ORYZA NIRVANA?

An NGO Review of the International Rice Research Institute in Southeast Asia

A SEARICE Publication

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of the International Rice Research Institute in Southeast Asia

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CONVENTIONS USED IN THIS BOOK

1 ton (US spelling)	=	1 metric tonne
1 cavan (Filipino measure)	=	1 sack of approximately 48-50 kg. of rough rice or 45-48 kg. milled rice
1 acre	=	0.4 hectares

Ciba-Geigy is referred to under its old name

FOREWORD

The following study was independently commissioned by SEARICE, Manila, Philippines, a non-profit NGO. This project was first discussed by a group of Southeast Asian NGOs in August 1991 in Bangkok in one of the informal meetings held alongside a Southeast Asian NGO-GO Dialogue on Policies Related to Developments in Biotechnologies organized by SEARICE and the Dag Hammarksjold Foundation. Also present during the discussion were representatives from GRAIN and RAFI. In that meeting, the group of NGOs decided that there was a need for an updated NGO review of the International Rice Research Institute (IRRI). SEARICE was assigned to coordinate the project.

The reasons for the decision were as follows: The increasing trend of privatization of agricultural research especially by transnational corporations (TNCs). The NGOs felt the need for a serious reassessment of public research institutions, including International Agricultural Research Centers (IARCs) which are established as non-stock and non-profit organizations. More specifically, the key question for the NGOs was: can the IARCs and especially IRRI, be reformed so that these institutions may better serve the interests of the poorer farmers.

Secondly, the NGOs were aware that IRRI is not a static, but rather, an evolving institution; and that the institute is not just an unthinking bureaucratic machine but an organization composed of human beings. Initial interaction was paved between IRRI scientists and some NGOs interested in understanding the changes occuring in the institute, with the hope that it is evolving towards a scientific and development paradigm that is sustainable and beneficial to small rice farmers?

Generally, the NGOs felt the need to update their over-all understanding and critique on the institute.

This study forms part of preparations for and follow-up to the *Southeast Asian Conference on Rice, Food Security and Ecology* in November 1992 held in Chiang Mai, Thailand co-organized by SEARICE, the Dag Hammarskjold Foundation, Genetic Resources Action International (GRAIN), Swiss InterChurch Aid (HEKS)-Cambodia and the Rural Advancement Foundation International (RAFI).

Two consultants were contracted to carry out the research and writing of this report. Mr. Nicanor Perlas, international consultant on sustainable agriculture, is Executive Director of the Center for Alternative Development Initiatives (CADI), an NGO based in the Philippines. He has a long experience in NGO activities in the Philippines and in North America to foster sustainable agriculture and scrutinize the impact of new biotechnologies on rural economies and the environment. Ms. Renée Vellvé, a development economist, is program officer of the Genetic Resources Action International (GRAIN), an international NGO based in Barcelona, Spain. She has been working with farmers' organizations and development NGOs in grassroots management of genetic resources and the impacts of biotechnologies on international agriculture since 1992. I closely interacted with them in all stages of the project.

The readers of this report will note that our study concluded that the International Rice Research Institute still requires fundamental changes if it is to serve the interest of the poorer farmers in particular, and the sustainability of rice farming systems, in general. While our study noted down some progressive and positive changes, what is more striking is that the study reaffirmed that the old research and development paradigm and institutional discipline of the 1960s still dominate the research objectives and operations of the institute.

SEARICE and the authors believe that while *Oryza Nirvana?* is written mainly for NGOs, it is also useful and addressed to donor agencies and policy makers.

I would like to mention and commend the people and organizations that made this study and report possible. First, SEARICE would like to thank the researchers and authors, Mr. Nicanor Perlas and Ms. Renée Vellvé. It was a labor based on their commitment to sustainable agriculture and towards fundamental changes within research paradigms and institutions.

Dr. Oscar Zamora of the University of the Philippines in Los Baños (UPLB) also assisted the researchers with technical advice. Dr. Zamora can even be considered as the third author of this report for the time and commitment he gave for the project. Dr. Pamela Fernandez, Ms. Teresita Borromeo and many other friends at UPLB also contributed to the project in different degrees and forms. Mr. Henk Hobbelink, the Coordinator of GRAIN, reviewed the manuscripts, provided technical and socio-political advice and additional data.

I would also like to thank the editors, Dr. Serlie Hamias of the Institute of Plant Breeding at UPLB and Ms. Janet Bell (presently based in Colorado).

SEARICE would also like to extend its gratitude to Dr. Klaus Lampe, who was the Director of IRRI during the course of this study, and to the senior scientists of the institute, Dr. Paul Teng and Dr. Michael Jackson. They encouraged and facilitated our study, and provided access to IRRI data. Their support also allowed other staff members to assist in the research.

I would like to thank, too, the donors that supported this project. CROCEVIA in Rome, Italy provided the initial resources for the research. Under the presidency of Mr. Antonio Honorati, CROCEVIA is active in plant genetic resources conservation and development with their partners in developing countries.

The Dag Hammarskjold Foundation in Uppsala, Sweden and the Swiss Interchurch Aid (HEKS) in Zurich, Switzerland, provided the resources for the editing and publication costs. The Dag Hammarskjold Foundation provided financial assistance within the context of their involvement in assisting the *Southeast Asian Workshop on Biotechnology and Biodiversity* held in Bangkok in August 1991, and their assistance in funding and organizing the *Southeast Asian Conference on Rice, Food Security and Ecology* held in Chiang Mai in November 1992.

HEKS assisted this project within the context of its "Food Security" program in the region. It works closely with farming communities, helps strengthen the farmers'

research capacities and assists in the sustainable management of agricultural resources (which includes on-farm management and research on plant genetic resources, ecological pest management and sustainable nutrient management).

I would also like to acknowledge Ms. Neth Daño, the Policy and Information Officer of SEARICE, who took over in the production stage of this report. She was assisted by our office staff, Mr. Albert Gavino and Ms. Crissy Romero. I would also like to recognize Ms. Pinky Serafica who took over as proofreader and supervised the printing of this report.

Finally, I would like to apologize for the delay of the publication of this report. First, SEARICE and the authors who hold key responsibilities in their organizations, were simply busy with other activities. While we tried a few updating of the data in early 1995, most of this report is based on the research that was largely completed in 1992. You will, therefore, find that some of our data are not up-to-date. The one year additional delay was caused by SEARICE's having to terminate the services of two layout artists.

Renato Salazar
Executive Director
SEARICE

INTRODUCTION

Nirvana:\ 1. A goal hoped for but apparently unattainable, a dream. Derived from Sanskrit, meaning "*act of extinguishing.*"

\ 2. An elusive and generally unattainable state of pure bliss, resulting from the extinction of all desires and passions. Derived from Sanskrit, meaning "act of extinguishing."

In the 1970s, the grassy stunt virus, transmitted by the brown planthopper, was devastating farmers' rice fields throughout Southeast Asia. First reported in the late 1960s in the Philippines, Thailand and Indonesia, it spread to Viet Nam, Laos, Cambodia and Burma. The epidemic particularly afflicted Indonesia, where it infested nearly 120,000 hectares of rice lands, causing harvest losses of three million tons of rice, worth over US$500 million, in a matter of a few years. In 1977 alone, two million tons of rice enough to feed six million people for one year were lost to the disease.[1]

Genetic uniformity was the cause of this unprecedented crop devastation. Never before in Southeast Asia's 7,000 years of rice cultivation had so many farmers been planting the same rice varieties. The varieties came from the International Rice Research Institute (IRRI), based in Los Baños in the Philippines. IRRI was set up by the Ford and Rockefeller Foundations in the early 1960s to breed high-yielding rice varieties in order to increase food production in Asia. The release of IRRI's "miracle rice," IR8, to farmers in 1966 set the Green Revolution in motion.

IR8 and its early progeny such as IR20 and IR24 (released in 1969 and 1971 respectively) could produce great yield gains under favorable conditions and rapidly replaced thousands of diverse traditional varieties as farmers adopted the new "seeds of hope." Their hopes, however, were crushed as the miracle rices succumbed to the brown planthopper. Not only were the IRRI rices genetically susceptible to the insect and the virus it transmitted, but the huge land area cropped to a small number of the same, uniform varieties gave the hopper an unprecedented feeding ground.

In 1970, IRRI breeders began a massive search for a solution to the problem. They meticulously screened 5,000 rice samples and 1,000 breeding lines in their search for a resistant plant. Among the thousands of different rice accessions maintained at the IRRI genebank, only one could stand up to grassy stunt. It was a wild rice called *Oryza nivara* that had been collected in Orissa State in India in 1963. An otherwise straggly and unproductive rice, *O. nivara* had what no other rice was found to have. Only three plants in IRRI's single accession contained a gene for resistance to grassy stunt. The gene was immediately crossed into new varieties to supplant the earlier IRRI rices. These included IRRI's superstar, IR36, which by 1982 covered 11 million hectares of Asia's rice lands, awarding it the dubious honour of being the world's single most widely-planted rice variety in history.[2] However, by the mid-1980s, the resistance provided by *O. nivara* was breaking down in farmers' fields, and IRRI breeders were back at the drawing board.

Why is the story of *O. nivara* so important? Because it is a metaphor for the problems facing rice farmers and agricultural development in Southeast Asia. Since IR8, IRRI has transformed the lives, cultures and opportunities of countless local communities dependent on rice for their livelihoods. The subject of both praise and criticism, IRRI's impact has been profound: Asian rice production has literally doubled since the 1960s, managing to keep ahead of population growth. But the strategy employed to achieve these gains, and the question as to who benefited from them, are subject to great controversy.

To perform well, IRRI's high-yielding rices required costly chemical inputs, access to credit and irrigation, and new forms of social organization. While some benefited from the new rices, many farmers became indebted, lost control of their production systems and became caught in a spiral of dependency. Urban consumers got cheaper (but tasteless) rice, while the social and ecological viability of intensified rice farming was slowly eroded. IRRI's persistent efforts to overcome hunger and poverty through the power of plant breeding and capital-intensive production methods have fomented decades of political struggle among Southeast Asian NGOs and farmers' organizations against this vulnerable but mighty institution.

Enter the 1990s. On 12 September 1992, the *Manila Chronicle* featured a full-page story under the bold title "IRRI's New Look." The article reports that IRRI is undergoing a major change in style and approach to rice research, described as "*environment friendly, farmer friendly, concerned over poor people, efficiency oriented, non-renewable resource conscious.*" After 30 years, the proposed shift sounded radical — and welcome.

This report attempts to make an initial assessment as to whether "IRRI's New Look" reflects a significant structural change in the Institute's work or whether it is a superficial face-lift. The need for this assessment has emerged from the NGO community working with small-scale farmers to promote sustainable agriculture in Southeast Asia.

The signficance of rice in Asia cannot be understated. Rice means life to most people in the region. Many farmers are now turning away from chemical-based and capital-intensive production systems towards more sustainable approaches that give new place and meaning to the aspects of rural life that have been negatively affected by IRRI over the past 30 years: biological diversity; water, soil, pest and disease management; and empowering forms of social organization. In short, their struggle is against addiction, erosion and alienation. Just as rice means life to most people in Southeast Asia, something that now characterizes the world of rice — whether we look at production, research, consumption, food security or the search for alternatives — is dependency. Dependency thwarts the quest for self-reliance.

IRRI claims today to be resolutely pro-farmer, pro-environment, pro-sustainability: buzzwords that soothe IRRI's donors and seduce IRRI's clients. This report tries to address what IRRI is actually up to, how it is re-organizing and implementing research towards its new concerns, and whether or not the Institute can empower small farmers and promote sustainability. What we see is a rapidly changing Institute that nevertheless has its feet bogged down in a 30-year old research culture designed by the planners of the Green Revolution.

Oryza nivara bought IRRI time. Is "The New IRRI" now on the right track? Or is it engaged in an elusive chase for *nirvana* instead?

1 1 Plucknett, D *et al.* (1987). *Genebanks and the World's Food.* Princeton University Press, p 176.

2 See Plucknett, et al. (1987), *Gene Banks and the World's Food,* Princeton University Press, for a story about IR36.

THE SETTING:
THREE DECADES OF THE GREEN REVOLUTION IN SOUTHEAST ASIA

1.1 PORTRAIT OF A REVOLUTION

"Agriculture is nothing more than the application of the principles of biology and other natural sciences"

Advisory Committee to the Rockefeller Foundation, 1951.[1]

IRRI's Green Revolution was the culmination of US, European and Japanese experiences in agricultural intensification. The US' agricultural revolution was initially machine-driven; Europe's was driven by chemical fertilizers; while Japan's mainly involved irrigation. In the 1930s, the development of hybrid corn pioneered a new era in agriculture which combined the use of machinery, chemical fertilizers, irrigation and genetics to achieve astounding increases in corn yields. In the 1940s, chemical pesticides were introduced into the technological package. The seed became the focus for all the driving forces that created the agricultural revolutions of the past 150 years.

1.1.1 THE ENGINE DRIVING THE GREEN REVOLUTION

Green Revolution scientists were aware that the seeds they spread throughout Southeast Asia would dramatically change agronomic practices. The so-called high yielding varieties (HYVs) of rice were to be their beachhead into the agricultural cultures of Southeast Asia. But HYV seeds were just carrots to achieve a much bigger agenda. The seeds came as part of a costly package of chemical fertilizers, pesticides, irrigation, machinery and infrastructure, bound together by Western science, values, and economic and political organization.

IRRI was established in 1959 by the Rockefeller and Ford Foundations. Its objective was to breed new rice varieties along the lines of Rockefeller's successful work with wheat in Mexico. The overt justification for IRRI's existence was to increase yields of rice so as to counteract the specter of an ever growing number of hungry people. From its birth, however, other than purely altruistic motives were at work.

The concern for feeding Asia's growing population was not borne out of compassion for the poor, but from a value system that gave meaning to America's foreign agenda. The US sought to contain the spread of communism, not through military means alone, but through palliative reform measures as well. US business interests also wanted new markets for their products, new investment opportunities and a healthy climate for global trade. The Rockefeller and Ford Foundations "*were not primarily interested in the land, labour, or rice of [Asia's rice] cultivators but in the way their conditions, their production, and their behavior impinged on American interests.*"[2]

At the beginning of the 1950s, the US foreign policy establishment was reeling from the loss of China to the communist world. It was waging a military war against communists in Korea. US interests in Asia and the Pacific were also threatened by the revolutionary fervor which was creeping into many Asian countries. The demand for structural changes in the inequitable distribution of resources and opportunities in the predominantly agrarian societies of Asia were causing a great deal of concern among Americans and their allies. Increasingly there were cries for land reform, freedom from landlord oppression, and related demands. Food was clearly recognized as a "*political weapon in the efforts to thwart peasant revolution in many places in Asia...[From] its beginning the development of the Green Revolution grains constituted mobilizing science and technology in the service of counter-revolution.*" [3]

Vandana Shiva points out that:

> *Peasant movements had tried to restructure agrarian relationships through the recovery of land rights. The Green Revolution tried to restructure social relationships by separating issues of agricultural production from issues of justice. Green Revolution politics was primarily a politics of depoliticization... Green Revolution science and technology were an integral part of a sociopolitical strategy aimed at*

> *pacifying the rural areas of developing nations in Asia, not through redistributive justice but through economic growth. And agriculture was to be the source of this new growth.*[4]

The economic motivation for the Green Revolution was spelt out by Arthur Moses, President of the US' Agricultural Development Council. He argued early in the Green Revolution that the co-operative social structure evident in many agrarian communities needed to be dismantled in order to encourage "*aggressive interest in the marketplace.*"[5]

At that time, Nelson Rockefeller (who later became Vice-President of the USA) chaired the International Development Advisory Board. This body was charged with expanding the Marshall Plan from the post-World War II reconstruction of Europe onto a global scale. In a 1951 article in *Foreign Affairs*, an influential foreign policy journal, Rockefeller made some telling remarks on the motives behind the Green Revolution, paraphrased below:

> *The biggest problem in a 'world economic policy and increased investment' was the problem of 'underdevelopment'... The correct response [to this] should be a 'widening of the boundaries of US national interests' and the first objective of US policy should be 'a drive to increase food production in the underdeveloped areas by 25%, which would bring them barely above the minimum needed for health.' This drive was to be followed by raw material development and extraction and, finally, by increased export of manufactured goods [from the US and Europe] to those areas [to be developed]. These were the only ways to increase private investment 'in frontier areas.'*[6]

Rockefeller's views were not simply his own, but captured the sentiments of powerful segments of the elite which controlled foreign policy in the US. He reminded doubters to consider the volume of market demand that could be generated if the billions of consumers in the underdeveloped free-world could raise per capita incomes from the existing US$80 per year to the US$473 level of Western Europe or to the US$1,453 level of the United States. Rockefeller also warned that *"any reckless handling of this problem can create such chaos... that [underdeveloped countries would be] thrown into the closed economic orbit of the enemy."*[7]

The goals of suppressing communism and expanding export markets were clear. IRRI was the mechanism for achieving them. The grain yield fixation can be attributed to the Rockefeller view of "*underdevelopment.*" While poverty is clearly political (distribution of power, wealth and resources), science can address only the quantitative parameters. Thus, just as John D. Rockefeller III went to work delivering contraceptives to defeat overpopulation in the poor countries, the Foundation set to work delivering high-yielding seeds to defeat hunger.[8] The founders of IRRI believed that the imperative was to introduce technical solutions to isolable problems and social change would follow.[9]

Rockefeller's agenda was to find "*isolable technical problems which are so important that their solution would find acceptance and application even under present circumstances.*"[10] This ingeniously deceitful choice of words must be decoded for its true meaning to become clear.

"*Under present circumstances*" meant that it would be undiplomatic to advise target Asian countries how to run their politics and economics. It also meant supporting existing oppressive agrarian structures. "*Isolable technical problems*" were the Trojan horses for propelling societies away from equitable food access and distributive justice and towards an integrated global economy friendly to US business interests. Low yields of food, especially rice, were identified as the "*technical problem,*" which could be isolated from its larger socio-political context.[11]

Since low yields were the result of technical problems, they could be fixed with technical solutions. Such an approach could easily find "*acceptance and application*" because the objective of increasing rice yields would be, in the words of Rockefeller Foundation officials, "*morally unassailable.*" For indeed, who would question the benevolent objective of increasing food production so that hunger could be vanquished?

This Rockefeller formula is "social engineering"[12] at its best. Firstly, it gave government decision-makers and technocrats a scientific excuse for not dealing directly with questions of structural oppression and distributive justice. Yield-increasing technology provided the perfect distraction from having to face structural reforms. Secondly, this seemingly "neutral" and harmless technology is an instrument of radical social change, the technological posture avoids addressing difficult social issues. In reality, this "acceptable" and "morally unassailable" technology forces the target population to undergo radical societal transformation. Ironically, the apologists of this subversive technology were heralded as modern-day heroes because they were doing "good" and bringing a "benefit." Those who praised them did not know what the options were and what alternative futures had been surrendered.

The Rockefeller ideology of "neutrality" would be spouted out whenever IRRI was confronted with the social and ecological consequences of its technological creations. IRRI's apologists have even built up a technocratic, pseudo-scientific "induced innovation" theory to absolve themselves from any responsibilities for their involvement in the creation of IRRI technologies.[13]

The Green Revolution was designed to transform Southeast Asian societies so they could become a market for farm tools, fertilizers, pesticides, irrigation and other agricultural equipment.[14] Before public outcry forced IRRI to change, it accepted financial support from chemical companies that stood to benefit from the opening up of Southeast Asia to foreign capital through the Green Revolution.

Rockefeller associate, David Hopper, has suggested that national governments must clearly separate the goal of agricultural growth from the goals of social development and political participation:

> *These goals are not necessarily incompatible, but their joint pursuit in unitary action programs is incompatible with development of an effective strategy for abundance. To conquer hunger is a large task. To ensure social equity and opportunity is another large task. Each aim must be held separately and pursued by separate action. Where there are complementarities they should be exploited. But conflict in program content must be solved quickly at the political level with a full recognition that if the pursuit of production is made subordinate to these aims, the dismal record of the past will not be altered.*[15]

People outside the Rockefeller Foundation also recognized the strategic importance of rice. John King, an agricultural economist who later became a CIA intelligence officer, pointed out that:

> *South and South East Asia must be made to realize that increased production and a higher standard of living are possible in their own countries without adoption of totalitarian methods. The struggle of the 'East' versus the 'West' in Asia is in part a race for production, and rice is the symbol and substance of it.*[16]
>
> *Economic and sociological changes are the preconditions of greater production, and they cannot be achieved quickly by non-totalitarian methods. A long road stretches between scientific investigation and the lessons of the experimental farms, and the practices of the rice farmer.*[17]

In the early 1950s, the Rockefeller Foundation added a new agriculture division to its operations. Shortly thereafter, it established the highly influential Population Council and the Agricultural Development Council. Rockefeller staff undertook a series of investigative journeys to Asia to find ways of implementing the organization's vision of a new Asia. These initiatives ultimately resulted in the creation of IRRI. Thus, the birth of IRRI was directly linked with motives and goals much larger than its professed mandate.

The Institute was an instrument to "modernize" Southeast Asia. The contradictory motives that created it slowly permeated the research strategies and activities of IRRI, and drew mixed public reception towards the Institute. IRRI has not cast off its shadowy heritage. The original Rockefeller goals are still being pursued even if the present crop of scientists are not aware of IRRI's founding motives.

What has changed at IRRI is the more conscious examination of the technologies used to attain these goals. The ecological costs of the tools made them less "acceptable" to recipient farmers and governments. Technology could not fulfill its intended role as a Trojan horse because it was generating too much "noise" and too many environmental side effects. IRRI recognizes that if the "noise" of the technological locomotive could not be reduced, the Rockefeller Foundation formula for social engineering might break down.

Thus, IRRI's attempt at "greening" the Green Revolution, paying more attention to some environmental consequences of its technology, is, at best, fine-tuning and sharpening of its tool. Fundamentally, IRRI still buys into and reproduces the founding motives of the social engineers at the Rockefeller Foundation.

1.1.2 THE MACHINERY FOR THE REVOLUTION

The mixed motives that accompanied the birth of IRRI expressed themselves in the Institute's package of rice technologies. IRRI developed a technological package which guaranteed that Southeast Asian farmers could increase grain yields only through external inputs.

IRRI selected its rice varieties under conditions of high external inputs, including chemical fertilizers and hazardous pesticides. It also selected its varieties for particular agronomic conditions: areas with high population densities, monoculture production, and irrigation. The Institute made no attempt to harness local resources internal to the farm to achieve increased rice and total systems productivity.[18]

IRRI ignored the tremendous amount of farming wisdom that existed in Asia. Even almost a hundred years back, the discerning eyes of a British observer in India could see more to indigenous agricultural systems than sentimental attachment to the idea that "new" means "better" might allow:

> *I explain that I do not share the opinions which have been expressed as to Indian agriculture being, as a whole, primitive and backward, but I believe that in many parts there is little or nothing that can be improved. Whilst where agriculture is manifestly inferior, it is more generally the result of the absence of facilities which exist in the better districts than from inherent bad systems of cultivation ... I make bold to say that it is a much easier task to propose improvements in English agriculture than to make really valuable suggestions for that of India. To take the ordinary acts of husbandry, nowhere would one find better instances of keeping land scrupulously clean from weeds, of ingenuity in device of water raising appliances, of knowledge of soils and their capabilities as well as of the exact time to sow and to reap as one would in Indian agriculture, and this not at its best only but at its ordinary level. It is wonderful, too, how much is known of rotation, the system of mixed crops and of fallowing. Certain it is that I, at least, have never seen a more perfect picture of careful cultivation combined with hard labor, perseverance and fertility of resource.*[19]

Building upon such sophisticated farming knowledge and systems was not part of IRRI's agenda and approach. In the words of IRRI's Plant Breeding Department:

> *By removing the* ***unessential features*** *of traditional varieties, as exemplified by our early varieties like IR8 and IR5, we increased the*

> *productivity of rice to almost 200 cavans per hectare... All the energy traditional varieties have to spend to compete with other plants have been converted into grain in modern varieties. Almost 60% of the mature plant of a modern variety is grain — double that of traditional varieties.*[20] [Emphasis added.]

Asian indigenous knowledge and rice farming systems were implicitly perceived as inferior; while Western science and technology was implicitly hoisted up as superior. The new technologies were diffused in a top-down process which did not involve farmers. IRRI helped start the trend of dependency on external sources of scientific and technological "goods," creating the loss of self-reliance and self-respect now so prevalent in rice growing areas of Southeast Asia.

IRRI scientists did not appreciate that the "unessential features" of traditional varieties performed valuable ecological services and were important in the total food system of rice cultures. Straw was used to help maintain soil fertility and moisture in rice paddies and other crops, and as fodder for farm animals which served multiple functions in peasant agriculture. Animals were also sources of valuable manure which maintained the fertility and productivity of Asia's rice paddies for generations and centuries.[21]

Furthermore, IRRI failed to appreciate that the traditional varieties were often high-yielding themselves. Dr. R.H. Richaria, an internationally renowned Indian rice scientist, was known to have documented that rice varieties selected and improved by peasants and indigenous peoples of India could match and even outyield IRRI's HYVs. The following is an account of grain yields obtained more than 15 years *before* IRRI launched the Green Revolution in Southeast Asia. The highest yields reached 12,000 lbs/acre or 13.64 tons per hectare!

> *The possibility of obtaining phenomenal and almost unbelievably high yields of paddy in India has been established as the result of the crop competitions*

> *organized by the Central Government and conducted in all states. Thus, even the lowest yields in these competitions has been about 5,300 lbs/acre, 6,200 lbs/acre in West Bengal, 6,100, 7,950, and 8,258 lbs/acre in Thirunelveli, 6,368 and 7,666 kg/ha [sic] in South Arcot, 11,000 lbs/acre in Coorg and 12,000 lbs/acre in Salem.*[22]

IRRI neglected Southeast Asia's wealth of indigenous knowledge, practices and achievements in rice, an oversight which continues to trouble its current research strategies. Focusing instead on its own agenda, IRRI altered, through breeding, the architecture and physiology of the rice plant to achieve high yields of calories. It collected and bred traditional varieties from many parts of the world. The "best" lines eventually became the IRRI rice varieties that later dominated the countryside.

In the beginning, IRRI selected for the following characteristics in its rice varieties: short stature, photoperiod insensitivity (to allow for year-round rice growing), fast maturity, responsiveness to inorganic fertilizers and high grain yields. This research strategy yielded IR8, the so-called "miracle rice." IR8 was tasteless and it was attacked by a number of pests. So, in the late 1960s and early 1970s, IRRI expanded its breeding objectives to include improved grain quality and host plant resistance (HPR) to insects and pests.

These new breeding objectives resulted in varieties like IR26, IR36 and IR64 which spread widely throughout Southeast Asia. However, the built-in resistance of rice to pests, especially brown planthopper, was not durable. HPR collapsed under field conditions. Since then, it has been a breeding and pesticide race against pests.

1.1.3 THE IMPACT OF THE REVOLUTION

The Philippines was one of the first countries to open its arms to IRRI's package of technologies. IR8 was barely out of the research lab in 1966 when the Philippines, under

President Ferdinand Marcos, launched a national program based on IRRI technology.[23] Between 1955 and 1965, grain yield increases contributed only 32% to rice production growth in the Philippines, while increases in area contributed 68%. However, in 1965-1980, grain yield increases brought about by the use of Green Revolution varieties, fertilizer and irrigation accounted for 81% of total rice production growth. Additional land area contributed only 19% to total growth in rice production (*see Table 1.1*).

TABLE 1.1: *Contribution of area and yield increasing factors to rice production growth in the Philippines (%)*

	1955-1967	1967-1980
AREA	68	19
YIELD	32	81
factors of which:		
- new varieties		(26)
- fertilizer		(31)
- irrigation		(24)

Source: Gomez, AA (1986), Philippines and CGIAR Centers: A Study of Their Collaboration in Agricultural Research, *CGIAR Study Paper No. 15, Washington DC: The World Bank, p. 47*

During the same period (1965-82), 93% of the irrigated lowlands in the Philippines were converted to IRRI varieties. This is a very rapid adoption rate considering that before 1965 not a single hectare of Philippine irrigated lowlands, outside of the IRRI experiment station, was planted to an IRRI variety. Grain yields for irrigated rice in these areas increased from 1.72 to 2.75 tons per hectare between 1969 and 1979. By the end of 1968, the Philippines was self-sufficient in rice. But in the early 1970s, typhoons and tungro disease wiped out the short-lived rice surplus. The vulnerabilities of the "miracle rice" had begun to show.

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Nevertheless, with further government support, grain yields and overall production continued to increase. The Philippine government reported that as much as 96% of the farmers were extended credit, many of them without collateral.[24] By the end of the 1970s, self-sufficiency in rice was again in sight and agricultural scientists and policymakers expressed great satisfaction with the package of Green Revolution technologies.

Yet, a paradox emerged with the Philippine experience, which continues to haunt proponents of the Green Revolution. Despite reported increases in overall national rice production, the food situation for most Filipinos did not improve. During the same period that spectacular increases in rice output were being reported, official government sources also announced that 60-70% of all young Filipinos were undernourished. A UN study concluded:

> *Ten years after the beginning of a successful Green Revolution, the Philippines had one of the highest tuberculosis rates in the world. This must be taken as evidence of widespread nutritional deficiency.*[25]

The Philippine picture roughly reflects what happened both at the Asian and global levels. IRRI is happy with its achievements on all levels, and is quick to acknowledge the role that the national agricultural research systems (NARS) and country governments have played in diffusing the Green Revolution. IRRI describes its "joint" achievements with NARS on a global level as follows:

> *In just over two decades following the introduction of modern varieties and improved crop management, 11 Asian countries showed a mean rice yield increase of 63% on 121 million hectares grown to rice. Increases for the rest of the rice world totaled only 17%. That percentage difference translates to 0.94 ton/hectare, or 114 million tons. At the present rate of rice consumption in Asia, that additional production is enough to feed 500 million persons.*[26]

IRRI's rice technology "saved" on land by increasing grain yields. But, as seen briefly in the case of the Philippines, yield increases were achieved at great costs. For many farmers and communities in Southeast Asia, the price tag has been too high for the benefits the Green Revolution has brought.

1.2 IRRI'S NEW LOOK

In its 35 years of existence, IRRI has gone through a number of phases of development and change. Starting as a small research team of 12 with an annual budget of $5 million and a very clear mission, IRRI underwent almost 30 years of somewhat unguided expansion until its shake-up in the late 1980s. The IRRI of the 1960s was dynamic and clear in purpose: to become a center of excellence in rice research, above national politics, and get Asian rice production to outstrip population growth through plant breeding. The IRRI of the 1970s was already being forced to deal with some backlashes of the Institute's simplistic technology-first approach: pest and disease problems, the danger of isolating rice from other aspects of Asian farming and food systems, and so on. The IRRI of the 1980s was seen by many as a visionless and disorganized monolith, vulnerable to external attacks, in certain ways corrupt, and lacking direction.[27]

At this time, pressure for change began mounting from both the public and donors. Hostility toward IRRI in its host country grew precipitously in the mid-1980s. An IRRI-instigated survey on the impact of its high-yielding varieties on poor farmers led to a major national farmers' conference on rice, where criticism of IRRI was loudly articulated and concerted nationalist efforts to oppose the Green Revolution through farmer-scientist partnerships were launched.[28] At the same time, IRRI was undergoing court investigations related to formal charges that "*IRRI was a plot to sabotage the Philippine economy.*"[29] Soon after, public scandal about IRRI's rice blast research being pursued in co-operation with the DuPont Corporation, among others, nearly brought IRRI to close down in 1987 (see *Section 5.2.1*).[30] These and numerous other events, involving demonstrations, wide media coverage and even violence, distilled years of farmer and

NGO frustration with a foreign agency that had taken a dominant role in directing Philippine agricultural development.

The second and more powerful source of pressure bearing upon the organization came from its donors. Following the 1987 external review of IRRI, which crystallized donor criticism and coincided with funding cutbacks, IRRI embarked on a massive and profound change of organization. Donors demanded that IRRI, like other CG centers, revamp its operations to effectively address issues of "sustainability" in rice production, and "equity" — particularly with respect to gender — in its research and output. With the replacement of IRRI's Director-General M.S. Swaminathan by Klaus Lampe in 1988, IRRI began an aggressive and painful restructuring process. Staffing was slashed, the organization was entirely redesigned to provide for more effective and efficient management, and a major effort to regain donor confidence was launched.

By the early 1990s, IRRI had regained vitality, vigor and some sense of purpose. The CGIAR's 1992 external review panel claimed to have found "*a rejuvenated IRRI.*"[31] Anyone visiting the Institute at that time would have had to agree. However, despite the dramatic transformations IRRI underwent between 1988 and 1992, IRRI, like many other CG centers, is still struggling to adapt to the changing external environment and prove its relevance.

The third form of pressure has to do with IRRI's *raison d'être*: increase rice production to quell hunger and unrest. In a sense, IRRI is a victim of its own success. In its early years, IRRI dramatically raised the yield ceiling of the irrigated rice plant. By all accounts, IR8 was a "show stopper." It was a big change in the rice plant and offered a stunning jump in grain yields. But with it, the show stopped and the gains have been slowly eroding. Much of IRRI's output since has generated new problems: increasing genetic erosion, soil degradation, pest problems and other factors which are contributing to the perceptible decline in irrigated rice yields throughout Southeast Asia. IRRI's successes have become its failures, making the Institute look like a doctor that creates illness. But now, the show is back on the road as IRRI tries to come to its own rescue. Where yields flattened out, IRRI is struggling to raise the roof again. This time, a bit more "sustainably" and with more concern for the farmers beyond the irrigated lowlands, so it is said. If every breakthrough hides another crisis, this might not spell the long-term security that farmers and consumers need.

As IRRI moves into the 1990s, it has a fresh face, fewer and younger staff, and a somewhat updated discourse — but a strikingly familiar repertoire and research agenda. There are positive changes underway. IRRI is downplaying chemicals as automatic pest control and optimal plant fertilization strategies. The Institute also seems to be starting to realize that technology is not socially-neutral and that there is more to rice production than the controllable, monocropped irrigated field. IRRI, running one of the best gene banks in the world as its sole conservation option for rice germplasm, also recognizes now that farmer-based strategies for genetic resources management are worth looking into. The key question addressed by this report is whether we are witnessing an institutional face-lift, rather than a fundamental redirection of IRRI's operations.

1 Advisory Committee to the Rockefeller Foundation, "*The World Food Problem, Agriculture and the Rockefeller Foundation*," 21 June 1951. Quoted in: Anderson, RS et al (1991), Rice Science and Development Politics, Oxford: Clarendon Press.

2 Anderson, RS et al. (1991), Rice Science and Development Politics, Oxford University Press, New York, p 55.

3 Quoted in Shiva, V (1991), The Violence of the Green Revolution, Dehra Dun, India, p 22.

4 Shiva, V (1991), op cit, pp 21-23.

5 Booth, B (1992), "*GERM PLASM: Slave Trade of the 20th Century? Who Owns the Seeds of the Earth?*". Biodynamics, Issue No. 181, p 6. Booth cites the work of Michael Perleman (1977), "*Farming For Profit in a Hungry World*," Landmark Series.

6 Anderson, RS et al, (1991), op cit, pp 22-23.

7 Ibid., p 23.

8 Anderson, R (1991), "*The Origins of the Rice Research Institute*," in Minerva, XXIX, p 66.

9 Ibid, p 72.

10 Ibid., p 35.

11 Ibid, pp 30-31.

12 Rockefeller Foundation's propensity for "social engineering" can be seen in its efforts in Mexico with "miracle wheat," the creation of the Population Council in 1952, and the Agricultural Development Council in 1953.

13 For a discussion of "induced innovation theory," see Bruce Koppel and Edmund Oasa (1987), "*Induced Innovation Theory and Asia's Green Revolution: A Case Study of an Ideology of Neutrality*," Development and Change, Vol. 18 , pp 29-67.

14 Ibid, p 6.

15 From David Hopper's Strategy for the Conquest of Hunger, quoted in Vandana Shiva (1991), op cit, p 23.

16 Quoted in Shiva, V (1991), op cit, p 36.

17 Ibid, pp 36-37.

18 Rice grain yields are not the same as total systems yields. In traditional rice farming systems, farmers not only harvest rice grains. They also obtained other types of food from their rice paddies including indigenous species of vegetables, fishes, shrimps, and other edible animals and plants. This myopic focus on the grain yield alone is taken up further in the section on problems of the Green Revolution.

19 Voeleker, JA (1893), Report on the Improvement of Indian Agriculture, London: Eyre and Spothswoode, p 11. Cited in Vandana Shiva, The Violence of the Green Revolution, Dehra Dun, India, p 6.

20 IRRI Plant Breeding Department (1988), Rice Breeding Program, 15 Oct., p 1.

21 Richaria, RH (1986), Paper presented at Consumers Association of Penang (CAP) Seminar on Modern Science, Penang, November. Cited in Shiva, V (1991), op cit, pp 44-45.

22 Regna Iyengar, AK (1944), Field Crops of India, Bangalore: BAPPCO, p 30. Cited in Shiva, V (1991), op cit, p 45.

23 Johnson, S (1991), The Green Revolution, New York: Harper & Row, p 190.

24 Pearse, A (1980). Seeds of Plenty, Seeds of Want; Social and Economic Implications of the Green Revolution, Oxford: Clarendon Press, 1980, p 213.

25 Ibid, p 214. Pearse was a member of a team of scholars and scientists that did a long term study on the social and economic impact of the Green Revolution for the United Nations Research Institute for Social Development (UNRISD).

26 IRRI, "*Impact of IRRI on Rice Science and Production, 1960-1992*," IRRI, Los Baños, Laguna, Philippines, p 2.

27 For an official account of this period, see TAC, Third External Program and Management Review of the International Rice Research Institute, TAC Secretariat, Rome, 1988.

28 BIGAS (Bahanggunian ng mga Isyu sa Bigas) Conference, University of the Philippines at Los Baños, June 1985.

29 IRRI (1992), Myths and facts about the International Rice Research Institute, IRRI, June, p 4. The charges were dismissed based on IRRI's defense.

30 According to IRRI sources. The allegations against IRRI suggested that the Institute had abused its ample liberties as an international research organization based in the Philippines. It was argued that blast was not a major disease in the country but IRRI could cause it to become one, as the containment facilities for the highly virulent strains were inadequate. The fact that DuPont Corporation provided the strains and had a vested interest in increasing fungicide sales to control blast in Asia angered IRRI's detractors.

31 IRRI (1992), Rice Research in a Time of Change: A Medium Term Plan for 1994-1998, first draft, November.

THE STRUCTURE:

IRRI'S IDENTITY

"One of the questions most frequently asked of the Institute's staff relates to how the Institute's research, training and related programs will change the way farmers grow rice. For many reasons, the Institute can not communicate directly with the millions of rice producers in the many countries involved, nor does it consider such direct communication desirable or necessary."

IRRI, Annual Report, 1964[1]

In 1995, IRRI celebrated its 35th birthday as an international agricultural research organization. The Institute was established in 1960 by a letter of agreement between the Philippine government and the Rockefeller and Ford Foundations, and the genebank was opened in 1961. In 1962, IRRI officially began full operations as an international research institution.

From the release of its first nitrogen-responsive semi-dwarf rice, IR8, in 1966, IRRI has pursued a path of increasing rice yields one step ahead of population growth. The Institute's mission has never wavered from this goal. Social criticism of the Green Revolution, environmental drawbacks of IRRI's approach to rice production, and the very limits of its narrow focus on grain yield have rocked the Institute's boat more than once. But due to the effectively shielded character of this CGIAR agency, and because of strong leadership, IRRI has managed to stay afloat.

Despite public and donor pressure to reform its structure and operations, IRRI has remained a stolid institution committed to its founding and central goal: to raise the yield of the rice plant in order to feed an ever-growing population. Pursuit of this goal at any cost — be it environmental, social or political — has perpetually been IRRI's stumbling block. Its dogged determination in this respect reflects the organization's unquestioning loyalty to the values that guide the organization and the ideological framework within which IRRI operates.

2.1. VALUES AND GUIDING PRINCIPLES

IRRI's institutional identity draws directly from its origins as a private initiative of the Rockefeller Foundation. This may seem surprising, as organizations usually have to evolve as circumstances change. However, IRRI's history has been marked by its full and effective internalization and reinforcement of "the Rockefeller culture."

At the heart of this institutional culture is a set of very clear and immutable values, and an ideological framework within which those values are pursued and put to work. On the surface, a simplistic mindset characterizes IRRI's *raison d'être* and form of organization. First, IRRI exists to perform and advance rice science as a critical contribution to the fight against hunger. In IRRI's ideology, rice science did not exist before it arrived on the scene. As a Rockefeller 1954 report pointed out,

> *Despite the importance of the rice plant ... little was known scientifically about rice because rice was important mainly in countries 'where science has not progressed very rapidly.' The rice plant was vigorous, adaptive, resistant to disease, and 'would produce a tolerable crop under almost any circumstances.' There had therefore been 'little incentive to study this marvellous plant.'* [2]

This mindset that IRRI is the world's "definitive" protagonist in advancing knowledge of rice — despite the fact that farmers have been growing, breeding and developing technologies for rice production for over 7,000 years — is engraved in the Institute's mandate and has marked the organization up until today. IRRI's scientific reports and other publications are replete with illustrations of this superior vision IRRI cultivates with respect to rice production. For example, IRRI describes how it has "*demonstrated the importance of ... crop rotation*"[3] and says that "*assembling riceland geographic information ... will allow extensionists to demonstrate to farmers how informed judgements ... are made.*"[4]

IRRI's ideological framework effectively excludes farmers from the research process. Farmers are not considered important contributors to knowledge about rice and rice production, despite the fact that they have domesticated and managed rice farming systems with obvious skill and ability. Instead, rice farmers have been relegated from their position as active protagonists in the culture of rice to that of passive recipients of institutionally improved technologies. IRRI's claim of dominance in rice science is subsidiary to, and a condition of, the Institute's single goal: to raise grain yields in order to feed the hungry.

One core idea — that technical solutions can catalyze political and social change — forms IRRI's institutional backbone, and lays the ground for most all of its values and goals. For example, based on this conviction, IRRI (like other CG centers) has long justified its claims to political neutrality.

Without this self-imposed mask of neutrality, IRRI could not vindicate the superiority of its mission.[5] In IRRI's logic, research and technology are supposed to set/provide the conditions for shifts in power relationships but cannot dictate them: "*The persistent experience — of hungry populations co-existing with adequate and even surplus world food production — means that better distribution systems, even within countries, cannot be relied upon to feed people.*"[6]

Putting the technical before the socio-political as a condition for effective change, IRRI also justifies its conviction that the universal is superior to the local and specific, and that the centralized is superior to the dispersed. The first is a qualitative value omnipresent in IRRI's work and organization; the second is a functional one. Universality is a measure and standard of good (or correct) IRRI science. IRRI reduces complexes to their constitutive parts in order to reach a generic and quantifiable knowledge of reality. This has long been reflected in IRRI's institutional research structure, which isolates different disciplines applied to rice science: entomology, plant physiology, plant pathology, germplasm conservation, breeding, etc. It also extrapolates information from specific situations and treats it as generic.

Another overwhelming assumption at IRRI is that the modern is superior to the traditional. IRRI's approach to improving rice production has always been one of creating new (= better) to replace the old (= bad). The starting point is not the farmers' understanding of rice production, but IRRI's interpretation of it. For example, IRRI's research in the uplands is aimed to "*design a range of rice production practices that will help rehabilitate ... and transform them into sustainable agroecosystems.*"[7] Swidden agriculture and other farming practices in the uplands are becoming less sustainable due to human pressures (migration, deforestation), not the failings of traditional agroecological systems. In irrigated rice areas, demand for quality rice is important. In taking this on board, IRRI's goal is that "*within the next 2-3 years, new high-yielding, aromatic varieties will replace the low-yielding ones.*"[8] This is clearly a linear vision of a march towards progress. In the Cambodia country-project, IRRI was proud to announce that they have returned over 400 traditional Khmer varieties to the war-plagued country. But at the same time, they are busy multiplying large quantities of IR66 on site. The assumption is that "*the higher yield of [IR66 and new hybrids], once grown over a large area, will almost eliminate the rice deficit in Cambodia.*"[9]

The guiding principles that determine IRRI's goals and objectives have been largely rewritten in the past few years. Particularly due to donor pressure and the need to justify funding, IRRI has put forward a new ideological and institutional front that uses terminology now in vogue but does not *yet* stand up to scrutiny. In its strategy document *IRRI: Toward 2000 and Beyond*, IRRI has advanced a set of "guiding principles" (*please see box 1*).

IRRI has a surprisingly romantic view of its relationship with people, and farmers in particular. Its guiding principles state boldly up front that "*our main concern is people.*" This may be heartwarming, but IRRI does not and cannot relate either to farmers or consumers directly. The very fact that IRRI designates people as both its constituency and its beneficiaries testifies to the dilemma. Unless the institute restructures itself, IRRI's constituency is and has to be its *donors*. So long as no formal mechanisms of consultation and feedback exist, IRRI cannot claim accountability to farmers or consumers.

Box 1: *IRRI's Guiding Principles*

Concerns

Our main concern is people — the producers and consumers of rice. They form the constituency to which we are ultimately accountable. We belong to the worldwide community committed to alleviating poverty and hunger by applying science to improve the productivity of human, natural, and institutional resources devoted to all aspects of rice production. We commit ourselves to the preservation of rice genetic resources. We value present ricelands, as well as potential new rice areas, as the living base for generations to come and promote their wise use and conservation.

Beneficiaries

Our target beneficiaries are rice farmers and consumers, especially those with low incomes.

Partners

We work worldwide with all research institutions that share our goal, in particular with the national rice research systems of countries where our target beneficiaries live. Rice research has no political boundaries. We search for new solutions to old and emerging problems through personal and institutional efforts and through partnerships with farming communities and other institutions, both public and private.

Role and responsibility

The driving forces of agricultural and economic growth are trained people, effective institutions, improved technology, developed rural infrastructure, and appropriate public policies. IRRI's role as part of an international scientific community is to contribute worldwide to the improvement of rice technology and to the development of human resources in research and related activities. National governments are responsible for the formulation of appropriate public policies. IRRI's role is to draw attention to the socioeconomic and policy research results that are relevant to the establishment of public policies that will help in achieving the goal.

As we respond to the challenge of the research needed on rice, we strive for excellence through rigorous research and for relevance through cooperation and dialogue with all who can contribute to our goal.

Management

We maintain and work to enhance:

- A research environment conducive to innovation, creativity, and excellence.
- A multicultural, institute-wide social system that encourages all staff members to learn from one another, to share resources and knowledge, and to freely exchange ideas and information.

➢

➢ *Box 1*

- Management policies that encourage open communication in all directions and that continue to promote our standards of scientific integrity -- which include moral accountability, honesty, commitment, enthusiasm, and cost-consciousness.
- Decentralized management based on visible leadership, interactive problem analysis, and shared responsibility.
- Openness in all our research undertakings.
- Compensation levels based on performance, fully competitive with market standards.

Our guiding principles have resulted in high standards of performance. We state them here as a reminder that they will not be compromised.

Source: "IRRI: Toward 2000 and Beyond," IRRI, Los Baños, pp.14-15

IRRI states that one of its guiding principles is to search for new solutions "*through partnerships with farming communities.*" Yet farmers have no role within IRRI. They are not part of the research process; they are merely expected to consume the results. IRRI acknowledges the constraints that effectively prevent it from working with farming communities:

- It is not IRRI's responsibility to work with farmers, but that of the national programs;
- IRRI lacks the cultural advantage that NARS have to work with farmers;
- IRRI is an international organization moving upstream towards strategic research, i.e., they are structurally too far removed from local, problem-based realities.[10]

Former Director General Klaus Lampe was straightforward about this: "*We don't and won't have contact with farmers.*"[11] In IRRI's five-year plan for 1990-94, farmers are explicitly described as "*the end users of rice research.*" "End" plainly indicates that they are not the starting point. "Users" demonstrates that farmers are not creators, participants or actors of research. On the contrary, their role, as established by IRRI convention, is to acquiesce to, accept and consume IRRI output. This is not a matter of semantics, but of political and practical importance.

IRRI's institutional approach to research and technology development and diffusion is still fundamentally top-down. It aims to serve NARS and hopes the results will be passed on to farmers. While the service function towards NARS is increasingly considered (by IRRI at least) a partnership type of relationship, farmers and their organizations remain out of the picture.

2.2. LEGAL MATTERS

IRRI's legal identity as an institution is important, especially for an agency which has long professed to be international in character. IRRI was initially established through a Memorandum of Understanding (MOU) between three parties: the Philippine Government, the Rockefeller Foundation and the Ford Foundation. The MOU, signed on 9 December 1959, laid out the rules for the Institute's organization, powers, operations, place under Philippine law, financing and termination. The MOU spelt out the activities IRRI would engage in: advancing rice research, disseminating results, training scientists and acting as a clearinghouse for global knowledge about rice. It also stipulated that IRRI could be dissolved by "mutual agreement," presumably amongst the three parties that created it.

IRRI was formally established the following February. Its Articles of Incorporation, which define its legal identity as a "non-stock, philanthropic and non-profit corporation under the laws of the Republic of the Philippines" legally supersede the MOU. From 1960 on, IRRI was technically a corporation registered under Philippine law and ultimately subject to national jurisdiction affecting corporations. In 1979, IRRI was granted a wide range of privileges and immunities, normally issued to UN-like agencies, by President Marcos. These favors, along with the multinational banner of the informal CGIAR, gave IRRI the aura of an international organization. Legally, however, IRRI only became international in 1995.

In May 1995, IRRI signed an Agreement with the Philippine government and twelve others establishing the international legal personality of the Institute for the first time. Attached to the Agreement is an all new "IRRI Charter" laying out rules governing the Institute. The Charter updates the previous Articles of Incorporation. Most importantly, it radically amends previous rulings on IRRI's dissolution. The Institute was established to function for a period not exceeding 50 years from its date of incorporation (1960), "*unless earlier terminated in accordance with the law.*" IRRI was created as a temporary catalyst, to be phased out when the NARS were fully empowered. According to the 1995 Charter, the Institute can now be dissolved by a three-quarters majority vote of its Board. IRRI can be shut down if the Board feels it has fulfilled its purposes to "*a satisfactory degree*" or if it is determined that the Institute "*will no longer be able to function effectively.*"

The new procedure for IRRI's dissolution also finally clarifies what happens to IRRI's most important asset: the genebank and its 80,000 rice samples. Prior to the 1995 Agreement, all anyone knew (even in IRRI) was that if the Institute closed down, all of its assets would revert to the property of the University of the Philippines, i.e. the government. No one knew if this included the seeds in the genebank. For 35 years, the destiny of the world's most unique rice collection was undecided. The new 1995 Agreement stipulates that upon IRRI's closure, the genetic resources held at IRRI will pass to the control of the agent that has trusteeship over them, i.e. the "international community" in the form of the UN Food and Agriculture Organization. The Agreement has been signed by the Philippine government, which suggests that it is secure.

2.3 FINANCES

IRRI depends predominantly on the CGIAR for its funding (*see Table 2.1*). Grants are supplemented by IRRI-earned income (publication sales, interest earnings, etc.). The breakdown between core funding and special projects is shown at the end of Table 2.1. This is an important consideration: special project funding for activities not considered a priority

TABLE 2.1: *IRRI's Source of Funds, 1994 (US$)*

SOURCE	TOTAL	SOURCE	TOTAL
Japan	10,153,291	Rockefeller Foundation	661,160
USAID (USA)	4,474,896	ADB	450,000
IBRD (World Bank)	3,928,340	IDRC (Canada)	400,773
UNDP	2,724,001	Rep. of Korea	263,833
Switzerland	2,716,191	France (*)	242,953
Australia	2,585,752	Belgium	134,846
European Union	2,146,954	Norway	132,585
ODA (UK)	1,475,693	Philippines	117,194
EPA (USA)	1,355,178	Ford Foundation	100,000
Denmark	1,306,031	India	100,000
CIDA (Canada)	1,014,000	P.R. China	90,000
Netherlands	822,961	Islamic Rep. of Iran	85,672
BMZ (Germany)	783,868	Spain	40,000
BMZ/GTZ (Germany)	707,386	Indonesia	12,500
SAREC (Sweden)	609,691	Others	33,271

TOTAL 39,668,020

Of which:

- Core unrestricted 23,807,345
- Core restricted 2,928,814
- Special projects 12,931,861

* France also provided IRRI the services of four resident scientists

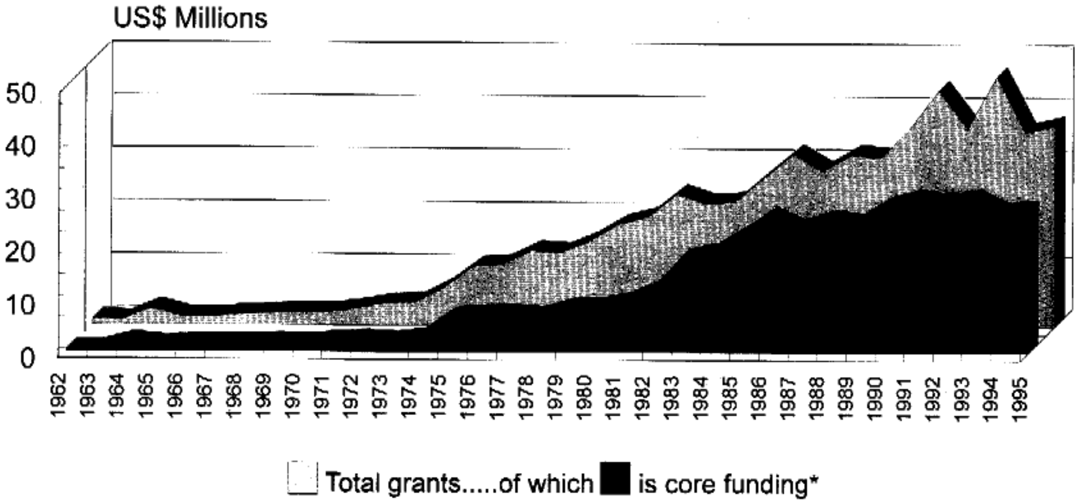
Source: International Rice Research Institute, IRRI 1994-1995: Water, a looming crisis, *IRRI, Los Baños, 1995, p. 70a.*

by TAC is on the rise in many IARCs, especially IRRI. This suggests that there are discrepancies in priority-setting within the CG System. IRRI also enjoys leniency in how it spends funds as over one-half of its grants are for unrestricted core activities.

As mentioned in Chapter 1, the CG system has been operating on a stagnating and even declining budget since the early 1980s. IRRI's own financial base has also been shrinking. In real terms, its budget was cut by 5% in 1991 and 7.5% in 1992. In both 1993 and 1994, IRRI received a total of just under US$40 million in grants, about US$26-27 million of which went to core activities.[12] For 1994-1998 the projected core requirements were US$152.4 million or roughly US$38 million per annum.[13]

These restrictions have resulted in large staff reductions. From 1988 to 1992, the number of internationally recruited scientists dropped from more than 120 to 81, and nationally recruited core employee numbers fell from 2,000 to 1,500. But at the same time, IRRI made a number of new major investments on its facilities. For example, it revamped the 30-year old electrical system, turned the administration office into a Visitors' Center, installed a sophisticated seed drying room for the genebank and replaced the irrigation system on IRRI's 254-hectare experimental farm.

TOTAL GRANTS TO IRRI 1962-1995



Compiled by GRAIN from IRRI Annual Reports
for CGIAR-approved activities; excludes special project and complementary grants

FIGURE 1

TAC's 1992 revised priorities and strategies for the CGIAR system bode poorly for IRRI.[14] Despite rice remaining as the CGIAR's most important commodity, funding for IRRI is on the decline. With a stagnant CG funding portfolio, resources are simply thinner for an expanding network. Among the Asian centers, IRRI and ICRISAT are destined to receive less and ICLARM and IIMI more. At best, IRRI's allocation of core funds may stagnate at $28 million; at worst, it may drop down a full $5 million to $23 million.[15] With an annual inflation of 5%, both scenarios translate as a decrease in real funding.

2.4 MANAGEMENT AND DECISION-MAKING

Following IRRI's 1987 External Program and Management Review, the Institute underwent a major structural overhaul. This began when Germany's Klaus Lampe arrived as Director General in 1988. In principle, IRRI has become more decentralized and transparent, but in practice, it remains a hierarchical body. The Board of Trustees, a self-elected body of 15 people, is endowed with the most power. The Board elects the nine members itself, while the CGIAR nominates three. To serve, each Board member must be a "*qualified reputable individual coming from the international community, primarily from rice-producing countries of the world and from donor entities.*"[16] The remaining three members fill *ex officio* posts permanently guaranteed to three officials: the Secretary of Agriculture of the Philippines; the President of the University of the Philippines System; and IRRI's Director General. Membership term for the elected is three years.

The Board is endowed with the policy-making powers of the Institute and decides on priorities, work plans, budgets and management procedure. It is also solely responsible for appointing the Director General (DG), whose power it overrides. IRRI's 1996 Board of Trustees cuts even on gender balance and corporate connections. Of the 15, three are women and three more are from the private sector (among which are USA's Pioneer Hi-Bred, the world's number one seed company, and Denmark's NovoNordisk, a major biotechnology firm). Of the NGO seats, if that's what they are, you won't find the likes of a farmer, but there is a journalist and a family planner.

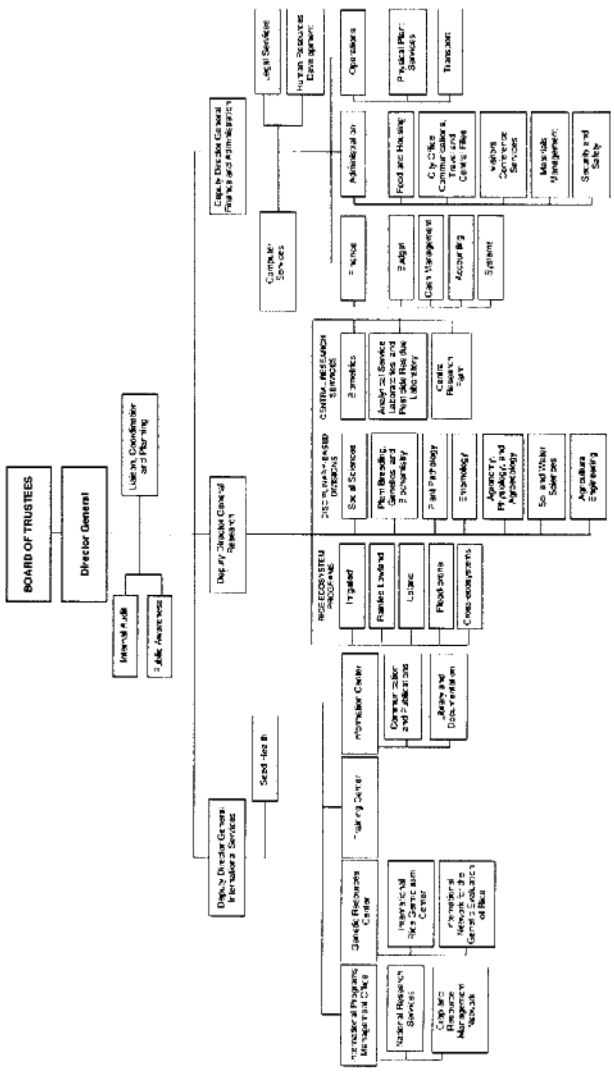


FIGURE 2: *IRRI's Organizational Structure*

IRRI's new organizational structure has become more centralized in some ways and more decentralized in others. From an unclear and overlapping spread of directorship posts responsible under the DG, there are now three major divisions of the organization, each headed by a Deputy Director General: Research, International Programs and Administration and Finance (*see Fig. 2*). This streamlining of upper level management allows for stricter control and tighter communication. However, the division — at least at management level — between research and international programs is not clear, since they overlap considerably.

Senior management is assisted by other bodies. A liaison unit is responsible for communication with the Board and the donors, and assists in planning and monitoring procedures. Four standing committees — executive, program, audit and nominating — are supposed to facilitate cross-section communication and planning, and *ad hoc* task forces are mounted to tackle specific problems.

Within the research division, the new structure increases administrative and managerial burdens. Some top IRRI scientists now spend half their time on administrative work, rather than innovative research. The benefits of such an important trade-off remain to be seen. The new system makes the management of program planning and resource allocation seem more participatory. However, there are now more people to answer to, while many staff members sense that power still remains at the top, with a number of "shadow persons" — as they put it — strongly influencing decisions.

The main aim of this new structure is to provide transparency and a degree of democracy in budget planning and resource allocation. However, with the seeming clash between more centralization and new decentralization, it is too soon and difficult for outsiders to judge the result.

2.5 IRRI IN THE PHILIPPINES

IRRI exists to help service and support rice production in the major rice-producing countries. Therefore, IRRI's external relations are a critical facet of the institution's existence. Of all its external relationships with its host country, the Philippines has probably been the most problematic, both with government and civil society. IRRI's identity in the Philippines has been ambiguous from the start. The Institute claims that the Philippine government misconstrued IRRI's mission. "*When IRRI was established in 1960, the Philippine government perceived it to substitute for a national rice research program. This led to the perception that IRRI existed to benefit the Philippines.*"[17] But research into the Rockefeller files demonstrates that this was no misconception, nor was it the Philippine government's fault.

Technically, the Philippine government invited the Rockefeller Foundation to invest in rice research in the Philippines. The Foundation responded in 1951 by advising its Board that "*There was a special problem in the Philippines in regard to the relations of hunger and the appeal of communism, and that there was perhaps a special responsibility on the part of the United States government to do something about agriculture in the Philippines.*"[18] When Rockefeller finally decided to establish IRRI at Los Baños, University scientists questioned whether the new Institute would "*take over from Los Baños such work on rice as is now going on there.*"[19] This IRRI did, but not because of a misinterpretation by the Philippines government. As the archives show, IRRI "*persuaded senior officials of the Philippine government that the institute would do such a good job that research on rice by the government of the Philippines was not urgent.*"[20] This was tantamount to advising the Philippines to drop national rice research efforts altogether.

Whether the Philippine government misinterpreted IRRI's mission or IRRI's persuasion was responsible, the fact is that national rice research was indeed halted in the Philippines until the mid-1980s. NGOs and farmers' organizations long clamored for a national — and nationalist — rice research institute. IRRI itself was supportive of such a move, presumably to downplay its exposure in the country. When the Philippine Rice Research Institute (PhilRice) was finally established in 1986, IRRI was placed on its board. To complicate this maladroit relationship even more, IRRI also sat on the Philippine's National Seed Board, which recommended IRRI rice varieties to Filipino farmers. This was one of the most contentious issues arousing public denunciation of IRRI's interference in national security issues and biased promotion of its own rices and technology packages. Only in 1991 was the Seed Board abolished and replaced by the National Seed Industry Council. IRRI does not sit on the Council itself, but is active in the Council's rice crop committee. IRRI's Deputy Director General for International Programs still sits on the board of PhilRice.

Twisted interactions with the government research and industry sectors have long been complicated by hostile relations with civil society. IRRI has been the subject of attacks in the press, farmer demonstrations, popular campaigns to "nationalize IRRI or close it down" and public denouncement of what was dubbed the "Imperialist Rice Research Institute." Farmers, organizations, NGOs and environmental groups have been some of IRRI's most active enemies in its host country. IRRI was particularly hurt by what it calls "vicious media attacks" to which its most virulent response was the official publication of *Myths and Facts about the International Rice Research Institute.* Largely directed to the Philippine public, the paper attempts to lay to rest many claims brought against the Institute.

Open antagonism has subsided recently. In September 1992, a national dialogue between IRRI and members of the Philippines' Sustainable Agriculture Coalition took place in Los Baños. For most NGO participants, long-time adversaries of the Green Revolution, this was the first time they had set foot on IRRI's grounds. While the meeting was not public, it served to air decades of mistrust and was heavily attended by IRRI scientists. In November 1992, IRRI participated in the Southeast Asian NGO/NARS/IARC *Conference on Rice, Food Security and the Ecology*, held in Thailand. This was the first public dialogue bringing IRRI together with NARS and NGOs of Southeast Asia to discuss areas of concern in rice farming and research. The dialogue resulted in a joint resolution, expressing a progressive stance on key issues such as pesticides, biotechnology, conservation and the role of farmers in rice research.[21] IRRI management has kept up interest in implementing the resolution and continuing the dialogue with NGOs.

In its three decades of existence, IRRI's style and internal organization have ostensibly shifted in many ways over recent years. However, the Institute's fundamental values, vision and decision-making structures are still those of its founding fathers. Despite the challenges facing farmer-relevant rice research, IRRI remains a centralized breeding operation fixed in a center-periphery relationship with the outside world.

1 IRRI (1964), *Annual Report*, IRRI, Los Baños, p 299.

2 This Rockefeller report, entitled Research on Rice was written by Rockefeller employees Warren Weaver and George Harrar. Quoted in: Anderson, RS et al (1991), "The Origins of the International Rice Research Institute", in: *Minerva*, XXIX, p. 71.

3 IRRI (1992), *IRRI 1960-1992: Impact of IRRI on Rice Science and Rice Production*, IRRI, Los Banos, pp 29-30.

4 IRRI (1992), ibid.

5 For a discussion on neutrality and the International Agricultural Research Centres see Oasa, EK (1987) "The Political Economy of International Agricultural Research: a Review of the CGIAR's Response to Criticisms of the "Green Revolution"", in Bernhard Glaeser (1987), *The Green Revolution revisited: Critique and alternatives*, Allen & Unwin, pp 13-55.

6 IRRI (1989), *IRRI: Toward 2000 and Beyond*, IRRI, Los Baños, p 7.

7 IRRI (1989), *Implementing the Strategy: Work Plan for 1990-1994*, IRRI, Los Baños, p 25.

8 IRRI (1991), *Program Report for 1990*, IRRI, Los Baños, p 9.

9 IRRI (1991), ibid, p 271.

10 See IRRI (1989), *IRRI: Toward 2000 and Beyond*, IRRI, Los Baños, p 19.

11 Klaus Lampe, speaking at the Southeast Asian NGO/NARS/IARC Dialogue on *Rice, Food Security and the Ecology*, Chiang Mai, 12 November 1992.

12 IRRI (1994), *Program Report for 1993*, IRRI, Los Baños, p 304; and IRRI (1995), *IRRI 1994-1995: Water, a looming crisis*, IRRI, Los Baños, p. 70a.

13 IRRI (1993), *Rice Research in a Time of Change: IRRI's Medium-Term Plan for 1994-1998*, IRRI, Los Baños, p 60.

14 See TAC (1992), *Review of CGIAR Priorities and Strategies*, TAC Secretariat, FAO, Rome, April.

15 Ibid.

16 IRRI (1995), *Charter of the International Rice Research Institute*, Article VI(1)(a).

17 IRRI (1992), *IRRI 1988-1992: Initiating and Responding to Change*, draft dated 7 April, p 71.

18 Anderson, RS et al (1991), op cit, p 67, summarizing what is written in the Advisory Committee to Rockefeller Foundation for Agricultural Activities, *The World Food Problem, Agriculture, and the Rockefeller Foundation*, 21 June 1951 (RAC).

19 Ibid, p 87, quoting directly from official sources.

20 Ibid, p 87.

21 SEARICE (1993), *Rice, Food Security and the Ecology: Conference Resolutions*, SEARICE Publications, Manila.

CHAPTER THREE

THE ACTION: IRRI'S AGENDA FOR THE NINETIES

"I am advocating a Green Evolution: social, political, economic and scientific"

Klaus Lampe, IRRI Director General, 1988-95[1]

3.0 FACING THE RIGHT CHALLENGES?

In the remaining sections of this book, the question as to whether IRRI is capable of responding to the main concerns of NGOs with respect to agricultural development in the rice economies of Southeast Asia will be discussed.

Donors, TAC, IRRI's Board of Trustees and national agricultural research systems are the traditional sources of external pressure that come to bear on IRRI: judging, evaluating and proposing priorities and avenues for action. These forces represent government, power and vested interests. Their relations with farmers are distant at best (perhaps), and oppressive at worst (for certain).

NGOs by contrast are voluntary, self-organized groups seeking change in these relations, often in conflict with the State. They are generally closer to the real concerns and needs of local communities. While structurally they have been absent from the consultation process directing IRRI, CG centers — like their supporting governments — are starting to realize that NGOs are a force to contend with. They have a legitimacy that is hard to define and identify, but which manifests itself in many ways.

To judge IRRI from an NGO perspective, two parameters were used which were found to be of critical value to non-governmental development forces today. The first is farmer empowerment. The second is sustainability. These are two main and long-term "agenda items" of most NGOs working the field of agricultural development in Southeast Asia. At other times they have had different names; tomorrow those names will surely change again.

In the NGO community, empowering farmers (or other social groups) implies that structural relations (mainly of class) are altered by opening up space for decision-making at the local level. We are talking about small-scale farmers, those who are often labelled as "marginalized" or "resource-poor." With respect to agricultural research, what is at stake is how technological change is carried out on or reaches the farm: whether farmers control, manage and direct the innovative process or are left out of it.

Sustainability refers to the long-term viability of social, ecological and production systems. Again, power relations are at the crux of the matter. An agricultural development strategy may be environmentally ideal — zero chemical input, totally self-sufficient in nutrient cycling, stable and resilient — but socially oppressive. This is not sustainability.

3.1 RESEARCH

In 1988, IRRI undertook a strategic planning exercise under the dictates of its donors. The Institute scanned its complex global environment, looked at its institutional history, and re-examined its mandate in the light of important new developments. The results of that exercise, embodied in the document *IRRI Toward 2000 and Beyond,* are discussed here.[2]

IRRI acknowledges concerns about global warming and the role that flooded ricefields may play in generating methane, a greenhouse gas. It also examines the prospect of feeding six billion people by the year 2000, and eight billion people by 2020 (*see Box 2*). The Institute observes that food production has kept up with increasing population, but that governments and institutions have not distributed the food "*in such a way that serious hunger and malnutrition can be avoided in some regions of the world.*"[3] By the year 2000, seventeen (17) of the world's 23 expected megacities containing over 10 million people will be in the South. Twelve of these will be in Asia. Feeding the rapidly growing urban population is a major concern of IRRI's:

> *Complacency with past achievements is unwarranted. Even maintaining the status quo in rice production would be unacceptable, characterized as it*

Box 2: *Exploding IRRI's Population Bomb*

There is one premise central to IRRI's existence. This argument is so powerful in its simplicity and its appeal that IRRI has sung the variations of the same song for 35 years. The reward for its remarkable feat is continued funding. The 1995 version of the song goes as follows:

There will be around 5 billion rice eaters in the year 2025. To feed this huge population of rice eaters,who will be mostly in Asia, 870 million tons of unmilled rice must be produced each year, or 70 percent more than is currently being produced today. Innovative rice science and technology is needed to produce these gigantic amounts of rice on much less land and water, with much less labor, and in a manner that does not harm the environment.

But this is only one "supply side" perspective of the food problem. IRRI and its donors seem to have forgotten some societal nuances of the "demand side" of reality.

In November 1992, 64 representatives of national agricultural research systems (NARS), international agricultural research centers (IARCs), non-government organizations (NGOs) and people's organizations (POs) came together in Thailand. The purpose of this unusual gathering was to discuss "Rice, Food Security and the Ecology" in the context of Southeast Asia. After wide-ranging and sometimes heated debate, the participants came out with a declaration which outlined the development framework that should guide sensitive agricultural research:

> *The world is threatened by the interrelated problems of unjust socio-economic structures, poverty, environmental and resource degradation, overconsumption by the North and increasing population. Within this context, agricultural researchers and development workers of South and Southeast Asia are faced with the challenge of increasing food production to feed the growing population.*
>
> *It is therefore not enough to focus solely on providing technological solutions to the complex social problem of feeding an increasing population....*
>
> *Demographers have identified unjust socioeconomic structures as one of the determinants of population increase. Social inequity breeds poverty which, in turn, forces the poor to seek economic and social security by increasing the number of their children. Even if sufficient food is available, the poor lack the financial means to purchase enough. Often they are forced to marginal areas where they engage in sustainable resource management strategies. Thus, part of the solution to stabilizing food, population growth and sustainable resource management is to address issues of equity, poverty and distribution.*[1]

This "demand side" articulation of the rice problem is unpalatable to many policy makers and scientists including the research establishment at IRRI. It requires

➢

Box 2

abandoning the equivalent of a biased, technocratic approach to the volatile social, economic, cultural and political issue of population. It implies that we desist from discussing the matter in terms of "over population" and mere "growth" when the issue is one of balances.[2] It means changing policies which breed and reinforce poverty by supporting powerful economic structures and interests.

Some top IRRI officials were signatory to the Declaration. But this is cold comfort. For IRRI itself has proudly written that complacency with past IRRI achievements is "unwarranted" and "unacceptable" since major *"disturbing and unresolved questions about distribution of benefits"* still remain. It has also said it is IRRI's role *"to draw attention to the socio-economic and policy research results that are relevant to the establishment of public policies."*[3]

Unfortunately, this rhetoric has not permeated IRRI's culture, much less its research agenda. The specter of the old Rockefeller ideology is too ingrained and established. One symptom of this is clearly manifested in IRRI's Medium-Term Plan for 1994-1998,[4] where it describes being *"forced to make hard choices"* in abandoning research on *"relationships among growth in productivity, environment, and poverty."* Instead, it budgeted US$ 1.2 million for its own *"security and safety"* (a new indicator for irrelevant research?) and a whopping US$ 11.3 million for the Office of the Director General.

For all the talk about new frontier and man-on-the-moon thinking at IRRI, there is much more comfort with the automatic enthusiasm and commitment stimulated by the tried and tested Rockefeller ideology.

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1 SEARICE (1993), *Southeast Asian NGO/NARS/IARC Dialogue on Rice, Food Security and the Ecology: Conference Resolutions*, SEARICE, Manila.

2 To cite two illustrations: no one agrees on what the carrying capacity of the earth is; and population growth demagogues tend to omit the fact that mortality rates have dropped enormously since the 1970s.

3 IRRI (1989), *IRRI Toward 2000 and Beyond*, IRRI, Los Baños, p 15.

4 Stated in Appendix C.

> *is by major disturbing and unresolved questions about the distribution of benefits, food security and production sustainability (p 2)*

IRRI summarizes the present "*world of rice*" by identifying five main issues which need to be addressed:

1) Forecasts of rice supplies must take into account factors that could adversely affect the long-term security and stability of rice production.

2) The factors affecting production apply equally to both unfavorable and favorable rice ecosystems. Future needs of the populations that depend on the unfavorable areas should be addressed more directly.
3) In the foreseeable future, the world will continue to rely heavily on the favorable ecosystems, in particular to feed urban consumers. The vulnerability of these systems to degradation demands continued and, in some aspects, increased attention.
4) Rapid scientific advances in many fields have potential to help IRRI and the partners find solutions to continuing and emerging problems.
5) A wide range of interrelated factors — political, economic, technical, institutional — contribute to increasing and sustaining rice production, protecting the environment, and improving the well-being of farmers.

IRRI briefly examines its institutional history. The Institute sees its "*comparative advantage*" in its disciplinary depth, technical support, political neutrality, international credibility and international assets (such as its 83,000 accessions of rice germplasm and its 125,000 rice publications).[4] IRRI is proud of its achievements:

> *In terms of human benefit, IRRI's achievements in the irrigated and favorable rainfed lowland rice ecosystems... have been one of the bright spots of agricultural development in the 20th century. (p 16)*

On the deficit side, the Institute blames its organizational structure for hampering timely, effective and multi-disciplinary research. It also indicates the need for new facilities to support its research activities. It fails to mention the role it played in contributing to the destruction of rural communities and the pollution of the environment. Any negative impacts of IRRI technology are seen as the responsibility of national governments:

> *The driving forces of agricultural and economic growth are trained people, effective institutions, improved technology, developed rural infrastructure,*

> *and appropriate public policies. IRRI's role as part of an international scientific community is to contribute worldwide to the improvement of rice technology and to the development of human resources in research and related activities. National governments are responsible for the formulation of appropriate public policies. IRRI's role is to draw attention to the socio-economic and policy research results that are relevant to the establishment of public policies that will help in achieving the goal. (p 14-15)*

3.1.1 POLICY AREAS

Having zeroed in on knowledge and technology as its area of competence, IRRI identifies five policy areas to guide its research: research relevance, environmental sustainability, efficiency and equity, women and rice, and disciplinary strength and interdisciplinary focus.

1) Research Relevance

IRRI sees the need for a more "intimate" understanding of the different rice ecosystems. However, the Institute has made it a policy decision not to work directly with farming communities because national governments have the "cultural advantage" to work directly with farmers. Besides, IRRI sees itself as moving "upstream," towards more "strategic" research. Thus, when IRRI uses the term "participatory research," it refers to participation with national governments or private institutions which possess comparative advantage in the area of biotechnology.

2) Environmental Sustainability

At last IRRI has acknowledged that increased cropping intensity and ever higher grain yields are being won at the expense of the soil, the larger environment and health. It also recognizes that previous yield gains are "*being eroded by pests, diseases and soil and water problems.*"[5]

> *In Thailand, for example, rough rice yields in the Chiang Mai Valley increased from 4 to 7t/ha per year when farmers changed from traditional to intensive cropping practices. Ten years later, yields have slipped back to the original levels despite continued high inputs of lime and other fertilizers ... Yields of IR8 and some other improved varieties in IRRI's long-term fertility trials also have declined. (p 8)*

As a result of such observations, IRRI has made environmental sustainability central to its programming.

<u>*3) Efficiency and Equity*</u>

IRRI perceives a dilemma between the pursuit of efficiency and equity:

> *An efficient research system would allocate resources to return the same marginal social benefits per unit research input, regardless of where that input was made. It would not be concerned with who received the benefits. (p 20)*

The Institute recognizes three dimensions of the equity problem. Firstly, it accepts, but does not take responsibility for, the inequities that have arisen between farmers in favorable rice areas and those in marginal areas. Secondly, it recognizes the problems that exist in differential access to water, fertilizer and credit, even in favorable rice areas, but is hesitant to admit to equity problems. It claims that most farmers, even the "late adopters," have eventually caught up and used their technology, and that the majority of rice consumers benefit from the increased rice supply and low prices.

But IRRI is missing something here. In its description of the growth of megacities, it says,

> *Many of these newly urbanized people may be forced to follow the well-trodden path, from*

rural poverty to urban poverty and, finally, to destitution. (p 2)

IRRI does not see that in addition to the early and late adopters, there are non-adopters who have become the urban poor. Some late adopters have also become the urban poor because of decreasing or even negative net income from the use of IRRI technology.

With respect to the third equity dimension, "*being fair to future generations,*" IRRI directly acknowledges that "*human intervention is transforming large portions of the so-called favorable areas into unfavorable ones.*"[6] To address this problem of inter-generational equity, IRRI will "*maintain*" a strong focus on "*sustainable farming systems.*"[7]

4) Women and Rice

Women's concerns will be addressed through studies on the role of women in production, marketing and consumption of rice (*see Box 3*). The Institute also recognizes and supports the principle of "affirmative action" in recruiting women to its staff.

5) Disciplinary Strength and Interdisciplinary Focus

IRRI sees the need to balance disciplinary depth with interdisciplinary focus. As a consequence, it has decided to re-organize its research programs according to four ecosystems: 1) the irrigated rice ecosystem; 2) the rainfed lowland rice ecosystem; 3) the upland rice ecosystem; and 4) the deepwater and tidal wetland rice ecosystem.[8] A fifth program is devoted to cross-ecosystem research, handling issues common to two or more individual ecosystems. These, however, are not ecosystems but water regimes, and IRRI admits that this is a risky simplification.

The research program is run on a matrix management basis (*see Fig. 2*). The five ecosystem-

Box 3: *Women, Equity and Other Thorny Issues*

Women were last seen in IRRI's budget and program focus back in 1993. Where have they gone?

IRRI has not shone for its gender sensitivity in designing rice farming technologies. It first stumbled across social problems in the 1970s, when its seed packages were causing an uproar among the politically sensitive. Its most notable response was two programs aimed at women which were pursued in the 1980s. *"Prosperity Through Rice"* aimed to raise women's income through the small-scale manufacturing of goods based on rice by-products, notably rice paper, toys and greeting cards. While it made lovely photographs for press releases and seated a few businesswomen on the scene, the program petered out after a couple of years. The other notable initiative was the mushroom project: helping women earn extra income from mushroom cultivation. What does this have to do with a rice research institute? Good question.

In the late 1980s, "women" were promoted to one of five key policy areas in IRRI's new, long-term vision for rice research.[1] The "women and rice" program focused mainly on women as rice researchers, but also promised to look at women as producers and consumers of rice. Yet, as the decade got underway, women disappeared rather rapidly from the IRRI scene. The Women in Rice Farming Systems network, which was not an IRRI program but which IRRI participated in, faded into the Crops and Resource Management Network. Gender analysis was swept into the agro-ecological characterization work. Most notably, "women and rice" were simply deleted from IRRI's banner of basic policies in the 1994-1998 Medium Term Plan.

Given the (resolutely male) CGIAR culture, it is safe to assume that "women" have been silently silenced into IRRI's consideration of "equity." The main reason for this is that in the world of international agricultural research, both women and equity tend to be reduced to a matter of "income," so that the success or failure of research is measured by people's participation in the market economy.

IRRI might shuffle embarrassedly on the question of gender consideration, but it considers equity to be its shining star! In the 1990s, income-generation, especially for the "resource poor," has become a prime determinant of the kind of research IRRI decides to undertake. The outcome remains to be seen. But the prospects are not encouraging, as indicated by two key thrusts of its equity-related work:

● IRRI's renewed emphasis on the "unfavourable" ecosystems. IRRI tattered about in the uplands and rainfed lowlands from the 1970s to mid-80s, but — according to IRRI's own analysis — it did not achieve much. The 1990s concerns of equity (income) and sustainability (environment) forced IRRI to take this work more seriously. As the logic goes: with the impending population bomb, every hectare counts. As a research focus, marginal rice lands are certainly in need of attention. But IRRI is flawed in assuming that economic poverty is a function of ecosystems.[2]

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> *Box 3*
>
> • The ever-present technological fix. IRRI puts forward the view that apomixis (the capacity to produce seed) will make hybrid rice a popular option for tropical rice farmers, "especially the resource poor." Apomixis is IRRI's flagship research under the equity banner. Scientifically, it certainly is a bold endeavour. It requires finding, cloning and artificially engineering an apomixis gene from wild rice, pearl millet or some other grass into hybrid rice. This will enable farmers to benefit from the heterosis effect (a 15%-30% jump in yield) from hybrid rice and be able to save the seed rather than return to the market for a fresh supply. A tidy response. But what was the question? Equity? Or how to make hybrid rice a viable technology?
>
> Like gender, IRRI's response to social issues like equity lack a solid, analytical underpinning. This forces the Institute to mold its research to the language, without necessarily addressing the problem.
>
> 1 IRRI (1989), *Toward 2000 and Beyond*, IRRI, Los Baños.
>
> 2 See Ravenborg, HM (1992), *The CGIAR in Transition: Implications for the Poor, Sustainability and the National Research Systems*, Agricultural Administration (Research and Extension) Network, Overseas Development Institute, Network Paper 31, ODI, London.

oriented research programs constitute one axis, and the divisions based on disciplines (agronomy, entomology, pathology, etc.) constitute the other.

3.1.2 RESEARCH PRIORITIES

As IRRI's research priorities are guided by these new policies, it strives to find a balance between the following dimensions of research:

- Ecosystems: (irrigated, rainfed lowland, upland, and deepwater and tidal wetland);
- Geographical regions (Asia, Africa, Latin America);
- "Pure" research and technical assistance;
- Research levels (basic, strategic, applied, adaptive); and
- Sustainability "versus" higher grain yield levels.

IRRI intends to continue with research on favorable areas, being the major source of rice at present. However, in the long term, less favorable areas will be given greater relative weight. The Institute will continue to focus on Asia where most population increases of poor people are expected and where most of the world's rice is consumed. However, it also plans outreach activities in other regions, especially in collaboration with other IARCs.

IRRI hopes that NARS will become increasingly proficient at adaptive and applied research, allowing IRRI to concentrate on "strategic" research. Meanwhile, it will collaborate with advanced research institutes that specialize in basic research, thereby gaining access to results of "cutting edge" basic research (mainly biotechnology).

As its final priority, IRRI intends to pursue sustainability and increasing rice yields at the same time. However, IRRI believes that the "*distinction between the two research targets [of yields and sustainability] may be more apparent than real,*" and that it is possible that research in one area would "*result in knowledge that benefits both targets.*"[9] It goes on to say that:

> *Given their strategic importance, we believe that research should be directed toward* ***ensuring the long-term security of increased rice supplies*** *from the irrigated and favorable rainfed lowland ecosystems. We will conduct more strategic research on critical problems of securing yield gains and on raising the yield potential in all ecosystems through new environment-friendly technology.* (Emphasis added, p. 32)

It is important to recognize the crux of IRRI's thinking on this pivotal issue: *what needs to be sustainable are the yield increases* that IRRI engineers, *not the farmers' production systems* themselves. This is how IRRI effectively lifts the contradiction between seeking ever higher yield levels and realizing sustainability at lower yield levels.

3.1.3 RESEARCH STRATEGY

Having spelt out its policies and priorities, IRRI's strategy to attain its objectives and goal is:

TABLE 3.1: *IRRI'S "Ecosystem" Research Objectives*

1. Irrigated Lowlands:

a) Increase yield potential to 15 tons per hectare per crop by the year 2010. IRRI aims to develop a plant type with 3-4 panicles per plant and no unproductive tillers (40% of today's tillers are unproductive). This new plant type will be direct-seeded rather than transplanted. In the interim, IRRI will create hybrid rice which can increase current yields by 20%.

b)Improve crop and resource management techniques to increase yields at the same time as sustaining land productivity. IRRI will research the long-term impact of continuous rice production on soil fertility. It will examine ways to make rice plants utilize applied nitrogen more efficiently. Increased attention will be placed on the role of other essential nutrients.

c)Sustain yield gains. IRRI's main concern is the search for "durable resistance" to new strains of pests and tolerance to soil stresses.

d)Bring farm yields closer to potential yields. IRRI will examine the economic, institutional, policy and social factors that impede the diffusion of its new technologies.

2) Rainfed Lowland Rice Ecosystem:

a)Develop sustainable higher yielding breeding lines with special emphasis on tolerance for submergence and drought. IRRI will strive to attain a 5-7 ton per hectare yield potential in rainfed lowland rice ecosystems. It will rely on its collection of wild rices to transfer genes for pest resistance, adaptability and stress tolerance.

b)Develop a complementary set of improved production practices and systems. IRRI will study the physiochemistry of soils which are alternately flooded and drained to establish the effect of such growing conditions on the physiology of rice plants. It will develop tillage, planting and other cultural practices appropriate to the driving variables of this ecosystem.

3.Upland Rice Ecosystems:

a)Develop sustainable rice production techniques that rehabilitate degraded uplands. IRRI will develop acid-tolerant breeding lines; explore the use of organic fertilizer and soil and water conservation; and investigate the integration of crop and livestock systems.

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➢ *Table 3.1*

b)**Develop methods and technologies for increased, sustainable rice yields.** IRRI will research ways to improve drought and stress tolerance. Integrated pest management and resistance to rice blast disease will be a special focus.

c) **Develop a perennial upland rice cultivar by the year 2010.** One of IRRI's dream objectives is a perennial rice plant that can tolerate diseases, pests, low temperature and drought. Ideally, the cultivar will have nitrogen-fixing capabilities, and the ability to compete with weeds and adapt to adverse soil conditions. Its yield is expected to be 3-4 tons per hectare.

4. Deepwater and Tidal Wetland Rice Ecosystems:

IRRI has three interconnected objectives: to develop new high-yielding breeding lines (3-4 tons per hectare); crop and resource management practices to attain the yield target; and a rice-based cropping system that will increase the land use efficiency of deepwater and tidal wetland ecosystems. In the latter, IRRI sees fish as an essential component of the farming system.

5. Cross-Ecosystems Research:

IRRI's objective is to develop modern scientific tools and methods that will increase knowledge and understanding of the different rice ecosystems and to make these available to national programs. Among the activities connected with the cross-ecosystem program are:

- Characterization of the physical, biological and socio-economic aspects of rice ecosystems, particularly in the less favorable ecosystems.
- Transfer of genes for disease and insect resistance fromwild relatives of rice into cultivated rice, enhancing and exploiting new genetic variability for improving yield and grain quality.
- Investigation of the biology, ecology, and population dynamics of pests and beneficial organisms, as a basis for developing practical pest management systems.
- Development of screening methods for cooking and eating qualities of rice.
- Development of participatory research methods for on-farm systems research.
- Investigation of the interactive impacts of technical change in rice farming systems on productivity, stability, environmental sustainability, socio-economic conditions and target beneficiary groups.
- Investigation of the role of resource allocation in farming systems design and its relationship to socio-political institutions.

> *To increase rice production efficiency and sustainability in all rice-growing environments through interdisciplinary research and to ensure the relevance of IRRI research and the complementation of international and national research efforts through close collaboration with national programs.*

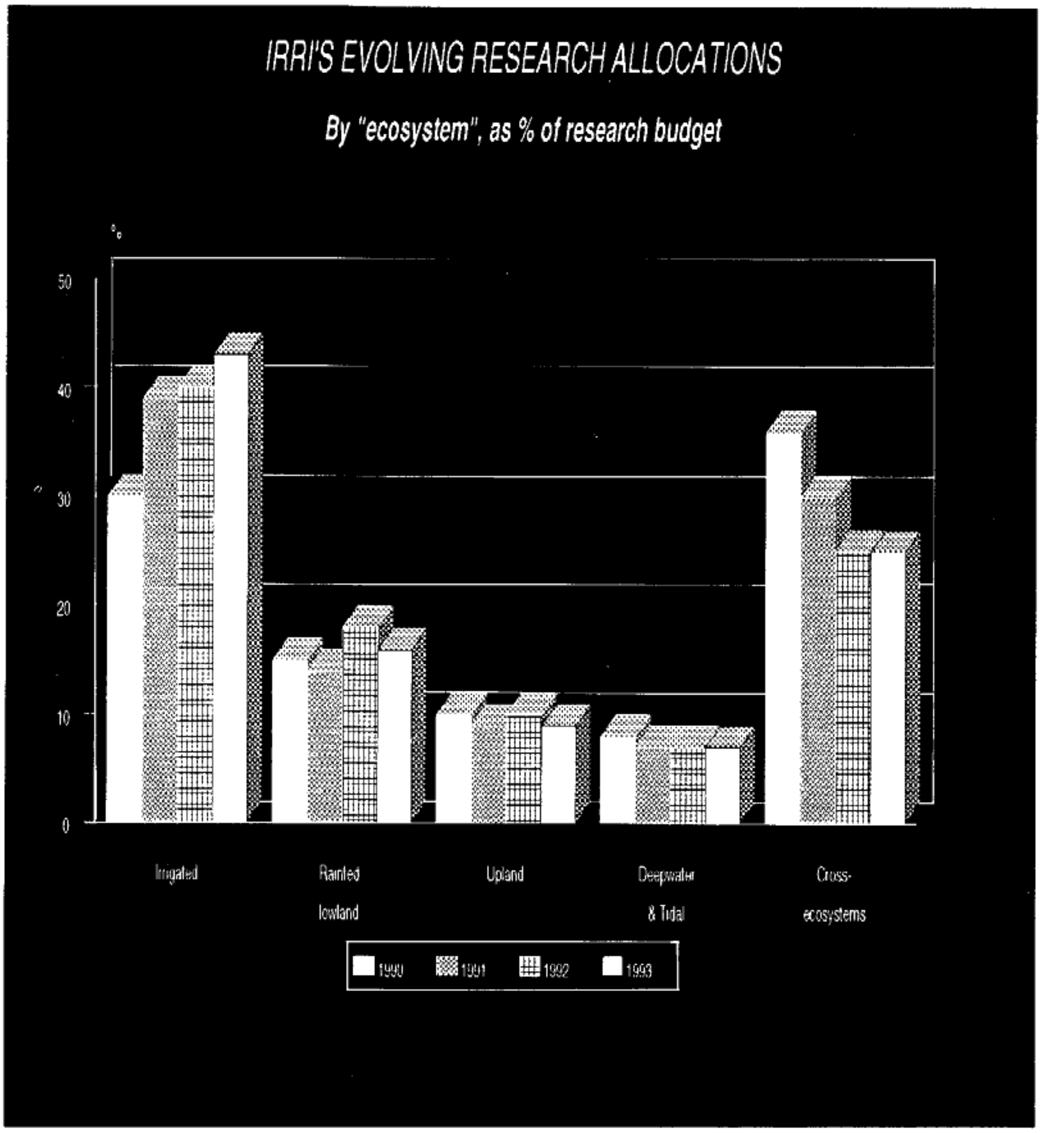
The focus of the research programs is the four rice "ecosystems," complemented by the cross-ecosystem program. The goal for each rice ecosystem is sustainable and resource-efficient higher rice productivity. The specific objectives to attain this common goal, however, vary according to the nature of the various rice ecosystems (see *Table 3.1*).

In the past, IRRI's research agenda was fairly limited to irrigated and favorable rainfed rice production systems. Its perspective was monocultural and the output monovarietal. This focus started changing in the 1980s when the CGIAR began putting greater emphasis on equity issues, including the role of women. The 1988 restructuring of IRRI's research agenda heralded more changes.

IRRI is now pursuing two parallel research strategies. On the one hand, IRRI assumes that irrigated production systems will continue to feed the bulk of the rice-eating population, especially growing urban populations. In these systems, grain yield must be increased and crop management strategies improved. On the other hand, pressure on marginal areas and increasing concern for environmental degradation have forced IRRI to move into the unfavorable rice ecosystems. Here the objective is not to raise yields in any substantial way but to improve rural income and reform or replace environmentally destructive farming practices, such as intensified swidden agriculture.

The restructuring of IRRI's research agenda had led to two important changes with respect to the role of farmers. Much of IRRI's former multiple cropping and farming systems research work was handed over to national programmes and the new research consortia IRRI encourages — moving IRRI further away from

FIGURE 3



farmers. Going upstream means distancing yourself from the downstream. At the same time, the broadening of its emphasis to less favorable lowlands puts IRRI in a very ambiguous position. These more fragile eco- and farming systems are characterized by extremely high levels of diversity (cultural and ecological) that necessitate specific, rather than blueprint, strategies. They are also systems where rice is not a dominant crop, straining IRRI's mandate. In fact, it seems to be common, but unspoken, knowledge at IRRI that the rice crop has little or no future in upland farming systems.

IRRI's resource allocation for the four ecosystems and cross-ecosystems research in recent years is presented in *Fig. 3.*

3.1.4 INTERNATIONAL SUPPORT PROGRAMS

The goal of IRRI's international support programs is to "support and strengthen the rice research capacity of national systems and to serve the international rice research community." There are five component programs: 1) germplasm conservation and dissemination; 2) information and knowledge exchange; 3) networks; 4) training; and 5) technical support.

The germplasm conservation and dissemination program is intended for IRRI to continue its role as the world's largest storage site of rice germplasm. The information and knowledge exchange program has five sub-components: a library, scientific publications, databases on rice, conferences and workshops, and public awareness. The Institute sees itself as "*a politically neutral and commercially disinterested research institution,*" and as having a comparative advantage as the world's largest information resource on rice. Its call for an "accurate understanding" of IRRI by the public reflects its perception that much of the criticism hurled against the Institute reflects a lack of information about its true nature.

The networking program aims to strengthen research knowledge and capabilities among NARS, IARCs and IRRI. The training program assists national rice research systems in attaining a "critical mass" of scientists involved in advancing rice research and production in their own countries. In nearly three decades, IRRI has trained over 5,000 rice scientists from 78 countries, many of whom now occupy important positions in national rice research systems.[10]

The technical support program is limited by resource constraints, and IRRI has set the priority for countries which are economically poor, have low rice yields and undeveloped research capabilities, have clear national policies on increased rice production and productivity, and which formally request IRRI's assistance.

3.2 BREEDING

Germplasm improvement remains at the heart of IRRI's strategy to feed the world.[11] IRRI hopes to create new varieties that achieve "sustainable high yields," have multiple resistance to pests and tolerance to environmental stresses.

3.2.1 A NEW BREEDING AGENDA

1. *The Quest For Hybrid and Direct-Seeded Rice*

IRRI aims to increase rice yields by creating rice hybrids and new plant types. It is attracted by the 20% grain yield advantage of hybrids over conventionally-bred rice varieties and hopes to design new direct-seeded plant types that yield as much as 15 tons per hectare. It plans to incorporate durable multiple resistance to pests and tolerance to abiotic stresses into these new plant types and hybrids, and to enhance nutrient use efficiency. IRRI hopes that some of these new varieties will also have the ability to fix biological nitrogen.

But these new innovations will bring considerable baggage with them. In the case of hybrids, farmers cannot replant their seeds, as the yield advantage disappears. Additionally, hybrid seeds are much more costly to produce commercially. This will increase their price and make farmers dependent on external seed sources. Without a yield advantage of at least 20-25%, hybrids are an uneconomic option for rice farmers. IRRI is trying to palliate the problem by engineering apomixis — the ability to produce seed — into its hybrid rice technology (*see Box 3*). To complicate matters more, hybrids are linked in the public imagination with crop vulnerability. When hybrids are produced using male sterile lines, the paternal cytoplasm is automatically transferred to the offspring, meaning the seeds. If that cytoplasm is susceptible to disease, farmers who plant the seeds may be in trouble. At present, virtually all modern varieties developed in public research institutes carry the same maternal cytoplasm. So the widespread use of a limited number of male sterile lines for hybrid rice production could double the risks.

IRRI's support for new direct-seeded plant types to save on the "drudgery" of rice culture is admirable. Instead of having to transplant seedlings, farmers will be able to plant the seed directly. But direct seeding involves significant amounts of herbicides, which will increase groundwater contamination and health impacts, especially in children. IRRI says that it will conduct research on cultural, mechanical and other non-chemical practices to manage weeds. However, the "*efficient use of chemical inputs*" still governs IRRI's research paradigm. The Institute has not abandoned its chemical crutch. Given its inherent belief in chemicals, it is doubtful that IRRI will ever develop an herbicide-free practice for direct-seeded rice.

2. *Breeding for sustainability*

IRRI is intent on creating varieties which can achieve "sustainable high yields." Although not made explicit, IRRI's understanding of sustainability is limited to immediate environmental factors, rather than extending it to the sustainability of communities and livelihoods. But even achieving environmental sustainability seems to be a romantic dream for IRRI.

In the past, as IRRI's own data have shown, high grain yields were obtained at the expense of the rice crop's production resource and environment. How can IRRI attain sustainable high yields when sustainability has not been achieved even with the current lower yielding varieties and the conditions for sustainable production have not been explored?

The experience with IR8 illustrates this point. IRRI bred IR8 in a production environment which presumed that it was acceptable to use massive amounts of pesticides and fertilizers, and that consumers would choose the food security of high yields in exchange for mediocre grain quality and taste. IRRI was wrong on both counts. High pesticide use did not control all insect pests. The pests, such as the stem borer, simply became resistant to pesticides; and new pests, such as successive brown planthopper "biotypes," appeared and proliferated. Furthermore, consumers complained that IR8 tasted bland.

3. *From ideotype to ideosystem*

IRRI's agronomic practices have resulted in land degradation and the emergence of new pest and disease complexes. New varieties need to be developed to address these problems. To do this, some IRRI scientists recognize the need to broaden their horizons from the "ideotype" or ideal rice plant and identify, understand and characterize what they call the "ideosystem" or ideal, sustainable rice-growing environment. However, they do not fully appreciate the relative importance of the ideosystem over the ideotype; nor that only after the ideosystem has been identified can the search for the ideotype be fully undertaken. The ideotype has no identity outside the broader ideosystem.

An analogy may help to distinguish between ideotype and ideosystem. In a watershed, for example, good quality water is available in large quantities only if the watershed is intact. If the watershed is slowly destroyed, the quantity and quality of the water slowly diminish. And as the watershed disappears, water flow ultimately vanishes. The water is the "ideotype" and the watershed is the "ideosystem."

The ideosystem is a step in the right direction, but it does not go far enough. IRRI's experience clearly demonstrates the need to further refocus its breeding program. How can high grain yields be secured and made sustainable, without knowledge of the soil fertility, pest complex and cultural practice matrices under which the varietal selection process takes place? IRRI would do better in the long-term to focus its research efforts on answering the puzzle of sustainability. Breeding work could then resume in this context.

4. Durable resistance

New diseases and pests are likely to emerge as unforeseen consequences of plant manipulation. These may be the result of simple gene associations, such as disease susceptibility being linked to a particular source of cytoplasm. Or they may be the consequences of the fact that the plant is a part of a wider, dynamic ecosystem with which it interacts in unpredictable ways. Animal scientists have already demonstrated that animals bred for new characteristics, such as dwarfism, have produced a host of associated "production diseases." In a similar manner, alterations of genes or gene systems may confer new pest susceptibilities to the new, morphologically altered plant types that IRRI is interested in creating.

Given its present approach, IRRI's search for durable, multiple resistance may be headed up a blind alley. The multiple resistance of some of its "successful" varieties, including IR36 and IR64, has broken down. At present, IRRI does not know what constitutes durable resistance, but it is high on IRRI's list of research priorities. However, for reasons discussed in Section 4.1, IRRI may never find durable single resistance, let alone durable multiple resistance.

Secondly, much of the literature on host plant resistance (HPR) has demonstrated that there is an energy cost associated with the establishment of resistance in plants. IRRI may be up against a classic optimization problem: increasing one trait may decrease a related and equally desirable trait. Increasing multiple host plant resistances may lower yield potentials. Higher grain yields may be won at the expense of lower and non-durable pest resistance. There is no free lunch in nature.

Box 4: *The BPH Fiasco: The Pest that IRRI and Pesticides Created*

There is a pest of rice that many farmers in Southeast Asia and Indochina know only too well. But very few know the true origin of this voracious and unconquered rice pest — it is one of IRRI's dark secrets.

The brown planthopper (BPH) is considered by many as the most serious rice insect pest in the world today. IRRI is hesistant to give a full account of the origins of BPH, since people would realize IRRI's responsibility for its emergence. BPH is one of the skeletons in IRRI's closet, a skeleton that (we hope) continually reminds IRRI to be more respectful of the processes of nature.

The story of the BPH starts with IR8, IRRI's "miracle rice," and other so-called high-yielding varieties (HYVs). To attain the high yields, early breeding at IRRI channelled the limited energy and material resources of rice plants away from protection towards production. This strategy made the "miracle rice" and its progenies highly susceptible to insects and diseases. Consequently, massive amounts of pesticides accompanied the use of IRRI's HYVs in order to control stem borer and other pests. But, in turn, the target pests developed resistance to pesticides and remain serious pests in rice today.

Historically, the brown planthopper was not a significant pest. But most of the beneficial organisms which controlled it were wiped out by the poisons. Without its natural enemies, BPH populations rapidly increased and BPH has become one of the most serious pests in rice. A range of insecticides were then used to control BPH, which merely fueled widespread epidemics of the pest. ➢

Likewise, tolerance to abiotic stresses may be gained at the expense of new pest vulnerabilities and/or drops in grain yield. If too great a focus is made on developing specific traits, the plant loses its inherent physiological diversity. Specialization can occur only at the expense of the future potential of the plant to survive in an altered or different environment. Even where tolerance is effectively introduced, the specter of genetic uniformity and all its disadvantages looms large.

IRRI seems to perceive this problem subconsciously. In its official documents, IRRI is already rationalizing its failure to attain durable resistance:

> Box 4

Since its emergence, the brown planthopper has eaten its way through hundreds of thousands of hectares of ricefields, destroying millions of metric tons of rice worth hundreds of millions of dollars. Viet Nam, Thailand, Indonesia, and the Philippines have all been victimized by BPH. In 1977, Indonesia lost over a million tons of rice, enough to feed 2.5 million people. Thailand recently lost hundreds of thousands of hectares of rice due to pesticide-induced resurgence of brown planthopper. Two million metric tons of potential rice yields were eaten up by these insects. Indonesia currently has a very troublesome BPH problem and is importing rice again as a result.

Peter Kenmore, who did his PhD dissertation on BPH and is currently head of FAO's Rice IPM Program for Asia and the Pacific, explains the scientific basis for the tragic error of IRRI technology with regards to BPH:

> *The brown planthopper is kept under complete biological population control in intensified rice production fields that are not treated with insecticides. When immigration increases, even over 1,000 reproducing adults per square meter, the numerical responses of indigenous natural enemy species exert such massive mortality on the population that densities go down and rice yield is unaffected....Insecticide applications disrupt that natural control, survival increases by more than ten times, and compound interest expansion then leads to hundreds of times higher densities within the duration of one rice crop. Trying to control such a population outbreak with insecticides is like pouring kerosene onto a housefire.*

>

> *An effective breeding program for disease and insect resistance* **must continuously** *incorporate new genes for resistance, to counteract the effects of new physiological races or biotypes. (Emphasis added, p 17)*

Despite its portent of failure, IRRI sees no alternative but to continue its deadly race between man and insects. It does not seem to have learned from the hard lessons of the past. These show that faulty analysis and inappropriate solutions for a serious rice production problem only waste scarce research resources, create

> *Box 4*
>
> During the late 1970s and early 1980s, however, these findings were disregarded. Fixated on its biotype concept, IRRI was more interested in a breeding, rather than an ecological, approach to solving the brown planthopper problem. IRRI believed that biotypes 1, 2, 3 and 4 were distinct strains of BPH, not realizing that these so-called biotypes were artifacts of its laboratory. For decades, IRRI's breeding program concentrated on incorporating genes "resistant" to brown planthopper "biotypes." IRRI did not realize that their "biotype" had no reality in the field; that biotype 1 can overcome the genetic resistance of varieties designed for biotype 3 through simple selection pressure.
>
> Kevin Gallagher, a former IRRI researcher, did his PhD dissertation on IRRI's biotype approach for breeding pest resistance in rice. His research confirmed Kenmore's data.
>
> > *Plant resistance for control of BPH needs to be put in perspective of the managed rice ecosystem. ... The development and use of resistant varieties under an insecticide-based BPH management strategy concealed for a long time the importance of natural enemies in controlling BPH and other insect pests in rice. ...*
> >
> > *BPH is a Green Revolution pest that has been induced by insecticides. This leads to the obvious conclusion that too many resources were invested in breeding programs against a problem of man's creation. No doubt similar misdirected programs are ongoing in other crops world wide fueled by breeding programs that treat yield maximizations as a goal totally out of context with ecological reality.*
>
> NGOs have asked IRRI to publicly acknowledge its role in the BPH fiasco. IRRI refused. Next time IRRI hails the emergence of its next "super rice", don't forget to ask if it will be accompanied by another super pest like BPH.

new vulnerabilities for farmers and nations, hinder the exploration of more effective alternatives, and result in dangerous national rice policies. IRRI's creation of the brown planthopper problem is a lucid — if not lurid — example of IRRI's looking for answers in all the wrong places (*see Box 4*).

5. Increased Nutrient Efficiency

IRRI plans to develop new rice types which use nutrients more efficiently. Its approach is short-sighted and fundamentally flawed. IRRI's strategy for obtaining higher nutrient use focuses on the efficient use of chemical inputs, fostering continued dependency on external inputs among farmers, both monetarily and psychologically. Sustainable agriculture hinges on developing farmers' capacity to manage ecological processes sustainably, empowering them through the acquisition of knowledge and an enhanced capacity to manage local resources without sacrificing grain yields. A cartoon in one of IRRI's laboratories depicts an exhibition where farmers display their products. One farmer has gigantic products produced through biotechnology. Another has smaller agricultural products labelled "organic." The message ignores this crucial aspect of sustainability.

A similar observation can be made with regard to IRRI's multiple resistance approach. Multiple resistance is embodied through breeding in a rice variety, rather than in the complex web of ecological processes that, in the end, really determine resistance (*see Section 4.1*). This adds another layer of dependency: farmers become *de facto* dependent on the industry because of the technologies being developed at IRRI.

There is a contradiction here. Integrated pest management, which IRRI promotes, places pest management decisions in the hands of farmers. Yet IRRI continues to produce rice lines with internalized resistance, tolerance and efficiency traits to be adjusted to local conditions and sold to farmers. Instead of facilitating the development of capacities within the farmers' field, IRRI's "neutral" technology takes that power away from farmers. It implicitly discourages farmers from developing their capacities for the ecological management of pests, tolerances and efficiencies using their own resources. Understanding the ecological basis for desirable varietal properties is not part of the package IRRI offers farmers because it assumes they have already been internalized in the seed.

3.2.2 SHADY SCIENCE

1. The Limitations of External Inputs

Wrapped up in its fetish for soluble ions of nitrogen, phosphorus and potassium, IRRI has forgotten that plants also require comparatively large complexes of organic matter. IRRI pays no attention to the evidence demonstrating the importance of the products of organic decomposition. During the process of decomposition, organic matter is transformed into an amorphous, dark-colored, colloidal and chemically heterogeneous substance called humus. The impact of humus on the physical, chemical and biological properties of the soil is well-known.[12] However, many scientists, including IRRI researchers, are not aware that humic substances can be taken in directly by plants, increasing crop productivity even under adverse weather conditions.[13]

Even as early as the 19th century, Albrecht Thaer, founder of the "humus theory" of plant nutrition, already showed the uptake of humic compounds by plants. Thaer's findings were ignored due to the increasing popularity of the mineral theory championed by Justus von Liebig, the father of agricultural chemistry and one of the inspirations for the use of chemical fertilizers.[14]

Humic compounds have been found to increase oxygen uptake, enhance shoot and root growth (by 300% in one study[15]), decrease transpiration, increase chlorophyll levels, increase wilting resistance, and increase total dry matter production.[16,17] In the presence of humic compounds, grain yields have been shown to *increase* in adverse conditions. Fulvic acid, a low molecular weight component of humus, has been shown to trigger high dry biomass production[18] even under conditions of decreased illumination.[19] Further experiments have shown that low molecular weight humic compounds enhance potassium and nitrate absorption, aid chlorophyll formation and enhance photosynthesis, and increase salt tolerance.

These findings illustrate the inadequacy of breeding for greater nutrient efficiency. Science has shown that improved nutrient efficiency can also be attained independent of genetic characteristics. In all these experiments, IRRI's independent variable, variety, was held constant. But IRRI refuses to look into this important and complementary approach to its breeding efforts. The potential synergy contained in this combination of approaches may never be realized. As will be further discussed in Section 4.1, IRRI has adopted a reductionist breeding approach which prevents it from exploring new and potentially more productive approaches.

2. *The Limits of Genetic Determinism*

A Russian expert on soil organic matter has demonstrated that humus-treated plants always imparted their character, especially the ability for quick germination and rapid growth, to their descendants. In contrast, plants grown without treatment of humic substances always produced deteriorated seed stocks.[20]

Fellow Russian Khristeva also came up with similar findings.[21] He noted that humic substances increased the albumen content of plants, a characteristic that was passed on to the next generation. The new generation showed greater germinating capacity than plants that did not receive humic substances. The quantity of DNA increased in humus-treated samples, a trait that persisted for two generations. This novel DNA exhibited greater resistance to inhibitors of DNA synthesis compared with those that did not receive any humic treatments.

The mechanisms for the numerous actions of humic acids have not yet been clearly elucidated. Many scientists think that humic compounds probably achieve their effect by modifying the Krebs Tricarboxylic Acid cycle in cells, a key process in cell respiration. But even without a clear understanding of their mode of action, humic acids have been shown to have dramatic and wide-reaching effects on plant metabolism.

Box 5: *Rethinking Inheritance*

John Baptiste Lamarck was the first naturalist to develop a comprehensive model of evolution, which was based on the inheritance of acquired characteristics. He used the example of a giraffe, whose long neck he described as the cumulative product of a great many generations of giraffes stretching higher and higher to reach leaves to eat. Larmarck's ideas were subsequently ridiculed as Darwin's theory of natural selection gained support. However, recent research suggests that Lamarck may have been on to something.

One of the foundations of neo-Darwinism is August Weismann's doctrine of the independence of the germ line: that modifications induced by the environment cannot pass from the body to the cells that make sperm or egg (and hence to future generations). But in the past five years, research has shown that Weismann's barrier is far from absolute. In all higher organisms, there is a well-used route of communication between the body and the "germline." Messenger RNA can be converted into DNA — a process known as reverse transcription — which is then reinserted into the germline genome. The resulting "pseudogenes" comprise both single structural genes (which encode proteins) and for shorter sequences that are highly repeated and dispersed throughout the genome.

Even more striking are the changes in the DNA of the germline that can be induced by the environment within a single generation. The best-studied example done in the University of Chicago is the ability of fertilizers to induce heritable changes in some varieties of flax, where stable lines of "genotrophs" produced were found to differ both in their physical structure as well as in their DNA.

Molecular geneticists are now being compelled to adopt the revolutionary concept of the "fluid genome," and the present-day concept of heredity needs to be reformulated. Instead of a linear chain of command from DNA to phenotype, there is a complex of interlocking feedback processes. Nucleus communicates with cytoplasm and cells communicate with cells. During development, interactions between layers of cells induce tissues to form. In relationships between the organism and the external environment, the internal processes are orchestrated and coordinated. Inheritance is a property and function of the whole system, not just the genes in the from nucleus.[1]

[1] Ho, M *et al* (1986), *New Scientist*, February 27, pp 41-43.

These findings give new meaning to on-farm observations that agricultural crops raised solely on external chemical nutrition tend to "run out"[22] — a common complaint among Filipino farmers.[23] Long-term experiments comparing chemical with organic farming techniques in the UK demonstrated this phenomenon with wheat grown in "chemical" plots. No such problem was encountered in plots receiving properly decomposed stable manure containing generous amounts of humic acids.

The implications of these findings are revolutionary. They imply that the benefits of breeding — resistances, tolerances and nutrient efficiencies, among others — can be counter-balanced or even reversed by improper agronomic and soil fertility management approaches. Durability of traits becomes a dynamic, fluid and systemic property, instead of being simply determined by a gene fragment. Ironically, molecular biology, which has provided the foundations for IRRI's research, is providing one of the strongest arguments for the infeasibility of its breeding strategy (see *Box 5*).

These new findings indicate that genes cannot be isolated from the environment and that heredity is the product both of an organism's genes *and* its interaction with the environment. This has implications for IRRI's approach to breeding for chemical-responsive nutrient efficiency and internal pest resistance. The loss of resistance encountered by IRRI's scientists may not just be merely a case of insects overcoming the resistant genes of plants. It may also be that inappropriate agronomic practices are affecting the genome itself. The loss of resistance may be the product of both genetic alteration and pest co-evolution.

Many scientists, including those at IRRI, would dismiss these findings almost instinctively. They violate the dominant paradigm of modern evolutionary biology, Neo-Darwinism. But what if neo-Darwinism is not the complete answer? During the heyday of Newtonian mechanics, it was almost impossible to conceive of any other physical reality. But today, Newtonian physics is simply a subset of the more

Box 6: *"BT, Phone Home!"*

On April 5, 1995 IRRI scientists were taken by surprise. Dr. Ingo Potrykus of the Swiss Federal Institute of Technology (ETH by its German abbreviation) in Zürich had just sent them rice seeds that contained the much awaited Bt genes. However, the transgenic rice seeds were intercepted by the environmental group, Greenpeace, which claimed that the ETH had not obtained a permit to export the seeds. But the delay was temporary. After about a week, Dr. Potrykus sent another batch of transgenic seeds through diplomatic pouch. And this time IRRI got them.

This episode again thrust IRRI's biotechnology work into the public eye. IRRI is staking its reputation on the hope that the gene coding for the insecticidal protein from the bacteria, *Bacillus thuringiensis* (Bt), can be transferred to rice and that this toxin would then be able to protect transgenic Bt rice from yellow stem borer. This feat, IRRI believes, will signal the start of more environmentally-friendly methods of rice farming.

But scientific studies indicate that IRRI may be introducing a whole new generation of negative health, agronomic and ecological impacts on rice producers and consumers:

1. Microbiologists have sounded a warning that Bt may be involved in eye infections and is potentially hazardous to individuals with immuno-suppressive illnesses, including AIDS, malaria, and childhood measles.
2. Insect pests have developed resistance not only to insecticides but also to conventional usage of Bt in crop production. Many scientists predict that pests will similarly develop resistance to the insecticidal toxin of transgenic Bt crops.
3. Bt rice may induce the development of more voracious stem borers which can inflict more damage on non-transgenic rice.
4. Studies at Oregon State University have shown that Bt can harm non-target beneficial organisms.
5. Spending millions of dollars on non-durable and dubious Bt research is siphoning scarce funds away from studies on more sustainable and durable control of rice pests via community ecology approaches.
6. IRRI's Bt research ignores alternative large-scale natural biological control mechanisms that suppress stem borer, a reality in over five thousand hectares of Philippine rice lands managed under sustainable agriculture methods.

The Bt controversy promises to escalate. Already close to 100 NGO organizations in the Philippines, Asia, and around the world have expressed their opposition to IRRI's Bt research. Philippine NGOs are challenging IRRI's Bt research both in Congress and the courts.

➢

➢ *Box 6*

Even though the National Committee on Biosafety of the Philippines has given IRRI a green light to conduct Bt trials in greenhouses, NGOs argue that the Committee has violated its own guidelines. The Philippines' biosafety guidelines mandate a discussion on alternatives of the type indicated in item 6 above. Yet IRRI never had to justify Bt research in the light of evidence (empirical and experiential) showing that farmers are already controlling the yellow stem borer with much safer methods that do not threaten human health and the environment.

encompassing theory of quantum mechanics. The fate of Neo-darwinism could be similar to that of Newtonian physics. Many of the problems identified in IRRI's breeding approach are insoluble given the current mindset of the Institution. If IRRI does not transcend its scientific blinders, it will not be able to address a significant portion of its research agenda.

3.2.3 BIOTECHNOLOGY

IRRI is a born-again breeding operation. What it cannot attain through conventional breeding, it seeks to achieve through biotechnology. The Rockefeller Foundation has spent more than US$33 million to fund a network of biotechnology laboratories working specifically on rice; and it granted IRRI over US$4 million to establish four biotech laboratories.[24] IRRI has also started to develop links with private corporations involved in biotech work (*see Boxes 10 and 11*).

The first promised field application of IRRI's rice biotechnology will be the deployment of Bt genes (*see Box 6*). IRRI believes that the deployment of the endotoxin of the soil bacterium *Bacillus thuringiensis* (Bt) will let farmers control serious rice insect pests, especially the stem borer, without adversely affecting the environment. Bt toxin breaks down the gut wall of some insects, but is innocuous to most living organism, and has been used as a biological pesticide by organic farmers since the early 1950s.

The environmental friendliness of Bt caught the eyes and pocket of industry, which is scrabbling around for new ideas in the face of constraints to the spread of conventional pesticides. Genetic engineering techniques have enabled scientists to insert the bacterium's toxin-producing genes into crops, which then produce the toxin in each of their cells. At least 14 Bt-producing crops and trees have been field tested in the US and many large agrochemical companies (including Ciba-Geigy,[25] Monsanto, Pioneer Hi-Bred and ICI) are hoping to market Bt crops in the near future and reap rich returns.

However, nature's logic may render Bt crops, rice or otherwise, a short-lived novelty. The problem of resistance has already been documented, and it is potentially a much more serious problem than anything IRRI has had to face yet. First, even in the selective expression of the Bt endotoxin in specific plant tissues, the Bt gene could be expressed continuously in specified parts of the plant.[26] This is the functional equivalent of spraying an insecticide daily on specific plant parts. Experience has shown that the more a plant is sprayed, the faster the target pests develop resistance. Another factor hastening the resistance process is the sheer scale of Bt use which is likely to result, given its application to such a wide range of crops and the interest shown by so many corporations. Although rice is not (yet) a lucrative commercial crop, the scale of the stem borer problem in Southeast Asia means that the draw of Bt rice will be immense, especially in the absence of alternative strategies.

The deployment of genetically-engineered Bt toxin may induce and accelerate the formation of more virulent forms of stem borer as they co-evolve with toxin-bearing transgenic rice plants. Transgenic rice fields could become breeding grounds for the creation of more virulent pests, as well as staging areas for the pests to start decimating other ricefields.

Bt work is a source of tension between IRRI's biotech people and some of its more ecology-oriented scientists who believe that genetically-engineered rice expressing the toxin will not be useful in farmers' fields. The skeptics nevertheless see the Bt research as a way to quantify and understand the dynamic co-evolution of host plant toxins and pests.

Others also question the value of the investment. At best, the toxin will work for a short period, then become obsolete as stem borers develop resistance. In any case, biotech work on Bt is already being undertaken in other public institutions, whereas no institution is working on ecological approaches to stem borer control. If IRRI is serious about being a "strategic" research institution, it should recognize this as a more fruitful research direction.

IRRI has recently taken a positive step in this direction. In response to NGO criticism, it announced that it would not use biotechnology to produce herbicide-tolerant rice crops and has promised to introduce predictive ecology research in its strategic research plan. This provides a long-term strategic basis for more ecological and sustainable farming. It is also a prerequisite for field applications of biotechnology.

There are other biotech issues with which IRRI must contend. Wide hybridization and other biotech tools may hasten the development of a transgenic 15-ton per hectare rice. This technological "advance" may merely accelerate present sustainability problems, catalyzing the massive use of fertilizers and pesticides, and the concommitant degradation of the rice environment. New biotech creations may also speed up the emergence of "disease complexes" and other pest problems which have emerged even at lower yields and cropping intensities. How can it consider such moves when it has not yet dealt with the publicized suspected 30% drop in grain yields from nematode infestations which are creations of IRRI technology?

IRRI's tissue culture method is also inherently flawed. There is evidence that it increases the propensity of plants to be attacked by insects and diseases. The experience of Malaysia with oil palm, for example, shows that tissue cultured crops have to be treated six times more with agrochemicals. Tissue culture can, thus, induce farmers to spray chemicals more often to protect their crop.

It seems that biotechnology will only exacerbate IRRI's existing sustainability problems which arise from its blinkered breeding agenda. Without knowledge of sustainability problems at existing grain yield levels, not to speak of super high yield levels, biotechnology is a blind, even dangerous, tool.

3.3 CONSERVATION

3.3.1 IRRI'S CONSERVATION AGENDA

Genetic resources are at the hub of IRRI's research work. Assuring the conservation and availability of genetic

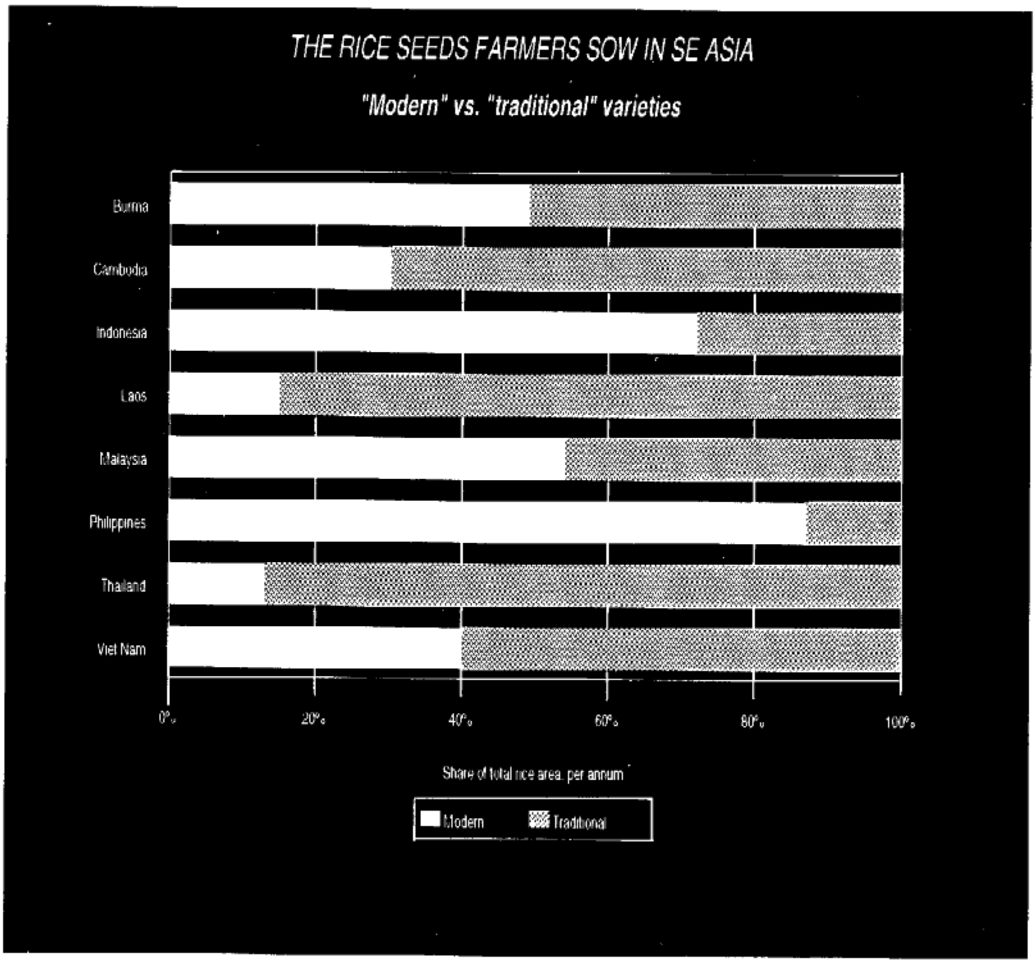


FIGURE 4

resources of rice and rice-related genera is an important part of IRRI's mandate. IRRI also holds global responsibility for Asian tropical rice germplasm conservation within IPGRI's (formerly IBPGR) network of base collections.

There are two cultivated forms of rice and some 20 related wild or weedy forms. Asian rice, *Oryza sativa L.*, has been cultivated in north-central India and east China for at least 7,000 years. Its center of origin is thought to span most of Southeast Asia. The other cultivated rice species, *O. glaberrima*, was later domesticated in Africa and represents a small portion of the rice grown there today. Rice has spread and developed into an enormous array of different landraces and varieties through continuous adaptation; farmer selection, conservation and exchange; and new cultural practices. Over time, *O. sativa* has split into three distinct ecogeographic races: indica, javanica and japonica (also known as sinica). These diversified further into a wide range of upland, lowland, deepwater and seasonal types.

The astonishing diversity of Asian rice attests to the plant's adaptability to different cultural and ecological niches and provides plant breeders, be they farmers or scientists, with a wealth of material to work with. Vedic literature talks of more than 500,000 rices in India alone.[27] Some rice scientists say that farmers, and later public breeders, have created around 140,000 varieties over time.[28] Still others suspect that perhaps only 1,200 varieties are being grown in the field today.

In recent decades, many of the old and diverse rice cultivars have been replaced by modern varieties (*Fig. 4*), with the result that rice genetic resources have been and continue to be irreplaceably lost, particularly in the lowlands which were more amenable to the Green Revolution technology package (*see Fig. 4A-4B and Box 7*). While farmers, NGOs and local scientists are working to stem the tide of this genetic erosion by promoting on-farm management, breeding and exchange of materials, IRRI's focus is to collect, conserve and make available the world's largest stock of rice germplasm.

IRRI'S GENEBANK

IRRI started up its rice collection with 260 accessions in 1966. Ironically, IR8 was released that same year, beginning the spiral of decline of rice genetic diversity in the field. In the 1971 Rice Breeding Symposium at IRRI, scientists urged the Institute to take resolute action. With funding from US sources, IRRI launched field collection missions in Bangladesh, Burma, Cambodia, Indonesia, Sri Lanka and Viet Nam. National scientists and extension workers in other countries mounted similar campaigns, engaging volunteers, missionaries and even anthropologists in their efforts.[29] In the late 1970s, the IBPGR (created in 1974) joined forces with IRRI for further field collection.

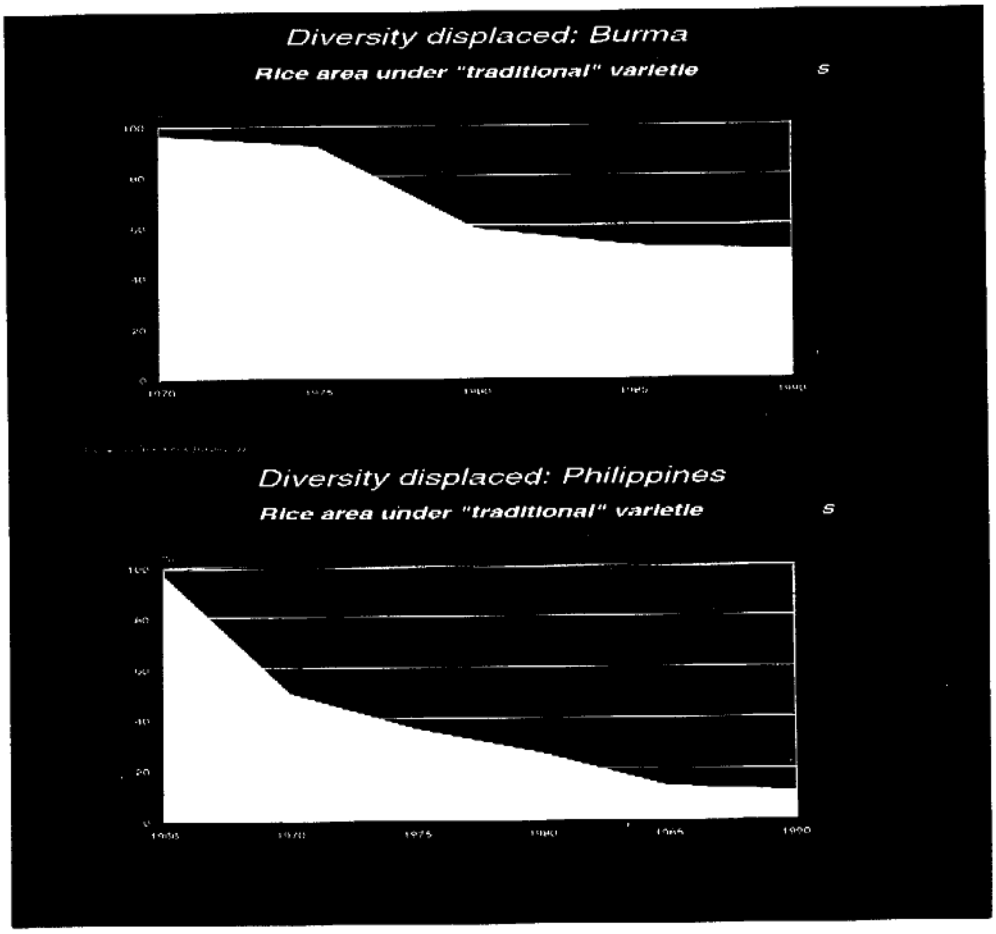


FIGURE 4A

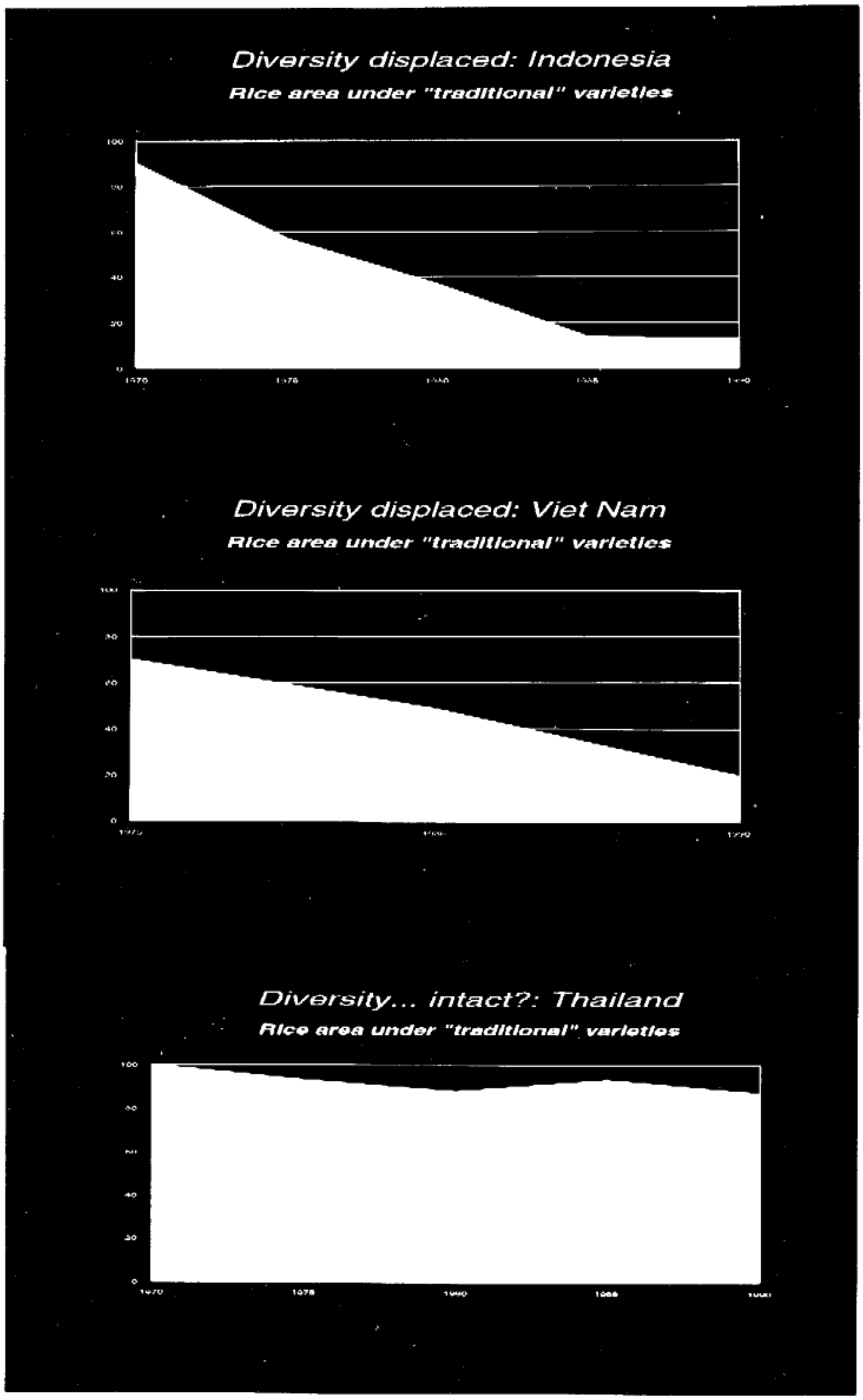

Diversity displaced: Indonesia
Rice area under "traditional" varieties
Diversity displaced: Viet Nam
Rice area under "traditional" varieties
Diversity... intact?: Thailand
Rice area under "traditional" varieties

FIGURE 4B

When it opened in 1977, IRRI's long-term genebank operated as part of IRRI's Plant Breeding Division. In 1983, it became a separate unit called the International Rice Germplasm Centre (IRGC), a move which coincided with the introduction of conservation into IRRI's mandate. The genebank's activities include the introduction, multiplication, preservation and dissemination of rice samples to scientists. IRRI plant breeders use the germplasm to develop new rice lines which are then disseminated and evaluated through various mechanisms such as the International Network for Genetic Evaluation of Rice (see *below*), national programs, IRRI's country projects and rice research consortia. National programs adapt and release new varieties based on these materials. However, most of the genebank's germplasm (for example, 80% annually in the years 1990-1992) is used internally at IRRI.

By mid-1994, the genebank held about 75,000 accessions from 113 countries in long-term storage[30] — about 80% of all existing unique rice accessions worldwide.[31] This makes it the world's largest collection of germplasm for any single crop. According to IPGRI, 82% of the cultivated germplasm held in the genebank has been donated to IRRI.[32] Only 12,000 samples have actually been collected by the Institute, through the 70-odd missions carried out in 15 countries of Asia, Africa and the Pacific since 1972.[33]

The genetic resources of rice are being kept at IRRI for various purposes: backup storage for national collections; a tool box for rice breeding and research; and a permanent repository of cultivars that might otherwise be lost. IRRI has repatriated entire national collections to a range of countries which suffered losses in (or neglect of) their germplasm collections, including Cambodia, Philippines, Pakistan, Nepal, Senegal, Sri Lanka and three states of India.[34] This represents over 9,000 accessions of rice.[35]

IRRI's long-term storage unit is considered to be one of the best in the world, due to its shock-proof design and history of careful management. Still, for safety reasons, 45,000

Box 7: *Diversity Displaced: Breeding Genetic Uniformity*

One major drawback of modern agricultural development is genetic erosion. In agriculture, the loss of diversity within a species is of greater concern than the loss of species themselves. Rice is unlikely to disappear altogether, but countless varieties that farmers have developed, conserved and grown through Asia's impressive agricultural history are seriously threatened. Accurate estimates are impossible to obtain, since rice has been grown and selected by farmers for over 6,000 years in very different social and ecological settings. Scientists' estimates vary from 100,000 to 140,000 varieties[1] — some figures refering to existing diversity[2] and some the total diversity ever cultivated.[3]

What we do know is that the number is diminishing rapidly, and that IRRI has a lot to answer for:

- IR8, or what IRRI pompously calls "*the first modern rice variety*[4]," was released in November 1966. It would more accurately be called "the first mega-locational (or megalomaniacal!) rice variety."[5] Within a few years, IR8 dominated rice production in tropical Asia. The lure of its high yield potential quickly lost its attraction, however, as consumers found it tasteless, and it succumbed to pests and disease. The dangers of genetic uniformity became evident in 1970, when a tungro epidemic wiped out the Philippines' rice crop, which was heavily planted to IR8.
- IR20, released in 1969, quickly replaced IR8 but itself fell victim to brown planthopper and grassy stunt virus by 1973. IR26 became the next superstar, covering vast areas of Indonesia, Philippines and Viet Nam by the mid-1970s.

But IR26 also fell to the brown planthopper, which was increasingly becoming a major scourge in Southeast Asia.[6]

- IR36 is probably the single crop variety in the history of agriculture that has defied the logic of diversity and specificity. Released in 1976, and carrying multiple forms of resistance, IR36 soon became the world's most cultivated variety of any crop. By 1984, the lone IR36 was being grown under a dozen names throughout Asia covering 10 million hectares. However, this uniform feeding ground again invited further pest and disease calamities and the massive relay race goes on.
- By 1991, "*Almost 60% of all modern rice varieties released in 40 rice-growing countries [were] IRRI progeny, having at least one IRRI line in their pedigree. Of 1,872 rice varieties developed worldwide since IRRI's 1966 release of IR-8, the first widely grown semi-dwarf variety, 1,123 have an IRRI ancestor in their genealogy. An IRRI variety is a direct parent of 937 breeding lines, or half of the varieties developed. Twelve per cent — 223 varieties — are IRRI-developed lines released under a local name by national seed boards.*"[7]

➢

➣ *Box 7*

- Not only have single rice varieties displaced a rich panorama of local ones, but through IRRI's breeding work, a small number of "super genes" has been silently and massively deployed as shotgun solutions to SE Asia's rice problems. IRRI has ushered in the era of genetic dependency: for some major traits, farmers are getting very few options. Virtually all of the semi-dwarf varieties being grown today, the prime characteristic found in all modern rices to prevent lodging, contain the same dwarfing gene (sd1) from one rice (Dee-geo-woo-gen, from Taiwan). Grassy stunt virus resistance has, until now, been engineered into modern varieties from one source: *Oryza nivara* from India. Breeders working on stem borer rely on India's TKM6, while the major genetic donor for tungro resistance is Utri Merah, also from India. Laboratory-bred rices resistant to bacterial blight come from Indonesia's Cisadane while salinity tolerance leans heavily on Pokkali from India.[8]
- Perhaps most disturbing in terms of the displacement of diversity and crop vulnerability at the farm level, most post-IRRI modern rices are derived from one maternal parent, Cina (formally Tjina, from China via Indonesia), whose single form of cytoplasm is nearly ubiquitous in the rice fields of Asia today. In 1980, Cina was the ultimate maternal parent of 74% of the "post-IR8" rice varieties in Indonesia, more than 50% of those in the Philippines, and 25% of Thailand's.[9] In the South Asia, the figures were 75% in Sri Lanka and 62% in Bangladesh.[10] By 1994, a full 91% of all post-IR8 rice varieties officially released in the Philippines could be traced back to Cina.[11] These figures are cause for serious concern. In rice breeding, the maternal parent contributes about 60% of the genetic material found in the ensuing progeny, largely through the cytoplasm. Cytoplasm carries extranuclear genes for disease and pest resistances which can be as vulnerable to resistance breakdown as nuclear genes. In 1970, a fungus wiped out 15% of the US corn crop, costing farmers millions of dollars in losses, because all the corn varieties carried the exact same susceptible cytoplasm.[12] Therefore, "the Cina Syndrome" — uniformity in rice cytoplasm — is a major issue today. In 1987, IRRI's External Review voiced the alarm: "*In addition to genetic* diversity, *it is probably important to have cytoplasmic diversity as well. Moreover, now that hybrid rice may develop, the cytoplasmic uniformity issue could become more important.*"[13]
- Finally, IRRI-developed rices are often little more than blood sisters: different selections from basically the same crosses, with far too much genetic material in common to justify their allure as different varieties.[14] IR28, IR29 and IR34 are variations on a theme. IR32, IR38 and IR40 are derived from the exact same cross, as are IR36 and IR42. IR52 and IR54 are also cosmetic cousins.[15]

➣

Box 7

1 By comparison, there are reportedly 20,000 cultivated varieties of common bread wheat (*Triticum aestivum*). M. Feldman, M and Sears, E (1981) "*The Wild Gene Resources of Wheat*," in *Scientific American*, 1:98.

2 See for example: Perret, PM (1991), "*A Proposal for a Network on Rice Genetic Resources Conservation*," in *Rice Germplasm: Collecting, Preservation and Use*, IRRI, Los Baños; or Swaminathan, MS (1984),"Rice", in *Scientific American*, Vol. 250, No. 1.

3 Vaughan, DA and Chang, (1994), *Case study: Collecting the Rice Genepool*. Paper presented to the Scientific and Technical Advisory Committee of the Intergovernmental Committee of the Convention on Biological Diversity, Mexico, 11-15 April 1994.

4 IRRI (1985), *International Rice Research: 25 Years or Partnership*, IRRI, Los Baños, p 82. This is a ridiculous claim. China was developing semi-dwarf rices in the mid-1950s, before IRRI even existed. China began large-scale dissemination of "high-yielding" rice varieties in 1964, two years before IR8. And China has been developing and promoting hybrid rice since the mid-1970s. See Dalrymple, DG (1986), *Development and Spread of High-Yielding Rice Varieties in Developing Countries*, USAID, Washington DC, pp 42-43.

5 In fact, it wasn't even bred by IRRI. According to Indian rice scientists, the cross was originally made in India, in the 1950s, and was later "picked up" by IRRI.

6 For a review of the history of IRRI's varietal releases, see Dana Dalrymple (1986), *Development and Spread of High-Yielding Rice Varieties in Developing Countries*, Bureau for Science and Technology, USAID, Washington DC.

7 IRRI (1991), *IRRI Hotline*, Vol. 1, No. 3, September.

8 Data on major genetic donors compiled from IRRI literature, IRTP/INGER reports and personal communications with UPLB and PhilRice scientists.

9 Hargrove, TR *et al*. "Ancestry of Improved Cultivars of Asian Rice" in *Crop Science*, Vol. 20, p 721.

10 Idem.

11 De Leon, JC (1994), *Genetic Relationships Among Philippine-Bred Rice Varieties as Determined by Pedigree- and Morphology-Based Measures*, MS thesis (plant breeding), UPLB, October 1994, p 45.

12 Plucknett, DL *et al* (1987), *Gene Banks and the World's Food*, Princeton University Press, NJ, p 14.

13 Technical Advisory Committee (1987), *Report of the Third External Program* Review and External Management Review of the International Rice Research *Institute*, Consultative Group on International Agricultural Research, TAC, Rome.

14 IRRI stopped releasing named varieties with IR34 in the mid-1970s. However, IRRI lines continued to be tested and released by national programs and can be identified through their IRRI designations.

15 Pedigrees examined from: de Leon, JC (1994), *Genetic Relationships Among* Philippine-Bred Rice Varieties as Determined by Pedigree- and Morphology-Based *Measures*, MS thesis (plant breeding), UPLB, October 1994.

duplicate accessions are maintained in a black box at the National Seed Storage Laboratory (NSSL) in Fort Collins, Colorado, USA. NSSL authorities have no right to open the box: if IRRI wants something out of it, the entire box is shipped back. IRRI has been discussing the possibility of establishing a second duplicate back-up collection at the Japanese genebank of Tsukuba.

IRRI's current rice germplasm holdings are presented in *Table 3.1*. Not surprisingly, 94% come from the South. The top ten donors' contibutions represent 70% of the genebank's booty. Wild materials only make up 2% of the collection and are now a priority for IRRI collectors. Wild species often provide unique natural sources of pest and disease resistance, male sterility factors, and tolerance to many forms of stress. IRRI is also collecting landraces in Southeast Asian countries that were previously difficult to enter or were bypassed, such as Laos, Burma, Cambodia, Viet Nam and Papua New Guinea. Other areas under stress are also being prioritized, such as the Mekong Delta, where new dam projects that threaten the incredibly rich rice genetic diversity of the region. Additionally, as biotechnology makes it possible to introduce genes from virtually any species into rice, IRRI is broadening its collection to more distant relatives like *Zizania*, the so-called "wild rice" of North America, which is actually not rice at all.

There are limitations to, and some important gaps in, IRRI's global rice collecting strategy (*see Box 8*). In 1985, IRRI reported that it was missing "tens of thousands" of varieties held in national collections and not passed on to Los Baños.[36] The principal geographic holes are India, China and Indochina. In the case of Indochina, collecting work was not possible until recently due to the political situation. In other cases, governments and research institutes are simply not keen to share materials with the Institute. This is certainly the case with the People's Republicof China, which maintains some 60,000 accessions of indigenous rices in *ex situ* storage,[37] but receives five times more germplasm than it sends to IRRI. It is not just governments that are unwilling to part with their germplasm. Numerous community seed projects throughout Southeast Asia will only exchange materials on the condition that they are not handed over to IRRI, which they see as creating rather than solving the problem of genetic erosion.

Conservation of IRRI's 75,000 rice accessions is a long-term activity requiring careful maintenance, monitoring and management. Further work is needed to collect, research,

Box 8: *Diversity Misplaced: The Drawbacks of IRRI's Genebanks*

- IRRI has only collected germplasm "*from easily accessible areas.*"[1] Hence, a good amount of rice diversity can be presumed missing from the bank's vault.
- In 1987, IRRI launched intensive efforts to collect wild relatives of rice "*to reinstate genetic diversity in major commercial cultivars*"— its own admission about the genetic uniformity of IRRI lines, the basis of most modern releases. Wild species are very poorly represented in the genebank yet are a particularly rich source of stress resistance and other traits.
- IRRI has done nothing to address a warning signal from its 1987 review: "*At present, the conservation of cytoplasmic genomes is not considered specifically by the International Rice Germplasm Center. Because of the importance of this specific type of germplasm to supplying specific characters for future breeding, the IRGC should consider their collection and conservation.*"[2] This recommendation had not been taken up until the early 1990s, and IRRI's germplasm program leader did not feel it was a pressing issue.
- Up to the present, IRRI has relied almost entirely on cold storage of seeds for conservation. While its genebank program has excelled in the science of *ex situ* conservation, it is still a hit and miss strategy. Seeds die in storage, and *ex situ* conservation means that seeds are frozen in time, which reduces or removes their ability to adapt to changing environmental conditions. When an NGO conservation program in the southern Philippines attempted to grow out IRRI's genebank collection from Mindanao, the plants couldn't hack it. Once defrosted and repatriated, they were not adapted to present realities in their home turf. Seeds also undergo genetic drift (alteration) in long term storage. Little has been studied about this effect, but it means that what you save may not be what you get when you grow it out.[3] Especially when you grow seeds out under conditions far different from those under which they developed their characteristics in the first place.

1 IRRI (1994), "Switzerland aids the preservation of rice genetic resources", *News about Rice and People*, IRRI release, 16 February.

2 Technical Advisory Committee (1987), *Report of the Third External Program* Review and External Management Review of the International Rice Research *Institute*, Consultative Group on International Agricultural Research, TAC, Rome.

3 IRRI has limited itself to looking at a common problem of *ex situ* seed degeneration: the loss of pigmentation in seedlings!

evaluate and promote the materials. The characterization, evaluation and rejuvenation of rice samples and seed distribution are particularly important activities.

IRRI's rice accessions are also systematically screened for major traits such as pest and disease resistance, tolerance to stress, nutritional qualities and a host of other factors. This information helps plant breeders and researchers access the kinds of materials they are interested in. For example, it was only recently found that the wild *O. minuta* provides a natural source of resistance to blast disease. Continuous screening has also shown that the African rice *O. brachyantha*, held at IRRI, offers genetic resistance to the two viruses that make up the tungro disease complex.[38]

IRRI's genebank has distributed well over half a million seed packets to rice researchers around the world over the years. The NARS, supposedly the main target recipients of IRRI germplasm, have received only a quarter (130,000) of these. In 1993, the largest recipient of rice germplasm was the UK.[39] (British farmers may not grow much rice but their scientists do biotechnology on it.) In fact, if you compare who donated the seeds to the genebank and who took out seeds in a given year, again using 1993 data, you get a picture such as the one in the accompanying graph in *Fig. 5*.[40]

Germplasm Evaluation: INGER

IRRI's important evaluation and plant breeding activities serve not only its own needs, but enhance the work of the International Network for the Genetic Evaluation of Rice (INGER). INGER was established by IRRI in 1975 and now links more than 1,000 rice scientists in 75 countries. Funded by UNDP, the network enables national scientists to test pre-screened breeding materials under a wide range of conditions either for specific production systems characteristics (e.g. tidal wetlands) or for particular agronomic traits (e.g. cold tolerance).

Through a system of germplasm exchange and multi-locational trials at international nurseries, INGER has been single-handedly responsible for the enormous flow of rice germplasm among breeding programs throughout the world. When it started up with 20 member countries, IRRI genebank materials represented 75% of the material being tested through the network. Today, they account for only 5%

Table 3.2: *The Donors of Rice Germplasm to IRRI's Genebank* (as of June 1994)

Country of origin	Total Number of Accessions	Of which is Wild
India	15272	318
Indonesia	8365	84
China, Peoples Republic of	7377	54
Thailand	5583	471
Bangladesh	5499	76
Philippines	4419	88
Malaysia	2646	51
Sri Lanka	2104	99
Liberia	1808	1
Myanmar	1795	86
Taiwan	1791	80
Vietnam	1611	43
Nepal	1487	14
Laos, Peoples Democratic Republic of	1309	21
Cambodia	1150	84
Japan	1127	1
United States of America	1114	
Pakistan	1075	
Korea, Republic of	1033	
Madagascar	990	4
"Unknown"	982	45
Brazil	882	36
Ivory Coast	840	10
Sierra Leone	774	18
Guinea	679	15
Senegal	663	16
Burkina Faso	508	3
Nigeria	445	35
Mali	438	107
Soviet Union	344	
Kenya	262	9
Bhutan	231	
Ghana	199	6
France	193	
Iran	193	
Cuba	165	4
Australia	156	63
Italy	156	
Tanzania	145	28
Brunei	139	13
Gambia	139	6
Cameroon	124	44
Mexico	122	3
Chad	102	48
Surinam	102	7
Zimbabwe	94	
Colombia	88	3
Panama	88	1
Guyana	83	2
Argentina	75	2
Afghanistan	70	
Portugal	70	
Hungary	66	
Guinea Bissau	65	1
Peru	65	
"Africa"	64	6
Turkey	52	
Zaire	50	2
Egypt	48	
Haiti	47	
Papua New Guinea	46	34
Ecuador	45	
Spain	42	
Puerto Rico	40	
El Salvador	38	
Zambia	37	6
Burundi	36	
"West Africa"	36	
Romania	33	
Venezuela	30	3
Bulgaria	28	
Fiji	26	
Sudan	26	8
Guatemala	21	8
Costa Rica	19	7
Ethiopia	16	10
Iraq	15	
Uganda	15	15
Netherlands	14	
Bolivia	11	
Malawi	11	
Hong Kong	10	
Dominican Republic	9	
Niger	9	7
Poland	9	
Mozambique	8	
Chile	7	
Korea, Peoples Democratic Republic of	7	
Ponape Island	7	
Jamaica	6	
Togo	6	
Central African Republic	5	
"Indochina"	5	
Uruguay	5	
Belize	3	
Greece	3	
Yugoslavia	3	
Austria	2	
Benin	2	2
Botswana	2	2
Congo	2	
Morocco	2	
Solomon Islands	2	
"Central America"	1	
French Guiana	1	1
Honduras	1	
Mauritania	1	1
Mauritius	1	
New Zealand	1	
Nicaragua	1	1
Paraguay	1	1
Saudi Arabia	1	
Tunisia	1	
TOTAL	78, 272	2,214

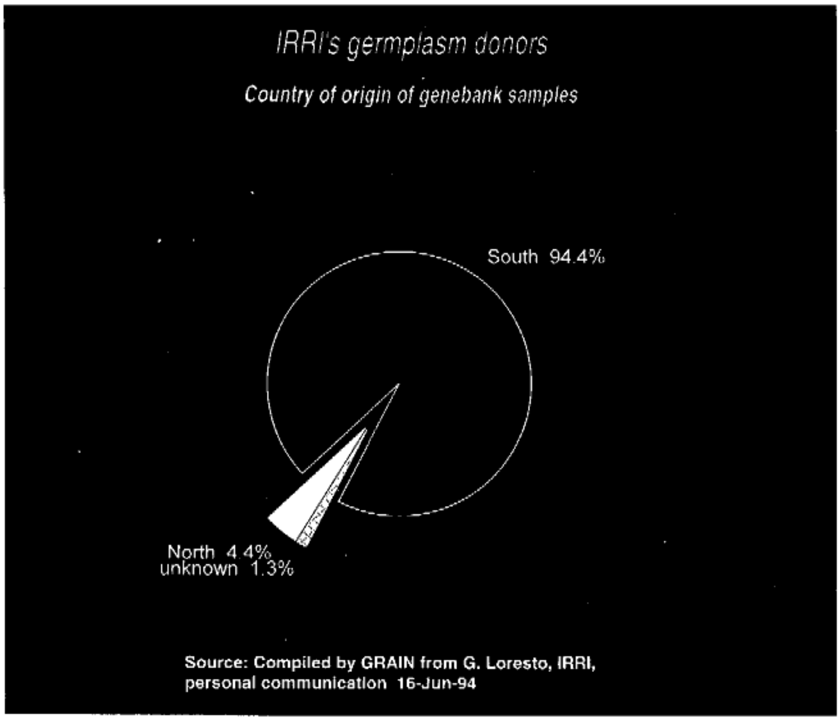
Source: Personal communication from Genoveva Loresto, IRRI Genetic Resources Center, to Renée Vellvé, GRAIN, dated 16 June 1994.

of the germplasm circulating through INGER, while other international centers provide 30%, and materials from national programs account for 65%.

Since 1975, nearly 2,000 lines distributed through INGER have been used in national and international breeding programs, and 210 INGER entries have been released as varieties in 55 countries. Obviously, the idea is to promote diversity, but the opposite can also result. Parental materials from three countries — China, Indonesia and India — are omnipresent in national releases traceable through INGER.[41] Thanks to INGER, 76% of the rice varieties released in Latin America over the past 20 years are derived from IR8.[42] Other calculations show that 70% of the genes incorporated into nearly 150 rice varieties currently grown in Latin America come from a genetic core of 14 landraces, mostly from Asia.[43] Had INGER not existed, much of this germplasm would not have been circulated and used.[44]

From insult to INGERY

The consequences of IRRI and INGER's varietal dissemination programmes have been dramatic. As there has been no comprehensive assessment of the state of global rice biodiversity, the national level can give us an idea of the extent of genetic erosion (*See Box 9*). Two indicators of the genetic vulnerability of a country's agriculture are the number of varieties of the various crops being grown in the field, and the degree of genetic variation within the varieties. According to these indicators, the status of rice in Southeast Asia is variable, but alarming. For some countries like Indonesia and Thailand, a handful of rice varieties supply the bulk of the harvest (*Fig. 6*). This is also fast becoming the case in the Indochinese countries of Cambodia and Viet Nam. The country worst affected by genetic vulnerability at the farm level is probably IRRI's home base, the Philippines, where over 60% of the country's ricelands are sown to one (IRRI) variety: IR64.[45]


IRRI's germplasm donors
Country of origin of genebank samples
South 94.4%
North 4.4%
unknown 1.3%
Source: Compiled by GRAIN from G. Loresto, IRRI, personal communication 16-Jun-94

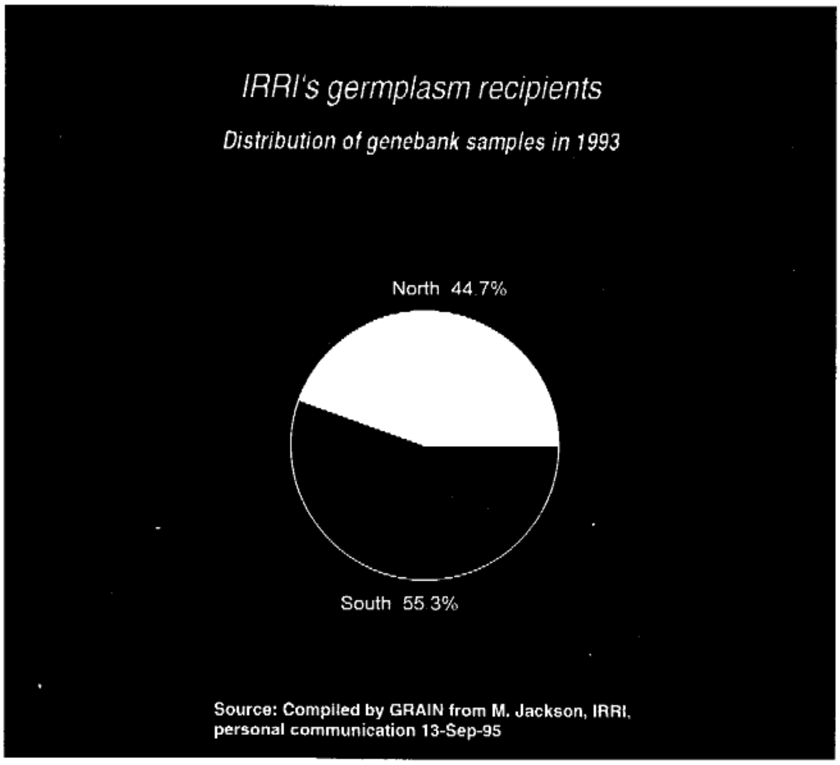

IRRI's germplasm recipients
Distribution of genebank samples in 1993
North 44.7%
South 55.3%
Source: Compiled by GRAIN from M. Jackson, IRRI, personal communication 13-Sep-95

FIGURE 5

Such dependency on one or two varieties is extremely dangerous for food security. One stroke of bad luck and, not only are farmers in trouble, but the whole economy and the nation's political security can be upset.[46] In 1980, some 75% of South Korea's rice lands were sown to genetically similar HYVs, establishing "a precarious basis for greater productivity," to say the least.[47] That same year, the country's rice crop fell to blast disease because of cool weather. The price tag? One billion US dollars worth of imports in 1981[48] — more than any country had ever spent importing rice in any given year over the three decades between 1960 to 1989. Weather is not the only threat. Insects mutate rapidly and can have a feast on a country's rice crop when all the fields are planted to the same variety. This is all too familiar in Southeast Asia where the brown planthopper has become a perennial problem. The answer is not, as the experts assert, just having an arsenal of resistant varieties on hand (meaning a genebank and a team of breeders) to replace the defeated ones. That is genetic roulette, lurching rice production and peoples' livelihoods from one crisis to another. The answer lies much more in diversifying the genetic base of rice farming, taking a non-deterministic approach to breeding and decentralizing people's power over rice genetic resources.

3.3.2 THE CONSERVATION AGENDA IRRI LEFT OUT

Today's political, scientific and agricultural development agenda increasingly emphasize the need for more diversified and integrated plant genetic resources management programs involving community, national, regional and international action. Dependency on one technical approach to genetic conservation is now accepted, by all, as a problem. But the socio-political and cultural ramifications of leaving the responsibility for conservation and use of genetic resources to government alone, including international genebanks such as IRRI's, are still less appreciated. There is something devious and disempowering about people taking seeds from

Box 9: *Where have All the Rices Gone?*

Viet Nam: Country or Colony?

Vietnamese farmers have provided nearly 2,000 rices to IRRI's genebank collection: 1,895 cultivated rices and 10 samples of three wild species. In "return," the US government and IRRI have been helping Vietnamese farmers convert to a few, IRRI-based super-seeds. From the mid-1960s to the mid-1970s, the years of heavy US presence in South Viet Nam, USAID imported substantial amounts of IRRI seed into the country, mainly IR20. By 1975, IRRI material was everywhere. In 1977, brown planthopper devastated rice fields in the south and 250 tons of IR36 was rushed in from the Philippines. Estimates from IRRI and others suggest that in the early 1980s, IR36 covered 60% of the rice acreage in the south and IRRI varieties blanketed one-third of the entire country's rice acreage.[1] Today, 60% of the the Mekong Delta, where the bulk of Viet Nam's rice is produced, is sown to IRRI varieties, of which there are only 42 in the entire country.[2] Farmers there complain about the government heavily pushing one IRRI line, IR-19660, which is causing a huge upsurge of brown planthopper infestations again and local harvest losses of 20%.[3]

Indonesia: squandered wealth

Indonesia is the second largest donor of rice genetic diversity to IRRI's genebank: 8,281 cultivated and 84 wild accessions. Entire areas of this richly endowed country have never been seen by the fair eyes of an IRRI germplasm collector but genetic erosion has still been intense. In 1986, a massive 75% of the country's ricelands (7.5 million hectares) were planted to modern varieties, 83% of which were planted to eight lonely rice varieties (four of which came directly from IRRI). Government data suggest that one half (47%) of Indonesia's entire rice crop that year came from two varieties: Cisadane and PB36 (= IR36)![4] As a consequence, no less than 1,500 local rice varieties have become extinct in the last fifteen years, according to the government.[5] Indonesia's fifth Five Year Development Plan made it official policy that "*traditional cultivars must be wiped out from rice fields.*"[6] No wonder then, that the brown planthopper and drought did so much damage in 1995 that Indonesia may have to import 2-3 million tons of rice in 1996.[7]

Taiwan

When the Japanese first occupied Taiwan in 1895, they found the Formosan farmers cultivating 1,365 varieties of indica rice. By the 1920s they started replacing the indicas with high-yielding varieties of their preferred japonica rices. The Taiwanese grew japonicas for export because they commanded twice the price of indicas. For domestic consumption, they stuck with their native indicas which local consumers preferred and which required less fertilizer. By 1969, however, there were only 86 indica (farmer-bred) varieties in WRI

➢

➢ *Box 9*

cultivation, alongside 53 japonica (institutionally-bred) strains. The drop in indica varieties from 1,365 to 86 represents a 94% drop in on-farm rice biodiversity.[8]

Cambodia

In the mid-1960s, Cambodia was exporting half a million tons of rice per year. Then came the nightmare of war and with it a violent mauling of the country's agriculture. People were displaced or disposed of; much of the land area sown to rice, the country's sustenance, went out of production. Deepwater rice cultivation was banned altogether by the Pol Pot regime.[9] The Green Revolution never infiltrated the country. Until the early 1990s, that is, when some semblance of stability returned and IRRI set up a project office in Phnom Penh. The Australia-funded work of IRRI in Cambodia is a single-minded campaign to uplift a depleted agricultural country to what the donor community considers desirable. And in terms of rice biodiversity, that means IR66. Even if you have pay farmers to grow it.[10] To date, IRRI has collected nearly 2,000 traditional Cambodian rices but the mindset of what agricultural development is about in this country is IRRI rice, with all the latent problems that brings along. As a matter of policy, IRRI crosses one local rice with the HYVs it imports in its rice improvement efforts. But most of the actual seed multiplication has been dedicated to straightforward IR-lines, replete with brown planthopper susceptibility and the ever uniquitous Cina cytoplasm. Some may say it's a question of time until Cambodians control their own rice research work better. The fact of the matter is that IRRI is showing them just how to do that.

The data is scanty, the stories sometimes anecdotal. For what we could put together, a picture of rice genetic uniformity on the farm — in terms of varietal use per hectare — is presented in *Figure 6.*

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1 Data taken from Dalrymple, DG (1986), *Development and Spread of High- Yielding Rice Varieties in Developing Countries*, USAID, Washington DC, pp 65-67.

2 IRRI (1995), *Facts about Co-operation: Vietnam and IRRI*, p 5.

3 Discussions with farmers in provinces south of Can-tho, March 1993.

4 Direktorat Bina Produksi Tanaman Pangan 1987 and 1988, quoted in: Tjahjadi, RV (1995) "*Business and Scholar Run for Plant Variety Protection*," in *Terompet*, No. 2, Vol. III, Jakarta.

5 Ministry of Population and Environment of the Government of Indonesia, 1989, quoted in WRI/IUCN/UNEP (1992), *Global Biodiversity Strategy*, Publications, Washington DC, p 9.

6 Tjahjadi, RV (1995), "*Business and Scholar Run for Plant Variety Protection*," in *Terompet*, No. 2, Vol. III, Jakarta.

7 McBeth, J (1995), "*Grain Games; Grain Pains*," in *Far East Economic Review*, Hong Kong, 29 June, pp 63-64.

8 Derived from Bray, F (1986), *The Rice Economies: Technology and Development in Asian Societies*, University of California Press, Berkeley, p 23.

9 Vinoy N. Sahai, Ram C. Chaudhary, and Sin Sovith (1992): *Rice Germplasm Catalog of Cambodia*, Cambodia-IRRI Rice Project, Phnom Penh, p. 13.

10 According to several reports from NGO workers in Cambodia, IRRI coerces farmers to sow IRRI rice through a form of "crop insurance" payment. Any production loss is promised to be reimbursed. In the markets, however, IRRI rice varieties go conspicuously unsold because people don't like to eat them.

the communities and sticking them on a shelf in some refrigerator somewhere. Too often, communities do not see anything in return until after a veritable disaster — like civil war or genebankruptcy or a UN agreement — has struck.

Concern and action for a more holistic and farmer-oriented approach to genetic resources management have been growing over the past years. Yet IRRI's formal mandate and track record in the field is somewhat restricted: to rice; to *ex situ* conservation; and to an international or supranational personality. This has its definite advantages. Rice is not a difficult crop to conserve and maintain. As a cereal, it can be dried and preserved without damage for a period of time.

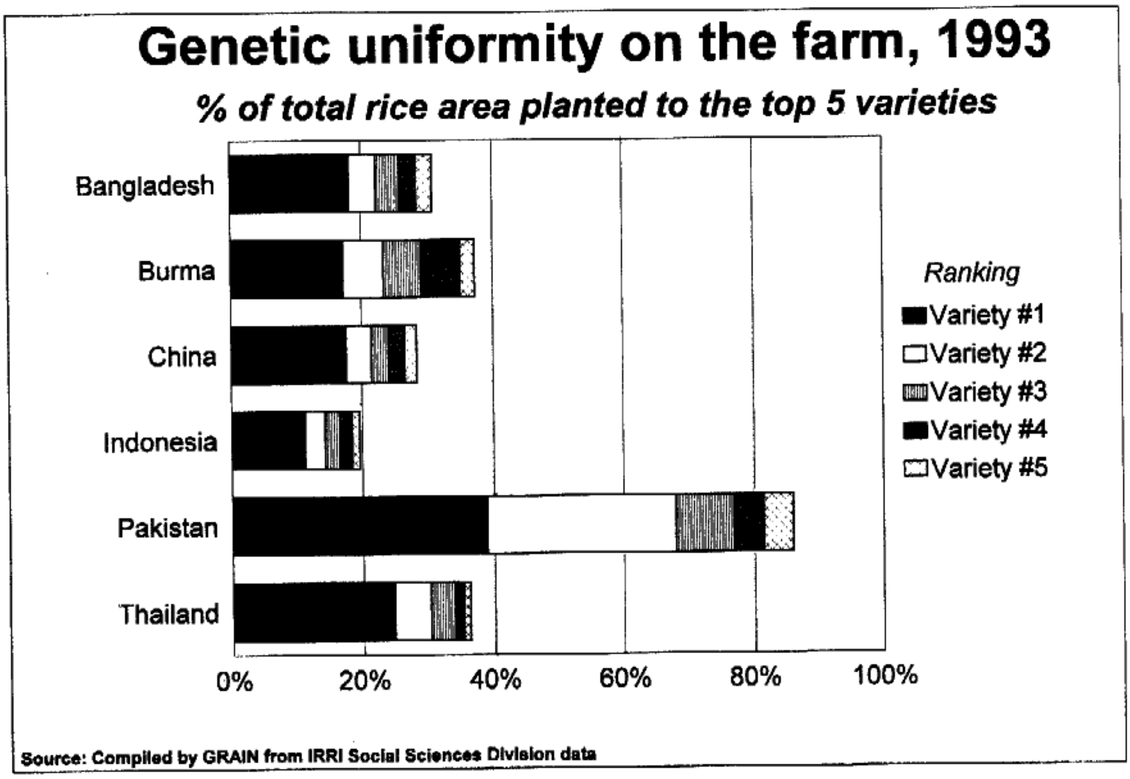

FIGURE 6

As a generally self-pollinated crop, it is buffered from "contamination" in the field during rejuvenation. Due to IRRI's consistent and competent efforts, its rice genebank is a soundly managed cold storage backup option, financed by a committed donor community.

But while excelling in expertise, IRRI has developed a somewhat introverted approach to rice conservation. Training and germplasm exchange have not been equalled by institution-building, national program support or regional networking. As a result, IRRI's vast and rich store of rice germplasm stands isolated and disconnected, especially from the grassroots genetic conservation programs.

Community-based management of rice biodiversity has been going on since rice was domesticated, perhaps 7,000 years ago. But only with the onslaught of the Green Revolution, which displaced indigenous planting materials under a blanket of HYVs overnight, did it fall under threat of extinction itself. In Southeast Asia, NGOs, POs and national scientists have organized a wide array of efforts and programs to retain and upgrade farmers' control over rice genetic resources.[49] The initiatives are extremely diverse, although all are engaged, at the least, in collecting and maintaining base materials, often a combination of traditional and improved varieties.[50] Some are centered on farmer breeding and selection, which implies new breeding strategies, systematic data management systems, orientations, trainings, and so on. Others complement the plant genetic aspect with bottom-up research and development in pest and soil management, cropping systems design, integrated agroforestry, credit and marketing systems, advocacy and so on.

While the linkages are complex, all these community-based actions carry explicit political programs of farmer empowerment and control over production and livelihood systems. Genetics, as such, is not the point.

IRRI decided to try and get out of its isolation in the ivory towers of genebanking as of the early 1990s. In the 1994-1998 Medium Term Plan, IRRI commenced a broadening out — on paper at least — of its conservation agenda to embrace *in situ* activities. Consequently, it went fundraising and in 1994, announced that it was going to assess and develop on-farm conservation of rice varieties:

> *In Asia, organizations such as the Southeast Asia Regional Institute for Community Education (SEARICE), TREE (Technology for Rural and Ecological Enrichment) in Thailand, and MASIPAG (Farmer-Scientist Participation for Development [sic]), and the Sustainable Agriculture Coalition in the Philippines have been working with farmer and community seed groups to collect and conserve traditional rice varieties. Community seed banks have been set up in some locations.* ***IRRI researchers will be evaluating these local conservation practices in order to develop appropriate methods for farm-based conservation*** *of rice.*[51] *(Emphasis added.)*

Never mind that it is highly unlikely that any of the organizations mentioned had actually asked IRRI to evaluate their practices, the point rests that IRRI *does* want to broaden its conservation agenda. It recognizes that community-based efforts are important and deserving of support. It has tried talking to numerous potential partners to find means of IRRI involvement. It even succeeded in raking in a few million dollars from the Swiss Government to study "these local conservation practices." But the efforts are being frustrated for many reasons (*see Box 10*).

The relevance of IRRI's approach to conserving the genetic base of rice farming to small farmers in Southeast Asia can be measured by two main indicators, which apply not just to germplasm conservation but to IRRI's breeding and research work as well:

(1) Is IRRI's exclusive focus on rice adequate? Will rice farming systems be able to evolve appropriately; and will sustainable agriculture in the region be effectively serviced by this narrow approach?

Box 10: *The SDC Saga*

The Swiss Development Cooperation (SDC) is a bureau of the Swiss Ministry of Foreign Affairs and an avid IRRI fan. Swiss NGOs have long been raising awareness about problems associated with the Green Revolution and the International Agricultural Research Centers, like IRRI, which SDC supports. Groups like Swissaid, HEKS and Helvetas support farmer-based grassroots approaches to genetic resources work as a necessary complement to the prevailing "eggs in one basket" genebank approach to conservation.

The SDC's response to the NGOs' clamouring for wider and more relevant agenda was to hand IRRI a fat envelope containing US$3.5 million for a five-year project to promote on-farm conservation of rice biodiversity. IRRI was starving for funds (by the measure of its own appetite) and SDC wanted to do something really hip and contemporary. Why not this on-farm conservation of genetic resources that the NGOs are talking about? And what better way to do it than send a handsome check to a Western scientific monolith basking cool and clean in the sultry heat of tropical Asia?

Thus began what NGOs in Southeast Asia call "the SDC saga." And it's a sad affair, especially for the 1990s.

The SDC/IRRI project is a research project which aims to support community conservation by answering a few "key" scientific questions. The basic idea is noble, but certainly not novel: put government-sponsored science to work to help improve farm-level management of rice biodiversity. Yet SDC did everything it could possibly do wrong in conceiving, designing and trying to implement the project.

First, it took the wrong approach. Community management of rice biodiversity certainly needs support, and that includes developing new scientific tools: new methodologies, new indicators, new conservation and breeding techniques, new forms of partnership between rural communities and institutionally-trained professionals. Yet SDC and IRRI divorced the scientific agenda from the development agenda in their research strategy. The project seeks only to answer a few scientific questions for the satisfaction of Science — or at least a few scientists: "*Why do farmers conserve diversity?*" "*What happens to the genetic makeup of rice varieties managed by local communities?*" "*Is dynamic, on-farm conservation efficient?*" That is the stuff of the agenda. When IRRI invited Southeast Asian NGOs to a planning meeting for the SDC project in February 1994, it annexed a list of 38 "research questions" that IRRI wanted to answer through the project. The NGOs, who were expected to be partners in the affair, laughed. Not only did the questions sound silly, but farmers and field workers already had answers to most of them. From the NGO perspective, the "research" agenda was irrelevant to farmer empowerment, even scientifically primitive.

The wrong approach buried SDC in its wrong partnership. The project aims to support community conservation. But IRRI does not work with communities. So, the idea was to get the national programmes and NGOs on board. The NARS were very interested, but NGOs boycotted the show because they recognized that

➢

➢ *Box 10*

dumping millions into a centralized, international research facility is not the way to strengthen community work. It is an attractive, easy option for donors, but it is a waste of their money.

Angered and confused by its plans getting nowhere, SDC started to put pressure on NGOs back home. In March 1995, it invited some Swiss development agencies to exchange information about on-going conservation programs. As one participant put it, "*During this meeting, SDC made it clear that if the dissenting Southeast Asian groups would not cooperate with the IRRI programme, or at least 'give up working against IRRI,' then SDC might decide to stop channelling money through the Swiss development NGOs for their Southeast Asian partners.*"[1] All this trouble just to spend nearly US$4 million to see if microscopic alleles jump around in farmers' fields!

The SDC saga epitomizes almost everything that NGOs working on sustainable agriculture in Southeast Asia have ever seen wrong with IRRI — minus a chemical connection or some balistic biotech hyperbole. The wrong target, the wrong people, and the wrong approach for the wrong pay-off.

[1] Miges Baumann, SWISSAID, personal communication, 21 May 1996.

(2) Do farmers participate in and benefit from IRRI's conservation work, not only in the future but today?

It would be presumptuous to try to advance some definitive answer to these questions, but some general lines of thinking can be put forward.

On the first point, IRRI has certainly created and maintained an excellent rice genebank but it is too isolated: from other farming systems components and from the full dynamics and needs of successful national programs. For the irrigated rice areas and favorable rainfed lowlands, where exploitation of IRRI-based rice technologies can be maximized within their own biological and social limits, IRRI's conservation program is probably adequate. But as IRRI moves into more marginal areas, especially the uplands, crop diversification and cultural diversity impose themselves and harsh, often fragile, environments set other needs. This is where IRRI's lack of expertise and genetic resources in other farming systems components — not to mention a social approach to germplasm — may be felt, and the weakness of national programs also manifested.

Should IRRI pursue the conservation of other rice farming system components — such as nitrogen-fixing organisms, legumes, rotation crops, animals (both aquatic and land-based), and perennial species? This would make sense if either IRRI became a Rice Farming Systems Institute or if the CGIAR's proposal that IRRI assume an ecogeographical mandate were taken to the extreme. Single commodity centers have made an important contribution to the conservation of their mandate crops, and IRRI perhaps has gone further in this direction than any other international center. However, the logic of focusing on farming systems rather than isolating their components is compelling, especially with respect to "reinventing" sustainable agriculture — or integrated, biologically-enhancing farming systems that were largely destroyed by the Green Revolution.

On the second question, it is clear that farmers do not participate in IRRI's rice conservation work. They donate their seeds and see them shipped off. In absence of community, farmer-based approaches to conservation, this is fundamentally disempowering. In theory, farmers are supposed to enjoy security of rice germplasm for the future through IRRI's efforts, but in reality, that security is unsure. Sometimes farmers have requested for seeds and been turned down; other times NGOs have retrieved the seeds but the seeds were useless; further still, politics can make a mess of nice *ex situ* security theories.

Farmers' seeds belong to them. They can never be IRRI's, or their government's, or the international community's, no matter what state legislation or supranational treaties say. Few farmers would object to sharing seeds with scientists (although this generous attitude is understandably waning) and few have put a flag on them (*ditto*). But seeds are not just germplasm — they are a collective, cultural product, a human heritage that farmers have been responsible for. In the effort to separate germplasm from the cultural forces that have created Asia's incredible diversity in rice, IRRI is offering little by way of security, except perhaps in a mechanistic sense of stock-piling genes to eventually overcome problems largely catalyzed by IRRI in the first place. IRRI's *ex situ* conservation strategy largely removes from farmers part of their basis for cultural — and agricultural — survival. And it remains to be seen whether IRRI has a role in supporting community-based approaches.

1 Statement made at the Southeast Asian NGO/NARS/IARC dialogue on *Rice, Food Security and the Ecology*, Chiang Mai, Thailand, 12 November 1992.

2 IRRI (1989), *IRRI Towards 2000 and Beyond.* Details of strategy implementation are contained in the companion volume, *Work Plan for 1990-1994.* Both from IRRI, Los Baños, Philippines.

3 IRRI (1989), *IRRI Towards 2000 and Beyond*, IRRI, Los Baños, Philippines, p 2.

4 Idem., p 17.

5 Idem., p 32.

6 Idem., p 21.

7 IRRI's use of the phrase "maintaining a strong emphasis on sustainable farming systems" is misleading. IRRI's concern for environmental sustainability is very recent, and its work on farming systems is historically negligible.

8 Later renamed flood-prone ecosystem.

9 IRRI (1989), *IRRI Towards 2000 and Beyond*, IRRI, Los Baños, Philippines, p 32.

10 Idem., p 49.

11 As outlined in its workplan for 1990-94.

12 N. Allison (1975), *Soil Organic Matter and Its Role in Crop Production*, Amsterdam: Elsevier.

13 Khristeva, LH (1968) "About the Nature of Physiologically Active Substances of Soil Humus and of Organic Fertilizers and Their Agricultural Importance" in eds: *Organic Matter and Soil Fertility*, Pontifical Academiae Scientarium, New York: John Wiley and Sons, pp 701-721. Khristeva showed that, in concentrations as low as 1/100,000 moles per liter, sodium humate exerts a favorable effect on plant growth. He further noted that this beneficial impact was more pronounced during extreme weather conditions.

14 Pauli, W (1961), "Humus and Plant: The Direct Humus Effect," *Science Progress*, Vol. 49, pp 427-436.

15 Schnitzer, M and Khan, S (1972), *Humic Substances in the Environment*, New York: Marcel Dekker.

16 Pauli, W (1961), *op cit.*

17 Flaig, W (1968) "Uptake of Organic Substances from Soil Organic Matter by Plants and Their Influence on Metabolism" in eds.: *Organic Matter and Soil Fertility*, Pontifical Academiae Scientarium, New York: John Wiley and Sons, pp 723-770.

18 Schnitzer and Khan (1972), *op cit.*

19 Flaig, W *et al* (1968), *op cit.*

20 Krasil'nikov, NA (1961) *Soil Organisms and Higher Plants*, Washington DC: Israel Program for Scientific Translations.

21 Khristeva, NA (1961), *op cit.*

22 Howard, A (1947), *The Soil and Health*, New York: Devin-Adair, pp 74-75. Pfeiffer, EE (1956) *Bio-Dynamics: Three Introductory Articles*, Pennsylvania: Bio-Dynamic Farming and Gardening Association, p 27.

23 Discussions with rice farmers in several provinces in Luzon, Visayas, and Mindanao, 1990-1993.

24 "Scientists re-inventing rice" *The Nation* (Thailand), Tuesday, October 15, 1991, p F2.

25 As known prior to its March 1996 proposed merger with Sandoz.

26 Scientists are also trying to install a trigger to control expression.

27 Rene Salazar, "Community plant genetic resources management: experiences in Southeast Asia," in Cooper et al. (eds), *Growing Diversity: Genetic resources and local food security*, IT, London, 1992, p 21.

28 Duncan A. Vaughan and T.T. Chang, "*Case study: Collecting the rice genepool*," paper presented to the Scientific and Technical Advisory Committee of the Intergovernmental Committee of the Convention on Biological Diversity, Mexico, 11-15 April 1994.

29 IRRI (1985), *International Rice Research: 25 Years of Partnership*, IRRI, Los Baños, p 43.

30 This number is approximate. In 1987, 78,500 accessions were registered in the genebank's database, but only 74,000 appeared on the shelves. Two brochures published by IRRI within a month of each other in 1995 put the total number of accessions in the genebank at 84,000 and 80,000 respectively (*Facts about Cooperation: Vietnam and IRRI* and *Facts about Cooperation: India and IRRI*).

31 Perret, PM (1991), "*A Proposal for a Network on Rice Genetic Resources Conservation*," in IRRI, *Rice Germplasm: Collecting, Preservation, Use*, IRRI, Los Baños, p 33.

32 Engels, J (1992), "Approaches and Strategies of the Formal Sector in the Conservation and Use of Plant Genetic Resources." Paper presented to the Southeast Asian NGO/NARS/IARC Dialogue on *Rice, Food Security and the Ecology*, Chiang Mai, 12-14 November 1992.

33 IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, IRRI, Los Baños, p 24.

34 IRRI, *IRRI 1960-1992: Impact of IRRI on Rice Science and Production*, IRRI, undated mimeo, p 11.

35 IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, IRRI, Los Baños, p 24.

36 IRRI (1985), *International Rice Research: 25 Years of Partnership*, IRRI, Los Baños, p 44.

37 Vaughan, DA (1991), "Gene distribution in germplasm collections", in IRRI, *Rice Germplasm: Collecting, Preservation, Use*, IRRI, Los Baños, p 47.

38 IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, IRRI, Los Baños, p 25.

39 IRRI (1994), *Program Report for 1993*, IRRI, p 221.

40 Data from: Dr. M.T. Jackson, IRRI, personal communication to Rene Salazar of SEARICE, dated 13 September 1995.

41 IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, IRRI, Los Baños, p 54.

42 IRRI (1991), *Programme Report for 1990*, IRRI, Los Baños, p 277.

43 IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, IRRI, Los Baños, p 63.

44 Evenson, RE and David, C (1992), *Rice Study* for the project "Structural Adjustment and Technological Change in Developing Country Agriculture", OECD Development Centre, Meeting on 20-21 January 1992, draft, mimeo.

45 "*Gurdev S. Khush talks on Super Rice and rice production*," in *Greenfields*, Vol. 23, No. 11, November 1995, Planters Printing Inc., Manila, p 8.

46 Plucknett, DL *et al* (1987), *Gene Banks and the World's Food*, Princeton University Press, p 15.

47 *Ibid.*

48 IRRI (1991), *World Rice Statistics 1990*, IRRI, Los Baños, p 43.

49 For an overview see: SEARICE (1988), *Asian Regional Workshop on Plant Genetic Resources Conservation and Development and the Impact of Related Technologies*, proceedings of conference held in Malang, Indonesia, 6-11 December 1987, SEARICE, Manila; SEARICE (1990), *Southeast Asian NGO Training Workshop on Community-Based Plant Genetic Resources Conservation and Utilization*, proceedings of a workshop held in Thailand, 1-21 November 1990, SEARICE, Manila, 1992; Cooper D *et al* (1992), *Growing Diversity: Genetic Resources and Local Food Security*, London : IT Publications, pp 17-43; Briones, A *et al*, "Farmer-based research for sustainable rice farming," in *ILEIA Newsletter*, December 1989, ILEIA, Leusden, pp 24-25; Vicente, Perfecto M (1994), "The MASIPAG Program: An Integrated Approach to Genetic Conservation and Use" and Zamora, O (1994), "Agricultural Genetic Resources Management by the Informal Sector in Southeast Asia: Challenges and Needs," both in *Growing Diversity in Farmers Fields*, Naturskyddsföreningen, Stockholm, 1994, pp 18-55; and Fernandez, Pamela G and Zamora, Oscar B (1995), "Farmer-based Variety Development, Maintenance, Multiplication and

Genetic Conservation in the Philippines," paper presented at the workshop "Integrated Seed Systems for a Low-Input Agriculture," 24-27 October 1995, MARIF, Malang, Indonesia.

50 These terms cover quite different realities, depending on who uses them. In most IRRI literature, "traditional" varieties are those developed *before* IRRI/1960, even if they were bred by perfectly recognizable scientists such as Dr. Hadrian Siregar, the Indonesian breeder who developed Peta, one of the parents of IR8. For some NGOs, traditional rice is any rice developed with indigenous germplasm, even if it is a cross with IRRI materials. For yet other NGOs, there is no reason not to designate farmer-developed rices as "improved" or "modern," since they are selections from crosses as contemporary as any IRRI line.

51 IRRI, "*Switzerland Aids the Preservation of Rice Genetic Resources*," *News about Rice and People*, IRRI, Los Baños, 16 February 1994.

3.4 CROP AND RESOURCE MANAGEMENT

IRRI has published studies describing land degradation and declining grain yields in its research farms after more than 20 years of intensive use of chemical fertilizers. These developments are a serious indictment of the Institute's past and current approach to agricultural intensification in rice.

To address these problems and support its move into different rice ecosystems, IRRI has delineated a range of crop and pest management subprograms. Their objectives cluster around four general concepts: integrated pest management, integrated nutrient management, cropping systems and sustainable resource management.

3.4.1 INTEGRATED PEST MANAGEMENT (IPM)

IPM research is probably IRRI's most advanced attempt at ecologically — sound farming practices. In 1989, IRRI banned all Category 1 pesticides from its experimental farms. It also stopped the practice of testing coded chemicals and conducting bioefficacy tests on pesticides. The Institute has conducted a major study on the environmental impacts of pesticides. A significant number of its recent publications are critical of pesticide use. IRRI has also refused research grants from agrochemical corporations. It no longer promotes the "package" approach to rice farming and is exploring ecological cultural practices as alternatives to pesticides. Its research for the various rice ecosystems are as follows (*Table 3.2*):

TABLE 3.3: *IRRI'S IPM Strategies by "Ecosystem"*

RICE ECOSYSTEM	IPM STRATEGY
Irrigated and Rainfed	• Characterize the dominant pest complexes in high-input rice systems. • Examine the interactive effects of agronomic practices with chemical and non-chemical methods of control. • Develop "socially acceptable" IPM approaches. • Address socio-economic issues, such as the role of women in IPM programmes and farmers' risk analysis. • Improve pesticide application technology. • Explore the integration of herbicidal, mechanical and cultural approaches to weed control.
Upland	• Examine the interactive effects of plant resistance, phosphorus nutrition and cultural practices in blast management. • Examine interactions between weeds, disease and insects. • Explore the integration of herbicidal, mechanical and cultural approaches to weed control.
Deepwater and Tidal	• Study the ecology, epidemiology and economic importance of yellow stemborer and ufra nematode and develop resistant varieties. • Study the occurrence of bacterial blight, blast, rice hispa and armyworm. • Explore the integration of herbicidal, mechanical and cultural approaches to weed control.

IPM work has been intensified. In place of the Economic Threshold Level (ETL), an early IPM concept that did little to reduce pesticide use in farmers' fields, IRRI is developing a behavioral IPM approach where simple decision rules (such as "No spraying is necessary to sustain yields") are based on farmer practice.

IRRI endorsed the following resolutions on IPM drawn up at a conference held in 1992 in Thailand :

> *IPM systems should be based on ecological principles and should utilize the best possible mixture of traditional and modern techniques, while conserving beneficial organisms, natural enemies and biodiversity. The systems should be economically viable, and farmers should be empowered to make decisions for maintaining crop health.*
>
> *IPM systems should NOT use any of the following: (1) WHO Category 1 pesticides; (2) persistent pesticides; (3) pesticides with chronic effects; (4) pesticides which may induce pest resurgence; (5) pesticides which are banned and unregistered in the country of origin; (6) the "dirty dozen" pesticides — i.e. those identified by the World Health Organization as excessively toxic: the Drins (Aldrin, Endrin and Dieldrin), BHC (HCH), Chlordane (Heptachlor), DDT, Parathion, Toxaphene, Paraquat, Ethylene Dibromide (EDB), Chlordlmelorm, DBCP, Pentachlorophenol and 2-4, 5-T; and (7) calendar-based spraying of pesticides.*[1]

However, even in this most promising area of IRRI research, IRRI has a blind spot. This is the concept of the "*efficient use of chemical inputs*" including insecticides, fungicides and herbicides, if only in reduced amounts. While IRRI questions the overuse of pesticides, most IRRI scientists agree with former Director General Klaus Lampe that, "*pesticides are necessary tools like a headache tablet.*"[2]

An important issue is at stake here. If IRRI has already decided that pesticides are necessary for effective rice farming,

Box11: *IRRI, Pesticides and IPM: Mixed Signals*

Integrated Pest Management (IPM) research is probably IRRI's most advanced attempt at ecologically-sound farming practices. However, IRRI has a blind spot. IRRI believes in the concept of "*efficient use of chemical inputs*" including insecticides, fungicides and herbicides, even if in reduced amounts only. Most IRRI scientists agree with former Director General Dr. Klaus Lampe that, "*Pesticides are necessary tools like a headache tablet.*"

It is one thing to question the overuse of pesticides. But it is altogether a different issue to ask whether they are necessary at all. IRRI inherently believes that pesticides are necessary, which blocks research efforts into making pesticides obsolete. It is fine to take a headache tablet — so long as it has no side effects, which pesticides obviously do. But if it is possible to avoid the headache in the first place (as many farmers have shown), there would be no need for the tablet.

IRRI's thinking on this matter is, in essence, no different from that of the pesticide industry, which have started to try and hide their pesticides behind a green gloss. It is therefore not surprising that, in 1994, IRRI decided to join efforts with the pesticide giant, Ciba-Geigy, in developing sustainable agricultural practices in the tropics. IRRI and Ciba-Geigy are committed to the use of IPM which both define as "*the best mix of cultural practices, biological and chemical tools for a particular problem at a particular time and place.*"

IRRI has fallen into a trap, endorsing the integrated use of pesticides in the IPM program instead of an IPM program that purely relies on the natural controls of a rice ecosystem. IRRI's mixed signals have upset not only environmentalists who are closely monitoring its pest management program. It has also disillusioned some progressive scientists within IRRI itself who recognize that ecological pest management holds tremendous promise for pesticide-free rice farming.

But the IRRI-Ciba pesticide collaboration is only the beginning. Recently, IRRI imported genetically-engineered rice seeds containing the endotoxin Bt gene from the Swiss Federal Research Institute. The Swiss, in turn, obtained their seeds from the American subsidiary of Ciba-Geigy.

For many years, IRRI tried to clear its reputation from its early image of being a cheap research outfit for peddlers of toxic poisons. Its recent strategic collaboration with Ciba-Geigy opens these old wounds anew and raises the question of what type of "sustainable agriculture" IRRI plans to transfer to rice farmers of the world.

IRRI's cooperation with Ciba-Geigy has not only alienated NGOs who hoped that finally IRRI was really moving in a more environment-friendly direction. The IRRI-Ciba collaboration has also raised questions about IRRI's

➢

> ➢ *Box 11*
>
> true motives regarding its research. Is there a deeper link between IRRI and Ciba-Geigy? Are there personal ties linking the two organizations? Or is IRRI simply interested in accessing Ciba's Bt genes? Does IRRI have any sense of its moral responsibility for the health of farmers and sustainability of their environment?
>
> Strategic research on pesticide-free rice promises enormous benefits. Nations and farmers are simply fed up with the continued use of pesticides that seriously harms human health and the environment. But, from the looks of it, IRRI wants no part in this dream. Instead, it wishes to avoid its moral responsibility and continue sacrificing farmers' health and lives to the altar of the pesticide industry.

it is not engaged in true "strategic" scientific research. Because of ideological leanings, it has prejudged the answer to a scientific question without evaluating the evidence, which strongly indicates that pesticides are not necessarily required.

IRRI's approach, in essence, mirrors that of the pesticide industry. With the increasing call for sustainable agriculture and pesticide bans all over the world, the pesticide industry is suddenly interested in IPM. Companies are setting up IPM programs and calling themselves advocates of sustainable agriculture. Some describe their products as "environment friendly" and those with minor negative effects on health and environment are rationalized as a necessary evil. It is, therefore, not surprising that IRRI is open to collaboration with such "enlightened" pesticide companies in its IPM work.

IRRI is cultivating a close relationship with one such chemical giant, Ciba-Geigy, now merging with Sandoz (*see Box 11*). The embracing of chemical inputs in its IPM program is seen as a major step backwards in the eyes of many scientists, inside and outside of IRRI, who recognize that:

1. Pesticides merely play the role of artificial predators at the expense of a more vast range of real predators and other beneficial organisms.
2. Hundreds of scientific studies demonstrate the realities of fertilizer-induced pest attacks.

3. There is a wealth of evidence demonstrating that high grain yields can be achieved in pesticide-free rice ecosystems.

In partial recognition of the drawbacks of chemical pesticides, IRRI aims to explore the potential of botanical pesticides. The latter, however, suffer many of the same drawbacks. Firstly, insects can develop resistance to botanical insecticides in the same way as they do to chemical pesticides. This was clearly demonstrated in an organic farming project in Iloilo in the Philippines where a potent broad spectrum insecticide derived from the roots of the *Derris* plant was used to control cucumber beetles. Initially, *derris* worked well, but its efficacy dropped over the ensuing months because the beetles developed resistance to the insecticide.

Secondly, botanical pesticides can harm beneficial insects and spiders in farmers' fields. As with chemical pesticides, this can result in pest resurgence and new pests, both of which occurred on the Iloilo farm. The use of botanical pesticides reduced the number of beneficial insects keeping the population of cucumber beetles in check. Not only did cucumber beetle numbers increase, but a new viral disease emerged amongst the cucumbers.

Although further research could uncover more selective botanical pesticides, the only advantage they offer over chemical pesticides at the moment is that they are easily biodegradable and do not persist in the food that humans eat. The best alternative to chemical pesticides is ecological pest management. This new approach examines all the components of the agroecosystem and assesses their impact on pest populations. An integral part of ecological pest management is to ensure that plants are properly fed so they do not succumb easily to disease or insect attack. The approach relies heavily on encouraging the proliferation of beneficials, since these almost always keep pest populations under control.

IRRI could move its IPM agenda forward by phasing out the use of pesticides in rice farming, since strategic research on pesticide-free rice promises enormous benefits, while the continued use of pesticides will incur greater and greater costs related to human and environmental health.

3.4.2. INTEGRATED NUTRIENT MANAGEMENT (INM)

In recent years, concerns about sustainability have prompted IRRI to look beyond external inputs and chemical fertilizers. It has achieved some interesting results with its biofertilizer program, producing grain yields of more than 8 tons of rice with the use of green manure only. Its recent anthropological research has confirmed the superiority of farmers' practice in the use of nitrogen fertilization over IRRI recommendations, and even criticized earlier IRRI attitudes towards farmer knowledge and practice. These findings have encouraged some at IRRI to study farmer practices more closely.

The idea behind INM is to integrate inorganic and organic fertilizers to sustain crop yields. IRRI's INM program varies according to the rice "ecosystem" (*Table 3.3*):

Like its overall approach to rice farming, the Institute's INM strategy becomes more ecology-oriented as it moves from the irrigated lowlands to the uplands. There are limitations to IRRI's nutrient management strategy for both irrigated and rainfed lowlands. Nutrient efficiency is a key objective for IRRI, but it is not clear whether the Institute seeks to achieve this through the external application of fertilizer or the internal enhancement of soil fertility.

In the past, IRRI has focused on the external approach. For example, it has experimented with the deep placement of nitrogen fertilizers and new types of slow-release nitrogen fertilizers.

It has done little to explore the fact that the healthy functioning of the soil dramatically improves nutrient efficiency. When nitrogen is given as an external input, plants obtain 30% of their nitrogen from the fertilizer, but still get

70% from other sources. If the soil is impaired, overall nutrient efficiencies decrease, with more and more fertilizer needing to be applied to obtain the same grain yields. It is possible that efficiency achieved through "improved" methods of fertilizer application may, in the long-run, adversely affect the efficiency governed by healthy soil fertility.

With the "mineral theory" of plant nutrition so deeply embedded in its methodology, IRRI continues to overlook the promising and important role of humic acids in nutrient efficiency (*see Section 3.2.2*). There is considerable evidence that humic acids increase the efficiency with which nitrogen and other nutrient ions are absorbed by plants. IRRI would do well to expand its research agenda to include humic compounds and the role of compost in the production of such compounds.

The limitations of IRRI's INM approach is illustrated by its green manuring program. Even NGO advocates of sustainable agriculture slip into a reductionist perspective in regarding the use of legumes as green manure. Green manuring is often seen as a substitute for nitrogen fertilizers. But, to be effective, green manuring must be complemented with composting. It is difficult to control the quality of humic substances through green manuring. In contrast, with composting, it is possible to direct and control the decomposition process to ensure the production of effective humic substances.

In addition, green manure does not necessarily improve the soil's long-term structure. In aerated soil, it can even hasten the decomposition of organic matter resulting in poorer soil structure. In this respect, it can have the same detrimental impact as synthetic nitrogen fertilizer. Microbes use available nitrogen to break down the carbon tied up in the organic matter of the soil. Green manures, like synthetic nitrogen fertilizers, can release large quantities of nitrates which hasten the breakdown of soil organic matter.

Green manuring is not a substitute for soil fertility management, but is one facet of it. At the minimum, fertile soil must have adequate capacity to supply plant nutrients, sufficient air, enough water, proper acidity, enough warmth, quality organic matter, and a diverse and vital microbial population.

The shortcomings of INM are similar to those of green manuring. INM aims to integrate inorganic and organic fertilizers. In ecological agriculture, the objective is to manage soil fertility, not just components of it. If humic acids are not understood or included, it is not "integrated" enough. If the "integrated" enough. The interaction between the organic and inorganic portions of INM must be examined closely. Urea nitrogen, for example, increases soil acidity in the uplands, which may be related to the emergence of soil-borne pests, like nematodes.

An equally disturbing aspect of IRRI's new "sustainable" farming agenda is that it makes no serious attempt to free the small farmer from dependency on external inputs like fertilizers. In this way it perpetuates the culture of dependency, one of the most disturbing impacts of the Green Revolution. INM sounds laudable on the surface, but IRRI has shown no signs of working on INM with farmers to design rice ecosystems that require little or no external inputs; rather, it focuses merely on increasing the efficiency of the external inputs used in order to raise grain yields.

3.4.3 CROPPING SYSTEMS

Since IRRI assumes that the irrigated lowlands will continue to be the major source of rice especially for the Asia's urban populations, it envisions a future characterized by double or even triple rice monoculture cropping systems. This is the context for its breeding IPM and INM programs. IRRI also hopes to improve existing tillage, irrigation and drainage practices to support high cropping intensities.

In rainfed lowlands, IRRI's goal is to intensify the rice cropping systems. IRRI will examine the biophysical and socio-economic factors that affect the choice of crops planted

TABLE 3.4: IRRI'S INM Strategies by "Ecosystem"

RICE ECOSYSTEM	INM STRATEGY
Irrigated	• Improve fertilizer formulations. • Increase efficiency of nitrogen (N) fertilizer use through better understanding of N-cycling and role of N-fixing bacteria. • Cut inorganic N use by 25%. • Increase understanding of role of other micronutrients.
Rainfed	• Research the role of soil organic matter, particularly N-fixing green manures. • Study soil properties, especially relationship with phosphorus availability and efficiency. • Long term soil fertility trials.
Upland	• Explore soil conservation, rice-livestock interactions and long-term nutrient balance. • Examine relationship between phosphorus and mycorrhiza. • Research calcium and soil acidity. • Conservation of organic matter.
Deepwater and Tidal	• Nitrogen dynamics for various soil types under differing water conditions.

before or after rice; the impact of irrigation and puddling on non-rice crops; the use of crop residues and green manure across rice-non-rice cropping sequences; on-farm water conservation techniques for crops moving toward the drier parts of the year.

For the uplands, IRRI advocates diversified cropping systems and will explore long-term rotations, alley cropping systems, crop-animal systems, crop associations which conserve soil organic matter and nutrients, different external and internal input scenarios for increasing crop productivity while maintaining long-term sustainability, and minimum tillage and water conservation practices to support diversified cropping systems.

IRRI explicitly recognizes that the cropping systems methodology developed by the Institute in the last decade has limited application for the uplands. It will, therefore, explore innovative methods of on-farm researches involving farmers, NGOs, and national and international research institutions. While this is a welcome move on paper, judging from its forays into participative conservation with farmers (*see Box 10, above*), it seems unlikely that IRRI really has the commitment and humility to make such a research possible. It is also disappointing that IRRI limits its plans for on-farm researches to the uplands, believing that it knows all it needs about appropriate farming practices for the other rice ecosystems.

IRRI also hopes to intensify cropping systems in deepwater and tidal wetlands. It will explore the introduction of dry-season crops where irrigation water is available. The Institute is even willing to look into replacing deepwater rice with a sequence of crops before and after the flooding. If rice is to be retained, IRRI will explore the impact of ratooning[3] and the use of rice foliage as animal feed as means of increasing rice-based cropping intensity. They will study rice-fish culture in collaboration with other institutes which specialize in this research area.

3.4.4 SUSTAINABILITY

IRRI is painfully aware that its own work "*indicates that using present techniques, the high yields from modern rice technology may not always be sustainable.*" Thus, in its search for sustainable high yields, it will address "*a major concern: the impact of modern rice production technologies on the ecology — soil, water, flora, fauna and atmosphere — as rice cropping intensifies and expands into new areas.*"

Many of its subprograms have "sustainability" as the major objective. In IRRI's strategic policies, sustainability balances out, at least conceptually, with the Institute's concern for higher grain yield potentials in all ecosystems. It must be stressed that IRRI's understanding of sustainability is limited to its environmental dimensions, and does not extend to social and cultural aspects.

"Sustainability" also permeates IRRI's cross-ecosystems research program which aims "*to characterize rice ecosystems; to develop modern* scientific tools, methods, and knowledge for addressing current and *anticipated rice production problems common to several ecosystems.*" Under this program, IRRI states that:

> *Long-term socio-economic and environmental impact relative to the cost of developing new technology sets all IRRI research priorities. That requires consideration of trade-offs between efficiency and equity, short-term efficiency and long-term sustainability, strategic and applied research, and comparative advantage of national and international institutions.*

This greater awareness within IRRI of the externalities of the Green Revolution is also reflected in the attitude of some of its senior scientists, many of whom advocate *ex ante* evaluation (before deployment), in addition to *ex post* (after the event) impact analysis. IRRI's principal rice breeder, charged with creating IRRI's 15-ton ideotype rice plant, is unwilling to trade plant resistance traits for higher grain yields at the expense of sustainability. He is concerned that this will result in greater pesticide use by farmers.

IRRI is beginning to realize more profoundly that the rice technologies it has promoted all over Asia are unsustainable. Its own research work on environmental sustainability has unearthed a number of problems associated with intensified rice production, such as nematodes which reduce rice yields by as much as 30%, and a "disease complex" of unknown causes. These add to earlier problems of unstable host plant resistance, insect pest resurgence and secondary pest outbreaks, created by the use of pesticides, drinking water contamination, farmer poisoning, etc.

IRRI's approach to upland rice production reflects its awakening to the complexities of rice production. It sees upland rice as part of a larger cropping system. Considering the complexity of uplands, the Institute advocates different approaches for different areas. It has set modest targets for grain yield increases, does not rely solely on a breeding approach and aims to preserve the quality of upland rice. Field exposure has made the scientists more sensitive to the cultural nuances of upland cropping systems.

Key scientists have given up tenured positions at universities to join IRRI's sustainability research. The decision is a significant one considering that, for scientists, tenure is very important career-wise. Long-term fertility trials do not reward scientists with many publications. The reward system of science is biased towards frequent publication. This shows their commitment to sustainability research.

However, for IRRI's research to be of real value to the rice farming community, it must first address some fundamental problems. For example, the Institute is conducting research on the "*efficient use of chemical inputs,*" rather than addressing the question of whether or not pesticides are necessary for rice farming. The previous section on IPM demonstrates the scientific folly of such an approach, which also contradicts IRRI's own policies. IRRI often applies the concept of comparative advantage in determining its research priorities. In this arena , IRRI's research is no different from the "product stewardship" or "strategic use" concept of the pesticide industry. Surely, the pesticide industry has more comparative advantage than IRRI in this field.

Other policies are also contradicted by IRRI's chemical crutch approach. In line with its equity agenda, it would be more appropriate for the Institute to help farmers use local resources to manage pest problems. With its strategic research policy, it would be more logical for IRRI to explore nonpesticide rice systems. But IRRI's starting point is always the fact that external props and support are, and will always be, necessary in rice ecosystems.

If IRRI is genuinely "accountable" to consumers, it should be asking if pesticides and chemical fertilizers are really necessary for crop production. IRRI has little appreciation for the undesirable impacts of chemical fertilizers on soil and plant health. It makes more scientific sense to ask whether or not rice plants' nutrient needs, especially for nitrogen, can be met through biological means, and to design cropping systems accordingly.

Even in the seemingly innocuous arena of germplasm evaluation, IRRI's sustainability quest is compromised. How can effective evaluation and selection of germplasm be undertaken when IRRI has not identified the crux of its sustainability problem? This research identifies "useful" and "desirable" genes. But desirable in what context? Under which crop environment, soil fertility practice, pest management condition or cropping system? The germplasm evaluation program leaves much to individual interpretation, since IRRI has no definition of sustainable rice farming and no proper criteria for evaluating germplasm for sustainability.

The program description for "germplasm evaluation" shows that IRRI scientists are not aware that evaluation involves value decisions about what constitutes a sustainable ecosystem and a sustainable society. With these criteria excluded, evaluation is, by default, biased towards grain yield.

THE 15-TON HYPOCRISY

Which brings up another problem related to the question of yields versus sustainability. While IRRI strives to be "non-renewable resource conscious,"[4] it is pushing a 15-ton rice agenda before it has determined the ecological and technological context that can support 15-ton rice. To sustain such a yield, what price must society pay, in terms of consuming and/or destroying its non-renewable resource heritage? How much soil degradation must occur? To what extent will farmers' health be sacrificed by the "necessary use" of pesticides? IRRI has no answers to these questions. Instead, it rather lamely points out, that in reality, farmers will attain only a 10-12 ton grain yield, reducing sustainability impacts (*see Box 12*).

The problem is that, in farmers' fields, the sustainability limit is already being reached at much lower yield levels. NGO field workers in Southeast Asia are inundated with farmers' complaints of having to use ever greater fertilizer and pesticide inputs to maintain existing grain yields. Their lands and future resource base are being progressively degraded. These farmers manage irrigated lowlands with yields of 4-6 tons per hectare, much less than IRRI's 15-ton yield potential, or even the 10-12 tons it thinks farmers will actually reap.

The situation can only get worse. Sustainability is a problem in the here and now, and at much lower yield levels (*see Fig. 7*). IRRI research has shown that Green Revolution technologies for rice, which it developed, are slowly destroying the health and livelihood of farmers and gradually degrading their land. A lot of people feel that the Institute has an urgent moral responsibility to redress the harm it has inflicted on millions of farmers and on the resources and environments of nations. If IRRI were truly accountable to rice farmers, it would cut its 15-ton breeding program and rechannel its budget to research on sustainability, predictive ecology and ecological resource management. Only when the problems of sustainability have been identified and satisfactorily addressed can IRRI pursue its 15-ton yield frontier (within clearly defined sustainability parameters).

Efficiency: IRRI's Holy Grail

IRRI endeavors to be "efficient," and efficiency is often pitted against sustainability when choices have to be made. Efficiency usually wins out, but IRRI's measuring sticks are highly selective in the criteria they use to measure it. In

Box 12: *The 15-ton Super Rice*

IRRI's new rice type for the irrigated lowlands has been baptized by the press as "Super Rice" because it is supposed to yield 15 tons/ha. Targeted to hit farmers' fields by the turn of the 21st Century, the 15-tonner is a second Green Revolution in and of itself. For IRRI's supporters, it's the miracle needed: [populations are increasing and aid agencies are growing restless to see a spectacular response.] For IRRI's detractors, it is a super nightmare [sustainability is a problem at much lower yield levels and the urgent problem is not production but access to food.] For anyone concerned about how three-quarters of humanity will feed itself tomorrow, there's no sideline to the debate.

The 15-ton rice is IRRI's flagship response to the sustainability problem plaguing Asia's paddy fields. According to IRRI, it will provide a 25% yield increase to feed growing populations on equal or less land. It will do so without demanding greater amounts of fertilizer. In the words of IRRI's principal plant breeder, Gurdev S. Khush, who is the hands-on creator of this second miracle rice, "*The farmers who plant it won't have to use pesticides.*"[1] *In fact, Khush states, IRRI is conducting research* "*that will make the plant produce its own herbicide.*"[2] In the few years since IRRI started crossing and selecting the 15-tonner, US$ 2.5 million have been spent on the promised plant.[3]

Beneath the hype, IRRI's 15-ton rice is a transparent illustration of the scientific biases of this powerful institution. This is IRRI doing — or trying to do — what it does best.

1. Problem definition: The problem IRRI sees is feeding more mouths. The way it choses to see that done is by extracting more grain from the rice plant more efficiently. That is the basis of the 15-ton rice. As such, some people dismiss it as a top-down, technological approach to the complex structural inequities that underlie poverty and hunger in the first place. Farmers wonder why IRRI races after skyscraping yield frontiers without adequately addressing current on-the-ground problems first. The 15-tonner begs all of us to believe that the problem is one of supply and that higher rice yields is the best answer. Never mind political issues — IRRI's mandate is to increase rice production. It's back to the 1950s. And, with IRRI's luck, we might be here forever.

2. Objective: To feed these mouths, IRRI is redesigning the entire rice plant through a genetic overhaul. It has not done this in thirty years since the first super rice, IR8. The effect is visually spectacular (*see Figure 7*). In a sense, however, it's very simple.

Before IRRI, rice was a "source"-limited plant. The leaves (= source) of the older varieties did not convert enough sunlight into filled grains.

➢

➤ *Box 12*

Therefore, IRRI radically changed the architecture of the rice plant by shortening the stem and making the leaves stiff and erect. And it designed a package of practices to exploit that source to its maximum. Now the "sink" has become the problem — that is, where all the source energy ends up. Today's rice plants are on a non-stop binge: they intake too much for their structures to store as grain. So, 30 years later, IRRI is reformulating the equation again, by creating rice plants which produce more grains and denser ones at that. In a sense, the source became overwhelming, causing the sink to overflow. So now they build a bigger sink.

The onus of reaching IRRI's 15-ton frontier will fall squarely on the irrigated lowlands, the target of the first Green Revolution. Never mind why farmers there still can not get the yields IRRI gets on its experimental farm. And never mind the other rice farmers — they are promised milder medicine. While IRRI reaps 10-12 t/ha with its best rices today, farmers get 6-8 under "optimum" conditions or 4-5 under normal ones. The gap, IRRI claims, is due to non-adoption of technology. Which does not mean farmers do not spray enough or apply enough fertilizer as it is. It means they do it "inefficiently." And a new technology is supposed to resolve that.

3. Means: For IRRI, to feed more people you need more rice, meaning you rearrange genes so plants produce more grain. Increasing production becomes a matter of delivering better seeds over and above improving farming systems (much less farm policies). This is IRRI's comparative advantage — or stumbling block. As an international research agency, they feel they have to isolate production constraints from the complex environment and propose a few generic technologies rather than a million specific ones. IRRI emphasizes breeding as the route to 15-ton rice. This is an ideological choice. For example, research conducted at IRRI shows that the main factor controlling tillering ability in rice — which is key to supporting the heavy grain heads — is spacing between plants.[4] That is, cultural management. But IRRI translates that into a breeding problem because that's what IRRI does best.

The 15-ton rice is something like a glorified Lego construct. First, they got the genes in the right place for the 15-ton yield, but the plant fell prey to every bug and disease around. So they then introduced some genes to ward off insects, but the short, round grains were bound to turn off consumers as well. Next came a few changes in grain quality and now the plant is top-heavy, so they're lowering the canopy with hormones. And so on. In the end, they might take their eyes off the rice plant and search for a super farmer to grow it.

4. Impact. If the 15-ton Super Rice sounds like "more of the same," that's because it could be. And it could be 15 times more damaging than what created IRRI's sustainability problem in the first place. There are three glaring questions:

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➢ *Box 12*

At what cost?

The biggest controversy is whether or not soils can support a 15-ton rice. For current yield levels of 4-6 t/ha, farmers are applying a historically unprecedented 120 kg of nitrogen per hectare. At that level already, yields have stagnated and are even declining in some areas. IRRI doesn't know why, but it's probably due to a lack of micronutrients. If you want to get 10 t/ha, like on IRRI's experimental farm, the rice plant would need 200 kg of nitrogen. And if you want 15 tons, the calculation is obvious. Even if IRRI manages to improve the efficiency with which rice plants absorb nitrogen from fertilizer (at present only 30-50% ends up in the plant), the 15 tonner would need between 240 and 400 kg of nitrogen per hectare. Double or triple current soil doping rates! How can the soils manage? How can the farmers afford it?

Another controversy is the kind of pest management strategies the rice will need. IRRI's aim is to engineer durable resistance in the rice and do away with pesticides. Such a result would be welcome but is unlikely. Even durable resistances would break down. Farmers would still depend on breeders for the next trick and on chemicals as ever ready resort. It is not for no reason that IRRI has recently renewed long silenced collaborative activities with major pesticide manufacturers like Ciba-Geigy.[5] The pest and disease problem is not just caused by pathogens adapting to the narrow genetic base of modern cultivars. It is also widely aggravated by heavy nitrogen fertilizer applications in intensive production systems. Sheath blight, red stripe, stem borer, tungro, nematodes, the brown planthopper, etc.: IRRI's data clearly show that all of these current problems have been induced or directly exacerbated by chemical fertilizers and intensive cropping patterns — which IRRI has not-so-inadvertently promoted. Given that 15-tons are impossible without unabated nitrogen-pumping, will Super Rice create Super Pests? Further, the 15-tonner will be sown directly into the soil rather than transplanted. Direct-seeded rice is already linked to notably increasing herbicide use in Southeast Asia because the scattered placement of the plants makes mechanical weeding difficult and, besides, herbicides are cheaper than labour. The new plant type could exacerbate this trend, at least in the medium-term.

Who will benefit?

Little analysis has been made of the social impacts of the impending 15-ton rice. The Super Rice is directed at irrigated farms, which represent 40% of Southeast Asia's ricelands in area, 75% in grain output and the higher echelons of agricultural income. These are the "better off" farmers, though their intensively cropped lands may not be so well off. The technology is being built for this clientele and is, therefore, intended to improve their relative power. IRRI is also developing other technologies for other clienteles, better known as the "resource poor." But with less emphasis.

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Box 12

As with the first Green Revolution rice varieties, changes in labour patterns are embedded in the Super Rice design. This, at least, has to do with planting, irrigation/draining and weeding. (What about harvesting?) Comprehensive studies have not been seen.

Beyond the farmlands, Super Rice will have to be eaten and the cost must be within reach of the urban poor if it is to achieve its aim of nourishing Asia's growing population. Production prices may well rise depending on fertilization recommendations, irrigation needs and pest control practices, absorbing labour cost declines. Much of the real effect will depend on government support policies such as irrigation works and fertilizer subsidies.

Is this sustainability?

The sustainability issues IRRI is trying to address through the 15-ton rice are environmental ones: how to keep chemical fertilizer use minimized, how to eliminate the need for pesticides. Whether or not we are on the verge of a planetary Eco-Rice Revolution remains to be seen. A number of farmers' groups, scientists and NGOs involved in alternative rice research programs in the region are doubtful. Some of the seemingly "green" research priorities IRRI pursues in the 15-ton quest teeter on debated foundations — durable resistance, breeding vs. cultural management, IPM, herbicide tolerance, soil fertility dynamics, etc. — and continue to bear the hallmark of centralized, top-down science conducted in largely artificial environments. High yields have high energy costs which can put quite a drain on the rice plant when all its life defenses are genetically packed in. Plants are not machines.

More disconcerting on the sustainability plane is the question of who will be empowered by the 15-ton rice (farmers? rice cartels? urban communities? IRRI?) and whether or not it is a serious response to serious concerns. Making food accessible to everyone is a major task and one to which a lot of people are contributing. If IRRI believes, as many of its top scientists do, that the problem is too many people, and if IRRI is not in the business of peddling birth control but rice to accommodate those people, something does not match up. It's because IRRI *accepts the status quo* and expects farmers to bear the brunt of how IRRI feels society should adjust to the status quo that makes sustainability a missed agenda in the race for yet another miracle rice.

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1 "*Gurdev S. Khush talks on Super Rice and rice production*," in Greenfields, Vol. 23, No. 11, November 1995, Manila, p 10.

2 Quoted in Raymond Tribidino (1996): "*IRRI Researchers Discover Improvements in Rice Yield*," Business World (Philippines), Business World Publishing Corporation, 16 January 1996.

3 Idem.

4 Jekyu Kim (1988), "*Physiological studies on low-tillering rice: an ideotype for increasing grain yield potential*," PhD thesis, UPLB, Los Baños, pp 169-170.

5 For the first time in a long time, IRRI cites a chemical TNC as one of it collaborating institutions in IRRI 1994-1995: Water, a looming crisis, IRRI, Los Baños, 1995, p 87. The collaboration is on IPM but neither IRRI nor Ciba, obviously, rules out pesticides within their IPM strategies.

the long term, sustainability should be a key indicator of efficiency, not a separate concern pitted against it.

At present, IRRI's technology is not resource-efficient, since its practices are destroying the resource base. Nor is it biodiversity-efficient as it does not encourage a total system yield approach and actively destroys varietal diversity. IRRI varieties are neither nutrient-efficient nor water-efficient, since the majority are only suitable for irrigated production. IRRI's techniques are not ecologically-efficient, since the herbicides IRRI promotes destroy microbes in the soil and contaminate farmers' drinking wells. The Green Revolution is not health-efficient as it endangers health with the continuous use of chemicals.

The quest for efficiency is another sustainability problem. These problems, like those encountered in IRRI's breeding, biotechnology, INM, IPM and cropping systems agenda, suffer from a common defect: IRRI's reductionist orientation. This serious generic defect is discussed in the next section.

3.5 OUTREACH

3.5.1. PUBLICATIONS AND COMMUNICATIONS

Organizing the dissemination of information related to rice research is an integral part of IRRI's mandate and function. In quantitative terms, this effort has been massive. IRRI maintains a library with over 170,000 publications, said to constitute the world's most complete collection of rice literature. IRRI has 180 books in print, many of which have been translated into numerous languages. *A Farmer's Primer on Growing Rice* has been published in nearly 40 languages, with distribution close to 270,000 copies. Newsletters, conferences and databases are other communications tools IRRI uses to disseminate information on rice research.

While most of this is scientific information, and some of it quite excellent, IRRI has recently begun efforts to develop more popular tools for public awareness, including videos, fact sheets and songs. Some of these materials border on propaganda, which is alarming for a scientific research institute. A number of recent IRRI public awareness documents contain misleading, oversimplified statements. For example, according to one recent IRRI Corporate Report, "*The unit cost of production is lower for modern rice varieties than for traditional varieties.*"[5] No data is provided to indicate what costs are factored into this assertion, which would shock more than one farmer. IRRI has also abrogated the right to declare it a "myth" that "*Farmers in the Philippines should return to their traditional varieties.*"[6] IRRI hardly seems the kind of institution that should produce emotional campaign material. Regardless of these observations, IRRI plans to give further emphasis to such public awareness materials and closely monitor public perceptions and allegations about the Institute. In 1995, it produced a very defensive publication entitled *IRRI and the World of Rice*, which focuses mainly on refuting recent allegations against it.[7] The Institute has also started producing popular brochures about its research on IPM and on *Bacillus thurigiensis* (Bt) and other themes, and converted part of its facilities to a permanent historical display called "Rice World," coveniently trapped inside IRRI.

3.5.2 INTERACTIONS WITH COLLABORATIVE INSTITUTES

The major actors with which IRRI maintains relations or has to contend with include: NARS (or the public sector in the South); public sector research units in the industrialized countries; the private sector (North and South); NGOs; farmers and their organizations; other CG centers; and IRRI's host country government. Its forked-tongue approach to dealing with the public is outlined in *Box 13*.

1. THE NARS

IRRI has its strongest vested interests in relations with the national rice research programs of Asia. Structurally speaking, they are the "clients," the professional customers, of IRRI research. One of IRRI's top priorities has long been to strengthen national programs so that they become full-fledged and dynamic actors in rice research. IRRI claims to have largely succeeded in this endeavor in a range of countries like South Korea, Thailand and the Philippines. Yet it continues to remain a vital challenge to the Institute in a number of others like Cambodia, Laos PDR and Burma. One of the most visible ways in which IRRI has impacted on national programs over the decades has been through training. IRRI has trained nearly 7,000 national scientists, 88% of which were Asians; many of them hold research, administration or teaching positions related to rice research in their countries.[8] Yet training does not make for a strong NARS. In fact, IRRI does not seem to have a clear (much less "objective") measuring stick of what is a "strong" and what is a "weak" NARS. (The same can be said for the entire CGIAR system.)

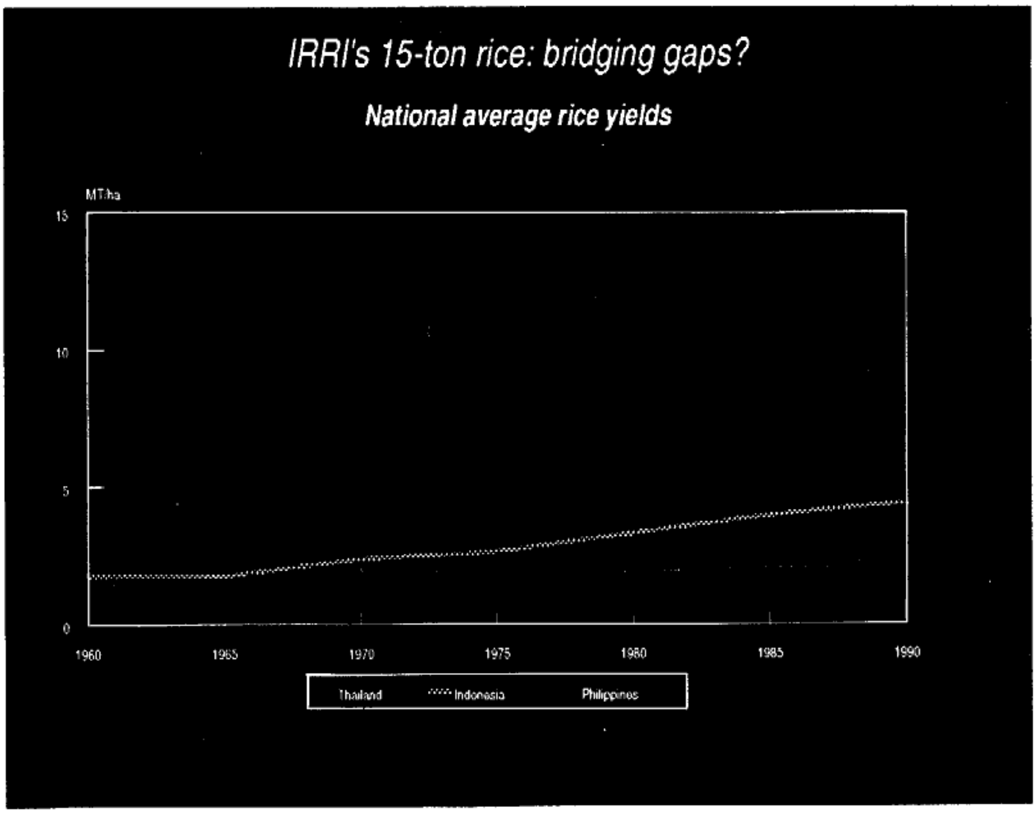

Figure 7

Such has been the alleged success of IRRI's investment in strengthening NARS that its relationship to them is changing from a teacher-student dynamic into real partnerships through research networks, joint program planning, consortia and other collaborative ventures. This has had a profound impact on IRRI's direction. Over 35 years of operation, IRRI's outreach efforts have resulted in the establishment of institutions able to take up part of IRRI's work and apply research to specific national conditions. From an institute devoted to both basic and applied research, carrying out fundamental studies on rice and releasing finished varieties to the national programs, IRRI is now able to shift its emphasis upstream to strategic research and provide rice research support services. This means striking a new balance between centralized research and germplasm management, which IRRI cannot relinquish, and hiving off certain roles and activities to its partners. The NARS are not yet equal partners — IRRI seems still to seek and maintain central control even within collective networks and consortia.

How does IRRI delegate authority, devolve responsibilities, and pass functions on? This is an important question, especially with respect to the seeming plethora of networks and consortia IRRI is engaged in: germplasm evaluation (INGER), farming system research (ARFSN), soil fertility (INSURF), pest management (IPMN), and the rice ecosystem consortia (rainfed lowland and upland so far). The case of rice research for the deepwater and tidal wetlands ecosystems provides an indication of the issues that arise from the devolution of IRRI responsibilities to a NARS.[9] In 1991, IRRI and the government of Thailand signed a Memorandum of Understanding which "*enables Thailand to* conduct research in deepwater rice for the benefit of that ecosystem *throughout South and Southeast Asia*."[10] Does the Thai — or any other— government have the right to unilaterally accept the regional mandate and responsibility embodied in the MOU? Since IRRI is not a governmental organization nor a regional organization, who formally entrusts it with the capacity to delegate such authority

Box 13: *Doublespeak: IRRI Style of Dealing with the Public*

October 1988 was a bleak month for IRRI. The Philippine Senate was investigating the Institute over charges by Filipino scientists and farmers that IRRI was conducting "high risk" experiments on rice blast disease. At the same time, Philippine senators and their technical staff scheduled a field visit to investigate IRRI.

IRRI personnel were anxious but prepared. They handed out information sheets including a paper prepared by IRRI's Plant Breeding Department. In this document, IRRI made an incredible claim:

> *In the Philippines, pest and disease resistance became the most important feature of new varieties. ... Blast became a less important problem in irrigated rice because new varieties have been genetically tailored to resist the disease. ... The brown planthopper [BPH], which was a major threat to rice cultivation ... is rarely seen now. ... We were able to contain them with new releases having broader and stronger resistance. Crop losses due to stem borer are minimal today. We were able to reduce tungro virus disease by developing resistance to the green leafhopper, its vector. We are now looking for resistance to the virus so that it can be completely eliminated.*[1]

The general impression was that IRRI's plant breeding work had been so successful that the various pests and diseases afflicting rice in the Philippines had been conquered by IRRI-bred varieties. However, less than two years later, a paper by IRRI entomologists and pathologists was presented to its Board of Trustees. Away from the public eye, IRRI scientists had a different story to tell:

> *Pests have continued to cause significant crop losses in all the rice ecosystems that IRRI is concerned with, in recent cropping seasons. ... There is a perception in several countries that pest problems are increasing in intensity because of cultivation practices that encourage more crops per year, more yield per unit area, more inputs and increasing genetic homogeneity. This is particularly the case with inefficient nitrogen fertilization leading to increased severity of sheath blight, and injudicious use of insecticides leading to BPH outbreaks from destruction of natural enemies.*
>
> *There have been several recent insect outbreaks causing significant losses in the infested areas. These require further attention by IRRI, working with the national program(s) concerned.*[2]

The paper then describes problems with the white stem borer and tungro in the Philippines, which were claimed to have been contained by IRRI varieties in the 1988 paper. Furthermore, it expressed concern over the widespread devastation (128,300 hectares) being caused by the brown planthopper in Thailand and Viet Nam where "*either susceptible varieties and those that have*

➢ *Box 13*

'lost' resistance are being grown." The IRRI scientists hypothesized the reasons for resistance breakdown and proposed greater emphasis on integrative and other new modes of research:

> *The insect outbreaks and disease epidemics listed above have resulted from single or multiple causes, ranging from the development of new pest 'strains' that can overcome prevailing host plant resistance, to changes in cultural practices, to pesticide misuse. While IRRI has successfully used host plant resistance (HPR) as a first line of defense against diseases (and to a lesser extent against insects), it must now put more effort on the stability of HPR. ... Integrative research is being done in several pest management projects, but research on evolution/co-evolution of pest populations is still lacking at IRRI and is an area which we need to develop some expertise in.*[3]

Meanwhile, tungro and BPH continue to be significant problems in the Philippines and Indonesia. And recently, the head of IRRI's biotech effort justified Bt research by arguing that the stem borer is the most serious rice pest today.[4]

The facts speak for themselves. IRRI likes to see itself as a "scientific NGO." As such, IRRI has no business in purveying what can generously be considered half-truths about the results of its work. IRRI should be truthful about its problems with "durable" resistance, which is currently a major headache. IRRI's lack of transparency and conscious misleading of the Senate and the public pose serious threats to its credibility. Continuing its doublespeak will mean digging its own grave, since public outcry will escalate to the point of causing IRRI to shut down.

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1 This document was entitled International Rice Research Institute, Rice Breeding Program.
2 The paper, presented in August 1990, was entitled The State of the Rice World - Pests.
3 Ibid.
4 John Bennett, head of IRRI's biotech research, made this statement at the 1995 Federation of Crop Science Societies of the Philippines conference.

supposedly for the benefit of South and Southeast Asia? If Thailand fails to respect the MOU, to whom should Bangladesh — as one potential beneficiary of the arrangement — complain?

2. The Public Sector in the North

The second external group with a strong vested interest in IRRI are the universities and public research organizations of industrialized countries. A number of these — such as Japan, USA, France, UK, Italy and Australia — carry out rice research and/or biotechnology applicable to rice. It is natural, then, that IRRI should seek cooperation with such institutes, particularly to gain cost-effective access to technologies that IRRI cannot develop in-house.

Of all public research outfits in the North, IRRI's relationship is strongest with Cornell University. US professors had been teaching agricultural sciences at the University of the Philippines at Los Baños (UPLB) 50 years before IRRI set up house on its campus. After World War II, the US government put vigorous efforts into revitalizing agricultural teaching in the Philippines, using the land-grant system and Cornell University as its model. Long and active relations between Cornell and UPLB were significant in the establishment of IRRI at Los Baños. The strong and long-standing relationship between the Rockefeller Foundation and Cornell University no doubt also played its part in this.

IRRI's relationship with Cornell is currently focused on rice biotechnology. The Rockefeller Foundation launched its Rice Biotechnology Program in 1985, with Cornell and IRRI playing central roles. Within this program, IRRI and Cornell have launched a "shuttle research" mechanism whereby molecular biologists scuttle back and forth between Ithaca and Los Baños. The IRRI-Cornell partnership is probably the most long-lasting and developed among all university links that IRRI maintains in the industrialized countries.

3. *The Private Sector*

Far less is known and documented about IRRI's relations with private industry, North or South. Private sector activity in rice breeding and seed production is not as important as in other crops. This will change, however, when advances in hybrid seed technology for the tropics (which IRRI and others are working on) render seed production profitable for the private sector. IRRI is already anticipating

Box14: *The PGS Fiasco: From the Frying Pan into the Fire?*

In 1988, IRRI entered into a four-year joint research endeavor with the Belgian genetic engineering firm, Plant Genetic Systems (PGS). The project was IRRI's first foray into direct collaboration with the private sector, and aimed to develop transgenic Bt rice resistant to yellow stem borer. The project, which ended on silent terms in 1992, was a fiasco for several reasons. In private, IRRI scientists say they got nothing out of it — except "bad publicity" — while a lot was lost. The nuts and bolts of the joint agreement with this company included two very disturbing clauses:

First, IRRI agreed to provide PGS with 4,000 strains of indigenous Filipino Bt[1], a soil bacterium which produces an endotoxin lethal to certain insects. Asia, including the Philippines, is a center of diversity for Bt. Samples were collected and handed over to PGS with no further ado, which would have been completely inconceivable halfway through the project when the global Convention on Biological Diversity was signed in 1992. The Convention, ratified by the Philippine Government in 1993, holds that exportation of national biological resources such as Bt should be governed by rules of prior informed consent by the Philippine authorities and the sharing of mutual benefits between the two parties. But in this case, there were three parties with IRRI — a quasi-international organization — acting as arbitrator. At the time, IRRI was still legally chartered as a national corporation under Philippine law. Technically speaking, IRRI did nothing wrong, but it must have been aware of the substance of the Convention which was under negotiation at the time. This example clearly illustrates the need for the Convention, for the agreement drawn up by IRRI allowed PGS to gain 4,000 Filipino Bt strains and the chance to patent them, absolutely free of charge.

Second, and perhaps more disturbing, IRRI agreed to enter the research collaboration with PGS on condition that IRRI would withhold information developed through the project from "*certain industrialised countries,*" presumably PGS' main competitors. IRRI defensively jumped the gun and boasted to the public that this agreement was in "*the interests of low income rice farmers in the tropics.*"[2] Hard to prove, but unlikely. The most important issue is that getting in bed with the private sector often means imposing secrecy on research results. And this is not the mandate of public or quasi-public research agencies like IRRI. On the contrary, IRRI's existence is meant to foster the development and dissemination of information pertaining to rice in order to benefit humanity. This was a clear breach of contract between IRRI and its donors. By accepting to withhold certain information because of PGS' corporate interests, IRRI sacrificed its own. The CGIAR's fourth external review of IRRI in 1992 frowned upon the deal and its implications for IARC research.

The PGS project ended in 1992 and neither party has talked to each other since. Why? Because IRRI is tongue-tied about the bad deal the Institute

➣

➢ *Box 14*

(or was it the "low income rice farmers" IRRI was representing in signing the agreement?) got. The contract was naught more than money to "*collect the materials and sell the rights*," as one disgruntled IRRI scientist put it. As for PGS, business is business. When the project ended, they packed their bags and trotted down the road to start a new Bt research partner at Biotech, the Philippines' national biotechnology research outfit.

Nevertheless, IRRI still has high hopes for controlling stem borer through Bt transgenic rice. In 1995, it started a new joint research project, this time with agrochemical giant Ciba-Geigy. The terms state that IRRI is free to use Ciba's proprietary Bt endotoxin gene, which has been modified and synthesized to express a certain level of toxicity efficiently in plants. A free super-gene, even if its patent is protected in the North! IRRI can sing from the bell tower again about how it brings the benefits of biotechnology to the South, especially to the poor... There's one hitch, though. (Business *is* business after all, unless IRRI wants to continue learning that the hard way.) If IRRI "improves" the gene, Ciba has the right to prohibit the commercialization of any transgenic rice IRRI develops with it. IRRI will almost inevitably "improve" Ciba's Bt gene, since it has to be adapted to tropical rice. Although IRRI does not commercialize rice, it will pass on germplasm containing the improved Ciba gene to national breeders, and that's where the trouble will start. This is why IRRI started talking about the need to protect intellectual property rights over its own biotech work and where it could start getting into trouble with giants like Ciba-Geigy.

1 IRRI (1993), IRRI 1991-1992: Sharing Responsibilities, IRRI, Los Baños,p 15.

2 Ibid.

1 SEARICE (1992), *Southeast Asian Conference on Rice, Food Security and Ecology: Consensus Resolutions*, 12-14 November, Chiang Mai, Thailand, p 14.

2 Robles, AC (1992), "IRRI's New Look," *The Manila Chronicle*, 12-18 September, p 13.

3 The growing of a second crop after the first crop has been harvest, using the same plant.

4 IRRI (199?), *Work Plan for 1990-1994*, IRRI, Los Baños, p 38. This statement refers to subprogram III, entitled "Ecosystem characterization and impact analysis":

5 Robles, AC (1992), *op cit.*

6 IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, IRRI, Los Baños, p 6.

7 IRRI (1992), *Myths and Facts about the International Rice Research Institute*, IRRI, Los Baños, p 6.

8 IRRI (1995), "IRRI and the World of Rice", *Questions and Answers about the International Rice Research Institute*, IRRI, Los Baños, September. This publication addresses questions about pesticides, transgenic rice, IRRI's track record, policies, funding, intellectual property rights and the new "super rice."

9 IRRI (1993), *IRRI 1960-1992: Impact of IRRI on Rice Science and Production*, IRRI, Los Baños, p 39.

10 In 1994, these were renamed "Flood-Prone" ecosystems.

11 IRRI (1992), *IRRI 1988-1992: Initiating and Responding to Change*, IRRI, Los Baños, draft dated 7 April, p 15.

12 To the tune of 1% of IRRI's annual budget in the years 1963-1975.
See IRRI's Annual Reports.

CHAPTER FOUR

THE PROCESS: PARADIGMS AND PEOPLE

4.1 METHODOLOGY

The trouble at IRRI is that everything here is a model method. If IRRI sprays pesticide they spray like crazy with firehoses. If IRRI does weeding, they remove everything. One result is that you get lots of different bugs in lots of stages and conditions. Nothing here is representative of farmers' fields.

A visiting scientist at IRRI, April 1978[1]

The various shortcomings of IRRI's research agenda are manifestations of a much deeper problem. IRRI's research is guided by a particular scientific paradigm or way of viewing reality. IRRI adheres to a significant number of assumptions which are taken as given and left unexamined. It is guided by a reductionist mindset, which means that it attempts to explain complex realities using simple theories and models. IRRI reduces the complex world of biology and ecology to an almost total reliance on molecular biology and genetics. Because the potential impacts of these unconsidered factors cannot be integrated, let alone understood, IRRI is unable to come up with durable solutions to address its problems.

There is voluminous literature describing how different paradigms impede or enhance scientific progress. The following discussion describes how reductionist paradigms shape IRRI's work, and discuss how a move to more holistic paradigms could redress the imbalance created.

4.1.1 CURRENT SCIENTIFIC PARADIGMS

1. Methodological Reductionism

Most conventional scientific approaches today rely on a method called reductionism which reduces complex causative factors in the real world to one or a few factors which are then considered to be "the" cause or "the dominant" cause. For example, when a crop is attacked by insects, scientists immediately look for the offending insect, without considering farming methods or other factors that could predispose the crop to insect attack.

Complex reality is fragmented and broken apart conceptually. A fragment of that reality is then hoisted up to explain the reality. This type of reductionism is called *methodological* or *overt* reductionism. Depending on which facet is exaggerated and upheld as *the* cause of a specific reality, overt reductionism can be further classified into socio-structural, technological, economic, psychological, cognitive or other forms of reductionism.

In agricultural research, overt reductionism is employed to explain complex phenotypic traits on the basis of the genome. In order to confer pest resistance, the genes that govern resistance are sought out. Biotechnology owes its existence to overt reductionism.

2. *Metaphysical or Materialistic Reductionism*

Overt reductionism is merely an expression of a far more virulent and destructive form of reductionism which assumes that all natural, psychological and social realities can be fully explained by material and physical causes and processes. This stance is called *covert, metaphysical* or *materialistic* reductionism or, simply, *materialism.*

It is one thing to explain complex systems through an elaboration of their parts (overt reductionism); it is quite another to then say that the sum of its parts is the reality (covert reductionism).

To believe the popular superstition that life is simply a bunch of DNA molecules and their interactions is to fall into the trap of metaphysical reductionism. This conceptually reduces a web of living relationships to the DNA molecule, which it then takes not as constituent of life, but as life itself. Thus, the complexity of nature and human beings, including the societies they create, become nothing but artifacts or "epiphenomena" of DNA molecules and their dynamic properties. This gripping paradigm or worldview is fully articulated by Harvard sociobiologist E.O. Wilson.

3. *Horizontal Integration or Holism*

The "easiest" alternative to reductionist science is to integrate the fallen fragments, a process called *horizontal integration* or *holism.* But even this first step is difficult and requires considerable courage and energy from scientists.

In biotechnology, attempts at horizontal integration involve explaining gene behavior within the context of wider realities. Instead of taking DNA as the dominant explanatory principle, scientists analyze the workings of DNA in conjunction with other cellular, organismic and ecosystemic phenomena. In plant resistance studies, instead of relying solely on genes to confer resistance to pests, scientists also examine how cultural practices, environmental conditions, soil fertility and other factors all contribute to the final pest resistance "capacity" in plants.

In horizonal integration, the gene, cell and ecosystem are all understood using methodological or even metaphysical reductionism, and are then regrouped to form a whole. Often what emerges is an "artificial whole" rather than an "authentic whole." Essential factors can be left out even if there is an honest attempt to integrate, leading to only partial integration.

Horizontal integration cannot create a complete picture because it assumes that all reality is physical or material, and it does not incorporate non-physical causative parameters into its framework. Many types of ecological research fall into this category. If undertaken properly, horizontal integration ultimately leads to vertical integration. As the interrelationships between the different spatial and temporal levels of phenomena are unravelled, the realization dawns that the established relationships are merely conceptual rather than real.

4. *Vertical Integration or Holism*

Vertical holism must be appreciated in the context of the recent demise of philosophical materialism. Logical positivism became the 20th century's version of 19th century materialism. At a little publicized conference in 1969, philosophers of science formally abandoned logical positivism as a workable approach to science.[2] With its demise, many research programs, including the agricultural and biological sciences, lost their scientific and philosophical foundations.

Increasingly, metaphysical reductionism or materialism has been difficult to uphold. Materialists only accept things that can be counted, measured and weighed. However, their "truths" are as much based on assumptions as any other theories and explanations.[3] Materialistic science is based on the acceptance of many "occult" or hidden, non-visible entities. No one really knows what electricity is, although we use it everyday. The same is true with other entities of modern physics — no one has really seen an atom, a quark, a neutrino or a quantum level. Nevertheless, industrialized civilization is based on these "occult" entities of materialistic science. Some scientists are also questioning whether the "facts" of materialistic science are real or merely artifacts created and reified by the tools of modern science.[4]

In addition, and contrary to traditional scientific belief, the brain does not "objectively" mirror what we see. Cognitive scientists have discovered that unstated assumptions and preferences, including cultural upbringing and scientific training, unconsciously censor what we ultimately see. We perceive many of these subjective biases as objective fact.[5] Materialists forget that they use their thinking faculties to build their science. By their own definition, this is impossible since thought is non-physical and, therefore, subjective and unreal.

New scientific developments clearly indicate the existence of non-material reality and show that non-material forces can influence and govern the structure and dynamics of matter itself. These findings provide the "vertical" dimension necessary for a more comprehensive integration of science that had been fragmented and reduced by the prevailing dogmatic, materialist framework.

4.1.2. IRRI'S RESEARCH PARADIGM

IRRI tries to balance its reductionist methodology with multidisciplinary research and matrix management. It encourages pluralism, scientific freedom and a diversity of opinion. In recent years, IRRI scientists have been more open about their scientific differences, as exemplified by the Bt and 15-ton rice debates.

Its shift towards a more pluralistic, holistic approach has been prompted by the environmental and social consequences of its earlier research and development activities. For instance, serious doubts about the stability of host plant resistance and the efficacy of Bt-rice in controlling rice stem borer, have led IRRI to undertake parallel research on natural and cultural control as well as ecological habitat modification approaches.[6]

IRRI's attempt at balancing reductionism is an example of partial horizontal integration. The intention is laudable, but IRRI hasn't licked the problem of reductionism. It proceeds with a methodological and metaphysical reductionist research program, hoping that an "authentic whole," will somehow emerge from the process. The problem is clearly illustrated in its work on germplasm improvement and resistance.

Germplasm improvement, as the term implies, involves improving only the germplasm, rather than the total system. It reduces, in a direction determined by the breeding agenda, the relevance of the larger ecosystem within which the germplasm finds itself — the cells, the physiology of the rice plant, the whole plant, other rice plants and plant species, the community of arthropod and other faunal species, the climate, soil fertility, and all their interactions through time. IRRI says of its research agenda:

> *The focus will be on incorporating genes or genetic systems for durable resistance to major diseases and insects and tolerance for low temperature and soil stresses into the best available plant types*

(high yield potential, range of growth duration, improved grain quality). We will improve techniques... to study the genetic and physiological mechanism of resistance to and tolerance for biotic and abiotic stresses.

The emphasis is in looking for genes which govern "resistance" and "tolerance," rather than exploring the interactions of a wide range of causative factors. IRRI adopts this approach because it is not aware of alternative scientific possibilities. Like many scientists around the world, IRRI researchers cling to "*the central dogma of biology*" in the form of the modern synthetic theory of evolution or Neo-Darwinism. The theoretical constructs that govern IRRI's research are increasingly being questioned by biologists themselves, a development which has tremendous implications for IRRI's gene-focused research.

4.1.3 CHALLENGING THE CENTRAL DOGMA

The central ideology of modern biology is that, all the complex anatomical, physiological and behavioral traits of an organism are but "expressions" of its genes. There is one-way causation from the DNA of a gene to transcription by messenger RNA and the manufacture in the ribosome of the corresponding protein. This protein, in conjunction with other proteins manufactured by other genes, largely determines the phenotypic traits (physical apprearance) of the organism. Although widely accepted, this central dogma of modern biology has a questionable empirical base.

Researchers in breeding for plant resistance, for example, rely heavily on the central dogma to guide their work. They ignore empirical evidence showing that gene-based pest resistance is also affected by other factors such as temperature, light, moisture, pesticides and chemical nitrogen fertilizers.[7]

In addition, there is increasing evidence that pest resistance in plants is not gene-driven, but an emergent property controlled by cytoplasmic, physiological, cultural and environmental factors.[8] If these new developments in science are not factored into IRRI's research process, its search for durable resistance may be unattainable. Such a development would continue the addiction of farmers to pesticides despite IRRI's best intentions.

It is useful to juxtapose these new scientific developments with the way IRRI envisions its research. IRRI's biotech program is a good example:

> *Mapping the rice chromosomes is an important first step ... This map tells us where specific genes are and provides markers for rapidly identifying them. Eventually — when researchers perfect gene cloning and splicing techniques — we may be able to develop an improved rice plant by introducing a 'superior' gene directly into the DNA, without having to do a conventional cross.*[9]

The belief here, consistent with the central dogma of biology, is that genes are discrete carriers of traits which can be transferred from one species to another and expressed in the recipient species. Even careful IRRI molecular biologists who know that this is not accurate, easily fall into this way of thinking even as they are aware that, at best, there is a correlational, not a casual, relationship:

> *Scientists have found that, in most cases, it is several genes working together, rather than individual genes that provide long-lasting disease resistance... We use molecular markers in two ways. Initially, to determine which genes are* **associated** *with durable resistance. Then, when we cross for resistance, to determine how many of these genes have been inherited by the progeny. This allows us to select plants with the desired genes for resistance* (Emphasis added).

In this statement, correlational thinking slips into causal thinking. There is no mention of other causal factors such as nutritional, cytoplasmic, environmental and cultural practices that create resistance.

The shaky scientific foundations of IRRI's understanding of the "resistance" phenomenon and the parameters of sustainability means that these goals are likely to remain elusive. At best, millions of dollars in scarce research resources will be wasted. At worst, farmers and policymakers will be lulled into a false sense of security. This could be especially devastating if farmers and policymakers are depending on the promised grain yields and "sustainability" of 15-ton rice. If farmers are not able to sustain the 15-ton production levels, IRRI will have ironically contributed to food problems as a result of the collapse of rice ecosystems. In addition, the hype surrounding 15-ton rice yields could deflect attention from the structural issues related to population, environmental degradation and poverty.

IRRI's new horizontal integrative paradigm poses a serious challenge to IRRI's scientists. But there is an even greater challenge: that of vertical integration. Research in embryology and developmental biology points to the existence of a supersensible differentiated space that governs the unfolding of biological form in physical space. If IRRI does not factor this new biological reality into its research procedure, it may never be able to attain many of its strategic research goals.

4.1.4. *IMPLICATIONS FOR IRRI*

IRRI has yet to address the research implications of new biological developments in its "strategic" research agenda. To its credit, the Institute has started work on understanding the ecological and biological limits to sustained high yields. However, it has not explored other important ecological relationships which bear on sustainability.

An area of investigation which may prove useful in understanding the ecological limits of intensifying rice production is organic farming and other alternative agriculture systems. But IRRI is biased against organic farming which it views as low yielding, a throwback to the past, and unsustainable. This irrational behavior has no place in a scientific research institution. True science does not arbitrarily reject phenomena without serious examination, especially when those phenomena strongly indicate that they may have some of the answers that IRRI is looking for.

The need for long-term work examining chemical-free rice farming is urgent, especially since the soil and ecology at IRRI's own research farm is deteriorating. Stress elicits physiological reactions in humans and animals, and rice plants are unlikely to react differently. The "sickness" of IRRI's own farmland may make it an inappropriate environment for IRRI to be trying to understand how a healthy, high-yielding system operates.

IRRI scientists often blame a lack of funding for preventing them from exploring sustainability issues. Interviews with IRRI scientists, however, show that inadequate funding is only part of the dilemma. The more serious problem is the mindset and the paradigms that guide IRRI research. Most of its senior scientists are not poised to even consider the new, radical, yet empirically-grounded developments in science and biology, let alone assess the potential implications of these developments on their scientific assumptions and methodology. There is a bias for simpler analyses, to focus on one or two hypotheses assumed to have the most explanatory power. This is a gross scientific error because such judgements cannot be made until all possible factors have been assessed. Assuming certain factors are overriding will be a self-fulfilling prophecy since other (perhaps even more important) factors will not be examined. It would make more scientific sense to explore different classes of potential hypotheses when you are not really certain which of the factors are operative and dominant.

Lack of funding is a very poor excuse for the deficiencies in IRRI's research agenda. It is more a question of priorities. For example, sustainability research lags behind productivity research. Breeding is heavily funded. One IRRI scientist estimates that 70% of resources for tungro research is still connected with a breeding approach.[10] Very few funds support research on the cultural and environmental conditions which produces the tungro problem.

IRRI has not been helpful in providing the necessary information to further assess whether the stated "balance" between sustainability/equity and productivity goals are being attained or not. It is not clear among IRRI scientists whether this research balance has been given quantitative objectives. For example, does "balance" mean a 50-50 or 70-30 split between productivity and sustainability research? IRRI has reduced the budget for "cross-ecosystems" research, the flagship for IRRI's move towards more holistic, less reductionist research. With this budget cut, the whole search for environmental sustainability, which obligates a multidisciplinary/integrative research protocol, is also endangered.

Reductionism and Environmental Impact

Agricultural scientists believe insects to be the cause of damage in crops, as insects are seen eating plant parts. Such a reductionist perspective emboldens their technological associates to develop insecticides and, if money can be made from these technical inventions, business easily magnifies a "technological fix" into a worldwide reality, especially in this era of global markets.

Scientific reductionism, technological fixes and their large-scale projection by business interests are among the major culprits in the on-going destruction of the environment in Southeast Asia.

In many Southeast Asian countries, calls to "modernize" agriculture and produce more food on less land for an ever increasing population are critical to progress towards NIC-hood.[11] For its hi-tech proponents, modernizing agriculture inevitably means adopting the chemical fix developed via the reductionist perspective.

Many scientists do not study, for example, the impact of chemical fertilizers on the emergence of insect pests. Nor do they inquire as to how monoculture induces insect pests to proliferate. There is no interest to explore how irrigation, spacing and plant architecture may encourage the multiplication of insect pests. Most scientists prefer to slice up reality and "reduce" their inquiry to find ways of killing the pests. No one asks how pests arise in the first place and how pesticides impact other lifeforms. Because of this, scientific reductionism and the technological-fix orientation guarantees side effects.

Pesticides currently poison 25 million people annually, mostly poor farmers in developing countries. In the Philippines, scientists have strong evidence that pesticides killed 4,000 farmers in Central Luzon alone during the mid-years of the Green Revolution. Untold thousands of farmers are suffering from chronic illnesses as a result of using "safe" doses of insecticides. Consumers face future deleterious impacts on their health from the daily accumulation of chemicals from their food. Tens of thousands of indigenous food plants and animals, such as indigenous fish species, edible frogs and snails and nutritious weeds have been destroyed.

Insecticides are the "chainsaw" in the ecology of a farm. They "clear-cut" the important and functional biodiversity of the farm by killing beneficial insects and organisms that keep the population of harmful insects in check. When this ecological balance is upset, insecticides make monsters out of minor, relatively unimportant insects. The brown plant hopper in rice is a prominent example of a devastating insect pest created by the proper use of reductionist science as embodied in the insecticide techno-fix.

The environmental havoc caused by chemical inputs are not the "unintended side-effects" that Green Revolution apologists claim. They are the direct products of the successful implementation of reductionist science and a technology fixated on one facet of reality that has been blown out of proportion. Scientists, policymakers, businessmen, farmers and other users or victims of science and technology should be aware of this "inner logic" of conventional science and technology before blindly asking for more.

4.2 PARTNERS, CLIENTS, BENEFICIARIES AND "END-USERS"

IRRI uses yield and production increases as its measure of success over the past 35 years. According to these criteria, it has achieved stunning success.

But the social costs of these achievements have been profound and are deeply rooted in the Rockefeller culture that still guides the institution.

4.2.1 THE SOCIAL COSTS OF IRRI'S AGENDA

IRRI's concern for "*income distribution among people within and across generations*" is based on the Rockefeller policy which seeks to integrate the peasant economy into the global economy. This one-dimensional social focus, however, does not examine whether this is desirable in itself and, if so, at what rate should transformation occur and under what conditions. IRRI's agenda has reinforced the urban bias that works against small farmers in the countryside. It has led to the massive migration of rural populations to cities only to become the new urban poor.

IRRI's answer to this is to reduce the price of rice for poor urban consumers so that, at least, a certain aspect of their destitution is addressed. However, by not asking questions about the implicit social engineering embedded in its grain yield-focused technologies, IRRI has been partly responsible for the creation of urban slums. This is because its attempt to address the issue of equity has focused on only one indicator: income. The larger social question of what its technology has done, in terms of rural pauperization, and the consequent migration of the rural poor to cities, remains unanswered.

Another significant impact of IRRI's work has been the disempowerment of farmers. Its concern for the "poor people"[12] is limited to benevolent paternalism. Its research process and products instill dependency rather than empowerment. Technology is not neutral; it embodies a worldview and set of values. The worldview of reductionist science animates Green Revolution technologies.

Among other values that Green Revolution technology promotes is *de facto* centralism and disempowerment and dismantling of rural communities. The technology was conceived based on the assumption that peasants and indigenous farmers are illiterate, and must learn from the dazzling products of scientists based in some central experiment station. In this manner, knowledge became centralized, homogenized and a form of domination over farmers.

The technology of the Green Revolution depends largely on external inputs.

How does this affect farmers? First, they begin to feel that they are illiterate and have nothing of value to contribute to agriculture. When farmers stop believing in themselves and in their own capacities, it is the beginning of cultural collapse. They unconsciously begin to boycott indigenous modes of knowledge and technology; they listen to the radio, to what the pesticide advertisers and their suppliant scientist supporters have to say.

In due time, key decisions about pest management are no longer made by the farmers themselves. The decisions become externally driven. This disempowerment stunts human development and dismantles the cooperative culture of agrarian societies.

IRRI's "yield-frontier" mentality is driven by the primitive thinking which gave birth to the Institute. IRRI was created to address the problem of feeding the world's growing population and, indirectly, to contain the spread of communism in the countryside. IRRI assumes that population growth will always increase contrary to the fact that some countries now have negative growth rates.

IRRI's Malthusian hype has come into full flower. Its simplistic analysis of the population problem could prove harmful to millions in Asia, as the Institute's imbalanced pursuit of high grain yields could lull national governments into complacency, causing them to reduce or abandon efforts to confront political and structural problems which fuel population growth. IRRI's approach also overlooks distribution issues related to hunger.

Ultimately, due to the fragility and unsustainability of intensive, high-yield rice farming, as well as the disparity of incomes between the rich and the poor, much larger population collapses may occur with intervention for 15-ton yield targets.

While only too eager to take the credit for the benefits of the Green Revolution, IRRI takes no responsibility for the social problems that have followed in its wake. Instead, it places the blame squarely at the feet of national governments. IRRI hides behind the cloak of neutrality even as it advocates *de facto* policy positions through its research thrusts. For example, the Institute's continued work on rice monoculture is equivalent to advocating an economic policy of labor division and specialization, a rural culture inextricably driven by urban dynamics, and the forced mass entry of farmers into the market economy.

Another example is IRRI's advocacy of the technological fix as the solution to complex social issues surrounding the population problem. Likewise, its continued focus on commercial sources of nitrogen has created a *de facto* policy that farmers must rely on external sources of this key nutrient — this undermines the farmers' goal of self-reliance.

At the end of the day, it is still basically IRRI of the 1960s: it is still pretty much grain yield oriented with a few qualifying remarks regarding environmental impact, some appropriate language outlining its concern for social impact (without questioning the inequitable structures in society which result in the population problem it is creating and trying to address at the same time). It is still product-oriented, instead of empowerment — oriented, and it still relies on external "expert" knowledge and seeds instead of harnessing and enhancing farmer wisdom.

But there may be a window of opportunity for change. According to former Director General Klaus Lampe, "a

Box 15: *Benefits of IRRI Germplasm to the North*

Industrialised countries have benefitted substantially from IRRI's germplasm improvement" work.

According to the International Food Policy Research Institute, IRRI's sister CGIAR center based in Washington DC:

- Around 73 percent of the total US rice acreage in 1993 was sown to varieties with IRRI ancestry. Many of these new varietites have developed IRRI germplasm has gradually found its way into locally bred varieties. IRRI rice varieties have been used primarily as parent stock inthe development of medium and long-grain, semi-dwarf rice varieties in California andthe Mississippi Delta states.
- From 1970 to 1993, the U.S. economy realized at least some $30 million and up to $1.0 billion through the use of improved rice varieties developed by IRRI. Total U.S. government support of IRRI has cost about $63 million, an investment equal to about 9 cents per $100 U.S. rice production. The benefit-cost ratio for U.S. government contributions to IRRI is as high as 17 to 1. (a)

Data put together by the Rural Advancement Foundation International (RAFI) indicate that:

- Farmers in the industrialised world reap an economic benefit of US$655 million each year from the use of "IRRI rice genes." (b)

Given that IRRI has cost its donors, mainly from the North, a total of US$615 million since its inception in 1960, this is not a bad return on the investment.

Sources:
(a) Philip G. Pardley, Julian M. Alston, Jason E. Christian and Shenggen Fan, *Hidden Harvest: U.S. Benefits from International Research Aid*, IFPRI, Washington DC, September 1996
(b) Cited in "CGIAR: Agricultural Research for Whom?," *The Ecologist*, March 1997

research center has to be a change agent," and "*IRRI has an obligation to speak up and raise its voice if more effort in rice is needed.*" He was referring to the need to raise awareness of the social and ecological issues linked to rice agriculture. He listed three "degradations" which need to be addressed: social (including population growth, resource misuse and urbanization); economic (unemployment, poverty, rural neglect and the Third World debt) and ecological.[13]

IRRI has started speaking in public about the need for concern regarding pesticide use, but has been almost silent about other social concerns connected with rice. IRRI must now make a much stronger effort to address these, if it is to live out its dream of sustainable and equitable rice economies.

4.2.2 THE STRUCTURAL ROOTS OF DISCONTENT

The question of IRRI's relevance for small farmers and sustainable farming systems in Southeast Asia forces us to look at how IRRI operates as an institution (essentially who participates in it) and what its aims and objectives are. IRRI was set up as a model institute for international agricultural research and a number of other CGIAR centers have comparable structures and mandates. However, these should not be seen as immutable and should be challenged as to their appropriateness for meeting the needs, not just of donors and scientists, but of the intended beneficiaries of international research.

4.2.2.1 IRRI'S ORGANIZATIONAL STRUCTURE

In spite of much needed changes on the surface (internal organization) and evolving relationships with national programs in Southeast Asia, IRRI's structure is essentially that of the institution that was set up by the Ford and Rockefeller Foundations 35 years ago. By design, IRRI is a highly centralized research institute governed by scientists and administrators whose dominant concern is advancing rice research — to a large extent for the sake of rice research. The newly refocused IRRI is a scientific research organization, not a development organization. This is valuable but also problematic.

We have identified five problems and one opening for positive change within IRRI's institutional structure that bear an impact on pro-farmer concerns and the capacity of IRRI to effectively service sustainable agricultural development in Southeast Asia.

1. Northern Mindset

IRRI is dedicated to supporting *rice* agriculture and food security in *Asia*. It is, therefore, something of an oddity, if not an insult, to many local people that the Institute is run by such a large number of Northerners who come from non-rice eating, non-Asian countries. For 30 (out of the 35) years, Northern men have run the Institute. Further, they have been very close to the old boys' club called the CGIAR, a rather tightknit circle of donor agencies' representatives for whom the Green Revolution has been a career in disguise.

Decade after decade, there is a drone uniformity in IRRI's dominant mindset about what agriculture and development are all about. As one group of observers put it very articulately, the atmosphere at IRRI is "*more American than anything else, a cross between the research division of a transnational corporation, a military base and a diplomatic enclave.*"[14] This neither humble nor fortuitous cross permeates the work, direction and kind of thinking which is sanctioned at IRRI.

2. Elitist Priority-Setting

IRRI has a relatively elitist mode of operation in that its agenda is set by scientists, not farmers. Scientists can obviously best judge research needs for the advancement of their disciplines, objectives and problem-solving. But the problems they are ultimately attending to should be farmers' real-life problems, not purely intellectual challenges, career opportunities or governmental power politics. Having scientists at the helm without input from those who are expected to benefit from IRRI's work can lead to irrelevant research and projects motivated by vested-interests.

3. *Centralized Non-Participatory Research*

It is now being more widely recognized that a prerequisite for developing sustainable agricultural systems is decentralized, participatory research. IRRI is trying to respond to this reality without abandoning what it knows how to do best. Research consortia and networks opportunities to carry out applied research, in principle closer to farmers. But IRRI's mandate remains geared toward lab-based germplasm enhancement of the rice plant for these environments, not farming systems improvement.

Strategic research is certainly necessary to provide improvements for marginal rice-based farming systems and diagnostic surveys will be important in trying to ask the right questions. But the remoteness of IRRI from local realities and the exclusion of farmers from a research process entirely geared on one plant does not predispose IRRI to making the contributions that could be meaningful. Neither in its narrowly construed rice improvement research nor in its rice biodiversity management is IRRI intent on directly strengthening farmer participation. Instead, collaboration with NGOs is being sought out.

Whether, or not this will really add to the effectiveness and relevance of IRRI's work remains to be seen.

4. *Inadequate Evaluation System*

As part of the CGIAR System, IRRI is subjected to external and internal reviews. The so-called "external" reviews, which take place every five years, are really peer evaluations from CGIAR colleagues, academics and management consultants. IRRI (nor the CGIAR) has never commissioned a truly external review from farmers or the development NGO community. In 1992, the fourth IRRI external review panel did, however, make the effort to meet with representatives of farmers' organizations and the Sustainable Agriculture Coalition (SAC) of the Philippines. And individuals from the farming and NGO communities have been invited to express their opinions on IRRI's Medium Term Plan for 1994-98. Most of these individuals declined for various reasons, including a justified fear of tokenism.

5. *IRRI's Isolation and Remoteness*

Engaging a science-driven, Northern-funded and Northern-governed operation to service the day-to-day problems of poor rice farmers and consumers in Southeast Asia is a daunting challenge. Years of self-imposed isolation means that IRRI is an outsider and distant enemy to numerous small farmer groups working on sustainable agriculture. In the Philippines, rice growing is divided among the IRRI and non-IRRI farmers. IRRI farmers are those who are still dependent on HYVs, inorganic fertilizers and pesticides — and heavily burdened by debt. Non-IRRI farmers are those who are trying to throw off those shackles and re-adopt and improve on sustainable agricultural practices.

In other Southeast Asian countries, for example Thailand, Cambodia and Laos, IRRI is seen by numerous NGOs and POs as a threat. Not surprisingly, scientists that do approach local farmers report communication problems, owing to the divide that has sprung up over the years.

Positive Opening for Change?

In the last few years, IRRI has demonstrated a willingness to open up its rigid structural walls and listen to the views and perspectives of non-peers. On several occasions, management and staff have sat down to dialogue with members of the NGO and farmer communities at the national (Philippines), regional (Southeast Asia) and international levels. These discussions[15] have been very difficult, and sometimes excruciating, as two worlds which are in many ways opposed have tried to face each other closely and interact to achieve some new mutual understanding. But they have demonstrated a shift in IRRI's attitude and could be learned from or built upon.

IRRI now sees NGOs as necessary links to the farming community, where farming systems research and local genetic resources management is being carried out beyond IRRI's reach. IRRI's former Director General was resolute about this: "*We need NGOs to help make IRRI research relevant.*"[16] So far, research collaboration with NGOs has been limited to a few isolated cases in the Philippines and the IRRI-Cambodia Project (where, frankly, there is really not much choice) and is under development for Nepal. But it is only logical that if IRRI really wants to strive for relevance, then some kind of practical interaction and policy dialogue with NGOs involved in farmer empowerment and sustainable agriculture and biodiversity management at the grassroots level is imperative.

4.2.2.2 IRRI'S MANDATE

Having seen how IRRI operates, the question of whether IRRI's mandate is adequate to face the needs of small-scale farmers and sustainable development in Southeast Asia has to be grappled with. IRRI's mandate is outlined in *Annex 3*. Three issues dominate: the rice *plant*, *yield*, and a *center-periphery* relationship with the world around IRRI. Even from the perspective of rice-based farming systems alone, the mandate is largely imbalanced as it stresses production and quantity above all other aspects of rice economies.

But this is not to look at IRRI from the perspective of rice economies alone, but rather that of agriculture, food security and farmers' rights in Southeast Asia. The isolation of the rice plant is a major failing of IRRI's approach. Rice is obviously one important staple throughout Southeast Asia, but many other crops, livestock and aquatic animals are extremely important for the social, ecological and economic viability of local communities. In this light, the move to reduce IRRI's funding relative to that of other CG centers operating in Southeast Asia such as ICLARM and IPGRI might seem justified. The problem is that it is still a remote international research institute rather than hands-on, problem-solving and capacity-building force at the grassroots level.

To be fair, the mandate does not totally remove the rice plant from the rice economy. But IRRI has far excelled in mobilizing its resources on the plant and production systems above research devoted to distribution issues — which are critical if IRRI's goal is to help alleviate poverty and inequity. At the same time, the mandate states that IRRI should "*help increase **total food** production from rice-based farming systems*" (Emphasis added), but IRRI's forte is rice. Some attention is devoted to rice-wheat and rice-legume cropping systems, but it remains restricted.

Secondly, is the mandate's emphasis on — and IRRI's overwhelming commitment to — rice science and Western-style management of research truly relevant? Science and research are certainly important, but they are only one contribution to the political struggle for development in Southeast Asia. They are tools of power — but whose? Rice science is largely serving scientists more than it is serving farmers. It has certainly benefitted some farmers and doubled rice production through massive intensification of "resource-endowed" land. But half of the rice-growing area of Southeast Asia (the "unfavorable" ricelands) and probably a larger proportion of farmers,[17] have not been impacted by IRRI in 30 years. So, in talking about "development," science must be humble — unless it is willing to explicitly serve a political process of empowerment.

IRRI's mandate is to empower scientists so that they service national development.[18] Full stop. Here, IRRI (like the other IARCs) would say: the problem is the national programs. To some extent that is certainly true. But the problem *is* also IRRI and those who are behind it: after all, IRRI molded the bulk of rice scientists in Southeast Asia. After 25 years of dependency on IRRI, the Philippines wanted a nationalistic and farmer-oriented rice research institute. They got, as the adage goes, a "mini-IRRI."

The training, information gathering, germplasm storage and communications aspects of IRRI's mandate are very important under certain conditions. A clearinghouse on rice research resources (intellectual and biological) is precious, as long as it is appropriately managed, participatory in function and geared toward serving farmers' needs. Adequate management refers to IRRI rice germplasm and literature collection, which need to be safeguarded through continuous support and renovation, when necessary, as a collective heritage.

"Participatory" means breaking down the center-periphery structure that marked IRRI's function 35 years ago and evolving and ensuring full and free access to knowledge and germplasm. IRRI is starting to try to do this, notably by decentralizing training and drawing up a policy on intellectual property rights and material transfers agreements. Their current intellectual property rights policy, however, contradicts their mandate in this respect (*see Chapter 5*) as do certain practices of withholding rice research related information when collaborating with the private sector (*see Box 14*).

As to IRRI's pro-farmer bias, we find it lacking. Information and propaganda have been translated into an impressive range of local languages for Southeast Asian farmers, but IRRI's approach is still very top-down. IRRI's structure and mandate isolate IRRI from local communities, agricultural systems and more relevant farmer-empowering activities.

4.2.3 PARTICIPATION OF FARMERS AND NGOS

IRRI's relationship with farmers and their organizations is one of the most crucial and difficult problems it faces. Within IRRI, the whole issue of relations with farmers is fraught with contradictions. Scientists are faced with a structural research protocol that formally bars them from working with farming communities. This is problematic because research carried out under institutional conditions can simulate but never fully emulate on-farm conditions. On-farm conditions are characterized not only by specific and diverse ecological factors, but by cultural factors as well. How can IRRI contribute to sustainable rice agriculture when it is so distant from farmers' realities?

There are three different ways in which institutional scientists approach farmer-level realities: on-farm research, farming systems research, and working with farmers or participatory research. Each has its own dynamics and logic, especially with respect to empowerment and research relevance. IRRI carries out activities in the first field, has largely dropped the second and is foreign to the third.

As with most other CG centers, IRRI is in a categorical but ambivalent position with respect to the possibility of working with farmers. IRRI develops technology for farmers, but it must be delivered to national programs for refinement and dissemination at the national level within the local political and economic context. Mandated as a scientific research service and support agency, IRRI cannot carry out extension work and substitute itself for national systems. As stated clearly in its strategic plan:

> *IRRI can only generate knowledge and technology (the objective); it cannot directly generate higher incomes or feed people more adequately (the goal).*[19]

In fact, the logic of IRRI's relation to NARS has been following a straightforward and intentional course. Set up in 1960 to "get things going,"[20] as if nothing was going on

IRRI has progressively pulled out of areas that NARS could increasingly handle and deliberately made this possible through training. In recent years, IRRI has dropped most all of its adaptive research work and moved resolutely upstream to strategic research. Step by step, these are moves away from the task of translating generally — applicable findings into locally-specific results; what the NARS can or are supposed to do, IRRI does not do. And that includes working with farmers. But this neat division of labor is being totally upset by IRRI's research shift to the less favorable rice ecosystems and confrontation with the real political objectives of the NARS.

It is not only institutional distance that separated IRRI from farmers. The ambivalence arises from the attitude of individual IRRI scientists and the challenge of moving into the marginal rice-producing areas.

The Attitude of Individual Scientists

According to IRRI staff, a (shrinking) number of scientists at the Institute are genuinely in favor of working with farmers, while the administration is not. Whether this is true or not, few IRRI scientists are engaged in on-farm field work and when they are, it does not appear to be very participatory. The work of the Social Sciences Division — not the plant breeders, plant pathologists or agroecology staff — is put forward by administration as the illustration of IRRI's involvement with farmers. Much of it is diagnostic surveying and tries to stress that farmers and their indigenous knowledge are a resource for IRRI and other researchers to tap into. While some of the findings are interesting, and negate the assumptions behind results of IRRI-driven research,[21] farmers are still seen as forces that can serve and hence legitimize or validate IRRI's research model. The drive is perhaps to be "honest" about the context in which IRRI operates, but not to change structural relations.

From our discussions with IRRI staff, we have the impression that their attitude in working with farmers, while respectful and courteous, does not bear the will to alter the rigid scientist-farmer divide. Generally, they look at farmers as people who have great practical know-how that *they*, the "real" scientists, need to tap into and understand in order to help solve problems. This is an extractive and elitist mode of operation. It is not an empowering mode of bringing farmers into the research process, giving them a direct role in setting the agenda, carrying out the work and appropriating meaningful capacities by doing so. So long as farmers are treated as objects rather than subjects of research, IRRI will continue to foster the alienation of rural communities, creating conditions for the development of inappropriate technologies.

The Challenge of Moving into the Marginal Areas

IRRI's move from what it sees as the homogeneous, irrigated environment to embracing the utterly heterogeneous uplands, wetlands and difficult rainfed areas defies centralized "off site" research and broadens the agenda of challenges to rice productivity. Such research has to be more responsive to farmers' needs and diverse situations, and calls for direct interaction with local communities to be relevant. IRRI recognizes this:

> *One way to improve research relevance is to develop a more intimate understanding of the environment, production systems, and problems of prospective users and beneficiaries of research results. This implies close contact with farming communities. IRRI faces several constraints in this respect. National programmes have the responsibility and the cultural advantage for working with farming communities. IRRI is an international institute and we are moving upstream to conduct more strategic research.*[22]

This problem is compounded by three faulty assumptions:

1) ***The NARS' responsibility to work with farmers necessarily translates into such work actually being carried out.*** IRRI scientists themselves admit that, "*contrary to the [IRRI] propaganda*," NARS are not interested in working with farmers. Only in a few Southeast Asian countries with what IRRI describes as "weak" national programs — such as Burma and Cambodia — do the NARS have interest in on-farm research. And in others, farming systems research to stabilize upland rice agricultural systems can be secondary to government objectives to displace and control indigenous communities.

2) ***International organizations like IRRI cannot work with farming communities.*** Some can and do effectively. This is more a statement of intent than an assumption: IRRI does not *want* to work with farmers.

3) ***On-farm or farming systems research, rendered imperative by the ecosystems framework, is not strategic research.*** IRRI's definition of "strategic" research is very open-ended. To some, it means any pre-technology research. To others, on-farm and farming systems research is seen as strategic, while breeding is not. To yet others, developing new rice ideotypes is "germplasm enhancement," rather than "breeding," and thus strategic!

The problem is obviously much broader than particular relationships between scientists and farmers, and questions IRRI's role in addressing the challenges it has set for itself: focusing on sustainability, equity and resource-poor farmers, which are major issues in the marginal areas. Just as farmers cannot be ignored in the rice production paradigm, nor can they be ignored by rice research. This demands that the Institute reassess just how its research work can take farmers' knowledge, experience, innovative capacities and real concerns on board and how local communities can participate in setting agenda, carrying out site-specific research, evaluating results and offering recommendations.

Compared to the better-off irrigated systems, some general characteristics of the less favorable rice environments include the following:

1) they are generally cultivated by small, poorer farmers;
2) they have been less affected by the rice HYVs and chemical technologies;
3) they produce lower grain yields;
4) rice is only one element of complex farming systems.

From a farmer perspective, this means that:

1) decisions on rice (research) will affect all other components of the farming systems;
2) IRRI's bias toward cash income and environmental security is narrow and insufficient;
3) the role of extension or development agents is far more crucial; and
4) the fragility and complexity of these ecosystems either limits IRRI's role or makes it potentially dangerous.

Taken together, the move to look at small farmers' production systems in marginal or unfavorable rice areas raises the almost absolute need for decentralized research. Two questions follow then: 1) If IRRI moves upstream to strategic research, will farmers be involved? 2) Can national systems play IRRI's relay role in a way that is meaningful to small farmers? The answer to both of these questions seems to be "no" and this is disturbing.

On the first question, IRRI scientists themselves calculate that any move upstream is a move further away from farmers. This does not mean that strategic research will inevitably be irrelevant to small farmers. However, it does mean that there is little chance for farmers to cast their vote on priorities, participate meaningfully in the investigative and innovative process, and judge the results in a way that has useful bearing on rice-related research.

On the second question, national programs (research and extension) are not inclined to work with small farmers and few seem equipped to. IRRI — which has trained and molded the overwhelming bulk of rice scientists in Southeast Asia — has never had a relevant farming systems approach to impart to national counterparts. As stated by one IRRI scientist, "*Although conventional wisdom is that national agricultural research systems have a comparative advantage in 'adaptive' research, they have rarely developed ways to systematically incorporate farmer perspectives in setting research priorities.*"[23] This is an enormous drawback, especially with regard to promoting sustainable rice farming systems in unfavorable environments.

With IRRI resolutely cut off from farmers and NARS either averse to or incapable of playing the relay role, IRRI has to find a solution or it will not contribute relevant research for the marginal areas. The solution the Institute has in mind seems to be to co-operate with NGOs:

> *Recognizing IRRI's mandate and comparative advantage, country projects do not incorporate extension, seed production, or development activities, although we accept the need to ensure that research findings are communicated to our target groups through ... inclusion of extension and development personnel (including those from non-governmental organizations) in in-country training programmes and adaptive research activities.*[24]

This is an obvious solution. Farmer-based agricultural research and the development and diffusion of appropriate technology is a central activity of many NGO programs, putting this sector in an intermediary level between NARS and farmers. In fact, in some Southeast Asian countries, the NGO community is currently substituting for non-existent or newly-emerging NARS.

NGOs are a critical link for IRRI. If IRRI's research results do not reach farmers, the Institute might just as well close down. In the unfavorable rice environments and marginal areas of Southeast Asia where IRRI technology has *not* penetrated widely in the past, the Institute needs new structures to cooperate with or depend on for diffusion of research results. National extension services may continue to pass technologies on to farmers. But it is the NGO community that is best placed to develop participatory approaches to the research process. Further, NGOs working with farmers are also better placed to help develop appropriate structures for the supply of inputs (such as seeds or organic fertilizers), marketing of products, and the channelling of policy concerns to local governments. IRRI management is straightforward about it: *We need NGOs to help make IRRI research relevant.*[25]

However, NGOs involved in strengthening farmers' rice production systems in Southeast Asia do not necessarily see IRRI as a perfect partner. So far, only a few have done so: among them, World Neighbors and IIRR in the Philippines, and a number of groups present in Cambodia. But it seems that IRRI is intent on building new forms of collaboration with NGOs. In fact, IRRI's "success" in the marginal areas could depend on it.

1 Cited in Anderson, et al., *Rice Science and Development Politics: Research Strategies and IRRI's Technologies Confront Asian Diversity (1950-1980)*, Clarendon Press, Oxford, 1991.

2 Suppe, F (1977). *The Structure of Scientific Theories*, 2nd ed., Chicago: University of Illinois Press.

3 See, for example, Burtt, E.A (1954), *The Metaphysical Foundations of Modern Science*, Garden City, New York: Doubleday. The most devastating critique is by Smith, JW (1984), *Reductionism and Cultural Being: a Philosophical Critique of Sociobiological Reductionism and Physicalist Scientific Unificationism*, The Hague: Martinus Nijhoff Publishers.

4 Ziman, J (1984), *An Introduction to Science Studies: The Philosophical And Social Aspects of Science and Technology*, Cambridge University Press, p 38.

5 Davidson, M (1983), *Uncommon Sense: The Life and Thought of Ludwig von Bertalanffy*, Los Angeles: J.P. Tarcher, p 214.

6 Although in this instance, since the evidence of the non-workability of the Bt approach is considerable, IRRI should not be wasting money on it. The important point is IRRI's openness to explore other, more ecological options.

[7] Tingey, WM and Singh, SR (1980). "*Environmental Factors Influencing the Magnitude and Expression of Resistance*" in: Maxwell, FG and Jennings, PR: *Breeding Plants Resistant to Insects*, New York: John Wiley, pp 89–113. See also Chaboussou, F (1986). "*How Pesticides Increase Pests,*" *The Ecologist*, Vol. 16(1), pp 29-35.

[8] Duffey, SS and Bloem, KA (1986). "Plant Defense-Herbivore-Parasite Interactions and Biological Control" in Kogan, M (ed.) *Ecological Theory and Integrated Pest Management Practice*, New York: John Wiley, pp 135–183. See especially discussion on pp 168–169.

[9] "Scientists re-inventing rice" *The Nation*, (Thailand) Tuesday, October 15, 1991, p F2.

[10] Despite much effort, it proves extremely difficult to put clear numbers on IRRI's actual research allocations in terms of total spending and partitioning of the budget to disciplines.

[11] NIC = Newly industrialized country

[12] Robles, AC (1992), "IRRI's New Look", *The Manila Chronicle*, 12-18 September, p 13. This article is based on an interview with Klaus Lampe.

[13] *Ibid.*

[14] Anderson, et al. (1991), *Rice Science and Development Politics: Research Strategies and IRRI's Technologies Confront Asian Diversity (1950–1980)*, Clarendon Press: Oxford, p 55.

[15] Both consultants of this study participated in all three of these encounters: Washington DC (international, October 1991), Los Baños (national, September 1992) and Chiang Mai (regional, November 1992).

[16] Klaus Lampe speaking at the Southeast Asian NGO/NARS/IARC Dialogue on *Rice, Food Security and the Ecology*, Chiang Mai, 12 November 1992.

[17] We tried to get statistics on the number of farmers this area represents, but aside from it being difficult to compile, IRRI indicated that the data would be misleading. We feel obliged to accept that as probably correct.

[18] Ironically, though, while IRRI is not in the business of empowering farmers, it does claim credit for empowering consumers by contributing to the decline of rice prices through a reduction in the cost of production. We feel this is somewhat unfair.

[19] IRRI (1989), *IRRI Toward 2000 and Beyond*, IRRI, Los Baños, p 14.

[20] "Getting things going" meant raising rice production and fostering national programs to take over IRRI's work. See Anderson, RS (1991), "The origins of the International Rice Research Institute, in *Minerva, XXIX*.

[21] See for example Fujisaka, S *et al* (1992), *Could Farmers Rejecting a Recommendation be Right? The Case of Basal-N for Irrigation Rice*, Paper presented at the Annual Meeting of the Federation of Crop Science Societies of the Philippines held at Zamboanga City, Philippines, 24-28 May 1992.

[22] IRRI (1989), *IRRI Toward 2000 and Beyond*, IRRI, Los Baños, p19.

[23] Fujisaka, S (1990), "Rainfed lowland rice: building research on farmer practice and knowledge," in *Agriculture, Ecosystems and Environment*, No. 33, Amsterdam, p 72.

[24] IRRI (1991), *Programme Report for 1990*, IRRI, Los Baños, p 268.

[25] Klaus Lampe speaking at the Southeast Asian NGO/NARS/IARC Dialogue on *Rice, Food Security and the Ecology*, Chiang Mai, 12 November 1992.

CHAPTER 5

POLICY AND ADVOCACY

The farmers willingly contributed the seed without any hesitation. They would be happy to hear that their traditional varieties are preserved ... in the germplasm bank of International Rice Germplasm Center, at IRRI Los Baños, Philippines. Their heritage is safe in our hands.

Vinoy N. Sahai, Ram C. Chaudhary, and Sin Sovith, Cambodia-IRRI-Australia Project, 1992.[1]

How IRRI deals with policy issues that are important to small farmers in Southeast Asia is not straightforward or transparent. This is not unusual for CGIAR-supported IARCs.

As reviewed earlier, IRRI grapples with internal policy which guides IRRI research activities, and external policies that affect rice scientists, farmers and consumers in Asia as elsewhere. Examples of internal policies IRRI has recently developed include banning the use of Category 1 pesticides on IRRI's experimental plots, and introducing concerns for equity and the environment into the design of its research programs. External policies, mainly translated into government legislation at the national level, cover a wide range of matters such as input subsidies, land tenure, irrigation management, intellectual property rights, consumer price controls and so on. We assume that internal policy formation is based on scientific or other evidence to edict certain rules of conduct and subjected to Board approval. As to position-taking and advocacy on external policies, things are not altogether clear.

Policy research is not part of the Institute's mandate; it is the explicit mandate of IRRI's sister institute, IFPRI. IRRI recognizes the importance of policies that affect rice farming, marketing and consumption. After all, they influence the success or failure of IRRI's work. But while policy issues are the subject of some IRRI research (to assess trends in rice supply and demand, prices, infrastructure investment and subsidies, and advise governments thereof), "policy research" does not appear in IRRI's work plans and the social sciences division is a meager one. It is in this sense that IRRI's commitment and approach to policy issues seem a bit ambiguous.

IRRI's investment in policy work has been patchy. In the past, it had a good reputation for its economic research on the impact of modern rice varieties on farmers and more recently on pesticide use. But those were mainly *ex post* analyses explicitly addressed at policymakers. TAC is now demanding that CG centers devote more resources to socio-economic research and public policy, an area in which IRRI is weak.

A second and more important ambiguity arises from IRRI's advocacy work. Again, this is not part of IRRI's mandate, but through its information outreach, IRRI *de facto* recommends policy directions to governments and international agencies.[2] And through daily interaction with NARS, policy issues necessarily arise. IRRI insists that it only plays an indirect role in national policy formulation, although sometimes it appears to be direct, as in the Uplands Program and in the Country Projects. Former top management has been a bit more emphatic about it: "IRRI is not a politically impotent animal;" stressing, however, that it stops short of actually advising governments.[3]

The NGO community, farmers organizations, scientists and development workers engaged in sustainable agriculture with rice farmers in Southeast Asia have cautiously welcomed recent policy developments at IRRI related to pesticides and some biotechnology research, but are anxious for resolution of other questions. While banning Category 1 pesticides at IRRI and putting emphasis on IPM research, IRRI has not taken a categorical stance against chemical use in rice farming. Its position is rather to reduce pesticide use in rice, still believing that such inputs are necessary to achieve the yields to feed consumers. In the field of biotechnology, IRRI's pronouncement that it will not do research on herbicide resistance in rice in the short-term has no formal backing to it. Recently formalized, however, was a Board-approved set of policies on intellectual property rights (IPRs), which should be examined in the light of IRRI's new status as an "international" organization.

5.1 INTELLECTUAL PROPERTY RIGHTS AND IRRI'S ASSETS

Who controls the genetic resource base of rice farming is probably one of the most politically, economically, ethically, and culturally charged questions facing rice producers and consumers throughout the world, particularly in Asia. This is because rice, along with the rest of the world's biodiversity, is being transformed from a public resource to private property. The implications of this shift are immense. Biodiversity underpins peoples' livelihoods, and free access to genetic resources and the knowledge of how to use them has always been critical for people to develop and adopt their food production systems. This connection is particularly acute for people who grow and harvest their own food.

The privatization of agricultural research and the pressure to allow for monopoly rights over the genetic resources fundamental to food security and market control have been building up over the past few decades (*see Box 16*).

This trend is increasingly being felt in the rice-growing developing countries. Pressure to bring the world economy into line with Northern intellectual property rights (IPRs) interests (through the World Trade Organization, the World Intellectual Property Organization or bilateral trade sanctions) is extremely strong.

To date, intellectual property rights on rice — including patents and plant breeders' rights (PBR) — are exercised mainly in the industrialized countries. Major rice-producing countries of Asia, such as Thailand, Korea and India, have been under pressure from the North and from locally-operating private seed enterprises to develop patent and PBR protection for its agricultural products. Indonesia is being lobbied hard to enact UPOV-style Plant Breeders' Rights.[4] IRRI's host country, the Philippines, is contemplating several bills dealing with plant variety protection and community intellectual rights. The Trade Related Intellectual Property

Box 16: *The Push to Patent Rice*

The push to patent rice (individual varieties or the species) is a threat to IRRI's research work and the interests of national rice research programs and farmers. On the one hand, countries where this is possible are taking out intellectual property on IRRI-based rice technologies and IRRI gets nothing in return. For example, a US breeding company, Farms of Texas Co., made some minor modifications on IRRI's IR8 and patented it for exclusive sale in the United States.[1] This is obviously unfair to IRRI breeders who got no compensation for their work, and certainly says nothing about the farmers who developed the parents of IR8.

The US biotech firm, Agracetus, is currently introducing foreign genes, for example, for herbicide tolerance, into a number of popular IRRI varieties (including IR26, IR36, IR54 and IR72) and applying for worldwide patents on the transgenic IRRI rices.[2] Some observers fear that Agracetus, owned by WR Grace, may try to claim a "species patent" on all forms of genetically-engineered rice, as it has done with cotton. In China, the immense gains from hybrid rice production are based on fertility restorer lines from IRRI. Ignoring that, the Chinese government has given exclusive market rights to at least two American companies for the sale of hybrid seed in Asia. What does IRRI get in return?

Another important development in IPRs on rice is a project funded by the Rockefeller Foundation engaging IRRI, Japan and Cornell University in a collective quest to map the entire rice genome. Cornell is already offering non-exclusive licenses on RFLP probes developed in collaboration with IRRI at a starting price of US$1,000 per probe.[3] The Rockefeller Rice Biotechnology Program stipulates that project grantees should make the project results available to developing country scientists at "zero royalty" rate and that Third World farmers *"should pay no...or at most nominal royalties"* on new varieties developed through the program. Yet, the Rockefeller grantees — including IRRI and Cornell — are free to patent the results in developed countries.[4]

On the other hand, IRRI is and will increasingly find intellectual property obstacles barring its access to biotechnology, as processes and products (including valuable genes) are increasingly protected by intellectual property, or restricting the freedom IRRI has long enjoyed in communicating scientific results. In the first case, Agracetus, once again, developed a proprietary method for transferring genes into rice with great speed and offered its services to IRRI. The price was exorbitant and IRRI declined.[5] In the second case, IRRI's co-operative agreement with the Belgian biotech firm, Plant Genetic Systems, on Bt research obliged IRRI to provide Asian Bt strains to the company (which could readily patent them) while IRRI commits itself to refrain from releasing any strain or sharing information with PGS' competitors.

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Rights (TRIPs) agreement of GATT, completed in 1994, requires all signatories to introduce IPRs on plants: either by patents or "effective *sui generis* legislation." Many NGOs, indigenous peoples' organizations and policy-makers throughout Southeast Asia are vigorously trying to work out creative and appropriate provisions for national *sui generis* legislation.

Two major international agreements on the legal status of genetic resources have been drawn up. The first is the International Undertaking on Plant Genetic Resources, originally endorsed by the international community through FAO in 1983. This voluntary Undertaking is committed to "the fair and equitable sharing of the benefits arising out of their [genetic resources] utilization." It also recognizes "Farmer's Rights," which are not ownership rights but rights

Box 16

This is some of the background to why IRRI developed its IPR policy. And perhaps to why IRRI invited the recently retired head of Pioneer Hi-Bred International to join IRRI's Board of Trustees. Pioneer is the world's top seed company and has built its empire around corn. Little might some people suspect, it's also one of the top patent holders on biotechnological inventions related to rice. Of all the patents granted on genetic engineering in rice worldwide and recorded in the Derwent Patent Literature database, a major reference in the field, Pioneer is the largest patent holder on inventions related to transgenic rice.[6] Maybe they have some insider tips to share with IRRI.

1 Fowler, C and Mooney, P (1990), *Shattering: Food, Politics and the Loss of Genetic Diversity*, University of Arizona Press, Tucson, p 185, and Dalrymple, D (1986), *Development and Spread of High-yielding Rice Varieties in Developing Countries*, USAID, Washington DC, p 115.

2 *TIBTECH*, July 1992, and Hope Shand, RAFI, personal communication, 5 January 1993.

3 RAFI (1992), "Rice Biotechnology", *RAFI Communique*, November 1992, Rural Advancement Foundation International, Ottawa, Canada, p 6.

4 *Rockefeller Foundation International Program on Rice Biotechnology: Policy Statement on Research Collaboration and Proprietary Rights*, dated 24 September 1991.

5 *Ibid*, pp 5-6.

6 GRAIN scan of the Derwent Patent Documents Database, February 1996. Of 143 patents cross-indexed for "genetic engineering" and "rice", Pioneer held the lead with 21 patents.

to compensation for providing humanity with the genetic diversity vital to food and agriculture.

The second legal instrument is the Convention on Biological Diversity (CBD), signed in June 1992 at the UN Conference on Environment and Development by 153 countries. The Convention declares that biological resources are subject to national sovereignty and access to them should be granted on the basis of mutually agreed consent. Neither of these agreements clearly resolve the North/South dispute over who controls and benefits from genetic resources. Since June 1995, the International Undertaking has been under renegotiaton, and will hopefully become a legally–binding protocol to the CBD. If so, it may establish for the first time international principles and mechanisms to honor Farmers' Rights.

IRRI's position regarding these issues has historically been unclear. However, since the early 1990s, the Institute has made efforts to clarify its position and policies regarding the legal and political status of rice germplasm maintained and exploited at IRRI. Three issues are at the heart of this development: 1) the legal status of IRRI's genebank; 2) trusteeship; and 3) IRRI policy on intellectual property rights.

5.1.1 THE LEGAL STATUS OF IRRI'S GENEBANK

IRRI's Articles of Incorporation stipulated a number of important points with respect to IRRI's legal status (*see Section 2.2*). One problematic point has always been whether the germplasm held in storage at IRRI's genebank should be legally considered an "asset" of the Institute and hence destined to the become the property of the Philippine government should IRRI be dissolved for any reason.

For over ten years, NGOs and POs pressured IRRI to clarify whether or not the IRRI genebank and its 80,000 samples from more than 112 countries would indeed become the property of one government upon IRRI's closure. For many concerned about what those seeds represent in terms of food security and the inalienable rights of the farmers who donated them to IRRI, such a scenario would be unacceptable. The lobby effort finally paid off when in May 1995, IRRI's international legal personality was finally established (*see Section 2.2*).

In the new IRRI Charter, annexed to the Agreement, clear rules are finally laid out for the dissolution of the Institute. If and when IRRI's existence is terminated, all the assets go to the University of the Philippines with one colossal exception: the genebank and genetic resources held in trust at IRRI, and its most valuable asset. IRRI has, albeit rather belatedly, made a tremendous step forward in making the choice that the seeds donated by thousands of farming families should never become the property of any single nation or private interest. Instead, should IRRI disappear, they will be held in trust by the international community, currently represented by the UN Food and Agriculture Organization.

5.1.2 "TRUSTEESHIP"

Prior to the era of trusteeship, the CG system's international genebanks were governed by the CGIAR policy on plant genetic resources, adopted in 1989, which stipulates that "*Collections assembled as a result of international collaboration should not become the property of any single nation, but should be held in trust for the use of present and future generations of research workers in all countries throughout the world.*"[5] There have been — and remain — a number of problems thwarting the value of this "policy."

First of all, there was no one behind it other than the small informal grouping called the CGIAR. Rather than a source of confidence for germplasm donors, it was a self-gratifying proclamation of a few CG fans with no weight behind it. This has changed, somewhat, since the CGIAR requested the FAO Commission on Plant Genetic Resources

TABLE 5.1: *IRRI's IPR policies related to biological materials and technologies* (adopted by the Board of Trustees, Sept. 1994)

1. Intellectual property rights and rice genetic resources

1. The rice genetic resources maintained in the genebank of IRRI are held in trust for the world community.
2. IRRI adheres to the principle of unrestricted availability to the rice genetic resources it holds in trust (except germplasm held under "black box storage" on which the donor of the germplasm has placed distribution restrictions), including related information.
3. IRRI will not protect the rice genetic resources it holds in trust by any form of intellectual property protection.
4. IRRI is opposed to the application of patent legislation to plant genetic resources (genotypes and/or genes) held in trust.
5. The rice genetic resources held in trust by IRRI will be made available on the understanding that the recipients will take \no steps that restrict their further availability to other interested parties.

2. Intellectual property rights and breeding lines, elite germplasm, and hybrid rice

1. IRRI adheres to the policy of free availability of the breeding lines, elite germplasm, and parental lines of hybrid rice produced in its conventional breeding program.
2. IRRI will not seek intellectual property protection on the breeding lines, elite germplasm, and parental lines of hybrid rice emanating from its conventional breeding program.
3. IRRI recognizes that the private sector is likely to play an increasing role in the development of rice technology, and particularly hybrid rice technology.
4. IRRI will provide breeding lines, elite germplasm, and parental lines of hybrid rice to both the public sector institutions and the private organizations on the understanding that;
   a. the material is not intended for exclusive use by any single organization,
   b. IRRI retains the right to distribute the same material to other organizations,

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➣ *Table 5.1*

c. the use of IRRI materials will be publicly recognized when a derived variety or hybrid is released.

5. Collaboration with profit-making organizations for the development of rice technology will proceed after consultation, where appropriate, with the authorities in the respective developing host country.

6. This protocol does not cover materials derived from genetic engineering.

3. Intellectual property rights and inventions and materials derived from biotechnology

1. In negotiating collaboration agreements for the development of products and techniques derived from biotechnology, IRRI will seek to ensure free access to the products of the research.

2. To make advanced biological technologies and techniques available to developing nations, IRRI may, but only to the extent necessary, and for a limited period of time, accept limitations on distribution of the derived and associated materials.

3. To ensure availability to developing nations of advanced biological technologies or biological materials such as microbial strains, IRRI will, exceptionally, apply for intellectual property protection of the technologies or materials or provide them to a collaborator on a restricted basis but only after a specific judgement that such arrangements best serve IRRI clients — the farmers in the developing countries.

4. In obtaining and exercising any form of intellectual property rights over biological material, IRRI will, in good faith, seek to notify and consult with the nation or nations from which the material came.

5. In all of its biotechnology-associated work, IRRI will meet appropriate biosafety standards and include clauses designed to ensure as far as possible that its collaborators meet such standards and to protect itself against any corresponding liabilities.

Source: "Intellectual property rights and IRRI in a changing world," IRRI Reporter, *June 1995.*

to formally recognize the CG centers' "trusteeship" over the materials in their genebanks. Trusteeship, as agreed to with the 100+ governments that make up this high-level Commission, means that IRRI and the other CG centers hold the responsibility to preserve the global germplasm collections of their mandate crops, implying committed long-term funds and an effort to duplicate those collections and assure their safety and unrestricted availability. To help guarantee this, the designated germplasm collections were placed under FAO auspices whereby FAO — as "senior custodian" — will intervene in case of any disturbance threatening the "trust" materials. The agreement, finally signed in October 1994, only covers "designated" germplasm: not necessarily every seed sample found in the genebanks, nor the duplicates sent to other countries for "safety" backup storage, nor the IBPGR/IPGRI base collections. Each genebank is supposed to submit a detailed listing of what they delegate to the trust arrangement.

While the "trust" idea is valuable, it is limited in two ways. By default, it can only cover those materials collected prior to the CBD. Since the CBD became international law in December 1993, genetic resources collected under its purview — even if the "*result of international collaboration*" as the CGIAR "policy" puts it — legally fall under the national sovereignty of the country of origin. So everything entering IRRI's and other CG centers' genebanks since that date belongs to the country they came from, not the "international community." And they surely cannot become part of the trust collection without the consent of the donor nation. Ambiguously and in a certain sense, IRRI's trusteeship might have commenced in October 1994 and ended in December 1993. IRRI may very well try to convince governments to forego their rights to national sovereignty and continue "donating" germplasm to the international cause of the world's "gene pool in trust." In fact, since IRRI acquired its international status in May 1995, its standing under the rules of the CBD is not clear. No longer "just" a Philippine corporation, hence subject to some national treatment, is IRRI now "above the law" of the Convention as implemented by its host country?

The second limitation of the trusteeship arrangement is that the seeds are only protected from appropriation so long as they sit quietly in IRRI's genebank. Once they leave the premises, the laws of the IPR jungle take over. Victim of its informality and political divisions despite common concerns, the CGIAR has not been able to come up with a system-wide policy on intellectual property rights at the IARCs: it is either incapable or does not really want to. In the meantime, individual IARCs like IRRI feel obliged to come up with their own policies and practices (to the delight of those who don't want a system-wide ruling, for fear it constrains IPRs).

5.1.3 IRRI'S POLICY ON INTELLECTUAL PROPERTY RIGHTS

With the CG system unable to reach its own agreement on "across the board" rules for intellectual property administration at the IARCs, IRRI has been struggling to come up with its own. In September 1994, after several years of internal debate (and no public consultation), IRRI's Board of Trustees adopted an official policy on intellectual property rights. The policy, as concerns biological materials and technologies, comprises three sections. The first governs "rice genetic resources," but in fact, only refers to the genetic resources held "in trust" as per IRRI's 1994 agreement with FAO. The second protocol lays out IRRI's (non-)IPR provisions for genetic materials which are manipulated through conventional breeding techniques. The third section opens the avenues for intellectual property restrictions on techniques and products of IRRI's biotechnology work. The policy provisions, as adopted by the Board, are presented in *Table 5.1*.

As a whole, the policy — while probably meant to assert transparency — is marred by what some scientists and NGO people in Southeast Asia view as "deceit."

Protocol 1: The first protocol states that "*the rice genetic resources maintained in the genebank of IRRI are held in trust.*" Deceit number one.

As a sweeping generalization it sounds reassuring, but it is misleading. If IRRI collects rice germplasm from a country party to the CBD that for some reason doesn't wish its rice to fall into the trust pot, then IRRI cannot impose trusteeship status on that rice. In fact, given that IRRI has been granted trusteeship by the international community since October 1994, and given that the legally-binding CBD entered into force in December 1993, it would seem that since the end of 1993 there have to be at least two chambers in IRRI's genebank: one for materials governed by trusteeship (everything collected prior to the Convention and designated by IRRI to FAO as "trust" samples) and another for those samples which governments wish to exercise their national sovereignty over, including the right to protect their resources through intellectual property.

IRRI has pronounced its opposition to patent protection for any trust materials. While this sounds heartening, it does not address the question of plant breeders' rights or other forms of intellectual property protection. In fact, the "material transfer agreements" which IRRI now employs when distributing germplasm (even to farmer-based programs), can amount to a kind of intellectual property protection. In any case, the protocol only says that IRRI is politically against the idea of patenting trust materials; it doesn't have any practical relevance.

A problem arises for the trusteeship materials when IRRI says it will distribute them on the understanding that no further restrictions will be slapped on them by others. How will IRRI enforce this? Besides, in the real world, scientists will be free to make slight modifications on the trust materials and call them theirs. So IRRI's pronouncement does not mean that the further circulation of trust materials will be unhampered by restrictions. IRRI is not a rice germplasm traffic cop.

Protocol 2: The second protocol covers the products of conventional breeding at IRRI. It states that IRRI will not seek intellectual property rights on the breeding materials it develops through conventional means. Here again, the intention is good but practicalities get in the way. The main practicality — aside from the enforcement problem — relates to how IRRI defines the boundaries of "conventional breeding" which is very unclear. For most people, conventional breeding means any crossing and selection work that doesn't employ "biotechnology." The term may also mean the tools and techniques that range from tissue culture to sophisticated transformation via genetic engineering.

Without bothering to clarify such definitions in its policy, deceit number two steps in. This relates to IRRI's ambiguous and seemingly interchangeable use of the terms "genetic engineering" and "biotechnology." The no-IPR protocol covers "conventional" breeding materials and parental hybrid lines, but excludes materials derived from "genetic engineering." Where does that leave techniques such as tissue culture and RFLP? The third protocol may provide the answer, since it introduces IRRI's pro-IPR practices for the products of the catch-all term "biotechnology," rather than specifying "genetic engineering."

IRRI seems implicitly to be implying that genetic engineering and biotechnology are one and the same — which, of course, they are not.[6] Biotechnology covers *most* of what IRRI does. IRRI is *de facto* reserving itself the right to take out IPRs or use other restrictions on any product or process from another culture to transgenic rice.

Protocol 3: IRRI's pro-IPR policy for biotechnology (protocol three) makes a mess of all of IRRI's good intentions and render protocols one and two almost redundant. For it basically says that IRRI is giving in to the process of privatization of research and of biological resources by joining the trend. It has capitulated to the corporate push to patent life as a means of getting access to biotechnology in the name of developing countries. The song is "We can't help it," but that's not true. This is where IRRI's cynicism — or the third deceit — shines through. It says it will exercise restrictions on access to its rice biotechnology, but only in limited cases, only for the benefit of the South, only where the interests of farmers warrant such exceptional behaviour and so forth. This is smokescreen logic at its best. The Third World argument is just to dress up the real issue: IRRI wants access to biotechnology because that is the kind of research IRRI wants to do. It is simply much more glamorous than working with farmers. And yet they even use farmers as a bargaining chip to gain political acceptance for a policy intended to restrict the flow of biodiversity which does not even belong to IRRI.

This policy will only end up hurting IRRI. It will create further distrust in the scientific community among Southeast Asian NARS about working with the grand old Institute who now claims legal monopolies on a good share of its work with rice germplasm. It will cause further isolation from critical NGOs who see IPRs at IRRI as a further negation of the innovations and rights of rural communities and have firm ethical stands against patents on life. It will cost IRRI a lot of money to implement, defend and enforce. And it goes directly against IRRI's mandate: "*to publish and disseminate research findings of the Institute and to promote the exchange and distribution of new technologies, research methods, tools and improved plant materials...*"[7] IRRI had better amend its Charter to reflect its new, blatantly pro-restrictions stance.

IRRI certainly tried to balance many different interests in completing its IPR policy. In the end, the genebank materials remain patent-free, the conventional breeding outputs will not be subject to IPR restrictions, but everything that bears the mark of biotechnology is fair game for IRRI to slap a patent on. "Exceptionally," they say, and "only" in the interests of IRRI's clients. Doublespeak? Or deceit?

5.2 BIOSAFETY

In addition to intellectual property rights issues, pressure has increased on IRRI to address another public concern: health and the environment. The 1970s ushered in a general awakening to the negative, long-term effects of agrochemicals, which the 1980s transcribed into concerns about risks associated with modern biotechnology, especially genetic engineering. "Biosafety" is the buzzword for mitigating these risks. It presents a whole new challenge for both IRRI and the rice-dependent societies of Southeast Asia.

Biosafety has become a major issue in regulating biotechnology worldwide because, for the first time, scientists can move genes from one organism into another across biological barriers that could never be traversed if nature was left to its own devices. Genetic "manipulation" or "transformation" — such as removing a gene from a fish and embedding it in a rice plant — provides us with the means not just to acclerate evolution, but to supercede it altogether. Genetically-engineered crops are not necessarily inherently dangerous, but the introduction of new traits (such as resistance to cold, drought, pests, etc.) will necessarily result in unpredicatable interactions with the environment into which the plant is introduced. Transgenic plants are likely to be less predictable than those produced by traditional breeding techniques, because the genes they have been "improved" with are from a completely different species, rather than from a related variety. New genes may not be subject to the same mutual constraints as those that have evolved as a group, which may result in unexpected behavior. At the same time, they *are* subject to the normal rules of genetic drift that occur in the process of natural selection and reproduction. This means that they can be transmitted to wild and weedy populations.

Assessing the risks of releasing genetically modified organisms (GMOs) is extremely difficult since there are no precedents to follow, since the behavior of the novel genes defy any natural processes. How can we know that their release will not represent ecological time bombs when deployed on a large scale? Because of the uncertainties, the question of biosafety has captured the public imagination and stirred up much distrust. In Southeast Asia, the question of "risk" associated with biotechnology is widening to include not only environmental aspects but also negative socio-economic consequences.

IRRI has not been spared the public's biosafety agitations, and for good reason. IRRI has already leapt eagerly onto the biotechnology bandwagon. Many people see biotech at the very least as an extension of the Green Revolution, with all its built-in social, economic and environmental biases that resulted in considerably more than the higher rice grain yields IRRI had bargained for. Still, much potential debate has remained quelled by a seemingly "progressive" regulatory climate in IRRI's host country and by the Institute's obvious desire not to shoot itself in the foot on this one.

Consequently, IRRI has invested heavily in advocacy and public outreach work related to biosafety. In its promotional materials, IRRI states that "*a transgenic rice plant is simply a normal rice plant — with one or more additional genes from diverse sources.*"[8] But it does not explain why, if transgenic rice is so "normal," IRRI has had to build a new hermetically-sealed, "biological hazard level 4" greenhouse for it, designed to withstand earthquakes, typhoons, and fire.

5.2.1 THE BLAST SCANDAL

IRRI's first encounter with public hostility on the biosafety front occurred in the mid-1980s, when a scandal broke out about "*high risk research at IRRI.*"[9] The issue was blast — a fungal disease that affects rice mainly in upland

and temperate areas, occasionally at epidemic levels. As blast is not a major problem in the tropical lowlands, Filipinos were outraged when they learned that IRRI was importing, hybridizing and testing for virulence several strains of *Pyricularia grisea*, the fungus that causes rice blast disease, to its research labs in Los Baños. The strains had been developed and donated by several institutes including Du Pont, the US-based, transnational chemical corporation. The Philippine public's main fear was that highly potent forms of *P. grisea* might somehow leak out of IRRI's labs and wreak havoc in an environment defenseless against this exotic scourge.

The scandal was significant. It was the first time that IRRI had been attacked for working with biohazardous materials that could threaten peoples' livelihoods. Blast *was* a real biohazard, and IRRI immediately responded and *ceased* the experiments under the guise of it being preferable, after all, "*to err on the safer side.*"[10] IRRI was investigated by the Philippine Senate for, among other points, abusing its diplomatic privileges and importing foreign isolates without import permits. And, thereafter, the Institute set to get its safety record straight. Upon halting the contested blast research, IRRI established a Standing Committee on Biosafety and reviewed its facilities, leading to a decision to build its current containment greenhouse for transgenic plants.

5.2.2 A FRAMEWORK IN PLACE

By the turn of the 1990s, the first successful genetic transformations on rice were moving ahead in countries like Japan and the US. Genetically-engineered tomatoes, tobacco, rapeseed are already on the market in several Northern countries. In 1995, the US granted and released approval for genetically-engineered Bt corn, cotton and potatoes. IRRI is keen to ensure that it has access to the new tools of biotechnology and to deliver its products to rice farmers in Asia. Eager to play by the books (for fear of repercussions), IRRI helped to write the books. In the late 1980s, as a national corporation under Filipino law, IRRI was legally bound to abide by the biosafety laws of the Philippine government. At the time, however, no developing country had biosafety standards. They were still being painfully chiselled together in the North in the face of vociferous resistance from the industrial lobby.

In October 1990, President Corazon Aquino signed Executive Order 240 establishing the National Committee on Biosafety of the Philippines. In 1991, the country's full-fledged guidelines for the importation, contained use and field testing of biohazardous materials like GMOs were published. The guidelines soon became renowned the world over for their clarity and progressiveness. IRRI claims to have had a heavy hand in writing them. So do numerous Filipino NGOs!

The "progressive" elements of the Philippine biosafety guidelines require:

1) the participation of representatives of the general community — not just academic experts — in the National Committee responsible for implementation;
2) GMO importation and experimentation permits to show that the research objectives cannot be met effectively through alternative approaches;
3) public deliberations on all proposed importations of / or experiments with GMOs.

5.2.3 THE TRANSGENIC RICE DEBATE

With the rules in place, IRRI has been moving busily on its way to become a premier rice biotechnology delivery system. Its first planned product is stemborer resistant rice, based on Bt and other insecticidal protein-producing genes. In 1993, IRRI started importing transgenic rice from abroad. The first batch came from a Japanese company, Plantech, and carried a rice chitinase gene. The second batch came in 1994 from Cornell University, harboring a rice protease inhibitor gene. The third installment was a Bt rice that arrived in 1995 "courtesy" of Ciba-Geigy via the Zürich Institute of Technology. (This last one got press coverage because Greenpeace International intercepted the DHL package.)

NGOs in the Philippines brought the Bt rice story to the attention of the public and its legislators. One major contention contravenes the national biosafety guidelines since IRRI has not explored current farmer practices for controlling yellow stem borer — the main target of the Bt toxin and other transgenic rice genes. These proven systems could be undermined by IRRI's biotech solution, which may be very short-lived if it is deployed massively under monocrop conditions, as is likely. Another problem is that IRRI cannot say how transgenic rice with Bt or other genes will behave or interact under field conditions over a length of time. Lacking a strong framework for ecological approaches to rice research, IRRI will make its best estimates based on a deterministic view of nature.

The transgenic rice debate has helped all those interested in rice research and development opportunities for resource-poor farmers in Southeast Asia to reassess the implications and value of rice biotechnology. Project approval for acquisition and testing of GMOs has a clear set of rules. Whether or not these rules are implemented well and the fact that no other country in Southeast Asia has anything like them is another matter. But at least information about who is doing what and testing and why is basically available. This allows for healthy public debate and collective questioning about the desirability and potential repercussions of biotechnology research in the region.

But the debate has also left a lot of questions hanging:

No International Standards:

For some time, the South has been clamoring for an international protocol on biosafety to ensure minimum security standards, especially regarding transboundary movements of GMOs. An important step in this direction was taken at the Conference of the Parties to the Biodiversity Convention meeting (COP II) in November 1995. There it was agreed, much to the chagrin of Northern delegations, that a biosafety protocol would be attached to the CBD.

But there is a long way to go before this translates into action — even draft *ideas* on what the protocol should address will not be reviewed until COP IV in 1997. An international biosafety protocol is vital because GMOs do not recognize national boundaries and because the industry cannot be relied upon to self-impose appropriate restrictions.

IRRI and the Philippine government are both exceptions in their approach to biosafety. IRRI is trying to make rice biotechnology publicly available, cutting deals with TNCs like Ciba-Geigy to this end, even at a cost. The Philippines has taken an unusually socially responsible approach to drawing up national guidelines. Moreover, the Philippine Government's Council for Sustainable Development, under the Office of the President, is of the view that there should be a moratorium in place on transboundary movements of GMOs until an international protocol has been agreed upon. Until such a moratorium is enacted or an international protocol achieved, other countries in Southeast Asia are at risk of unregulated testing.

Greenhouse or Field:

IRRI is not satisfied with the Philippine biosafety legislation which — it claims holds that it can only test transgenic rice in its containment facility. It cannot pass on new lines on to the national programs for release to farmers unless field testing has been done, and is pressurizing for legislative changes accordingly. Is it up to IRRI to write and rewrite the national laws of its host country? Would IRRI pressure other governments to serve this need if the Philippines disappoints it?

Whose Vote?

The public has effectively little or no say over what kind of biotechnology research is pursued in relation to rice-based farming systems at the international or national levels. As recent experiences with biosafety controversies in the Philippines show, despite the actual public nature of such research, experiments are often "stumbled upon" by NGOs or critical scientists and resonate as a *fait accompli* coming from far away rather than a socially appropriated enterprise.

As with intellectual property, social concern over biosafety begs the need for a broader and more basic public discussion on whether and how biotechnology is actually needed or useful. Are 15-ton rice or anti-stem borer genes or herbicide-tolerant crops the answers to farmers' needs? Or is the real problem much deeper, concerning dislocation between ideas and aspirations of the powerful (represented by IRRI and national governments) about "development" or "food security" or "sustainable agriculture" and the visceral need for a fairer share of power and rights among the poor?

ORYZA NIRVANA?

1 Vinoy N. Sahai, Ram C. Chaudhary, and Sin Sovith (1992), *Rice Germplasm Catalog of Cambodia*, Cambodia-IRRI Rice Project, Phnom Penh, p. 67.

2 See, for example, IRRI's 1991-1992 corporate report: *"Faced with a choice* between accepting higher relative prices of rice and developing even more efficient technology to provide production incentives to farmers, policymakers concerned about poverty and the well-being of landless labor, marginal farmers *and the urban poor should prefer production incentives."* IRRI (1992), *Sharing Responsibilities: IRRI 1991-1992*, Los Baños, pp 8-9. Note that this is tantamount to saying: please continue to legitimize IRRI's choice and role in developing technology as the way forward.

3 This is contradicted by those involved in the Country Programs which work directly with national governments to strengthen national rice research systems. In some countries, like in Indochina or Burma today, IRRI actively tries to influence policies regarding the uplands –a politically and culturally sensitive matter. Maybe that's stopping short of "actually advising" governments but it comes perilously close.

4 See *Terompet*, No. 2, Vol. III, 1995, PAN Indonesia.

5 IBPGR (1989), *CGIAR Policy on Plant Genetic Resources*, IBPGR, Rome, p 12.

6 In a presentation to Philippines President F.V. Ramos in February 1995, IRRI's Biotechnology Co-ordinator, John Bennett, said that "The term biotechnology is used at IRRI to refer to the application of plant tissue culture, molecular biology and microbiology to the improvement of rice germplasm and farm practices ... Tissue culture at IRRI has a variety of applications: another culture, embryo rescue, genetic engineering ..."

7 Charter of the International Rice Research Institute, Article II(b), adopted in 1995.

8 IRRI (1995), "IRRI and the World of Rice", *Questions and Answers about IRRI*, September.

9 UPLB Multisectoral Forum, "High Risk Researches at the International Rice Research Institute," paper presented to, and adopted by, the National Conference on Genetic Resources Conservation and Development, Tagaytay City (Philippines), 2-6 September 1987.

10 Memorandum from Dr. M.S. Swaminathan, IRRI Director General, to Editors of Major

CONCLUSION

Thailand has been exporting rice for 200 years. The Philippines has been importing rice for 30 years. IRRI, no effect!

Daycha Siripatra, Executive Director, Technology for Rural Ecology and Enrichment, 1992 [1]

In September 1995, IRRI gleefully celebrated its 35th anniversary. Few joined in the festivities. Most people on the streets were concerned with the controversial "rice crisis" in the Philippines. A few months before, the government announced that it would have to import 220,000 metric tons of rice from Thailand, India and China to supplement the national harvest which, it claims, fell due to bad weather.

Traditionally, the third quarter of the year is the lean quarter for the Philippines' national rice supplies. The previous year had yielded a better-than-average harvest. But the National Food Authority (NFA), which is mandated by the government to ensure a buffer stock for 90 days, had only managed to buy up one-tenth of the rice harvest because it could not pay the asking rate. This is because in 1993, the government had borrowed US$125 million from the Asian Development Bank for an agricultural loan. One of the conditions for the loan was to freeze the NFA's rice buying price at a level which happened to be lower than the market price, to keep the government deficit down. When the first imports finally arrived in July, hoarding by the rice cartel and rich speculators took over, the bins went bare and prices skyrocketed.

What does this have to do with IRRI? A lot, some people say. After all, 35 years of IRRI has not changed much for the better, in the countryside or the urban slums. The average national yield in the Philippines went from 1.3 to 2.8 tons per hectare — double, but hardly impressive. Despite its loud self-adulation, in 35 years, IRRI has never surpassed the yield potential of its first shining star, IR8, which launched the Green Revolution in some areas. More important than IRRI's failure to produce varieties that reliably produce high yields, is the environmental degradation that has accompanied its rices. Chemicals and misguided fertilization recommendations have poisoned the soils and

created new, important, pest problems. Some even believe that the soil at IRRI's central farm is biologically dead. How can rice farming be sustained in such conditions? Is the Philippines condemned to import rice?

IRRI's objective is to help alleviate poverty but it carries out little analysis of what poverty is about, who is poor and why. The assumption seems to be that bumper crops and low prices at the marketplace are a boon for all. There is a huge mismatch between IRRI's goal and the means it employs to achieve it.

In fact, IRRI has helped to extend the gap between rich and poor. The middle class is indeed increasing and the rise in rice grain output is a step above population growth, but according to the recent figures from the World Bank, 68% of rural Filipinos — or 39% of the whole country — remains below the poverty line.[2] The founders of IRRI prognosed that technical change would induce political change. (If you think about it, so did Lenin.) The gamble was that science would feed people and improve their livelihoods. Some have won, but the majority have not.

This report was intended to update the NGO community on "the new IRRI" of the 1990s and examine two key concerns of those groups working to promote alternative rural development in the region: IRRI's relevance to small farmers in Southeast Asia and its capacity to foster sustainable agriculture. Five main conclusions are evident.

1. IRRI is a waste of money.

From an NGO perspective, there is, and always has been, a fundamental fault in IRRI's problem definition which has shaped its existence. For IRRI, the problem is production: growing enough rice to feed an increasing number of mouths. For NGOs, this is a superficial and inadequate position. For them, the problem is power relations: inequity in distribution of wealth, rights, resources and capacities. IRRI insists that NGOs concerned with power issues are misguided and off-target when they take their concerns to the world of rice research and green revolutions, cogs in the complex struggle for food security. But this is a cop-out. Fundamental issues of justice can and must be addressed by science, but IRRI can't and won't. IRRI's forte is empowering scientists and trying to keep consumers quiet. For NGOs, sustainable agriculture is simply impossible without empowering farmers.

Centralized research systems cannot, in most cases, adequately address farmers' specific and complex problems or needs. One result of centralized science is the emergence of blanket technologies, which are dispersed in the hope that they will somehow be fine-tuned to fit reality. This is irresponsible. The other result is to run away into higher spheres of scientific endeavour: to accept that proximity to farmers is impossible and, hence, relegate yourself to produce science for other scientists, hoping they, instead, will bring it down to the level of the farmers. This is self-serving.

IRRI's penchant for gambling is unlikely to pay off. The 15-ton rice, IRRI's great promise for the future of rice-eating Asia, terrifies many advocates of sustainable agriculture and farmers whose lands have already been ruined by Green Revolution agriculture. For the risks are extremely high: further soil corrosion, greater dependency on external resources, increased fragility of farming systems, potential increase in chemical use and further socio-economic disruptions. IRRI is aware that yields are already declining under intensive rice cropping conditions and that the resource base is being degraded. But it shows little commitment to find out why and rectify this urgent current problem before launching Southeast Asian agriculture into an even more intensive agricultural regime.

IRRI is not strengthening national programs in a way that is meaningful to local communities and the NGOs that work with them. IRRI's rationale was, from the start, to catalyze the development of national rice research capacities and to make itself redundant in a world of strong national rice science. This has not happened. For many NGOs in Southeast Asia, their NARS are worse than IRRI: conservative, insensitive, often unwilling to serve other than (sometimes repressive) government policies. Many regret that the splendid resources allocated to IRRI could have been better spent in revamping national agricultural research in a meaningful, bottom-up fashion.

Resources that go to IRRI are potential resources which others are deprived of. Southeast Asia's NARS are starved for funds, which increasingly drives them to cut deals with the private sector, at times against the interests and dignity of farmers. NGOs also resent the amount of money donors pour unthinkingly into IRRI, when its impact has been largely negative on the constituency it is supposed to serve. Forty million dollars flowing into IRRI each year is an immense amount of money compared to what others engaged in sustainable agriculture research in the region would ever dream of.

Peoples' doubts about IRRI as a rational economic investment are heightened by the fact that its senior scientists are paid US$ 100,000+ per annum to spend so much time on airplanes — at 35,000 feet above any farmer — and then complain that IRRI doesn't get enough support. According to some IRRI scientists, only 10% of the core annual budget — or US$3 million — is actually spent on research, the rest going to attractive salaries, administration costs, undercover security, fancy supplies, and so on. What makes donors fund IRRI? Because it is IRRI and doing the best job possible? Or because they can't conceive of anything else? Do they choose IRRI over national forces because IRRI is more glamorous and easier to control? Or is it easier to fund IRRI because choosing which Southeast Asian governments to support is politically too discomforting?

2. *Even IRRI's sacred cow of science is flawed.*

IRRI recognizes that it has weaknesses, but prides itself on scientific excellence. Like most academic establishments it scorns criticism from non-scientists, but it is also ignoring hard, scientific evidence and its own experience that clearly demonstrate that its research engine is going off the rails.

IRRI has always been a breeding operation with the primary objective of raising grain yields. Yet, in three decades, IRRI breeders have never been able to develop rice that surpasses the yield potential of IR8, released in 1966. Since then, it has focused (out of force of circumstance) on incorporating genetic resistance to pests and diseases, which IR8 and its earlier progenies lacked. IRRI has become completely caught up in a cat and mouse game, trying to keep one step ahead of the past problems it has created. It does not take a scientific genius to recognize cause and effect. These problems are the result of its obsession with genetic tinkering from the laboratory level, rather than addressing agricultural challenges — indeed, food security — in a more holistic way from the peoples' level.

Genetic determinism is the scientific principle underpinning most of IRRI's research. This central dogma of biology pervades most scientific pursuits around the world. Yet, there is a huge body of evidence that demonstrates the limitations of this theory (and it is still a theory), and points to the negative ramifications of pursuing it doggedly, which IRRI is now seeing even in its own experimental plots.

IRRI has not bothered to find out why its technology causes such problems in the field, and simpy seeks to replace them with more potent technologies. This is not science: it is denial.

This is clearly the case with the 15-tonner. In the Philippines, many rice varieties have the potential to yield 5-6 tons, but only produce 3 tons under field conditions. Without solving why, IRRI wants to create a rice with a 15-ton potential in the hope that it might give 9 tons in the field. This is akin to "rice roulette."

IRRI's monocrop, monocultural and monovarietal approach narrows the scientific mind. Its reductionist approach leaves out much of the reality — and restricts research directions and outputs. IRRI has always focused almost exclusively on rice alone, rather than embracing and enhancing complex farming systems and livelihood strategies of the poor. This has led to inadequate problem definition and inappropriate responses. For example, total systems yield, nutrition and productivity are often reduced to very limited definitions, distorting the wider picture. Yield is reduced to grain, nutrition to chemical fertilizer and productivity to the rice plant, ignoring other components of farming systems. This approach also has IRRI promoting the single variety farming logic, when farmers are better off planting several rice varieties together for risk insurance, better resource management and higher productivity.[3]

IRRI is not in the business of consulting with farmers when designing, implementing and evaluating research. Farmers are seen as the recipients of science, not its actors. If anyone bothered to look closely, they would see that farmers are just as scientific in their approach to breeding, varietal selection and evaluation, fertility management trials, pest and water management systems, intercropping and so on. In fact, their science is more challenging as it is grounded in complex realities rather than reductionist black holes. The arrogant oversight of IRRI's scientists dramatically reduces the relevance of IRRI's work and damages its credibility. This approach is a structural reality of the entire CG system, give or take a few progressive actors.

At IRRI, the rice plant has become a profession. What happened to farming?

3. *IRRI is the pawn of a 1950s socio-political agenda called "development."*

IRRI was not set up to do science for its own sake (though, observing year to year progress, one could be excused for thinking so). The Rockefeller Foundation, shouldered later on by the World Bank and the CGIAR, had a very clear idea of what IRRI's scientific agenda was meant to achieve: the appeasement of rural (and subsequently urban) unrest; the containment/downfall of ideologies inimical to Northern capital; the creation of solvent consumer markets for industry; and the realization of a particular global economic system based on certain values. It advocated societal engineering through rice seeds. IRRI is thus, a scientific cover for political ends.

The initial Rockefeller ideology is deeply entrenched at IRRI. Its fundamental assumptions and values have not evolved an iota and are guiding IRRI unfalteringly today. The main features of the Rockefeller ideology include Malthusianism, genetic determinism, science as a better solution than politics, technology as tool for social change, and reductionism. These underlying values are embedded in IRRI's activities and outputs. Given secure financial props, this ideological framework produces a very asceptic scientific research environment coated with optimism and naiveté. Many IRRI people *genuinely* believe they are doing Science to do Good.

Another problem that complicates IRRI's role is that it is largely a donor-driven enterprise. The founding mission established by the Rockefeller Foundation has been effectively sold to 20 or so governments and international organizations which now run the Institute through financial support. The donors are the ones who are ultimately responsible for IRRI. They help shape and share IRRI's agenda and sometimes play a heavy role in pushing specific research directions. Despite differences in emphasis, IRRI's donors partake of a common (Rockefeller) vision on how IRRI is to promote what is often sold as "Third World development."

4. *IRRI undermines communities and stifles human resources.*

IRRI fosters dependency rather than self-reliance and engages in proselytization over and above empowerment. The two are closely linked. IRRI's relations with rice producers, rice consumers, scientists, students, policy-makers, journalists and others in the region are, in many cases, center-periphery relations. This is a very expensive and debilitating operation. IRRI creates dependency through what it deems as its field of excellence: training, information work, and technological outputs. IRRI's intellectual impact on rice researchers and policy-makers in Southeast Asia has been almost at the level of brainwashing. Many, if not most, NARS people in the region have been successfully acculturated into the IRRI mindset, which IRRI's founders, and later, the CGIAR, stressed as vital. Many government people and national scientists mimic IRRI's discourse on "the population bomb" and the need for higher yields as a solution to hunger and poverty.

For farmers, the impact has been equally powerful. IRRI rice technology has instilled a push-button approach to rice farming. Weak soil? Fertilize. Bugs? Spray. Everyone seems to be waiting for the next hand-out — be it a 15-ton rice, a prestigious upcoming IRRI conference, the chance to be cited, or new methodologies for IPM. This is not empowerment but drug addiction. The technical fix mentality is not a promising path to sustainable futures.

5. IRRI's approach is environmentally unsustainable.

The evidence of the past three decades demonstrates that centralized breeding could be seen as a conscious effort to introduce more risk, more vulnerability and more fragility into agriculture. It is almost a deliberate weakening process, both in ecological and social terms. It is blindingly obvious that generic technologies can not meet local specifications without recourse to additional props or yet further work to fine-tune and adjust. The props have taken hold: pesticides, chemical fertilizer, high volume irrigation and financial debt are the norm of IRRI-driven rice farming in Southeast Asia. Centralized breeding requires expensive compensation (extra inputs, extra adaptation work, extra research and extra capital) to lower the heightened risks it inherently produces. And this expense creates further problems.

IRRI has caused, and only marginally made up for, a stunning loss of biological diversity in Southeast Asian rice farming. Nutritiously and ecologically superior polycultures were replaced by monoculture in many areas, and the "ace variety" syndrome has displaced more sustainable approaches to cropping patterns. The expansion of irrigation schemes to provide the water necessary for IRRI rice varieties has also led to deforestation and the loss of watersheds. Hundreds of thousands of unique, indigenous rice varieties have disappeared from local communities due to the seduction of just a few high-response varieties from IRRI. Luckily, 75,000 accessions — mostly landraces — are sitting in IRRI's genebank in Los Baños. But the families of those who developed and conserved the seeds will probably never see them again. Nor has much been given to them by IRRI in return. The loss of rice biodiversity is a loss of useful materials for people to work with at the community level and a further weakening of increasingly marginalized local cultures.

IRRI itself recognizes the devastating effect its technologies have had on soils, water quality, human health, biodiversity and overall ecosystem balances and health. But it can only bring itself to adopt an ambulance approach to dealing with these impacts, while simultaneously pursuing its nirvanic goal of 15-ton rice, which will obviously require even more intensive farming practices. Using the green gloss purveyed by industry, it talks boldly of pursuing a goal of environmentally sustainable agriculture, but it has chosen to take a dubious path to get there.

The more it changes...

IRRI, its founders, and its present donors have segregated one plant from the immense complexity of peoples' livelihoods systems in Southeast Asia and built a monolithic empire around it.

IRRI's starting point — that science is the problem and technology, the solution — makes no sense to NGOs promoting sustainable agriculture.

Research is needed for certain. Technical improvements can always be made on farming systems. After all, that is how agriculture and uncounted generations of creative farmers have kept humanity alive the past 12,000 years. But the basic root problems are socio-political. Inequity is not because we don't have apomixis in rice. And Vietnam is not a major rice exporter today because of IRRI, but because of land reform.

IRRI is essentially centralized and top-down as a rice research entity. This is great if you want fast results, an efficient scientific machine, and easy rapport with your funders. That, of course, is what the Rockefeller Foundation was attached to. But it makes for very skewed science. The research tools are very artificial: strange, controlled environments such as phytotrons and chemically-sterilized fields; farm labourers dressed like astronauts; genetic resources that have been cut off from evolution for the past thirty years sitting in a freezer, and so on. Yes, some of that can be useful, but it is nowhere near enough.

None of these points of critique is new. And ***that*** is, by far, the most disturbing conclusion of this study. We hoped that in 35 years of challenging work, IRRI would have instigated some changes so that its research could be more responsive to farmers' needs. Our findings show that the IRRI of today is not that different from the IRRI of the 1960s or early 1970s. Yes, the discourse has changed and become more politically correct. Yes, there are some progressive researches going on. Yes, IRRI knows what NGOs are. And yes, there are far more powerful tools being employed, many more sharp minds engaged, and mountains of new scientific data appearing on the rice plant and rice production. But the ideology, the research emphasis, the way of doing science and the power structure behind and reinforced by IRRI are still those of the Rockefeller dynasty.

1 Statement made at the Southeast Asian NGO/NARS/IARC Dialogue on "*Rice, Food Security and the Ecology*," Chiang Mai, 12 November 1992.

2 "Back on the Road: A Survey of the Philippines," in *The Economist*, London, 11 May 1996.

3 See for example Kulkarni, N (1995), "Competitive ability of medium-duration rices for grain yield," *International Rice Research Notes*, Vol. 20, Number 2, IRRI, Los Baños, p 9.

IRRI, its founders, and its present donors have segregated one plant from the immense complexity of peoples' livelihoods systems in Southeast Asia and built a monolithic empire around it.

ACRONYMS

BPH	brown plant hopper
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture (CGIAR, Colombia)
CIMMYT	International Wheat and Maize Improvement Centre (CGIAR, Mexico)
DNA	deoxyribonucleic acid
FAO	Food and Agriculture Organization of the United Nations
GATT	General Agreement on Tariffs and Trade
GMO	genetically modified organism
HPR	host plant resistance
HYV	high-yielding variety
IARC	International Agricultural Research Center (CGIAR)
IBPGR	International Board for Plant Genetic Resources (CGIAR, now IPGRI, Italy)
ICLARM	International Center for Living Aquatic Resource Management (CGIAR, Philippines)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (CGIAR, India)
IFPRI	International Food Policy Research Institute (CGIAR,USA)
IITA	International Institute for Tropical Agriculture (CGIAR, Nigeria)
INGER	International Network for the Genetic Evaluation of Rice
INM	integrated nutrient management
IPGRI	International Plant Genetic Resources Institute (CGIAR, Italy)
IPM	integrated pest management
IPRs	intellectual property rights
IRRI	International Rice Research Institute (CGIAR, Philippines)
NARS	National Agricultural Research System
NGO	non-governmental organization
PBR	Plant Breeders' Rights
PO	peoples organization
RFLP	restriction fragment length polymorphism
SDC	Swiss Development Cooperation
TAC	Technical Advisory Committee (to the CGIAR)
TRIPS	Trade-Related Aspects of Intellectual Property Rights (GATT agreement)
UN	United Nations

UNCED	United Nations Conference on Environment and Development
USAID	United States Agency for International Development
WARDA	West African Rice Development Association (CGIAR, Ivory Coast)

GLOSSARY

Accession: a sample of seeds or plants collected for storage in a gene bank.

Allele: alternative version of a gene. A gene for eye color may have several alleles, coding for green, brown, grey or blue eyes.

Agenda 21: the Plan of Action drawn up at the Earth Summit in Rio in 1992. It is a comprehensive set of programmes of action to promote sustainable development into the 21st century. Although non-binding, Agenda 21 is an important document representing a consensus of the world's governments.

Biodiversity: the diversity of life. The term refers to the millions of life-forms found on earth, the genetic variation between them and their complex ecological interactions. Biodiversity can also be thought of as a web of relationships between organisms and the environment which ensure balance and sustainability.

Bioprospecting: the exploration of commercially valuable genetic and biochemical resource.s

Biotechnology: any technique that uses living organisms to make or modify a product, improve plants and animals, or develop microorganisms for specific uses. Often (wrongly) used synonymously with genetic engineering. The term "biotechnology" covers a much wider spectrum of techniques and processes. For IRRI's definition, see p. 161.

Bt toxin: a generic term for a group of toxins produced by the bacterium *Bacillus Thuringiensis* which are active against a wide range of crop pests. The toxins are sometimes sprayed externally on the plants, but more interest is now going into transplanting the gene coding for the toxins into the crops themselves.

Chromosomes: a long, thread-like chain of genetic material found in the cells of most organisms. Chromosomes consist of DNA and protein wound together to form a double helical structure.

Conservation: the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations. Thus, conservation is positive, embracing preservation, maintenance, sustainable use, restoration, and enhancement of the natural environment.

Consultative Group on International Agricultural Research (CGIAR): an informal coalition of donors (largely from the North) that funds and promotes R&D into international agricultural research via its organs, the International Agricultural Research Centers (IARCs).

Convention on Biological Diversity: a legally-binding agreement for the conservation and sustainable use of biodiversity. Adopted in Nairobi in May 1992, the Convention was opened for signatures and signed during the Earth Summit by over 150 countries. By October 1995, it had been ratified by 126 countries and the EC.

Cultivar: a cultivated variety of plant, used interchangeably with "variety."

Deoxyribonucleic acid (DNA): the molecule found in chromosomes which is the repository of genetic information in almost all organisms. The information coded by the DNA determines the structure and function of an organism.

Dwarf genes: the genetic powerhouse of the Green Revolution. These genes produced varieties of crops such as wheat, rice and maize with shorter, stiffer stems, so that the plants can put more energy into the production of grain at the expense of peripheral parts such as stems, leaves, etc.

Ecosystem: a dynamic complex of plant, animal, fungal and micro-organism communities and their associated non-living environment interacting as an ecological unit.

Endemic: restricted to a specific region or locality.

Ex situ conservation: "off site" conservation. Keeping components of diversity alive outside of their original habitat or natural environment.

Farmers' Rights: a broad interpretation of intellectual property rights, designed to overcome the shortcomings of other IPR systems which fail to address the inventive process of informal systems. Adopted by the FAO's International Undertaking on Plant Genetic Resources.

Gene: the functional unit of heredity usually carried on the chromosome and made up of DNA. A gene codes for a particular protein molecule. A single gene sometimes codes directly for a particular characteristic, but more often a particular trait is the result of the interaction between several genes and the environment.

Genebank: a facility established for the *ex situ* conservation of seeds, tissues or reproductive cells of plants or animals.

Gene flow: exchange of genes between different, usually related, populations. Genes commonly flow back and forth amongst plants via transfers of pollen.

Gene pool: the variation in the genetic composition of individuals within or among species; the inheritable genetic variation within and among populations.

Genetic engineering: modifying the genetic make-up of living organisms using molecular biology techniques that can transfer genes between widely dissimilar organisms.

Genetic resources: strictly speaking, the physical hereditary material (germplasm) which carries the genetic charcteristics of life forms. In the broader sense, genetic resources are the germplasm plus information, funds, technologies and social and environmental systems (GIFTS) through which germplasm becomes a socio-economic resource.

Genome: the entire collection of an organism's hereditary material contained in its genes.

Genotype: the genetic make-up of an organism.

Germplasm: the genetic material that comprises the physical basis of the inherited qualities of an organism.

Herbicide: a chemical weed killer.

High-yielding variety: a variety that has been bred to produce a high yield of a particular crop. This was achieved with Green Revolution crops largely by the introductionof "dwarf genes" (see definition). Some critics think that "high response" variety is a more accurate term, since in the absence of fertilizers and irrigation, they perform worse than traditional varieties.

Intellectual Property Rights (IPR): a bag of tools designed to protect peoples' knowledge. Designed to promote and protect innovation by allowing the "owner" of the knowledge to have a monopoly over his or her invention for a designated period of time.

In situ conservation: "on site" or the conservation of biodiversity within the natural environment.

Micro-organism: single-celled organism often used as a vehicle or mini-factory for the production of genetically-engineered products, such as the sweetener, thaumatin or enzymes used in cheese-making, which can be harvested from the bacteria.

Miracle seeds: the seeds that gave rise to the so-called high-yielding crops of the Green Revolution.

Non-governmental organization (NGO): a non-profit group or association organized outside of political structures to realize particular social objectives (such as environmental protection) or to serve particular constituencies (such as indigenous peoples). NGOs range from small groups within a particular community to national or international organizations.

Natural selection: process by which the interaction between organisms and the environment leads to a differential rate of reproduction among genetic types in a population. As a result, some genes increase in frequency in a population, while others decline. Natural selection is one of the driving forces of evolution.

Patent: a legal mechanism offering a temporary monopoly of righs which is awarded to an individual in respect of innovative processes or products they have created.

Phenotype: the outward appearance, or physical and physiological characteristics, of an organism.

Plant Breeders' Rights (PBR): monopoly rights awarded to plant breeders and farmers. These differ from patents in that the monopoly is granted only for the marketing of a specific variety, not over ownership of the germplasm.

Polymorphism: the co-existence of two or more distinct forms of individuals bearing the same genes in a population.

Population: in genetics, a group of individuals which share a common gene pool and can interbreed. Traditional planting materials used by farmers are usually referred to as populations because they are heterogenous, as opposed to the pure lines produced by research centers or industry.

Reductionism: the dominant approach to the scientific method, which reduces organisms, and life itself, to their mechanistic parts and disregards the interconnections and dynamism between genes, physiological systems, organisms and their environments. Systems approach, holism.

Selection: any process used to sift out certain genotypes rather than others; breeding.

Species: a population whose members are able to interbreed freely under natural conditions.

Species diversity: the variety and frequency of different species.

***Sui generis* legislation:** a unique form of intellectual protection, designed to fit a country's particular needs and context. Because of its adaptability, *sui generis* protection is being considered in GATT and the Biodiversity Convention as an alternative to the universal blueprint protection that patents offer.

Sustainable deveopment: development that meets the needs of the present without compromising the ability of future generations to meet their own needs; improving the quality of human life while living within the carrying capacity of supporting ecosystems.

Sustainability: in IRRI-speak, discussions on sustainability only address the environmental aspects of sustainability, rather than the wider context of social and cultural sustainability.

IRRI's concern for sustainability is focused mainly on producing "sustainable high yields" of rice.

Systems approach: looks at living organisms and living systems as interconneced and co-dependent entities, rather than as isolated, self-contained units. Reductionism.

Trait: genetic predisposition for a physical characteristic, such as eye colour, pest resistance or drought tolerance.

Transgenic plant: one that has been genetically-engineered, or the offspring of other transgenic plants. Typically, a transgenic plant contains genetic material from at least one unrelated organism.

Variety: a group of plants within a speciies which share a common characteristic. Same as "cultivar."

Virus: the smallest known type of organism. Viruses cannot exist in isolation — they must first infect a living cell and usurp its synthetic and reproductive facilities. Generally causes disease in host organisms.

THE PUBLISHER

SEARICE is a non-government organization involved in community organizing, field work, public education and policy change related to conservation and use of plant genetic resources in Southeast Asia.

In the mid-1960s, the first "miracle rices" developed by the International Rice Research Institute, based in the Philippines, set in motion what became known as the Green Revolution. The so-called high-yielding varieties, and the package of technology that came with them, transformed rice farming in Asia. The promised yields depended on massive use of chemical fertilizers, pesticides, sophisticated irrigation and credit to pay for it all. In the process, rice farmers who stayed rice farmers were relegated to the job of consuming IRRI's prescriptions in the name of agricultural development. As a program for social, political and economic change, the Green Revolution — and IRRI as its prototype scientific engine —has stirred tremendous controversy. Yes, rice grain yields increased at a pace faster than population growth. But at a huge cost in human, environmental and socio-economic terms.

By the mid-1980s, IRRI, its funders and countless farmers in Southeast Asia were hard-pressed to face the downside of the Green Revolution. Key concerns of both the mainstream development community and NGOs became common buzzwords: sustainability, empowerment, peoples' participation, equity, gender. IRRI lost no time in adopting the jargon. By the early 1990s, it was announcing to the world its own overhaul to a more farmer and environment-friendly Green Evolution.

Southeast Asian NGOs long critical of the Green Revolution decided to take a close look at these promised changes to see if they draped a cosmetic facelift or IRRI really had something new and interesting to offer. As one part of a much wider process of dialogue, analysis and reality-check, SEARICE facilitated an independent NGO review of IRRI and its operations in Southeast Asia. *Oryza Nirvana?* is the output of that project. Its aim is twofold: to update the NGO community on IRRI 's current research activities and to examine whether or not the Institute can address widespread concern for farmer empowerment and sustainability in a truly relevant way. Thirty years down the Green Revolution pathway, is "the new IRRI" — is it really "new" or is it engaged in an elusive pursuit of nirvana instead?

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