FACTS ABOUT COOPERATION

India and IRRI

Rice research—which in the past had as its primary objective increasing yields and land productivity, to preserve the scarce land resources of Asia—had taken on an additional challenge: how to simultaneously increase the productivity of land, labor, water, and chemical fertilizers, while preserving natural resources and protecting the environment.

For the International Rice Research Institute (IRRI), the task was especially challenging: to spearhead a new "green-green revolution" in rice, the staple food on which over two-and-a-half billion people already depended. The number would increase by almost 50% to more than 3.5 billion people by 2025.

As the world population continued to increase by 85 million people a year, the developing world would be adding another 2.27 billion people over the first three decades of the 21st Century compared to an increase of 2.12 billion over the previous three decades.

Population growth would be higher in regions characterized by pervasive poverty and malnutrition such as South Asia and sub-Saharan Africa, where per capita grain consumption was expected to increase greatly.

The challenge to the scientific community was how to help maintain a continuous increase in food production despite limited natural resources and declining arable land and water supplies in a manner that protected the soil, water, and biotic resource base from which all food must come.

Meeting this daunting challenge required continuing investment in agricultural research and development. IRRI, its scientists, and its research partners in the developing and industrialized world, were in the forefront of such research.

IRRI was established in 1960 by the Rockefeller and Ford Foundations to conduct research that helped developing countries grow more rice. The first semidwarf breeding lines were developed in the mid-1960s; IR8 was released by IRRI in 1966. With the adoption of new varieties, average rice yields in South and Southeast Asia in 1995-97 were 95 percent higher than in 1964-66, the 3 years before the introduction of the first modern varieties. Total production rose by 141 percent, while land planted to rice increased by only 24 percent. The population of the region, however, grew by 82 percent during that period.

IRRI was one of 16 international agricultural research centers supported through the Consultative Group on International Agricultural Research (CGIAR).

The Institute's interdisciplinary approach was based on close collaboration with national agricultural research systems (NARS) and advanced laboratories worldwide, including several in India. Working together, these scientists sought new sources of genetic diversity, developing new biotechnology tools, seeking new knowledge on the impact of intensified cropping on the soil-resource base, improving the understanding of rice-pest co-evolution, and acquiring new insights into the effects of global climate change.

IRRI supported the world rice research community through the conservation, evaluation and dissemination of rice germplasm; accessible data bases and rice literature collections;

publication of the results and applications of rice research; and training programs to strengthen the scientific and managerial capacities of national research institutes.

Contributions of Indian scientists

Numerous Indian scientists had worked as internationally recruited staff (IRS) members at the IRRI headquarters in Los Baños, Philippines. Others had worked in IRRI's outreach programs outside the Philippines and many more had served as visiting and postdoctoral scientists.

Indian scientists, administrators, and policymakers had served on IRRI's Board of Trustees. Dr. M.S. Swaminathan, 1987 World Food Prize laureate, served as IRRI Director General from 1982 to 1988. Dr. D.S. Athwal was Assistant Director from 1967 to 1975, then Deputy Director General of IRRI, from 1976 to 1977. Dr. M.D. Pathak served as an entomologist and Head of the Entomology Department from 1962 to 1974, then as Director of Research and Training, from 1974 to 1989. Dr. V.L. Chopra, was reelected to the IRRI Board of Trustees for 1997-99 after serving from 1994 to 1996.

There were Indian IRS assigned at IRRI headquarters, some outposted, some project scientists, visiting scientists, and consultants. At IRRI headquarters, these scientists conducted major research in the following areas: G.S. Khush, breeding, genetics, and biotechnology; S.K. Datta, tissue culture; S.S. Virmani, hybrid rice; J.K. Ladha, biological nitrogen fixation; D.S. Brar, wide hybridization; V.P. Singh, ecosystems analysis and natural resources management; V. Balasubramanian, coordinator of the Crop and Resource Management Network (CREMNET); S. Saxena, microbiology; P.M. Reddy, microbiology, cellular and molecular biology, plant tissue culture; P.Plaha, plant genetics and cytogenetics; M.V.R. Murty, agricultural physics; T. George, nutrient management with emphasis on phosphorus and legumes; and M. Aulakh, soil fertility and biochemistry.

Visiting Indian scientists were S. Singh, molecular basis of disease resistance in rice; D. Mahapatra, plant breeding and genetics, molecular characterization of alien introgression genes particularly for disease and insect resistance in rice; and K. Singh, plant molecular biology.

R.K. Singh was the liaison scientist for the IRRI-India Office. Outposted project scientists were G.S. Sidhu, Cambodia-IRRI-Australia Project; and S.A. Rao, Genetics Resources Center, Lao People's Democratic Republic. K. Alluri was former IRRI liaison scientist at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria. R.C. Chaudhary was former coordinator of the International Network for Genetic Evaluation of Rice (INGER). J. S. Bentur, rice entomology, host-plant resistance against insect pests, biological control, and B. Mishra, genetics and plant breeding, were project specialists at IRRI.

India-IRRI collaboration

India's recognition of IRRI's international legal personality. The Government of India, through the Ambassador in the Philippines, had officially recognized the international legal personality of IRRI in ceremonies witnessed by the President of the Republic of Philippines in September 1995 at the Malacañang Palace in Manila. Together with India, more than 20 countries also signed the agreement recognizing IRRI's international status.

IRRI-India Day, 27-29 September 1996. IRRI, in collaboration with ICAR, state agricultural universities, and other research organizations, organized a three-day IRRI-India Dialogue. More than 250 rice scientists, policy-makers, administrators, politicians, media, and the Minister of Agriculture, the Minister of Planning, Program Implementation and Science and Technology, and a Member of the Planning Commission, participated in the dialogue which aimed to review and discuss the 30 years of IRRI-India collaboration. The meeting also identified the priority areas for future collaborative rice research. Highlights of the program included a luncheon meeting of the then, IRRI Director General, Dr. George Rothschild with the Prime Minister of India and his

cabinet. The meeting provided an opportunity for the IRRI Director General to emphasize the need for greater support to rice research by the Government of India, being the largest rice growing country in the world.

Germplasm conservation and exchange. Institutions across India deposited duplicate samples of their rice collections at IRRI. More than 15,000 of about 80,000 accessions in the International Rice Genebank (IRG) were from India. These had provided vital traits to IRRI rice breeding programs for disease and insect resistance, and salinity and submergence tolerance. *O. nivara,* a wild rice from Uttar Pradesh, was, until then, the only known source of resistance to grassy stunt virus.

Since 1987, India's National Bureau of Plant Genetic Resources (NBPGR), CRRI, and IRRI had implemented cooperative missions to collect wild rices in India. During 1992-93, more than 100 wild rices were collected on an expedition to Bihar, Eastern India.

From 1993 to '94 sixty-five wild rices were collected from the Northeast, including Assam and other states.

Germplasm improvement. Indian cultivars had long been used as parents in IRRI's rice breeding programs. Similarly, IRRI lines had been used extensively as parents in India. More than 400 Indian rice varieties developed in the post-IR8 era were derived from crosses of IRRI and Indian lines. A number of IRRI lines had been released as varieties in India (Table 1).

Hybrid rice. India-IRRI collaboration on hybrid rice research started in 1980. Since then, cytoplasmic male sterile, maintainer, and restorer lines were exchanged. Almost all hybrids released so far by public and private sectors operating in India were developed by using IRRI-bred parental lines as one or both parents. Other areas of collaboration included consultancy, training in hybrid rice technology, seed production, and sharing of scientific and technical information.

Rainfed rice research, lowland, and upland rice consortia. Since the beginning of the rainfed rice research in 1992, India was recognized as a key partner. India had two main and five sub-centers of rainfed lowland; one for rainfed upland; and two for floodprone rice research.

Great progress had been made under lowland and upland rice research consortia in terms of explaining the mechanism of submergence and drought tolerance, and screening and selection of improved germplasm. Some of these mechanisms were tested under All India Coordinated Trials, and promising varieties would be released for cultivation.

Work under the Upland Rice Research Consortium was on drought and blast tolerance, long-term phosphorus experiments, and nutrient by water interactions and upland rice weeds.

International Network for Genetic Evaluation of Rice (INGER). India and IRRI had exchanged elite rice breeding lines through INGER nurseries since 1976. Between 1992-1998, 7,907 breeding lines in 1,015 nursery sets were dispatched to India. These were evaluated at 65 test sites for adaptation to irrigated, rainfed lowland, upland, and flood-prone environments and resistance to biotic and abiotic stresses. Six hundred eighty-six breeding lines from India had been tested in INGER nurseries for the period 1992-1998. Sixty-five breeding lines developed in India had been released as varieties in 27 countries. Fifty-two entries from IRRI and four countries (Bangladesh, Indonesia, Philippines, and Sri Lanka) were released as varieties in India (Table 1).

Table 1. IRRI-bred and other INGER-provided lines from NARS released as varieties in India.

Designation	Origin	Name given	Year

			released
BG367-4	Sri Lanka	ADT37	1987
BG367-7	Sri Lanka	-	1993
BG90-2	Sri Lanka	Phant Dhan 4	1983
BR51-46-1-cl	Bangladesh	-	1979
BR51-91-6	Bangladesh Radha	1983	
B2983b-SR-85-3-2-4	Indonesia	Mukhi (CTH1)	1990
Gama 318	Indonesia	Avinash	1985
Intan	Philippines	Intan	1975
IR10781-75-3-2	IRRI	KHP-2	1990
IR13427-45-2	IRRI	PY3 (Barathithasan)	1983
IR13525-43-2-3-1-3-2	IRRI	IR62	1988
IR17492-18-10-2-2-2	IRRI	CO45	1989
IR1561-216-6	IRRI	Prasad	1978
IR1721-14	IRRI	Paiyur-1	1979
IR18348-36-3-3	IRRI	IR64	1992
IR1846-284-1	IRRI	VL Dhan 16	1984
IR19661-150-2-2-2-1	IRRI	HKR120	
IR19728-9-3-2	IRRI	Pant Dhan 6	1986
IR2061-213-2-17	IRRI	IR34	1979
IR2061-214-3-8-2	IRRI	IR28	
IR2071-586-5-6-3	IRRI	IR42	1983
IR2071-586-5-6-3-4	IRRI	AU2	1983
IR2071-625-1-252	IRRI	IR36	1979
IR2153-159-1-4	IRRI	IR30	1979
IR21820-154-3-2-2-3	IRRI	ADT 38	1987
IR28224-66-2	IRRI	PR109	
IR32307-107-3-2-2	IRRI	IR66	
IR34	IRRI	IR34	1979
IR36	IRRI	IR36	1979
IR3941-45-Plp2B	IRRI	Himalaya 741	1986
IR442-2-24	IRRI	Pani Dhan 1	1973
IR442-2-58	IRRI	Pani Dhan 2	1973
IR47	IRRI	AU 42/1	1983
IR5-114-3	IRRI	Pankaj	1969
IR50	IRRI	IR50	
IR532-E-576	IRRI	IR20	1970
IR579-48-1	IRRI	Palman 579	1979
IR579-97-2-2-1	IRRI	Rajendra Dhan 201	1979
IR579-160-2	IRRI	IR22	1970
IR62	IRRI	IR62	1988
IR661-1-140-3	IRRI	PR103	1978
IR661-1-140-3-2	IRRI	IR24	1972

IR64	IRRI	IR64	1990
IR665-79-2-4	IRRI	PR106	1978
IR8-288-3	IRRI	IR 8	1966
IR9202-25-1-3	IRRI	CTH3	1992
IR9201-30-1-3-1-3	IRRI	Prabhat	1994
IR930-67-2-2	IRRI	Sita	1972
IR9224-117-2-3-3-2	IRRI	IR50	1982
IR9763-11-2-2-3	IRRI	Pant Dhan 10	1992
UPLRi-3	Philippines		1994
UPLRi-7	Philippines		1992

Crop management. Collaborative research in management included studies in direct seeding, weed control, yield gap, nutrient management, water use efficiency, use of pheromones for pest monitoring, biological control of insects, botanical insecticides, and postharvest management.

Eastern India-Rainfed Rice Improvement Research Program. The ICAR-IRRI special-funded project was for the improvement of rainfed rice production, funded by the International Fund for Agricultural Development (IFAD). The project aimed to develop ecologically sustainable and economically viable technologies to increase rainfed rice production in eastern India. The objectives were to increase rice productivity and improve farmers' welfare in rainfed rice areas. Research on rainfed rice production was conducted at 10 centers in cooperation with more than 1,500 farmers who conducted on-farm trials. The centers conducted research in specific agro-ecological environments—rainfed uplands and lowlands; shallow, stagnant, and deep water.

Promising technology packages had been developed for specific ecologies and their areas of applications delineated throughout eastern India. These technologiees were promoted for large-scale adoption by farmers.

Collaborative research networking, training, and technical cooperation among developing countries in South Asia. Scientists from IRRI, ICAR, and selected state agricultural universities (SAUs), together with scientists from Bangladesh, Nepal, and Pakistan collaborated in this project, the third component of *Collaborative research and development of sustainable rice farming systems in southern Asia (Phase II)* project funded by IFAD. The project, from 1995 to 1997, established technical cooperation and enhanced the utilization of research findings on rice and rice-based production systems in South Asia through collaborative research networking, training, and technical cooperation. The project linked with the *Rainfed Rice Farming Systems* and *Rice-Wheat Systems Research*, the Rainfed Lowland Rice Research Consortium, which had collaborative research projects of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Centro International de Mejoramiento de Maiz y Trigo (CIMMYT), and the International Irrigation Management Institute (IIMI) in the region, as well as with IRRI networks, particularly the CREMNET and the Integrated Pest Management Network.

Training and information exchange. More than 800 Indian researchers participated in educational and training programs at IRRI (Table 2). India contributed the most postdoctoral researchers to IRRI, with over 190 scientists having conducted their postdoctoral research since 1962. Hundreds of Indian scientists had participated in IRRI conferences, workshops, and monitoring tours.

Seven IRRI books had been published in nine Indian languages. More than 700 individuals and 195 libraries in India regularly received IRRI publications.

Table 2. Indian participants in IRRI's training programs, 1962-1997.

Category	Participants (no.)
Ph D degree scholars	47
MS degree scholars	14
Nondegree/on-the-job trainees	90
Short-term group trainees	651
Total	802

Financial contributions

The Government of India contributed between US$100,000 and US$200,000 per year to IRRI's budget since 1982. Its total contributions up to 1997 amounted to more than US$2 million (Table 3).

Table 3. The Government of India's contributions to IRRI's programs and activities, 1982-97.

Year	Contribution (in US$)		
	Agenda	Non-agenda	Total
1982	115,445	0	115,445
1983	125,000	0	125,000
1984	125,000	0	125,000
1985	125,000	25,000	150,000
1986	124,986	0	124,986
1987	125,000	0	125,000
1988	124,196	0	124,196
1989	100,000	0	100,000
1990	100,000	0	100,000
1991	100,000	0	100,000
1992	100,000	0	100,000
1993	100,000	0	100,000
1994	100,000	0	100,000
1995	200,178	0	200,178
1996	150,000*		175000
1997	150,000		150000
Total	1,964,805	25,000	2,014,805

*Restricted agenda.