RICE RESEARCH IN THE 1980s:

SUMMARY REPORT FROM THE 1982 INTERNATIONAL RICE RESEARCH CONFERENCE

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

Contents

IMPROVING THE PRODUCTIVITY OF RICE-BASED FARMING SYSTEMS: THE CHALLENGES AHEAD

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The first International Rice Research Conference was held in 1969; this is the twelfth in the series. Progress in rice research and production between the first conference and this latest conference has been impressive. IRRl's early strategy of initiating a dynamic drive toward higher yields has paid rich dividends.

The emphasis on greater production through higher productivity has helped save enormous amounts of land in several South Asian countries with unfavorable land-man ratios. For example, if yield levels in the Philippines had not shown substantial improvement, 3.2 million hectares more land would have been needed to produce the quantity of rice that country now produces (Table 1).

The same is true of India: if yields had remained at 1965 levels, 34 million hectares additional land would have been required to produce the quantities of rice and wheat now harvested (Table 2). We should derive inspiration from these rapid advances.

At the same time, it is clear that the changes in rice field ecology brought about by irrigation, fertilizer application, and dense crop canopies have led to new plant and soil health problems. The triple alliance of pests, pathogens, and weeds tends to reduce yields and to escalate the costs of production. For example, during the last few years, yields in the intensive rice production plots of the Philippine Packing Corporation in Mindanao have been going down (Table 3). The major cause is disease. At the same time, costs of production are going up, partly because of reduced yields and partly because of the increasing costs of inputs, particularly energy (Table 4).

Table 1. Rice production, area, and yield in the Philippines, 1960, 1970, 1980.[a]

Year	Production rough rice (x 10^3 t)	Area (x 10^3 ha)	Yield (t /ha)
1960	3705	3198	1.16
1970	5343	3112	1.72
1980	7723	3459	2.23

[a] About 3.2 million ha more would have been needed to achieve the 1980 production level at 1960 yield level.
Source: Philippine Ministry of Agriculture, Bureau of Agricultural Economics.

Director-general, International Rice Research Institute, concluding remarks delivered at the International Rice Research Conference, 19-23 April, 1982, at IRRI, Los Banos, Laguna, Philippines

Table 2. Impact of new technology on yield and land requirement in India.

Crop	Year	Area (x 10^3 ha)	Yield (t/ha)	Production (x 10^3 t)	Area saved (x 10^3 ha)
Rice	1966-70	36,360	0.98	35,770	–
	1979	40,480	1.33	53,770	14,331
Wheat	1961-66	13,191	0.83	10,950	–
	1979	22,560	1.57	35,510	20,222

Source: Ministry of Agriculture, Government of India.

It is not only in the fields of private farmers that yields have tended to go down. Even in the IRRI plots at Los Baños, a similar trend can be seen (Fig. 1). The yield levels obtained in the various trials under the International Rice Testing Program are good from the point of view of average farm yields, but scientifically are not very inspiring (Table 5).

It is clear that a dynamic research program is essential if a dynamic production drive is to be sustained. We cannot be content with finding explanations for not achieving the yield potentials of present-day varieties. We must find methods for realizing that potential, at least in experimental fields. The necessity of not accepting low yields without careful scientific analysis of the constraints responsible for the low productivity was stressed by Dr. Robert F. Chandler in 1963:

> "It is disturbing to read paper after paper, from various research and educational organizations experimenting with rice, in which yield data ranging from 1,500 to 3,000 kilograms per hectare are reported and yet no reasons are given for the low yields. The production of grain is obviously the objective of rice growing. Certainly, therefore, all field research should be concerned, in part, with production." (IRRC Newsletter, 1963)

Advances in productivity and a higher intensity of cropping are the only pathways available for meeting the food requirements of fast-growing populations in most countries in Asia. When agriculture started about 10-12 thousand years ago thanks probably to women who collected seeds from wild flora and started cultivating them, while men went out to hunt and gather food—the total world population was probably about 15 million. Now, population growth in a country like India alone is 15 million more people every year. At the same time that population is growing, the factors limiting food output prospects are becoming more serious.

Table 3. Philippine Packing Corporation Rice Project yields.

	1978	1979	1980	1981
Total hectares planted	651.2	680.3	719.5	105.5
Crops/year	2.47	2.38	2.48	2.35
Yield average (t palay/ha per crop)	5.18	4.41[a]	4.15[b]	3.21[c]

[a]Drop due to tungro virus. [b]Drop due to low yield of tungro-resistant varieties. [c]Drop due to ragged stunt virus.

Table 4. Philippine Packing Corporation Rice Project costs and returns.

	1978	1979	1980	1981
Production cost of milled rice per kg (P)	2.33	2.48	3.09[a]	4.15[b]
Government ceiling price of rice per kg (P)	2.10	2.45	2.60	2.85

[a]Increase due largely to 40% increase in labor cost, 60% increase in fuel cost, and 15% to 30% increase in fertilizer and pesticide costs and lower yield. [b]Due to further increases in labor, fuel, fertilizer and pesticide costs, and a 28% yield reduction from the ragged stunt virus disease.

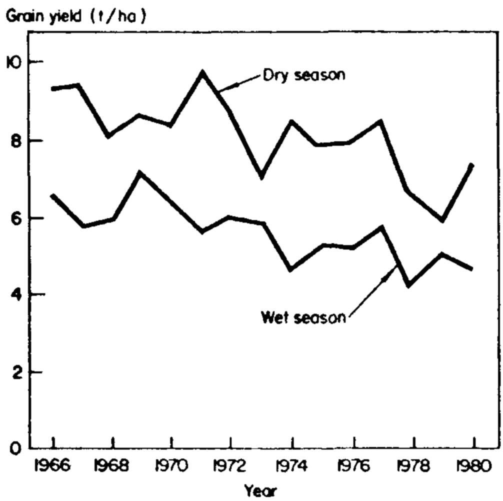

Fig. 1. Highest yield of rice varieties or lines at IRRI during the 1966-80 cropping seasons. (IRRI, unpublished)

Lester Brown listed these negative trends:

- Conversion of cropland to nonfarm use
  - 5 million ha in USA, 1967 to 1977.
- Soil erosion
  - 30% of world cropland being degraded.
- Deterioration and loss of irrigated land
  - salinity, lack of maintenance.
- Declining rate of yield increases
  1960s: 2.2%/year
  1970s: 1.6%/year.
- Likely higher real costs of energy. (Lester R. Brown, "World population growth, soil erosion, and food security," *Science* 27 November 1981)

This is why the need for increasing the pace of progress in agriculture was stressed at several international conferences during 1981. Here are just a few of those statements:

- The UN General Assembly reiterated its goal of international development strategy, that "hunger and malnutrition must be eliminated as soon as possible,

Table 5. Grain yields in IRTP yield nurseries (av over 30 sites in Asia, Africa, and Latin America), 1975-80.

Year	IRYN (Early) yield (t/ha)		IRYN (Medium) yield (t/ha)	
	Mean	Highest[a]	Mean	Highest[a]
1975	4.2	4.8	4.2	4.9
1976	4.1	4.6	4.0	4.6
1977	4.2	4.6	4.6	5.2
1978	4.4	4.9	4.2	4.7
1979	4.1	4.6	4.3	4.8
1980	4.3	4.9	4.3	4.7

[a]Highest entry average across sites.

and certainly by the end of the century."

- At Cancun, Mexico, participants in the summit on cooperation and development agreed that "persistent and widespread manifestations of hunger are entirely incompatible with the level of development attained by the world economy and, in particular, with existing food production capacity. Within as brief a period as possible, hunger must be eradicated. This objective is clearly an obligation of the international community and constitutes a first priority, both at the national level and in the field of international cooperation."
- Support for national food strategies was expressed by the Commonwealth Heads of Government meeting in Melbourne and by Heads of State of France and French-speaking African countries in Paris.
- The Council of Development Ministers of the European Economic Community (EEC) called for a "food sector strategy" and agreed to support food strategies as a basis for improved dialogue with interested developing countries.
- The UN Conference on least developed countries concluded that LDCs should "prepare strategies, plans, and policies for the agricultural sector – giving particular attention to food production and distribution."
- Soviet leader Leonid Brezhnev called food "economically and politically the central problem of the Eleventh Five Year Plan (1981-85) of the USSR."
- The FAO study "Agriculture: Toward 2000" predicted that the number of hungry people in the world may well grow from the current estimated level of over 400 million to almost 600 million by the year 2000. Therefore, the World Food Council has called for a "cultivation revolution" which could transform traditional small-scale agriculture.

It is obvious that we need to redouble our efforts in producing "high yielding *cum* high stability" technologies for different rice growing environments.

CONTRASTING SYSTEMS OF AGRICULTURE

Two opposing trends can be seen in the evolution of agricultural management systems in the world. On the one hand, there are large "super farms," each extending to over 2,000 ha, managed by machinery, with automated production and post-harvest technologies. An article on .rice cultivation in California described the cultivation methods used there:

> "The production of rice in California has evolved into one of the most highly mechanized agricultural operations in the world. including the levelling of fields by laser beam, the sowing of seed by airplane and the harvesting of the crop by special combines that do not bog down in the mud of the rice paddy. The 1979 California yield of 6,450 pounds of rice per acre was 50 per cent higher than the average in the other rice-producing states in the U.S. and nearly three times higher than the world average of 2,360 pounds per acre. Although the acreage devoted to rice in the U.S. is only 0.9 per cent of the world total, the U.S. produces 1.7 per cent of the world crop and in many years is the world's largest rice exporter."
> (Scientific American - February 1981)

The super farm model of cultivation is being adopted in developed countries, under conditions of both private and social ownership of land. The great advantage of such a system is the possibility of achieving a high degree of farm management efficiency — in the timeliness of planting, irrigation, and plant protection and in the harmonization of production and postharvest operations.

In contrast to the trend toward increasing size of operational holdings in developed countries, the size of an average farmholding is tending to get smaller and smaller in many developing countries. In several parts of Southeast Asia, average farm size is about one hectare. But the small farm in itself is not a handicap to the adoption of new technology. There is ample evidence that high yield technology is size neutral in regard to its relevance for farms of varying sizes. The small farm can facilitate intensive agriculture.

The small farmer does face many problems in the adoption of new technology – problems arising from the cost, risk, and return structure of farming. A small farmer usually has no capacity to take risks and very little ability to invest in inputs and land development. Also, he is subject to various forms of exploitation at the marketing end of farm operations.

Only by solving the problems of the small farmer can the potential of the small farm for producing more food per unit of time, land, and water be realized. Steps in this direction are largely in the realm of public policy. Sustained agricultural advance becomes possible only when an economically viable and socially acceptable package of technology is supported by an appropriate package of services and public policies.

These factors emphasize the need for a symphonic approach to project planning and implementation.

INCREASING DAILY PRODUCTIVITY

Scientifically developed multiple cropping systems could become important instruments for increasing productivity – and farmers' income and employment. The great advantage of the new varieties of rice is their relative photoperiod insensitivity, through which they become useful in multiple cropping systems. For example, jute-rice–wheat rotation has now become possible in Bangladesh and in parts of India (Fig. 2). However, photoperiod sensitivity is essential under conditions where a crop should mature in a specific season. Other factors, such as seed dormancy, also arc

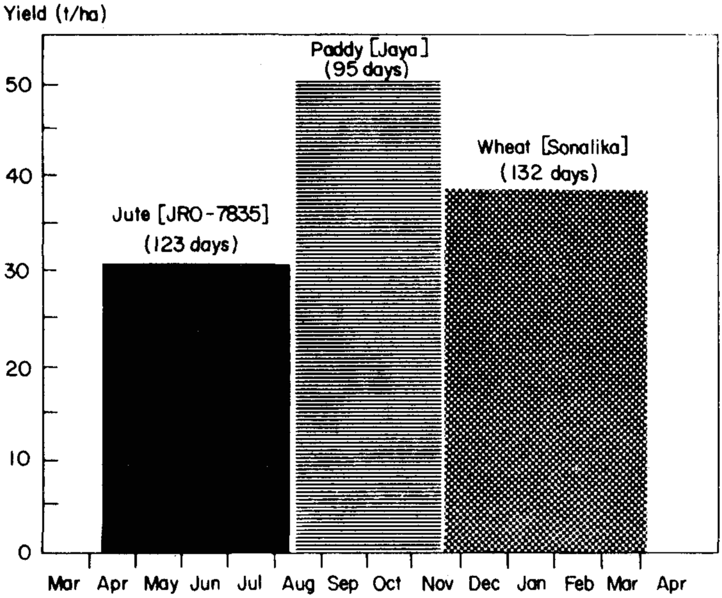

Fig. 2. Jute - rice - wheat rotation pattern used in Bangladesh and eastern India.

important when breeding period-fixed varieties. A clear understanding of the optimum combinations of characteristics required in a technological package is necessary for developing technologies capable of rapid diffusion.

IRRI constraints analysis methodology has helped identify the precise constraints responsible for the differential spread and impact of new technology, such as has occurred in India. In northwestern India, progress in the improvement of rice yields

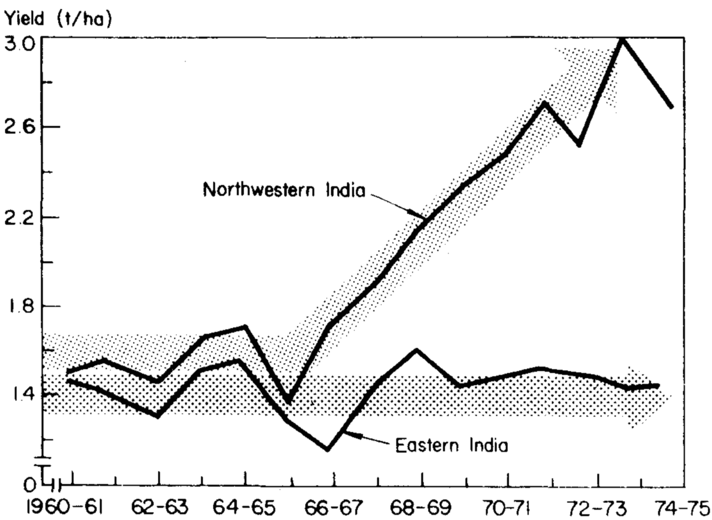

Fig. 3. Rice yields in eastern and northwestern India, 1960-75 Fewer constraints in the northwest permit new technology to increase yields.

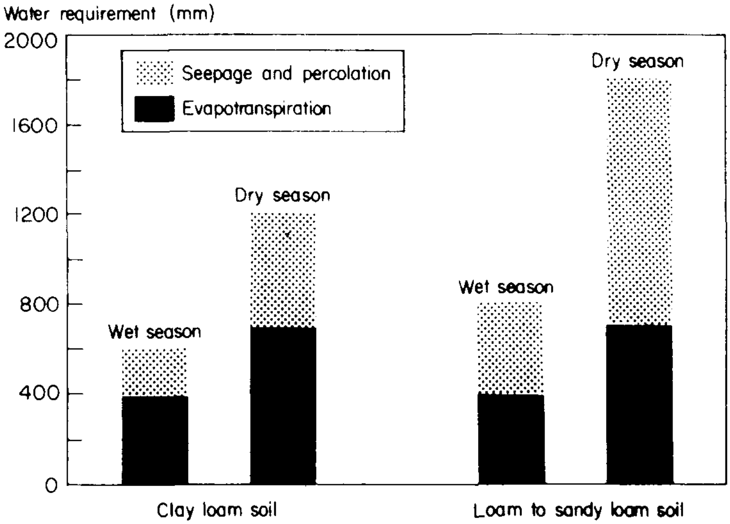

Fig. 4. Seasonal water requirements in Southeast Asia. (IRRI 1978)

has been rapid. In eastern India, a similar trend has yet to start (Fig. 3). Rice scientists will have to study the causes of such variability in the impact of the new technology and suggest remedial measures.

Most developing countries are now making major investments in the irrigation essential for both elevating and stabilizing yields. IRRI scientists have worked out the seasonal water requirements in Southeast Asia (Fig. 4). Bringing additional areas under irrigation has been emphasized, but corresponding efforts in promoting better on-farm management of water are lacking. Many irrigation projects are not contributing to increased production in the manner originally anticipated because of inadequate coordination and consultation between civil engineers and agricultural experts at the planning phase of a project. Even in World Bank-supported projects, this has been identified as a major deficiency.

In addition to attention to better on-farm management of water in irrigated areas and better watershed management in rainfed areas, soil health in its totality needs to be examined. Frequently, soil testing is undertaken only to establish nutrient status. To promote good soil health, other indices need concurrent consideration: climate, wetness, slope, erosion, run-off, overflow, texture, depth, permeability, nutrient status, salinity, alkalinity, and acidity.

Soil-water-crop relationships are greatly influenced by environmental factors. More detailed and microlevel environmental typing of rice-growing conditions is needed. A detailed analysis and classification of rice-growing environments will help sharpen research priorities and enable the formulation of effective development strategies. The maps now being prepared by Dr. K. E. Huke, in collaboration with IRRI and national research systems, could be very helpful to Land Use Boards and Commissions of different rice-growing countries. In hilly and undulating terrain, silviculture and horticulture will help prevent soil erosion; annual crops such as rice may not.

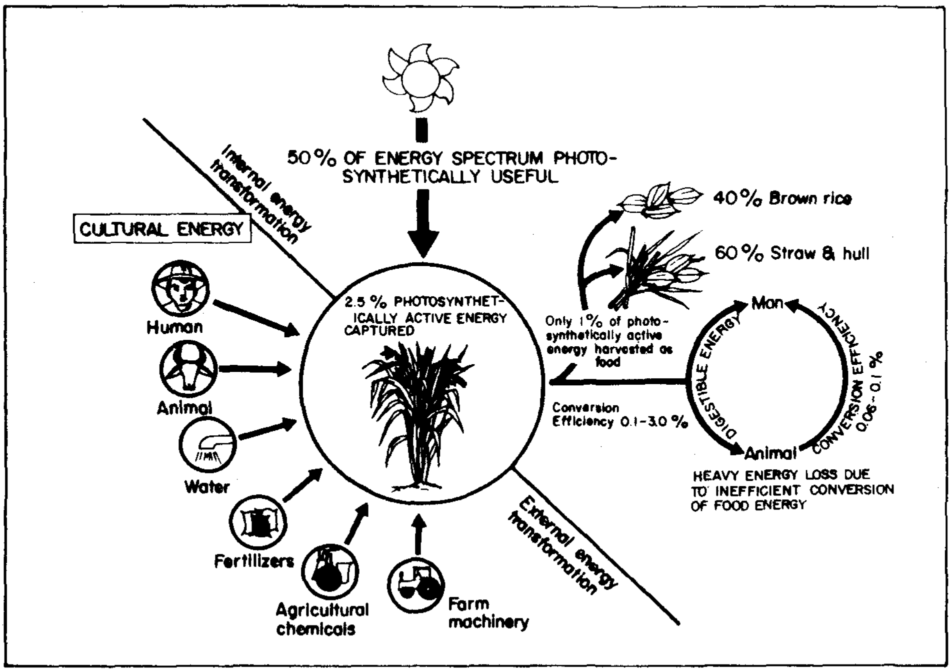

Fig. 5. Solar and cultural energy input and output cycles in rice.

Energy is becoming a key limiting factor in both agricultural and industrial production. Prior to 1972, energy use efficiency did not receive the attention it deserves. It has now become clear that, in order to bring about continuous improvement in productivity without simultaneously increasing dependence on fossil fuels, it is necessary to study carefully the solar and cultural energy input-output cycle (Fig. 5).

The relative importance of different forms of cultural energy may vary between countries and frequently within a country. And there are physiological and pathological leaks in the energy conversion system. The use of plants to feed animals and the more extensive adoption of the plant-animal-man food chain also increase energy losses.

We need an integrated study of all aspects of energy use in order to promote synergetic interactions among different forms of energy - for example, among variety, water, and fertilizer.

There is also a need to maximize the efficient use of both water and fertilizer. Fortunately, valuable data on fertilizer use efficiency are now becoming available through the International Network on Soil Fertility and Fertilizer Evaluation for Rice (INSFFER) program. Some of the strategies available for improving the efficiency of nitrogen fertilizer use are:

- Timing of nitrogen application,
- Deep placement of N fertilizer,
- Use of controlled-release fertilizers, and
- Use of inhibitors to block specific N transformation.

In addition to mineral fertilizers, there is now scope for harnessing nitrogen from the atmosphere through Azolla-Anabaena and blue-green algae. We need to develop integrated nutrient supply systems involving a blend of chemical, organic, and biological sources of fertilizer.

STABILIZING PRODUCTION

Three major groups of factors cause wide fluctuations in production from year to year: weather, pest epidemics, and public policies in the areas of pricing and marketing. The impact of aberrant weather on rice production could be mitigated to some extent by:

- Increasing the area under irrigation,
- Better moisture conservation,
- Enlarging the frontiers of varietal adaptation to temperature changes, and
- Contingency planning to suit different weather probabilities.

Pest and disease epidemics can cause considerable changes in yield. This is why IRRI, from its inception, has placed a high priority on the development of varieties with resistance to many of the important diseases and pests (Table 6). The breeding strategies adopted include these major approaches:

- Sequential release of varieties with single major genes for resistance,
- Major genes for resistance pyramided in the same variety or varieties,
- Development of multiline varieties,
- Development of varieties with horizontal resistance.

The first two approaches have been widely used. We need more research on the others.

With the changing ecology of rice cultivation, certain pests which were not historically important have assumed great importance. One example is the brown

Table 6. Disease and insect ratings of IR varieties

Variety	Growth duration (days)	Diseases				Insects					
		BL	BLB	TG	GS	BPH biotypes			GLH	SB	GM
						1	2	3			
IR8	130	S	S	S	S	S	S	S	MR	S	S
IR20	130	MR	R	MR	S	S	S	S	R	MR	S
IR24	125	S	S	S	S	S	S	S	R	S	S
IR26	130	R	R	MR	S	R	S	R	R	MR	S
IR28	105	R	R	R	R	R	S	R	R	MR	S
IR34	125	MR	R	R	R	R	S	R	R	MR	S
IR36	110	MR	R	R	R	R	R	S	R	MR	R
IR42	135	MR	R	R	R	R	R	S	MR	MR	R
IR46	140	R	R	MR	S	R	S	R	MR	MR	S
IR50	105	MR	R	R	R	R	R	S	R	MR	NA
IR52	115	MR	R	R	R	R	R	S	R	S	NA
IR54	120	MR	R	R	R	R	R	S	R	MR	NA
IR56	105	R	R	R	R	R	R	R	R	MR	NA

S = susceptible, MR = moderately resistant, R = resistant, NA = not available, BL = blast, BLB = bacterial blight, TG = tungro, GS = grassy stunt, BPH = brown planthopper, GLH = green leafhopper, SB = stem borer, GM = gall midge.

Table 7. Distribution of varietal reactions to brown planthopper biotypes, IRRI, 1975-80.

Region	Reaction[a]			
	PTB33	ASD7	Mudgo	TN1
East and Southeast Asia	R	R[b]	R	S
South Asia	R[c]	S	S	S

[a]Refers to biotype 1 in the Philippines, Taiwan, and Indonesia. R = resistant, S = susceptible. [b]Reaction to biotype not consistent in Taiwan. [c]Except at Pantnagar, India.

planthopper (BPH), with the additional complication of the occurrence of biotypes in this pest. About 7 years of data on BPH, collected through IRTP nurseries and collaborative projects, have revealed that BPH biotypes in East and Southeast Asia are distinctly different from those in South Asia.

In East Asia (China, Japan, and Korea), the BPH is still biotype 1. But in Southeast Asia (Philippines, Indonesia, and Solomon Islands), where resistant varieties have been extensively grown, biotype 2 has become predominant. Moreover, biotypes in South Asia (India, Bangladesh, and Sri Lanka) are more voracious and many of the varieties resistant in East and Southeast Asia are susceptible. The deployment of different resistance genes in different geographic regions appears feasible (Table 7).

The distinctive distribution of biotypes in South and Southeast Asia (Fig. 6) makes it possible to develop a coordinated regional gene deployment strategy. Early warning systems can also be developed.

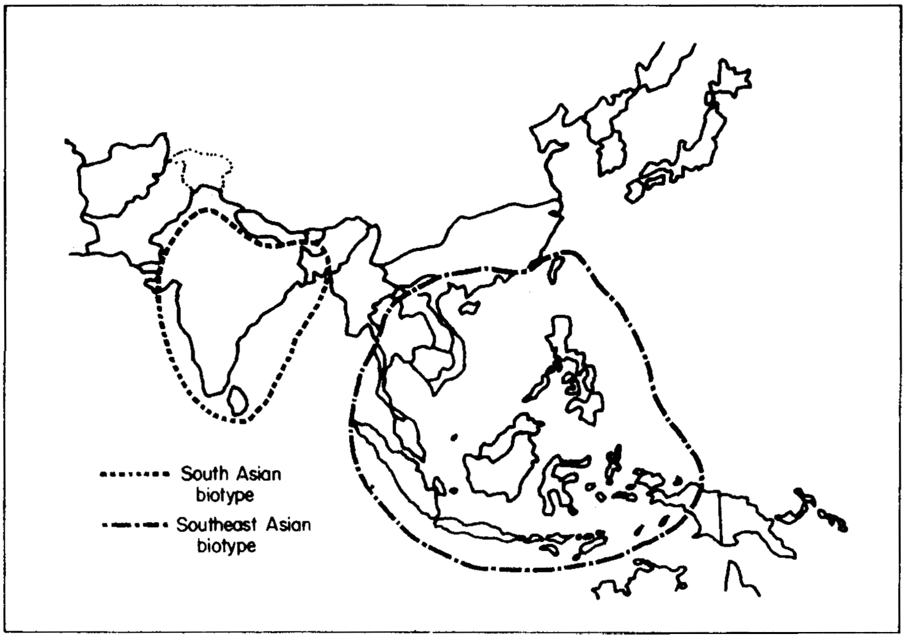

Fig. 6. Distribution of brown planthopper biotypes in South and Southeast Asia.

Table 8. Area in hybrid rice production and yield increases in China (Hunan Academy of Agricultural Sciences, Changsha, Hunan. China).[a]

	1974	1975	1976	1977	1978	1979	1980
Area (x 10^3 ha)	0.007	0.15	139	2133	4333	5067	5867
Production increase (x 10^3 t)	NE	NE	145	2000	3500	3900	NA
Yield increase (kg/ha)	NE	NE	1040	938	808	770	NA

[a]NE = not estimated, NA = not available.

An advantage of the Genetic Evaluation and Utilization (GEU) program initiated by IRRI is the possibility of identifying genotypes for a wide range of characteristics. Suitable screening procedures allow the identification of strains possessing tolerance for cold, heat, salinity, alkalinity, phosphorus deficiency, and a host of other constraints.

To meet the challenges presented by the wide range of requirements for elevating and stabilizing rice production, it is essential that we collect and preserve all available global rice genetic resources. It has been estimated that the total world genetic stock in rice may be in the order of 120,000 genotypes. The genetic stock collection now available in the IRRI gene bank is about 60,000 — only 50% of the estimated world stock. We owe much to Dr. Nyle C. Brady for converting the dream of rice scientists into reality by helping to create this facility.

Many of the habitats under which variability occurs are now under different forms of threat. Deforestation, soil erosion, water inundation, and urban expansion underscore the urgency of stepping up collection efforts. It is my sincere hope that by 1985, when IRRI commemorates its 25th anniversary, we will have in our gene bank as complete a collection as possible. This calls for coordinated and collective efforts among rice scientists throughout the world. This is a task which we should undertake together, in the interest of the future of rice farming.

INCREASING YIELDS

The spectacular advances made in China in introducing and popularizing hybrid rice production have aroused worldwide interest in the commercial exploitation of heterosis in rice (Table 8). But the male sterile lines identified in China show poor growth under tropical conditions. Therefore, it is necessary that stable male sterile lines with good combining ability and restorer systems be developed in tropical countries. Such a cooperative work will be undertaken under the GEU program.

Concurrently with the identification of hybrid combinations with marked heterosis, it is essential that the many problems connected with the economical production of F_1 seeds be studied. It would also be useful to undertake tissue culture studies to identify combinations possessing hybrid vigor for root growth.

Shouichi Yoshida has observed that an important constraint to higher yields in rice is inadequate spikelet numbers per square meter. Therefore, the capacity for dry, matter production and the partitioning of dry matter in favor of the grain require study. We should examine all possible breeding procedures for achieving the postulated yield potential of rice.

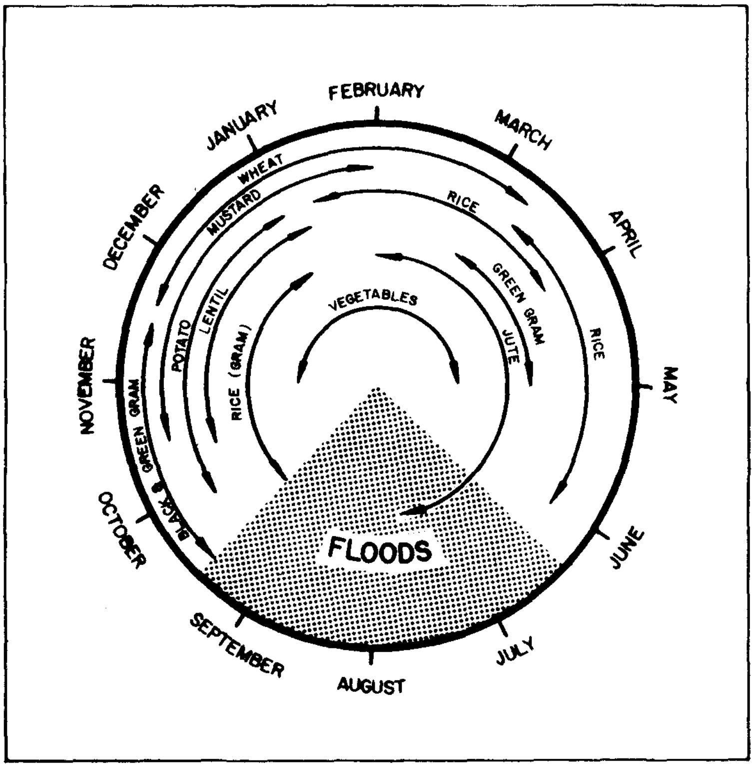

Fig. 7. Restructuring the cropping patterns in flood-prone areas of Assam, India

Recombinant DNA cloning techniques have generated the hope that rice plants capable of fixing atmospheric nitrogen and possessing many other desirable characteristics can be developed. It is rather premature to speculate, but nevertheless it will be prudent to undertake studies in collaboration with appropriate laboratories on the relevance of recombinant DNA techniques in rice improvement.

But the tendency to seek plant breeding solutions to every major rice growing problem is not wise. For example, it may be advisable in chronically flood-prone areas to develop methods of maximizing production in the flood-free season (Fig. 7). In many cases, this will call for an investment in the utilization of groundwater. The aquifer recharge technique has worked quite well in such areas. Through suitable development programs, small farmers can be assisted in installing tube wells. One method which could be utilized for this purpose is the organization of mobile banks to provide credit for the purchase of irrigation pumps.

Considerable progress has been made in developing improved implements and machinery for rice cultivation. Fertilizer placement drills are particularly valuable. One area which requires additional effort is gram drying. With increased yields and with the spread of photoperiod-insensitive varieties which may come to harvest when there is still some rain, the problem of gram drying is assuming serious dimensions. Several cases of hepatitis have been reported as a result of mycotoxins in rice and other cereal grains. Simple, economical methods of gram drying need to be developed rapidly.

FIGHTING THE FAMINE OF JOBS

The most difficult problem we will face in the coming years is job famine. Unemployment is becoming a problem even in developed countries and will become more serious in developing countries which have predominantly rural populations engaged in agriculture, animal husbandry, fisheries, and forestry. The Asian Development Bank made this observation in a recent report on agricultural programs:

> "One problem area is the growing number of landless rural peasantry, thrown onto a poor labor market by sheer population pressure. The average amount of arable land per rural family in several countries has now fallen to such a low point that — everything else being equal — a growing proportion of the land is worked at subsistence level. This means that there is no investible surplus for the farmer, and no room for one more addition to the family."

We need to rapidly establish large demonstration plots in the fields of small farmers on the theme "Prosperity through Rice." Such a demonstration plot should be designed so that the latest advances in rice research can be shown in a convincing manner to policy makers, extension workers. and farmers. To such people, "seeing is believing." Field demonstrations make a much greater impact on their minds than slide shows, color photographs, and articles.

Such a demonstration plot can be divided into two parts one dealing with the production phase of rice farming, the other with postharvest technology.

The production phase could include such factors of production as:

- Water,
- Mineral and biofertilizer,
- Variety,
- Plant protection, and
- Machinery.

It should also demonstrate a strategy of integrated production by showing:

- The enhancement of input efficiency through attention to nonmonetary practices,
- Yield maximization (yield per unit of soil, water, energy, and time),
- Scientific multiple cropping with rice, and
- Rice-based cropping and farming systems.

The postharvest phase could demonstrate:

- Harvesting, threshing, winnowing, drying, and storage:
- Straw utilization in animal nutrition, mushroom production, biogas generation, paper production, etc.;
- Rice bran utilization through oil extraction and uses for defatted bran; and
- Rice husk utilization in cement, brick, paper, and the preparation of solar grade silicon for the manufacture of irrigation pumps based on photovoltaic cells.

Ultimately, the success of any research program will depend upon the capacity, creativity, and dedication of its research workers as well as the management efficiency of the research system. IRRI has played a key role in helping national research systems develop a cadre of well-trained scientists. About 2,800 rice scientists have been trained so far.

One area of training which requires greater attention is the creation of large numbers of well-informed women scientists and extension workers. Women in most parts of Asia, Africa, and Latin America play a pivotal role in both the production and postharvest phases of rice cultivation. Unfortunately, many extension systems have bypassed women. Therefore, it is essential that the training of women scientists and extension workers receive added attention. IRRI plans to convene a workshop to examine all matters relating to the participation of women in rice farming.

Another field in which IRRl will take the initiative is the promotion of organized efforts in co-publication. This will enable the speedy, low-cost publication of useful information in many languages.

THE COMPLEX CHALLENGE

Modern rice production technology involves concurrent attention to:

- Scientific land use and soil health care,
- Appropriate tillage and erosion control,
- Dense crop canopies,
- Weed-free environments and appropriate use of hormones and growth regulators,
- Fertilizer use efficiency,
- Improved water management,
- Integrated nutrient supply,
- Integrated pest management,
- Integrated energy supply,
- Systems approach for crop-livestock, crop-fish, and crop-livestock-fish integrated production,
- Agro-forestry, and
- Contingency planning and risk distribution agronomy.

Obviously, small farmers will have to be assisted in the adoption of an optimum mix of these pathways to improved productivity. While we should proceed with the popularization of new technology with enthusiasm and vigor, we should remember that science and scientists alone cannot solve the problems of farmers. To quote Mang Juan, a Filipino peasant:

> "Youmust realize that we live in two different worlds. It is, as ifyou live in the world of the birds of the air and we in that of the fishes of the sea.
>
> When birds move, they of course move fast — because they fly. On the other hand, when we, the fishes, move, we move relatively slower — because we have to swim in an ocean.
>
> And so it sometimes happens that some birds want to do good for us from the height at which they fly. Condescendingly, they say: 'Mr. Fish, progress! Move like I do — this way and that way — so you can move faster!'
>
> We fishes, of course, cannot follow, because we have to move in this ocean of usury, and tenancy, and other unjust relations . . ."

(Page 1 *in* Antonio J. Ledesma, 1982. Landless Workers and Rice Farmers. International Rice Research Institute, Los Banos, Laguna, Philippines)

Hence, it is important that policy makers also become aware of the constraints responsible for the gap between potential and actual farm yields. IRRI should periodically organize seminars for policy makers based on carefully conducted case studies.

We are running a race against time in our war against hunger and unemployment. We have the tools and the know-how to win this war. We should not wait while we look for a perfect variety or a perfect technology, but should speedily transfer the best available technology to farmers. Our individual strengths are variable, but our collective strength is considerable. The IRRI family of rice scientists located all over the world, to which I now have the good fortune to belong, has the capacity to provide the tools for making the problem of hunger in rice-eating countries a problem of the past. We should accept this challenge as the primary goal of our work.

INTERNATIONAL RICE TESTING PROGRAM (IRTP)

In 1981, IRTP composed 20 regular nurseries for target environments and specific stresses, and 14 special screening sets. Several new nurseries for problem soils were initiated and more specific screening sets were designed within the deepwater complex.

Nursery sets totalled 1,215, dispatched to more than 50 countries in Asia. Africa, and Latin America. About 50% of the entries for the 1981 nurseries were received from national programs.

More than 35% of the data for 1981 nurseries (those submitted by 1 March 1982) were analyzed, summarized, and published for discussion. As in the past, results in the yield nurseries identified promising varieties for different regions and situations; results in the screening nurseries identified donors for the various stresses. Data also provided information on genetic variation in the causal organisms for specific biological stresses.

An important suggestion during the planning session was to improve the informativeness of data by:

- Including weather parameters,
- Commenting on yield nurseries,
- Giving information on local checks,
- Preparing hydrographs for deepwater nurseries, and
- Qualifying phenotypic acceptability ratings, with appropriate comments.

Other suggestions were made during the planning session:

- Test promising entries — particularly those with resistance to blast — in yield nurseries under favorable dryland conditions.
- Establish observational nurseries in a few selected locations for yield data.
- Divide rainfed wetland yield nurseries into early and late maturity groups.
- Compose a whitehacked planthopper nursery for 1982-83, if sufficient entries are available from a range of breeding programs.

1982 IRTP nurseries.

Nursery or screening set		Sets (no.)	Entries (no.)
	Irrigated		
Yield	–IRYN-VE	108	28
	IRYN–E	108	28
	IRYN-M	96	28
Observational	–IRON	120	350
	IRARON	24	65
	Rainfed		
Yield	IRLYN	48	30
Observational	–IURON	120	185
	–IRLRON	12	I20
	IRDWON I (flood toletance)	48	5.5
	IRDWON II (medium deep)	48	43
	IRDWON III (floating)	30	58
	IRDWON IV (tidal swamp)	20	42
	Stress screening		
Diseases	–IRBN	108	342
	IRRBN	20	103
	IRTN	24	168
Insects	–IRBPHN	60	235
	IRGMN	24	90
Soil	–IRSATON (salinity & alkalinity)	60	65
Temperature	–IRCTN	60	55
		84	166
	Special screening sets		
Diseases	–Leafscald	36	63
	Ragged stunt	12	64
Insects	–Yellow stem borer	24	25
	Leaffolder	24	31
	Thrips	12	15
Soil	–Iron toxicity	36	22
	Acid sulfate	24	21
	Acid upland	24	35
	Peat soils	24	25

Promising entries in the 1981 IRTP

Nursery	Promising entries
	Irrigated - yield
IRYN (very early)	• BG367-4, IR19729-61-3, IR50, BG367-7
IRYN (early)	• Taichung sen yu 285, BPT1235, IR13429-196-1. Chianung sen yu 13, lR9828-91-2-3, lRI3429-109-2-2-1
IRYB (medium)	• IR13540-56-3-2-1, IR54, R22–2, BR51-282-8, RP82-5-45-1-3
	Irrigated - observational
IRON	• C1321-9, C1322-28, IR9698-16-3-3-2, IR13240-108-2-2-3, IR13429-299-2-1-3, IR13538-48-2-3-2, Chianung sen yu 13, lR920-48-3-2, MRC603-303

Continued on next page,

Table continued.

Nursery	Promising Entries
	Rainfed - yield
IURYN (upland)	• IR5931-110-1, IR6115-1-1-1, UPL Ri-5, IR43, BPI Ri-6, IR52
IRLRYN (lowland)	• IR14632-2-3, IR14753-49-2, IR13146-45-2-3, BR4, IR46, lR4819-77-3-2, IR52
	Rainfed - observational
lURON (upland)	• IAC1246, IRl2979-24-1, IR5440-1-1-3, IR9256-59, IR9761-19-1, IR19793-25-2-2, IR3794-9-2-3, Jhum Sonal Ichikon, ITA235, ITA141, ITA164, ITA175, ITA183
IRLRON (lowland)	
Early group	• IR2987-13-1, IR3179-25-34, IR5853-198-1-2, IR5931-110-1, IR13146-13-3-3, IR4744-295-2-3, SYE63-36
Medium/late group	• IRl0781-143-2-3, IR10781-75-3-2-2, IR13257-46-IE-P1, IR13369-86-2-2, IR46, IR13419-113-1, IR13564-95-1, IR14875-98-5, IR15853-89-7E-P3, IR19431-72-2, IR4819-77-3-2, IR4829-89-2
IRDWON (deepwater)	
I. Flood tolerance	• BKNFR76109-1-2-1, BR118-3B-17, Nam Sagui 19, Raden Lang Sat, RP975-109-2, BH2, CR1030, lR13603-30-1E-P1, FR13A, IR8234-11T-4-2, IR9288-B-B-B5-2, IR9288-B-B-B252-1
II. Medium deep	• BKNFR76001-36-4-2-2, HTA7403-110-1-5, SPR7292-151-2-1-B-B
III. Floating rice	• BKNFR76004-4-1-1-1, BR224-2B-2-5, HTA77043-2, IR11288-B-B-118-1, SPR7411-7-2-1, SPR7410-0-256
	Stress screening
Temperature	
IRCTN (cold)	• JC99, China 1039, K39-96-1-1-1-2, Shin-ei, Fuzi 102, Jodo, Tasumi Mochi, Eiko, Stejaree 45, IR9224-K1, K143-1-2, T1668, IR9202-23-2-1, IR9202-25-1-3
Problem Soils	
IRSATON (salinity & alkalinity)	• *Salinity* *Vegetative:* IR19660-23-2-1, M242, Pokkali *Maturity;* IR10198-66-2, Nonasail, IR9884-54-3 • *Alkalinity* *Vegetative:* M152, Sonasail, IR52, IR38, IR2307-217-2-3. IR4227-28-3-2, IR4432-52-6-4, IR8192-200-3-3-1-1, IR8608-125-3-3, IR9224-162-3-1-3-2, IR9703-41-3-3-1, IR9736-16-1-2, IR9764-45-2-2, IR11418-15-2 *Maturity:* Nonasail, Pokkali, IR9884-54-3, IR38, IR52, IR46, IR8192-200-3-3-1-1, IR9736-16-1-2, IR9805-97-1, M152, IR4227-28-3-2, IR4227-109-1-3-3, IR8608-125-3-3, IR43, IR54, IR2863-35-3-3, IR4432-28-5, IR9217-58-2-2, IR9763-11-2-2-3, IR9975-5-1, IR10206-29-2, M242
Diseases	
IRBN (blast)	• CIAT-ICA5, Huan-sen-goo, IR19806-8-1-3-2, Soweon 299, Suweon 300, IRAT104, Camponi SML , Ciwini/Alupi, Tetep
IRBBN (bacterial blight)	• IR54, IR9209-48-3-2, RP633-519-1-3-8-1, RP633-76-1, IR4442-46 3-3-3, IRI3423-17-1-2-1
IRTN (tungro)	• ARC10342, ARC11353, ARC11554 Utri Merah, Utri Rajapan, IR50, S32C-46-7
Insects	
IRBPHN (brown planthopper)	• PTB33, PTB19, Sinna Sivappu, Suduru Samba, BG367-9, BG379-4, BG379-1, BG379-5, IRI3427-40-2-3-3, IR15324-117-2-2-3, IR17488-2-3-2, IR17494-32-1-1-3-2, IR19058-107-1, IR19660-274-3-3-1-3, IR19660-46-1-3-2-2, IR19661-150-2-2-2-1, IR19661-364-1-2-3

GENETIC EVALUATION AND UTILIZATION (GEU) PROJECTS

The collection of detailed information on varietal performance under different agroclimatic conditions — including problem soils, pests, and diseases — is aimed at identifying the genetics of resistance or tolerance for various physical or biological stresses and differences in the biotypes of pests and diseases at different locations. To obtain such information, which generally is not obtainable from experiments conducted at any one place, participating scientists use uniform methodology and frequently exchange information and materials. Collaborators test selected and differential varieties against specific problems at a few, select locations.

The 22 current collaborative projects include:

- Rapid generation advance and early generation testing;
- Rainfed rice and drought resistance;
- Resistance to insect pests — brown planthopper, gall midge, green leafhopper, whitebacked planthopper.
- Disease resistance — bacterial leaf blight, blast, tungro, ragged stunt;
- Problem soil tolerance — coastal salinity, inland salinity, acid sulfate, iron toxicity, organic soils, phosphorus deficiency; and
- Tolerance for high and low temperatures.

The first phase of several of these projects is nearing completion. The completed projects on rice gall midge and brown planthopper have established that the insect populations in certain areas are of different biotypes. Using those biotypes, new genes of resistance in some rice cultivars have been identified.

Two new collaborative projects — those on sheath blight resistance and hybrid rice — have been established. The work plans follow:

- Studies on the pathogenic variability of Thanatephorus cucumeris (sheath blight)

Objectives

1 Develop a standard screening methodology.
2 Verify the levels of resistance in varieties already reported resistant.
3 Study variations in sheath blight pathogen virulence and group the isolates by degree of pathogenicity

Initially, the main emphasis will be to standardize screening test methodology and to identify a set of differential varieties. Collaborating scientists are from Korea, Indonesia, Philippines, Thailand, India, Bangladesh, and IRRI.

- Hybrid rice

  Scientists from IRRI and China have been working closely on hybrid rice since 1979. Two training courses have been held in China, in which 21 scientists from South and Southeast Asia participated.

  Objectives:

  1. Explore the prospects and problems of developing hybrid rice in different countries.
  2. Determine the extent of heterosis in different types of rice culture and identify any advantages they may possess under adverse environmental conditions.
  3. Develop male sterility and fertility restoration systems.
  4. Design techniques for hybrid seed production.

  Collaborating scientists are from India (6), Indonesia (3), Bangladesh (1), Sri Lanka (3), Thailand (2), Philippines (3), South Korea (l), Pakistan (3), and IRRI.

Continuing projects

- Cold Tolerance. Collaborative studies are being actively pursued with the Office of Rural Development, Korea, and the Bureau of Plant Industry (BPI) Research Station at Banaue, Philippines. Many other countries have evaluated the International Rice Cold Tolerance Nursery. Scientists from Bangladesh, China, India, Japan, and Nepal have expressed interest in collaborating in these studies.
- Rapid Generation Advance. Early flowering is induced by exposing photoperiod-sensitive rices to an optimal day length, thereby passing the breeding lines through several successive generations in one year. Questions were raised as to whether inducing early flowering would cause loss of breeding materials which have a phenotypic disadvantage in competitive ability. Additional experiments will be conducted to answer such questions.
- Early Generation Breeding Material. IRRI scientists make specific crosses for rice scientists around the world and supply early generation seeds (F_2 - F_3) for national evaluation and use. It was recommended that information on the performance in different areas of such crosses be made available to other scientists. The exchange and evaluation of better performing early generation materials among collaborating scientists are expected to result in the development of breeding lines with broad agronomic adaptability.
- Others. Drought resistance group researchers from Indonesia, Thailand, IITA, WARDA, and IRRI developed the 1982 plan for collaborative rainfed-wetland yield nurseries (in Thailand and IRRI) and expanded the exchange of breeding lines and the making of new crosses by IRRI staff. Indian workers continue to request F_2 seeds of crosses made at IRRI. Brazilian and IRAT researchers

INTERNATIONAL NETWORK ON SOIL FERTILITY AND FERTILIZER EVALUATION FOR RICE (INSFFER)

The 1981 INSFFER trials continued to test fertilizer nitrogen sources and methods and times of application for irrigated, rainfed, wetland, and deepwater rice. Phosphorus and long-term fertility trials also continued.

- Fifth INSFFER trial. Responses to nitrogen were obtained in 18 of 23 trials. Regression analysis showed that in 80-85% of the trials, basal broadcast of sulfur-coated urea (SCU), and basal deep point placement of urea supergranule (USG) were superior to split application of prilled urea. Maximum crop yields from the N sources were similar, but more prilled urea was required to reach the maximum. On the average, it took 25% less SCU and 30% less USG than urea to produce 0.75 t/ha.
- Fourth trial. Results were very similar to those of the fifth trial. Returns to USG and SCU over urea were marginal, but generally favorable.
- Third trial on N efficiency in rainfed wetland rice. Significant responses to nitrogen were obtained in9 of 11 trials. At low application rates, responses to N sources were similar. Responses to USG and SCU at higher rates were larger.
- Deepwater rice trials. Responses to nitrogen were obtained in 10 of 13 trials. Yields were consistently better in treatments which included SCU. In most trials, USG responses were similar to SCU.

INSFFER trial	Countries participating (no.)	Trials (no.)
N fertilizer efficiency		
Irrigated (5th)	8	23
Irrigated (4th)	9	24
Rainfed (3d)	4	11
Deepwater (1st)	5	8
P sources	6	11
Long-term fertility	4	11
Azolla	8	15
Total	I3	107

- 1978-1981 series of ^{15}N balance field studies. Deep placement of nitrogen using urea supergranules or coated supergranules minimized the loss of ^{15}N and increased plant recovery of applied nitrogen.
- NH_3 volatilization as a nitrogen loss mechanism. Substantial loss of NH_3 occurred when urea was topdressed within 2-3 weeks after transplanting. Direct measurements of denitrification activity were not made; however, indirect measurements suggest that this loss mechanism was not important under continuous flooding.
- Simulated rainfed field study. Denitrification was considered a factor that increased the loss of ^{15}N when floodwater was maintained. Appreciable loss of ^{15}N from deep placed supergranules also was recorded, indicating that this placement method may not reduce nitrogen losses very well in environments with poor water control, particularly when the soil cracks.
- Phosphate source trials. Annually-applied phosphorus has been studied for five seasons in some trials. Other trials are in earlier stages. Some have determined response to residual phosphorus through two to four crops. In general, the highly reactive phosphate rock gives responses which are equivalent to TSP. All sources of phosphorus have had residual values.
- Long-term fertility trials. Ten of 12 locations show stable responses to N, but only one shows significant responses to phosphorus or potassium. Responses to nitrogen plus phosphorus are generally greater than responses to nitrogen alone, and those responses are greater in the dry than in the wet season.
- 1981 azolla experiments with 8 common treatments. Fifteen sites joined the new network in 1981. Dual culture of azolla and rice at 2 plant spacings (10 × 40, 20 × 20 cm) was compared with 60 kg N/ha as urea or 2 kg fresh weight azolla/m^2 incorporated before transplanting plus 30 kg N/ha as urea. Spacing apparently did not affect growth of azolla. Except in three sites, no significant difference in yields was observed among plots receiving either chemical N, a combination of chemical N and one crop of azolla, or at least two crops of azolla. Rice plant spacing did not change yields except in 2 sites, where 10-cm × 40-cm spacing gave higher yield.

Plans for 1982

The INSFFER group decided to conduct seven trials in 1982 — three on nitrogen fertilizer efficiency (irrigated, rainfed, and deepwater) and one each on P sources, long-term fertility, azolla, and acid sulfate soil nursery:

- Fifth International Trial on N Fertilizer Efficiency in lrrigated Rice will include additional treatments for the dry season crop — USG deep placed at transplanting at 4 levels of nitrogen, followed by topdressing of 29 kg N from prilled urea 5-7 days before panicle initiation.
- Third International Trial on N Fertilizer efficiency in Rainfed Rice will continue with no modification. Some collaborators, however, are interested in adding optional treatments, such as prilled urea broadcast and incorporated at transplanting.
- Second International Trial on N fertilizer Efficiency in Deepwater Rice will have 13 new sets of treatments with different forms of urea and different

methods of application at 4 levels of N. The objective is to determine relative efficiency of the sources and to establish their N response curves.

- Phosphorus source trials will continue with the same sets of treatments. Collaborators who would like to join are encouraged to conduct this trial on a phosphorus-responsive soil and to have local rock phosphate materials properly characterized. On sites where residual effects are being determined, the trial should be continued until no appreciable residual effect is observed.
- Long-term fertility trials will continue without modification. Collaborators may add optional treatments, such as application of straw in addition to inorganic fertilizer or application of other nutrients likely to be deficient, such as zinc and sulfur.
- Azolla trials will repeat the same set of treatments. Collaborators are encouraged to measure the biomass applied. In selecting sites, soils rich in available phosphorus and low in phosphorus retention capacity or CEC should be considered. Based on the Philippine experience, farmers will adopt the use or azolla in rice cultivation under those conditions. A control plot should be included to determine the effect of added phosphorus on azolla growth.
- Acid sulfate soil nursery entries increased to 29, from 18 in 1981. Instead of comparing the effect of 2 sources of phosphorus on tolerance of entries, new treatments will include NK, NPK, and NPK + 5 t of lime + 50 kg MnO_2. Rices will be evaluated for tolerance for acid sulfate soil conditions with and without P fertilizer or ameliorating lime, and MnO_2.

INSFFER trial fieldbooks

A fieldbook for each of the INSFFER trials, describing the procedures for conducting experiments and observations and specifying the data to be collected, will be sent to each collaborator. The collection of site characterization data is emphasized to permit the analysis of responses by specified groups of sites. This will enable identification of the effects of confounding variables on response and allow the data to be used to identify potential areas where identified materials and application methods may be used.

ASIAN CROPPING SYSTEMS NETWORK (ACSN)

Varietal improvement of upland crops

Breeding. The project will concentrate on maize, soybean, sorghum, mungbean, cowpea, peanut, and yardlong bean. Only soybean, mungbean, and peanut are now funded by the International Development Research Center (IDRC). The International Fund for Agricultural Development (IFAD) is expected to fund the other crops. Plans for 1982-83 follow:

- Varietal screening at the Institute of Plant Breeding (IPB), University of the Philippines at Los Baños, will be expanded to include not only screening of lines and varieties from international centers and national programs, but also hybridization and selection. Breeding will focus on developing varieties with drought resistance, waterlogging tolerance, early maturity, photoperiod insensitivity (particularly soybean), early seedling development, seed dormancy, nonshattering, and minimum-input adaptation. Such traits as resistance to insect pests and diseases, in addition to high yielding potential, should be considered as important components of the package of varietal characteristics.
- After 2 years of breeding by IPB, segregating populations of crosses with major characters for intensive cropping will be distributed to interested national programs for further selection and evaluation.
- Screening for drought resistance will be done at IPB. The working group recommended collaborative evaluation with Thailand and Burma.
- The photoperiod insensitivity working group will test promising selections in the Asian Vegetable Research and Development Center (AVRDC), India, Burma, Sumatra (lowland and highland altitude), IPB, and Thailand.

Varietal testing. Entries for different crops:

- Each country may add its own promising varieties to the international trials.
- Collaborators should use recommended cultural practices for the site or experiment station for each crop.
- Data to be gathered and guidelines for collecting data were finalized during the varietal improvement workshop.
- Trials can be conducted at an experiment station or cropping systems research

Varietal testing. Entries for different crops.

Crop	Before rice	After rice
Mungbean	10	10
Cowpea	9	10
Bush sitao	8	8
Soybean		10
Peanut		10
Sorghum		10
Maize		10

site for 1 or 2 seasons. Evaluation must be done at the time the crop fits into the potential cropping pattern, before rice or after rice.

- Collaborative research on varietal testing will be expanded starting in 1982. Breeders and cropping systems program leaders have requested 117 trials for the 1982-83 crop year.

Training. A 1-month training on upland crop varietal testing before and after rice in January 1983 will emphasize field layout, data gathering, analysis, and interpretation. Plans also include on-the-job training, with emphasis on breeding techniques for intensive cropping.

Monitoring tours. A monitoring tour will enable scientists in varietal testing and breeding to visit variety trials in two to three countries.

Workshop. Fifty scientists from 10 countries participated in the 15-17 April 1982 workshop. A second workshop on varietal improvement of upland crops for rice-based cropping systems in 1984 will focus more on breeding progress, varietal testing, and collaborative efforts.

Long-term intensive cropping and fertilizer efficiency

Long-term intensive cropping. Many agricultural scientists are concerned that more intensive crop production may result in rapid losses of soil fertility and productivity. Longer term trials for cropping patterns and soil fertility are needed to determine the stability of new technology, particularly for upland crop production on aerobic soils in the humid tropics. Similar studies are needed for cropping patterns with wetland

Trials after rice.

Country	Number of sets							
	Mung-bean	Cowpea	Huh sitao	Soy-bean	Peanut	Sorghum	Maize	
Indonesia	3	2	1	4	4	2	4	5-10 May
Thailand	2	2	–	2	2	2	2	Dec-Jan
Malaysia	1	–	1	–	1		1	Sep-Oct
Vietnam	1	1	1	1	1		1	Sep
Sri Lanka	1	1	1	1	1	1	1	Oct–Nov
Bangladesh	1	1	1		1			Sep-Oct
Burma	1	1		1	1		1	Nov
Nepal	1	–		1			1	Feb-May
Philippines	7	4	4	3	2	3	3	Nov-Dec
Total	18	12	9	13	13	8	14	

Trials before rice.

Country	Number of sets							Planting date
	Mung-bean	Cowpea	Bush sitao	Soy-bean	Peanut	Songhum	Maize	
Thailand	3	3	-	-	1	-	-	1-15May
Vietnam	1	1	1	1	1	-	1	Dec
Burma	1	1	-	1	1	-	1	May
Nepal	-	1	-	-	1	-	-	May
Philippines	3	2	2	-	-	-	-	Apr-May
Pakistan	1	1	1	-	-	-	-	
Total	9	9	4	2	4	0	2	

rice, even though these systems are more stable than dryland agriculture.

The ACSN working group has decided to collaboratively evaluate the effects of new and more intensive cropping patterns on chemical and physical properties of the soil and to determine where the cropping patterns can be maintained over time under dryland and irrigated and rainfed wetland conditions.

Long-term fertilizer efficiency and soil fertility. Appropriate cropping patterns and management practices have been developed for many agricultural production areas in South and Southeast Asia. The major constraints involve supply and cost of inputs, soil conservation, and power limitations. Initially, more efficient sources and management practices for fertilizers and crop residues can be helpful. In many instances, there is sufficient and adequately distributed rainfall to permit year-round crop production. Slow-release sources of nutrients, such as raw and partially acidulated phosphate rock and sulfur-coated urea, should be studied in year-round cropping patterns over a long enough time to evaluate both their agroeconomic usefulness for crops and their long-term effects on soil properties.

The International Fertilizer Development Center (IFDO) has agreed to supply the slow-release materials needed for these experiments:

- Effectiveness of partially acidulated phosphate rock in year-round cropping patterns
- Crop and soil responses to lime and phosphorus treatments over time
- Effectiveness of controlled-release nitrogen fertilizers (SCU) in dryland cropping patterns
- Effects of crop residue management on soil and the production of rice and soybean in year-round cropping patterns
- Long-term effects of sulfur-free and sulfur-containing fertilizers on the fertility, status of soils.

The importance of characterizing research sites by climate and soil classification was emphasized.

Countries and institutions planning to collaborate on long-term studies are in the table.

Insect management

The collaborative project developed by 21 members of Asian Rice-Rased Cropping Systems Entomologists in Bogor, Indonesia, 15-16 May 1981, before the 11th

Countries and institution planning to collaborate on long-term studies.

	Trials (no.)							
	Cropping intensity			Fertilizer efficiency and fertility				
	Dry-land	Irri-gated	Rain-fed	1	2	3	4	5
Bangladesh			1				1	
Burma		1	1	1		1		
China		1		1	1		1	
Indonesia	2	2	2	2	5	4	4	4
Korea		1			1	1		
Nepal	1	1				1	1	
Pakistan		1						
Philippines								
Sri Lanka[a]								
Taiwan	1	1					1	
Thailand	1	1	1			1	1	
Vietnam[a]								
IRRI						1	1	

[a]Representative not present at final planning session.

Cropping Systems Working Group Meeting, will be implemented this year at cropping systems sites in the Philippines, Indonesia, Thailand, and Bangladesh.

The use of economic thresholds as an insect control practice will be tested on rice and maize at each site. Comparing one, two, or three economic threshold values for each pest will allow identification of the level which provides the greatest economic return. When testing the use of economic thresholds, entomologists will use the least expensive recommended insecticide for their country.

The determination and use of economic thresholds gained the support of the participants at this meeting. They agreed that economic threshold values are conditioned by factors specific to sites and that nationally or internationally derived values may not be universally applicable.

Farm implements for intensive cropping systems

The performance of the Rolling Injection Planter (RIP) for crops before or after rice in a rice-based cropping system will be evaluated this year.

Establishment of dryland crops by three seeding methods, and their performance before and after monsoon rice and under zero and optimum tillage will be measured. Seeding methods are traditional or farmers' methods (broadcasting); use of RIP at recommended row spacing and seeding rate; and furrow seeding using an animal-drawn plow at recommended spacing. The split-plot design will include 4 replications.

Data to be taken are seeding rate (g/ 10 m^2), seedling emergence, seedling vigor, days to flowering, plant population at harvest, grain yield, and soil moisture content at planting time. The experiments may be done in farmers' fields or at experimental stations. Suggested crops are maize and mungbean, but other crops may be included. Participating countries are Indonesia, the Philippines, Nepal, Burma, Bangladesh, Sri Lanka, Thailand, and Pakistan. IRRI will provide one RIP to each participating country before October 1982 for use in planting after monsoon and in May 1982 for use in planting before monsoon rice. IRRl also will monitor and coordinate the program and evaluate network data.

Pilot production programs and their impact

Cropping systems research in several member countries of the ACSN has passed beyond the site research phase to the preproduction evaluation and even to the production program phase.

Procedures were presented for monitoring and evaluating pilot production programs.

Plans were made to develop four country studies to document farmer-adopter experiences and to examine their implications for research methodology and farm level impact.

Farm surveys are going on in Nepal, Sri Lanka, and the Philippines. The Indonesian study will start in early May. The goal is to prepare the results of these studies for publication by late July 1982. Similar studies will be initiated in Thailand and Bangladesh.