

RESEARCH SUPPORT SERVICES

ANALYTICAL SERVICE LABORATORIES

As the centralized analytical service facility for the Institute, the Analytical Service Laboratories (ASL) continues to provide routine analyses in plant, soil, and water samples to various clients within IRRI and outside collaborators and to UPLB. It also provides liaison-related services to projects involving use of radioactive materials.

Analytical services

ASL completed a total of 55,463 analyses for routine plant, soil, and water samples. Plant samples accounted for 65% of the completed analyses with N, Fe, and Zn as the most requested determinations (ASL Table 1). About 83 % of the total samples received came from Crop and Environmental Sciences Division (CESD); the rest came from Plant Breeding, Genetics, and Biotechnology Division (PBGB), Grain Quality,

ASL Table 1. Analyses completed in 2006.

Analysis	ASL Section		Total	Percent
	PSL ^a	MSL ^b		
Plant	28,646	7,633	36,279	65.41
Soil	14,919	1,068	15,987	28.82
Water	3,197	0	3,197	5.76
Total	46,762	8,701	55,463	100.00

^aPlant and Soil Laboratory. ^bMass Spectrometry Laboratory.

ASL Table 2. Profile of samples and analyses completed in 2006, by OU.

OU	Samples (no.)	Percent	Analyses (no.)	Percent
CESD	17,806	82.98	44,778	80.73
PBGB	2,983	13.90	8,785	15.84
GQNPC	50	0.23	140	0.25
SSS	4	0.02	4	0.01
IPMO	72	0.34	72	0.13
ICRAF	61	0.28	61	0.11
UPLB	451	2.10	1,591	2.87
PHILSURIN	32	0.15	32	0.06
Total	21,459	100.0	55,463	100.0

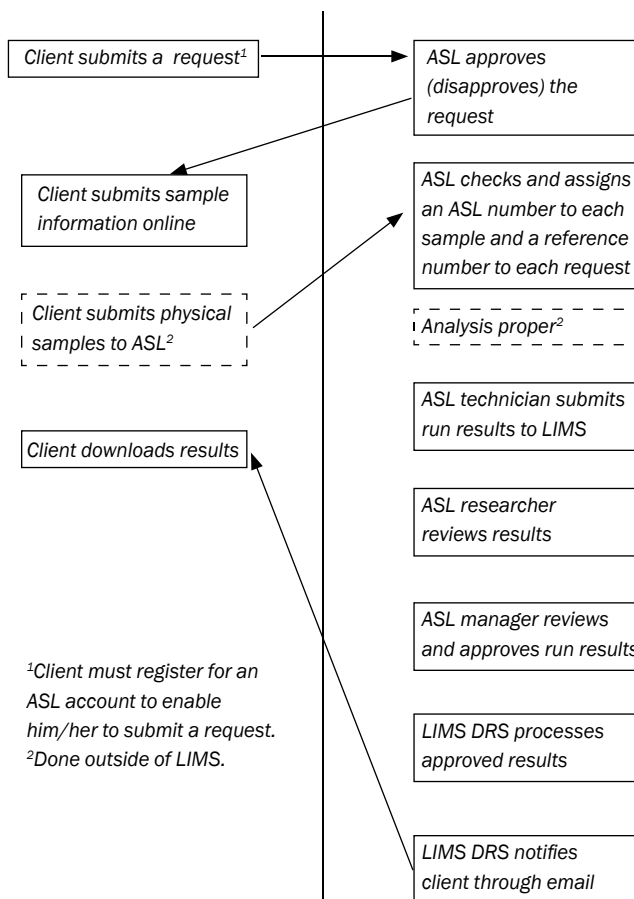
Nutrition, and Postharvest Center (GQNPC), Safety and Security Services (SSS), International Programs Management Office (IPMO), World Agroforestry Centre (ICRAF), University of the Philippines Los Banos (UPLB), and the Philippine Sugar Research Institute (PHILSURIN) (ASL Table 2).

Laboratory information management system

Information management and automated data processing are important functions of ASL. A commercial laboratory information management system (LIMS) is very expensive and requires significant customization for the type of work done at ASL. The cost of a commercial system would easily exceed several hundred thousand dollars and this may greatly exceed potential benefits. The ASL LIMS project with the UPLB-FI through the Institute of Computer Science developed a new ASL LIMS web site at <http://swsdsrv1/lims/index.jsp>. ASL clients are now provided with a web application that manages all information and requests related to their

experiments. ASL clients can send online requests for analysis, facilities, and services as well as submit sample information that will be used in processing and tracking the status of their requests. LIMS uses an email notification system to alert both ASL and clients on any changes in request status.

The chart at right shows the steps involved in processing a request for analysis. LIMS requires that all clients register for an account to avail of ASL's online services. When making requests for sample analysis, the client submits a request using his/her account. ASL reviews and approves the request online. Once the request is approved, the client submits sample information online and physical samples are sent to ASL for analysis. Chemical processes then begin in the respective laboratories. Once analyses are done, results are submitted by the technician in a format suitable for LIMS for review and assessment of quality of results by a researcher. The ASL manager does the final review and approval. Afterward, LIMS processes the results and saves the data for the online data retrieval system (DRS). Clients are notified of the availability of their results, which can be downloaded using their accounts.



The process of analysis using LIMS.

New inductively coupled argon plasma

As endorsed by the Advisory Committee (AC), through the recommendations of the ASL resource person, Dr. Sarah Johnson-Beebout, and the ASL ICP Selection Committee, ASL purchased a new Perkin Elmer Optima 5300 dual-view inductively coupled argon plasma (ICP) in November 2006 and the unit arrived at IRRRI on 22 Dec 2006. This very important acquisition for IRRRI has an expected useful life of about 15 years. The new ICP will enable the unit to perform multielement, heavy-metal, and total-arsenic determinations to meet the Institute's future strategic need for such analyses.

ASL's operational plan for the new ICP-optical emission spectrometer (OES) is presented in ASL Figure 1. Multinutri-

ent analysis with its new ICP was endorsed by the AC, with priority given to the analysis of plant samples for elements already determined on the current ICP plus arsenic and cadmium. IRRRI scientists will be asked whether additional priority elements need to be considered for method development. The old ICP will be retained until the new ICP is fully operational, and a decision on the fate of the old ICP will then be made.

Order	Shipment	Installation & commissioning	Training	Method development	Cross calibration & transitioning	New ICP fully operational	Revisit plan for old ICP
2 wk	6 - 8 wk	4 wk	2 wk	3 - 4 mo	1 - 2 mo		
Oct 06	Nov - Dec 06	Jan 07	Feb 07	Mar - Jun 07	July - Aug 07	Sep 07	Oct 07

ASL Fig. 1. Timeline for operating the new ICP-OES.

Radioisotope Laboratory

Ms. Lilia R. Molina was designated as IRRIs radiological health and safety officer (RHSA) on 6 Feb 2006 by the Philippine Nuclear Research Institute (PNRI). The following projects were assisted through the use of radioisotope laboratory facilities and liaison services of the PNRI:

- Identification and characterization of RTSV-responsive gene in rice
- Identification and characterization of small RNA-related genes in rice
- Sulfur cycling in rice-maize cropping systems
- Analysis of gene expression in response to rice tungro virus infection in rice plants
- Southern blotting and hybridization
- Applying genetic diversity and genomic tools to benefit rice farmers at risk from drought
- Fertilization-independent formation of embryo, endosperm, and pericarp for apomictic hybrid rice

A new document, *Security measures for IRRIs*, was prepared and submitted to PNRI on 3 Mar 2006, in compliance with security provisions in IAEA-TECDOC-1355 to ensure security of its radioactive sources to prevent unauthorized access, as well as loss, theft, and unauthorized transfer of sources for possible malevolent use.

A radiation safety course for IRRIs staff was conducted by PNRI trainers from 31 Jul to 4 Aug 2006. Five scholars and seven staff members participated in the training.

Training

All ASL staff participated in the institutewide quality assurance training by Dr. Edgar Paski from the British Columbia Institute of Technology (29-31 May 2006). All technicians also attended the glass blowing training (hands-on) with Mr. Robert Jimenez of DOST (24-27 Apr 2006) and glass blowing (lecture) with Engr. Perfecto Braganza, also of DOST (5 Jun 2006). Ms. Molina participated in a short postgraduate course on soil and plant analysis and data handling in Wageningen University, The Netherlands, 6-30 Jun 2006, while Mr. Chavez attended the 12th Canadian CF-IRMS Workshop in the University of Victoria, Victoria, BC, Canada on 11-14 Jun 2006.

CROP RESEARCH INFORMATICS LABORATORY

The new Crop Research Informatics Laboratory (CRIL) and its associated research program were officially launched via a video conference link between IRRIs and CIMMYT in January 2006. This is the first major output of an Alliance between IRRIs and CIMMYT that was formally established. The centers see several areas where this unified facility will help build a

sufficient critical mass to accomplish previously unattainable goals and help establish a more powerful platform for synergizing progress across cereal species.

A primary pillar of the CRIL vision is the integration and comparative analysis of data across disciplines (within the germplasm enhancement value chain) and across species (within the well-studied cereal crops). By capturing synergies and harnessing complementarities across both institutes; by developing improved scientific data management systems (including genebank, plant breeding, agronomy, socio-economic, and GIS data), including harmonizing data standards across disciplines and institutions; by supporting crop research (especially comparative biology and genomics across cereals); by providing training in scientific informatics; and by developing increasingly powerful decision-support tools for plant breeding; the CRIL will contribute to the common IRRIs and CIMMYT institutional mission of promoting food security and material livelihoods of resource-poor farmers and consumers with reference to the production, distribution, and consumption of the world's three main staple cereals rice, maize, and wheat that collectively represent more than half a billion hectares of global food and feed production.

Biometrics consultation

Statistical consultation was provided by CRIL statistics staff to 110 clients in 2006 and several papers were reviewed for *International Rice Research Notes* and international refereed journals.

Organizational unit	Clients (no.)
CESD	46
PBGB	35
GRC/CPS/SSD/GQNPC/AEU	10
Others	19
Total	110

Statistical software

Statistical models have been developed to incorporate knowledge of the coefficient of parentage between lines into the estimation of breeding values and additive by additive genetic components and their interaction with environments. This will enhance the efficiency of breeding evaluations and should lead to improved genetic gains in breeding programs.

Simulation of top-cross strategies to simultaneously capture favorable allele combinations of nine marker-linked genes from three parental wheat lines were studied with the

QuCim/QuLine simulation package. Results offer opportunities for improving efficiency of marker-assisted breeding programs. The simulation package has been enhanced and is now available to simulate alternative breeding strategies for almost any crop. The package has also been linked to a physiological model so that genetics and physiology can be integrated into the same simulation environment.

CRIL has continued the development of IRRISTAT to handle logistic regression and log-linear modeling and further development of REML to allow multiplicative covariance structures, fixed symmetric covariance structures, and sections of error covariance with structures and/or parameters.

Biometrics training and workshops

CRIL conducted four in-house (85 participants) and two in-country (48 participants) trainings. Three of these courses were newly developed and were offered only during this period. These were *Analysis of Experimental Data Using the SAS System*, *Introduction to Data Quality Management*, and *Introduction to SPSS and Analysis of Categorical Data*. It has also participated in two IRRI-based workshops (37 participants).

Course/workshop	Date	Participants (no.)
<i>In-house training</i>		
Introduction to the SAS System	7-11 Nov 2005	22
Basic Experimental Design and Data Analysis Using IRRISTAT	17-21 Apr 2006	21
Analysis of Experimental Data Using the SAS System	10-14 Jul 2006	19
Introduction to Data Quality Management	24-28 Jul 2006	23
<i>Other short-term course/workshop</i>		
Interpretation of Research Results from Experiments on Crop Residue Management	9-20 Jan 2006	15
Increasing the Impact of Rice Breeding Programs	17-18 Apr 2006	22
<i>In-country training/workshop</i>		
Introduction to SPSS and Analysis of Categorical Data, RNR-RC, The Kingdom of Bhutan	4-8 Apr 2006	20
International Crop Information System (ICIS) Training Course, El Batan, Mexico	8-12 May 2006	28

Database development and deployment—International Rice Information System (ICIS)

1. ICIS development (released ICIS 5.3)
2. Implementation of the Genetic Resources Information Management System (GRIMS) of ICIS is progressing well and scheduled for completion in 2007
3. ICIS sample tracking implemented for the wheat genebank of CIMMYT and ICIS inventory management set up and awaiting stock-taking and bar-coding exercise with Dr. Payne, CIMMYT
4. Wheat breeding information system at CIMMYT integrated with ICIS (IWIS3) and available for deployment in wheat breeding projects of CIMMYT and partners. IWIS3 published on the Web using ICIS technology
5. Strategy developed for integrating Maize Fieldbook and Maize Finder database with ICIS. Programming started on capturing maize pedigrees into ICIS GMS with Dr. Vivek (Zimbabwe)
6. Further development of ICIS breeder application with Nunza and GBA to support traditional and molecular breeding. ICIS 5.3 released
7. Refinement of the ICIS browse application to allow rapid computation of large COP matrices for use in modeling evaluation data from crop improvement

Bioinformatics

Bioinformatics activities in 2006 focused primarily on the work related to two projects: the Generation Challenge Program (GCP) and the Perlegen SNP Discovery Project.

For the GCP, IRRI staff convened back-to-back scientific consultations on IRRI-led GCP projects for platform software and the GCP scientific domain model development, in partnership with the African Centre for Gene Technology, in Pretoria, South Africa. Following these review meetings, the domain models and platform technologies were developed further, resulting in new Web-based tools for accessing GCP research data across local and internet-dispersed databases (prototype site at <http://rice.generationcp.org>).

Complementary to these GCP software development activities, two postdoctoral scientists, Dr. Samart Wanchana of Thailand and Dr. Ramil Mauleon of the Philippines joined CRIL in 2006 as bioinformatics data curators on two GCP-funded projects: a comparative stress gene catalog (see <http://dayhoff.generationcp.org>) and comparative microarray data analysis, respectively.

Concurrently, the CRIL bioinformatics team, led by NRS team leader Victor Jun Ulata, was engaged in bioinformatics analysis of rice genome sequences for the IRRI-hosted

Perlegen germplasm resequencing experiment. This experiment, whose data are expected to be delivered in the spring of 2007, is undertaking to perform DNA-DNA hybridization of 100 million base pairs of relatively unique Nipponbare reference sequence against 19 other *Oryza sativa* landraces representing a broad spectrum of biological diversity in rice. The aim of the experiment is to construct a valuable new whole genome mapping resource of rice DNA polymorphism markers (so-called “single nucleotide polymorphisms” or SNPs) for use in association genetics analysis, classical genetic mapping, and marker-assisted selection in plant breeding.

Research data management

- An IRF position with the major focus on research data management and data quality was established at IRRI.
- As part of the CRIL MTP, the work will be conducted at IRRI and CIMMYT. During a visit to CIMMYT, initial discussions and consultations mainly on crop management and socioeconomic data took place.
- At IRRI, work has started on socioeconomic data, climate records, and several experimental data sets.
- IRRI has continued to lead a GCP-commissioned research project on data quality improvement and assurance.

Collaboration systems

As part of a GCP project, Web-based collaborative systems are maintained to support software development and textual content development. The use of these systems has expanded in 2006 as follows:

- The use of the Wiki system (<http://cropwiki.irri.org>) was extended to host the internal collaboration space as well as the external Web site of CRIL. The GCP and the ICIS development communities have continued to be the main users of this system.
- The use of the collaborative software development system (<http://cropforge.org>) has increased from 49 hosted projects in 2005 to 67 projects in 2006. The projects are related to the development of software, mainly from the GCP and the ICIS communities. Other projects hosted include IRRISTAT (IRRI), DIVA (CIP), MGIS (INIBAP), and ICRISAT LIMS (ICRISAT).

Open source/open content licensing

After approval by the BOT, IRRI's intellectual property policy for information products was changed. The default is now open source and open content licensing and efforts are under way to put the new policy into practice for software and the content of collaborative (Wiki) sites.

COMMUNICATION AND PUBLICATIONS SERVICES

Publications and publishing

Through CPS, IRRI produced 14 titles in 2006, including seven scientific books, four issues of *Rice Today*, the Annual Report of the Director General 2005-06, and IRRI's strategic plan, *Bringing hope, improving lives*. Also produced were two issues of the *International Rice Research Notes (IRRN)* and three issues of *Rice Research for Intensified Production and Prosperity in Lowland Ecosystems (RIPPLE)*. Currently, 26 titles are in the production queue for 2007 and beyond.

In the area of copublishing, the Chinese version of *Breeding rice for drought-prone environments*, published by the Shanghai Agrobiological Gene Center, has become the model for such translation projects with such outside publishers in the future. Also, Sid Harta Publishers in Australia published *Sharing rice for peace and prosperity in the Greater Mekong Subregion*, by Peter Fredenburg and Robert Hill. This title, also advertised on Sid Harta's Web site, follows the same style and format as *The burning of the rice*, by Don Puckridge, and serves as the second installment of a popularly written book series on IRRI's impact that CPS is establishing with Sid Harta. CPS also collaborated with CABI to produce *Environment and livelihoods in tropical coastal zones: managing agriculture-fishery-aquaculture conflicts*.

We are collaborating with the science publisher World Scientific Publishing Co. (WSPC), based in Singapore. In 2007, WSPC and IRRI will copublish the proceedings of *Rice genetics V* as an e-proceedings, a hard copy print-on-demand (POD) book, and as part of a CD to be called *The rice genetics collection* that will contain the searchable files of all past rice genetics symposium proceedings and other historical publications on rice genetics and cytogenetics from 1964 through 2006.

IRRI on the Web

New features added to the IRRI intranet in 2006 included links to tracking Pacific tropical cyclones, the IRRI announcements Wiki, the Los Baños Wiki, the Strategic plan 2007-15, the Medium-term plan 2007-09, latest earthquakes in the world, a searchable IRRI staff list for 1961-2005, IRRI Alumni.net, and planning for pandemic flu. Rice News Worldwide (available internally and externally at <http://ricenews.irri.org> and RSS compatible) has become a very useful current summary (and archival listing dating back to 15 Apr 2005, now containing more than 1,350 news and feature stories) of links to stories and features about rice from around the world.

We also continue to add articles and audio feeds at www.irri.org/media/articles.asp that quote IRRI staff via other Web sites such as *SciDevNet*, *Science*, *Washington Post*, *Time Asia*, *BBC News*, *ABC Radio Australia*, *Reuters*, and *Discovery Channel*. This collection of now more than 110 features and audio feeds dates back to June 1968.

Google Custom Search using Google Co-op is now the featured search engine on the IRRI external Web site (www.irri.org). Also, a pilot donor page set up at www.irri.org/donors/SDC/index.asp for the Swiss Agency for Development and Cooperation can be used as a model for uploading similar materials related to funded projects for other key donors. And, as IRRI approaches its 50th anniversary in 2010, the Web page on Significant dates in IRRI history at www.irri.org/about/history.asp is continually being updated as new events occur and more past historical events are added.

New IRRI photo bank

IRRI's 2nd-generation, user-friendly photo bank at www.ricephotos.org went online in early January 2007. At its debut, the bank contained around 1,000 new images in this bank with more to be added monthly. However, until a critical mass of new photos is added and classic photos from IRRI's first photo bank are transferred, the classic photo bank will remain online at <http://rice-photos.irri.org>. Special features of the new facility include

- New breath-taking images of rice landscapes, farmers, children, events, research, and other related subjects;
- Fresh images added monthly;
- Advanced keyword search;
- All images at high resolution (300 dpi);
- Instant downloads via a special link;
- Image slideshow feature for a category; and
- Share alike Creative Commons License Deed.

When using the new photo bank for the first time, users need to register one time only if they want to download images. In its debut, the front page of the new photo bank featured images of the Mayon Volcano in July and November 2006 tied to the *Rice Today* feature, *Once were rice fields*, showing the before-and-after effects of the devastating mud flows that rushed down the mountainside with the passing of Typhoon Durian.

CPS and Information Technology Services (ITS) are also running a parallel photo distribution experiment by putting selected IRRI images on Flickr, a Yahoo company, that provides online photo management and sharing applications.

A trial version of these IRRI rice images on Flickr can be found at www.flickr.com/photos/ricephotos. Anyone can view and there is no need to sign up. Persons with a (free) Flickr/Yahoo account can also leave comments about the images.

IRRI Digital Publications Project and the Rice Thesaurus Project

CPS funded both phases 1 and 2 of these projects, managed by Library and Documentation Services (LDS). Phase 2 was completed 31 May 2006. As stated in the terminal report, as more publications are digitized, so must the database be updated along with the Rice Thesaurus. Subject access is very important in information retrieval. New keywords must be generated as the database grows. These keywords will be important in the metadata for both the IRRI Photo Bank and the IRRI Publication Archives. The comprehensive Rice Thesaurus now has 2,479 terms with subject trees related to rice.

Communications support

CPS continues to provide communication support for the entire Institute, including editing, graphic design, art and illustration, audiovisual, photography, video, and advice on printing.

On 1 Mar 2006, the IRRI print shop was closed permanently to make way for a new digital copy center, managed by ITS, that officially opened on this same date. Since 1985 when records were first kept until its closing, the print shop had produced approximately 174 million impressions for a wide array of IRRI publications and forms. Truly, this date marked the end of an era and the beginning of a new one. ITS reports that the new copy center generated 202,864 copies in 2006 between 1 Mar and 31 Dec.

In 2006, approximately 26,351 new digital photographs were produced. Eighteen video programs were produced and 131 shorter clips were provided for the *Bulletin* (IRRI's weekly newsletter for staff, BOT, and alumni; <http://bulletin.irri.cgiar.org>) and PowerPoint presentations.

Graphic artists produced 60 illustrations, laid out 2,252 pages for publications, and prepared and printed 151 posters.

IRRI editors worked on more than 900 pages appearing in refereed journal articles, 1,495 pages appearing in IRRI's scientific books, plus 123 pages for the *International Rice Research Notes*, and more than 500 pages of additional conference papers, abstracts, proposals, and other documents.

EXPERIMENT STATION

The Experiment Station (ES) provided support services to a total of 325 field and greenhouse experiments. Of this, the Field Operations Unit served 163 field experiments, while the Controlled Plant Growth Facilities and Grounds Unit (CGFG) supported 64 experiments in the Phytotron and CL4 transgenic greenhouse facilities and 98 experiments in all other greenhouses. A total of 9,083 maintenance and service requests were served by the various support units of the ES during the year.

Land use

A total of 312.28 ha were used in 2006. ES was the biggest user of the farm with the utilization of some 144.06 ha for field demonstration, seed increase, and rice production purposes. PBGB, the second biggest user, planted a total of 127.91 ha.

Seedling requirements of the various field experiments were established and maintained by the ES in 5.72 ha of dry and wet nursery beds, using field nurseries covering 3.72 ha and 2 ha, respectively. The rest of the seedling requirements were grown on a 40-m × 10-m pavement using modified dapog nurseries.

Division	Dry season (ha)	Wet season (ha)	Total
CSWS	14.16		14.16
CESD		8.82	8.82
EPPD	2.99		2.99
ES	56.72	87.34	144.06
GRC	10.17	2.92	13.09
PBGB	83.35	44.56	127.91
TC	1.25		1.25
Total	168.64	143.64	312.28

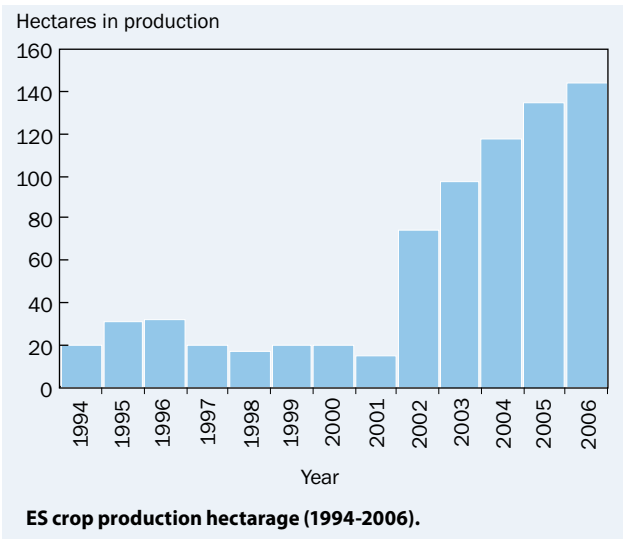
Crop production operations

ES seed increase and rice production operations in 2006 reflected a 7% increase in cropped area compared with the 2005 cropping of 134 ha and a 60% increase over the annual target of 90 ha of rice production crop.

More than 43% of all rice field crops were established mainly by direct seeding through manual broadcasting of pregerminated seeds, drum seeding on wet fields and by seed drilling on dry-prepared areas, whereas the rest were established using manual and mechanical transplanting methods, particularly in deep plots and during the wetter periods of the year when weather and field conditions did not favor direct seeding operations.

ES harvested 326 t of paddy from ES-managed production plots. The highest yield noted in ES-managed production plots was 5 t ha⁻¹ from blocks 1002 to 1005 planted to NSIC122

in the 2006 dry season. Another 168 t of mixed varieties were harvested from researchers' excess materials and border rows. Harvesting in large plots was mainly done with the use of mechanical combine harvesters.



Agrochemical applications and crop protection services

A total of 96 t of different kinds of fertilizers were served to various users of the farm in the form of ammonium sulfate, complete, muriate of potash, solophos, urea, zinc oxide, and zinc sulfate. This total amount reflected a 17% reduction in fertilizer application as compared with the previous year.

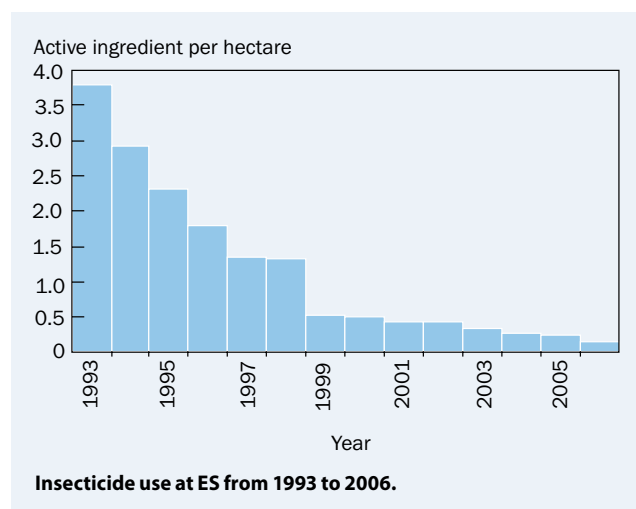
Sustained pesticide use reduction efforts resulted in 36% and 4% reduction in insecticide and molluscicide use, respectively, compared with 2005 levels. Use of resistant varieties and zero insecticide application in most ES-managed production plots, as well as reduced use in researchers' plots and reduced insect pressure about the fields, contributed to the decrease in insecticide use. Routine manual snail and snail egg collections in the fields and greenhouses, on the other hand, contributed to the reduction in molluscicide use.

Herbicide use, however, increased by 10%. This can be attributed to the predominantly wet weather during the year that enhanced weed growth, as well as to the increased preference for chemical weed control in view of reduced operating budgets and rising costs of manual and mechanized weed control using mowers and grass cutters. Manual weed control remains to be the single most costly, labor-intensive field maintenance operation at the farm. Herbicide use has been a more cost-effective option. While preference to herbicide use in field experiments is gradually growing, the bulk is still in the application of nonselective herbicide in maintaining production plots, perimeter areas, fallow fields, and levees. Integrated pest management practices, combined

with the use of machines and chemical applicators, helped reduce the cost of pest control as well as improve the safety of field operations.

For the nonchemical control of avian pests, manual bird scaring remains the preferred method, while bird nets and bird tapes were installed on 3.56 and 16 ha, respectively.

Current rat management practices, which mainly include trap barrier systems, maintenance of fallow areas, burrow destruction, flame throwing, field sanitation and hygiene, and closed seasons, resulted in zero incidence of severe rat damage in all rice crops. Rat control services included the installation of 250 baiting stations, 37.83 ha of active barrier systems, and 227 live traps. This reflected a reduction of 15.2%, 40.9%, and 72.7%, respectively, compared with 2005 installations. The rat traps yielded a total of 877 live catches for 2006.



Irrigation and drainage services

Irrigation requirements of all field experiments were met and maintained through staggered work schedules by ES research technicians. Sprinkler and perforain irrigation systems were set up on 8.4 ha in blocks UZ, UQ, UM, UP1, UR, D24, and B2 during the 2006 dry season and on 13.3 ha in blocks UO, UW, UP1, D24, and in the UN and UX seedling nurseries during the wet season. Portable pipes equipped with overhead sprinklers were used to supply the water requirements in most upland blocks, including blocks B, D, the 833 series, the 900 series, UD, UJ, UI, UP, UO, UQ, UW, UX, UR, UL, UM, UN, UMN, UV, UW, and in the dry bed nurseries. Ten units of drainage outlets at the old area, new lowland, and upland area were developed and constructed. Major irrigation repair work involved the extraction, repair, and reinstallation of malfunctioning submersible pumps in block UW, UK, C1, UT, and the 2000 series and three main gate valves in the

lowland, upland, and old areas. Minimum downtime of damaged pumps was maintained up to only a maximum of 3 d in allowable delay. An automated water level sensor control system was installed and tested in block C1 reservoir. The new setup can potentially save on pumping costs as well as avoid irrigation water wastage and over-pumping and help improve the reliability of water supply in the reservoirs.

Land development and civil works

More than 2 ha of upland fields were converted to lowland fields in blocks UG, UL, UR1, UR2, UR3, the 900 series, and the 2000 series. One hectare in block UI and another hectare in upper MN were reworked to improve hard pan and field levels. Some 20 km of farm access roads were rehabilitated and developed from the main ES building. The rest of the 44 km of farm roads were routinely maintained through scraping, backfilling, road patching, and compaction using the road roller. Routine civil maintenance work done included rice straw collection, regular mowing of 15 farm water reservoirs, weekly bulldozing of garbage into excavated pits of the dumpsite area, and roadside mowing. Heavy equipment operations done involved the regular maintenance of some 44 km of farm road network through surface scraping, backfilling, patching, and compaction. As part of the continuous farm perimeter fence improvement plan, an additional 150 m of concrete wall was put up along the perimeter areas in block 1000, whereas more than 100 m of wire fence were repaired in perimeter areas from block 100 to block 800. Floodwaters and strong winds of typhoon “Milenyo” in September caused severe damage to more than half of all perimeter fences of the institute, including over 100 m of concrete wall. These were all repaired toward the end of the year.

Equipment fabrication, repair, and maintenance services

The ES Mechanical Shop provided repair, fabrication, and maintenance services for the tractors, farm equipment, implements, machineries, and irrigation facilities. Requests for repair and maintenance of light and heavy equipment and farm implements from the different units and research divisions (total of 1,224) were accomplished. Defective and malfunctioning vertical motors and submersible pumps in blocks UW, UK, C1, UT, and the 2000 series were extracted and repaired with minimum downtime. Fifty units of different types of threshers and 32 units of different dryers were also repaired and maintained. Routine maintenance and repair services were also provided to the Rice Mill Unit. A strip tillage machine was designed and fabricated for use by the CESD.

Postharvest services and rice mill operations

Postharvest support services provided by ES included threshing, cleaning, drying, and storage, among others. Majority of the drying requirements of researchers for plant samples and harvested grains were accommodated using the oven dryers and flatbed dryers being maintained by the station. Two typhoons caused significant damage to the drying and milling facilities in May and September of 2006, affecting crop yield and milled rice output as well, in terms of timeliness, quality, and quantity of the produce.

From 494 t of dried (at 14% moisture) rice paddy intended for milling in 2006, the Rice Mill Operations Unit produced 290 t of milled rice. About 16 t were issued in response to various requests from different organizational units for milled rice, while 5 t were sold to the highest bidder via sealed public bidding process organized by the Materials Management (MM) unit. The rest of the milled rice, equivalent to some 272 t, was issued to the MM unit for distribution to nationally recruited staff's (NRS) monthly rice entitlement. The Rice Mill output for 2006 was able to meet 8 months' supply of milled rice for all IRRI NRS.

The byproducts of the milling operations totaled 21 t of broken rice, 57 t of rice bran, and some 12,000 sacks of rice hulls. The broken rice was sold through a bidding process, while the rice hulls were sold to regular buyers who use hulls for insulation, animal beddings, and landscaping/composting purposes. Set aside were 37 t of rice bran used as fish feed in the fish production project of the ES; another 20 t were sold to the highest bidder.

Phytotron/CL4 services

Basic research support services were provided by the Phytotron/CL4 unit to all experiments conducted in the Phytotron and transgenic greenhouse facilities. Some 186 maintenance and service requests were served during the year. The main bulk of manual operations at the CL4 involved the autoclaving of incoming and outgoing soil and plant materials. A significant increase in autoclaving operations was noted, along with the increased frequency of breakdown of the pass-through autoclave, further highlighting the need to upgrade the old autoclave unit and augment the setup with an additional autoclaving machine. The staggered annual preventive maintenance shutdown of each transgenic greenhouse bay in the CL4 facility was implemented one bay at a time throughout the year, while the annual preventive maintenance shutdown operations for the Phytotron were done in November. Phytotron users consumed a total of 25,280 gallons of reverse-osmosis grade water for their experiments. Improvements done in 2006 for the Phytotron

cooling system included the replacement of the old controllers in the glasshouse bays with new upgraded models, the installation of a new air compressor and upgrade of the memory card and hard disk of the central computer. Installation of a new centralized and energy efficient setup to replace the old cooling system of the transgenic greenhouses was initiated during the year. Sustained efforts toward efficient energy utilization at the Phytotron helped achieve a 17% reduction in total kwh used compared with the previous year's electricity consumption.

The demand for the use of Phytotron facilities almost doubled this year. Several waitlisted requests were not accommodated due to lack of available space.

Greenhouse services

The Greenhouse Unit provided basic support services to all experiments conducted in the glasshouses, screenhouses, and associated facilities. This included the servicing of 318 maintenance requests, provision of 3,355 assorted pots, and delivery of 735 t of ground soil to support the soil requirements of greenhouse experiments and some field requirements for soil cover on seedbeds as well. Routine operations of the Greenhouse Unit included soil hauling, grinding and delivery, glass roof cleaning, and overall upkeep and maintenance of greenhouse surroundings and landscapes. Staggered 1-mo greenhouse shutdown operations in most greenhouse facilities facilitated unhampered annual preventive maintenance operations. The procedure helped reduce pesticide applications by providing a long break in the crop, pest, and disease cycles inside these facilities. Shutdown operations included general clean-up, surface wash down, and repair of roofing and all support structures. Some researchers though have opted to forego the shutdown operations in some glasshouses and screenhouses in view of special requirements to continuously use available space. Increased frequency of pesticide applications, buildup of pest populations, and recurring pest-related problems were noted in such facilities that did not have the standard shutdown period.

Two strong typhoons caused extensive damage to the greenhouses. Worst hit by typhoon Caloy in May 2006 were greenhouses CS01 to CS04, CS09, CS10, US01, US02, AG01, BG02, and CG01. Relatively minor damage was noted in MG01 and AG02. In September, typhoon Milenyo wreaked havoc on AS01, BS05, BS07, CS05, CS06, CS08, OS02, OS03, MS01, US03, AG01, BG01, BG02, BG13, BG14, CG01, NG03, MG01, and NS02. Repair work in the typhoon-damaged greenhouse facilities was the main activity in the last quarter of 2006. The last quarter also saw the upgrading and modification of transgenic screenhouses CS01, CS02, and

CS07 to enable implementation of new procedures/protocols and to meet work requirements of the PBGB and CESD.

Grounds services

The Grounds Services Unit served 253 requests for plant decorations, landscape maintenance and development, and other services. Service requests from office staff at the research center and from residents at the staff housing included indoor plant decorations and outdoor landscaping support services for various residential areas, offices, the auditorium, and building halls and during seminars, workshops, and special events conducted at IRRI. Routine operations mainly included lawn maintenance and regular mowing services, road sweeping, brush cutting, and garbage collection in the research center, meteorological stations, reservoirs, and various staff housing units of the institute. Areas that were improved and landscaped in 2006 included the old IRRI marker in Tabon gate, the main entrance gate, the board room, Rice World Museum, Staff Housing swimming pool surroundings, and house numbers JH10, JH12, JH13, JH26, JH37, PD5C, and PV11. The waste segregation schemes in the greenhouse area and staff housing were also continuously implemented. Trimming of trees and clearing operations on perimeter fence areas were done at the IRRI Staff Housing as part of the annual clearing program. Old hedges in several locations around the institute were removed to lower landscape maintenance costs. The Grounds Unit also managed the fish production project in the farm reservoirs. Low-cost maintenance operations included periodic pond clean-up, weekly harvesting, and regular feeding of the fish with rice bran from the rice mill. Some 949 kg of fresh fish were harvested and sold to IRRI staff. New equipment acquisitions for the year included a new electric boom machine, three brush cutters, five push mowers, one pressure washer, a new mower attachment, assorted tools and gadgets, one telescopic tree pruner, and personal protective gears. Forty worn-out trash bins were also replaced with new units, while eight segregation bins were rehabilitated during the year.

Kabesilya labor services

Performance monitoring of kabesilya services was continuously implemented by the ES Administrative Unit. The summary of performance data taken from the job completion feedback forms revealed very high annual total acceptability values of 99.9% for bird-scaring services and 99.7% for the other contractual labor services in 2005. Feedback ratings given by endusers ranged from good to excellent, with no more than 0.1% incidence of poor performance rating.

Man-hour utilization of kabesilya services rendered by two service providers as requested by the various research divisions and support units totaled 624,206 man-hours in 2006. This represents a 17% reduction in utilization from the previous year. Manual bird-scaring services also went down by 4%, from 112,852 man-hours in 2005 to 108,589 man-hours in 2006. Wage rates for the kabesilya workers went up twice in 2006, amounting to a total of 5% pay hike, following two regional wage orders issued by the National Wage Board.

Partnership activities and other support services

In coordination with the Partnerships Office, various external requests for equipment assistance and associated technical support services from the surrounding communities, organizations, and institutions such as the local government units of Bay and Los Baños, nongovernment organizations, PhilRice, the Los Baños Science Community Foundation Incorporated, the University of the Philippines Los Baños (UPLB), and the UP Open University were accommodated by the ES. Equipment and manpower assistance were provided by ES to various UPLB and municipal government units, schools, and communities and during clearing operations after typhoon Milenyo. Communication linkages and close coordination with UPLB were also maintained by the station through regular meetings of the IRRI-UPLB Management Committee and personal communication between UPLB and ES staff. Other support activities provided by ES in 2006 included the conduct of field tours and demonstration for visitors endorsed by the Visitors and Information Services (VIS) as well as the orientation of new staff and scholars endorsed by the Training Center (TC). ES staff also participated as facilitators and trainers in course offerings of the TC and provided planning and logistical support for the conduct of various field demonstration and tours.

Environmental management system implementation

In line with the goals of the IRRI Environmental Agenda, the ES continued implementing its Environmental Management System (EMS) in 2006. The EMS team was constituted with lead staff of each of the ES work units serving as members and the ES senior manager as the team leader and overall EMS coordinator. The review and in-house registration of the first draft of the *EMS manual and system procedures* were completed during the last quarter of the year. Environmental aspects identified by ES staff during the 2005 workshop were reviewed and prioritized by the EMS team and used as basis for establishing five environmental management programs—i.e., management of environmental aspects related to air emissions, solid wastes, energy use, pesticide use, and waste

water effluents. Highlights of this year's EMS-related activities included a seminar workshop and the review of the EMS, which is part of the continual improvement program of the ES. It primarily aims to ensure continuing suitability, adequacy, and effectiveness of various management practices, environmental management programs, and activities to efficiently manage potential environmental impacts of ES operations, products, and services. The workshop was attended by all ES staff and major manpower service contractors for farm labor supply and agrochemical application. The activities of these groups at IRRI can significantly influence the various environmental aspects of farm operations and potentially can cause environmental impacts. The workshop focused on introducing and reviewing various EMS and ISO 14001 concepts, giving updates on the status of EMS implementation, presenting various environmental management programs, and business continuity planning.

LIBRARY AND DOCUMENTATION SERVICE

Enabling information and communication technologies (ICT) transformed traditional library services into better and faster information delivery modes focusing more on electronic rather than print resources. This trend is evident in the IRRI Library and Documentation Service (LDS), as it uses a combination of traditional and modern means of knowledge sharing with clients. Utilizing the latest advances in ICT, the Library continued to strengthen its collection of print and electronic technical literature on rice and related subjects to sustain its ability to put appropriate information sources into the hands of the world's rice researchers.

Enhancement of the electronic contents of the Library's home page (<http://ricelib.irri.org>) was given top priority. The staff regularly provided information service through current awareness, answering of reference questions, computerized literature searches, and electronic document delivery. The Library continued to assume the role of a public library in the community, as evidenced by 11,631 walk-in clients, consisting mostly of students and faculty members from neighboring and remote universities and researchers from various institutions, who availed of LDS facilities and services during the year.

Making information available via IRRI researchers' desktops and other services were accomplished through the Library's knowledgeable and dedicated staff, the robust collection, and state-of-the-art library system, the *Millennium*, which is currently running on *Release 2005*. In addition, collaboration with other libraries, institutions, and

information providers helped to augment the limited resources available.

Information resources

Collection development is hampered by the universal problem of the ever-increasing volume of new relevant books and journals plus the rising costs of access licenses and the limited budget. A summary of collection growth is given in LDS Table 1.

Rice technical literature. The literature output of rice scientists is growing at an unprecedented rate. Alerts, generated by Current Contents Connect for rice articles published in peer-reviewed journals, carry an average of 50 citations per week. Procurement of these articles is a top priority and those published in nonsubscribed journals usually become problematic due to the limited budget. All five librarians teamed up to get free copies from authors and partner institutions. Hence, the number of journal articles purchased via pay-per-view was very minimal at 44. Rice articles, numbering 2,259 (excluding those in print journals), were added to the collection: 10 reprints and 2,249 in pdf. Ninety-eight percent of these were acquired free of charge. Translating this number into savings, assuming that the average cost of pay-per-view is US\$30, the amount saved would be approximately \$66,450.

Partner libraries in the CGIAR system were instrumental in acquiring electronic copies of some rice articles. Rice literature procurement received a major boost through the availment of periodic free trials from publishers of journals and databases.

Digital resources. For instant access to full-text documents, electronic links were created regularly on the Library's databases. Added to the online catalog were 243 electronic journals and 207 electronic monographs (including theses). There were 3,557 links added to the rice database; it now has a total of 5,757 hyperlinks. Through a single mouse click, 8,319 full text documents in pdf are instantly accessible. This is continually increasing as new items are added daily. Regular searching of rice technical literature on the WWW was pursued vigorously by a full-time project employee up to September 2006.

Print monographs. Three thousand and two hundred eighty-five monographic materials (books, theses, and reprints) were added to the print collection. Only 292 monographs, books, and theses were purchased for the Library and 146 for other units. Most of the monographs acquired were donations or exchange materials.

Databases/journal subscriptions. Subscriptions to vital databases such as Current Contents Connect, Web of science,

CABDirect, LC classification Web, and TEEAL (The Essential Electronic Agricultural Library) were sustained. An additional vital full-text resource added is Anthrosource, which makes up for the limited number of current journals in Anthropology available.

The LDS is slowly moving from print journals to online only, which sometimes poses a problem in archival access. Selection of journal titles for subscription is a very complicated process, as the Library already reduced the number of subscriptions to core titles only. While rice technical article content is the main criterion for prioritizing journals for subscription, those titles that are read regularly by local scientists must also be delivered promptly. To make sure that the LDS is in the right track in selection, a survey of journal preferences of IRRI staff was conducted from April to July. The 2006 survey was done via SurveyMonkey, a freeware on the web. Results show that the top 20 titles cited by respondents are already accessible to IRRI staff, which implies that selection is on the right track. The results also indicate a strong preference for electronic journals.

The costs of journals in scientific disciplines relevant to IRRI's research program increased by an average of 38% for the period 2002-06. The LDS subscribed to 174 journal titles, of which 104 are available online. Membership in the CGIAR Libraries and Information Services Consortium (CGIAR-LISC) increased access to e-journals. While only paying for licenses to 34 titles, access is enabled for a total of 131 titles through the payment of cross-access fees. Open access journals available via the WWW were promptly linked to the online catalog and the e-journal links on the web site.

LDS Table 1. Collection development in 2006.

Publication type	Added in 2006	Total collection
Monographs (books and pamphlets)	1,026	76,304
Rice reprints	2,259	27,763
PDF	2,249	8,319
Journals (print and electronic)	6 print	
	17 electronic	1,575 active titles
Rice theses	119	4,589
Video cassettes	10	221
CD ROM	13	173 titles
Online databases	1	47 (includes free sources)
Electronic links created		
OPAC	207	2,562
Rice database	490	5,757
Total	3,282	141,198

Information access

The Library's integrated system: the Millennium. Innovative Interfaces, Inc., the software provider, continually develops the software by issuing annual or semiannual upgrades. *Release 2005* was installed in December, after adding 36.4 GB of disk storage space to the Innopac server. To further improve search and retrieval capabilities, two additional modules were purchased. A URL checker was installed on 20 Jan to monitor activity of hyperlinks on the two databases. The Advanced Searching module was acquired on 15 Jul. These modules enable faster and more sophisticated searches.

The rice database and the online public access catalog (OPAC). The rice database provides instant access to the world's technical rice literature. It grew with 5,467 rice literature citations added this year, making a total of 251,610 bibliographic records, with all documents available upon request. About 5,757 citations have links to the full text. As in the past, the database is available in both print (*Rice literature update*) and electronic formats.

Bibliographic records for 1,146 books, journals, pamphlets, and nonrice reprints, nonprint materials, and remote electronic resources were added to the OPAC. There are 76,304 records in this catalog, with 2,562 electronic links to full-text documents, Web sites, or databases.

The Library's Web site at <http://ricelib.irri.cgiar.org>, which is available to global users with Internet connection, was regularly updated with new information sources: Web sites, databases, and links to electronic journals and monographs. A regular review of information provided and hyperlinks was done for accuracy and seamless connectivity. New information resources were added soon after they are discovered. In 2006, 53,874 users visited the Library's Web site, an average of 4,489 visits per month.

LDS services

The LDS staff worked as a team to fulfill the needs of clients. Normally, requested articles were delivered on the same day the requests were received. Documents were delivered electronically using the latest version of the Ariel software, which is the most cost-effective way of transmitting electronic documents. Only requests without email addresses were filled using the conventional way—i.e., photocopies sent via snail mail. As a research support service, the LDS staff jointly accomplished the following:

- Delivered information to scientists and librarians in 46 countries worldwide with 1,068 documents delivered and 1,308 reference questions answered.

- Did 47 literature searches for IRRI and other scientists.
- Published 2 issues of the *Rice literature update*, the print edition of the rice database.
- Processed 16,167 book loans, renewals, reserves, and holds.
- Lent 40 books to the libraries of UPLB, PhilRice, and the Badham Library, University of Sydney. LDS borrowed 37 books from the UPLB Main Library and 1 from the Badham Library.
- Issued 55 current awareness announcements in the electronic *IRRI Bulletin* and the *IRRI Announcements* Wiki. These included New Books of General Interest, New Reference Sources, Useful Web Sites, Publications by IRRI Staff, Newly Acquired Technical Rice Literature, Rice Theses, Table of Contents Alerts, Free Access to Journal Issues, etc. Some lists carry links to electronic full-text documents.
- Updated the featured lists of new acquisitions, videocassettes in the AVLIC, and rice theses on the library's Web site monthly.
- Conducted orientation and briefings to 161 new staff, scholars, trainees, and visitors.
- Gave instruction to 15 IRRI staff on the installation and use of database and management software such as EndNote, Procite, and WebAGRIS.
- Facilitated the inclusion of IRRI Library's online catalog in the CG Virtual Library. This can be searched, along with other CGIAR library catalogs, at <http://cgvlib.cgiar.org>. Several requests for literature were answered through this portal.
- Added content to the CG Virtual Library by compiling a list of CGIAR databases and feeding the information to the Virtual Library Team.
- Purchased and cataloged 146 books for other units of IRRI.
- Trained a library science student from Germany, Mr. Kai Scheuing, on all aspects of library operation up to February 2006.
- Bound 1,128 volumes of books and journals and fabricated 136 Princeton files and folders.

As in the past, IRRI continued to be a major provider of free documents to CGIAR center libraries (LDS Table 2). In return, IRRI received 58 free documents from CGIAR center libraries.

Countries, availing of LDS services, were reduced from 49 in 2005 to 46 in 2006 (LDS Table 3). One possible explanation is the increasing number of hyperlinks to full-text documents provided via the library's databases.

LDS Table 2. Document delivery/reference questions answered in 2006.

Center name	Articles delivered (no.)	Reference questions answered (no.)
CIAT	2	3
CIFOR	2	14
CIMMYT	47	49
CIP	110	39
ICARDA	6	7
ICRAF	58	48
ICRISAT	85	38
IFPRI	35	20
IITA	37	24
ILRI	13	16
IPGRI	9	9
IRRI	289	231
IWMI	19	25
WARDA	22	3
WorldFish	2	5
Other institutions	332	777
Total	1,068	1,308

LDS Table 3. Document delivery/reference questions answered in 2006.

Country	Reference questions received (no.)	Documents delivered (no.)	Country	Reference questions received (no.)	Documents delivered (no.)
Australia	4	13	Peru	39	110
Bangladesh	1		Philippines	494	362
Benin	3	22	Poland	2	
Brazil	2		Singapore	3	
Cambodia		1	Spain	1	3
Canada		5	Sri Lanka	25	19
Chile	1		Switzerland	2	
China		8	Syria	7	6
Colombia	4	2	Taiwan		1
Costa Rica	1	2	Thailand	1	1
Croatia	1	1	Turkey		3
Egypt		58	UK	1	
Ethiopia	16	13	USA	26	43
France	2		Vietnam	1	
Germany	1		IRRI staff (local & foreign)	231	289
Ghana	1		Total	1,068	1,308
Guyana	1				
India	53	152			
Indonesia	15	2			
Iran	1	5			
Italy	12	9			
Japan	6	6			
Kenya	48	58			
Lao PDR		3			
Malawi		2			
Malaysia	1	11			
Mexico	28	47			
Myanmar	1	1			
Nepal	2	1			
Netherlands		3			
Nigeria	25	37			
Pakistan	5	9			

LDS Table 4. Projects pursued in 2006.

Project title	Entries added in 2006/remarks	Total
International Directory of Rice Workers	415 (revisions and additions)	2,168
Searching of Free Rice Articles/Monographs from the WWW	1,267	2,040 (linked and added to pdf archives)
PDF Archives	6,863	8,319
Rice Thesaurus (jointly with CPS)	841	2,479 terms with subject trees
Database of IRRI Digital Collections (jointly with CPS)	1,976	5,283
Survey of Journal Preferences of IRRI Scientists	Full report may be requested from the LDS	
Digitization of Rice in the News and IRRI in the News Clippings (jointly with VIS)	Digitization of retrospective up to early 2006 was finished on 4 Jul 2006	
IRRI in the News and Rice in the News Database	1,518	15,931
New Publications by IRRI Staff (e-list posted on the Library's Web site)	73	334

Library projects

In addition to basic services, some projects were undertaken to improve library services and to preserve the existing collection for the use of future generations (LDS Table 4). Searching and downloading freely available pdf files of technical rice articles and dissertations from the Web continued until September 2006. This is still being done but no longer on a full-time basis. A total of 1,267 rice articles, books and conference proceedings, and dissertations were downloaded and linked to bibliographic records in the Library's databases.

Partnerships within and outside IRRI

No library, working on its own, can supply all the needs of its clients. At this age of dwindling resources, collaboration with other libraries and institutions enables the LDS to avail of additional services and resources, e.g. interlibrary loans, document delivery, etc.

Within IRRI, the LDS collaborated with Communication and Publications Services (CPS) and Visitors and Information Services (VIS) in undertaking three projects: Phase 2 of the Rice Thesaurus Project and the Database of IRRI Digital Collections (DIDP), and the Digitization of Newspaper Clippings about IRRI and Rice. Phase 3 of the Rice Thesaurus and the DIDP started in December.

The partners outside of IRRI include

- *Exchange partners.* 600+ libraries in the Philippines and overseas received IRRI's free publications.
- *Document delivery partners.* Some local libraries that lent support to IRRI are the Thomas Jefferson Information Center, the libraries of the University of the Philippines Los Baños, the Asian Development Bank, University of the Philippines-Diliman, the Philippine Rice Research Institute, Ateneo de Manila University, and the De La Salle University.

Outside the Philippines, assistance was received from some CGIAR libraries; the IRRI outreach offices in China, India, Korea, and Thailand; the National Agricultural Library in Maryland; the Badham Library, University of Sydney; Developing Libraries Network (India); FAO, and the Hong Kong University of Science and Technology Library. Many foreign authors gave pdf copies of their papers, free of charge. Dr. Takanori Hayashi of the Agriculture, Forestry and Fisheries Research Information Center (AFFRIC) in Japan supplied some of the Japanese rice literature needed by the LDS.

- *CGIAR libraries.* The IRRI LDS supported the creation of the CG Virtual Library (<http://vlibrary.cgiar.org>), which gave wider exposure to the Library's online catalog and to IRRI publications as well. Joint subscriptions with CGIARLISC members continued. Systemwide coordination was done by the IRRI chief librarian. Free-document delivery is another major benefit derived from the consortium.
- *Agriculture Centers Information Network (AGNIC).* A project on digitization of selected pages of IRRI-assisted theses and dissertations started in October in partnership with AGNIC. The digitized collection will be posted in the AGNIC database for wider awareness and accessibility. From the LDS end, links to these resources will be created on the online catalog and the rice database.
- *Food and Agriculture Organization of the United Nations (FAO).* Bibliographic records (257) were contributed to FAO's AGRIS database. The FAO-developed software, WebAGRIS, and Information Management Resource kit CD-ROM were promoted for use by local librarians.
- *International Association of Agricultural Information Specialists (IAALD).* Dr. Enrica Porcari, CGIAR chief

information officer, strengthened the CGIAR's organizational ties with IAALD by contracting for institutional memberships all 15 CGIAR centers and the CG Secretariat libraries.

- Hong Kong Innovative Users' Group. This association of Innopac users invited IRRI librarians to serve as resource persons and to participate in the annual meeting with no charge for registration.
- Local library associations/networks:
 - Agricultural Librarians Association of the Philippines (ALAP). As in the past, three IRRI librarians served as trainers during the Seminar-Workshop on Retooling Librarians and Information Managers on Digital Resources, Database Creation and Management, Benguet State University, 23-24 Feb.
 - PhilAgriNet. IRRI librarians participated in its annual general assembly and assisted in the drafting of a project proposal for submission to FAO. Five members of the network were trained on WebAGRIS installation and database management.
 - Cavite Librarians Association. The IRRI chief librarian was invited to serve as a resource person in two of its major conferences.

The library continued to share extra resources, consisting of superseded editions, duplicate materials, and IRRI publications with local libraries. The following institutions are beneficiaries of these donations: Aklan State University, Mapua University, University of the Philippines Los Baños, Camarines Sur State Agricultural College, Center for Agriculture and Rural Development (CARD-MRI Development Institute (Laguna), University of Southern Mindanao, and V. Mapa High School (Manila).

Professional growth of staff

Most of the Library staff availed of in-house training courses on various Microsoft modules, personnel management, and personal development offered by IRRI.

To be aware of different library facilities and practices, the staff visited the following advanced libraries of the following institutions: the De La Salle University Library, the Philippine Women's University, Brent School, and the Asian Institute of Management.

Through IRRI's professional growth program, all LDS staff participated in the 3-day Millennium Refresher Course conducted by Ms. Krissana Thampalo of Innovative Interfaces, Inc., the provider of the current automation system.

VISITORS AND INFORMATION SERVICES

The Institute welcomed some 46,031 visitors (VIS Table 1). These included distinguished guests such as the president of India, HE A. P. J. Abdul Kalam; the mayor of the California city of Davis, Ruth Asmundson; Senator Ramon Magsaysay, Jr. of the Philippines; five ambassadors; 1,671 government officials; six ministers; various members of the diplomatic community; and representatives of donor and international organizations, including the ADB, the US embassy, and ACIAR. The Institute was also visited by 1,054 farmers.

IRRI via the Visitors Office also hosted the first Rice Camp for young students from Thailand and the Philippines on 24-28 Apr. This was done to mark the start of a major new effort to encourage young Asians to consider a future in rice. During the 5 days, the students—selected because of their interest in or knowledge of rice—learned the very latest scientific techniques in rice research and more specifically were convinced of how rice research can make the future of rice in the region brighter.

Three new sets of activity books for the three school categories (pre-school, elementary, and high school) were introduced to the 38,804 students who visited IRRI last year. The books are intended to educate children on the importance of rice as a staple food and at the same time help them enjoy their tour of the Riceworld Museum and Learning Center.

In providing audio visual support, the Visitors Office also handled 205 Institute seminars, training sessions, and workshops and an overall total of 664 audiovisual requests compared with last year's 535.

Workshops, conferences, and meetings

During the year, IRRI hosted or cohosted 27 regional and international conferences, workshops, and symposia (VIS Table 2). The regional and international workshops attracted 982 delegates from 37 countries.

Riceworld and facilities

Representing IRRI, the Riceworld Museum and Learning Center staff were able to participate in six exhibitions:

- a. Agri-Aqua Fair and Exhibit at the House of Representatives, Quezon City, May 2006
- b. National Science and Technology Week and DOST Annual Science and Technology Fair, Pasay City, Jul 2006
- c. Los Baños Science Community Exhibit, Los Baños, Aug 2006
- d. Bañamos Tuklas-Agham Exhibit, Los Baños, Sep 2006
- e. International Rice Congress, New Delhi, India, Oct 2006

VIS Table 1. IRRI visitors, by group, in 2006.

Visitor group	Philippines	Asia	Africa	Australasia	Europe	Latin America	North America	USA	Total
Students	38,339	375		4	57	11		18	38,804
Conference participants	577		11						588
Nongovernment organizations	284	35			1			1	321
Donors	52	19		3				2	76
Government officials	1,376	286	7					2	1,671
Farmers	585	469							1,054
Faculty members/parents	378	179			8		3	12	580
Scientists, researchers	332	174	1	7	14	3	1	10	542
Private sector	736	325		12	10		2	17	1,102
UN agencies, CGIAR, TAC, etc.		1	2			1		3	7
Diplomatic corps	2	7			12			1	22
Media	57	48			1			1	107
Religious groups	120	59			1			4	184
Tourists	72	170		4	23		4	27	300
Others	548	39	3	11	9	1	6	56	673
Total	43,458	2,186	24	41	136	16	16	154	46,031

Museum improvements were done on the art and culture exhibit section by restoring two *kipping* (rice wafer) chandeliers, two Riceworld panicle signage, and three rice panicle chandeliers. Repairs were also done on the Rice Song section.

The Rice History section was painted over to make way for a future updated version.

Non-IRRI groups requesting to use IRRI facilities but with activities not in line with IRRI's mission and vision were not allowed in the Institute in 2006. IRRI, however, hosted ICRAF, PhilRice/Department of Agriculture/UPLB, UPLB Dev Com, and the Southern Luzon Association of Museums.

Distinguished visitors in 2006

Legislators and government officials

Hon. Thomas Mandlate, minister of agriculture, Maputo, Mozambique, 13 Jan

H.E. Dr. Avul Pakir Jainulabdeen Abdul Kalam, president of India, 5 Feb

Hon. Roberto M. Pagdanganan, secretary, Department of Tourism, Philippines, 5 Feb

Mr. Kentaro Kawaguchi, assistant director, Biotechnology Safety Division, Agriculture, Forestry and Fisheries Research Division, MAFF, Tokyo, Japan, 21 Feb

Md. Hamidur Rahman, director general, Department of Agricultural Extension (DAE), Bangladesh, 7 Mar

Md. Abdur Razzaque Buiyam, project coordinating director, Small Holders Agricultural Improvement Project, DAE, Bangladesh, 7 Mar

Md. Rejaul Haider, private secretary to the Secretary, Ministry of Agriculture, Bangladesh, 7 Mar

Md. Fazlul Jaque Mollah, deputy director, administration, DAE, Bangladesh, 7 Mar

Md. Abu Yusuf Mia, additional deputy director, administration, DAE, Bangladesh, 7 Mar

Hon. Qinglin Du, minister of agriculture, People's Republic of China, 26 Mar

Hon. Ruth Uy Asmundson, mayor of Davis City, California, USA, 30 Mar

Atty. Noel Servigon, division director, DFA-UNIO, 13 May

Ms. Azlina Binti Abdullah, Division of Paddy and Rice Industry, Ministry of Agriculture and Agro-based Industry, Malaysia, 29 Jun

H.E. Abdalla Yahia Adam, secretary general, Afro-Asian Rural Development Organization, New Delhi, India, 24 Jul

Hon. Dr. Xu Guanhu, minister, Ministry of Science and Technology, China, 25 Aug

Hon. Ramon Magsaysay, Jr., member of the Philippine Senate, 7 Sep

H.E. Lyonpo Sangay Ngedup, minister of agriculture, Royal Government of Bhutan, 20 Oct

Dr. Kyaw Than, vice president, Myanmar Academy of Agricultural, Forestry, Livestock and Fisheries Sciences, 13 Nov

Chief internal auditors, The Royal Kingdom of Bhutan, 5 Dec

Mr. Ir. Sutarto Alimoeso, director general, Good Crop, Ministry of Agriculture, Indonesia, 14 Dec

Mrs. Atik Wasiati, director, Plant Crop Protection, Indonesia, 14 Dec

Ms. Yang Xinyu, deputy secretary general, China Scholarship Council, Ministry of Education, China, 14-15 Dec

Mr. Xu Haijiang, deputy director, Foreign Economic Cooperation Center (FECC), Ministry of Agriculture (MOA), China, 22 Dec

Ms. Zhang Li, director, Foreign Economic Cooperation Department, FECC, MOA, 22 Dec

Representatives of various organizations

Dr. Sandra Lee Kunimoto, head, Hawaii State Department of Agriculture, 9 Jan

Dr. Andrew Hashimoto, dean, College of Tropical Agriculture and Human Resources, University of Hawaii, Manoa, 9 Jan

Mr. Yasuhiro Onozaki, senior officer, General Affairs Section, Japan International Research Center for Agricultural Sciences (JIRCAS), 5-8 Feb

Mr. Toshiaki Kikuchi, senior officer, Overseas Staff Support Section, Administrative Division, JIRCAS, 5-8 Feb

Dr. Stephen McGurk, regional director, Regional Office for South East and East Asia, International Development Research Centre (IDRC), 20-21 Feb

Dr. Ellie Osir, senior program specialist, Regional Office for South East and East Asia, IDRC, 20-21 Feb

Mr. John Mwangi, associate director, CGIAR IAU, Nairobi, Kenya, 27 Feb

Mr. Thotekat N. Menon, head, Internal Audit, International Crops Research Institute for the Semi-arid Tropics, India, 27 Feb

Professor Sho Shiozawa, Department of Biological and Environmental Engineering, Graduate School of Agricultural and Life Sciences, The University of Tokyo, 20-22 Mar

Air Commodore O. Petinrin, one-star general officer, National War College of Nigeria, 3 May

Dr. Henry Miller, Hoover Institution; founding director, Office of Biotechnology, U.S. Food and Drug Administration, 5 May

Dr. Tuan-Hua David Ho, director, Institute of Plant and Microbial Biology, Academia Sinica, Taiwan, 10 Jul

Mr. Dhak Tshering, deputy chief, Ministry of Works and Human Settlement, Royal Kingdom of Bhutan, 1 Aug

Dr. Muhammad Ehsan Khan, project economist, Southeast Asia Department, Asian Development Bank (ADB), 4 Aug

Dr. Christine Hotz, nutrition coordinator, Harvest Plus Challenge Program, International Food Policy Research Institute (IFPRI), 7-10 Aug

Dr. J. V. Meenakshi, policy and impact coordinator, Harvest Plus Challenge Program, IFPRI, 7-10 Aug

Dr. John Dixon, director, Social Sciences Division, International Maize and Wheat Improvement Center, 9 Aug

Mr. Harry Stine, CEO/owner, Stine Seed Company, Iowa, USA, 22 Aug

Members of the University of the Philippines Board of Regents, 25 Aug

Dr. R.K. Mittal, principal scientist for technical coordination, Indian Council for Agricultural Research, 31 Aug

Dr. Nihal Amerasinghe, international consultant, ADB, 16 Sep

Dr. Urooj S. Malik, director (SEAE), Agriculture, Environment and Natural Resources Division, ADB, 7 Sept

Dr. Achmad Suryana, director general, Indonesian Agency for Agricultural Research and Development, 4-5 Sep

Developing member country (DMC) officials, ADB, 16 Sep

Dr. Kay Porter, director of rice research, Pioneer Hi-Bred International, Inc., 25-27 Sep

Dr. Selvam Ramaraj, vice president, Industrial Malaysian Biotechnology Corporation, 1 Oct

Dr. Richard Jefferson, CEO, CAMBIA, Australia, 5 Oct

Ms. Amelia Goh, communications officer, CGIAR Gender and Diversity Program; molecular genetics researcher, Worldfish Center, 11 Oct

Mr. Erin Zink, scientific program coordinator for social sciences, International Foundation for Science, 11 Oct

Dr. Hu Peisong, head, Department of Program Management and International Cooperation, China National Rice Research Institute, 18 Oct

Dr. Larry Beach, biotechnology advisor, United States Agency for International Development, Washington, D.C., 26 Oct

Prof. Timothy Reeves, Australian Centre for International Agricultural Research, 13 Nov

Dr. Guomin Sui, director general, Liaonin Rice Research Institute, 5 Dec

Prof. Huang Xingqi, president, Yunnan Academy of Agricultural Sciences, 7-8 Dec

Dr. Xu-rong Mei, director general, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, 11-13 Dec

Ms. Chen Yidan, president, Longping International Company, 22 Dec

Mr. Zhou Chengsu, vice president, Longping International Company, 22 Dec

Mr. Md. Muklesur Rahman, chair, and Mr. Sohrabuddin Khon, joint director, Bangladesh Agriculture Development Corporation.

Members of the diplomatic corps

H.E. Muhammad Abul Quashem, ambassador of the People's Republic of Bangladesh to the Philippines, 31 Mar

H.E. Muhammad Naeem Khan, ambassador of the Islamic Republic of Pakistan to the Philippines, 9 May

H.E. W.M. Senvirathna, ambassador of the Democratic Socialist Republic of Sri Lanka to the Philippines, 6 Jun

Mr. Cleveland Charles, deputy economic counselor, Embassy of the United States of America, Manila, 21 Mar

H.E. Prof. Dr. Irzan Tandjung, ambassador of the Republic of Indonesia to the Philippines, 26 Jul

H.E. Peter Beckingham, ambassador of the United Kingdom of Great Britain and Northern Ireland to the Philippines, 26 Sep

Ms. Debra Benavidez, economic officer, and Ms. Maria Theresa Villa, economic specialist, Embassy of the United States of America, Manila, 14 Nov

H.E. Vu Xuan Truong, ambassador of the Socialist Republic of Vietnam to the Philippines, 4 Oct

VIS Table 2. International and regional conferences, workshops, symposia, and meetings hosted or cosponsored by IRRI in 2005.

Date	Title	Venue	Participants (no.)	Countries represented (no.)
13-14 Feb	The Impact of Rice Production on Environmental Sustainability: Development of Environmental Sustainability Indicators Workshop I—Biological Indicators	IRRI	25	2
14-16 Feb	Project Review and Planning Meeting of ADB-supported Project	Pakistan	39	5
22-24 Feb	Message Design Workshop: Environmental Radio Soap Opera for Rural Vietnam	Vietnam	28	2
6-8 Mar	International Dialogue on Rice and Water: Exploring Options for Food Security and Sustainable Environments	IRRI	52	9
6-9 Mar	Fifth Annual Meeting of the Consortium for Unfavorable Rice Environments (CURE) and Natural Resource Management Workshop	Bangladesh	79	12
20-24 Mar	Climate Change and Rice Planning Workshop	IRRI	55	12
30-31 Mar	2nd Annual Meeting of CPWF Project 10, "Managing Water and Land Resources for Sustainable Livelihoods at the Interface between Fresh and Saline Water Environment in Vietnam and Bangladesh"	IRRI	28	5
3-4 Apr	Aerobic Rice: Progress and Prospects	IRRI	70	12
5-6 Apr	Preliminary Planning Meeting of the ADB-funded RETA project on Development and Dissemination of Water-saving Rice Technologies in South Asia	IRRI	33	7
5-7 Apr	IRRI Board of Trustees Meeting	IRRI	15	10
25-27 Apr	2nd Annual Review and Planning Meeting of CPWF Project 7, "Development of Technologies to Harness the Productivity Potential of Salt-affected Areas of the Indo-Gangetic, Mekong, and Nile River Basins"	India	65	6
2 Jun	World Environment Day 2006: Launching Ceremony	Vietnam		3
17-21 Jul	Supercharging the Rice Engine: C4 Rice Workshop	IRRI	61	8
24 Jul–4 Aug	IRRI Training Workshop: Concepts and Tools for Agricultural Research Evaluation and Impact Assessment	IRRI	25	11
21-23 Aug	The Impact of Rice Production on Environmental Sustainability: Workshop on the Development of Sustainability Indicators	Malaysia	50	6
29-30 Aug	Differential System for Blast Resistance for a Stable Rice Production Environment and Work Plan Meeting for JIRCAS Research Project	IRRI	27	13
13 Sep	IRRI-Philippines Workplan Meeting	Philippines	44	1
25-26 Sep	Inception Meeting of the ADB-supported Project: Development and Dissemination of Water-saving Rice Technologies in South Asia	IRRI	39	6
27 Sep	Workshop on Soil and Root Health Issues in Water-saving Rice Systems	IRRI	39	6
2-6 Oct	Drought Frontier Project Planning Workshop	IRRI	17	10
9-13 Oct	International Rice Congress	India	1,400	46
11-13 Oct	IRRI Board of Trustees Meeting	India	17	10
13-14 Oct	CORRA Meeting	India	32	17
6-8 Nov	LEARN-IT Planning Meeting	Thailand	31	6
7-8 Nov	2nd Annual Meeting of GCP, "Revitalizing Marginal Lands: Discovery of Genes for Tolerance for Saline and Phosphorus-deficient Soils to Enhance and Sustain Productivity	IRRI	36	7
17 Nov	IPMO Annual Meeting	IRRI	24	10
4-8 Dec	Assessing the Potential of Rice-maize Systems in Asia	IRRI	23	9
Total			2,354	

Media

For the Philippine and International media, VIS arranged programs for visits, interviews, and filming in 2006.

Philippine media: AP Television, *The Philippine Star*, ABS-CBN, and *Philippine Daily Inquirer*

International media: TV MBN, Radio CBS (Korea), SciDev Net (London), MMTV Film Production (Germany), Reuters, Bloomberg/Newsroom, Arte F2 and F3, Public Channels, Singing Nomads Productions (Victoria, Team Europe (Russia), China Central Television (China), Cloud South Films Ltd., Info Resources (Switzerland), SciTech (China), *Science Magazine* (Japan), *Nature* (United Kingdom) BBC World Service (United Kingdom), Dow Johnson News-wires (Chicago), *China Daily*, Netscribes PVT. Ltd. (India), United Media (New York), *Seed Magazine* (New York), Hat Trick Production (London), *Catholic Daily* (Italy), Agence France-Presse (AFP) Television, *The Wall Street Journal*, The Development Newswire, BBC Radio, Newsmaker (Washington, Cinema Vision (India)

Press releases. VIS issued 17 press releases during 2006

- Crop development efforts get major boost (24 January)
- Indian President focuses on farmers (7 February)
- The green revolution comes to Laos (15 March)
- Climate change: the rice genome to the rescue (27 March)
- The direct approach: South Asian rice farmers look for more efficient ways to plant rice (6 April)
- The direct approach: South Asian rice farmers look for more efficient ways to plant rice (7 April)
- A rice future for Asia (26 April)
- A cleaner, greener rice industry (5 June)
- Examining a tricky issue and inspiring the future of rice in Asia (29 June)
- International rice industry prepares to gather in India (12 July)
- A more powerful and efficient engine for rice: the C3-C4 challenge (26 July)
- New flood-tolerant rice offers relief for world's poorest farmers (9 August)
- IRRI genebank helps protect Philippine crops (5 October)
- Typhoon blasts rice research institute (2 October)
- Media Alert (5 October)
- A new vision for international rice research attacks the roots of P (9 October)
- Change in IRRI's copyright policy to facilitate the free exchange of vital information (20 October)

In conjunction with CPS, four issues of *Rice Today* were published and distributed to more than 2,425 subscribers in more than 98 countries and 4 on line *IRRI Hotline* issues were released to 2,583 recipients.

INFORMATION TECHNOLOGY SERVICES

The Information Technology Services team improved several aspects of the IRRI IT infrastructure, including a major upgrade of network storage and an increase of Internet connectivity to a total of 8 mbps. The introduction of managed printing and copying services moves IRRI toward a more efficient and environment-friendlier 'fleet printing model' consisting of distributed high-end print/scan/copy/fax devices plus a printing and copy center for high-volume jobs.

Professional development of IRRI's staff and scholars in the information technology area saw a large number of course participants and a record amount of people passing industry-standard certification exams. All staff members are now required to pass the locally developed Computer Security Awareness test, which is accompanied by a training session. The IRRI Cybercafé (actually the ITS training room after working hours, no coffee but plenty of Java) has become popular with staff and scholars. ITS team members participated in several professional training events both in the Philippines and in the region.

The connection to the Asia Pacific Advanced Network (APAN), a network of research institutions that interconnects to similar networks in other parts of the world, continues to enable collaboration with partners in other research organizations. The consortium of Advanced Research Networks (ARNs), also known as Internet 2, has features including the rapid transfer of very large datasets, broadcast-quality multi-party videoconferencing sessions, grid computing, and access to specialized databases. Use of ARNs within the CGIAR system was expanded as a result of the Information and Communication Technology/Knowledge Management (ICT/KM)-funded project, which enabled the connection of CIP and CIMMYT to ARNs in their regions, and laid the foundation for several other centers to follow suit.

IRRI also played a lead role in the CGIAR Enterprise Security and Business Continuity (ESBC) project. A security scan of IRRI's ICT infrastructure was extremely useful, and acted as an eye opener for many. The results of a 'social hacking' exercise were particularly revealing and confirmed the need for professional development of center staff in the use of IT networks. The documentation of the IRRI IT infrastructure was enhanced as a result of the report, with improved policies and procedures where required.

To mobilize the global network of rice researchers that have at any point in their career spent time at IRRI, the alumni project is seeking to collect contact information of all alumni. In addition, the www.irrialumni.org Website was set up using free Web hosting resources, complete with e-mail accounts for all interested alumni. This effort forms part of

activities in IRRI's newly developed MTP to create online communities in rice research by applying existing social networking tools.

Towards the end of 2006, Paul O'Nolan left the position of head of ITS unit after 7 years with IRRI. His contributions are illustrated by IRRI's admission to the "CIO 100 honouree 2006" of *CIO Asia* magazine's annual index of Asia's top-performing enterprise users of IT.

SEED HEALTH UNIT

Phytosanitary certification

The Seed Health Unit issued 355 phytosanitary certificates covering 74,788 seedlots (26,709.60 kg) and sent to 57 countries worldwide in 2006 (SHU Table 1). By region, East Asia received 83 rice seed shipments (8,224 seedlots weighing 25,100.320 kg), Europe received 44 rice seed shipments (2,283 seedlots weighing 25.98 kg); Latin America received 15 rice seed shipments (692 seedlots weighing 7.67 kg); North America received 32 rice seed shipments (6,829 seedlots weighing 142.74 kg); Oceania received 12 rice seed shipments (638 seedlots weighing 9.81 kg); South Asia received 48 rice seed shipments (22,425 seedlots weighing 305.42 kg); Southeast Asia received 101 rice seed shipments (32,532 seedlots weighing 1,072.16 kg); sub-Saharan Africa received 9 rice seed shipments (825 seedlots weighing 26.02 kg); West Africa received 2 rice seed shipments (58 seedlots weighing 1.33 kg); and West Asia and North Africa received 9 rice seed shipments (282 seedlots weighing 18.15 kg).

The exported rice seeds originated from different organizational units: International Network for Genetic Evaluation of Rice (INGER), 23 shipments (1,090 seedlots weighing 58.59 kg); Crop and Environmental Sciences Division (CESD) 13 shipments (417 seedlots weighing 191.04 kg); Genetic Resources Center, 138 shipments (56,817 seedlots weighing 755.12 kg); Grain Quality, Nutrition and Postharvest Center (GQNPC), 30 shipments (480 seedlots weighing 1.11 kg); and Plant Breeding, Genetics and Biotechnology Division (PBGB), 151 shipments (15,984 seedlots weighing 25,703.74 kg) (SHU Table 2).

The different pathogens detected with corresponding detection level and affected seedlots are shown in SHU Table 3. Routine seed health tests conducted on 10,374 nontreated, outgoing seedlots showed that *Curvularia* spp. affected 99.80% of the seedlots, followed by *Phoma* spp., 97.84%, *Sarocladium oryzae*, 75.97%, *Nigrospora* spp., 74.91%, *Fusarium moniliforme*, 55.15%, *Trichoconis padwickii*, 52.07%, *Microdochium oryzae*, 9.42%, *Bipolaris oryzae*, 2.17%, *Tilletia barclayana*, 0.34%, *Aphelenchoides besseyi*, 0.31%, and *Pyricularia oryzae*, 0.24 %. 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.

A total of 71 phytosanitary certificates were also issued to INGER for their nursery rice seed distribution covering 26,662 seedlots (676.49 kg) and sent to 36 countries worldwide (SHU Table 4). By region, East Asia received 17 shipments (4,058 seedlots weighing 104.80 kg); Europe received 8 shipments (1,008 weighing 26.29 kg); Latin America received 6 shipments (3,195 seedlots weighing 73.20 kg); South Asia received 14 shipments (10,743 seedlots weighing 269.30 kg); Southeast Asia received 15 shipments (4,448 seedlots weighing 123.20 kg); sub-Saharan Africa received 6 shipments (886 seedlots weighing 24.80 kg); and West Asia and North Africa received 5 shipments (2,324 seedlots weighing 54.90 kg).

Post-entry clearance

Sixty-one incoming rice seed shipments (covering 7,908 seedlots and weighing 191.224 kg) from 23 countries worldwide were also processed for post-entry clearance (SHU Table 5). The highest total number of rice seed shipments originated from Southeast Asia, with 19 shipments, while the highest total number of seedlots and total weight originated from East Asia with 6,332 seedlots weighing 103.07 kg. The consignees of these seed shipments are shown in SHU Table 6. Plant Breeding, Genetics and Biotechnology received the highest number of incoming rice seed shipments with 31 shipments (6,595 seedlots weighing 137.40 kg); followed by GQNPC, 10 shipments (226 seedlots weighing 7.50 kg); CESD, 7 shipments (497 seedlots weighing 20.24 kg); INGER, 7 shipments (72 seedlots weighing 11.06 kg); GRC, 4 shipments (474 seedlots weighing 14.38 kg); IPMO, 1 shipment (32 seedlots and 0.42 kg); and Intellectual Property Management Unit (IPMU), 1 shipment (12 seedlots weighing 0.22 kg).

SHU Tables 7a and 7b show the result of post-entry examination conducted on incoming 1,838 seedlots. Out of the visually inspected seedlots, 0.00 % were contaminated with weed seeds, 0.11 % had seeds with soil, and 0.29% were damaged by insects mainly by *Sitotroga cerealella*. In terms of general quality, 1, 378 seedlots (74.97%) were under category 3. The seed health tests on 146 incoming nontreated rice seedlots showed that *Trichoconis padwickii* affected 90.41%, followed by *Curvularia* spp. 89.04%, *Bipolaris oryzae* (82.88%), *Sarocladium oryzae* (60.96%), *Phoma* spp.

(57.53%), *Fusarium moniliforme* (48.63%), *Nigrospora* spp. (41.78%), *Microdochium oryzae* (25.34%), *Tilletia barclayana* (22.06%), and *Pyricularia oryzae* (1.37%) (SHU Table 8). The results also show that none of the incoming seedlots were infected with *Aphelenchoides besseyi*. The prescribed ASEAN standard treatments were applied to all incoming seeds.

Crop inspection

Crop health inspections were conducted on post-entry quarantine areas and GRC, PBGB, CESD, and GQNPC multiplication plots during the 2006 dry and wet seasons. Post-entry crop health inspection was conducted on 1,909 entries during the dry season and 4 entries during the wet season. Furthermore, preexport crop health inspection was also conducted on 8,325 entries during the dry season and on 13,658 entries during the wet season. SHU Table 9 shows the different diseases observed with corresponding percentage prevalence. For incoming materials, the most prevalent disease observed during the dry season was rice tungro (11.16%), while the most prevalent disease observed during the wet season was bacterial leaf streak (100%). On the other hand, for materials planted in the multiplication plots, the most prevalent disease observed during the dry season was *Sclerotium* seedling blight (42.10%), while the most prevalent disease observed during the wet season was bacterial leaf streak (20.10%).

Advance testing for GRC seeds

A total of 4,560 GRC seedlots for long-and medium-term storage were processed for seed health status. The different fungi detected with corresponding detection level and affected seedlots are shown in SHU Table 10. Routine seed health testing on 2, 328 untreated seedlots revealed that *Curvularia* spp. affected 99.96% of the seedlots, followed by *Phoma* spp., 93.77%, *Trichoconis padwickii*, 92.27%, *Nigrospora* spp., 68.51%, *Sarocladium oryzae*, 48.28%, *Bipolaris oryzae*, 43.69%, *Fusarium moniliforme*, 33.38%, *Microdochium oryzae*, 5.93%, *Aphelenchoides besseyi*, 2.96%, *Pyricularia oryzae*, 1.63%, and *Tilletia barclayana*, 0.17%

Nonseed biological materials and soil samples

Outgoing (exported). Through the SHU, a total of 71 shipments covering 5,897 samples were processed for phytosanitary certification and sent to 16 countries worldwide (SHU Table 11). By region, East Asia received 11 shipments covering 1,334 samples; Europe received 15 shipments covering 1,477 samples; Latin America received 2 shipments covering 12 samples; North America received 25 shipments covering

2,626 samples; South Asia received 2 shipment covering 14 samples; Southeast Asia received 9 shipments covering 37 samples, and sub-Saharan Africa received 3 shipments covering 254 samples. SHU Table 12 shows the nature of nonseed biological materials with corresponding total number of shipments and total number of samples exported by IRRI during 2006. The highest number of exported non seed biological materials was DNA with 26 shipments covering 2,670 samples, followed by RNA with 13 shipments covering 1,284 samples. The nonseed biological materials came from various organizational units: CESD with 10 shipments covering 1,203 samples of various materials; GQNPC with 2 shipments covering 6 samples of various materials; GRC with 12 shipments covering 1,234 samples of various materials; and PBGB with 47 shipments covering 5,897 samples of various materials (SHU Table 13).

Incoming (imported). Twenty-seven shipments (1,150 samples) coming from four regions were also processed for post-entry clearance (SHU Table 14). The highest number of shipments originated from Europe (14 shipments), while the highest number of samples originated from Southeast Asia (718 samples). SHU Table 15 shows the nature of incoming materials with corresponding total number of shipments and total number of samples. The highest number of incoming materials were ground soil, charcoal, fertilizer, and water with 450 samples, followed by rice ground leaf powder with 276 samples. The recipients of these incoming materials were CESD with 21 shipments covering 959 samples, which consisted of various materials; IPMO with 4 shipments covering 160 samples, which consisted of various materials; and PBGB with 2 shipments covering 31 samples, which consisted of various materials.

Workshops, training courses, and visitors

SHU also participated in various trainings/workshops coordinated by the Training Center, Rice Production Course with 15 participants from 6 countries; Upland Rice Variety Selection Techniques (for African countries) Training Course with 11 participants, and Rice Camp 2006 with 10 Thais and 9 Filipino high school students as participants.

Other visitors included two plant quarantine officers and one administrative officer from Korea (Seed Multiplication Project); 15 Seed Pathology students and 2 professors from Central Luzon State University, Muñoz, Nueva Ecija; 10 Biology students from the Adventist University of the Philippines; 32 Agronomy 170 (Seed Technology) students from UPLB; scientists from INIA, Spain; head of Information Network, RDA Genebank, National Institute of Agricultural Biotech; two visitors from Chile – director of Department of

Plant Science, School of Agriculture & Forestry, Catholic University of Chile and assistant manager for Arroceros, Tucapel; one USDA technical consultant together with 2 Philippine Plant Quarantine Service Officers; 18 women farmers from Central Luzon who are Members of the *Pambansang Koalisyon Ng Kababaihan sa Kanayunan*;

25 health workers who are members of the Alegheny County Medical Alliance, Young Filipino American of Pittsburg (YPAP), and *Pagmamahal sa Kapwa* Foundation, Inc; four JICA delegates ; two representatives of Pioneer, Inc., and one plant quarantine officer from USDA-APHIS, Beltsville, Maryland, USA.

SHU Table 1. Distribution, by region and country, of rice seeds exported by IRRI, 2006.

Region/country	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)	Region/country	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)
East Asia (6)				South Asia (5)			
Hongkong	1	1	.060	Bangladesh	7	293	12.039
Japan	23	1,048	9.982	India	36	21,858	289.908
Korea N	2	89	1.460	Nepal	2	193	1.800
Korea S	8	4,564	25,064.446	Pakistan	2	59	1.370
China, PR	43	2,396	23.347	Sri Lanka	1	22	.300
Taiwan	6	126	1.025	Subtotal	48	22,425	305.417
Subtotal	83	8,224	25,100.320	Southeast Asia (8)			
Europe (14)				Indonesia	5	129	.688
Austria	3	33	.666	Laos	5	25,694	297.600
Belgium	2	6	.080	Malaysia	3	37	.324
Czechoslovakia	1	1	.015	Myanmar	6	103	15.910
Denmark	1	3	.225	Philippines	58	6,086	746.708
France	4	1,036	5.745	Singapore	4	22	.581
Germany	7	45	2.539	Thailand	7	172	7.136
Italy	1	7	.190	Vietnam	13	289	3.211
Netherlands	2	4	.038	Subtotal	101	32,532	1,072.158
Portugal	1	36	.190	Sub-Sahara Africa (7)			
Russia	2	28	2.198	Ethiopia	1	9	.419
Spain	4	97	1.215	Ghana	2	24	.390
Sweden	2	42	.963	Nigeria	1	599	16.900
United Kingdom	13	594	3.418	Rwanda	1	102	3.900
Uzbekistan	1	351	8.500	Somalia	2	75	3.060
Subtotal	44	2,283	25.982	South Africa	1	15	.148
Latin America (8)				Togo	1	1	1.200
Brazil	2	53	.234	Subtotal	9	825	26.017
Chile	2	35	2.257	West Africa (1)			
Colombia	5	331	1.677	Benin	2	58	1.333
Cuba	1	17	.024	Sub-total	2	58	1.333
Ecuador	1	90	1.300	West Asia & North Africa (4)			
Surinam	1	103	1.300	Egypt	3	197	16.200
Uruguay	1	17	.024	Iran	4	76	1.838
Venezuela	2	46	.854	Israel	1	1	.010
Subtotal	15	692	7.670	Turkey	1	8	.100
North America (2)				Subtotal	9	282	18.148
Canada	4	92	1.095	Grand total			
USA	28	6,737	141.644	355	74,788	26,709.595	
Subtotal	32	6,829	142.739				
Oceania (2)							
Australia	10	513	5.521				
Papua New Guinea	2	125	4.290				
Subtotal	12	638	9.811				

SHU Table 2. Sources of exported rice seeds exported by IRRI, 2006.

Pathogen	Affected seedlots ^a (%)	Detection level (%)	Mean (%)
International Network for Genetic Evaluation of Rice (INGER)	23	1,090	58.590
Crop and Environmental Sciences Division (CESD)	13	417	191.043
Genetic Resources Center (GRC)	138	56,817	755.117
Grain Quality, Nutrition, and Postharvest Center (GQNPC)	30	480	1.105
Plant Breeding, Genetics & Biotechnology (PBGB)	151	15,984	25,703.740
Grand total	355	74,788	26,709.595

^aBased on 200 seeds/seedlot drawn for testing (n=784).

SHU Table 3. Seedborne pathogens detected on untreated outgoing seeds received by SHU for phytosanitary certification, 2006.

Pathogen	Affected seedlots ^a (%)	Detection level (%)	Mean (%)
<i>Trichoconis padwickii</i>	52.07	1–62	2.52
<i>Curvularia</i> spp.	99.80	1–95	12.56
<i>Sarocladium oryzae</i>	75.97	1–60	3.28
<i>Microdochium oryzae</i>	9.42	1–6	1.08
<i>Fusarium moniliforme</i>	55.15	1–16	1.47
<i>Bipolaris oryzae</i>	2.17	1–3	1.04
<i>Phoma</i> spp.	97.84	1–94	11.80
<i>Pyricularia oryzae</i>	0.24	1–24	2.72
<i>Nigrospora</i> spp.	74.91	1–92	8.53
<i>Tilletia barclayana</i>	0.34	1–90	9.51
<i>Aphelenchoides besseyi</i> ^b	0.31	1–3	1.41

^aBased on 200 seeds/seedlot for testing (n=10,374) ^bActual nematode count using sedimentation test.

SHU Table 4. Distribution, by region and country, of rice seeds exported by IRRI through INGER, 2006.

Region/country	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)	Region/country	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)
East Asia (3)				Southeast Asia (7)			
Korea N	2	1,099	28.400	Indonesia	1	106	3.500
Korea S	1	636	17.400	Laos	2	443	10.700
China PR	14	2,323	59.000	Malaysia	1	544	12.100
Subtotal	17	4,058	104.800	Myanmar	2	641	27.400
Europe (5)				Philippines	3	595	16.000
France	1	92	1.500	Thailand	2	854	20.400
Italy	2	206	5.100	Vietnam	4	1,265	33.100
Russia	2	183	5.300	Subtotal	15	4,448	123.200
Spain	1	29	0.290	Sub-Saharan Africa (5)			
Uzbekistan	2	498	14.100	Ethiopia	1	66	2.300
Subtotal	8	1,008	26.290	Gambia	1	106	3.500
Latin America (6)				Mozambique	2	208	6.700
Brazil	1	1,236	20.700	Senegal	1	66	2.300
Ecuador	1	196	6.000	Sierra Leone	1	440	10.000
Nicaragua	1	642	17.600	Subtotal	6	886	24.800
Peru	1	462	11.700	West Asia & North Africa (4)			
Surinam	1	274	6.500	Afghanistan	2	1,045	21.000
Venezuela	1	385	10.700	Egypt	1	876	21.600
Subtotal	6	3,195	73.200	Iran	1	292	8.500
South Asia (6)				Turkey	1	111	3.800
Bangladesh	6	1,528	42.200	Subtotal	5	2,324	54.900
Bhutan	1	546	13.600	Grand total	71	26,662	676.490
India	3	6,267	153.600				
Nepal	2	1,108	25.600				
Pakistan	1	974	27.300				
Sri Lanka	1	320	7.000				
Subtotal	14	10,743	269.300				

SHU Table 5. Origin and corresponding total number of shipments, total number of seedlots, and total weight of rice seeds imported by IRRI, 2006.

Region/country	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)	Region/country	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)
East Asia (4)				South Asia (3)			
Japan	5	3,556	35,532	Bangladesh	4	182	9,660
Korea S	4	1,919	51,500	India	3	9	2,210
China, PR	7	856	15,963	Sri Lanka	1	3	.036
Taiwan	1	1	.075	Subtotal	8	194	11,906
Subtotal	17	6,332	103,070	Southeast Asia (8)			
Europe (3)				Cambodia	1	32	.423
Netherlands	1	100	2,200	Indonesia	1	67	.870
Spain	4	4	3,950	Laos	5	94	6,719
United Kingdom	1	40	.216	Malaysia	1	9	.204
Subtotal	6	144	6,366	Myanmar	1	27	1,400
Latin America (2)				Philippines	6	413	33,751
Colombia	1	20	8,500	Thailand	1	42	.570
Surinam	1	4	.624	Vietnam	3	365	13,725
Subtotal	2	24	9,124	Subtotal	19	1,049	57,662
North America (1)				West Asia & North Africa (1)			
USA	5	123	.789	Turkey	1	20	2,000
Subtotal	5	123	.789	Subtotal	1	20	2,000
Oceania (1)				Grand total	61	7,908	191,224
Australia	3	22	.307				
Subtotal	3	22	.307				

SHU Table 6. Consignees and corresponding total number of shipments, total number of seedlots, and total weight of imported rice seeds, 2006.

Consignee	Total shipments (no.)	Total seedlots (no.)	Total weight (kg)
Crop and Environmental Sciences Division (CESD)	7	497	20,240
Genetic Resources Center (GRC)	4	474	14,375
Grain Quality, Nutrition, and Postharvest Center (GQNPC)	10	226	7,502
International Network for Genetic Evaluation of Rice (INGER)	7	72	11,062
Intellectual Property Management Unit (IPMU)	1	12	0,223
International Programs Management Office (IPMO)	1	32	0,423
Plant Breeding, Genetics & Biotechnology (PBGB)	31	6,595	137,399
Grand total	61	7,908	191,224

SHU Table 7a. Results of visual inspection conducted on incoming rice seeds received by SHU for post-entry clearance, 2006.

Observation	Infested seedlots (no.)	Percent ^a
Weed-contaminated	0	0.00
Weeds		
<i>Echinochloa</i> spp.	0	0.00
<i>Ischaemum rugosum</i>	0	0.00
Insect-damaged	5	0.29
Insects		
<i>Sitotroga cerealella</i>	5	0.29
Seeds with soil	2	0.11

^aBased on 1,838 seedlots visually inspected.

SHU Table 7b. General quality of imported rice seeds received by SHU for post-entry clearance.

General quality ^a	Seedlots (no.)
Category 1	100
Category 2	215
Category 3	1,378
Category 4	145

^aBased on 1,838 seedlots visually inspected.

SHU Table 8. Seedborne pathogens detected on untreated outgoing seeds received by SHU for phytosanitary certification, 2006.

Pathogen	Affected seedlots (%)	Detection level (%)	Mean (%)
<i>Trichoconis padwickii</i>	90.41	1 – 64	24.62
<i>Curvularia</i> spp.	89.04	1 – 72	11.38
<i>Sarocladium oryzae</i>	60.96	1 – 38	5.83
<i>Microdochium oryzae</i>	25.34	1 – 4	1.35
<i>Fusarium moniliforme</i>	48.63	1 – 11	2.17
<i>Bipolaris oryzae</i>	82.88	1 – 46	4.45
<i>Phoma</i> spp.	57.53	1 – 25	4.30
<i>Pyricularia oryzae</i>	1.37	1 – 1	1.00
<i>Nigrospora</i> spp.	41.78	1 – 12	2.48
<i>Tilletia barclayana</i>	22.60	1 – 99	23.42
<i>Aphelenchoides besseyi</i> ^a	0.00	1 – 1	0.00

^aActual nematode count based on 200 seeds/seedlot (n=146).

SHU Table 9. Diseases^a observed on incoming and outgoing entries planted at post-entry quarantine areas (GRC, PBGB, CESD, and GQNPC seed multiplication plots and post-entry quarantine areas), dry and wet season, 2006.

Observation	Incoming				Outgoing			
	Dry-season entries	%	Wet-season entries	%	Dry-season entries	%	Wet-season entries	%
Bacterial leaf blight	0	0.00	0	0.00	6	0.07	0	0.00
Bacterial leaf streak	9	0.47	4	100.00	405	4.86	2,747	20.10
Bacterial stripe	1	0.05	0	0.00	0	0.00	1	0.01
Bakanae	0	0.00	0	0.00	5	0.06	0	0.00
Blast	8	0.42	0	0.00	7	0.08	10	0.07
False smut	1	0.05	0	0.00	46	0.55	18	0.13
Leaf scald	5	0.26	0	0.00	10	0.12	73	0.53
Narrow brown leaf spot	0	0.00	0	0.00	21	0.25	5	0.04
Rice tungro	213	11.16	2	50.00	1,029	12.36	459	3.36
Sclerotium seedling blight	11	0.58	1	25.00	3,506	42.10	309	2.26
Sheath blight	6	0.31	1	25.00	14	0.17	5	0.04
Sheath rot	49	2.57	0	0.00	36	0.43	36	0.26
Yellow dwarf	0	0.00	.	0.00	10	0.12	0	0.00
Dead entries	6	0.31	0	0.00	54	0.65	31	0.23
Entries without diseases	1,588	83.00	0	0.00	3,635	43.60	10,350	75.70
Total entries	1,909		4		8,325		13,658	

^aDiseases observed on plants originating from incoming seeds were not of an introduced nature.

SHU Table 10. Routine seed health test results of untreated GRC seeds for long-term storage (January to July, 2006).

Pathogen	Affected seedlots ^a (%)	Detection level (%)	Mean (%)
<i>Trichoconis padwickii</i>	92.27	1 – 46	5.73
<i>Curvularia</i> spp.	99.96	1 – 110	16.47
<i>Sarocladium oryzae</i>	48.28	1 – 72	3.10
<i>Microdochium oryzae</i>	5.93	1 – 5	1.17
<i>Fusarium moniliforme</i>	33.38	1 – 7	1.25
<i>Bipolaris oryzae</i>	43.69	1 – 10	1.16
<i>Phoma</i> spp.	93.77	1 – 101	4.12
<i>Pyricularia oryzae</i>	1.63	1 – 4	1.26
<i>Nigrospora</i> spp.	68.51	1 – 55	5.02
<i>Tilletia barclayana</i>	0.17	1 – 1	1.00
<i>Aphelenchoides besseyi</i> ^b	2.96	1 – 25	3.64

^aBased on 200 seeds/seedlot drawn for testing (n=2328).

^bActual nematode count using sedimentation test.

SHU Table 11. Distribution, by region and country, with corresponding total number of shipments, and total number of samples of nonseed biological materials exported by IRRI, 2006.

Region/country	Total shipments (no.)	Total samples (no.)	Region/country	Total shipments (no.)	Total samples (no.)
East Asia (3)			Oceania (1)		
Japan	5	673	Australia	4	143
Korea S	5	653	Sub-total	4	143
China, PR	1	8	South Asia (1)		
Subtotal	11	1,334	India	2	14
Europe (7)			Subtotal	2	14
Austria	1	15	Southeast Asia (1)		
Belgium	1	5	Philippines	5	20
France	6	733	Vietnam	4	17
Germany	2	371	Subtotal	9	37
Italy	2	265	Sub-Saharan Africa (1)		
Netherlands	1	38	Nigeria	3	254
United Kingdom	2	50	Subtotal	3	254
Subtotal	15	1,477	Grand total	71	5,897
Latin America (1)					
Peru	2	12			
Subtotal	2	12			
North America (1)					
USA	25	2,626			
Subtotal	25	2,626			

SHU Table 12. Nature of materials with corresponding total number of shipments and total number of samples of nonseed biological materials exported by IRRI, 2006.

Nature of materials	Total shipments (no.)	Total samples (no.)
5 TAQ polymerase enzyme, 60 commercial DNA markers (SSR), 1 RNase, 5 PCR buffer & 1 magnesium chloride	1	72
Antisera	5	19
Bacterial culture (<i>Pseudomonas fuscovaginae</i> isolates)	1	4
Bacterial culture (<i>Xanthomonas oryzae</i> pv. <i>oryzae</i> isolates)	1	12
Brown spot fungus	1	5
DNA	26	2670
DNA and nucleic acid primers	1	6
DNA and RNA	3	203
DNA of rice plants and Taq polymerase enzyme	1	136
DNA samples-PCR products	2	132
Dried mycelia in paper discs	1	3
Frozen leaf	1	11
Frozen roots	1	71
Giami rice granule-bound protein	1	1
Ground leaf samples	1	261
Ground leaf samples, soil samples and zinc sulfate	1	49
Ground straw samples	1	115
Home-made and commercial Taq polymerase, PCR buffer, DNA ladder and DNA weight stand	1	46
Isolates	1	2
Pollen mother cell of <i>O. brachyantha</i>	1	2
Rice main stems	1	648
RNA	13	1284
Roots, shoots (frozen tissues) and extracts	2	53
<i>Sesbania rostrata</i> seeds	1	1
<i>Sesbania</i> seeds	1	3
Soil dry and wet	1	88
Total	71	5,897

SHU Table 13. Sources of nonseed biological materials exported by IRRI, 2006.

Organizational unit	Total samples (no.)	Unit of measurement	Nature of materials
Crop and Environmental Sciences Division (CESD)	15	Tubes	DNA samples-PCR products
	49	Packets	Ground leaf, soil and zinc sulfate
	115	Envelopes	Ground straw samples
	648	Envelopes	Rice main stems
	372	Tubes	RNA
	1	Plastic bag	<i>Sesbania rostrata</i> seeds
	3	Plastic packets	<i>Sesbania</i> seeds
Subtotal 10	1,203		
Grain Quality, Nutrition, and Postharvest Center (GQNPC)	5	Tubes	Brown spot fungus
	1	Sterile microfuge tube	Giami rice granule-bound protein
Subtotal 2	6		
Genetic Resources Center (GRC)	703	Tubes	DNA
Subtotal 12	1,234		
Plant Breeding, Genetics & Biotechnology (PBGB)	72	Ependorf tubes	5 TAQ polymerase enzyme, 60 commercial DNA markers (SSR), 1 RNase, % PCR buffer and 1 magnesium chloride
	19	Tubes	Bacterial culture
	4	Ampoules	(<i>Pseudomonas fuscovaginae</i> isolates)
			Bacterial culture
	12	Tubes	(<i>Xanthomonas oryzae</i> pv. <i>oryzae</i> isolates)
			DNA
			DNA and nucleic acid primers
			DNA and RNA
			DNA of rice plants and Taq polymerase enzyme
			DNA samples-PCR products
			Dried mycelia in paper discs
			Frozen leaf
			Frozen roots
			Ground leaf samples
			Home-made and commercial Taq polymerase, PCR buffer, DNA ladder and DNA weight stands
			Isolates
			Pollen mother cell of <i>O. brachyantha</i>
		RNA	
		Roots, shoots (frozen tissues) and extracts	
		Soil dry and wet	
Subtotal 47	3,985		
Grand total 71	5,897		

SHU Table 14. Origin, total number of shipments, and total number of samples of imported nonseed biological materials, 2006.

Region/country	Total shipments (no.)	Total samples (no.)
Europe (1)		
Netherlands	14	29
Subtotal	14	29
Latin America (1)		
Mexico	1	20
Subtotal	1	20
South Asia (2)		
Bangladesh	3	372
India	1	11
Subtotal	4	383
Southeast Asia (4)		
Cambodia	4	160
Laos	2	143
Thailand	1	404
Vietnam	1	11
Subtotal	8	718
Grand total	27	1,150

SHU Table 15. Descriptions, total number of shipments, and total number of samples of imported nonseed biological materials, 2006.

Nature of materials	Total shipments (no.)	Total samples (no.)
Beech leaf dried ground plant samples	1	1
Corn ground-dried samples	2	17
Corn seeds	1	20
Fresh rice leaves	1	11
Grass ground dried plants(20 g); wheat ground dried plants(20 g); Melon ground plants(20 g); tulip tuber ground dried plants(20 g)	1	4
Grass ground-dried samples	1	1
Ground soil, charcoal, fertilizer, water	1	404
Melon dried-ground samples	1	1
Mungbean dried-ground plant samples	1	16
Pepper dried-ground plant samples	1	1
Potato ground plants (20 g); barley ground plants(20 g); <i>Lucerna</i> ground plants(20 g); Grass ground plants(20 g)	1	4
Reed ground-dried samples	1	1
Rice ground leaf powder	1	276
Rice plant ground samples	2	57
Rice straw dried samples	1	77
Soil ground dried samples	3	9
Soil samples	4	108
Soil, wheat grain, wheat straw and rice straw	1	11
Straw ground samples	1	130
Tulip ground	1	1
Total	27	1,150

SHU Table 16. Consignees of imported nonseed biological materials, 2006.

Organizational unit	Total samples (no.)	Unit of measurement	Nature of materials	Organizational unit	Total samples (no.)	Unit of measurement	Nature of materials
Crop and Environmental Sciences Division (CESD)	1	Packet	Beech leaf dried plants	Subtotal	130	Packs	Straw ground samples
	1	Packet	Corn ground-dried samples		1	Packet	Tulip ground
	4	Packets	Grass ground-dried plants, wheat ground-dried plants; melon ground-dried plants; tulip tuber ground-dried plants		21	959	
International Programs Management Office (IPMO)	1	Packet	Grass ground -dried samples	International Programs Management Office (IPMO)	16	Packets	Corn ground-dried samples
	404	Plastic bags	Ground soil, charcoal, fertilizer and water	16	Packets	Mungbean ground-dried plants	
	1	Packet	Melon ground-dried samples	56	Packets	Rice plant ground samples	
	1	Packet	Pepper ground-dried plants	72	Bags	Soil samples	
	4	Packets	Potato ground plants, barley ground plants; <i>Lucerna</i> ground plants; grass ground plants	Subtotal	2	160	
	1	Packet	Reed ground-dried samples	Plant Breeding, Genetics & Biotechnology (PBGB)	20	Packets	Corn seeds
	276	Vials	Rice ground leaf powder	11	Glassine bags	Fresh leaves	
	1	Packet	Rice plant ground samples	Subtotal	2	31	
	77	Packets	Rice straw dried samples	Grand total	27	1,150	
	9	Bottles	Soil ground dried samples				
	36	Bags	Soil samples				
11	Plastic bags	Soil, wheatgrain, wheat straw and rice straw					

GRAIN QUALITY, NUTRITION, AND POSTHARVEST CENTER

Grain quality evaluation services

GQNPC continued to provide rice quality evaluation services to the breeders using new and established methods. A total of 74,750 analyses were performed in 2006, slightly less than the total 78,000 analyses done in 2005. The decrease is likely due to more careful selection of breeders' lines for quality evaluation.

Of the total analyses, 75% was done on breeders' lines collected from the pedigree nurseries (PN), 20% from replicated yield trials (RYT), and hybridization blocks (HB). About 5% of grains evaluated were from the other programs (Korean and INGER).

Visual screening to evaluate the milling potential comprised 40% of work done on breeders' lines, while physical and cooking quality evaluation comprised 33% and 27%, respectively.

New and improved methods for quality evaluation

Physical quality evaluation. In collaboration with FOSS Tecator AB, the maker of the Cervitec™ 1625 Grain Inspector, work was done to improve the applicability of this instrument for physical quality evaluation of a wider range of rice varieties. This automated high-speed grain image inspection system evaluates physical qualities such as chalkiness and grain dimensions (length, width, area) as well as head rice and damaged kernels. The grains are separated by a rotating disk or wheel that has cavities of specific dimensions to capture each grain. Images of each grain in the cavities are then evaluated using a factory precalibrated system based on artificial neural network technique.

Initial trials showed that the two wheels provided with the instrument (for medium and long grains) were not giving accurate measurements for other rice types. When measuring the short type, two grains were sometimes captured in a cavity, which was recognized by the software as one grain or one small grain was misinterpreted as broken. Hence, GQNPC worked with FOSS to develop two new wheels with the right size and shape of cavities (for short fat and for short skinny rice) and the appropriate calibrations. The program for exporting data from the Cervitec to an MS Excel database was also updated.

In 2006, about 1,800 samples from breeders were evaluated for physical quality (chalkiness, broken, grain length and width) or about 5,400 analyses were completed using the improved Cervitec.

Micronutrient screening. A new instrument, a benchtop analytical Minipal4 energy dispersive X-ray fluorescence spectrometer (XRF), was acquired and set up by GQNPC as a high-throughput tool for screening varieties of rice naturally rich in minerals, specifically Fe, Cu, and Zn. The method is fast, easy to use, nondestructive, usually requiring minimum sample preparation and giving accurate multielement analysis in concentrations down to ppm levels. Analysis by XRF is both qualitative and quantitative. By measuring the energies emitted by the sample, it is possible to determine which elements are present; by measuring the intensities of the emitted energies, it is possible to determine the concentration of each element in the sample. Hence, when calibrated with appropriate standards, the XRF is also a versatile tool for studying other mineral elements and contaminants present in rice.

About 350 Lao colored rice varieties were screened for high Fe content using the Minipal4 XRF. The effect of parboiling on the micronutrient content of rice was also evaluated using this method.

Sample preparation. Delayed and unreliable evaluation results are usually traced to poor sample preparation. Rice milling (or polishing) and grinding are two of the time-consuming and labor-intensive steps in preparing samples for rice quality evaluation. Moreover, undermilling and improper grinding could lead to inaccurate results. To meet the need for a high-throughput, efficient and contamination-free sample preparation system, the use of paint shaker was explored for use in efficient polishing and grinding a large batch of samples.

For a long time, a test tube mill fabricated by Agricultural Engineering has been in use at the Quality Evaluation Lab to polish the limited number of grains from the breeders' pedigree nursery. About 3 g of unpolished rice is mixed with 2 g of an abrasive aluminum oxide in a test tube and 70 tubes are shaken vigorously for 1 h. Although the test tube mill is acceptable for polishing most rice samples, the crude design of the machine is unsuitable for laboratory use. Initial tests revealed that the paint shaker could perform the same task with the use of proper vial size and shaking time. Moreover, the device is more suitable for laboratory use because of its quiet and safe operation. It also has the added capability to pulverize grains with the use of appropriate sample capsules and grinding balls. Testing was done on several containers and balls of various sizes and materials. For micronutrient screening, it was found that polycarbonate tubes and tungsten carbide balls were suitable for contamination-free grinding of the rice samples. Since layers of sample tubes can be stacked

at one time, the paint shaker shows potential as a high-throughput sample preparation system for quality evaluation.

Cooking quality

Amylose content estimation by CT repeat and G/T polymorphisms. Apparent amylose is also determined using a DNA marker on exon 1 of granule bound *starch synthase*—the gene responsible for amylose synthesis. There are at least eight polymorphisms, so the marker is useful in a breeding program aiming to capture quality because progeny with the allele of the high-quality parent can be identified and progressed. The marker was used on 1,100 samples from pedigree nurseries and for the varieties in the hybridization block.

Fragrance detection by allele-specific amplification of FGR gene related to betaine aldehyde dehydrogenase. Our collaborators gave us the primers to detect a deletion in the gene that leads to the accumulation of fragrant compounds. We used the marker to screen for fragrance in many trials and in fragrant rices from the genebank. We also associated the presence of the fragrance gene with the amount of fragrant compounds in the rice, which are analyzed by gas chromatography.

SS11a snps for GT. Starch synthase 11a is the gene that contributes the most to the trait of gelatinization temperature. In one of our collaborative research projects, we discovered four single nucleotide polymorphisms (SNP) in the gene and we have developed markers to detect each functional SNP. This has not yet been introduced to the quality evaluation program.