Accelerating the impact of rice research

IRRI's ability to make positive and lasting contributions to poverty alleviation, food security, and sustainable management of natural resources depends on

- the quality and relevance of our research, and
- the effective evaluation, adaptation, and delivery of research products to users.

New high-yielding rice varieties and knowledge-based rice technologies can increase the productivity and efficiency of rice farming. The program, Accelerating the Impact of Rice Research (IM), draws available research results from the research programs, synthesizes them into usable technologies, and evaluates and adapts them to specific rice-growing conditions in collaboration with national agricultural research systems (NARS). The IM program has four projects:

- Strengthening partnership with NARS
- Delivery of knowledge-intensive technologies (KIT): Crop and Resource Management Network (CREMNET)
- Collecting, exchanging, and distributing knowledge and information about rice
- Human capital development of NARS rice professionals

Strengthening partnership with NARS

East and Southeast Asia

CAMBODIA

Varietal improvement

M. Sarom, O. Makara, P. Phon Hel, H. Yadana, and E. Javier

Farmer's yields and acceptance of Cambodia-IRRI-Australia Project (CIAP)-released, improved local, long-duration rice varieties (CAR4, CAR5, and CAR6) were measured during 1995-98. The varieties performed well in wide-ranging environments and cultural practices. All exceeded the farmer's best variety in yield (Table 1) and acceptability. CAR4 was the most preferred variety, with an average acceptance rate of 42%. The three varieties contribute significantly to higher production across 40% of the rice-growing area of Cambodia.

Farming systems agronomy

C. Phaloeun, T. Vuthy, S. Sakkhunthea, and H.J. Nesbitt

A technology package involving variety, land leveling, soil management, fertilizer, and integrated pest management (IPM) was tested during 1995-98 in rainfed lowlands in southeastern Cambodia. The technology increased rice yields by as much as 140% and farmers' income by 69%. However, farmers had to have off-farm income or ability to borrow money for investing in inputs to realize the full potential of the technology package.

Table 1. Mean yield (t ha^{-1}) of CAR4, CAR5, CAR6, and a local variety in on-farm adaptive trials in Cambodia, 1995-97.[a]

Variety	1995	1996	1997	Av
CAR4	2.8 ± 1.1 (23)	2.6 ± 1.0 (13)	3.1 ± 1.4 (15)	2.83± 1.2 (17)
CAR5	2.7 ± 1.1 (17)	2.5 ± 0.9 (9)	3.0 ± 1.4 (11)	2.73± 1.1 (13)
CAR6	2.8 ± 1.2 (23)	2.5 ± 0.9 (9)	3.1 ± 1.5 (15)	2.80± 1.2 (17)
Local variety	2.3 ± 0.9	2.3 ± 0.9	2.7 ± 1.2	2.43± 1.0

[a] Number in parenthesis indicates the percentage yield advantage over the local variety.

Table 2. Yield response of IR66 to cutting off leaves and stems at different crop stages.

Treatment	Mean yield (t ha^{-1})			
	Cutting off leaves (IR66)	Cutting off 50% stems (IR66)	Complete stem cutting (IR66)	Complete stem cutting (CAR11)
Cut off all seedling leaves	3.1	2.8	0	1.2
Cut off 50% of leaves at tillering	3.2	3.1	1.5	2.8
Cut off 50% of leaves at booting	2.6	2.5	0.5	0.4
Control	3.3	3.3	3.0	3.8

Crop protection and farming systems (socioeconomics)

P.G. Cox, G.C. Jahn, Mak Solieng, Chhorn Nel, Tuy Samram, K. Bunnarith, and P. Chanthy

Farmer participatory research for rat management. CIAP researchers worked with Catholic Relief Services during 1998 to identify weaknesses in farmers' rat management practices and make improvements in them. Farmers in nine villages already used traps and baits, which were complemented by rat hunts. The work helped farmers understand that destroying rats in their burrows in off-season improved control of rat populations.

Pest damage simulation. Four simulation trials in a glasshouse determined the types and levels of pest damage affecting rice yields at different crop stages. The results (Table 2) suggest that rice has considerable capacity to compensate for or recover from drastic damage at vegetative phase. Thus, it may not be necessary to manage pests that restrict their damage to leaves before panicle initiation (PI). Likewise, pests that cut tillers, such as rats, are likely to reduce yields after PI. Cutting off 50% of tillers at stem elongation did not reduce yields of IR66, which has the ability to grow new tillers, suggesting that IR66 could tolerate fairly heavy gall midge damage before PI.

Integrated nutrient management

N. Heer, P. White, and M. Sana

The recently introduced Cambodian Agronomic Soil Classification System (CASC) provides a simple means for agronomists and extension officers in Cambodia to identify and manage soils. A survey among 22 agronomists and extension officers in 6 provinces determined that CASC was used by all to

- identify the soil where their research trials were located, and
- help farmers identify their soils and determine appropriate fertilizer rates.

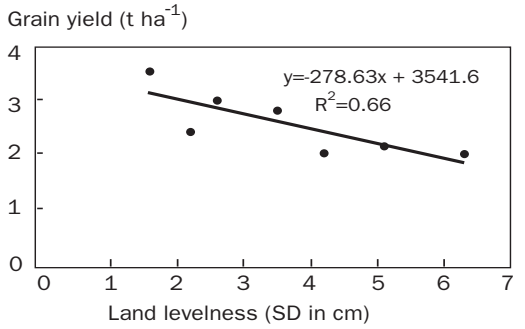
Agricultural engineering

J. Rickman, S. Bunna, and P. Sinath

Land leveling is used in Cambodia to improve water use efficiency and crop management in rainfed rice crops. Land leveling increased yields by more than 30%. Good land preparation and water management reduced weeding time from 21 to 5 d ha^{-1}. Leveling also increased the opportunity for direct seeding with 1 d ha^{-1} used, compared with 30 d ha^{-1} for transplanting. Water use efficiency was also improved by use of water from higher elevation fields to establish and improve crops in lower fields.

Yields in 1998 trials were compared in large fields (0.25–0.50 ha) with different degrees of levelness but with identical crop management and inputs. A strong correlation was found between yield and land levelness (Fig.1).

Animals, 2-wheel, and 4-wheel tractors have been successfully used to level fields with harrows and leveling boards. These techniques required total water coverage in the field. Four-wheel tractors were effective in leveling both wet and dry fields. The cost of land leveling with a tractor ranged from $3 to $5 per centimeter of soil moved per hectare. Contractors are presently charging double that amount. If appropriate plowing techniques are adopted, re-leveling should not be necessary for at least 8-10 yr.



1. Crop yield as affected by land levelness. CIAP, 1998.

CHINA

S. Tang and NARS staff

The International Rice Molecular Breeding Program was organized and will be initiated in 1999. Collaboration on hybrid rice will continue. Seeds of 261 Chinese rice varieties were sent to IRRI for research purposes.

INDONESIA

M. Syam and NARS staff

A rice crop intensification program involving the growing of a third crop of rice annually was launched in 1998. About 120,000 ha of irrigated lowland areas in five provinces of Java and Bali were covered. About 90% of the area had been harvested by Dec 1998 with an average yield of 5.3 t ha^{-1}. Field observations in Bali were that three IRRI lines (IR69075-1-1-3-2-11, IR69726-116-1-3, and IR71031-4-5-5-1) were highly resistant to tungro while IR64 was almost completely damaged by the disease.

LAO PDR

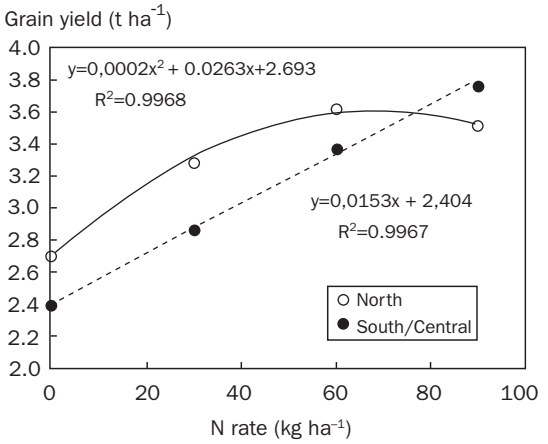
J. Schiller, B. Linquist, K. Fahrney, and NARS staff

The Swiss Agency for Development and Cooperation (SDC)-funded Lao-IRRI project started in Aug 1990 and is currently in its third phase. In Nov 1998, the SDC indicated in-principle support for a Phase 4 that will extend the project to Dec 2002.

Varietal improvement. By 1998, eight improved glutinous varieties had been released, five of which had IRRI genotypes in their parentage.

Plant nutrition. Four varieties and N rates from 0 to 120 kg ha^{-1} were compared in field trials in 1998 dry season (DS). Combined analyses across sites indicated significant variety and N effects, and variety × site interactions. The yield response to N was typically linear between 0 and 120 kg ha^{-1} for all varieties. Similar observations were made in rainfed lowland trials in wet season (WS).

The response of TDK1 to N in WS rainfed lowland trials was evaluated at 20 sites between 1993 and 1998. Average yield without N was 0.3 t ha^{-1}, lower in the southern and central Lao regions than in the north. In the south and central regions, the average yield response of TDK1 was linear between 0 and 90 kg N ha^{-1} (Fig. 2). In the north, yields did not increase with N rates above 60 kg N ha^{-1}. Lower solar radiation may contribute to the lower yield in the north.



2. Grain yield response of TDK1 in central and southern Lao PDR compared to northern Laos in rainfed lowland sites, 1993-98 WS.

Farming systems research. On-farm trials at rainfed lowland sites highlighted the potential for improving yields by use of simple technology packages based on use of improved varieties, fertilizer management, and agronomic practices. Average yield of adopters of the full package was 56% higher (3.4 t ha^{-1}) than partial adopters (2.3 t ha^{-1}), and 108% higher than nonadopters (1.6 t ha^{-1}) in Champassak Province. Average net return of adopters of the full package was 43% greater ($510) than partial adopters ($356) and 96% higher than nonadopters ($259).

JAPAN
T. Morinaka, K. Marooka, and NARS staff

IRRI Hotline Vol.8 and *News about Rice and People* were published in Japanese and copies of each issue distributed to news media, policymakers, rice researchers, and persons concerned in international cooperation. Selected articles of *Hotline* and *Science on Line* on the IRRI home page were also translated into Japanese and distributed.

MYANMAR
A. Garcia and NARS staff

Split application of urea improved efficiency of applied N. Results of 1997-98 DS experiments on irrigated rice were that gypsum (sulfur) application, combined with 4-6 split applications of urea N fertilizer gave higher yields than the farmers' practice of applying half the recommended rate (28 kg N ha^{-1}) during planting. Wet-season trials on upland rice in Kalaw, Shan State, showed that locally produced liquid BioSuper fertilizer partially substituted for N requirement.

A small credit scheme and community tree planting were successfully organized to support farmers. Fifty-eight Myanmar Agricultural Services researchers and extension workers participated in three in-country courses: Sustainability of the Community-based Natural Resource Management (25), Field Collection and Preservation of Rice Germplasm (23), and Introduction to Basic Geographic Information Systems (10).

South Asia

BANGLADESH
S. Bhuiyan and NARS staff

During the year, scientists from IRRI spent more than 170 d working with scientists from the Bangladesh Rice Research Institute (BRRI) and other organizations on several collaborative projects. Those included yield gap research and the megaproject Poverty Elimination Through Rice Research Assistance (PETRRA), which will start in 1999.

INDIA
R.K. Singh and NARS staff

Initial results of research on farmers' participatory breeding indicate that farmers' and breeders' selection criteria based on agronomic traits did not differ much. One of the early impacts of the project was manifested in terms of changing the mind-set of breeders. The interaction with farmers, as well as social scientists involved in the project, helped breeders to better appreciate the multiplicity of farmers' goals and the complexity of the environment.

East, Central, and Southern Africa (ECSA)
M. Gaudreau, V. Balasubramanian, and NARS staff

The inaugural Steering Committee Meeting of ECSA Rice Research Network (ECSARRN) was held at Entebbe, Uganda. An ECSARRN project

proposal was developed and submitted to the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) for review and funding by potential donors.

MADAGASCAR
M. Gaudreau and NARS staff

Collaborative research programs. The United States Agency for International Development (USAID)-funded Madagascar-IRRI Environment and Agriculture Research Project (US$1.5 M for 3 yr) started in Jan 1998. A program to collect, characterize, and test the pathogenicity of a fungus that attacks striga was established and trials on striga control in upland rice were set up. An experiment to determine the fungi most effective against black beetle (*Heteronychus)* was established.

Latin America and the Caribbean

V. Balasubramanian and NARS staff

The annual and Technical Advisory Committee meetings of the Caribbean Rice Industry Development Network (CRIDNet) and the annual meeting of the Caribbean Rice Association were held in Haiti in Feb 1998. IRRI provided limited research support to CRIDNet through rice germplasm and information exchange and provision of one chlorophyll meter each to Guyana and Cuba.

Delivery of knowledge-intensive technologies: Crop and Resource Management Network (CREMNET)

V. Balasubramanian, A.C. Morales, and NARS staff

Rice production technologies are becoming more location-specific, complex, and knowledge-intensive with movement toward high yields (8-10 t ha^{-1}) in farmers' fields. CREMNET is designed to facilitate the identification, free exchange, participatory evaluation, and promotion of promising technologies in rice farming.

Techniques for real-time N management in rice

The nutritional status of rice plants reflects the availability and uptake of nutrients from different sources. Simple tools are available to monitor crop N status and to apply fertilizers at the right time to meet crop demand.

CHLOROPHYLL METER

The chlorophyll meter, also called the SPAD meter, is a simple, portable diagnostic tool that monitors crop N status in the field. When properly calibrated to locally important rice varieties and crop-growing conditions, the SPAD meter serves as an efficient tool for developing need-based, variable-rate N application on rice crops.

A SPAD threshold value of 35 works well for semidwarf indica varieties in DS transplanted rice (TPR) systems in the Philippines. The value is reduced to 32 for WS TPR when solar radiation is low. However, the SPAD threshold values for TPR have to be kept at 35 for *kharif* (wet) season and 37-38 for *rabi* (dry) season in India to obtain high yields. This is probably due to higher solar radiation during both seasons in India.

For wet-seeded rice (WSR) in the Philippines, a SPAD threshold of 29-30 is optimum for broadcast WSR with a planting density of 800 productive tillers m^{-2}, and 32 for row WSR with 650 productive tillers m^{-2}. Thus, the critical SPAD value is inversely related to plant density, which varies with crop establishment methods.

We observed three outcomes with the use of the SPAD meter:

- An increase in grain yield but with a higher fertilizer N use. N use efficiency (NUE) was the same for both the farmers' practice and the SPAD method, indicating efficient fertilizer use by farmers. However, grain yield can be further increased with additional N application, e.g., Nueva Ecija, Philippines, 1996 DS (Table 3).
- A saving in N fertilizer use without reducing the grain yield. Here the NUE is higher for the SPAD method than for the farmers' practice, indicating the need for improving farmers' N management practice, e.g., Nueva Ecija, Philippines, 1996 WS; Sukamandi, Indonesia, 1996 DS (Table 3).
- An increase in grain yield and a reduction in N fertilizer use. In this case, farmers' NUE is low. Improvement in farmers' fertilizer use practice is needed to save N fertilizer and to

Table 3. Comparison of chlorophyll meter (SPAD) method with farmers' practice for N management in rice in four countries, 1996.

Site and season	Treatment	N used (kg ha^{-1})	Increase or decrease in N use (%)	Grain yield (t ha^{-1})	Increase or decrease in yield (%)
Nueva Ecija, Philippines 1996 DS	Control	0	–	3.7	–
	Farmers' practice	126	–	6.0	–
	SPAD	150	+ 19	6.7	+ 11
Nueva Ecija, Philippines 1996 WS	Control	0	–	3.2	–
	Farmers' practice	101	–	4.2	–
	SPAD	73	– 28	4.2	+ 0.1
Sukamandi, Indonesia 1996 DS	Control	0	–	4.8	–
	Local recommendation	90	–	6.6	–
	SPAD	60	– 33	6.5	– 0.8
New Cauvery Delta, TN, India 1996 DS	Control	0	–	5.3	–
	Local recommendation	125	–	6.5	–
	SPAD	60	– 52	7.1	+ 10
Cai Lay, Vietnam 1996 WS WSR	Control	0	–	2.8	–
	Local recommendation	120	–	4.0	–
	SPAD	70	–42	4.0	+ 2

increase rice yields, e.g., New Cauvery Delta, India, 1996 DS; Cai Lay, Vietnam, 1996 WS (Table 3).

The cost of a SPAD meter is US$1,400, which individual farmers cannot afford. However, field researchers, extension soil specialists, crop consultants, and farmer cooperatives can purchase SPAD meters to monitor crop N status and advise farmers on N fertilization. CREMNET has distributed 38 chlorophyll meters to various collaborators in Asia and the Caribbean for evaluation and adaptation to local conditions. Use of the SPAD meter technique by NARS is increasing in Bangladesh, India, Indonesia, Myanmar, Philippines, and Vietnam.

LEAF COLOR CHART

Farmers generally use leaf color as a visual indicator of the rice crop's need for N fertilizer. A Japanese prototype color chart was used by IRRI and PhilRice to develop an inexpensive leaf color chart (LCC) to determine the N fertilizer needs of rice crops. The chart contains six gradients of green color from yellowish green (No. 1) to dark green (No. 6). It is calibrated with the SPAD meter and used effectively for guiding N application in rice fields. A simple instruction sheet in the local language helps the farmer determine the correct time of N application to rice crops.

Use of the LCC promotes timely and efficient use of N fertilizer and can help minimize the pollution of surface and groundwater. The chart can be successfully adapted and used in irrigated and favorable rainfed rice ecosystems.

CREMNET will extend this technology to rice-growing countries of Asia, Africa, Latin America, and the Caribbean. Farmers in the Philippines and Vietnam were eager to use the simple and handy LCC to manage N in their rice crops. The Philippine Department of Agriculture distributed 15,000 color charts nationwide to agricultural extension agents and farmer-cooperators. About 5,000 charts were distributed to farmers in the Mekong Delta area of Vietnam. The Vietnamese farmers claim that adopting the color chart saved them 20-25% of N fertilizer, avoided lodging, and increased grain yield in WSR (Table 4).

Table 4. Comparison of leaf color chart (LCC) method with farmers' practice for grain yield and N use efficiency in the Philippines and Vietnam, 1996–98.

Site and season	Treatment	N used (kg ha^{-1})	Increase or decrease in N use (%)	Grain yield (t ha^{-1})	Increase or decrease in yield (%)
Nueva Ecija, Philippines 1996 WS; 17 farmers	Control	0	–	3.2	–
	Farmers' practice	101	–	4.2	–
	LCC	48	– 52	4.2	+ 0.4
Nueva Ecija, Philippines 1997 WS; 12 farmers	Control	0	–	3.5	–
	Farmers' practice	97	–	4.5	–
	LCC	87	–10	4.3	4.4
Cai Lay, Vietnam 1996 summer; WSR; 14 farmers	Farmers' practice	107	–	4.9	–
	LCC	64	– 40	4.9	+ 0.8
Cai Lay, Vietnam 1997-98 DS; WSR; 14 farmers	Farmers' practice	88	–	7.0	–
	LCC (3 critical values)	64	– 27	7.1	+ 1.4

Collecting, exchanging, and distributing knowledge and information about rice

I. Wallace, G. Hettel, B. Hardy, S. Inciong, M. Movillon, and staff

IRRI is a major disseminator of rice research information. Activities include

- Creating, producing, and disseminating information materials that cover rice research and related issues, that create public awareness, and that are accurate, interesting, and useful.
- Improving the publishing and disseminating of IRRI research results and promoting global exchanges of rice research information among scientists.
- Making rice research information accessible electronically.
- Maintaining the IRRI Library and Documentation Service as the world's major repository of rice literature and facilitating access to the collection by rice scientists worldwide.
- Serving as a convener, clearinghouse, and forum for dialogue among IRRI partners and IRRI in setting program strategies and priorities, planning rice research activities, sharing results, and promoting discussion on institutional and policy issues.
- Maintaining IRRI Riceworld as the world's leading museum devoted to rice culture.

Public awareness and general publications

AUDIENCES AND KEY MESSAGES

The public awareness program is aimed at raising global awareness of the importance of rice research and IRRI research products. Activities focus on donors, policymakers, news media, NARS, advanced research institutions, nongovernment organizations (NGO), farmers' organizations, and the general public.

Many journalists visited IRRI in 1998. At least 180 articles on rice and about IRRI were featured in leading publications in Sweden, Japan, Germany, Thailand, France, Hong Kong, Saudi Arabia, Republic of Korea, Malaysia, Italy, Lao PDR, Vietnam, United Kingdom, India, Bangladesh, USA, Myanmar, Australia, Canada, Indonesia, and the Philippines. These articles resulted from the story ideas provided by IRRI.

Six radio interviews were organized for IRRI staff to describe the Institute's major programs and key research issues on two Philippine radio stations, *BBC World Service Radio, Dutch National Radio, Australian Broadcasting Corporation,* and the *Science and Technology Report* of the United States. National and foreign TV film groups visited IRRI to produce special segments or documentaries about rice and the Institute. Articles about IRRI were featured on numerous worldwide web sites.

IRRI participated in four exhibitions—the International Cooperation Days in Japan (Oct), the University of the Philippines Los Baños (UPLB) Loyalty Day in the Philippines (Oct), the anniversary of the International Fund for Agricultural Development (IFAD) in Rome (Feb), and the Frankfurt Book Fair (Oct). The Institute gained special recognition from the *Far Eastern Economic Review:* winning a Silver Award for Asian Innovations.

COMMUNICATION MATERIALS

Five issues of the newsletter *Hotline* were produced in English and made available on the web. A corporate report, *IRRI 1997-1998: Biodiversity: Maintaining the Balance*, was published and distributed.

New editions of *Facts about Cooperation* (FAC) for 25 donors and rice-producing countries were published. A Japanese version of the FAC booklet for Japan was also published. A revised edition of *Facts about IRRI* was produced. A Chinese version of the IRRI slide show, *Filling the World's Rice Bowl*, was produced.

Scientific publishing

Nineteen titles were produced and distributed–10 IRRI books, 7 IRRI discussion papers, a new publications catalog, and the *Program Report for 1997.* A bibliography is provided in the section on publications and seminars near the end of this program report. Three of the IRRI books were dual imprints with the Pacific Basin Study Center, the Thailand Development Research Institute, and Kluwer Academic Publishers. A significant set of papers on nutrient use efficiency in rice cropping systems appeared in a special issue of *Field Crops Research* (Elsevier).

A complete revamping of the *International Rice Research Notes (IRRN)* started in 1998 with the appointment of an editorial board of scientists. The new *IRRN* will debut in April 1999 with a new look and features. *IRRN* has also been included in Cornell University's Essential Electronic Agricultural Library, which is a stand-alone compact disk library available only to scholars and students in developing countries. IRRN is also available on the Internet at http://www.cgiar.org/irri/irrn.htm.

IRRI's efforts on the worldwide web resulted in significant accomplishments. More than 50,000 user sessions (more than 200,000 successful hits) were recorded on the IRRI homepage (http://www.cgiar.org/irri). It had electronic versions of the *IRRN*, the *1997 Program Report*, *Bt* Gene Information Bulletin, Rolling MTP 1999-2001, *Sandiwa* (new monthly IRRI newsletter), and more than 200 abstracts from 10 recent IRRI conferences and workshops. The Riceworld site (http://www.riceworld.org) was redesigned and relaunched during International Centers' Week. The Riceweb site (http://www.riceweb.org) was recognized as a high-quality educational site by *USA Today* and *Dow Jones*, among others.

Successful credit card sales of IRRI books (through the German book vendor TRIOPS) began on the Internet via the IRRI homepage. Orders for more than 100 books were received from around the world.

Library and documentation service

IRRI Library continued providing scientific information about rice to scientists globally. An External Program and Management Review panel noted that "The Library is unparalleled in the world."

COLLECTIONS

The *Rice Bibliography* grew by 5,480 references, of which 66% were in English, 14% each in Chinese and Japanese, and the remaining 6% in other languages. The online portion of the *Rice Bibliography* covers literature from 1970 onward, more than 172,000 references.

The online Library Catalog, containing mostly book entries, grew to more than 33,000 bibliographic records, including 92 new dissertations on rice, from 10 different countries. The Library now has 1,370 active serial records and a growing collection of maps from many countries.

RELATIONS WITH NATIONAL AGRICULTURAL RESEARCH SYSTEMS (NARS)

The Library received requests for information by e-mail, from countries as far away as Uruguay and Mozambique. Most of these external correspondents had used the Library's Web site and were following up with specific queries.

Efforts were made to strengthen information ties with NARS partners, most notably during extended visits to IRRI Library by librarians from Indonesia, Japan, and Pakistan. The IRRI librarian provided library training in Bhutan and visited colleagues in Indonesia, Philippines, and Republic of Korea.

INFORMATION TECHNOLOGY

IRRI Library is fast becoming a library without walls as outside electronic resources form an important part of the collection. Clients now have access to a vast array of information that the IRRI Library does not own in the traditional sense, and that is not located within the library building. Additional links to electronic journals, newspapers, bookstores, libraries, and reference sources were added during the year. Connections were expanded to the web sites of partner institutes and organizations such as CAB International, the Food and Agriculture Organization, and research centers within and outside the Consultative Group on International Agricultural Research (CGIAR).

The Library provided web clients with a frequently revised list of forthcoming conferences of interest, often with electronic links to the organizers. Ties were also established with an on-line patent delivery service.

IRRI visitors, conferences, and workshops

IRRI welcomed about 71,000 visitors from 35 countries during 1998. Many came to observe IRRI's research activities and to explore the Riceworld Museum and Learning Center. Visitors included 2 heads of state, 13 state ministers, 10 ambassadors and members of the diplomatic corps, 7 donor representatives, and 16 representatives of international organizations. IRRI hosted or cosponsored 31 international and regional conferences, workshops, symposia, meetings and reviews, in which 1,249 nationals from 33 countries participated (Table 5).

Human capital development of NARS rice professionals

R. Raab and staff

IRRI, as a research and training institution, develops human resources of NARS to improve their capability for rice research. More than 12,000 degree

Table 5. International and regional conferences, workshops, symposia, and meetings hosted or cosponsored by IRRI in 1998.

Date	Title	Venue	Participants (no.)	Countries (no.)
12-16 Jan	Workshop on Quantification of Yield Losses due to Rice Pests and Analysis of Survey Data in Plant Protection II	IRRI	29	7
14-21 Jan	Sysnet Workshop on Exploratory Land Use Planning Methodology for Ilocos Norte Province, Philippines	Philippines	51	3
19-22 Jan	Planning and Implementation Workshop for Crop Loss Assessment and Rice Straw Management Research	IRRI	26	5
16-26 Feb	Sysnet Workshop on Multiple Goal Land Use Planning for Can Tho Province, Vietnam	Vietnam	38	3
26-28 Feb	Think Tank: Increasing the Impact of Engineering in Agricultural and Rural Development	IRRI	20	9

Table 5 continued.

Date	Title	Venue	Participants (no.)	Countries (no.)
24-25 Mar	Annual Workshop of the IRRI-India Participatory Plant Breeding Project	India	26	1
23-30 Mar	Land Use Systems Analysis Methodology for Haryana State, India	India	41	3
6-8 Apr	Management of Rodent Pests in Southeast Asia	IRRI	23	8
20-22 Apr	Prioritization of Rice Research in Asia	IRRI	24	9
03-09 May	Land Use Systems Analysis Methodology for Kedah-Perlis Region	Malaysia	34	1
11-13 May	Inaugural Meeting of the Project "Development and Use of Hybrid Rice in Asia"	IRRI	21	9
15-19 Jun	SysNet International Workshop on Exchange of Methodologies in Land Use Planning	Vietnam	180	9
17-20 Jun	Review and Planning Workshop for Themes I and II of IPM Network	Thailand	39	10
22-24 Jun	Scaling Methodologies in Ecoregional Approaches for Natural Resource Management	Vietnam	57	11
29-31 Jul	Workshop on Increasing Water Productivity and Efficiency of Rice-based Cropping Systems	IRRI	26	13
10-13 Aug	First Technical Committee Meeting of the Project "Development and Use of Hybrid Rice in Asia"	IRRI	11	7
24-28 Aug	IRRI-ACIAR Workshop on Strategic Research on Gender Issues in Rice-based Household Economy	IRRI	32	11
2-3 Sep	Workshop on USAID-sponsored IRRI-US University Collaboration	USA	29	3
16 Sep	Natural Resource Management in the Chao Phraya Basin: an Ecoregional Approach	Thailand	105	6
21-25 Sep	Irrigated Rice Research Consortium/ IPMNet/INMNet Joint Technical and Steering Committee Meetings	People's Republic of China	39	10
21-25 Sep	Upland Rice Research Steering and Technical Committee Meetings	Thailand	72	11
22-24 Sep	Third IPM Network Steering Committee Meeting	China	16	9
6-8 Oct	Steering Committee Meeting of the Project "Development and Use of Hybrid Rice in Asia"	India	12	7
12-15 Oct	Nutrient Research in Rainfed Lowland Rice	Thailand	75	14

Table 5 continued.

Date	Title	Venue	Participants (no.)	Countries (no.)
15 Oct	Rainfed Lowland Rice Research Consortium 9th Steering Committee Meeting	Thailand	14	7
20 Oct	Ecoregional Approach for Planning and Management of Land and Other Natural Resources in the Ayerwaddy Delta	Myanmar	14	1
9-10 Nov	Technical Workshop on Ecoregional Approaches for Natural Resource Management in the Red Basin, Vietnam	Vietnam	42	4
9-11 Nov	Workshop on Rice Tungro Management	IRRI	45	8
16-20 Nov	Center-Commissioned External Review (CCER) of the Rainfed Lowland Rice Program	IRRI	55	4
23-27 Nov	Research Methods for Studying Weed Succession	IRRI	10	7
30 Nov-2 Dec	Sysnet Technical Review Workshop	Thailand	25	3
1-3 Dec	Workshop on Genetic Improvement for Rice in Water-limited Environments	IRRI	47	12

Table 6. Participants in degree and postdegree training at IRRI, 1998.

PhD scholars			
Alam, Muhammed Murshedul	Bangladesh	Tran, Chi Thien	Vietnam
Biswas, Jatish Chandra	Bangladesh	Truong Van, Tuyen	Vietnam
Chharom, Chin	Cambodia	Cui, Kehui	China
Oberthur, Thomas	Germany	Fu, Binying	China
Muhsin, Muhammad	Indonesia	Jianli, Wu	China
Alinia-Gerdroudbari, Faramarz	Iran	Li, Luping	China
Fallah, Allahyar	Iran	Lu, Wenjing	China
Nouanthasing, Lasay	Lao PDR	Tu, Jumin	China
Ramanantsoanirina, Alain Marie Justin	Madagascar	Yahai, Lu	China
Razafinjara, Aime Lala	Madagascar	Yueqiu, He	China
Eow, Boon Tiak	Malaysia	Zhong, Daibin	China
Htet, Kyu	Myanmar	Zhong, Xiaoyan	China
Htut, U Tin	Myanmar	Zhong, Xuhua	China
Thet, Khin Maung	Myanmar	Ziqi, Wang	China
Winn, Tun	Myanmar	Baisakh, Niranjan	India
Khadka, Yajna Gajadhar	Nepal	Dey, Moul	India
Abbasi, Fida Mohammad	Pakistan	Kaur, Jatinder	India
Arif, Muhammad	Pakistan	Mathan, Natarajan	India
Asghar, Muhammad	Pakistan	Mitra, Sudip	India
Faiz, Faiz Ahmad	Pakistan	Nath, Palash Deb	India
Hussain, Fayyaz	Pakistan	Esfahany, Masoud	Iran
Ijaz, Muhammad	Pakistan	Naoyoshi, Kawano	Japan
Rillon Jr., Guillermo S.	Philippines	Okada, Kanako	Japan
Tado, Caesar Joventino M.	Philippines	Ojha, Gana Pati	Nepal
Trillana, Nemesio U.	Philippines	Bernardo, Eleuterio Noel	Philippines
Dirie, Ahmed Mohamoud	Somalia	Nghia, La Tuan	Vietnam
Lersupavithnapa, Boontium	Thailand	Deka, Nivedita	India
Cuong, Ngo Luc	Vietnam	Lourdusamy, Gabriel Stephen	India
Ngo, Ngoc Hung	Vietnam	Abdullah, Buang	Indonesia
Nguyen, Van Hong	Vietnam	Bhandari, Hum Nath	Nepal

Table 6 continued.

Trolove, Stephen Neil	New Zealand
Borines, Lucia	Philippines
Cabuslay, Gloria	Philippines
De Los Reyes, Jeannelyn	Philippines
Lumbo, Susanita	Philippines
Linwattana, Grisana	Thailand
Sripongpankul, Krishnapong	Thailand
Graw, Stephen	United States
Le, Cam Loan	Vietnam
Le, Thi Phuong	Vietnam
Tran, Thi Ut	Vietnam
MS scholars	
Sattari, Majid	Iran
Inthavong, Soulaphone	Lao PDR
Rasabandit, Sengpaseuth	Lao PDR
Andriantsimialona, Dodelys	Madagascar
Rakotomalala, R. Mbolarinosy	Madagascar
Adhikari, Chiranjibi	Nepal
Upadhyay, Bhawana	Nepal
Abao, Jr., Elias B.	Philippines
Ong, Marilyn A.	Philippines
Phengchanh Somphet	Lao PDR
Le Van, Lang	Vietnam
Ngo, Dang Phong	Vietnam
Nguyen, Thi Phong Lan	Vietnam
Thach, Thi Ngoc Anh	Vietnam
Truong, Thi Ngoc Chi	Vietnam
Shimizu, Akifumi	Japan
Varghese, Pulickal	India
Bhattarai, Kiran	Nepal
Alcantara, Jovencio	Philippines
Madamba, Reina Suzette	Philippines
Maghirang, Reycel DM	Philippines
Ulat, Victor Jun	Philippines
Nondegree on-the-job trainees	
Dema, Kezang	Bhutan
Golinowski, Shawn Paul	Canada
Richards, Barbara	Canada
Schnupf, Mirjam	Canada
Gao, Lizhi	China
Hu, Fengyi	China
Ma, Zhenrong	China
Wang, Ying	China
Xie, Xiaobo	China
Kurniawan, Hakim	Indonesia
Minantyorini	Indonesia
Setyowati, Mamik	Indonesia
Adachi, Shimpei	Japan
Jeong, Eung-Gi	Korea
Lakmaitry, Khamsone	Lao PDR
Abro, Abdul Haque	Pakistan
Askari, Ejaz	Pakistan
Bhand, Amir Ali	Pakistan
Oad, Gulshan Lal	Pakistan
Shah, Zahoor Hussain	Pakistan
Newingham, Ma. Cristina V.	Philippines
Barnard, Katherine Patricia	United Kingdom
Anh, Ta Hoang	Vietnam
Do Tuan, Khiem	Vietnam
Mai, Duong Thi Hong	Vietnam
Minh, Vo Quang	Vietnam
Nguyen, Thach Can	Vietnam
Nguyen, Van Tao	Vietnam
Tran, Danh Suu	Vietnam
Interns	
Manio, Denise	Australia
Chung, Carrie-Lee	Canada
Golinowski, Shawn Paul	Canada
Gray-Donald, James	Canada

scholarships, postdegree on-the-job training, and short-term group training fellowships have been provided to NARS scientists since 1961.

Degree and postdegree training

Degree and postdegree training provides rice scientists with opportunities to pursue a PhD or MS degree or acquire relevant skills through an on-the-job training or an internship with IRRI scientists. In 1998, IRRI extended degree and postdegree training opportunities to 126 scientists, mainly from the Asian region (Table 6). Fifty-six scholars and fellows completed their programs in 1998 (Table 7).

Development of short-term courses

Short-term group courses provide NARS scientists with an opportunity to update their knowledge and skills on specific areas of rice science. Eleven group courses in 1998 attracted 144 NARS scientists from 18 countries.

Genetic Evaluation and Utilization (GEU) training at Ubon, Thailand, focused on the rainfed ecosystem. An IRRI plant breeder was the course coordinator.

Development of new training methodology

IRRI intensified efforts to improve its capability for distance education during the year. Implementation of an International Development Research Centre-funded project, Application of Distance Learning Technologies to Human Capital Development in NARS, was initiated. IRRI, Simon Fraser University, and the Commonwealth of Learning collaborate in this project. IRRI staff members conducted an assessment of connectivity capabilities and re-

Table 7. Scholars and trainees who completed training at IRRI during 1998.[a]

Country	Type I		Type II		Type III	Total
	PhD	MS	PhD	MS	ND	
Africa						
Madagascar	0	0	0	1	0	1
Somalia	0	0	1	0	0	1
Subtotal	0	0	1	1	0	2
Asia						
Bangladesh	0	0	1	0	0	1
Bhutan	0	0	0	0	1	1
Cambodia	0	0	1	0	0	1
China	3	0	0	0	5	8
Indonesia	0	0	0	0	3	3
Iran	0	0	1	0	0	1
Japan	0	1	0	0	0	1
Korea	0	0	0	0	1	1
Lao PDR	0	0	1	1	1	3
Malaysia	0	0	1	0	0	1
Nepal	0	0	1	1	0	2
Pakistan	0	0	2	0	5	7
Philippines	1	1	4	2	1	9
Thailand	0	0	0	1	0	1
Vietnam	0	0	0	2	7	9
Subtotal	4	2	12	7	24	49
Europe						
Germany	0	0	1	0	0	1
United Kingdom	0	0	0	0	1	1
Subtotal	0	0	1	0	1	2
North America						
Canada	0	0	0	0	3	3
Subtotal	0	0	0	0	3	3
Total	4	2	14	8	28	56

[a]Type 1 = MS and PhD scholars, thesis research at IRRI; Type II = MS and PhD scholars, coursework and thesis at IRRI; Type III = on-the-job or nondegree training.

quirements of a recipient site in Hyderabad, India. Preparations continued for the first IRRI online course on Experimental Design and Data Analysis (EDDA) in collaboration with Simon Fraser University. The whole course will be ready for pre-testing by summer 1999.

TRAINING MATERIALS DEVELOPMENT

IRRI develops training materials for use by both trainers and trainees in group courses. Training materials were produced for courses on

- GEU for rainfed lowland rice ecosystems
- Instructional video production (supplementary readings)
- Integrated pest management (IPM)(1st ed.)
- Rice tungro disease identification and management (one for extension officers, one for farmers)
- Problem-based technology generation for rainfed lowland environments-Indonesia offering

Collaborative in-country training

Collaborative in-country courses were initiated in 1989 to help develop NARS institutions' indigenous training capability and to complement IRRI training activities at headquarters. Fifteen collaborative in-country courses were offered in 1998, training 257 NARS scientists (Table 8).

Table 8. Participants in collaborative group training courses. IRRI, 1998.

Course and date	Participants (no.) /country	Course and date	Participants (no.) /country
Regional		EDDA/IRRISTAT in Chlorophyll Meter and Leaf Color Chart Technology 28 Sep-3 Oct	16 Indonesia
Integrated Pest Management 17 Aug-9 Oct	Host: Philippines 3 Cambodia 2 Lao PDR 2 Philippines 1 Colombia 1 Madagascar	IRRISTAT Training 14-16 Oct	6 Thailand
		IRRISTAT Training 19-21 Oct	10 Lao PDR
Rice Production Research (Course 6) 6 Oct-27 Nov	Host: Thailand 8 Cambodia 1 Ghana 3 Lao PDR 1 Surinam 2 Tanzania 2 Thailand	Introduction to GIS Training Course 19-30 Oct	9 Myanmar
		Experimental Design and Data Analysis with IRRISTAT 22-30 Oct	8 Bangladesh
		Presentation Skills Course for Lao Trainers and Scientists 26 Oct-6 Nov	17 Lao PDR
Subtotal	26	Training on Data Management and Documentation for Genetic Resources 26 Oct-7 Nov	17 India
Consortium or Network			
Problem-based Technology Generation for Rainfed Lowland Environments 9-22 Apr	16 Indonesia	Refresher Course on Identification and Management of Rice Tungro Disease for DA Technicians 27 Oct	17 Philippines
Subtotal	16		
National		Rice Tungro Disease Identification	
Transformation and Molecular Analysis of Transgenic Plants 17-27 Aug	10 Iran	28 Oct 29 Oct	38 Philippines 35 Philippines
Field Collection and Conservation of Rice Germplasm, 14-19 Sep	27 Myanmar	Subtotal	215
IRRISTAT Training 16 Sep	5 Cambodia	Total	257

Regional in-country courses are conducted collaboratively with a NARS institution for an international group of trainees. Two regional courses were conducted for 26 trainees from 9 countries in Asia and Africa—IPM by the National Crop Protection Center of the University of the Philippines Los Baños and Rice Production Research course by the Pathum Thani Rice Research Institute in Thailand.

National in-country courses are adapted to the specific needs of the requesting country. Twelve national courses were conducted in 9 countries, upgrading the skills of 142 rice scientists. Moreover, a farmer's version of one of the courses (Rice Tungro Disease Identification and Management) trained 73 farmers.

Network and consortium courses are requested and funded by research networks and consortia. The course on Problem-based Technology Generation for Rainfed Lowland Environments conducted in Bogor and Pati, Indonesia, for the Rainfed Lowland Rice Research Consortium.

IRRI also assists national systems in formulating their own training programs. Training needs assessments were made and training plans were developed for Cambodia and Papua New Guinea.

Program outlook

The Strengthening Partnership with NARS project will continue to support country and regional collaborative projects for strengthening NARS capabilities and collaborative research. The IRRI liaison offices in different countries will help develop new projects and identify funding sources; monitor progress of all collaborative research activities; facilitate in-country training, workshops and conferences, and visits of scientists; and assist in the exchange of information and knowledge among rice

scientists. IRRI-NARS research dialogues and planning meetings will be held in India, Indonesia, Nepal, Philippines, and Sri Lanka in 1999.

CREMNET will continue to evaluate the chlorophyll (SPAD) meter, LCC, controlled-release urea, and urea briquette deep placement in four countries. Farmers will be surveyed to gain increased understanding of their knowledge and rationale in fertilizer use on rice in Bangladesh and India.

Information and knowledge exchange activities will continue and ways and means of efficiently disseminating information about rice and IRRI will be developed. Web activities will assume even greater importance as IRRI sites are redesigned to make them more attractive and easier to search, while more content is added from IRRI programs, centers, and divisions. Web-based sale of IRRI publications will likely increase as customers become aware of a credit card option as part of a shopping basket concept.

IRRI will publish around 20 titles in 1999 and *International Rice Research Notes (IRRN)* will expand its content under a new editor-in-chief and editorial board.

The Riceworld Museum will unveil as many as nine new exhibits, including displays on the CGIAR and IRRI-NARS collaboration, as well as a revamped look at some IRRI milestones of the past four decades.

A complete overhaul of library acquisitions is planned with new staff and computer software expected early in 1999. In addition, the Library will extend its activities into Lao PDR, sign an information memorandum of understanding with partners in Korea, and add new online services such as FirstSearch, which provides access to more than 60 databases and document delivery suppliers.

IRRI will maintain about 85 scientists in its degree and postdegree training programs. About 30 scientists should complete their studies by the end of 1999.

Fourteen regular and three regional courses for a maximum of 200 scientists are planned. New courses will be designed and developed during 1999: 1) Modern Rice Farming and 2) Transgenic Rice: Production and Deployment with Special Reference to Sheath Blight and Rice Stem Borer Resistance.

Collaborative in-country courses for 1999 will include Problem-based Technology Generation for Rice Environments in collaboration with CIAP for rice scientists in Cambodia; Engineering for Rice Agriculture in Bangladesh; Scientific Writing and Presentation and Community-based Natural Resource Management (CBNRM) in Bhutan; Strategic Planning for Effective GO-NGO Collaboration in support of an ongoing project in northeast Thailand; and CBNRM in Myanmar in collaboration with the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).

IRRI will improve its training strategy through an in-depth review during 1999 and will seek direction for its distance education initiatives through a meeting of distance and open learning experts. Staff skills on training in the distance mode will be improved through training and teamwork with information and communication technology professionals.

Collaboration with universities and other training institutions will be explored and used to retool IRRI staff to enhance quality of training for NARS scientists.