irrigation affects crop residue decomposition and nutrient supply in rice-based cropping systems. In: Annual meeting abstracts. Madison, WI (USA): ASA-CSSA-SSSA.

Johnson SE, Angeles OR, Peng N, Wang K, Buresh RJ. 2004. Organic acid measurements during decomposition of rice straw in submerged soil. In: Annual meeting abstracts. Madison, WI (USA): ASA-CSSA-SSSA.

Kumar R, Atlin G, Lafitte G. 2004. Evaluation of rapid drought stress protocol to predict field performance of rice under drought stress conditions. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 167-168.

Nivong S, Haefele SM, Linquist B, Sengxua P. 2004. Nutrient management of rainfed lowland rice in Laos: achievements and opportunities. In: Proceedings of the Mekong Rice Conference, 15 -17 Oct 2004, Ho Chi Minh City, Vietnam.

Nozoe T, Agbisit R, Fukuta Y, Rodriguez R, Yanagihara S. 2004. Iron (Fe) tolerance of elite breeding lines developed at IRRI in relation to Fe-excluding power of rice roots. In: Proceedings of the 20th Meeting of the Japanese Society for Root Research. p 6 (abstr.).

Nozoe T, Agbisit R, Fukuta Y, Rodriguez R, Yanagihara S. 2004. Mechanisms of Fe tolerance in rice lines developed at IRRI. Analysis in the field with Fe toxicity. Abstracts of the Annual Meeting of the Japanese Society of Soil Science and Plant Nutrition. p 50 (abstr.).

Phong ND, Tuong TP, Dan NV, Tho LT, George BA, Dang NV, Turral H. 2004. Operational and resource-use performance in the Cu Chi Irrigation system. In: Malano HM, George BA, Davidson B, editors. A framework for improving the management of irrigation schemes in Vietnam. Proceedings of a workshop held on 28 Nov 2003, Ho Chi Minh City, Vietnam. ACIAR Proceedings No. 118. p 31-40.

Thuy NH, Larazo W, Buresh RJ. 2004. Nutrient availability in rice soils as affected by water and tillage during fallows. In: Annual meeting abstracts. Madison WI (USA): ASA-CSSA, SSSA.

Tsubo M, Fukai S, Basnayake J, Tuong TP, Bouman BAM, Harnpichitvitaya D. 2004. The water balance on sloping land in rainfed lowland rice ecosystem. In: Fisher K et al, editors. New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep-1 Oct 2004. Brisbane, Australia. www.cropscience.org.au/ics2004/poster.

Tuong TP, Bouman BAM, Mortimer M. 2004. More rice, less water-integrated approaches for increasing water productivity in irrigated rice-based systems in Asia. In: New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia. www.regional.org.au/au.cs.

Wang R. 2004. Rice farming - its potential for sustainable resource use. Proceedings of the Third Session of the Workshops on Sustainable Use of Agricultural Resources and Environment Management with Focus on the Role of Rice Farming, 21-23 Jan 2004, Tokyo, Japan. Japan: Japan FAO Association, Ministry of Agriculture, Forestry, and Fisheries. p 47-59.

Zhang X, Meinke H, Devoil P, van Laar HH, Bouman BAM, Abawi Y. 2004. Simulating growth and development of low-land rice in APSIM. In: New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep–1 Oct 2004, Brisbane, Australia. Published on CD. www.regional.org.au/au/cs.

Diseases and their management

Leung H, Wu J, Liu B, Bustaman, M, Sridhar R, Singh, K Redona E, Quang VD, Zheng K, Bernardo M, Wang G, Leach J, Cho IR, Vera Cruz C. 2004. Sustainable disease resistance in rice: current and future strategies. New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia. Published on CD. www.cropscience.org.au.

Genomics, bioinformatics, and molecular biology

Hussain J, McNally KL, Lafitte HR. 2004. Identification of SSR markers linked to candidate genes for drought tolerance in rice. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop, 24-28 May 2004, Cuernavaca, Mexico. p 45-46.

Phillips RL, Leung H, Cantrell RP. 2004. An international genetic platform for the assessment of gene function in rice. New directions for a diverse planet. In: Proceedings of the 4th International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia. Published on CD. www.cropscience.org.au.

Plant breeding, genetics, and transgenics

Atlin GN, Lafitte R, Venuprasad R, Kumar R, Jongdee B. 2004. Heritability of rice yield under reproductive-stage drought stress, correlations across stress levels, and effects of selection: implications for drought tolerance breeding. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004,Cuernavaca, Mexico. p 32-36.

Datta SK, Baisakh N, Ramanathan V, Narayanan KK. 2004. Transgenics in crop improvement. In: Jain HK, Kharwal MC, editors. Plant breeding—Mendelian to molecular approaches. Proceedings of the International Diamond Jubilee Symposium on Hundred Years of Post-Mendelian Genetics and Plant Breeding—Retrospects and Prospects, 6-9 Nov 2003, New Delhi, India. p 333-371.

Datta SK, Vasconcelos M, Rai M, Khalekuzzaman M, Rehana S, Torrizo L, Abrigo E, Oliva N, Tan J, Baisakh N, Datta K. 2004. Bioengineered rice with enhanced iron and provitamin A. In: Seshadri M, Siddhu A, editors. Proceedings of the Ninth Asian Congress of Nutrition, 23-27 Feb 2003, Nutrition Foundation of India, New Delhi, India. p 79-83.

Dwivedi DK, Gao YM, Lafitte R, Vijayakumar CHM, Fu BY, Xu JL, Ali J, Domingo JR, Maghirang R, Mackill D, Li Z. 2004. Marker-aided breeding for development of drought-tolerant IR64 lines. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 258-259.

Jena KK, Jeung JU, Shin MS, Heu S, Choi YC, Hwang HG, Brar DS, Mackill DJ. 2004. A *Pi-ta* gene homologue present in an *O. australiensis* introgression line in rice confers resistance to blast isolates of Korea. Plant and Animal Genome XII, San Diego, CA, USA. p. 170.

Jiang YZ, Bagali P, Gao YM, Lafitte R, Fu BY, Xu JL, Maghirang R, Domingo R, Hittalmani S, Mackill D, Li ZK. 2004. High-resolution mapping of a genomic region harboring several QTLs and *sd1* in rice. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 215.

Kakuda K, Nozoe T, Ando H. 2004. Factors determining the recovery of fertilizers in tropics Analysis in the field with Fe toxicity. Abstracts of the Annual Meeting of the Japanese Society of Soil Science and Plant Nutrition (abstr.).

Kondo M, Ideta O, Barlaan E, Imbe T, Itoh, S, Pablico PP, Aragones DV, Agbisit R, Brar D. 2004. Genotypic variations of δ13C in rice (*Oryza sativa* L. and *Oryza glaberrima* Steud.) in relation to transpiration efficiency and biomass production as affected by soil water conditions and N. In: Proceedings of the 4th International Crop Science Congress, 26 Sep-1 Oct 2004, Brisbane, Australia. p 1-6.

Lafitte HR, Ismail A, Bennett J. 2004. Abiotic stress tolerance in rice for Asia: progress and the future. In: Proceedings of the 4th International Crop Science Conference, Brisbane, Australia. Published on Internet and CD.

Lafitte HR, Shi Yan, Gao YM, Li ZK. 2004. Response to direct selection for yield under reproductive stage stress in rice backcross populations. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 169-170.

Li ZK, Lafitte R, Vijayakumar CHM, Fu BY, Gao YM, Xu JL, Ali J, Zhao MF, Yu SB, Domingo J, Maghirang R, Khush GS, Mackill D. 2004. Developing high yield and drought tolerant rice cultivars and discovering the complex genetic network underlying drought tolerance in rice. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 222-224.

Moliñawe-Ramos J, Jeung EG, Corral ML, Chavez J, Kim HY, Jena KK, Brar DS. 2004. Production and characterization of interspecific hybrids between japonica rice cultivars of Korea and five wild species of *Oryza*. Philipp. J. Crop Sci. 29(1):59 (abstr.).

Peng S, Laza RC, Visperas RM, Khush GS, Virk P, Zhu D. Rice: Progress in breaking the yield ceiling. In: New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, Brisbane, Australia, 26 Sep-1 Oct 2004. Published on CD. www.cropscience.org.au.

Robin S, Manimaran R, Pushpa R, Jeyaprakash P, Mahendran S, Mahalingam L, Shanmugasundaram S, Chandra Babu R, Lafitte HR, Atlin G, Thiyagarajan K. 2004. Breeding for reproductive stage drought tolerance through development of near flowering lines in rice. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 128-129.

Virk P, Virmani SS, Lopena V, Cabangon R. 2004. Enhancing water productivity in irrigated rice. New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, Brisbane, Australia, 26 Sep-01 Oct 2004. Published on CD. www.cropscience.org.au.

Virk PS, Khush GS. 2004. Breaking the yield barrier in rice. In: Proceedings of the 1st International Conference on 'Rice for the Future,' 31 Aug-2 Sep 2004, Bangkok, Thailand. p 36-42.

Wing RA, Ammiraju JSS, Luo M, Kim H, Yu Y, Kudrna D, Wang W, Nelson W, Soderlund C, Brar D, Mackill D, Han B, Stein L, San Miguel P, Jackson S. 2004. The Oryza Map Alignment Project: the golden path to unlocking the genetic potential of wild rice. In: Proceedings of the First International Conference on Rice for the Future, Kasetsart University, Bangkok. p 1-9.

Xu JL, Lafitte R, Gao YM, Fu BY, Li ZK. 2004. Identification of QTLs for drought tolerance in a set of random introgression lines of rice. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water-limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 248-250.

Ya JD, Hwang HG, Jena KK, Lee MH. 2004. Evaluation of rice cultivars for cold tolerance in relation to cold stress on spikelet sterility. In: Proceedings of the International Rice Cold Tolerance Workshop, 22-23 Jul 2004, Canberra, Australia (abstr.).

Zheng TQ, Ramos EA, Xu JL, Fu BY, Gao YM, Jiang YZ, Lafitte R, Maghirang R, Jessica R, Verulkar S, Dwivedi D, Vijayakumar CHM, Zhao MF, Virmani SS, Mackill D, Li ZK. 2004. Association mapping of loci for drought tolerance and non-target traits using introgression lines in rice. In: Poland D, Sawkins M, Ribaut JM, Hoisington D, editors. Resilient crops for water- limited environments. Proceedings of a workshop held 24-28 May 2004, Cuernavaca, Mexico. p 276-277.

Postharvest and farm mechanization

Bakker R, Borlagdan P, Hardy B, editors. 2004. Partnership for modernizing the grain postproduction sector. IRRI Limited Proceedings 9. 89 p.

Socioeconomics and policy

Cantrell RP, Hettel GP. 2004. New challenges and technological opportunities for rice-based production systems for food security and poverty alleviation. In: Proceedings of the FAO Rice Conference, 13-14 Feb 2004. Rome (Italy): Food and Agriculture Organization. www.fao.org/rice2004/en/pdf/cantrell.pdf.

Ding S, Gu X, Chen F, Chen C, Pandey S, Zhang Q, Luo L. 2004. Rice seed systems in southern China: views from institutions and farmers. In: Proceedings of a workshop on Resilient Crops for Water-limited Environments, Mexico.

Magor NP, Salahuddin A. 2004. Reaching resource-poor farmers, men and women through improved uptake methods and pathways. In: Proceedings for Uptake Methods Workshop, 18-19 Apr 2004, Department of Agriculture Extension, Karmabari. p 2-22.

Soils and nutrient management

Bueno CS, Ladha JK. 2004. Effect of cultivation on some properties of rice-rice and rice-wheat soils. In: Proceedings of the ASA/CSSA/SSSA Annual Meetings, Seattle, USA.

Buresh RJ, Witt C, Peng S, Alam MM, Ladha JK. 2004. Site-specific nitrogen management for rice in Asia: principles and implementation. ASA-CSSA-SSSA Annual Meetings, 31 Oct-4 Nov 2004, Seattle, USA.

Gupta RK, Ladha JK. 2004. Extending conservation agricultural practices to rice-wheat systems of the Indo-Gangetic Plains. In: Proceedings of the National Conference on Conservation Agriculture. New Delhi (India): Centre for Advancement of Sustainable agriculture. p. 8.

Gupta RK, Ladha JK. 2004. Sustaining productivity of rice-based cropping systems in Eastern Indo-Gangetic Plains. In: Proceedings of the National Rice Workshop, Directorate of Rice Research, Agartala, India.

Ladha JK. 2004. Managing N for crop productivity and environmental quality. In: Proceedings of the International Symposium on Rainfed Rice Ecosystems: Challenges and Opportunities. Raipur (India): Indira Gandhi Agricultural University.

Ladha JK, Bell M. 2004. The Rice Knowledge Bank, an opportunity for partnership between NDUAT and IRRI. In: Proceedings of an International Symposium on Rice. Faizabad (India): The Narendra Deva University of Agriculture and Technology.

Ladha JK, Bhushan L, Singh S, Gupta RK. 2004. Evaluating double zero tillage in rice-wheat system. In: Proceedings of the ASA/CSSA/SSSA Annual Meetings, Seattle, USA.

Ladha JK, Gupta RK. How Extensive are Yield Declines in Long-Term Rice-Wheat Experiments in Asia? In: Proceedings of the International Symposium on Green Revolution to Gene Revolution. Directorate of Rice Research, Hyderabad. Vol. 1 Extended Summaries p. xii.

Shen J, Zhang F, Peng S, Wang G, Zou Y, Huang J, Yang J, Zhong X, Liu Y, Li R. 2004. Present perspective of nutrient management in the irrigated rice systems in China. ASA-CSSA-SSSA Annual Meetings, 31 Oct-4 Nov 2004, Seattle, USA.

Singh S, Bhushan L, Ladha JK, Gupta RK. 2004 Integrated weed management in zero-till direct seeded rice. In: Proceedings of the National Conference on Conservation Agriculture. New Delhi (India): Centre for Advancement of Sustainable Agriculture. p 22.

Training and knowledge management

Atkinson AD, Bell MA. 2004. Creating an information and communication technology system that captures, stores and delivers rice information to extension workers and farmers. In: Modern rice farming. Proceedings of an International Rice Conference, 13-16 Oct 2003, Alor Setar, Kedar, Malaysia. Malaysia: Ministry of Agriculture and Agro-based Industries. p 217-220.

Bell MA, Reinke R. 2004. RiceCheck–a stepping stone to success. In: Redona ED, Castro A, Llanto GP, editors. Rice integrated crop management: towards a RiceCheck system in the Philippines. Proceedings of the First National Workshop on Rice Integrated Crop Management, 4-5 May 2004, PhilRice. Science City of Munoz, Nueva Ecija (Philippines): PhilRice. p 18-24.

Magor NP. 2004. Partnerships in research and development. In: Proceedings, Emerging Technologies of the PETRRA Subprojects, 23-24 May 2004, BRRI Auditorium, Gazipur. p 2-8.

Water management

Castañeda AR, Bouman BAM, Peng S, Visperas RM. 2004. Testing of aerobic rice in the Philippines; results of field experiments at IRRI. In: Proceedings of the 54th Philippine Agricultural Engineering Annual National Convention, 19-22 Apr 2004, Central Luzon State University, Muñoz, Philippines. p 145-161.

Rickman JF, Sinath P. 2004. The development of tube-well irrigation systems in Cambodia. In: Water in agriculture. Proceedings of a CARDI International Conference: Research on Water in Agricultural Production in Asia for the 21st Century, Phnom Penh, Cambodia, 25-28 Nov 2003. p 174-177.

Tuong TP, Bouman BAM, Mortimer M. 2004. More rice, less water–integrated approaches for increasing water productivity in irrigated rice-based systems in Asia. In: New directions for a diverse planet. Proceedings of the 4th International Crop Science Congress, 26 Sep–1 Oct 2004, Brisbane, Australia. Published on CD. www.regional.org.au/au/cs.

IRRI electronic publications

Crop management, agronomy, and physiology

Bell MA, Rickman JF, Balasubramanian V. 2004. Cultural weed control. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Weeds/fs_cultCtrlWeeds.pdf.

Bell MA, Rickman JF, Balasubramanian V. 2004. Main weeds of rice in Asia. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Weeds/fs_mainWeeds.pdf.

Buresh R, Witt C, Bell MA. 2004. Addition plots. Fact sheet. www.knowledgebank.irri.org/factsheets/Nutrient_Management/Nutrient_Management_Practices/Addition_Plot.htm.

Gregory R, Jahn G, Bell MA. 2004. Rice-fish systems. Fact sheet. www.knowledgebank.irri.org/factsheets/Technology_Transfer_Methods/fs_riceFish.pdf.

Ladha J, Bell M. 2004. Sesbania. Fact sheet. www.knowledgebank.irri.org/factsheets/fs_sesbania.pdf.

Diseases and their management

Bell MA. 2004. Human diseases and rice. Fact sheet. www.knowledgebank.irri.org/factsheets/Health_and_Nutrition/fs_Health.pdf.

Vera Cruz C, Oña IP, Bell MA. 2004. Bacterial leaf streak. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Diseases/Bacterial_Leaf_Streak.htm.

Vera Cruz C, Oña IP, Bell MA. 2004. Brown spot. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Diseases/Brown_Spot.htm.

Vera Cruz C, Oña IP, Bell MA. 2004. Rice blast. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Diseases/fs_blast.pdf.

Pests and their management

Jahn G, Bell MA. 2004. Gall midge. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Insects/fs_gallMidge.pdf.

Jahn G, Choi I, Bell MA. 2004. Green leafhopper. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Insects/Green_Leafhopper.htm.

Jahn G, Choi I, Bell MA. 2004. Tungro. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Diseases/Tungro.htm.

Singleton G. and Bell, MA. 2004. Rodent control. Fact sheet. www.knowledgebank.irri.org/factsheets/Pest_Management/Rodents/fs_rodentControl.pdf.

Plant breeding, genetics, and transgenics

Graham R, Bell MA. 2004. Human nutrition and rice. Fact sheet. www.knowledgebank.irri.org/factsheets/Health_and_Nutrition/fs_nutrition.pdf.

IRRI. 2004. IRIS database version 4. CD and Internet. www.icis.cgiar.org.

McLaren CG, Portugal A, Sallan M, Eusebio W. 2004. ICIS Software, Version 4.2c, CD and Internet. www.icis.cgiar.org.

Postharvest and farm mechanization

Gummert M, Rickman JF, Bell MA. 2004. Grain drying-sun drying. Fact sheet. www.knowledgebank.irri.org/factsheets/post-harvest_management/fs_sundrying.pdf.

Gummert M, Rickman JF, Bell MA. 2004. Grain storage –hermetically sealed systems. Fact sheet. http://www.knowledgebank.irri.org/factsheets/Post-Harvest_Mangement/fs_grainStorageHermetic.pdf.

Gummert M, Rickman JF, Bell MA. 2004. Paddy drying systems. Fact sheet. www.knowledgebank.irri.org/factsheets/Post-Harvest_Mangement/fs_paddyDryingSystems.pdf.

Soils and nutrient management

Bell MA, Balasubramanian V, Rickman J. 2004. Composting rice residue. Fact sheet. www.knowledgebank.irri.org/factsheets/Nutrient_Management/Nutrient_Management_Practices/Composting_Rice_Residue.htm.

Training and knowledge management

Atkinson AD. 2004. Creating a decision support tool with Robohelp and Flash. www.macromedia.com/devnet/robohelp/articles/support_tool.html

Atkinson AD, Bell MA, Lapitan J, Arboleda MS, Gavino D, Zarsadias G. 2004. Presentation checklist. Reference guide. www.knowledgebank.irri.org/presentationCheckList.pdf.

Atkinson AD, Bell MA, Shires D. 2004. Running Effective Meetings. Fact sheet www.knowledgebank.irri.org/factsheets/technology_transfer_methods/fs_effectiveMeetings.pdf.

Atkinson AD, Bell MA. 2004. Designing effective training interventions. Fact sheet. www.knowledgebank.irri.org/factsheets/Technology_Transfer_Methods/Designing_Effective_Training_Interventions.htm.

Bell MA. 2004. Diagnosing field problems. Interactive scenario. Rice doctor. www.knowledgebank.irri.org/riceDoctor_MX/Process/Diagnosing_Field_Problems.htm.

Bell M. 2004. Organic rice. Fact sheet. www.knowledgebank.irri.org/factsheets/Growing_Organic_Rice.htm.

Bell MA, Heong KL, Escalada M, Rickman JF, Lapitan J, Balasubramanian V. 2004. Creating extension materials. Fact sheet. www.knowledgebank.irri.org/factsheets/Technology_Transfer_Methods/fs_creating_extension.pdf.

Bell MA, Lapitan J, Barclay AP. 2004. Engaging participants: some ideas. Fact sheet. www.knowledgebank.irri.org/factsheets/Technology_Transfer_Methods/Engaging_Participants.htm.

Cook D, Castillo G, Macintosh D, Escalada M, Bell M, Shires D. 2004. Handling conflict resolution. http://www.knowledgebank.irri.org/factsheets/Technology_Transfer_Methods/Conflict_Resolution.htm.

McLaren CG, Deomano E, Bartolome V. 2004. IRRISTAT 4.2c, CD and Internet.

Monographs (or Monograph Series)

Crop management, agronomy, and physiology

Verburg PH, Veldkamp A, Willemen L, Overmars KP, Castella JC. 2004. Landscape level analysis of the spatial and temporal complexity of land use change. In: De Fries R, Asner G, Houghton R, editors. Ecosystem interactions with land use changes. AGU Geophysical Monograph Series. Washington, D.C., USA.

Socioeconomics and policy

Abedin MZ, Bool MRL, editors. 2004. Agricultural technologies for rural poverty alleviation. Technical Advisory Notes. Flood-prone Rice Farming Systems Series. Los Baños (Philippines): International Rice Research Institute and International Fund for Agricultural Development. 57 p.

Periodicals

Crop management, agronomy, and physiology

Buresh RJ. 2004. Specific benefits: farmers earn more from their rice crop by scientifically optimizing fertilizer use. Rice Today 3(4):32-33.

Kropff MJ, Cassman KG, Peng S, van Larr HH. 2004. Yields at IRRI research farm are still close to the climatic potential level. Int. Rice Res. Notes 28 (2):19-21.

Genetic resources

Banaticla MCN, Almazan MSR. 2004. Vanishing populations of *O. minuta* Presl. in Pangil, Laguna, Philippines. Int. Rice Res. Notes 29(2):94-95.

Pests and their management

Jahn GC 2004. Effect of soil nutrients on the growth, survival and fecundity of insect pests of rice: an overview and a theory of pest outbreaks with consideration of research approaches. Int. Org. Biol. Contr. Bull. 27 (1):115-122.

Plant breeding, genetics, and transgenics

Jena KK, Jeung JU, Yea JD, Choi YH, Hwang HG, Moon P, Virk PS, Yanagihara S, Mackill DJ. 2004. Evaluation and identification of cold-tolerant rice genotypes by cold-water irrigation stress. Int. Rice Res. Notes 29(1):54-56.

Mou TM, Li CH, Xu JY, Sanchez DL, Virmani SS. 2004. Development of TGMS lines and two-line rice hbyrids through a shuttle-breeding program between IRRI and China. Int. Rice Res. Notes 29(2):14-15 .

Virk PS, Khush GS, Peng S. 2004. Breeding to enhance yield potential of rice at IRRI: the ideotype approach. Int. Rice Res. Notes 29(1):5-9.

Virmani SS, Kumar Ish. 2004. Development and use of hybrid rice technology to increase rice productivity in the tropics. Int. Rice Res. Notes 29(1):10-20.

Zhao KJ, Wang ZQ, Ding L. 2004. International Year of Rice [in Chinese]. Crops 1:57.

Socioeconomics and policy

Dawe D. 2004. Rice imports come with the territory: exporters plant more than half of their crop area to rice–importers less than half. Rice Today 3(2):37.

Dawe D. 2004. Rice to the tiller: lower prices can put more rice in the bowls of the landless rural poor--the forgotten, anonymous, and voiceless underclass that provides most of the labor to grow it. Rice Today 3(3):42.

Dawe D. 2004. Trading up: a fresh look at the world's rice market for Asians who still equate food security with self-sufficiency. Rice Today 3(1):36.

Dawe D. 2004. Saving labor: boosting productivity on rice farms raises living standards, even for landless workers. Rice Today 3(4):41.

Kam SP. 2004. Pinning down rural poverty. Rice Today 3(3):30-31.

Occasional/discussion papers

Socioeconomics and policy

Banik P, Edmonds C, Fuwa N, Kam SP, Villano L, Bagchi DK. 2004. Natural resource endowments, subsistence agriculture, and poverty in the Chhotanagpur Plateau. IRRI Discussion Pap. 47.

Casiwan CB, Dawe D, Moya P. 2004. Increasing the competitiveness of Philippine rice farming in anticipation of trade liberalization. PhilRice Tech. Bull. 8(2).

Hossain M, Bose ML, Ahmad A. 2004. Nature and impact of women's participation in economic activities: insights from household surveys. Research Paper Series, University of Lund. www.nek.lu.se/NEKAAH.

Kam SP, Bose ML, Latif T, Chowdhury MAH, Hussain SG, Ahmed M, Iqba A, Villano L, Hossain M. 2004. Geographical concentration of rural poverty in Bangladesh Occasional Paper Series No. 38. Centre for Policy Dialogue, Dhaka, Bangladesh.

Shrestha S. 2004. An economic impact assessment of the rice research program in Bhutan. 50 p.

Soils and nutrient management

Alam, Murshedul M, Buresh RJ, Ladha JK, Khan AH. 2004. Site-specific nutrient management (SSNM) for rice. Recommendations and user guidelines. Publication No. 145. Gazipur (Bangladesh): Bangladesh Rice Research Institute. 32 p.

Others

Crop management, agronomy, and physiology

Johnson DE, Mortimer M, Janiya JD. 2004. Common weeds of lowland rice in Asia. Los Baños (Philippines): International Rice Research Institute.

Johnson DE, Mortimer M, Janiya JD. 2004. Common weeds of lowland rice in India. Los Baños (Philippines): International Rice Research Institute.

Johnson DE. 2004. Running wild. Radio interview on wild rice for WREN Media. Published by New Agriculturalist at www.new-agri.co.uk/04-1/focuson/focuson2.html.

Lafitte HR, Ismail AM, Bennett J. 2004. Abiotic stress tolerance in rice for Asia: progress and future. 4th International Crop Science Congress, Brisbane, Australia, Sep 2004. www.regional.org.au/au/cs/2004/symposia/3/6/1137_lafitte.htm.

Mnguu YO. 2004. Indigenous nitrogen supply and nitrogen fertilizer use efficiency in direct seeded and transplanted rice (*Oryza sativa* L.) as affected by weed control methods. PhD thesis, University of the Philippines Los Baños (UPLB), Los Baños, Philippines.

Thuy NH. 2004. Yield trends, soil fertility changes, and indigenous nitrogen supply as affected by crop and soil management in intensive irrigated rice systems. PhD thesis, University of the Philippines Los Baños (UPLB), Los Baños, Philippines.

Genomics, bioinformatics, and molecular biology

Leung H, Wu JL, Liu B, Zeng LR, Boredos A, Baraoidan M, Madamba S, Wang GL, Leach J, McNally K, Choi IR, Vera Cruz C. 2004. Identification of broad-spectrum disease resistance through mutational and gene expression analyses. Crop Functional Genomics Symposium, 6-10 Apr 2004, Jeju, Korea. Workshop abstract CS-23.

Plant breeding, genetics, and transgenics

Bimpong IK, Carpena AL, Fernandez L, Reversat G, Brar DS 2004. Molecular characterization of introgression from African rice (*Oryza glaberrima* Steud.) into indica rice (*O. sativa* L.) Philipp. J. Crop Sci. 29: (supp no. 1). p 60 (abstr.).

Brar DS, Hue NT, Ramos J, Jeong, EG, Lee SB, Kim KY, Hwang HG, Jena KK, Khush GS. 2004. Transferring genes from wild species for tolerance to biotic and abiotic stresses from wild species into rice. In: International Rice Science Conference, Korea. p 53 (abstr.).

Brar DS. 2004. Transferring genes from wild species into rice: conventional and molecular approaches. In: 9th National Rice Biotechnology Network Meeting, 15-17 Apr 2004, New Delhi, India. p 56 (abstr.).

Jena KK, Jeung JE, Cho YC, Hwang HG, Brar DS, Mackill DJ. 2004. A Pi-ta gene homologue present in an *O. australiensis*-derived introgression line in rice confers resistance to blast isolates of Korea. Plant and Animal Genome XII, San Diego, USA. p. 170 (abstr.).

Molinawe-Ramos J, Eung-Gi J, Corral M, Chavez J, Kim HY, Jena KK, Brar DS. 2004. Production and characterization of interspecific hybrids between japonica rice cultivars of Korea and five wild species of *Oryza*. Philipp. J. Crop Sci. 29 (suppl no. 1):59 (abstr.).

Sana EA, Hernandez JE, Brar DS. 2004. Molecular tagging of genes for brown planthopper resistance introgressed from the tetraploid wild species *Oryza minuta* into rice. Philipp. J. Crop Sci. 29 (suppl no. 1):59 (abstr.).

Postharvest and farm mechanization

Bakker R, Borlagdad P, Hardy B, editors. 2004. Partnerships for modernizing the grain postproduction sector. IRRI Limited Proceedings No. 9. Los Baños (Philippines): International Rice Research Institute. 89 p.

Socioeconomics and policy

Sombilla M, delos Reyes AS, Cataquiz GC. 2004. The role of animal raising in mixed rice farming systems. PhilRice Tech. Bull. 8(2):1-16.

Training and knowledge management

Bell MA, Fredenburg P, Atkinson A, Shires D. 2004. How rice farmers benefit from ICT. www.new-agri.co.uk/04-4/focuson/focuson3.html.

Invited seminars

Genomics, bioinformatics, and molecular biology

McNally KL. 2004. Allele mining the bank–haplotype and candidate gene discovery. Invited seminar presented at the Department of Biochemistry and Molecular Biology, Oklahoma State University, Stillwater, Oklahoma, USA, 10 Jun 2004.

McNally KL. 2004. Allele mining the temperate zones: unlocking the banks. Invited seminar presented at the National Institute for Agricultural Biotechnology, Rural Development Administration, Suwon, Republic of Korea, 12 Apr 2004.

Socioeconomics and policy

Jackson MT. 2004. Achieving the UN Millennium Development Goals begins with rice research. Invited seminar presented at the University of Minnesota, 18 Oct 2004, St. Paul, Minnesota, USA.

Jackson MT. 2004. Achieving the UN Millennium Development Goals begins with rice research. Invited seminar presented to the Cross Party International Development Group of the Scottish Parliament, 2 Jun 2004, Edinburgh, Scotland.

Paris T. 2004. Understanding different cultures. Lecture given at the Leadership Course for Asian Women in Agriculture R & D and Extension, 11 Nov 2004. www.knowledgebank.irri.org.

Rice research seminars

Trade reforms, poverty and food security in rural China: lessons for the Philippines. Dr. D. Antiporta, senior policy adviser, UN FAO Regional Office for Asia and the Pacific.

Rice in the seven arts, Prof. Paul Zafaralla, Department of Humanities, UPLB.

Food security and environmental protection in the upland rice systems: can lowland rice help? Dr. S. Pandey.

New challenges and opportunities in plant sciences: systems biology. Prof. Martin Kropff, Wageningen University, The Netherlands.

NRS excellence: tales from Davao featuring "A farmer participatory approach in the adaptation and adoption of controlled irrigation for saving water: a case study in Canarem, Victoria, Tarlac." Dr. F. Palis.

The future role of IT in poverty alleviation. Ms. C. Mamon, president, Sun Microsystems Philippines and Ms. G. Minguez, World Bank consultant

ICTs in education and training: the basic issue. Dr. F. Librero, chancellor, UP Open University.

Civil society and conflict management in the Philippines. Dr. S. Rood, Philippine representative, The Asia Foundation.

Celebrating NRS excellence featuring the recipients of the CGIAR Outstanding Scientific Support Teams.

The British Council in the Philippines. G. Westaway, head, British Council.

Modelling rice ecosystems with stakeholders: companion modelling (ComMod) experiments in Asia. Drs. F. Bousquet, C. Vejpas, T.R. Gurung, and G. Trebuil.

Assessing the impact of climate change on global food production. Dr. M. Rosegrant, director, Environment and Production Technology Division, IFPRI.

Population, agriculture and communicable diseases. Dr. E. Miranda, WHO Western Pacific Regional Office.

The role of foundations in poverty alleviation. Ms. V. Garchitorena, president, Ayala Foundation.

Averting hunger and food insecurity in Asia. Dr. A. Balisacan, director, Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).

The journey of a rice pathologist. Dr. T.W. Mew.

Poverty and floods in Bangladesh: too little, too much. Dr. S.P. Kam.

Economic prosperity, trade liberalization, and sustainability of rice farming in Asia. Dr. M. Hossain.

The Philippine law on international organizations. Senator Miriam Defensor-Santiago.

Future challenges for IRRI. Dr. R.P. Cantrell.

Division seminars

Entomology and Plant Pathology

Molecular and cellular response of plants to diseases: *Nicotiana* species as model hosts. Dr. P. Goodwin.

Search for safe storage of rice seed for farmers' use. Dr. M.A. Taher Mia.

The rice bug, *Scotinophara coarctata* (Fabricius) (Hemiptera: Pentatomidae)—its spread and management in the Philippines. Ms. J.L. Catindig.

Pathogenicity assays with *Bipolaris oryzae* for brown spot of rice to assess potentially resistant and susceptible rice cultivars with different isolates from Laguna. Ms. S. Banu.

Integrating nutrient and pest management. Dr. N. Castilla.

Evaluating the effects of the rice bug *Leptocorisa oratorius* on rice yield, grain quality, and seed germination. Dr. G. Jahn.

A research overview for insect host plant resistance in rice: integrating ecology and population genetics. Dr. Y. Chen.

Analysis and application of rice full-length cDNA data. Dr. K. Satoh.

Plant genomics for everyone. Dr. S. Fluch, Biogenetics/Natural resources, Austrian Research centers GmbH-ARC a-2444 seibersdorf, Austria.

Plant Breeding, Genetics, and Biotechnology

Developing rice value added traits: antioxidant and anticancer activities in rice. Dr. Dong-Jin Lee, professor, Department of Agronomy, Dankook University, Korea.

GAMMA facility: gene discovery house @ IRRI. Ms. M. Bernardo.

Environmental safety assessment on GM rice. H. Shibaike, Kyoto University, Japan.

Use of molecular markers in hybrid rice breeding at IRRI. Mr. M. Nas.

CIMMYT in Southeast Asia: A partner for science and development. Dr. Kevin Pixley, Director, Tropical Ecosystems Program, CIMMYT.

Development of genetically engineered nutritious rice for Bangladesh. M.D. Khalekuzzaman, scholar.

Gramene: Web-based tools for comparative genomics and genetics. Mr. I. Yap, Department of Plant Breeding, Cornell University, USA.

Salinity/boron toxicity interactions and boron tolerance in wheat. Dr. A. Lauchli, associate vice chancellor for research, University of California, USA.

Worldwide sharing of breeding materials through INGER: concerns and prospects. Ms. C. Toledo.

Harvest Plus: an update. Dr. H. Bouis, director, Harvest Plus Challenge Program, IFPRI, Washington, D.C., USA.

Mapping and characterization of QTL related growth of rice in saline paddy field and linkage analysis of QTL for nitrogen use efficiency in rice-toward identification of the regulatory gene. Mr. T. Sato and Mr. M. Obara, Graduate School of Life Sciences, Tohoku University, Japan.

Characterization and origin of weedy rice found in Japan: the possibility of indica-japonica crossing. Dr. R. Ishikawa, associate professor of plant breeding and genetics, Faculty of Agriculture and Life Sciences, Hirosaki University, Japan.

Biotechnology and coastal area prosperity. Mr. A. Parida, research director, Plant Biotechnology, M.S. Swaminathan Research Foundation, India.

Development of molecular approaches to seed purity analysis for hybrid rice. Mr. R.O. Solis, supervising science research specialist, Plant Breeding and Biotechnology Division, Philippine Rice Research Institute, Nueva Ecija, Philippines.

A classical and molecular analysis: are genes for salinity tolerance at seedling and reproductive stages in rice the same or different? Mr. M. Mofazzal Islam, scholar.

Traits related to weed competitiveness in upland/aerobic rice. Mr. Z. Dule, scholar.

Molecular mapping and marker-assisted selection for fertility restoration in some CMS systems. Mr. M. Sattari, scholar.

Breeding rice for tolerance for abiotic stresses. Dr. S. Yanagihara.

Gene expression profiling in sorghum under drought stress using a rice genome array. Dr. A. Sanchez, Texas Tech University, USA.

Analysis and application of rice full-length cDNA data. Mr. K. Satoh, NIAS, Japan.

The impact of farmer-field schools on rice farmers in Indonesia. Dr. G. Feder, research manager for rural development, Development Research Group, World Bank, Washington, D.C.

Decision support in agricultural policy formulation: the role of agronomists. Prof. H. van Keulen Wageningen University and Research Center, The Netherlands.

Increasing rice productivity in South Asia-Cornell's Soil Management CRSP experience. Dr. J.M. Duxbury, professor of soil science and principal investigator, and Dr. J. Lauren, Soil Management Collaborative Research Support Program (SM-CRSP) for South Asia, Cornell University, Ithaca, New York, USA.

Crop, Soil, and Water Sciences

Development of a new seeding technology—Bokto seeder in Korea. Dr. Kwang-Ho Park.

The nutrient decision support system for irrigated rice. Dr. C. Witt.

The effect of water dosage and herbicides on sprinkler-irrigated rice. Ms. O. Blanco.

CIMMYT in Southeast Asia: a partner for science and development. Dr. K. Pixley, Director of Tropical Ecosystems Program, CIMMYT.

Rice production with low environmental loads under water-saving conditions. Dr. Y. Hozen, senior researcher, Crop Production and Environment Division, Japan International Research Center for Agricultural Sciences.

Site-specific management system for rice. Dr. K. Toriyama, soil scientist, Japan International Research Center for Agricultural Sciences.

Optimum on-farm reservoir (OFR) design for rainfed agriculture. Dr. S. Nath Panda, associate professor, Agricultural and Food Engineering Department, Indial Institute of Technology, West Bengal, India.

Site-specific nutrient management (SSNM): an update on principles and promotion. Dr. R. J. Buresh.

Management of rice grain quality from fields to consumers: an integrated approach at CIRAD. Dr. F. Gay, crop physiologist, CIRAD, Can Tho, Vietnam; and Dr. C. Mestres, head, Research Unit for Product Quality and postharvest management specialist, CIRAD, Montpellier, France.

Social Sciences

Global monitoring for food security: role of SAR for rice area and yield estimation. Dr. F. Holecz, CEO of SARMAP, specialist in Radar Remote Sensing Applications for Agriculture.

The current status of GM rice in China. Dr. C. Pray, Rutgers, The State University of New Jersey-Agricultural, Food and Resource Economics.

Seed health management: an affordable social technology for farmers. Dr. A.K.M. Zakaria, deputy director, Rural Development Academy, Bogra, Bangladesh.

Staff Changes in 2004

January

Dr. Yolanda Chen joined as scientist, Entomology and Plant Pathology Division.

Dr. M.A. Taher Mia joined as visiting research fellow, Entomology and Plant Pathology Division.

Mr. A.K.M. Zakaria joined as visiting research fellow, Entomology and Plant Pathology Division.

Mr. Jong-Cheol Ko joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Eung-Gi Jeong joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Mercedita Sombilla joined as consultant, Social Sciences Division.

Dr. Xuhua Zhong, postdoctoral fellow, Crop, Soil and Water Sciences Division, left after completion of his assignment.

Dr. Martin Mortimer joined as consultant, Crop, Soil, and Water Sciences Division; left after completion of his assignment the same month.

Dr. A. Jakir Hussain joined as consultant, Genetic Resources Center.

Ms. Gayatri Sahoo joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Mr. P.V.N. Kishore joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Mr. Tiago Felipe dos Santos Lourenco joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Renate Braun, collaborative research scientist, International Programs Management Office (LAO-IRRI Project), left after completion of her assignment.

February

Dr. Paul Marcotte joined as consultant, Crop, Soil, and Water Sciences Division; left after completion of his assignment the same month.

Dr. Sang-Bok Lee, visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Yeon-Kyu Hong joined as collaborative research fellow, Entomology and Plant Pathology Division.

Dr. Dong-Soo Park joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Nguyen Tri Khiem joined as visiting research fellow, Social Sciences Division.

Dr. Peter Mitchell joined as consultant, Crop, Soil, and Water Sciences Division; left after completion of his assignment the same month.

Ms. Kimberly Linholm joined as collaborative research fellow, Entomology and Plant Pathology Division.

Dr. Zenaida M. Sumalde, consultant, Social Sciences Division, left after completion of her assignment.

Dr. Shailaja Hittalmani joined as visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Woon-Go Ha joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

March

Dr. Thanda Wai, intellectual property rights specialist, Office of the Deputy Director General for Partnerships, left after completion of her assignment.

Dr. Zenaida M. Sumalde rejoined as consultant, Social Sciences Division.

Dr. A.W. Jalfiquar joined as visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Soon-Duck Yoon joined as collaborative research fellow, International Programs Management Office.

Dr. Margaret Yoovatana joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Esteban Godilano joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

Mr. A.K.M. Zakaria, visiting research fellow, Entomology and Plant Pathology Division, left after completion of his assignment.

Dr. M.A. Taher Mia, visiting research fellow, Entomology and Plant Pathology Division, left after completion of his assignment.

Dr. Nguyen Tri Khiem, visiting research fellow, Social Sciences Division, left after completion of his assignment.

Dr. Yeon-Kyu Hong, collaborative research fellow, Entomology and Plant Pathology Division, left after completion of his assignment.

Dr. Shailaja Hittalmani, visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of her assignment.

Dr. Jacob Kijne, consultant, Plant Breeding, Genetics and Biochemistry Division, left after completion of his assignment.

Dr. Min-Kyu Choi, collaborative research fellow, Crop, Soil, and Water Sciences Division; left after completion of his assignment.

Dr. Grant Singleton joined as collaborative research scientist, Entomology and Plant Pathology Division; left after completion of his assignment the same month.

Dr. Guo-Hui Ma joined as consultant, Plant Breeding, Genetics, and Biochemistry Division; left after completion of his assignment the same month.

Dr. Eung-Gi Jeong, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Arvind Kumar joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

April

Dr. Melissa A. Fitzgerald joined as international research fellow, Office of the Deputy Director General for Research.

Mr. Ravindra Babu joined as visiting research fellow, Biometrics and Bioinformatics Unit.

Dr. Sarah E. Johnson joined as postdoctoral fellow, Crop, Soil, and Water Sciences Division.

Dr. Sudhir K. Taunk joined as visiting research fellow, Social Sciences Division.

Dr. Zahirul Islam joined as consultant, Training Center.

Mr. P.V.N. Kishore, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Mr. Jong-Cheol Ko, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Dong-Soo Park, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Ms. Sahoo Gayatri, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of her assignment.

Dr. A.W. Jalfiquar, visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Zenaida M. Sumalde, consultant, Social Sciences Division, left after completion of her assignment.

Dr. Margaret Yoovatana, consultant, Plant Breeding, Genetics, and Biochemistry Division, left after completion of her assignment.

Dr. Rita Afzar joined as consultant, Social Sciences Division.

Dr. Grant Singleton rejoined as collaborative research scientist, Entomology and Plant Pathology Division; left after completion of his assignment on the same month.

May

Dr. Albert Atkinson, training and courseware specialist, Training Center, resigned.

Mr. Karl Goeppert, team leader, Lao-IRRI Project, resigned.

Dr. C.T. Hoanh joined as visiting research fellow, Social Sciences Division.

Mr. Bui Tan Yen joined as visiting research fellow, Social Sciences Division.

Dr. Sang-Bok Lee, visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Sudhir K. Taunk, visiting research fellow, Social Sciences Division, left after completion of his assignment.

Dr. Ajay K. Parida joined as visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Rita Afzar, consultant, Social Sciences Division, left after completion of her assignment.

Mr. Phil Gibson joined as consultant, International Programs Management Office.

Mr. Ha-Cheol Hong, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Surapong Sarkarung joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Bhanudeb Bagchi joined as visiting research fellow, Social Sciences Division.

Dr. Abdul Hamid joined as consultant, Social Sciences Division; left after completion of his assignment the same month.

Dr. Arvind Kumar, consultant, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Grant Singleton rejoined as collaborative research scientist, Entomology and Plant Pathology Division.

June

Dr. Thomas Metz joined as international research fellow, Biometrics and Bioinformatics Unit.

Dr. Ram K. Singh, liaison scientist for India, International Programs Management Office, left after completion of his assignment.

Dr. Conrad Stevens, molecular biologist/molecular pathologist, PETRRA Project, left after completion of his assignment.

Dr. Ravindra Kumar, international research fellow, Crop, Soil, and Water Sciences Division, resigned.

Dr. Glenn Gregorio, international research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Ho-Yeong Kim, internationally recruited staff seconded from Rural Development Administration (RDA), Korea, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Esteban Godilano, consultant, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Soon-Duck Yoon, collaborative research fellow, International Programs Management Office, left after completion of his assignment.

Dr. C.T. Hoanh, visiting research fellow, Social Sciences Division, left after completion of his assignment.

Mr. Bui Tan Yen, visiting research fellow, Social Sciences Division, left after completion of his assignment.

Dr. Manik Lal Bose, postdoctoral fellow, Social Sciences Division, left after completion of his assignment.

Dr. Abdul Bayes joined as visiting research fellow, Social Sciences Division; left after completion of his assignment the same month.

Dr. Sigrid Heuer, consultant, Plant Breeding, Genetics, and Biochemistry Division, left after completion of her assignment.

Dr. Nimal Ranaweera joined as consultant, Crop, Soil, and Water Sciences Division.

Dr. Seepana Appa Rao, consultant, International Programs Management Office, left after completion of his assignment.

Dr. Shamsher Ali joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Md. Shamsher Ali, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. C.N. Neeraja joined as postdoctoral fellow, Plant Breeding, Genetics, and Biochemistry Division.

Mr. Gregory Fanslow joined as consultant, Crop, Soil, and Water Sciences Division.

Dr. Bhanudeb Bagchi, visiting research fellow, Social Sciences Division, left after completion of his assignment.

Dr. Ireneo Manguiat joined as visiting research fellow, Crop, Soil, and Water Sciences Division.

Dr. Woon-Go Ha, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Ms. Kimberly Linholm, collaborative research fellow, Entomology and Plant Pathology Division, left after completion of her assignment.

Dr. Grant Singleton, collaborative research scientist, Entomology and Plant Pathology Division, left after completion of his assignment.

July

Dr. Hung-Goo Hwang joined as senior scientist, internationally recruited staff seconded from RDA, Korea, Plant Breeding, Genetics, and Biochemistry Division.

Dr. M. Zainul Abedin was reappointed as international research fellow (farming systems expert), Social Sciences Division.

Dr. Nimal Ranaweera, consultant, Crop, Soil and Water Sciences Division, left after completion of his assignment.

Dr. Ajay K. Parida, visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Surapong Sarkarung joined as consultant, Plant Breeding, Genetics, and Biochemistry Division; left after completion of his assignment.

Dr. Shamsher Ali, collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Sudhindra Nath Panda joined as collaborative research fellow, Crop, Soil, and Water Sciences Division; left after completion of his assignment the same month.

Dr. Niranjan Baisakh, postdoctoral fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Glenn Gregorio joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Nguyen Tri Khiem rejoined as visiting research fellow, Social Sciences Division.

Dr. Jianli Wu, postdoctoral fellow, Entomology and Plant Pathology Division, left after completion of his assignment.

August

Dr. T. W. Mew, principal scientist and head, Entomology and Plant Pathology Division, retired.

Dr. Zahirul Islam, consultant, Training Center, left after completion of his assignment.

Dr. Mercedita Sombilla, consultant, Social Sciences Division, left after completion of her assignment.

Dr. Nguyen Tri Khiem, visiting research fellow, Social Sciences Division, left after completion of his assignment.

Dr. Ramaiah Venuprasad joined as postdoctoral fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Stephen Zolvinski joined as postdoctoral fellow, Social Sciences Division.

Dr. Yueh-Kwong Leong joined as consultant, Social Sciences Division.

Dr. Nimal Ranaweera rejoined as consultant, Crop, Soil, and Water Sciences Division; left after completion of his assignment the same month.

Dr. Sellappan Krishnan joined as visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Jan Orsini, consultant, Entomology and Plant Pathology Division, left after completion of his assignment.

September

Dr. Glenn Gregorio rejoined as scientist, plant breeding, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Takuhito Nozoe, senior scientist, agronomy, Crop, Soil, and Water Sciences Division, left after completion of his assignment.

Dr. Yueh-Kwong Leong, consultant, Social Sciences Division, left after completion of his assignment.

Ms. Shaohong Zhang joined as visiting research fellow, Entomology and Plant Pathology Division.

Dr. Nimal Ranaweera rejoined as consultant, Crop, Soil and Water Sciences Division; left after completion of his assignment the same month.

Dr. Zenaida M. Sumalde rejoined as consultant, Social Sciences Division.

Ms. Hendrika van Laar joined as consultant, Crop, Soil, and Water Sciences Division.

Dr. Edgar F. Paski joined as consultant, Crop, Soil, and Water Sciences Division; left after completion of his assignment the same month.

Dr. Firdousi Naher joined as consultant, Social Sciences Division.

Dr. Sunendar Kartaatmadja joined as consultant, Crop, Soil, and Water Sciences Division.

October

Dr. Yasukazu Hosen joined as scientist, soil science, Crop, Soil, and Water Sciences Division.

Dr. Yoshimichi Fukuta, senior scientist, plant breeding, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Seiji Yanagihara, senior scientist, plant breeding, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Gregory J. Howell joined as international research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Ms. Josyline Javelosa joined as visiting research fellow, Social Sciences Division.

Dr. Jingsheng Zheng joined as postdoctoral fellow, Crop, Soil, and Water Sciences Division.

Dr. Arvind Kumar joined as postdoctoral fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Bhuban Barah joined as visiting research fellow, Social Sciences Division.

Dr. Gregorio Simbahan joined as consultant, Crop, Soil, and Water Sciences Division.

Dr. Y. Yogeswara Rao joined as consultant, Plant Breeding, Genetics, and Biochemistry Division; left after completion of his assignment the same month.

Dr. Grant Singleton rejoined as collaborative research scientist, Entomology and Plant Pathology Division; left after completion of his assignment the same month.

Dr. Alma Sanchez, consultant, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Yolanda Garcia joined as consultant, Social Sciences Division.

Mr. Adam Barclay joined as consultant, Training Center.

November

Dr. Suan-Pheng Kam, geographic information systems specialist, Social Sciences Division, resigned.

Dr. Firdousi Naher, consultant, Social Sciences Division, left after completion of her assignment.

Dr. Ireneo Manguiat, visiting research fellow, Crop, Soil and Water Sciences Division, left after completion of his assignment.

Dr. Zenaida M. Sumalde, consultant, Social Sciences Division, left after completion of her assignment.

Mr. Girish Chandel joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Yolanda Garcia, consultant, Social Sciences Division, left after completion of her assignment.

Ms. Hendrika van Laar, consultant, Crop, Soil, and Water Sciences Division, left after completion of her assignment.

Dr. You-Chun Song joined as collaborative research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Mr. Mayank Rai joined as visiting research fellow, Plant Breeding, Genetics, and Biochemistry Division.

Dr. S.X. Tang joined as consultant, Plant Breeding, Genetics, and Biochemistry Division; left after completion of his assignment the same month.

Dr. Yoshimichi Fukuta joined as consultant, Plant Breeding, Genetics, and Biochemistry Division.

Dr. Hatsadong joined as consultant, International Programs Management Office (Lao-IRRI Project).

Dr. Hong-Kyu Park joined as visiting research fellow, Crop, Soil, and Water Sciences Division.

Dr. Tran Thi Ut joined as consultant, Social Sciences Division.

Dr. Yong-Jin Park joined as visiting research fellow, Genetic Resources Center.

Dr. Jianxiang Liu, postdoctoral fellow, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

December

Dr. David Dawe, senior scientist, agricultural economics, Social Sciences Division, resigned.

Mr. J. Peter Fredenburg, editor/writer, Visitors and Information Services, left after completion of his assignment.

Dr. Ish Kumar, international research fellow, Plant Breeding, Genetics, and Biotechnology Division, left after completion of his assignment.

Dr. Arumugam Kathiresan, international research fellow, Plant Breeding, Genetics, and Biotechnology Division, left after completion of his assignment.

Dr. Gregorio Simbahan, consultant, Crop, Soil, and Water Sciences Division, left after completion of his assignment.

Dr. Sunendar Kartaatmadja, consultant, Crop, Soil, and Water Sciences Division, left after completion of his assignment.

Dr. Yoshimichi Fukuta, consultant, Plant Breeding, Genetics, and Biochemistry Division, left after completion of his assignment.

Dr. Hatsadong, consultant, International Programs Management Office (Lao-IRRI Project), left after completion of his assignment.

Dr. G.S. Khush joined as consultant, Plant Breeding, Genetics, and Biotechnology Division; left after completion of his assignment the same month.

Dr. Bong-Choon Lee joined as visiting research fellow, Entomology and Plant Pathology Division.

Dr. Hong-Kyu Park, visiting research fellow, Crop, Soil, and Water Sciences Division, left after completion of his assignment.

Dr. Yong-Jin Park, visiting research fellow, Genetic Resources Center, left after completion of his assignment.

Dr. Tran Thi Ut joined as consultant, Social Sciences Division; left after completion of her assignment the same month.

Dr. Muhammed M. Alam, postdoctoral fellow, left after completion of his assignment.

Mr. Gregory Fanslow, consultant, Crop, Soil, and Water Sciences Division, left after completion of his assignment.

Mr. Robert Hill, consultant, Visitors and Information Services, left after completion of his assignment.

Dr. Olivier Panaud joined as collaborative research scientist, Plant Breeding, Genetics, and Biotechnology Division.

Research support services

ANALYTICAL SERVICE LABORATORIES

The Analytical Service Laboratories (ASL) provide services to IRRI researchers to carry out routine analysis of plant, soil, and water samples as well as a user laboratory for nonroutine analysis. The facility also entertains requests from outside IRRI, particularly for institutions involved in collaborative projects with IRRI scientists.

Analytical services

ASL completed 50,810 routine analyses for plant, soil, water, and other samples. Plant samples constitute 68% of the completed analyses with N, Fe, and Zn as the most requested determinations (ASL Table 1). About 75% of the total samples received came from Crop, Soil, and Water Sciences Division (CSWS); the rest came from Plant Breeding, Genetics, and Biotechnology Division (PBGB), Entomology and Plant Pathology Division (EPPD), Social Sciences Division (SSD), International Programs Management Office (IPMO), International Livestock Research Institute (ILRI), and external clients (ASL Table 2).

ASL Table 1. Analyses completed in ASL, IRRI, 2004.

Analysis	ASL Section		Total
	PSL[a]	MSL[b]	
Plant	33,853	628	34,481
Soil	9,820	853	10,673
Water	5,596		5,596
Fertilizers	36	12	48
Catalyst		12	12
Total	49,305	1,505	**50,810**

[a]PSL – Plant and Soil Laboratory. [b]MSL – Mass Spectrometry Laboratory.

ASL Table 2. Profile of samples and analyses received in 2004 from different OUs.

	CSWS	EPPD	PBGB	SSD	IPMO	ILRI	External	Total
Samples	13,081	843	2,352	108	236	95	613	17,382
Analyses	34,449	907	8,508	464	1,738	1,520	3,224	50,810

Center-commissioned External Review

IRRI Management conducted a Center-commissioned External Review of the facility during 17-28 May 2004. The Review covered the function, management, operation, and modalities of ASL to ensure that ASL is fulfilling its role in serving the mission and research agenda of IRRI through making recommendations on

1. The financial chargeback policies
2. Management and efficiency in operation
3. Sufficiency of analytical protocols and equipment, whether they are sufficient in satisfying the current and future requests
4. Personnel expertise vs client needs
5. Safety rules and regulations–compliance with international and national standards
6. Quality assurance policy
7. Any other issues relevant to ASL operation and management

The review panel covered a 5-year record of personnel, finance, equipment, and operations. They appraised the facilities, equipment, working conditions and methodologies of its four laboratories, the Plant and Soil Laboratory (PSL), the Radioisotope Laboratory (RIL), the User Laboratory (UL), and the Mass Spectrometry Laboratory (MSL). PSL accounts for ~80% of ASL business and the other three laboratories, UL, RIL and MSL, account for ~20% of ASL's workload.

Current status of the laboratory

ASL analyzes about 20,000 samples and 50,000 determinations annually. It has the capacity to expand its throughput greatly, speed up its turnaround time, and increase the accuracy of its reporting. Instrumentation is generally good but the ICP-OES, one of the most highly used equipment in the laboratory will probably need replacement within the next 2 years or so. Quality assurance (QA) has been significantly improved with its participation in international proficiency testing programs such as the Wageningen Evaluating Program for Analytical Laboratories-International Plant Exchange (WEPAL-IPE), the North American Proficiency Testing (NAPT), and the Australasian Soil and Plant Analysis Program (ASPAC). The panel recommended continuous participation in these programs and ASL has this plan in place. The panel also noted that laboratory safety is very good and in compliance with international standards.

Restructuring of ASL and consolidation of organic analytical capability at IRRI

The new Grain Quality and Nutrition Research Center (GQNRC) potentially overlap in instrumentation and analyses of the UL of ASL. The review panel recommended the transfer of the UL, its supervisor, and functions to GQNRC. ASL will then be able to focus on its core activities of plant and soil analysis and will allow physical separation of soil and plant analyses, decreasing the risk of sample contamination. This recommendation is now being implemented; Ms. Jimenez was officially transferred to GQNRC on 2004 Nov 01 and a mechanism will be developed to ensure close coordination between ASL and GQNRC for enhanced efficiency and quality of service.

Enhancing the capacity of the Plant and Soil Laboratory. The ASL has a slow throughput that is hindering its development into an internationally recognized laboratory for plant and soil analysis. This is mainly due to its manual calculation and reporting of results that could be automated with a Laboratory Information Management System (LIMS). The panel recommended that the LIMS be installed in ASL. A contract with UPLB-FI for LIMS development package is currently under way and ASL-LIMS is expected to function by mid-2005.

ASL can also take an active role in providing training for staff of national agricultural research and extension services (NARES) in soil and plant analysis. The laboratory should be in a good position to do such training once its LIMS is in place and its QA program fully implemented. This will be done in close coordination with the Training Center and other training programs at IRRI.

ASL is also encouraged to accept samples from commercial entities to broaden its experience. Such requests will be accommodated on a case-to-case basis only for research purposes. The current *Plant and Soil Laboratory Manual,* as per panel's recommendation, is being updated to make it more accurate, precise, and user-friendly. The *Radiation Safety Manual* was already updated in November 2004 and is being reviewed internally for online publication.

Staff development. The ASL staff had limited contact with the world of soil and plant analysis outside the Philippines. They also had poor experience in handling service contracts of instrument manufacturers. Staff development will have an impact on the capacity and efficiency of ASL. It should also have in-house capacity to do routine maintenance and troubleshooting of specialized instruments.

The panel recommended that staff training budget be increased and a special one-time allocation be made for the training of an instrument specialist. IRRI management is currently examining the NRS training needs and increased budget for ASL training will be balanced with other OU needs and 2005 budget.

The ASL assistant manager will be sent for advanced training (preferably MS in soil and plant analysis). Serious 1-week staff training courses for sophisticated instruments operated at ASL should be considered. An in-house training on inductively coupled argon plasma (ICP) and atomic absorption spectrophotometer (AAS) was held at ASL on 20-28 Sep 2004 by Dr. Edgar Paski. All ASL staff were trained on basic and advanced operations, applications, and troubleshooting of '61E ICP. Assistance on expanding the applications of the AAS and practical tips on cost cutting on consumables and proper equipment maintenance were also taught. Also being planned in 2005 is additional training on the use and operation pf the newly acquired isotope ratio mass spectrometer (IRMS).

PDZE IRMS and Flash EA installation

A new stable IRMS was installed on 8-12 Nov 2004. Sercon Ltd. was chosen to do the installation and training on PDZ IRMS due to PDZ's failure to fulfill its contract prior to its

bankruptcy. This machine is the replacement of the 20-year-old outmoded unit for routine ^{15}N and ^{13}C analyses of soil and plant samples. It was interfaced with the existing Flash EA 1112 elemental analyzer to allow determination of ^{15}N, ^{13}C, as well as total N, C, and S simultaneously in plant, soil, and other samples. Equipment and method validations were performed to evaluate, calibrate, and set up appropriate parameters for the analysis of different types of samples.

With instrument upgrades, the unit is capable of analyzing deuterium (^{2}H) and stable isotopes of oxygen (^{17}O, ^{18}O) for water isotopic composition studies (trace water use, uptake, and transport by plants, and determine water evaporation from paddies and reservoirs).

New plant and soil preparation facilities

A new site for ASL's plant sample preparation area is now located at the ground floor level of the Kenzo Hemmi Building. It includes plant washing, drying, and grinding rooms. The new soil preparation area is also housed at the back of the Kenzo Hemmi Annex Building.

Radiation safety program

ASL continued to provide liaison services with the Philippine Nuclear Research Institute (PNRI) for staff using radioisotopes in their research work. In addition, ASL, through the radiological and safety officer, took the following initiatives in rekindling awareness on radiation safety and in improving the management of radioactive material use within the institute.

- A briefing was held with all concerned staff to raise consciousness and vigilance in complying with required regulations. The chief of the Nuclear Regulations, Licensing, and Safeguards Division of the PNRI was invited to update staff on the appropriate policies and regulations for the use of radiation sources in agricultural research. Her talk covered two issues: (1) national infrastructure for radiation and radioactive waste safety (the Philippine situation as far as regulatory aspects are concerned) and (2) practical aspects of radiation safety program implementation, including aspects related to agricultural research and current issues of global concern.
- Two training sessions on radiation safety were also held last March and October of 2004. The 40-hour course, conducted by trainors from the PNRI, is a prerequisite to granting license to use radioactive materials by the Philippine government. Ten trainees from three research divisions, PBGB, EPPD, and CSWS, successfully completed the course held in March while 15 scholars and staff, all from PBGB, fulfilled the required training held in October.
- In cooperation with the Security and Safety Office, a new radioactive waste storage area was set up on campus that will serve as a temporary depository for radioactive wastes generated from the use of radioisotopes in research.
- A thorough audit of radioactive materials and equipment on campus was conducted and a system of accountability for these materials was organized.
- A radiation safety manual was prepared and updated to cover all aspects of radioisotope use management, from acquisition to safe handling to proper waste disposal. The manual also includes information, policies, and procedures applicable to utilization of radioactive materials for research at IRRI.

Organic Analysis Laboratory

The projects assisted, through the use of the gas chromatograph and the gas chromatograph-mass spectrometer facilities, were

- Ethylene emanation in submergence-tolerant and -intolerant lines (CSWS).
- Evaluation of aromatic traits specifically, 2-acetyl-1-pyrroline, from rice samples consisting of about 200 recombinant inbred lines (EPPD/PBGB).

BIOMETRICS AND BIOINFORMATICS UNIT

Four new staff members were hired to facilitate Generation Challenge Program activities in 2004 and the structure of the unit was changed to a team-based structure. Four teams have been established: Biometrics, Data Management, Scientific Computing, and Bioinformatics. Two staff members were promoted to positions of team leadership. This is working very effectively. Unit seminars, internal training, and frequent team and project meetings have been used to build teams and coordinate workflow.

Biometrics consultation

The biometrics team carried out 92 consultations in 2004. Requests from different divisions are shown in the following table:

Organizational unit	Clients (no.)
EPPD	20
CSWS	27
PBGB	22
GRC/CPS/SSD	7
Others	16
Total	**92**

Statistical research

A PhD scholar completed her dissertation on integrating pedigree information into analysis of crop improvement trials.

Biometrics training

The following training courses and activities have been carried out in 2004:

BBU course/workshop	Date	Participants (no.)
ICIS Workshop for Plant Breeding Applications	19-23 Jan	33
IRIS Workshop for IRRI Database Administrators	2-4 Feb	11
Basic Experimental Design and Data Analysis Using IRRISTAT	3-7 May	18
Generation Challenge Program (GCP) Information Systems Platform and Network Implementation Workshop	5-30 Jul	27
Introduction to the SAS System	12-16 Jul	22
Other short-term course/workshop		
Rice Breeding Course	9-27 Feb	16
Microarray and Bioinformatics Workshop III	23-26 Feb	47
International Post-production Training Workshop	20 Sep- 8 Oct	20
1st Annual Bioinformatics Conference and Convention of the Network for Integrative Multi-disciplinary Bioinformatics Utilization Strategies (NIMBUS)	15 Oct	81
In-country training/workshop		
Training on Data Entry, Quality, Validation and Designing of Electronic Form (Vientiane, Lao PDR)	17-29 May	24
Grain Biotech Australia – International Rice Research Institute International Crop Information System (ICIS) Workshop	27-29 Sep	5

Statistical software

A new help system for IRRISTAT was developed and a new version released. About 3,000 users downloaded IRRISTAT from the IRRI Website. IRRISTAT was included on a CD in two technical books: *Breeding Rice for Drought-Prone Environments* and *The FAO G×E Manual*. In addition, IRRISTAT was used for courses conducted by FAO and one university in the USA. It will be cited in a new statistics textbook.

An important new module for REML analysis of mixed models is being developed and will be released in early 2005. This will make one of the most important advances in statistics of the last 20 years available to our NARES collaborators.

Development of the International Crop Information System (ICIS)

Work on developing ICIS in 2004 involved:

- Detailed designing of a generic Genetic Resources Information Management System within ICIS.
- Using a new interface, ICIS Forms, that facilitates the management of data, which are collected one record at a time. This applies to much of the GR data, which are essentially low-throughput, high-value data.
- Designing and developing an Inventory Management Module. It is essential for managing genetic resources as well as breeding stocks and is also general enough to be used to manage DNA and leaf stocks for molecular characterization.
- Developing ICIS applications for managing breeding programs is having a major impact at IRRI, ARIs, and NARES. Version 4.2 of the ICIS software was released in September with numerous improvements.

Curation and update of the International Rice Information System (IRIS)

IRIS is the rice implementation of the ICIS database system. It is a globally accessible database that provides rice pedigree and evaluation information to all rice researchers. New versions of IRIS have been continuously released via the Internet and on CD throughout the year and a mirror site was established on the APAN network in Japan.

NARES collaboration

- Technical support on the deployment and use of IRIS has been given to NARES partners in India, Thailand, Philippines, and China.
- In India, IRIS is being implemented to manage sorghum breeding. At Faisabad, it is being used for pedigree analysis.
- In Thailand, researchers at Ubon Ratchathani use IRIS for managing data from their pedigree breeding programs.
- Researchers at PhilRice have been using IRIS for data management.
- CNRRI in China has collaborated in the collection and capture of Chinese rice pedigree information.
- The ICIS international development team met once in IRRI in January and then in Perth in September. ARI partners, Nunza, GBA, and UQ VIDA have worked with ICARDA and IRRI to develop and improve ICIS applications.
- IRRI worked with the Australian rice breeders at Yanco and barley breeders at ICARDA to capture large volumes of historical data.

Training

- Training on the design and analysis of microarray experiments was conducted in the ARBN workshop for NARES partners.
- An extensive training workshop was held in Laos for genetic resources data management.
- NARES rice breeders were introduced to IRIS during the Rice Breeding Course at IRRI.
- NARES participants attended training on Basic Experimental Design and Data Analysis using IRRISTAT.

Bioinformatics

Bioinformatics infrastructure

Our infrastructure is fully deployed and in productive use. Activities in 2004 involved

- Commissioning a high-throughput cluster/grid-computing (HPC) system.
- Deploying a APBioNet "BioMirror" on HPC.
- Deploying core bioinformatics tools on HPC.
- Completing a prototype of IRIS Workbench.
- Supervising initial, exploratory deployment of GMOD tools and continued development of the IRIS-TNG Java+Web services++ platform.
- Initiating development of training materials through curation team leader.

Research data and information capture and documentation

Incremental progress was achieved in deploying GAMMA LIMS for GCP and microarray data. Scientific knowledge generated and published in priority trait areas included

- Drought genomics (BMZ/RF projects).
- Rice Mutant Bank (SDC project).
- Allele mining of the genebank collection.
- Deep biology for candidate gene discovery for specific target traits.
- Commissioned research for the Generation Challenge Program.

COMMUNICATION AND PUBLICATIONS SERVICES

Publications

Through CPS, IRRI produced and distributed 15 titles, including seven scientific books, the *Report of the Director General 2003-04*, two discussion papers, one limited proceedings, a booklet about IRRI's Environmental Agenda, and a second edition of G*raindell*—the first book produced by IRRI aimed at children. Also produced were four issues of IRRI's popular magazine, *Rice Today* (to provide expanded coverage of the International Year of Rice), two issues of the *International Rice Research Notes*, and a 1,000-copy reprint of the popular *ORYZA2000, an ecophysiological model for rice*.

In 2004, IRRI forged or continued to negotiate a number of copublishing arrangements for the following titles:

- *Innovations in pro-poor agricultural extension: lessons from Bangladesh* (with CABI, now in press);
- A Chinese version of *Breeding rice for drought-prone environments* (with the Shanghai Agrobiological Gene Center, now in press);
- *Rural livelihoods in Bangladesh: changes and challenges* (with University Press Ltd., in Bangladesh, still under discussion);
- *Why the Philippines imports rice* (contacts with Philippine publishers still under way); and
- *Rice improvement in the genomics era* (discussion with Howarth Press still under way).

Rice-feeding insects and selected natural enemies in West Africa: biology, ecology, identification, an IRRI-WARDA dual imprint, was printed and distributed in June 2004. WARDA acknowledged safely receiving 1,000 copies of this long-awaited technical monograph, which includes 600 hand-drawn insect and spider illustrations. This publication is a model to illustrate healthy intercenter collaboration, especially in the current CGIAR climate where sharing projects across centers is being encouraged.

The Japan International Research Center for Agricultural Sciences (JIRCAS) and IRRI have agreed to publish the proceedings of the scientific meeting of the November 2004 World Rice Research Conference (WRRC) on CD only. This will save an enormous amount of money in printing and distribution that a 700+ page traditional printed proceedings would have cost. Since publishing only on CD also enables CPS to make this information available more quickly in various forms, including on the Web, we are encouraging workshop organizers to consider this route for publishing such proceedings in the future.

CPS is working with IRRI's Publications Advisory Committee (PAC) to review the Institute's Publication Policies and Procedures, which need updating and revision. An updated version of these policies and procedures will be important in discussions with CIMMYT as CPS and its CIMMYT counterpart (Office of Corporate Communications) discuss the possible sharing of some aspects of scientific publishing as part of the IRRI-CIMMYT Alliance.

IRRI on the Web

In 2004, CPS designed and deployed special external Web sites for various key events tied to the International Year

of Rice including the World Rice Research Conference, the Mekong Rice Conference, and the International Rice Science Conference, Korea. In December 2004, CPS put a similar site online for the International Rice Genetics Symposium (set for 19-23 Nov 2005). CPS creative staff designed the logos for all four of these international events.

On the occasion of the *IRRI Bulletin*'s 200th consecutive Tuesday afternoon issue on 27 April 2004 (since its debut on 4 April 2000), it was announced that that the weekly newsletter (http://bulletin.irri.cgiar.org) had won a Silver Award (2nd place) in the Electronic Publications Class of the Publishing Category from the U.S.-based Association for Communication Excellence (ACE). The judges stated: "the short, clear, and basic articles in different 'tabbed' sections work very well and that the no-nonsense design makes it accessible and usable. It is an efficient and effective way to keep a disparate and dispersed staff in the loop."

A new version of the Riceweb site (www.riceweb.org) continues to undergo review and is scheduled to go online during the first quarter of 2005.

Gatekeeping for the Institute's various Web sites has been put on the agenda of the newly appointed Knowledge Management (KM) Task Force. It is agreed that there is a need for additional monitoring of information that goes to IRRI partners via the Web. The process must ensure such information is accurate, readable, and visually pleasing. Currently, various OUs manage different KM assets—e.g., CPS (main IRRI Web site; Riceweb); VIS (Media Resources and Riceworld); BBU (International Rice Information System—IRIS); Training Center (Rice Knowledge Bank and Training sites); Library (Library site); and CPS/ITS (internal portal pages), among others. In 2005, the KM Task Force and OU webmasters will agree on and implement appropriate approval and uploading procedures.

Rice photo bank and photography at IRRI

An additional 1,425 educators, students, photographers, graphic designers, and others registered online to view and sometimes obtain the images available in the IRRI rice photo bank (http://rice-photos.irri.org), which contains more than 5,000 rice-related images, including landscapes, people, events, markets, laboratories, pests, and diseases. To date, 2,625 persons worldwide have registered to gain access to the photo bank. Registrants have come from 94 countries, the top 10 being United States (222), India (188), Philippines (156), China (91), Japan (51), Australia (49), Malaysia (42), Thailand, (40), Germany (34), and Brazil (31). Approximately 2,000 digital images were downloaded by internal and external clients in 2004. A second generation of the photo bank will go online later in 2005 with an open architecture system that will provide a wider array of images and a more user-friendly downloading process.

To supplement the photography needs of the Institute and to help avoid unnecessary additional purchases of new cameras by OUs, CPS made available for checkout by IRRI staff members three digital single-lens reflex (DSLR) cameras (Nikon D70). To provide camera borrowers with basic know-how on how to use these cameras, CPS photography staff members are giving initial instructions to first-time users. In the long term, CPS will be periodically providing relevant basic and advanced digital camera short courses in 2005 and beyond.

In 2004, the CPS photography staff provided basic digital camera training for 52 IRRI staff members and spouses. This included two half-day sessions that were part of an IFSA workshop, *Using art to communicate science,* held in June. CPS photographers led a number of lectures and discussions covering principles and elements of photocomposition and basic techniques in digital photography. Most of the excellent photos appearing on the 2005 IRRI wall calendar came out of this IFSA workshop.

Camera borrowers are asked to share their photographs with CPS for possible placement in the photo bank. In early 2005, CPS will release instructions on how IRRI digital camera users can easily transfer digital image files and information for use in the photo bank.

Communications support

CPS continues to provide communication support for the entire Institute, including editing, graphic design, art and illustration, audiovisual, photography, video, and printing.

In 2004, the OU's print shop produced 744,450 impressions of various materials, not including IRRI books, which were outsourced to printers in Manila, and an additional 66,678 laser-generated color impressions.

Approximately 1,000 original slides were produced, compared to a peak production of 67,000 in 1992, indicating a dramatic switch over to digital images used in PowerPoint for this type of presentation. Approximately 4,000 new digital photographs were produced.

Eleven video programs were produced and 28 shorter clips were provided for the Bulletin and PowerPoint presentations.

Graphic artists produced 50 illustrations, laid out 3,368 pages for publications, and prepared and printed 143 posters.

IRRI editors worked on more than 830 pages appearing in 23 refereed journal articles, 1,572 pages appearing in IRRI's scientific books, plus 184 pages for the *International*

Rice Research Notes, and more than 2,200 pages of additional conference papers, abstracts, proposals, and others.

EXPERIMENT STATION

The Experiment Station (ES) Field Operations Unit provided support services to 180 field experiments. Some 8,570 maintenance and service requests were served during the year. A total of 311 hectares of land were prepared. PBGB remained the biggest user of the farm, planting some 140 hectares for its various field trials and varietal development programs. The ES, the second biggest user, planted 117 hectares for rice-production and seed-increase activities of the unit, which also included about 2 hectares for seed production of cover crops. Overall, land use increased by about 45% compared with the 10-year average (1993-2002) cropped area of the IRRI farm and by 12% compared with 2003 levels. Average cropped area for the last 10 years was 214 hectares per year while 2003 cropped area was 278 hectares.

Division	Dry season (ha)	Wet season (ha)
PBGB	73.87	66.33
ES	61.38	56.64
CSWS	14.60	10.13
EPPD	6.03	5.60
TC	1.92	1.69
GRC	8.01	4.47
Total	**165.81**	**144.86**

Nursery requirement

To meet the field nursery requirements of the various users from the different research divisions, 11 hectares have been used for centralized seedling production. Of this, dry-bed and wet-bed nurseries accounted for 7.5 and 3.5 hectares, respectively. On the other hand, the rest of the nursery requirements for majority of the crop production activities of ES were served by some 400 square meters of concrete space utilized as modified *dapog* nurseries at the back of the ES administration building.

Crop establishment

Manual broadcasting using pregerminated seeds was the main crop establishment method used by ES on wet fields, while drum seeding and drill seeding have mainly been used in dry prepared areas. More than 80% of the plantings were established this way. The manual and mechanical transplanting methods were used occasionally, depending on weather, depth of the hardpan, and soil conditions at planting time. An average of 20 hectares each season of the production plots were established within a month before the main planting season while the remaining production plots were established right after when all the field requirements of the research divisions have been met. Some 105 tons of different kinds of fertilizers in the form of ammonium sulfate, complete, muriate of potash, solophos, urea, zinc oxide, and zinc sulfate were used at the farm during the year. This reflected a 21% increase in fertilizer use compared with the previous year mainly brought about by the significant increase in the area under cultivation.

Integrated pest management

IPM has remained the standard practice in all ES-managed fields and, thus, zero insecticide application has been maintained in all seed production plots. For the rest of the farm, total pesticide use amounted to 1,485 liters and 6,512 kilograms for liquid and granular formulations, respectively. Herbicide use accounted for 43% of the liquid applications, which were mainly used in preemergence applications and for the maintenance of fallow areas, levees, and perimeters. The granular formulations, on the other hand, were mostly applied to researchers' plots both in the field and greenhouse experiments. The application of sublethal doses of nonselective herbicides continued year-round and helped reduce the costs of weed control in fallow areas, levees, and perimeter fences. The mudmaster four-wheel-drive mechanical pesticide application machine has been extensively used in the application of molluscicides for snail and in the preemergence herbicide applications for production plots. The tractor boom sprayers, on the other hand, were used in herbicide applications for fallow areas.

ES continued to provide rat control services at the IRRI farm. Some 493 baiting stations and 76 hectares of active barrier system with 918 live traps were installed. A total of 3,358 rats were caught during the year. Generally about 27% reduction was noted in the use of rat control devices compared with last year, even though the crop area under cultivation increased. This is indicative of the effectiveness of integrated rat control measures being practiced at the farm, which include the community trap barrier strategy, active management of fallow areas, and maintenance of the general cleanliness of the farm, among others. For bird control, about 1 hectare of bird net was installed. A control program for birds and snails was also initiated through regular bird trapping and manual collection of snails and snail eggs to reduce the populations of these pests to manageable levels.

Irrigation

Irrigation water for the entire IRRI farm was provided and maintained by a team of ES research technicians working on staggered schedules. Supply of irrigation water through the underground piping system was provided to some 244 hectares of lowland fields, while overhead sprinkler irrigation services were provided to some 54 hectares of upland setups and dry-bed nurseries in blocks B, D, 833, 900 series, UD, UI, UJ, UL, UM, UMN, UN, UO, UP, UQ, UR, UV, UW, and UX. About 15 units of drainage outlets in the old area, new lowland, and upland areas were developed and constructed while 2 units of gate valves, 10 irrigation risers, and 5 concrete boxes at upland and old areas were repaired. To solve previous water shortage problems in the upland area as well as meet the increasing demand for irrigation water from expanding research work on upland rice and aerobic rice, and in anticipation of potentially long dry spells especially during the summer season, a well was drilled in block UZ and a new 55-hp submersible pump was installed to augment water supply in the UX reservoir.

Rice harvesting

ES harvested a 285 tons of paddy from the ES-managed production plots. Another 226 tons of mixed varieties were harvested from researchers' fields. The highest yield noted in the ES-managed production plots was 7.5 tons per hectare in block 2001 planted to Rc18. Harvesting was done on all production plots mainly with the use of the combine harvesters. The onset of heavy rainfall toward the end of the year coincided with the grain maturation stage of most of the production plots and resulted in crop lodging in several production plots as well as hampered the efficiency of harvesting and most of the drying operations.

Land development

Continuing land development work was undertaken in 6 hectares of land consisting of conversion of upland to lowland fields in Blocks UI4, UN2, and UN4. Road patching and backfilling of about 5 kilometers of roads from the ES main building to the farm access roads was also done. Regular maintenance works such as rice straw collection, dumpsite maintenance, roadside maintenance, and road rehabilitation were conducted during the year. The ES Civil Works Unit also facilitated various requests for use of heavy equipment, tractors, and implements for use by the different units of UPLB, UPOU, and nearby communities.

Fabrication, repair, and maintenance

Fabrication work, repair, and maintenance services for tractors, earth movers, and light farm equipment as well as for irrigation infrastructure were continuously provided by the ES Mechanical Repair Shop Unit during the year. More than 600 requests for repair and maintenance of light and heavy equipment and implements were received and accomplished. Malfunctioning pumps were extracted and repaired in Blocks UK, UT, C26, the 500 series and 2000 series with minimum downtime. To effectively reduce downtime during pump breakdown in any of the reservoirs, reserve pumps and associated electrical accessories are maintained as 24-hour standby units. Pump models and specifications have also been gradually standardized to further improve on warehouse stocking efficiencies for various irrigation equipment and supplies. About 50 units of different types of threshers (panicle thresher, Vogel thresher, axial thresher, and grain cleaner) and 32 units of different dryers (circulating dryer, cabinet dryer, and batch dryer) were also repaired and maintained. Two units of seeders (Korean Bokto seeder and zero tillage seeder) were modified. Assistance was provided in the fabrication of a rice hull furnace, a project of a scholar from the Agricultural Engineering Unit. Maintenance and repair services were also provided to the rice mill.

Ricemill

The Rice Mill Unit processed 507.53 tons of paddy that were harvested from the IRRI farm and another 3.71 tons that were purchased externally. From a total of 288.09 tons of milled rice that was produced, 252.30 tons were supplied to qualified NRS during the year. The rest of all the milled rice produced by the rice mill (totaling 35.79 tons) were either sold to the highest bidder or provided to different requests from other units. Some 22.37 tons of broken rice and about 21.39 tons of rice bran were sold to the highest bidder. The rest of the bran produced from the milling operations was used as feed for fish being grown in the reservoirs. Physical improvements during the year included the installation of a high-capacity color sorter and a computerized temperature monitoring system for the milling processes. Having been instrumented to more closely monitor the milling processes and incorporate the latest in milling equipment, the mill has been capable of producing high-quality rice at a high level of efficiency, with minimum labor requirement and maximum throughput while being effectively used for training workshops, research, and demonstration of a modern working design for the national and international post harvest sector.

Landscape maintenance and development

The Grounds unit continuously provided landscape maintenance and development services for the whole institute. Some 786 maintenance and service requests were served by the unit during the year. The main bulk of routine operations included

regular mowing operations, road sweeping, brush cutting, and garbage collection services in the research center and the various staff housing units of the institute. Indoor plant decorations and outdoor landscaping support services were provided to various offices, the auditorium, building halls and during seminars, workshops, and special events conducted at IRRI as requested by various units. Areas that were improved and landscaped in 2004 included the frontage of Hemmi Building, Khush Hall, CPS1 (ITS), MSS Hall, Grain Quality and Nutrition Research Laboratory, back of the breezeway at Harrar Hall, old IRRI marker at the Tabon Gate, main IRRI entrance gate, and the two islands of the NCBL pond as well as the front and back portions of CL4. As part of established routine, annual trimming of trees was done both at the IRRI staff housing and the IRRI farm to rejuvenate old branches, improve light penetration, help reduce the frequency of leaf sweeping operations and, more importantly, to increase the margin of safety from falling tree branches and twigs during typhoon months.

The Grounds Unit also handled the fish production project in ES farm reservoirs. Some 1,776 kilograms of fish were harvested from two reservoirs and sold to employees at the end of each week. Other projects undertaken by the Grounds Unit in 2004 included trash bin relocation, replacement, repainting, and refurbishment; identification and labeling of trees and plants on the grounds of House #1; expansion of the fish production project to two more reservoirs with the planting of 45,000 fingerlings; improvement of security in the ponds through lighting and barbed wire installations; sprinkler replacements in the nursery area; and general cleaning of the farm reservoirs. Equipment acquisitions for the year included one riding mower, two push mowers, two brush cutters, and two power saws, among others.

Phytotron and greenhouses

The Controlled Growth Facilities and Grounds Unit (CGFG) of the ES supported 41 experiments in the Phytotron and CL4 transgenic greenhouses, and 84 experiments in the greenhouses. Some 1,203 maintenance service requests were served during the year.

The Phytotron/CL4 unit provided basic research support services to all experiments conducted in the Phytotron and transgenic greenhouse facilities. Part of the standard maintenance procedures done during the year include the staggered 1-month shutdown of the CL4 greenhouse bays and the annual preventive maintenance shutdown for all of the Phytotron facilities, which was done in November. The unit served some 130 maintenance and service requests. Projects undertaken by the unit during 2004 included modification of the cooling system of the outdoor growth chambers; replacement of defective parts of the indoor growth chamber and glasshouse bays; replacement of cold water pump #1, chilled water pump #2, and condenser fan motors at the CL4; upgrade of the Phytotron main software control system; replacement of the old controller of glasshouse #4; repainting of all air-handling units of the CL4; rehabilitation of centrifugal pump #2 of the Baltimore cooling tower; and the maintenance of three cold water tanks at NG-05-00. Various acquisitions during the year included spare parts, tools, gadgets, one humidifier, and six condenser fan motors.

Basic research support and maintenance services were provided to all experiments in all greenhouse and screenhouse facilities by the CGFG Greenhouse Unit. Some 287 maintenance service requests were served. Standard shutdown schedules and procedures were undertaken by the unit for all the greenhouses. A total of 1,400 pots were provided by the unit for use in various experiments. About 1,102 tons of ground soil was processed and provided by the unit, mainly for use in the Phytotron, CL4, and greenhouse experiments and partly for use as covering material for newly planted seeds in some field experiments and seedbed nurseries. Projects completed by the unit in 2004 included roof replacement of BG13, BG14, NG02-01, and NG02-02 with UV-resistant polycarbonate material; replacement and refurbishment of the wire mesh sidings of the CES Building and reinforcement with poly-gal sheets; installation of polycarbonate weather shield for the upland farm drying shed; installation of a more durable polyvinyl lining in US01 screenhouse for rat control purposes; refurbishment and replacement of typhoon-damaged screen cladding of CS06; repainting of CS04; refurbishment of the bio-safety room in BG08; relocation of the old soil grinding machine; and the centralization of soil grinding operations in the upland farm complex. Other routine maintenance operations done by the unit included screen repairs, garbage and junk disposal, glass roof repairs, issuance of pots, bench lining replacements, faucet repair, as well as various minor refurbishment work on greenhouses structures, tables, and benches.

Infrastructure projects

Major infrastructure projects undertaken by ES in 2004 included the construction of the PBGB field testing facility for transgenic rice materials, various renovation work in one PBGB and two EPPD head-house units, construction and renovation of head-house extension for PBGB in the upland complex, construction of a new wash shed and concrete benches in cluster B, renovation of the Nematology head-house area, as well as improvements in farm security through the general upgrade of the old rundown fence in block E and construction of a new interlink fence line along the road north

BC boundary as well as the construction of the first 100 meters of concrete wall near block 2000. ES also facilitated the construction and completion of the GRC screenhouse extension in the upland farm complex.

Kabesilya service

Utilization of *kabesilya* services by the various research divisions and support units totaled 546,332 person-hours. This represents an 18% reduction in utilization compared with the previous year's total of 666,211 person-hours. Manual bird-scaring services remained almost the same with a slight increase of less than 1% from 120,278 person-hours in 2003 to 121,108 person-hours this year. Considering the 12% increase in cropped areas this year, the data are suggestive of further improvements in the efficiency of contractual labor utilization as brought about by the improved system and control on labor use as well as by the mechanization and modernization of majority of farm operations. A very important contributing factor would be the improved kabesilya administration procedures and full implementation of the monitoring and control systems that were put in place in previous years.

Results of the monitoring and user-feedback mechanism previously established to regularly evaluate the performance of the current service provider for kabesilya services revealed high annual average acceptability values of 99% for bird boy services and 97% for other contractual labor services. Ratings given by end-users ranged from good to excellent with very few isolated cases of unacceptable performance. These were discussed with the division coordinators and the kabesilya leaders during monthly meetings with ES management: performance measures, user feedback, and areas for improvement.

Accommodating external and internal requests

As part of its continuing role in maintaining harmonious relationships with nearby communities and other organizations and institutions, ES served various external requests for equipment and services following established protocols and guidelines. The various groups include the different departments of the University of the Philippines, the UP Open University, a number of nongovernmental organizations, and the municipalities and barangays of Los Baños and Bay, among others.

As a whole, the ES generally had smooth, harmonious, and stable operations during the year. Restructuring and farm administration strategies continued with implementation of established protocols and procedures, manpower pooling and realignment, job rotation, staff training, mechanization, modernization, and outsourcing, among others.

Other additional responsibilities successfully undertaken by ES staff included training activities in support of the related training programs of the Training Center; year-round field tours and field demonstrations for visitors of the VIS office, orientation program for newcomers, and collaboration work with research units on a number of experiments and projects.

LIBRARY AND DOCUMENTATION SERVICE

The Library and Documentation Service strives to make maximum use of available resources and assume a proactive role as an information provider supporting IRRI's research programs. As in the past, Library clients consisted of walk-in and remote users from all over the world. Guided by the principle that electronic resources must supplement rather than replace conventional printed information resources, linking researchers with information resources at the quickest time possible became its goal. The Library's integrated system was upgraded to Millennium Silver, the latest enhancement on the software.

The Library's Web site (http://ricelib.irri.org)

The Web site was visited by an average of 4,000 users per month in 2004. It is one of the featured Web sites in Keiso's Meta Virtual Reference Desk at www.asahi-net.or.jp/~gb4k-ktr/mvrd.htm. The IRRI Library is the only institution coming from the Philippines.

The electronic journal page was redesigned to make the facility more user-friendly. Through color coding, a clear distinction was created among serial titles which are freely available on the web, those that allow full text access through paid licenses, and titles that allow users to read abstracts only. Again, there was minimal use of colors and graphics, allowing faster connection to the site.

Also, the contents of the home page were improved with the addition of more links to relevant web sites. The page now carries more than 1,200 links to current electronic journals and about 500 links to Web sites, documents, and databases.

Collection development

Monographic acquisitions, numbering 1,276, consist of purchased items and mostly free publications. The Online Public Access Catalog (OPAC), which is available anytime to worldwide users with Internet connection, now has 74,036 entries. Acquired were 120 doctoral and masteral dissertations on rice from 14 countries worldwide.

There were 2,009 rice reprints comprising the main bulk of acquisitions. Of these, 832 were purchased while 1,177 were obtained from free sources, such as authors themselves or the Web.

Rice literature and bibliography

More, than 12,000 current and retrospective references to technical rice literature were added to the rice bibliography database, making a total of 238,225 bibliographic entries. In some cases, abstracts were included in the citation. The staff continued to add links to full-text articles, with due regard to copyright restrictions. Hence, users can readily get to read the full papers with a few key strokes.

The Library produced two issues of the *Rice Literature Update* in 2004. A revised edition of the *International Bibliography of Rice Research* on CD was published to include entries from 2002 up to early 2004. The *Rice Literature Update* was distributed to more than 800 libraries and institutions worldwide.

Electronic and print journals and databases

Sustainability of subscriptions to journals and databases is becoming a major concern due to continuing price increases. In 2004, seldom used journal titles were purged from the subscriptions list. To supplement the current subscriptions, the Library arranged for free trial access to databases and electronic journals, whenever possible.

To acquire vital papers published in journals not available in the Library, free electronic copies were requested individually from authors. Free sources of technical literature were explored first, before resorting to pay-per-view. Dr. Sangeeta Kaul, manager of the Developing Library Network in New Delhi, India, in many instances, provided free copies of rice literature. IRRI's liaison scientist in Korea, Dr. Kshirod Kumar Jena, and Ms. Li Ding of the IRRI China Office were the main providers of free Korean and Chinese literature, respectively.

Collaboration with the other CGIAR libraries through the CGIAR Libraries and Information Services Consortium (CGIARLISC) resulted in access to more electronic journals. Through the consortium, journals not included in the Library's paid subscriptions but are paid for by other centers are made available online to IRRI researchers. IRRI pays for 26 titles in the consortium but has access to 85. The IRRI librarian is currently the coordinator for joint journal subscriptions for the CGIARLISC.

Through the Internet, more electronic journals were made available for use by IRRI research staff. With the addition of 368 titles (LDS Table 1), there are now more than 1,200 e-journals with links on the Library's Web page.

Electronic journals added in 2004.

Mode of access	Titles (no.)
Full text access through paid subscriptions	160
Full text access (free with print or through the Internet)	145
Full text access (through CGIARLISC)	20
Table of contents access only (free)	43
Total	**368**

Library services

Current awareness. The latest journal articles in relevant subject fields were brought to the attention of IRRI scientists through the Library's active alerting service. As before, the chief vehicles for current awareness services are the Library's Web site, 44 regular announcements in the electronic weekly *IRRI Bulletin*, e-mail messages, and occasional announcements on IRRI's public announcement folders regarding free offers of access to technical journals and databases. The list of forthcoming conferences and new acquisitions on the Library's Web page were promptly updated.

Electronic alerting services were set up for some IRRI scientists upon request. This current journal article-alerting service was mainly accomplished through *Current Contents Connect (Agricultural, Biological, and Environmental Sciences)* online, which is now available sitewide for up to three simultaneous users. Before, only single access was possible, as the service is very expensive.

To call the attention of walk-in clients to the capability to access nonprint journals, color facsimiles of e-journal covers, with appropriate notes, are prominently displayed in the Library's Reading Room shelves.

The Library and its staff were featured in the September 2004 (v.18, no.3) issue of *INN-Touch*, the monthly newsletter of Innovative Interfaces.

Reference service and document delivery. The Reference Service was boosted by partnerships with prominent universities and institutions here and in other countries such as the De La Salle University, Ateneo de Manila University, Asian Development Bank, Hong Kong University of Science and Technology, the Asian Institute of Technology, and the Chulalongkorn University.

Local as well as foreign researchers send requests for literature searches or for documents everyday. The Library tried its best to provide the document on the same day that the request was received. Document delivery was done through e-mail attachments via Ariel, an electronic document delivery software or through conventional means. Local IRRI staff and outreach scientists requested a total of 317 papers from journals not included in the Library's subscriptions.

The CGIAR libraries are regular recipients of IRRI's document delivery services.

The Library reached out to more countries, now numbering 41, by answering information requests, providing literature searches, and conventional and electronic document delivery.

Training. The Library collaborated with Training Center in its Engage 2004 seminar series on April 21. The training session, which was attended by IRRI staff, scholars, and trainees, made use of discussion and a video titled *Public Speaking* by the instructional group, Standard Deviants, which is available at the Library's Audio Visual Learning Center.

On 22 July, the LDS organized a demonstration on the use of EndNote, a bibliographic management software which can be used by researchers in managing bibliographic citations. Dr. Dave Mackill of PBGB conducted the demo, which was attended by more than 50 IRRI scientists and other staff.

Three IRRI librarians acted as resource persons in the capacity-building workshops organized by the Agricultural Librarians Association of the Philippines (ALAP) for the FAO at the Benguet State University in May. Also, individual instruction on the installation and use of WebAGRIS, a free software developed by FAO, was given to librarians from the University of the Philippines Los Baños and the Department of Agriculture's Bureau of Agricultural Research.

Individual instruction on the use of ProCite, a bibliographic management software, and searching using the various commercial databases available in the Library continued. Library orientation was given to more than 300 new staff, scholars, trainees, students, and visitors coming from all over the world.

Other Library databases

The *International Directory of Rice Workers*, an active database of 1,500 rice scientists continues to serve as a vital facility for searching biographical information.

The *Rice Patent Database* continued to grow and it now has 1,141 entries.

The Library has accumulated more than 500 electronic files of journal articles on rice and organized them in a *PDF Files Database*, now stored on the K: drive of IRRI's intranet. These technical papers are freely available to staff on campus. References to these papers are also available in the online public access catalog and the rice database with active electronic links to the full text.

The *News Clippings Database*, updated daily, now contains 13,347 entries of news items about IRRI and rice. Current and older files back to 1983 can now be searched electronically.

Archival preservation

Information stored in paper files is not permanent. Preservation for posterity was one of the key priority areas in 2004. Digitization of all rice translations was outsourced and these are now indexed and stored in a searchable file on CD-ROM using Alchemy.

Scanning of rice reprints continued at a slow pace, with reprints dated 1951-64 already stored on CD.

Collaboration with other institutions

Exchange relations continued with more than 600 libraries worldwide. Free copies of selected IRRI publications, including the *Rice Literature Update,* were sent, free of charge, upon publication.

Inputs in the *FAO AGRIS Database* continued with 302 citations of IRRI publications submitted online to the AGRIS Centre in Rome, soon after publication. Likewise, metadata describing IRRI's electronic publications were encoded online for the *FAO InfoFinder Project*. There are now 310 entries for full-text IRRI publications and 21 Web sites.

Interested local libraries received donations of duplicate and superseded publications from the Library. Some of the beneficiaries are the Department of Agriculture (Lipa City), Mindoro State College of Agriculture and Technology (Victoria, Oriental Mindoro), Don Mariano Marcos State University (Bacnotan, La Union), Palawan State College (Aborlan, Palawan), Camarines Sur State Agricultural College, Isabela State University, Lasam Institute of Technology (Cagayan), Benguet State University, Leyte State University, and various unit libraries of the University of the Philippines Los Baños.

Professional growth of staff

The professional growth of the Library staff was enhanced by attendance at in-house and off-campus training programs.

VISITORS AND INFORMATION SERVICES

The Institute hosted 50,581 visitors in 2004 compared with 86,550 (VIS Table 1) in 2003. This included distinguished visitors composed of 612 government officials, eight ambassadors, members of the diplomatic community, and representatives of various donor and international organizations. The overall decrease was caused by tighter controls on the number of visitors per day so that complete and specialized programs could be offered to each category or group.

The Visitors Office also celebrated the International Year of Rice (IYR) with two different activities: 1) a puppet show, which was watched by more that 1,200 pre-school and elementary kids from Los Baños and Bay area, and 2) an

on-the-spot painting competition where 14 high schools from around Los Baños and Bay took part. These activities aimed to make students aware of the importance of rice and rice research.

During the year, IRRI also hosted or co-hosted 15 regional and international conferences, workshops, and symposia (VIS Table 2). More than 500 delegates from 36 countries participated in the regional and international conferences and workshops.

In the IYR 2004, the Riceworld Museum and Learning Center celebrated its 10th anniversary during the Institute's Diplomats' Day on 4 March.

A simple ceremony starting with presentation of plaques of appreciation to the German Embassy guests and other people involved with developing Riceworld took place and ended with the formal opening of the Riceworld Bookstore and Coffee Shop.

Riceworld Museum staff also participated in 16 local and 2 foreign exhibitions on rice.

The Museum also loaned artifacts and materials to the PhilRice Science and Technology Museum in Muñoz, Nueva Ecija, and to the Museo Pambata in Manila.

Aside from the usual Institute events, IRRI seminar facilities, including Chandler Hall Auditorium and Asia Room located in Riceworld, played host to 27 various non-IRRI events including piano and violin concerts, health seminars, corporate meetings/seminars, graduation exercises, theatre plays, and other organizational activities.

IRRI and the International Year of Rice 2004

Major exhibits. VIS, with the assistance of Communication and Publications Services (CPS), coordinated IYR exhibits displayed during 23 major international and Philippine conferences, meetings, and festivals throughout 2004.

Foreign exhibits were staged at the **FAO IYR Launch**, Rome, Italy, 9-15 February; **the Tokyo Gallery of the UN House**, Shibuya-ku, Tokyo, Japan, July-August; **the CORRA Meeting**, 10-12 September/**International Rice Science Conference**, 13-15 September, and **IRRI Board of Trustees Meeting**, 16-17 September, Seoul, Korea; **World Food Prize Symposium**, Des Moines, Iowa, USA, 14-15 October; **Mekong Rice Conference**, Ho Chi Minh City, Vietnam; 15-17 October; **CGIAR Annual General Meeting**, Mexico City, 25-30 October; and the **World Rice Research Conference**, Tsukuba, Japan, 5-7 November.

Exhibits staged at Philippine events included **Crop Science Society of the Philippines**, 35th Anniversary and Annual Scientific Conference, 8-12 March, Davao City; **Pest Management Council of the Philippines**, 35th Anniversary and Annual Scientific Conference, Iloilo City, 16-19 March; **Science and Technology National Convention**, Baguio City, 19-20 March; **French Spring Festival**, Makati City, 21-30 June; **Los Baños *Bañamos Tuklas Agham***, University of the Philippines Los Baños (UPLB), 15-17 September; **Museo Pambata's *Ani* (Harvest)**, Manila, 25 September-30 December; **UPLB Loyalty Day**, 10 October; **University of the Philippines Rural High School**

VIS Table 1. IRRI visitors, by group, in 2004.

Group type	Philippines	Asia	Africa	Australasia	Europe	Latin America	North America	Total
Students	37,089	172						37,261
Conference participants	136	30	11					177
Nongovernmental Organizations	255	54						309
Donors								
Government officials/politicians	577	35						612
Farmers	2,978	95						3,073
Faculty members/parents	952	1			5			958
Scientists, university staff	158	64						222
Private sector	112	286		5	4	2	25	434
UN agencies, CGIAR, TAC, others	47							47
Diplomatic corps	32							32
Media	16							16
Religious groups	234							234
Tourists	109	299			5			413
Others	6,793							6,793
Total	**49,488**	**1,036**	**11**	**5**	**14**	**2**	**25**	**50,581**

VIS Table 2. International and regional conferences, workshops, symposia, and meetings hosted or co-sponsored by IRRI in 2004.

Date	Title	Venue	Number of	
			Participants	Countries represented
5-7 Feb	Final review meeting of IRRI/IFAD project on Validation and Delivery of New Technologies for Increasing the Productivity of Flood-prone Riceland of South and Southeast Asia	Vietnam	48	8
16-17 Feb	Planning and inception workshop on Accelerating Technology Adoption to Improve Rural Livelihoods on the Rainfed Eastern Gangetic Plains	India	48	7
23-26 Feb	The Microarray and Bioinformatics Workshop III: Applying Genomic Technologies to Identify Induced and Natural Variation in Stress Response	IRRI	44	10
11-23 Mar	6th External Program Management Review (Phase II)	IRRI	8	7
24-25 Mar	Inception Workshop for the Challenge Program on Water and Food (CPWF), Project No. 7--Development of Technologies to Harness the Productivity Potential of Salt-affected Areas of the Indo-Gangetic, Mekong, and Nile River Basins"	IRRI	15	7
7-8 Apr	EE: Entertainment-Education-Drama Launch Planning Workshop	Vietnam	18	2
31 Mar-2 Apr	BOT Program Committee Meeting	IRRI	15	11
19-20 Apr	Korea (RDA)–IRRI Collaborative Workplan Meeting	IRRI	38	2
17-21 May	Writeshop/Meeting on Trade Liberalization Project	Bohol, Philippines	12	1
2-4 Jun	Third CURE Steering Committee Meeting	Thailand	47	11
15-17 Sep	BOT Program Committee	Korea	15	11
11-12 Nov	IRRI Program 3 Scientific Meeting	IRRI	35	1
23 Nov	IRRI Representative, Liaison Scientist Meeting	IRRI	16	7
29 Nov–3 Dec	The Irrigated Rice Research Consortium (IRRC) Review and Planning Meeting	IRRI	117	13
7-9 Dec	Salient Observations and Recommendations in the Terminal Workshop of the IRRI/ADB Project	IRRI	30	9
Total			**506**	**36**

(UPRHS) Science Week, Bay, Laguna; 11-15 October, ***Rice is Life*** **and National Philatelic and Photo Exhibit**, Philippine Postal Corporation, Manila, 15-29 October; **UN Week *Rice is Life***, Department of Foreign Affairs, Roxas Boulevard, Pasay City; 18-25 October; **PHILSAGEN's 8th National Genetics Symposium**, IRRI, Los Baños, 21-22 October; **Kaunlarang Pangkabataan Production: Rice is Life Mobile Exhibit**, Olongapo and Pampanga provinces, 3-5 November; **Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development National Rice Awareness Month**, Los Baños, 10 November; **IRRI-Asian Development Bank Celebration of the IYR**, ADB Head Office, Pasig City, 11-18 November; **International Rice Forum, Festival, and Exhibit**, Philippine Trade Training Center, Manila; 27-29 November, and the **UPLB Genetics Society**, UPLB, Los Baños, 6-10 December.

IYR and other public awareness materials were also supplied to the following workshops, conferences, celebrations, and festivals in various countries:

- Workshop, Luang Prabang, Laos, 27-30 January.
- Workshop on IRRI/IFAD projects, Cantho Province, Vietnam, 5-7 February.
- 1st International Conference on Rice for the Future, Kasetsart University, Bangkok Thailand, 31 August–2 September.
- GIS Conference, San Diego, California, United States, August.
- Philippine Institute for Development Studies (PIDS), National Economic and Development Authority, Makati City, 21-23 September.
- 4th International Crop Science Congress, Brisbane Convention and Exhibition Centre, Queensland, Australia, 26 September–1 October.
- International Cooperation Festival, Tokyo, Japan, 2-3 October.
- Rice Expo 2004, Mombai, India, 8-10 December
- IYR Celebration, Phnom Penh, Cambodia, 17 December.

Media. Throughout 2004, IYR attracted the interest of numerous foreign and Philippine media organizations for which VIS arranged programs for visits, interviews, and filming.

Foreign media included CBC French Radio, ABC Radio Canberra, *Sacramento Bee*, Pressburo Segrund, *Science Magazine* (Japan Bureau), *New York Times*, *Helsingin Sanomat* (Finnish newspaper), Agence France Presse, Interpress Service (New Delhi and Asia Pacific), *Guangming Daily*, *Hands-On Earth Report*, *Asian Wall Street Journal*, Channel i Bangladesh, *Times of India*, *Le Temps*, KVMR-FM (Nevada City, California, USA), University of Nebraska, Voice of Ho Chi Minh, *Avenir Magazine* (France), The Moving Visuals Co. (Singapore), Tierravisions (Austria), *Seed World*, and Voice of America (Hong Kong).

National media included Philippine Agricultural Journalists, Inc., Asian Eye Productions, *Manila Times*, IBC 13, UNTV (Community Cable), ABS-CBN, *Mabuhay* Newspaper, and *Business Day* Magazine.

Community relations. IRRI held 3 open days at headquarters, which included open forums and tours of the Institute's laboratory facilities and field experiment stations:

- Farmers' Field Day, 3 March: More than 300 farmers and organized groups from various regions of the country participated, including the critical KMP–*Kilusang Magbubukid ng Pilipinas* (Farmers Movement of the Philippines).
- Diplomats' Day, 4 March: IRRI welcomed ambassadors and donor representatives.
- Host Country Day, 18 November: More than 100 Philippine government officials and employees attended. Senator Miriam Defensor Santiago highlighted the event with a seminar on *The Philippine law on international organizations*.

Other community activities and events included

- The *Romantic Piano Concerto Journey*, featuring international concert pianists, Ingrid Sala Santamaria and Reynaldo G. Reyes, 19 January.
- The IYR Mobile Exhibit (launched at the Los Baños National High School, Los Baños, 24 February) visited more than 50 primary and secondary schools in Los Baños, Bay, Calauan, Calamba City, and other towns in Laguna Province.
- Concluding celebration of the IYR-focused National Science and Technology Week, hosted by IRRI, 4 August.
- IYR briefing during the Regional Workshop on Sustainable Agriculture and Rural Development Farming Systems Evolution (SARD-FSE) Project sponsored by FAO and the Asian NGO Coalition for Agrarian Reform and Rural Development (ANGOC).
- Puppet shows attended by more than 1,500 school children from Los Baños and Bay, Laguna, 7-8 July.
- On-the-spot wall painting contest on the theme *Rice is Life* with 14 participating high schools around Los Baños and Bay, Laguna, 4 September.
- Publication of activity workbooks for pre-school children and high school students with specific programs for each category.

Press releases. VIS issued seven IYR-related press releases during 2004:

- Asian stability threatened by stagnating rice sector (12 February).
- International Year of Rice Activities (5 April).
- Rice Feeds the World exhibit arrives in the Philippines (18 June).
- The latest research on the food that feeds half the world (1 September).
- Major new rice alliance endorses 10-year, 3-point plan (15 October).
- Feeding half the world … sustainably (6 November).
- Indian scientists dominate science awards in the International Year of Rice (9 November).

INFORMATION TECHNOLOGY SERVICES

Seat management of computers

Probably the most important change in IT during 2004 was the shift from purchasing computers to renting them with bundled services. IRRI accepted a proposal negotiated with Hewlett Packard (HP) to switch to this kind of "seat management" arrangement, relieving IRRI of significant asset management headaches and improving service to staff. Following the deferment of PC replacements at a time when staff were retrenched, IRRI had a need to replace many more than the 300 minimum required by HP. In the end, more than 500 computers were replaced in the biggest desktop computer upgrade ever undertaken at IRRI. All the new computers were supplied to staff with Microsoft Windows XP and Office 2003 software.

Parallel to this deployment, the IT Learning Center, with a complement of 16 seats (upgraded from 10), began to offer Microsoft Office 2003 training (ITS Table 1). An important part of Office 2003 is the ability to use Microsoft Sharepoint document management technology. This was also deployed for the first time during 2004, giving some organizational units full-text search capability on filed documents for the first time. Another key software implementation during the year in which ITS was actively involved was the commissioning of a Microsoft Great Plains HR application for the Institute. Infrastructure upgrades included the deployment of redundant storage on campus for the first time, for the Rice Knowledge Bank, and a move from Microsoft Windows NT software to Windows Server 2003 for the Institute's network operating system software. The significance of the latter move may be summarized by saying that IRRI no longer has its own local area network but is now part of a larger CGIAR-wide area network.

ITS Table 1. IT Learning Center training statistics, 2004 .

Advanced Microsoft Excel 2000	25
Advanced Microsoft Outlook 2000	13
Basic Computer Concepts	21
Basic Microsoft Access 2000	38
Basic Microsoft Excel 2000	18
Basic Microsoft Outlook 2000	6
Basic Microsoft PowerPoint 2000	20
Basic Microsoft Word 2000	7
Excel for Scientists and Managers Part 1	8
Excel for Scientists and Managers Part 2	6
Intermediate Microsoft Excel 2000	21
Intermediate Microsoft Word 2000	6
Introduction to Microsoft Excel 2000	22
Introduction to Microsoft Word 2000	20
Using Microsoft Office Excel 2003	177
Using Microsoft Office Outlook 2003	86
Using Microsoft Office PowerPoint 2003	115
Using Microsoft Office Word 2003	117
Using Microsoft Windows XP	94
Word for Scientists and Managers Part 1	15
Total	**835**

Telecommunications

In 2004, many IRS began to use software phones to call home to IRRI when traveling, via the Internet and often at no cost. In many cases, they were able to do so using a new dialup Internet access provider (GoRemote), saving substantially on past costs. In future, perhaps starting in 2005, it is expected that the free call home will be via a wireless-enabled phone rather than a laptop with a headset. The Institute's video conferencing facilities took a step forward with work beginning on the construction of an Access Grid node in what is now the RP Cantrell Building. The Access Grid is advanced video conferencing technology for meetings. IRRI's IT manager, Paul O'Nolan, is leader of a World Bank-funded project to bring advanced research network connectivity to the CGIAR. An emerging CGIAR Access Grid is expected to be one of the early applications of such connectivity.

SEED HEALTH UNIT

Phytosanitary certification

The Seed Health Unit issued 347 phytosanitary certificates covering 69,362 seedlots (1.28 tons) sent to 51 countries worldwide (SHU Table 1). By region, East Asia received 102 rice seed shipments (26,992 seedlots); Europe, 39 shipments (4,388 seedlots); Latin America, 9 shipments (378 seedlots); North America, 18 shipments (14,325 seedlots); Oceania, 10 shipments (551 seedlots); South Asia, 57 shipments (18,004 seedlots); Southeast Asia, 93 shipments (4,123 seedlots); Sub-Sahara Africa, 7 shipments (147 seedlots); and West Asia and North Africa, 12 shipments (454 seedlots). The rice seed export originated from different organizational units: the International Network for Genetic Evaluation of Rice (INGER), 749 seedlots; Crop, Soil, and Water Sciences Division (CSWS), 201 seedlots; Entomology and Plant Pathology Division (EPPD), 5,535 seedlots; Genetic Resources Center (GRC), 32,118 seedlots; and Plant Breeding, Genetics and Biotechnology Division (PBGB), 30,759 seedlots (SHU Table 2).

The different fungi detected with corresponding detection level and affected seedlots are shown in SHU Table 3. Routine seed health testing of 1,378 nontreated, outgoing seedlots revealed that *Trichoconis padwickii* affected 85.34%

SHU Table 1. Distribution of exported seedlots. IRRI, 2004.

Region/country	Total no. of shipments	Total no. of seedlots	Total weight (kg)
East Asia (4)			
Japan	28	14,986	28.390
South Korea	28	8,134	112.293
People's Republic of China	43	3,630	38.832
Taiwan	3	242	1.013
Subtotal	102	26,992	180.528
Europe (15)			
Austria	2	5	1.477
Belgium	2	33	0.233
Denmark	4	4,041	6.409
Finland	1	1	2.000
France	2	14	1.295
Germany	9	105	3.050
Ireland	1	1	0.013
Netherlands	3	20	0.281
Norway	1	2	0.006
Portugal	3	7	0.039
Spain	1	32	0.341
Switzerland	1	11	0.051
United Kingdom	7	38	0.842
USSR	1	44	8.200
Uzbekistan	1	34	1.800
Subtotal	39	4,388	26.037
Latin America (4)			
Argentina	2	142	1.941
Colombia	5	225	5.352
Haiti	1	8	0.110
Mexico	1	3	0.077
Subtotal	9	378	7.480
North America (2)			
Canada	2	6	3.455
USA	16	14,319	269.082
Subtotal	18	14,325	272.537
Oceania (1)			
Australia	10	551	3.324
Subtotal	10	551	3.324
South Asia (5)			
Bangladesh	8	220	70.900
Bhutan	1	27	0.192
India	42	17,615	366.508
Pakistan	3	115	1.822
Sri Lanka	3	27	7.203
Subtotal	57	18,004	446.625
Southeast Asia (9)			
Cambodia	1	121	0.915
Indonesia	5	416	8.052
Laos	6	411	15.289
Malaysia	1	24	0.571
Myanmar	3	55	14.070
Philippines	62	2,760	250.433
Singapore	1	1	0.029
Thailand	3	44	4.056
Vietnam	11	291	17.701
Subtotal	93	4,123	311.116
Sub-Sahara Africa (4)			
Mali	4	58	1.053
Rep of Guinee	1	40	1.100
Rwanda	1	20	8.500
Senegal	1	29	0.367
Subtotal	7	147	11.020
West Asia & North Africa (7)			
Afghanistan	1	5	0.117
Egypt	2	197	15.210
Iran	2	14	0.598
Iraq	1	78	2.200
Israel	1	2	0.027
Syria	1	2	0.025
Turkey	5	161	1.779
Subtotal	13	459	19.956
Grand total	**348**	**69,367**	**1,278.506**

of the seedlots; followed by *Curvularia* sp., 82.22%; *Sarocladium oryzae*, 45.79%; *Fusarium moniliforme*, 41.51%; *Bipolaris oryzae*, 24.60%; *Microdochium oryzae*, 16.04%; *Tilletia barclayana*, 10.67%; *Aphelenchoides besseyi*, 8.42%; and *Pyricularia oryzae*, 0.44%. All exported rice seeds were cleaned for objects of quarantine importance, tested for health, and treated with prescribed ASEAN standard seed treatment for rice — hot water, 52-57 °C/15 min. This was followed by fungicide slurry treatment with benomyl and mancozeb both at 0.1% by seed weight, except for countries that do not allow seed treatment. Fumigation with phosphine was also administered to all outgoing seeds.

Fifty-seven phytosanitary certificates were also issued to INGER for their nursery seed distribution covering 27,008 seedlots (8.47 tons). These were sent to 25 countries worlwide (SHU Table 4). By region, East Asia received 13 shipments (3,707 seedlots); Europe, 4 shipments (1,074 seedlots); Latin America, 4 shipments (2,353 seedlots); South Asia, 11 shipments (11,686 seedlots); Southeast Asia, 18 shipments (5,926 seedlots); Sub-Sahara Africa, 3 shipments (438 seedlots); and West Asia and North Africa, 4 shipments (1,824 seedlots).

Twenty-five incoming seed shipments (3,293 seedlots) from 14 countries were also processed for post-entry clearance (SHU Table 5). Their consignment is shown in SHU

Table 6. The PBGB received 11 shipments (2,138 seedlots weighing 29.96 kg); CSWS, 7 shipments (750 seedlots, 10.9 kg); INGER, 4 shipments (190 seedlots, 12.6 kg); GRC, 2 shipments (214 seedlots, 5.0 kg), and EPPD, 1 shipment (1 seedlot, 2.3 kg).

SHU Table 7 shows the result of post-entry examination on 1,201 seedlots. Out of the seedlots that were visually inspected, only 0.08% had seeds with soil, while 10.41% were affected by insects, mainly by *Sitophilus* spp. (8.66%) and *Sitotroga cerealella* (0.75%). Contamination with weed seeds was only 0.75%, mainly *Echinochloa* spp. Seed health tests showed that *Curvularia* sp. affected 96.19% of the seedlots, followed by *T. padwickii* (79.19%), *B. oryzae* (41.43%), *S. oryzae* (27.62%), *M. oryzae* (22.38%), *F. moniliforme* (19.52%), *P. oryzae* (8.10%), *T. barclayana* (6.67%), and *A. besseyi* (1.9%) (SHU Table 8). The prescribed ASEAN standard treatments were applied to all incoming seeds.

Crop inspection

Post-entry and pre-export crop health inspections were conducted on GRC, PBGB, and INGER multiplication plots and post-entry quarantine areas during the dry (DS) and wet seasons (WS). For post-entry, crop health inspections were conducted on 3,294 entries during DS and 174 entries during WS. SHU Table 9 shows the different diseases observed with corresponding percent prevalence. The most prevalent disease observed during DS was *Sclerotium* seedling blight (21.98%). On the other hand, the most prevalent disease observed during WS was sheath rot (91.95%). Pre-export crop health inspection was also conducted on 4,746 entries during DS and on 1,522 entries during WS. The most prevalent disease during DS was bacterial leaf streak (16.9%), while during WS, the most prevalent disease was narrow brown leaf spot (80.16%).

Advanced testing for GRC seeds

A total of 5,780 GRC seedlots (46,240 plates) for long-term storage were processed for seed health status.

Workshops, training courses, and visitors

SHU also participated in various trainings/workshops coordinated by the Training Center: Rice Production Course (1st offering) with 12 participants from 5 countries and 3 participants from IRRI; (2nd offering) with 15 participants from 9 countries and 7 participants from IRRI; Hybrid Rice Seed Production with 9 researchers from 2 countries and 1 participant from IRRI; Rice Insect Pest and Disease Identification with 30 DA seed inspectors from Kalinga and Quirino provinces.

SHU Table 2. Sources of rice seedlots exported by IRRI in 2004.

Division/exporter	Total no. of shipments	Total no. of seedlots	Total weight (kg)
International Network for Genetic Evaluation of Rice	21	749	35.184
Crop, Soil, and Water Sciences	21	201	18.551
Entomology and Plant Pathology	15	5,535	15.331
Genetic Resources Center	121	32,118	539.382
Plant Breeding, Genetics, and Biotechnology		30,759	670.058
Grand total		**69,362**	**1,278.510**

SHU Table 3. Routine seed health test results for untreated outgoing seeds received by SHU for certification in 2004.[a]

Pathogen	Affected seedlots (%)	Detection level (%)	Mean value (%)
Trichoconis padwickii	85.34	1 – 71	11.80
Curvularia spp.	82.22	1 – 62	12.56
Sarocladium oryzae	45.79	1 – 60	4.73
Microdochium oryzae	16.04	1 – 23	1.38
Fusarium moniliforme	41.51	1 – 67	3.19
Bipolaris oryzae	24.60	1 – 12	1.40
Pyricularia oryzae	.44	1 – 12	3.17
Tilletia barclayana	10.67	1 – 169	8.46
Aphelenchoides besseyia[b]	8.42	1 – 51	9.76

[a]Based on 200 seeds/seedlot drawn for testing (n=1,378). [b]Actual nematode count using sedimentation test.

SHU Table 4. Distribution of INGER nursery seeds exported from IRRI in 2004.

Region/country	Total no. of shipments	Total no. of seedlots	Total weight (kg)
East Asia (2)			
South Korea	1	789	19.200
PROC	12	2,918	91.030
Subtotal	13	3,707	110.230
Sub-Sahara Africa (2)			
Ethiopia	2	378	13.100
Senegal	1	60	2.000
Subtotal	3	438	15.100
West Asia & North Africa (3)			
Egypt	1	745	19.700
Iran	2	529	13.900
Turkey	1	550	14.800
Subtotal	4	1,824	48.400
Grand total	**57**	**27,008**	**837.470**

Other visitors included 24 Bangladeshi collaborators on the Rice Seed Health Improvement Project; UPLB students: 31 Agronomy 170 (Fundamentals of Seed Technology) students; 16 researchers from various local government institutions/agencies/universities; and 6 farmers from Infanta, Quezon, working on Binhi ng Buhay Project. During these visits, lectures and hands-on exercises on routine seed health testing activities, identification of seedborne pathogens and other quarantine objects, and preparation of fungal crop pathogens for microscopy were conducted.

SHU Table 6. IRRI consignees of imported rice seedlots in 2004.

Division/importer	Total no. of shipments	Total no. of seedlots	Total weight (kg)
Crop Soil and Water Sciences	7	750	10.949
Entomology and Plant Pathology	1	1	2.300
Genetic Resources Center	2	214	5.013
International Network for Genetic Evaluation of Rice	4	190	12.600
Plant Breeding, Genetics and Biotechnology	11	2,138	29.956
Grand total	**25**	**3,293**	**60.818**

SHU Table 5. Origin and number of seedlots of imported rice seeds in 2004.

Region/country	Total no. of shipments	Total no. of seedlots	Total weight (kg)
East Asia (1)			
South Korea	1	1,580	15.000
Subtotal	1	1,580	15.000
Europe (1)			
United Kingdom	7	402	1.653
Subtotal	7	402	1.653
Latin America (1)			
Colombia	2	286	4.000
Subtotal	2	286	4.000
North America (1)			
USA	1	1	.054
Subtotal	1	1	.054
South Asia (2)			
Bangladesh	2	345	8.500
India	1	22	3.000
Subtotal	3		
Southeast Asia (5)			
Indonesia	1	10	.823
Laos	2	238	11.000
Philippines	2	2	2.313
Thailand	1	219	9.600
Vietnam	1	9	1.300
Subtotal	7	478	25.036
Sub-Sahara Africa (1)			
Mali	2	41	1.712
Subtotal	2	41	1.712
West Asia and North Africa (2)			
Egypt	1	121	.163
Turkey	1	17	1.700
Subtotal	2	138	1.863
Grand total	**25**	**3,293**	**60.818**

SHU Table 7. Quarantine objects intercepted in incoming rice shipments in 2004.

	No. of infested seedlots	Percent[a]
Weed-contaminated	9	0.75
Weeds		
Echinochloa spp.	9	0.75
Insect-damaged	125	10.41
Insects		
Sitophilus spp.	104	8.66
Sitophilus granarius	1	0.08
Sitotroga cerealella	8	0.75
Rhizopertha dominica	1	0.08
Seeds with soil	1	0.08

[a]Based on 1,201 seedlots visually inspected.

Seeds, by category (general quality)

- Category 1 ---------- 0
- Category 2 ---------- 121
- Category 3 ---------- 817
- Category 4 ---------- 263

SHU Table 8. Routine seed health test results received by SHU for post-entry clearance in 2004.

Pathogen	Affected seedlots (%)	Detection level (%)	Mean value (%)
Trichoconis padwickii	79.19	1 – 65	5.51
Curvularia spp.	96.19	1 – 52	11.39
Sarocladium oryzae	27.62	1 – 59	11.29
Microdochium oryzae	22.38	1 – 30	2.68
Fusarium moniliforme	19.52	1 – 4	1.24
Bipolaris oryzae	41.43	1 – 92	11.53
Pyricularia oryzae	8.10	1 – 33	4.29
Tilletia barclayana	6.67	1 – 88	18.57
Aphelenchoides besseyi[a]	1.90	1 – 3	1.75

[a]Actual nematode count based on 200 seeds/seedlot (n=210).

SHU Table 9. Diseases observed on incoming and outgoing entries planted at GRC, PBGB, and INGER seed multiplication plots and post-entry quarantine areas, 2004 DS and WS.

Disease	Incoming				Outgoing			
	Dry entries (no.)	%	Wet entries	%	Dry entries (no.)	%	Wet entries (no.)	%
Entries without diseases	2,329	70.70	14	8.04	3,124	65.82	33	2.17
Bacterial leaf streak	163	4.95	43	24.71	802	16.90	43	2.83
Leaf scald	0	0.00	0	0.00	6	0.13	3	0.20
Rice tungro	243	7.38	19	10.92	154	3.24	118	7.75
Yellow dwarf	2	0.06	0	0.00	2	0.04	0	0.00
Sheath rot	23	0.70	160	91.95	52	1.09	167	10.97
Sheath blight	0	0.00	0	0.00	7	0.15	3	0.20
Narrow brown leaf spot	0	0.00	1	0.57	16	0.34	1,220	80.16
Bakanae	8	0.24	0	0.00	111	2.34	0	0.00
False smut	0	0.00	0	0.00	3	0.06	6	0.39
Sclerotium seedling blight	724	21.98	0	0.00	248	5.23	0	0.00
Blast	0	0.00	0	0.00	7	0.15	3	0.20
Total entries (no.)	**3,484**		**237**		**4,532**		**1,596**	

[a]Diseases observed on plants originating from incoming seeds were not of an introduced nature.

Degree and postdegree training in 2004

Group training courses conducted in 2004.

Course title	No. of participants	Duration
Regular courses		
English for Conversation	26	9-20 Feb
Planning Rice Breeding Programs for Impact	16	9-27 Feb
ARBN Genomics Workshop: Application of Genomic Technologies for Identification of Induced and Natural Variation in Stress-Response Genes in Rice and Related Cereals	42	23-26 Feb
Developing Integrated Nutrient Management Options for Delivery (DINMOD)	33	1-12 Mar
Two-Week Rice Production Training Course (1st offering)	12	15-26 Mar
Basic Experimental Designs and Data Analysis using IRRISTAT for Windows	18	3-7 May
Scientific Writing and Presentation Skills Course	14	17-28 May
Introduction to the SAS System	22	12-16 Jul
Intensive English 1 Course	16	5 July - 10 Sep
Two-Week Rice Production Training Course (2nd offering)	23	6-17 Sep
Post-Production Training Workshop	21	20 Sep - 8 Oct
Integrated Water Management in Rice Production	35	4-8 Oct
Leadership Course for Asian Women in Agriculture R&D	17	8-19 Nov
Intensive English 2 Course	28	15 Nov - 3 Dec
Special Courses		
Hybrid Rice Seed Production	11	29 Mar - 7 Apr
Ecological Methods on Biodiversity Research	22	30 Aug - 3 Sep
Special Rice Production and Training Management	16	25-29 Oct
Total	**372**	

Scholars on board in 2004.

By country		By type	
Africa		Type I - PhD & MS scholars, thesis research at IRRI	
Ghana	1	PhD	36
Ethiopia	1	MS	23
Asia			
Bangladesh	10	Type II - PhD & MS scholars, coursework and thesis research at IRRI	
China	10	PhD	13
India	12	MS	4
Indonesia	2		
Iran	3	Type III - OJT/nondegree	2
Japan	2		
Korea	4		
Lao PDR		**Total**	**78**
Myanmar	6		
Nepal	1		
Pakistan			
Philippines	18		
Thailand	1		
Vietnam	5		
Europe			
Germany	1		
Netherlands	1		
Total	**78**		

Scholars who completed their training in 2004.

By country		By type	
Africa		Type I - PhD & MS scholars, thesis research at IRRI	
Ghana	1	PhD	21
Tanzania	1	MS	15
Asia			
Bangladesh	12	Type II - PhD & MS scholars, coursework and thesis research at IRRI	
Bhutan	1	PhD	7
Cambodia	2	MS	4
China	5		
India	11	Type III - OJT/nondegree	31
Indonesia	5		
Iran	1		
Japan	2	Japan-CGIAR Fellow	1
Korea	3		
Lao-PDR	1	**Total**	**79**
Myanmar	2		
Nepal	4		
Pakistan	4		
Philippines	10		
Thailand	1		
Vietnam	7		
Europe			
Netherlands	2		
France	1		
Spain	1		
North America			
United States	2		
Total	**79**		

Weather summary

Annual rainfall for year 2004 was 1,718 mm for the IRRI dryland (upland) site and 1,731 mm for the wetland (lowland) site (WS Table 1). These amounts were 369 mm lower than the long-term average rainfall for the upland site and 283 mm lower for the lowland site. Los Baños experienced twice as much rainfall in October and less rainfall in September this year, compared with the long-term amount (Fig. 1). The wettest day at IRRI occurred 19 Jul with more than 105 mm. The longest recorded continuous wet spell was 22 days at the upland site (14 Jul–4 Aug) and 10 days at the lowland site (8–17 Aug). The longest continuous dry spell was 29 days (8 Jan–5 Feb) at the upland and lowland sites.

Mean monthly solar radiation reached a peak in April (more than 23 MJ/m^2/d and gradually declined to 11.3 MJ m^2/d in November (Fig. 2). Solar radiation was relatively low during the second decade of November. The highest recorded cumulated solar radiation (28.3 MJ/m^2/d occurred 28 May. The average duration of bright sunshine was about 9.6 h/d in April and declined to low values of 4.4 h/d in November. The longest record of sunshine at Los Baños was on 24 Apr with 12.1 hours of bright sunshine.

Maximum temperature reached its highest monthly mean value in April (34.2 °C at the upland site and 33.2 °C at the lowland site); it then gradually dropped to its lowest monthly mean value in December (29.1 °C at the upland site and 28.6 °C at the lowland site) (Fig. 3). Except for the months of April, July, and September, the recorded averages of maximum temperature for 2004 were lower than the long-term average. The hottest days in Los Baños were on 15 & 23 April and 5 & 6 May, with 35.5 °C of recorded maximum temperature at the upland site. The distribution of minimum temperatures was more stable than the distribution of maximum temperatures. The coldest day for 2004 was on 17 Feb with 17.0 °C at the upland site and 17.5 °C at the lowland site.

Mean early morning relative humidity ranged from 79 to 87% in the upland site and 80 to 88% in the lowland site. Midday vapor pressure deficit was consistently higher in the upland site than in the lowland site (Fig. 4).

Daily mean windspeed, measured at 2-m height was 1.6 m s^{-1} in the upland site and 1.5 m/s in the lowland site. Windspeed was generally low (<2.1 m/s, except during the passage of tropical disturbances. Maximum 24-hour average windspeed was 6.1 m s^{-1} at the upland site on 2 Dec.

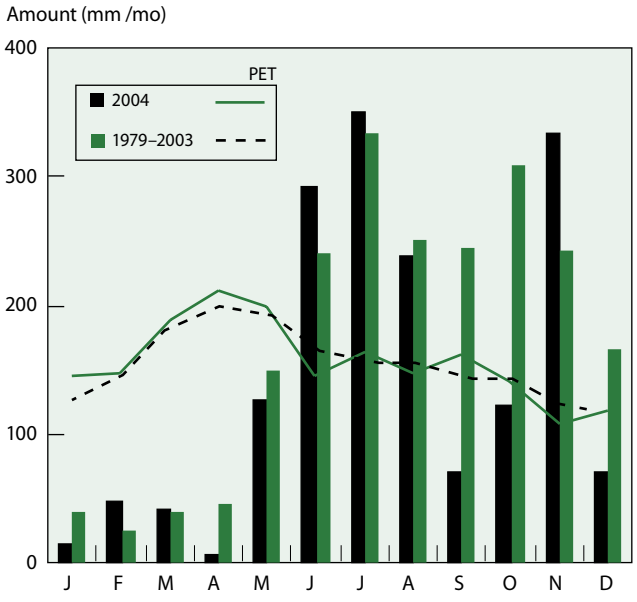
Because of a slightly higher air temperature, lower amount of rainfall, and higher vapor pressure deficit at midday, free water evaporation at the upland site was slightly higher than that at the lowland site. Open-pan evaporation totals were 1,799 mm at the upland site and 1,692 mm at the lowland site. These values were 47 mm higher than the long-term evaporation total at the upland site and 11 mm lower than that at the lowland site.

In 2004, 25 disturbances passed through the Philippine area of responsibility. A few days after the National Weather Bureau warning of a weak El Niño episode, four disturbances unexpectedly occurred in late November. A record of 512 mm of rains in 12 hours caused flash floods and damage in the eastern and central parts of Luzon.

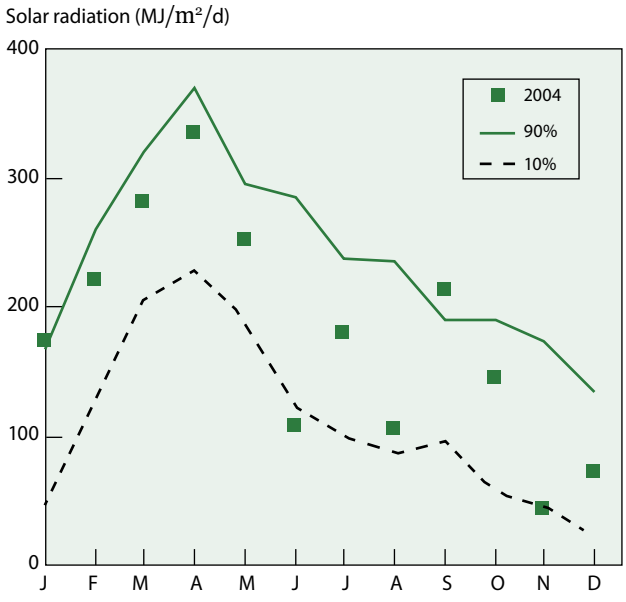
WS Table 1. Monthly weather data for IRRI and cooperating weather stations in the Philippines, 2004.

Site		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual total or daily average
						Rainfall (mm/mo)								
IRRI, dryland site	(14° 13′ N, 121° 15′ E)	15	48	42	7	126	292	351	239	71	123	333	71	1,718
IRRI, wetland site	(14° 11′ N, 121° 15′ E)	19	49	4	13	127	260	370	232	105	153	340	59	1,731
Dapdap, Paniqui, Tarlac	(15° 37′ N, 120° 44′ E)	1	9	9	35	191	435	209	320	180	117	110	98	1,713
MMSU[a], Batac, Ilocos Norte	(18° 03′ N, 120° 32′ E)	4	0	0	0	213	698	170	739	154	21	10	10	2,020
PhilRice, Muñoz, Nueva Ecija	(15° 45′ N, 120° 56′ E)	1	1	1	37	208	332	410	690	195	99	162	77	2,212
Siniloan, Laguna	(14° 10′ N, 121° 22′ E)	106	178	47	35	340	348	308	401	173	296	697	228	3,156
WESVIARC[b], Iloilo	(10° 46′ N, 122° 35′ E)	9	144	44	3	376	354	309	309	264	159	105	101	2,177
						Solar radiation (MJ/m² /d)								
IRRI, dryland site		16.9	18.8	21.2	23.4	20.1	14.3	17.2	14.2	18.5	15.8	11.7	12.9	17.1
IRRI, wetland site		16.4	18.3	20.6	23.0	19.7	14.2	16.9	13.8	18.2	15.4	11.3	12.4	16.7
Dapdap, Paniqui, Tarlac		21.4	23.4	25.3	25.5	20.1	17.1	23.3	20.0	22.9	22.8	19.3	20.5	29.1
MMSU, Batac, Ilocos Norte		m[c]	m	m	m	m	m	m	m	m	m	m	m	m
PhilRice, Muñoz, Nueva Ecija		25.0	23.0	25.4	26.4	19.0	14.8	18.5	15.1	19.9	18.5	15.7	16.2	19.8
Siniloan, Laguna		20.2	20.4	22.4	23.3	21.3	18.6	21.0	15.5	21.3	19.2	14.7	18.3	19.7
WESVIARC, Iloilo		m	m	m	m	m	m	m	m	m	m	m	m	m
						Relative humidity (%)								
IRRI, dryland site		84	84	84	79	80	83	87	85	85	86	87	84	84
IRRI, wetland site		86	85	84	80	80	82	85	86	85	87	88	84	84
Dapdap, Paniqui, Tarlac		85	83	85	88	82	90	90	95	94	87	84	84	87
MMSU, Batac, Ilocos Norte		81	81	79	81	77	81	81	83	82	81	82	79	81
PhilRice, Muñoz, Nueva Ecija		83	86	87	87	79	88	87	93	89	81	76	79	85
Siniloan, Laguna		92	92	91	87	91	91	89	95	90	92	95	91	91
WESVIARC, Iloilo		90	88	88	85	86	89	92	88	89	87	89	90	88
						Temperature (°C)								
IRRI, dryland site	Max	29.7	29.7	31.8	34.2	33.5	31.8	32.5	31.3	32.4	30.8	29.3	29.1	31.3
	Min	22.8	22.5	22.9	24.4	25.1	24.5	23.8	24.6	23.4	23.0	23.7	23.2	23.7
IRRI, wetland site	Max	28.9	29.0	30.9	33.2	32.7	31.2	31.7	31.0	32.1	30.7	29.2	28.6	30.8
	Min	22.8	22.5	23.3	24.4	25.3	25.0	24.5	25.0	23.9	23.4	24.1	23.4	24.0
Dapdap, Paniqui, Tarlac	Max	32.5	32.8	34.9	36.9	35.0	31.9	33.7	32.4	33.6	33.7	33.7	31.9	33.6
	Min	20.8	21.6	21.9	23.5	24.3	24.3	24.1	24.3	23.6	22.4	22.3	20.8	22.8
MMSU, Batac, Ilocos Norte	Max	32.5	33.1	33.6	35.1	35.1	33.6	33.0	32.8	32.9	32.6	33.8	32.5	33.4
	Min	16.9	17.0	17.8	19.8	22.0	21.8	22.3	22.6	21.6	18.9	19.7	16.9	19.8
PhilRice, Muñoz, Nueva Ecija	Max	31.1	31.0	34.0	35.8	34.6	32.3	32.9	31.6	33.4	32.6	32.4	30.7	32.7
	Min	22.0	22.3	22.5	23.4	24.1	24.1	24.1	24.0	23.2	21.9	22.9	21.9	23.0
Siniloan, Laguna	Max	25.7	26.2	28.3	30.4	29.3	28.6	29.9	27.9	30.0	28.3	26.2	25.7	28.0
	Min	20.3	20.9	21.3	22.7	23.4	22.6	22.4	22.5	22.4	21.5	22.4	21.6	22.0
WESVIARC, Iloilo	Max	30.6	31.2	32.2	34.1	33.2	31.1	31.5	30.8	32.0	31.3	31.7	30.7	31.7
	Min	23.6	23.4	24.1	24.6	25.4	24.5	24.1	24.5	23.2	23.4	24.2	23.5	24.0
						Windspeed (m/s)								
IRRI, dryland site		1.7	1.6	1.7	1.6	1.9	2.0	1.1	2.0	1.2	1.3	1.4	1.8	1.6
IRRI, wetland site		1.8	1.5	1.4	1.4	1.7	1.7	1.1	1.5	0.9	1.1	1.5	1.9	1.5
Dapdap, Paniqui, Tarlac		1.0	1.0	0.8	0.8	0.7	0.5	0.3	0.1	0.3	0.5	0.8	0.7	0.6
MMSU, Batac, Ilocos Norte		1.1	0.4	0.4	0.4	0.4	0.5	0.2	0.3	0.1	0.3	0.4	0.4	0.4
PhilRice, Muñoz, Nueva Ecija		2.9	2.2	1.4	1.1	1.8	1.4	1.3	0.9	0.8	1.2	2.2	2.5	1.6
Siniloan, Laguna		1.0	m	2.7	2.6	2.2	1.2	1.0	0.9	1.3	2.0	3.1	4.3	2.0
WESVIARC, Iloilo		1.9	1.8	1.6	1.4	1.4	1.4	0.9	1.8	0.8	1.1	1.2	1.6	1.4
						Evaporation (mm/mo)								
IRRI, dryland site		136	139	184	224	190	142	149	138	156	132	91	118	1,799
IRRI, wetland site		122	125	165	208	182	141	145	125	150	128	89	111	1,692
Dapdap, Paniqui, Tarlac		167	184	213	223	177	145	161	119	151	174	149	146	2,007
MMSU, Batac, Ilocos Norte		124	134	155	161	179	168	163	141	144	133	142	142	1,785
PhilRice, Muñoz, Nueva Ecija		195	173	205	201	179	109	136	105	122	134	123	148	1,828
Siniloan, Laguna		118	139	186	214	182	149	167	118	151	143	100	133	1,799
WESVIARC[b], Iloilo		135	140	163	211	207	123	146	137	149	130	132	119	1,791

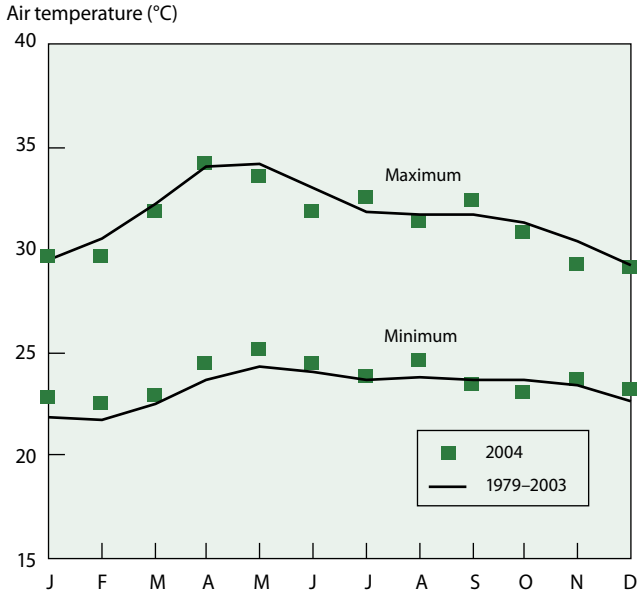
[a] MMSU = Mariano Marcos State University. [b] WESVIARC = Western Visayas Integrated Agricultural Research Center. [c] m = missing data.



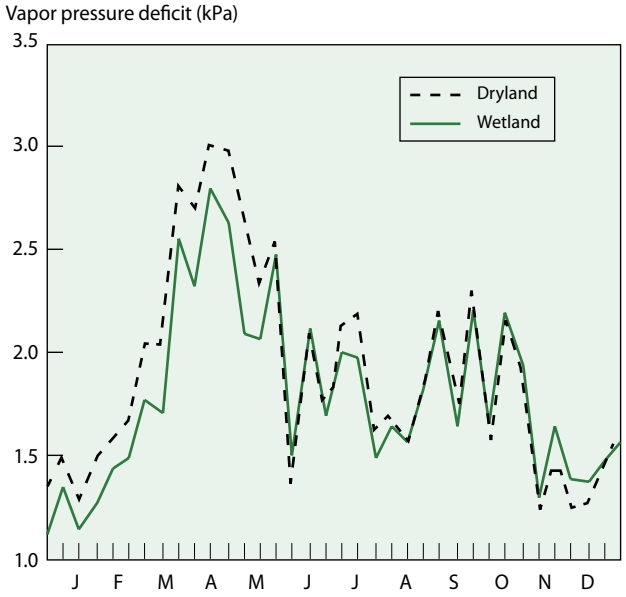
1. Rainfall and potential evapotranspiration patterns at Los Baños. IRRI, 2004.



2. Mean monthly solar radiation with 10 and 90% probability of occurrence. IRRI, 2004.



3. Maximum and minimum air temperature at the dryland site. IRRI, 1979-2004.



4. Midday vapor pressure deficit at the dryland and wetland sites. IRRI, 2004.

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E-mail: akita@ses.usp.ac.jp

Dr. Kay Beese
European Commission
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Directorate-General
Unit E1 – Plant Health
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B-1049 Brussels, Belgium
Tel: (32-2) 296-6808
Fax: (32-2) 296-9399
E-mail: kay.beese@cec.eu.int

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Jakarta Selatan 12540, Indonesia
Tel: (62-21) 780-5395; 780-6202
Fax: (62-21) 780-0644
E-mail: amfagi@cbn.net.id

Dr. Ralph Anthony Fischer
Program Adviser, South Asia
Australian Centre for International Agricultural Research
GPO Box 1571, Canberra ACT 260
Australia
Tel: (02) 6217-0500
Fax: (02) 6217-0501
E-mail: fischer@aciar.gov.au

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Ho-Yeong Kim, *PhD, senior scientist, IRS seconded from RDA-Korea*[1]
Kshirod Kumar Jena, *PhD, senior scientist, plant breeding and IRRI representative for Korea*
Zhikang Li, *PhD, senior scientist, molecular geneticist and coordinator, International Network for Molecular Breeding*
Parminder S. Virk, *PhD, senior scientist, plant breeding*
Seiji Yanagihara, *PhD, senior scientist, plant breeding*[1]
Gregory J. Howell, *PhD, international research fellow*[4]
Arumugam Kathiresan, *PhD, international research fellow*[1]
Ish Kumar, *PhD, international research fellow*[1]
C.N. Neeraja, *PhD, postdoctoral fellow*[4]
Ramaiah Venuprasad, *PhD, postdoctoral fellow*[4]
Arvind Kumar, *PhD, postdoctoral fellow*[4]
Niranjan Baisakh, *PhD, postdoctoral fellow*[1]
Jianxiang Liu, *PhD, postdoctoral fellow*[1]
A.W. Jalfiquar, *PhD, visiting research fellow*[3]
Sang-Bok Lee, *PhD, visiting research fellow*[3]
Shailaja Hittalmani, *PhD, visiting research fellow*[3]
Mayank Rai, *MS, visiting research fellow*[4]
A.W. Jalfiquar, *PhD visiting research fellow*[3]
Sang-Bok Lee, *PhD, visiting research fellow*[3]
Ajay K. Parida, *PhD, visiting research fellow*[3]
Sellappan Krishnan, *PhD, visiting research fellow*[4]
Ajay K. Parida, *PhD, visiting research fellow*[3]
Olivier Panaud, *PhD, collaborative research scientist*[4]
Ha-Cheol Hong, *collaborative research fellow*[3]
Jong-Cheol Ko, *collaborative research fellow*[3]
Eung-Gi Jeong, *PhD, collaborative research fellow*[3]
Shamsher Ali, *PhD, collaborative research fellow*[3]
Gayatri Sahoo, *MS, collaborative research fellow*[3]
P.V.N. Kishore, *MS, collaborative research fellow*[3]
Tiago Felipe dos Santos Lourenco, *MS, collaborative research fellow*[3]
Dong-Soo Park, *PhD, collaborative research fellow*[3]
Eung-Gi Jeong, *PhD, collaborative research fellow*[3]
Dong-Soo Park, *PhD, collaborative research fellow*[3]
Woon-Go Ha, *PhD, collaborative research fellow*[3]
You-Chun Song, *PhD, collaborative research fellow*[4]

Margaret Yoovatana, *PhD, consultant*[3]
Jacob Kijne, *PhD, consultant*[3]
Guo-Hui Ma, *PhD, consultant*[3]
Arvind Kumar, *PhD, consultant*[3]
Surapong Sarkarung, *PhD, consultant*[3]
Arvind Kumar, *PhD, consultant*[3]
Esteban Godilano, *PhD, consultant*[3]
Sigrid Heuer, *PhD, consultant*[3]
Y. Yogeswara Rao, *PhD, consultant*[3]
Alma Sanchez, *PhD, consultant*[4]
Girish Chandel, *MS, consultant*[4]
S.X. Tang, P*hD, consultant*[3]
G.S. Khush, *PhD, consultant*[3]
Marichu A. Bernardo, *MS, manager*
Maria Cristina B. Sison, *assistant scientist II*[1]
Antonio A. Evangelista, *BS, associate scientist*
Alvaro M. Pamplona, *BS, associate scientist*
Ma. Concepcion U. Toledo, *BS, associate scientist*
Vitaliano L. Lopena, *MS, associate scientist*
Benito U. Romena, *MS, associate scientist*
Rodolfo S. Toledo, *MS, associate scientist*
Lina B. Torrizo, *MS, associate scientist*
Editha M. Abrigo, *BS, assistant scientist*
Carlos L. Casal, Jr., *BS, assistant scientist*
Julio Romeo T. Chavez, *BS, assistant scientist*[5]
Marcelino A. Laza, *BS, assistant scientist*
Rhulyx D. Mendoza, *BS, assistant scientist*
Rowena H. Oane, *BS, assistant scientist*
Reycel M. Rodriguez, *BS, assistant scientist*
Mary Jeanie T. Yanoria, *BS, assistant scientist*[5]
Dante L. Adorada, *MS, assistant scientist*[5]
Modesto M. Amante, *MS, assistant scientist*
Leodegario A. Ebron, *MS, assistant scientist*[5]
Rogelio D. Magbanua, *MS, assistant scientist*[5]
Norman P. Oliva, *MS, assistant scientist*
Jessica D. Rey, *MS, assistant scientist*
Ellen B. Tumimbang, *MS, assistant scientist*[5]
Jose P. Roxas, *BS, assistant scientist I*[1]
Grace Lee S. Capilit, *MS, specialist - database administration*
Elma N. Nicolas, *BS, officer - administrative coordination*
Tamerlane Mark S. Nas, *BS, researcher*[5]
Joie M. Ramos, *BS, researcher*
Darlene L. Sanchez, *BS, researcher*[5]
Rizza Eve M. Santos, *BS, researcher*[4,5]
Dinah D. Tambalo, *BS, researcher*[4]
Justina M. de Palma, *MS, researcher*[5]
Apollo Neil R. Monroy, *BS, researcher*[1]
Ma. Teresa G. Sta Cruz, *BS, researcher*[1,5]
Jayson D. Talag, *BS, researcher*[1]
Marlon A. Calibo, *BS, associate - stock inventory*[5]
Yolanda C. Aranguren, *BS, secretary III*
Minerva B. Bandian, *BS, secretary III*
Felicidad S. Danglay, *BS, secretary III*
Nelie M. delos Reyes, *BS, secretary III*
Leonida P. Nazarea, *BS, secretary III*
Jose L. Angeles, *BS, technician III - research*
Ma. Emeru L. Bool, *BS, technician III - research*[4,5]
Socorro L. Carandang, *BS, technician III - research*
Rollin V. Deocampo, *BS, technician III - research*[5]
Norberto T. Quilloy, *BS, technician III - research*
Virgilio T. Ancheta, Jr., *technician III - research*
Danilo B. Balagtas, *technician III - research*
Danilo C. de Ocampo, *technician III - research*
Blesilda A. Enriquez, *technician III - research*
Leonardo S. Estenor, *technician III - research*
Angelito S. Francisco, *technician III - research*
Reynaldo (Abdullah) P. Garcia, *technician III - research*
Evelyn A. Liwanag, *technician III - research*[5]
Virgilio P. Magat, *technician III - research*
Eleazar O. Manalaysay, *technician III - research*[5]
Nestor D. Ramos, *technician III - research*
Ernesto C. Sumague, *technician III - research*
Marifa L. Corral, *research technician II*[1]
Mercy R. Dy, *research technician II*[1,5]
Mario M. Escote, *research technician II*[1,5]
Noel S. Malabanan, *research technician II*[1,5]
Lorelie S. Olivo, *BS, secretary II*[5]
Emily P. Alcantara, *secretary I*[5]
Michelle V. Racelis, *secretary II*[5]
Marilyn A. Rala, *secretary II*
Victor P. Banasihan, *BS, technician II - research*[5]
Ma. Gina L. Borja, *BS, technician II - research*[5]
Virginia M. Laluz, *BS, technician II - research*[5]
April Joy P. Madrigal, *BS, technician II - research*[4,5]
Lolita C. Mendoza, *BS, technician II - research*[4,5]
Florencia A. Montecillo, *BS, technician II - research*[5]
Emmanuel R. Adique, *technician II - research*[5]
Virgilio M. Angeles, *technician II - research*
Renel C. Aventurado, *technician II - research*[5]
Joselito M. Calibo, *technician II - research*[5]
Luisito L. Caracuel, *technician II - research*
Patricio M. Carandang, *technician II - research*[5]
Ronaldo L. Cornista, *technician II - research*
Reynaldo J. dela Cueva, *technician II - research*
Mario A. Garcia, *technician II - research*
Oscar A. Gonzales, *technician II - research*
Francisco V. Gulay, *technician II - research*
Rommel V. Javier, *technician II - research*[5]
Nestor P. Leron, *technician II - research*
Noel P. Llanza, *technician II - research*[5]
Orlando T. Lucero, *technician II - research*
Joel T. Macabenta, *technician II - research*[5]
Carmela D. Malabanan, *technician II - research*[5]
Apolonio N. Mamiit, *technician II - research*[5]
Alejandro C. Manio, *technician II - research*
Marina C. Manzanilla, *technician II - research*[5]
Jose M. Marasigan, *technician II - research*
Josefina G. Mendoza, *technician II - research*
Arsenio R. Morales, *technician II - research*
Honorio M. Oboza, *technician II - research*
Daniel L. Pasuquin, *technician II - research*
Juanito M. Pasuquin, *technician II - research*[5]
Godofredo B. Perez, *technician II - research*[4,5]
Macario S. Perez, Sr., *technician II - research*
Renato T. Pizon, Sr., *technician II - research*
Juvy G. Reyes, *technician II - research*[5]
Eloisa B. Suiton, *technician II - research*[5]
Julito P. Talay, *technician II - research*

Irma R. Tamisin, *technician II - research*[5]
Allan P. Trinidad, *technician II - research*[5]
Cenon P. Alvarez, *technician I - research*[4,5]
Rodante M. Nuevo, *technician I - research*[5]
Janice A. Sapin, *technician I - research*

Country-based

Thailand

Dome Harnpichitvitaya, *MS, assistant scientist II* [5]
Sompong Pachanapool, *field technician*[1]
Chaiporn Soising, *field technician*
Pramote Tanupant, *BS, field technician*

Social Sciences

Mahabub Hossain, *PhD, economist and head; leader, Improving Productivity and Livelihood for Fragile Environments Program*
Sushil Pandey, *PhD, senior scientist, agricultural economics and deputy head; leader, Strengthening Linkages Between Research and Development Program*
Francois Bousquet, *PhD, IRS seconded from CIRAD*[1]
David Dawe, *PhD, senior scientist, agricultural economics*[1]
Suan Pheng Kam, *PhD, senior scientist, GIS specialist*[1]
Thelma R. Paris, *PhD, senior scientist, gender specialist*
Guy Trebuil, *PhD, IRS seconded from CIRAD*[1]
Mohammed Zainul Abedin, *PhD, international research fellow*
Nobuhiko Fuwa, *PhD, international research fellow*
Manik Lal Bose, *PhD, postdoctoral fellow*[1]
Stephen Zolvinski, *PhD, postdoctoral fellow*[4]
Sudhir K. Taunk, *PhD, visiting research fellow*[3]
Nguyen Tri Khiem, *PhD, visiting research fellow*[3]
Bhanudeb Bagchi, *PhD, visiting research fellow*[3]
C.T. Hoanh, *PhD, visiting research fellow*[3]
Bui Tan Yen, *MS, visiting research fellow*[3]
Josyline Javelosa, *MS, visiting research fellow*[4]
Bhuban Barah, *PhD, visiting research fellow*[4]
Abdul Bayes, *PhD, visiting research fellow*[3]
Mercedita Sombilla, *PhD, consultant*[3]
Rita Afzar, *PhD, consultant*[3]
Abdul Hamid, *PhD, consultant*[3]
Yueh-Kwong Leong, *PhD, consultant*[3]
Firdousi Naher, *PhD, consultant*[3]
Zenaida M. Sumalde, *PhD, consultant*[3]
Yolanda Garcia, *PhD, consultant*[3]
Tran Thi Ut, *PhD, consultant*[3]
Piedad F. Moya, *MS, senior associate scientist*
Fe B. Gascon, *BS, associate scientist*[5]
Arnel B. Rala, *BS, associate scientist*
Amelia S. delos Reyes, *MS, associate scientist*[5]
Catalina P. Diaz, *MS, associate scientist*
Lolita L. Garcia, *MS, associate scientist,* [5]
Imelda R. Molina, *MS, associate scientist*
Florencia G. Palis, *PhD, associate scientist*
Vina A. Casumpang, *MS, assistant manager I - program coordination*[11]
Joyce S. Luis, *BS, assistant scientist*
Alice G. Laborte, *MS, assistant scientist*
Aileen V. Lapitan, *MS, assistant scientist*
Maria Lourdes E. Velasco, *MS, assistant scientist*
Sidky M. Macatangay, *BS, systems analyst/programmer*
Mirla D. Domingo, *BS, officer - administrative coordination*
Josephine H. Narciso, *BS, officer - database administration*
Ma. Romilee L. Bool, *BS, researcher*[5]
Ellanie R. Cabrera, *BS, researcher*[5]
Pio Adan A. Cenas, *BS, researcher*
Esther B. Marciano, *BS, researcher*
Aileen A. Maunahan, *BS, researcher*
Ma. Shiela D. Valencia, *BS, researcher*
Lorena S. Villano, *BS, researcher*
Ma. Aleli Sharon D. Fajardo, *MS, researcher*
Cornelia A. Garcia, *BS, associate - graphics*
Joel E. Reano, *BS, associate - statistics*
Lydia B. Damian, *BS, secretary III*
Rosendo G. Gutierrez, *BS, secretary III*
Angelina A. Malabrigo, *BS, secretary III*
Teodora D. Malabanan, *BS, assistant - statistics*
Frederick C. Lagasca, *assistant - statistics*
Anna Christine A. Doctolero, *BS, secretary II*[13]
Jocelyn L. Go, *BS, secretary II*

Experiment Station

Arnold R. Manza, *MS, senior manager*
Tomas P. Clemeno, *BS, manager*
Bienvenido B. Manimtim, *BS, assistant manager I*
Roberto P. Escandor, *BS, officer*
Mario A. Mandilag, Sr., *officer*
Erlinda A. Oracion, *MS, officer - administrative coordination*
Myra L. Collado, *BS, programmer*[1]
Sheila Sophia N. Roy, *BS, programmer*[4]
Rolando R. Pacion, *associate - stock inventory*
Virginia G. Aranda, *BS, secretary III*
Enrico A. Lucero, *secretary III*
Francisco G. Calibo, *technician III - equipment*
Jose F. Hernandez, *technician III - equipment*
Rolando G. Guevarra, *technician III - mechanic*
Rogelio R. Pamulaklakin, *technician III - mechanic*
Juanito M. Rosario, *technician III - mechanic*
Efren E. Viquiera, *technician III - mechanic*
Isaias C. Abuyo, *BS, technician III - research*
Abraham G. Dalid, *BS, technician III - research*
Jose D. Manuel, *BS, technician III - research*
Benedicto S. Alborida, *technician III - research*[5]
Jesse C. Banasihan, *technician III - research*
Sulpicio J. Malabanan, *technician III - research*
Nazario B. Timbol, *technician III - research*
Celso L. Varron, *technician III - research*
Romeo T. Llamas, *technician III - Welding*
Marcelino O. Magpantay, *research technician II*[1]
Cecilio L. Villamayor, *secretary II*
Daniel A. Barrion, *technician II - equipment*
Delfin M. Ilagan, *technician II - equipment*
Nicasio V. Malabanan, *technician II - equipment*
Pablito M. Pabalate, *technician II - mechanic*
Pedro C. Aala, *technician II - research*
Fabian L. Alcachupas, Jr., *technician II - research*
Carlos P. Alforja, *technician II - research*
Danilo O. Amoloza, *technician II - research*
Nestor M. Angeles, *technician II - research*

Anthony L. Aquino, *technician II - research*[5]
Melecio J. Arcillas, *technician II - research*
Efren A. Bagui, *technician II - research*
Restituto M. Bandoy, *technician II - research*
Policarpio S. Barbadillo, *technician II - research*
Rogelio V. Bargola, *technician II - research*
Efren P. Bautista, *technician II - research*
Efren L. Blanco, *technician II - research*
Pedro G. Cabrera, Sr, *technician II - research*
Luis M. Calma, *technician II - research*
Vicente E. Carandang, *technician II - research*
Lino M. Carandang, *technician II - research*
Oscar L. Caspillo, *technician II - research*
Aurelio M. Catangay, *technician II - research*
Bonifacio B. Chavez, *technician II - research*
Edgardo T. Diaz, *technician II - research*
Ariel R. Dimapilis, *technician II - research*
Rogelio M. Elbo, *technician II - research*
Cesar Z. Esguerra, *technician II - research*
William C. Fortuna, *technician II - research*
Benjamin C. Garcia, *technician II - research*
Danilo O. Gonzaga, *technician II - research*
Nestor L. Ilaw, *technician II - research*
Gaudencio S. Indico, *technician II - research*
Abraham G. Javier, *technician II - research*
Eduardo A. Lajarca, *technician II - research*
Virgilio T. Lalap, *technician II - research*
Fidel G. Lanorio, *technician II - research*
Mario M. Malbataan, *technician II - research*
Leopoldo P. Manito, *technician II - research*
Mateo F. Manzanilla, *technician II - research*
Pedro C. Mendoza, *technician II - research*
Godofredo M. Mercado, *technician II - research*
Andres M. Mercado, *technician II - research*
Gelardo R. Morales, *technician II - research*
Gregorio S. Oca, *technician II - research*
Ramiro C. Panting, *technician II - research*
Reynaldo A. Pelegrina, *technician II - research*
Roberto B. Revilleza, *technician II - research*
Antonio B. Rivera, *technician II - research*
Nestor G. Rizaldo, *technician II - research*
Quirino L. Atienza, *technician I - research*
Lucas M. Malbataan, *technician I - research*

Seed Health Unit

Patria G. Gonzales, *MS, associate scientist*
Janice Q. Bautista, *BS, assistant scientist*[14]
Carlos C. Huelma, *BS, assistant scientist*
Evangeline G. Gonzales, *BS, secretary III*
Atanacio B. Orence, *technician III - research*
Isabel L. Penales, *technician III - research*
Salome P. Bulaquiña, *data encoder*
Florencio I. Lapiz, *BS, technician II - research*
Aurelio A. Gamba, *technician II - research*
Jose F. Banasihan, *technician I - research*

Biometrics and Bioinformatics

Christopher Graham McLaren, *PhD, senior scientist, biometrics specialist and head*
Richard Bruskiewich, *PhD, senior scientist, bioinformatics specialist*
Thomas Metz, *PhD, international research fellow*[4]
Ravindra Babu, *MS, visiting research fellow*[4]
Alexander B. Cosico, *BS, associate scientist*
Arllet M. Portugal, *MS, associate scientist*
Gloria D. Reyes, *PhD, associate scientist*[4,5]
Violeta I. Bartolome, *BS, senior specialist, statistics - consulting & training*
Emily C. Deomano, *MS, assistant scientist*
May Ann B. Sallan, *BS, specialist - database administration*
Victor Jun M. Ulat, *MS, specialist - database administration*
Warren Vincent E. Constantino, *BS, systems analyst/programmer*[4,5]
Clarissa I. Pimentel, *BS, systems analyst/programmer*[4,5]
Lilibeth M. Sison, *BS, systems analyst/programmer*[4,5]
Ma. Teresa R. Ulat, *BS, systems analyst/programmer*[5]
Michael Jonathan M. Mendoza, *MS, systems analyst/programmer*[4,5]
Lourdes C. Paunlagui, *BS, officer - administrative coordination*
William H. Eusebio, *technician III - IT*

Genetic Resources Center

Nigel Ruaraidh Sackville Hamilton, *PhD, senior scientist, evolutionary biology and head*
Kenneth L. McNally, *PhD, senior scientist, molecular genetics/ molecular taxonomy*
Isaiah N. Mukema, *MS, international research fellow*
Yong-Jin Park, *PhD, visiting research fellow*[3]
A. Jakir Hussain, *PhD, consultant*[1]
Flora C. de Guzman, *MS, senior associate scientist*
Renato A. Reaño, *MS, associate scientist*
Ma. Socorro R. Almazan, *BS, assistant scientist*
Amita B. Juliano, *BS, assistant scientist*
Ma. Elizabeth B. Naredo, *BS, assistant scientist*
Maria Celeste N. Banaticla, *MS, assistant scientist*[5]
Adelaida P. Alcantara, *BS, specialist - database administration*
Roniela Q. Herrera, *BS, specialist - database administration*[4,5]
Sheila Mae E. Quilloy, *BS, researcher*[5]
Jason Alessandro C. Manilay, *BS, research technician III*[1,5]
Digna I. Salisi, *BS, secretary III*
Teresita C. Santos, *BS, secretary III*
Jeffrey A. Detras, *BS, technician III - research*[4,5]
Nelia A. Resurreccion, *BS, technician III - research*
Bernardino T. Almazan, *technician III - research*
Vicente M. Arcillas, *technician III - research*
Emerlinda E. Hernandez, *technician III - research*
Felix R. Llanes, *technician III - research*
Minerva I. Macatangay, *technician III - research*
Bernardo P. Mercado, *technician III - research*
Gregorio M. Mercado, *technician III - research*
Mario A. Rodriguez, *technician III - research*
Melencio R. Lalap, *assistant*
Melencio J. Apostol, *BS, technician II - research*[4,5]
Ma. Concepcion F. Lotho, *BS, technician II - research*[5]
Remegio L. Aguilar, *technician II - research*
Noel R. Banzuela, *technician II - research*
Belinda R. Caspillo, *technician II - research*[5]
Arnold B. Gonzales, *technician II - research*

Romulo R. Quilantang, *technician II - research*[5]
Florencio F. Villegas, *technician II - research*
Lydia G. Angeles, *BS, technician I - research*
Jeffe O. Cadion, *BS, technician I - research*[4,5]
Leanilyn O. Castanar, *BS, technician I - research*[4,5]
Alicia A. Lapis, *BS, technician I - research*
Marynel V. Malabanan, *BS, technician I - research*[5]
Yolanda P. Malatag, *BS, technician I - research*
Rancy M. Bauyon, *technician I - research*[5]
Liza Q. Berces, *technician I - research*[5]
Imelda P. Boncajes, *technician I - research*
Nerissa L. Boongaling, *technician I - research*[5]
Jane D. Carandang, *technician I - research*[5]
Rosa B. Carandang, *technician I - research*[5]
Isabelita P. de Mesa, *technician I - research*
Hipolito M. Elec, *technician I - research*[5]
Minerva N. Eloria, *technician I - research*
Minerva C. Gulde, *technician I - research*[5]
Wilma L. Lumaybay, *technician I - research*
Gilbert G. Mamiit, *technician I - research*[4,5]
Veronica V. Mangubat, *technician I - research*
Violeta T. Manila, *technician I - research*[5]
Mae C. Merluza, *technician I - research*[5]
Rhodora M. Pamplona, *technician I - research*[5]
Nenita T. Penales, *technician I - research*[5]
Jacqueline M. Ragudo, *technician I - research*
Maridee P. Reyes, *technician I - research*

Grain Quality Nutrition Research Center

Melissa A. Fitzgerald, *PhD, international research fellow and head*[4]
Adoracion P. Resurreccion, *MS, associate scientist*[14]
Rosario R. Jimenez, *BS, assistant scientist*[9]
Vito M. Butardo, Jr., *BS, researcher*[4]
Rosa Paula O. Cuevas, *BS, researcher*[4]
Inofra I. Sandoval, *BS, technician III - research* [14]
Artemio V. Madrid, Jr., *technician III - research*[9]
Ana Lyn J. Genil, *BS, secretary II* [10]
Juan L. Alzona, *technician II - research*[14]
Teodoro L. Atienza, *technician II - research*[14]

Communication and Publications Services

Gene Hettel, *MA, editor and head*
Bill Hardy, *PhD, science editor/publisher*
Albert A. Borrero, *BA, manager*
Sylvia Katherine S. Lopez, *MS, assistant manager II - product development*
Teresita V. Rola, *MPS, specialist - editorial*
Anna Natasha A. Arsenal, BS, *specialist - marketing*
Victor L. Alarcon, *BS, specialist - multimedia/web development*
Ginalyn H. Santos, *BS, specialist - multimedia/web development*
Maria Guadalupe B. Yandoc, *BS, specialist - technical writing*
Rogelio M. Alfonso, *CP supervisor I*[1]
Antonette Abigail E. Caballero, *MS, officer - administrative coordination*
Christina G. Peralta, *BS, officer - fulfillment & customer relations coordination*[4]
Ariel D. Javellana, *BS, officer - photography*
Jose M. Ibabao, *officer - video production*
Emmanuel A. Panisales, *BS, associate - graphic design*
George R. Reyes, *BS, associate - graphic design*
Juan V. Lazaro, IV, *associate - graphic design*
Aileen D. Rondilla, *MS, associate - photography*
Krisna A. Piñero, *BS, marketing assistant* [1]
Rogelio R. Quintos, *BS, secretary III*
Diadema I. Martinez, *BS, assistant - editorial*
Reynaldo L. Stevens, *printer*
Cynthia C. Quintos, *BS, secretary II*

Library and Documentation Services

Mila M. Ramos, *MS, chief librarian*
Carmelita S. Austria, *MS, assistant chief librarian - library information*
Allan Crispulo R. Vallarta, *BS, catalog librarian*[1]
Emerald F. Laxamana, *BS, librarian - catalog*[4]
Iris Marigold P. Operario, *BS, librarian - collections development*
Natalia V. delos Reyes, *BS, librarian - electronic resources & serials*
Maria Consuelo S. Parducho, *associate*
Maria Aisa M. Atienza, *BS, assistant*[5]
Marilyn O. Bonador, *BS, assistant*
Emmanuel P. Mendoza, *BS, assistant*
Corvette M. Apolinario, *assistant*
Isagani P. Garcia, *assistant*
Francisco A. Jaraplasan, *assistant*
Mauro T. Malabrigo, Jr., *assistant*
Guido O. Talabis, *library assistant I*[1]

Intellectual Property Management Unit

Gerard F. Barry, *PhD, head*[4]
Thanda Wai, *PhD, intellectual property rights specialist*[1]

Information Technology Services

Paul O'Nolan, *MS, IT manager*
Rogelio P. Alvarez, Jr., *BS, manager*
Wilbert Jay C. Almoro, *BS, assistant manager II*
Loreto R. Puyod, *BS, assistant manager II*
Eric B. Clutario, *BS, assistant manager II - MIS*
Nestor D. Marcelo, Jr., *BS, assistant manager I - MIS*[12]
Faiga A. Amping, *BS, systems analyst/programmer*
Sheila C. Verdan, *BS, systems analyst/programmer*
Ildefonso B. Cosico, *BS, officer - systems administration*
Annaliza Q. de Roxas, *BS, secretary III*
Nevado M. Ignacio, *BS, technician III - IT*
Bonifacio C. de Ocampo, *technician III - IT*
Jesus S. Fugen, *technician III - IT*
Bayani N. Perido, *technician III - IT*
Jovy P. Gador, *BS, assistant - telecoms*
Arminda B. Laluz, *BS, assistant - telecoms*
Rizza A. Escondo, *BS, secretary II*

Visitors and Information Services

Duncan I. Macintosh, *BA, head*
John Peter Fredenburg, *MA, editor/writer*[1]
Robert Hill, *consultant*[3]
Maria Charina Asuncion G. Ocampo, *BA,BL, manager - community relations*
Bita S. Avendaño, *MS, assistant manager I*

Paul Benjamin R. Hilario, *BS, assistant manager I - riceworld*
Juanito F. Goloyugo, *MS, specialist - information service*
Zorayda T. Menguito, *BS, associate*
Joselito A. Platon, *BS, associate - community project*
Arvin A. Benavente, *BS, assistant - audio/video*
Al A. Benavente, , *assistant - information service*
Harris L. Tumawis, , *assistant - riceworld*

Training Center

Mark A. Bell, *PhD, head*
Albert D. Atkinson, *EdD, training and courseware specialist*[1]
David Shires, *MEd, international research fellow*
Adam Barclay, *consultant*[4]
Dr. Zahirul Islam, *PhD, consultant*[3]
Eugenio C. Castro, Jr., *MS, associate scientist*
Gina E. Zarsadias, *MS, assistant manager I*
Maria Socorro S. Arboleda, *BS, officer*
Eric John F. Azucena, *BS, officer*
Ma. Teresa A. Clabita, *BS, officer*
Dennis Ian L. Gavino, *BS, officer*[5]
Sergio R. Magadia, *BS, officer*
Imee L. Aspiras, *BS, officer - administrative coordination*
Melanie M. Quinto, *secretary III*
Macario B. Montecillo, *assistant - training logistics*
Priscilla P. Comia, *BS, secretary II*
Jennifer D. Hernandez, *BS, secretary II*[5]
Lauro M. Atienza, *BS, secretary I*[5]

International Programs Management Office

Headquarters-based

Mark A. Bell, *PhD, head*
Vethaiya Balasubramanian, *PhD, senior scientist, agronomy*
Monina M. Escalada, *PhD, international research fellow*
Renate Braun, *PhD, collaborative research scientist*[1]
Soon-Duck Yoon, *PhD, collaborative research fellow*[3]
Phil Gibson, *consultant*[3]
Seepana Appa Rao, *PhD, consultant*[3]
Hatsadong, *PhD, consultant*[3]
Julian A. Lapitan, *MS, senior manager*
Ma. Angeles M. Quilloy, *BS, associate scientist*
Margaret Ann S. Jingco, *BS, officer - administrative coordination*
Cecilia V. Lopez, *BS, officer - administrative coordination*
Edna R. Reyes, *secretary III*

Country-based

Bangladesh

Noel P. Magor, *PhD, IRRI representative for Bangladesh and manager, EC, supported project*
M.A. Hamid Miah, *PhD, liaison scientist for Bangladesh*
Ahmad Salahuddin, *manager, Coordination and Capacity Development*[5]
Tapash Kumar Biswas, *manager, M&E*[1,5]
Mamunul Haque, *assistant manager II, communication*[5]
Jamila Khandekar, *MBA, assistant manager II, finance*[1,5]
Roucksana Begum, *facilitator*[1,5]
Md. Abdul Ghani, *research management officer*[1,5]
Md. Bazlur Rahman, *research officer (facilitation)*[1,5]
AKM Azad Chowdhury, *BS, systems coordinator*[1,5]
Khandakar Enamul Kabir, *administrative coordinator*
Shaila Arifa Nabi, *MS, researcher*[5]
Rokybul Imrose, *researcher (management information system)*[1,5]
Md. Atiquzzaman, *accountant I*[1,5]
Tahmina Banu, *MS, accountant I*
Alphonse Prodip Bashu, *MS, accountant I*[1,5]
A. S. M. Zahiruddin, *accountant I*[5]
Mohammad Furgan Masud, *accounts assistant*[3,5]
Mohammad Rafique Uddin, *accounts assistant*[3,5]
Shahjadi Parvin, *MA, secretary II*[5]
Fauzia Sultana, *MA, secretary II*[5]
Shamima Sultana, *MA, secretary II*[5]
Md. Ahsanullah, *motor transport operator*[5]
Babul Das, *motor transport operator*[5]
Nuruzzaman Badal, *motor transport operator*[5]
Jopinath Bazi, *motor transport operator*[5]
Nazmul Huda, *motor vehicle operator*[1,5]
Anthony Sarder, *motor vehicle operator*
Alimullah, *guard*[5]
Fazlu Miah, *guard*[5]
Ruhul Amin, *office attendant*[5]
S. M. Suzat, *office attendant*[5]

Cambodia

Marie Kim Leng, *administrative coordinator*

China

Kai-Jun Zhao, *PhD, IRRI liaison scientist for China*
Zhongqiu Wang, *BAg, administrative coordinator*
Li Ding, *BS, secretary*[1]

India

Ram K. Singh, *PhD, liaison scientist for India*[1]
Conrad Stevens, *PhD, molecular biologist/molecular pathologist*[1]
Sivaprasad Bandarupalli, *associate scientist*[4]
Jamal Pervez Noor, *BCom, finance & administrative officer*
Burhan Choudhury, *researcher*[3,5]
Ayodhya Lodhi, *driver/utilityman*
Vinod Kumar Singh, *driver/utilityman*
Nikhil Juneja, *BA, office clerk (travel)*[1,5]
Chander Mohan, *BCom, office clerk/messenger*[5]
Savita Sharma, *BA, steno-typist*

Indonesia

Mahyuddin Syam, *MPS, liaison scientist for Indonesia/Malaysia/Brunei Darussalam*
Iwan Adidharmawan, *BS, accounting supervisor*
Bambang Soewilanto, *BS, administrative coordinator*
Juanita Bawolye, *BA, executive secretary*
Diah Wurjandari Soegondo, *researcher*
Darman, *driver*[1]
I Made Agus Mahardhika, *driver*[4,5]

Korea

Ji-Ung Jeung, *PhD, senior research scientist*[5]
Seung-Hee Han, *BS, administrative coordinator*[5]

Lao PDR

Karl Goeppert, *MS, IRRI representative and project team leader, Lao-IRRI Project*[1]
Bouachanh Keopha, *administrator*[5]
Ounheuane Phouthachit, *administrator/accountant*[5]
Thiphavong Boupha, *PhD, economist and translator*[4, 5]
Thany Keovongvichith, *BA, English language translator*[4, 5]
Sansai Samountry, *accountant*[5]
Sone Mosky, *BS, training officer*[5]
Khampay Onesanga, *driver*[5]
Bounmy Sengthong, *driver-general services*[5]
Kham Souk Mosky, *driver-general services*[5]
Khamchanh Joutdala, *guard*[5]
Chanh Sommaniphone, *guard*[5]
Oudone Srithirath, *guard*[5]
Samien Luanglath, *guard/cleaner*[5]

Myanmar

Ohnmar Tun, *BAg, administrative coordinator*
Nanda Soe Myint, *driver/office aide*

Thailand

Punjama Tasana, *BA, senior accountant*
Aranya Sapprasert, *MS, administrative coordinator*
Amporn Sookyong, *office assistant*
Vitchu Chowanapong, *BS, office clerk*

Vietnam

Nguyen Hoai An, *BS, accountant*[1]
Nguyen Thanh Huyen, *BS, administrative coordinator*

Director General's Office

Sylvia R. Arellano, *BS, executive assistant II*
Rosalinda D. del Rosario, *BS, executive secretary*

Office of the Deputy Director General for Research

Adonna M. Robles, *MS, executive assistant I*
Lucia V. Gamel, *BS, executive secretary*
Ma. Velinda E. Hernandez, *BS, secretary II*[4]

Office of the Deputy Director General for Partnerships

Ramon A. Oliveros, *MS, executive assistant I*
Christian M. Concepcion, *BS, creative/art specialist*[1]
Rosalie P. Trinidad, *BS, executive secretary*
Frances Florifel B. Tesoro, *BS, secretary III*[1,5]
Marilou R. Camalig, *BS, secretary I*[1]

Office of the Director for Program Planning and Coordination

Corinta Q. Guerta, *MS, manager*
Ma. Sol V. Ogatis, *BS, assistant manager I*
Zenaida M. Federico, *BS, executive secretary*

Finance

Melba M. Aquino, *BS, senior manager*
Loriza E. Dagdag, *BS, senior manager*
Elisa S. Panes, *BS, senior manager*
Leonisa M. Almendrala, *BS, assistant manager II*[1]
Ma. Donnina S. Lopez, *BS, assistant manager II - accounting*[4]
Nestor C. Lapitan, *BS, assistant manager II - treasury*
Helen R. Aquino, *BS, accounting supervisor II*[1]
Imelda S. Silang, *BS, accounting supervisor II*[1]
Edelisa M. Bardenas, *BS, assistant manager I - accounting*
Reymunda C. Labuguen, *BS, assistant manager I - accounting*
Clarissa B. Mateo, *BS, assistant manager I - accounting*
Rodelita D. Panergalin, *BS, assistant manager I - accounting*
Miriam M. Telosa, *BS, assistant manager I - accounting*
Leny M. Medenilla, *BS, assistant manager I - budget*
Julie C. Carreon, *BS, assistant manager I - treasury*
Charlene F. Dalmacio, *BS, accountant II*[1]
Ailene R. Garcia, *BS, accountant II*[1]
Vilma T. Ramos, *BS, executive secretary*
Maria Judy M. Anicete, *BS, officer - accounting*
Mary Grace R. Bautista, *BS, officer - accounting*
Maria Preciosa C. dela Cruz, *BS, officer - accounting*
Judith E. Dionisio, *BS, officer - accounting*
Michelle V. Ella, *BS, officer - accounting*[4]
Jonalyn R. Gumafelix, *BS, officer - accounting*
Leonor R. Herradura, *BS, officer - accounting*
Evelyn V. Inocencio, *BS, officer - accounting*[4]
Alvin Z. Leal, *BS, officer - accounting*
Annie C. Magcamit, *BS, officer - accounting*[4]
Maria Zenaida V. Borra, *BS, officer - budget*
Eleah R. Lucas, *BS, officer - budget*
Lily G. Aquino, *BS, officer - treasury*
Betty Sarah R. Carreon, *BS, officer - treasury*
Gemma N. Corcega, *BS, officer - treasury*
Flordeliza P. Malonzo, *BS, officer - treasury*
Grace P. Abanto, *BS, associate - accounting*
Maricel I. Encanto, *BS, associate - accounting*[4]
Paulito J. Oleta, *BS, associate - accounting*
Norvin O. Fortuna, *accounting assistant*[1,5]
Roderick B. Maligalig, *BS, assistant - accounting*
Jane B. Carlos, *assistant - budget*
Noel T. Lantican, *BS, assistant - property & assets*
Marilyn I. Villegas, *data encoder*
Jonathan O. Masalonga, *BS, secretary II*

Office of the Director for Administration and Human Resources

Maria Liza R. Milante, *BS, officer - administrative coordination*

Human Resources Services – Employee Relations

Lilian M. Mendoza, *MS, manager*
Kathryn Rose C. Victoria, *BS, officer - HRS coordination*

Human Resources Services – International Staff

Selene M. Ocampo, *BS, officer - HRS coordination*
Nida E. Reyes, *BS, officer - HRS coordination*

Human Resources Services – National Staff

Fe V. Aglipay, *MS, manager*
Gladys Faith B. Tan, *BS, specialist - HRS*

Sylvia P. Avance, *MS, specialist - HRS*
Alfredo R. Reyes, *BS, officer - HRS coordination*
Iluminada B. Oleta, *BS, secretary III*
Larry A. Montermoso, *assistant*

Food and Housing Services
Ma. Obdulia B. Jolejole, *BS, senior manager*
Leody M. Genil, *BS, assistant manager I*
Melinda M. Cuyno, *BS, officer*
Benita M. Pangan, *MS, officer*
Fe C. de Ocampo, *BS, associate - food service*
Jojo P. Cabutin, *BS, assistant - recreation*
Anselmo R. Reyes, *assistant - recreation*
Limberto S. Aldipollo, *assistant - stock inventory*
Edgardo S. Estenor, *BS, attendant - housing*
Ricardo L. Bejosano, Jr., *attendant - housing*
Cristina E. Cauntay, *attendant - housing*
Irene S. Escoses, *attendant - housing*
Laureano M. Escuadra, *attendant - housing*
Aurelio C. Garcia, *attendant - housing*
Francisca O. Oro, *attendant - housing*
Alfredo G. Regalado, *attendant - housing*

International School Los Baños
Malaya S. Capiña, *BS, administrative coordinator*[1]
Joan L. Belsonda, *BS, officer - administrative coordination*[4,5]

Legal Services
Walfrido E. Gloria, *MS, senior counsel*
Cherryl C. Breva, *BS, secretary III*

Materials Management Services
Frisco L. Guce, *BS, senior manager*
Felicisimo N. Kalaw, *BS, assistant manager I*
Remedios E. Ballesfin, *BS, assistant manager I - central registry services*
Conception Elybeth A. Alcantara, *BS, officer*
Angelica P. Valintos, *BS, officer - administrative coordination*
Anatolio A. Magampon, *BS, officer - property disposal*
Zenaida M. Belarmino, *BS, officer - purchasing*
Lourdes A. Belison, *BS, officer - purchasing*
Anthony C. Daluz, *BS, officer - purchasing*[4]
Luzviminda G. Oleta, *BS, officer - purchasing*
Priscilla T. Cabral, *BS, officer - shipping*
Nerisa M. Gutierrez, *BS, purchaser*[1]
Louell R. Tanzo, *BS, assistant - central files*
Wilmer B. Jacob, *assistant - mailroom*
Felix C. Estipona, *assistant - Makati Office*
Anicia R. Malabanan, *data encoder*
Maureen C. Pader, *data encoder*
Francisco T. Quilloy, *materials expediter*
Ernesto L. Nimedez, Jr, *BS, warehouseman*
Fred B. Angeles, *warehouseman*
Irineo B. Esguerra, *warehouseman*[1]
William M. Estrellado, *warehouseman*
Jose L. Sibal, *warehouseman*
Delfin M. Lacandula, Jr., *attendant*

Physical Plant Services
Douglas D. Avila, *BS, senior manager*
Enrique O. delos Reyes, *BS, manager*
Alfredo M. Mazaredo, *MS, manager*
Jaime A. Fojas, *BS, assistant manager I*
Fernando B. Madriaga, *BS, assistant manager I*
Nestor A. Malabuyoc, *BS, assistant manager I*
Teodoro G. Carreon, *officer*
Marissa E. Templanza, *BS, officer - administrative coordination*
Fidel L. Alvarez, *technician III - carpentry*
Levi C. Malijan, *technician III - carpentry*
Virgilio V. Verano, *technician III - carpentry*
Luisito R. Vitan, *technician III - civil*
Robert F. Austria, *BS, technician III - drafting*[4]
Roberto E. Escueta, *BS, technician III - electrical*
Rufino R. Gibe, *BS, technician III - electrical*
Enrique D. Baterina, *technician III - electrical*
Mario C. Garcia, *technician III - electrical*
Felix M. Halili, *technician III - electrical*
Benjamin C. Libutan, *technician III - electrical*
Rolando N. Simon, *technician III - electrical*
Marcelino M. Navasero, Jr., *technician III - electronics & instrument repair*
Ramon R. Suarez, *technician III - electronics & telephone technician*[4]
Danilo F. Banasihan, *technician III - instrument & telephone*
Rodolfo G. Calibo, *technician III - physical plant*
Melencio E. Tapia, *technician III - plumbing*
Manolo M. de Guia, *technician III - refrigeration & airconditioning*
Leonardo S. Mangubat, *technician III - refrigeration & airconditioning*
Dionisio A. Ng, *technician III - refrigeration & airconditioning*
Juan L. Petrasanta, *technician III - refrigeration & airconditioning*
Ricardo C. Tabilangon, *technician III - refrigeration & airconditioning*
Domingo M. Ortiz, *technician III - telephone*
Apolinario T. Armia, *technician III - welding*
Anito Q. Mabalhin, *technician III - welding*
Fermin L. Junsay, *BS, assistant - stock inventory*
Almario S. Piñero, *painter*
Roberto N. Tamio, *technician II - masonry*
Regalado Q. Alcachupas, *technician II - plumbing*
Hilarion A. Hibek, *technician II - plumbing*[4]
Jennifer R. Jarlego, *BS, secretary I*

Safety and Security Services
Glenn A. Enriquez, *BS, senior manager*
Crisanto P. Dawinan, *BS, assistant manager I - occupational safety & health*
Andres V. Mendoza, *security supervisor I*[1]
Bionico R. Malacad, *security supervisor I*
Salvador T. Zaragoza, Jr., *security supervisor I*
William G. Amador, *BS, core guard*
Juanito C. Exconde, *BS, core guard*
Macario C. Punzalan, *BS, core guard*
Crisostomo M. dela Rueda, *core guard*
Rodelo M. Empalmado, *core guard*
Pablo C. Erasga, *core guard*
Roberto M. Espinosa, Jr., *core guard*
Esteban C. Palis, *core guard*
Ernesto S. Regulacion, *core guard*

Transport Services
Manuel F. Vergara, *BS, sr. manager*
John Arturo M. Aquino, *BS, assistant manager I - vehicle repair shop*
Carlito C. Cabral, *BS, officer - administrative coordination*
Reynaldo G. Elmido, *associate - MPDS dispatch*
Bonifacio M. Palis, *associate - MPDS dispatch*
Oscar A. Templanza, *associate - MPDS dispatch*
Ariel B. Nuque, *associate - MVRS coordination*
Perlita E. Malabayabas, *BS, secretary III*
Emilio R. Gonzalez, Jr., *technician III - AC mechanic*
Jaime D. Atienza, *technician III - mechanic*[16]
Romeo L. Jarmin, *technician III - mechanic*
Armando E. Malveda, *technician III - mechanic*
Roduardo S. Quintos, *technician III - mechanic*
Rolando L. Santos, *technician III - mechanic*
Diosdado D. Mamaril, *BS, driver*
Danilo G. Abrenilla, *driver*
Crisencio L. Balneg, *driver*
Rolando A. Cabrera, *driver*
Amador L. De Jesus, *driver*
Rodrigo M. Fule, *driver*
Hernani M. Moreno, *driver*
Eduardo L. Pua, *driver*
Angelito C. Quijano, *driver*
Renato C. Vivas, *driver*
Ronilo M. Villanueva, *BS, technician II - mechanic*
Edwin S. Cabarrubias, *technician II - mechanic*
Roger M. Cuevas, *technician II - mechanic*
Mabini M. Linatoc, *technician II - mechanic*

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[1]Left during the year.
[2]On leave.
[3]Joined and left during the year.
[4]Joined during the year.
[5]On project appointment.
[6]Effective 16 December 2004.
[7]Effective 18 June 2004.
[8]Effective 12 March 2004.
[9]Transferred from Crop, Soil, and Water Sciences.
[10]Transferred from Office of the Deputy Director General for Research.
[11]Transferred from Entomology and Plant Pathology.
[12]Transferred from Finance.
[13]Transferred from Information Technology Services.
[14]Transferred from Plant Breeding, Genetics, and Biotechnology.
[15]Transferred from Visitors and Information Services.
[16]Died during the year.

Appendix 1. IRRI's research partners

NARES

Bangladesh

Agricultural Advisory Society	
Bangladesh Academy for Rural Development	BARD
Bangladesh Agricultural University	BAU
Bangladesh Bureau of Statistics	BBS
Bangladesh Institute of Development Studies	BIDS
Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders	BIRDEM
Bangladesh Rural Advancement Committee	BRAC
Bangabandhu Sheikh Mujibur Rahman Agricultural University	BSMRAU
Bangladesh Water Development Board	BWBD
Center for Policy Dialogue	CPD
Health Education and Economic Development	HEED
Integrated Action Research and Development	IARD
Jahangirnagar University Dhaka	JU
Local Government Engineering Department, Bangladesh	LGED
Ministry of Agriculture	MOA
Rajshahi University	RU
Rural Development Academy	RDA
University of Dhaka	UD

Bhutan

Renewable Natural Resources Research Centre	RNRRC

Brazil

Instituto Rio Grandense do Arroz	IRGA

Cambodia

Day Eth Research Station	DERC
Ministry of Agriculture, Forestry and Fisheries	MAFF
Phrey Phdau Agricultural Research Station	PPARS

Canada

Semiarid Prairie Agricultural Research Center-Agriculture and Agri-Food, Saskatchewan	SPARC

Chile

Instituto Nacional de Investigación Agropecuaria-Centro de Investigación Regional	INIA-CRI

China

Anhui Rice Research Institute	ARRI
China Agricultural University	CAU
China National Hybrid Rice Research and Development Center	CNHRRDC
Chinese Academy of Sciences	CAS
Chinese Academy of Agricultural Sciences	CAAS
County Extension Bureau (Hubei, Hunan, Guangdong, Jiangsu, and Zhejiang provinces)	CEB
Fujian Academy of Agricultural Sciences-Rice & Wheat Research Institute	FAAS-RWRI
Gong Zu-ling Rice Research Institute	GZRRI
Guangdong Academy of Agricultural Sciences	GAAS
Guangxi Rice Research Institute	GRRI
Guanzhou Plant Protection Research Institute	GPPRI
Guanzhou Rice Research Institute	GRRI
Hainan Research and Development Base for Hybrid Rice	HRDBHR
Heilongjiang Rice Research Institute	HRRI
Hu Bei Crop Research Institute	HBCRI
Huazhong Agricultural University	HAU-Huazong
Hunan Agricultural University	HAU-Hunan
Hunan Hybrid Rice Research Center	HHRRC
Hunan Plant Protection Institute	HPPI
Hunan Rice Research Institute	HRRI
Kunming Food Crops Research Institute	KFCRI
Lancang Food Crops Research Institute	LFCRI
Nanchang Rice Research Institute	NRRI

Nanning Rice Research Institute	NRRI
National Natural Science Foundation of China	NSFC
Ningbo Agri Research Institute	NARI
Shenyang Agricultural University	SAU
Sichuan Academy of Agricultural Sciences	SAAS
Sichuan Rice Research center	SRRC
Wenzhou City Academy of Agricultural Sciences	WCAAS
Wuhan University	WU-China
Yangzhou University	YU-China
Yunnan Agricultural University	YAU
Yunnan Food Crops Research Institute	YFCRI
Yunnan Academy of Agricultural Sciences	YAAS
Zhejiang Academy of Agricultural Sciences	ZAAS
Zhejiang University	ZU
Denmark	
Danish Institute of Agricultural Sciences	DIAS
Ecuador	
Instituto Nacional De Investigaciones Agropecuarias	INIAP
Egypt	
Agricultural Research Center	ARC
Rice Research and Training Center, Egypt	RRTC-Egypt
Ethiopia	
Pawe Agricultural Research Center	PARC-Ethiopia
Haiti	
Ministry of Agriculture, Natural Resources and Rural Development	MANRRD-Haiti
Honduras	
Programa Nacional de Arroz, DICTA-SAG	PNDA
India	
Agricultural College and Research Institute -Trichy	ACRI-Trichy
Andhra Pradesh Agricultural University	APAU
Assam Agricultural University	AAU
Bidhan Chandra Krishi Viswavidyalaya (Bidhan Chandra Agricultural University)	BCKV
Birsa Agricultural University	BAU
Central Agricultural University	CAU
Choudhary Charan Singh Haryana Agricultural University	CCSHAU
Chinsurah Rice Research Station	CRRS
Department of Agriculture, India	DOA-India
Directorate of Rice Research, Hyderabad	DRR
Goa University	GOA
Govind Ballabh Pant University of Agriculture and Technology	GBPUAT
Gujarat Agricultural University	GAU
Himachal Pradesh Agricultural University	HPAU
Holy Cross Vocational Training Institute	HCVTI
Indian Council of Agricultural Research	ICAR
Indian Statistical Institute	ISI
Indira Gandhi Agricultural University	IGAU
Institut Français de Pondichérry	IFP
Jawaharlal Nehru Krishi Vishwa Vidlaya (Jawarharlal Nehru Agricultural University)	JNKVV
Marathwada Agricultural University	MAU
Nand Educational Foundation for Rural Development	NEFORD
Narendra Deva University of Agriculture and Technology	NDUAT
Orissa University of Agricultural Technology	OUAT
Punjab Agricultural University	PAU
Rajendra Agricultural University	RAU
Soil and Water Management Research Institute	SWMR
Tamil Nadu Agricultural University	TNAU
The Energy and Resources Institute	TERI
University of Agricultural Sciences, Bangalore	UASB
University of Agricultural Sciences-Regional Research Station	UAS-RRS
West Bengal Directorate of Agriculture	WBDA
West Bengal Rice Research Station	WBRRS
Indonesia	
Agricultural Service Center	DINAS-Central Java
Bogor Agricultural University (Institut Pertanian Bogor)	IPB
Central Research Institute for Animal Sciences	CRIAS
Indonesia Agricultural Post Harvest Research Institute	IAPHRI
Indonesian Agency for Agricultural Research and Development	IAARD
Indonesian Center for Agricultural Biotechnology and Genetic Resources Research and Development	ICABGRRD
Indonesian Center for Agro Socio-Economic Research and Development	ICAERD
Indonesian Institute for Rice Research	IIRR
National Assessment Institute for Agricultural Technology	NAIAT
National Seed Company	NSC
Provincial Agricultural Services (Dinas Pertanian Tanaman Pangan Propinsi)	DINAS-Indonesia
Provincial Agriculture Services (Central Java and West Java)	DES
Research Institute for Food Crops and Biotechnology	RIFCB
Sukarami Research Institute for Food Crops	SRIFC
Iran	
Rice Research Institute of Iran	RRII
Japan	
Japan International Research Center for Agricultural Sciences	JIRCAS
Japan Rice Genome Program	RGP
Kamikawa Agricultural Experiment Station	KAES
Kyushu National Agricultural Experiment Station	KNAES
Ministry of Agriculture, Fisheries and Forestry, Japan	MAFF-JAPAN
National Agriculture and Bio-Oriented Research Organization	NARO-Japan
National Institute of Agricultural Science and Technology	NIAST
National Institute of Agricultural Sciences	NIAS-Japan
National Institute of Agro-Environmental Sciences	NIAES- Japan
Korea	
Rice Research Institute, Korea	RRI- Korea
Rural Development Administration	RDA

Lao PDR

Department of Agricultural Extension	DOAE- Lao PDR
German Development Service	DED-Lao PDR
GTZ Bokeo Project	GBP
Ministry of Agriculture and Forestry, Lao PDR	MAF-LAO PDR
National Agriculture and Forestry Research Institute, Lao PDR	NAFRI
Savannkhet Provincial Department of Agriculture	SPDA

Malaysia

Agriculture Research Center - Tuaran	ARC-Tuaran
Malaysian Agricultural Research and Development Institute	MARDI-Malaysia
Universiti Pertanian Malaysia	UPM

Mozambique

National Agricultural Institute of Mozambique	NAIM

Myanmar

Agricultural Research Department	ARD
Central Agricultural Research Institute	CARI-Myanmar
Myanma Agriculture Service	MAS

Nepal

Khumaltar Agricultural Research Station	KARS
Nepal Agricultural Research Council	NARC-Nepal

Nicaragua

CENEMA/Departamento da Pesquisa Agricola/Ministère du développement rural et de l'agriculture	CENEMA/DEPA/MDRA

Pakistan

Atomic Energy Agricultural Research Centre	AEARC
National Agricultural Research Centre	NARC
Pakistan Agricultural Research Council	PARC

Philippines

Benguet State University	BSU
Bulacan National Agricultural State College	BNASC
Central Luzon State University	CLSU
Department of Agriculture/Philippine Rice Research Institute	DA/PhilRice
Leyte State University (formerly Visayas State College of Agriculture)	LSU (formerly VISCA)
Mariano Marcos State University	MMSU
National Irrigation Administration	NIA
University of Southern Mindanao	USM
University of the Philippines Los Baños	UPLB
University of the Philippines Los Banos Foundation, Inc.	UPLBFI
Western Mindanao State University	WMSU

Sri Lanka

Anne Van Dijk' Research Centre	AVDRC
Department of Agriculture, Sri Lanka	DOA-Sri Lanka
Regional Agricultural Research and Development Center-Bombuwela	RARDC-Bombuwela

Tajikstan

Tajik Agricultural Academy of Sciences	TAAS

Thailand

Chiang Mai Service Center for Crop and Production Resources	CMSCCPR
Chiang Mai University	CMU
Chulalongkorn University	CU
Department of Agriculture	DOA, Thailand
Kasetsart University	KU
Khon Kaen University	KKU
Ministry of Public Health, Thailand	MOPH-Thailand
Réseaux de recherche et d'innovation technologique	RRIT-Ubon Ratchatani
Rice Research Institute, Thailand	RRI-Thailand
Thai Nguyen University	TNU
Ubon Ratchathani University	URU

Timor Leste

Ministry of Agriculture, Fisheries and Forestry, East Timor	MAFF-East Timor

Turkmenistan

Ministry of Agriculture and Water Management, Turkmenistan	MAWM

Uzbekistan

Uzbekistan Research Institute for Rice	URIR

Vietnam

Agricultural Breeding Center, Bac lieu	ABC-Bac Lieu
Agricultural Extension Center, Cantho Province	AEC-Cantho
An Giang University	AGU
Can Tho University	CTU
Center for Remote Sensing and Geomatics	VTGEO
Gia Loc Food Crops Research Institute	GLFCRI
Hanoi Agricultural University	HAU-Vietnam
Hybrid Rice Research Center, Vietnam	HRRC- Vietnam
Information Center for Agricultural and Rural Development, Vietnam	ICARD-Vietnam
Institute of Agricultural Sciences	IAS-Vietnam
Integrated Resources Mapping Centre-Vietnam	IRMC-Vietnam
Masvingo Agronomy Institute	MAI
Ministry of Agriculture and Rural Development	MARD- Vietnam
Research Institute for Aquaculture 2	RIA2
Sub-Institute of Water Resources Planning	SIWRP
University of Agriculture and Forestry	UAF-Vietnam
Vietnam Agricultural Science Institute	VASI
Vietnam National University	VNU

ARIs

Argentina

Instituto Nacional de Technologia Agropecuaria-Estacion Experimental Agropecuaria	INTA-EEA Corrientes

Australia

Australian Centre for International Agricultural Research	ACIAR
Commonwealth Scientific and Industrial	CSIRO

Research Organisation	
Curtin University of Technology	CUT
Department of Primary Industries, Victoria	DPI-Vic
Macquarie University	MU
University of Adelaide	UA
University of Newcastle	UN - Australia
University of Queensland	UQ- Australia

Belgium

University of Ghent	UG- Belgium

Canada

McGill University	McGill
Simon Fraser University	SFU
University of British Columbia	UBC
University of Western Ontario	UWO

Denmark

Royal Veterinary and Agricultural University	KLV

France

Centre de coopération internationale en recherche agronomique pour le développement	CIRAD
Institut Francais de recherche scientifique pour le développement en cooperation	IRD (formerly ORSTOM)
Institut national agronomique Paris, Grignon	INA-Grignon
Institut national de la recherche agronomique	INRA
Montpellier II University centre des sciences humaines	CSH
Paris X University	PXU
Research and Technology Exchange Group	GRET
University of Perpignan	Uperpignan

Germany

Centre for Environmental Research	UFZ
Centre for Development Research	ZEF
Martin Luther University Halle, Wittenberg	MLU
Universitaet Bayreuth	UB- Germany
University of Bonn	UB-Bonn
University of Freiburg	UF
University of Hannover	UH- Hannover
University of Hohenheim	UH- Hohenheim

India

Shere-E-Kashmir University of Agriculture and Technology	SKUAT

Italy

Centro Di Richerche Sul Riso	CRSR

Japan

Aoyama Gakuin University	AGU
Chiba University	CU
Foundation for Advanced Studies on International Development	FASID
Hokkaido University	HU-Japan
Hokuriku Research Center	HRC
Kagoshima University	KU-Japan
Kyushu University	KU-Japan
Nagoya University	NU-Japan
National Graduate Institute for Policy Studies	GRIPS
Tohoku University	TU-Tohoku
Tsukuba University	TU-Tsukuba
University of Kyoto	UK- Japan
Waseda University	WU-Japan

Kazakhstan

Pre-Aral Research Institute of Agroecology and Agriculture	PRIAA

Netherlands

Groningen University	GU
Plant Research International	PRI
Wageningen University and Research Center	WURC

Peru

Instituto Nacional de Investigacion Agraria, Peru	INIA-Peru

Spain

Institute of Agro-Food Research and Technology, Spain	IART-Spain

Sweden

Stockholm School of Economics	SSE
University of Lund	UL - Sweden

Switzerland

Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule Zürich)	ETH

Thailand

Asian Institute of Technology	AIT

Turkey

Ege University	EU
Thrace Agricultural Research Institute	TARI

United Kingdom

CABI Bioscience	CABI
John Innes Centre	JIC
Natural Resources Institute	NRI
University of East Anglia	UEA
University of Liverpool	UoL
University of London-Imperial College	UOL-IC
University of Reading	UR- United Kingdom
University of Sheffield	US- United Kingdom

USA

Clemson University	Clem U
Cornell University	CU
Gramene Database Project	Gramene
International Service for the Acquisition of Agri-Biotech Applications	ISAAA
Kansas State University	KSU
National Center for Genetic Resources Preservation , USA	NCGRP- USA
North Carolina State University	NCSU
Pennsylvania State University	PSU
Purdue University	PU
Texas Tech University	TTU
University of Arizona	UA
University of California-Davis	UCD

University of Florida-Gainesville	UF-Gainesville
University of Georgia	UG- USA
University of South Florida	USF - USA
University of Utah	UU - USA
University of Washington	UW - USA
USDA Salinity Laboratory	USDA-SL
Virginia Polytechnic Institute and State University	Virginia University
Yale University	Yale

Venezuela

Fundacion Nacional Del Arroz	FUNDARROZ

IARCs

International

Centro Internacional de Agricultura Tropical	CIAT-Bolivia
EMBRAPA-Centro Nacional de Pesquisa de Arroz e Feijão	EMBRAPA-CNPAF
Centro Internacional de Agricultura Tropical	CIAT-Colombia
Africa Rice Center	WARDA
Caribbean Agricultural Research and Development Institute	CARDI
Center for International Forestry Research	CIFOR
Centro Internacional de Mejoramiento de Maiz y Trigo	CIMMYT
Fondo Latinoamericano de Arroz de Riego	FLAR
Food and Agriculture Organization-Plant Production and Protection Division	FAO-AGP
International Atomic Energy Agency	IAEA
International Board for Soil Research and Management	IBSRAM
International Center for Biosaline Agriculture	ICBA-UAE
International Center for Research in Agroforestry (World Agroforestry Center)	ICRAF
International Center for Research in the Semi-Arid Tropics	ICRISAT
International Center for Soil Fertility and Agricultural Development	IFDC
International Center for Tropical Agriculture	CIAT-Nicaragua
International Fertilizer Association	IFA
International Food Policy Research Institute	IFPRI
International Institute for Rural Reconstruction	IIRR
International Potash Institute	IPI
International Potato Center	CIP
International Water Management Institute	IWMI
Potash and Phosphate Institute/Potash and Phosphate Institute of Canada	PPI/PPIC
WorldFish Center	WorldFish

NGOs

Bangladesh

APEX, Bangladesh	APEX
CARE International	CARE- Bangladesh
Coastal Development Partnership (Upokulio Unnayan Shahojogy)	CDP
Debi Chowdhurani Palli Unnayan Kendra	CPUK
Friends in Village Development Bangladesh	FIVDB
Grameen Krishi Foundation	GKF
PRA Promoters Society Bangladesh	PPS-BD
Proshika- A Center for Human Development	Proshika
Rangpur Dinajpur Rural Service	RDRS
Shushilan	Shushilan
Uttaran	Uttaran

Benin

Songhai Center	Songhai

India

Ram Krishna Mission	RKM

Lao PDR

World Vision Laos, Savanaketh Project	WV-SP

Philippines

Process Foundation	PF

Spain

Cooperativa de Productores de Semillas de Arroz	COPSEMAR

Timor Leste

Catholic Relief Service	CRS

Private Organizations

Bangladesh

Agro Business Corporation	ABC
Association for Integrated Development, Inc.	AID-Comilla
Bangladesh Agricultural Development Corporation	BADC
Bangladesh Development Society	BDS
Bangladesh Rice Exporters Association	BREA
International Development Enterprise	IDE
MARK Industries (pvt.) Ltd.	Mark
Socioconsult Ltd.	SocioConsult

Cambodia

Cambodia Rice Millers Association	CRMA

India

Indian Farmers Fertiliser Cooperative Ltd	IFFCO
MAHYCO Research Foundation	MRF
Swaminathan Association	SA

International

Agent Links European Network	AgentLink
Asia and Pacific Seed Association	APSA

Italy

Sardo Piemontese Sementi	SAPISE

Kyrgyztan

Kyrgyz Center of Agrarian Sciences and Consulting Services	KCASCS

Netherlands

Nunza B. V.	NBV

Nicaragua

Assosacion Nicaraguense de Arroceros	ANAR
Spain	
Koipesol Semillas	Koipesol
Sri Lanka	
Ambalantota Research Station	ARS
Switzerland	
Syngenta Foundation for Sustainable Agriculture	Syngenta
USA	
Li-Cor, Inc. - Lincoln Nebraska	Li-Cor
Vietnam	
South Seed Company	SSC
Southern Seed Joint Stock Company	SSJSC

Appendix 2. Selected acronyms used throughout this publication

AEU	Agricultural Engineering Unit
AICRIP	All-India Coordinated Rice Improvement Project
ALAP	Agricultural Librarians Association of the Philippines
AMAF	ASEAN Ministers of Agriculture and Forestry
ARBN	Asian Rice Biotechnology Network
ARI	advanced research institution
ASA	American Society of Agronomy
ASEAN	Association of Southeast Asian Nations
ASL	Analytical Service Laboratories
AVRDC	The World Vegetable Center
BBU	Biometrics and Bioinformatics Unit
BOT	Board of Trustees
BRRI	Bangladesh Rice Research Institute
CCER	Center-Commissioned External Review
CGIAR	Consultative Group on International Agricultural Research
CGIARLISC	CGIAR Libraries and Information Services Consortium
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture)
CIP	International Potato Center (Peru)
CIMMYT	International Maize and Wheat Improvement Center (Mexico)
CIRAD	Centre de coopération en recherche agronomique pour le développement (France)
CORRA	Council for Partnerships on Rice Research in Asia
CPS	Communication and Publications Services
CRO	Community Relations Office (VIS)
CSSP	Crop Science Society of the Philippines
CSWS	Crop, Soil, and Water Sciences Division
CURE	Consortium for Unfavorable Rice Environments
DAHR	Director for Administration and Human Resources
DINMOD	Developing Integrated Nutrient Management Options for Delivery
DFID	Department for International Development (UK)
DPPC	Director for Program Planning and Coordination
DPRK	Democratic People's Republic of Korea
EIRLSBN	Eastern Indian Rainfed Lowland Shuttle Breeding Network
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agency for Agricultural Research)

EPMR	External Program and Management Review
EPPD	Entomology and Plant Pathology Division
FAO	Food and Agriculture Organization
GAMMA	Gene Array and Molecular Marker Application
GQNRC	Grain Quality and Nutrition Research Center
GRC	Genetic Resources Center
IARC	international agricultural research center
ICDAI	Integrated Community Development Assistance, Inc. (Infanta, Philippines)
ICIS	International Crop Information System
ICM	integrated crop management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (India)
IEA	IRRI Environmental Agenda
IEC	IRRI Environmental Council
IKO	IRRI-Korea Office
ILRI	International Livestock Research Institute
INGER	International Network for Genetic Evaluation of Rice
INRM	integrated natural resource management
IPMO	International Programs Management Office
IRAD	Institut de recherche pour le développement (France)
IRFG	International Rice Functional Genomics Consortium
IRG	International Rice Genebank
IRIS	International Rice Information System
IRS	internationally recruited staff
IRRC	Irrigated Rice Research Consortium
ISAAA	International Service for the Acquisition of Agri-Biotech Applications
ITS	Information Technology Services
IWMI	International Water Management Institute (Sri Lanka)
IYR	International Year of Rice
LDS	Library and Documentation Service
LIRRTP	Lao IRRI Rice Research and Training Project
LITE	Livelihood Improvement Through Ecology (PETTRA project)
NARES	national agricultural research and extension systems
NCGRP	National Center for Genetic Resources Preservation (Fort Collins, Colorado)
NGO	nongovernmental organization
NRM	natural resource management
NRS	nationally recruited staff
PBGB	Plant Breeding, Genetics, and Biochemistry (Biotechnology as of Dec. 2004) Division
PETTRA	Poverty Elimination Through Rice Research Assistance (Bangladesh)
PICPA	Philippine Institute of Certified Public Accountants
PVS	plant varietal selection
RDA	Rural Development Administration (Korea)
RKB	Rice Knowledge Bank
RWC	Rice-Wheat Consortium
SDC	Swiss Agency for Development and Cooperation
SHU	Seed Health Unit
SIF	Strategic Initiative Fund
SINoP	Society of IRRI Nonresearch Professionals
SSD	Social Sciences Division
SSNM	site-specific nutrient management
SSSA	Soil Science Society of America
TC	Training Center
TILLING	targeting induced local lesions in genomes
UNIC	United Nations Information Centre
VIS	Visitors and Information Services
WARDA	Africa Rice Center (West Africa Rice Development Association; Benin)
WRRC	World Rice Research Conference