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International Centers Week
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Agenda Item 6

Attached is a copy of the Third External Program Review Panel Report of the International Rice Research Institute (IRRI), including a transmittal letter from the Chairman of the Technical Advisory Committee (TAC) to the Chairman of the Consultative Group and TAC's Interim Commentary. The EPR process will be completed when a Board approved long-term strategy for IRRI becomes available to TAC.

These documents are for the consideration of the Group at ICW 1987 under Agenda Item 6 - Report of the Third External Program Review of IRRI.

Attachment

Distribution

CGIAR Members
TAC Chairman
TAC Members
Center Board Chairpersons
Center Directors
TAC Secretariat

THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

REPORT OF THE

THIRD EXTERNAL PROGRAM REVIEW

OF THE

INTERNATIONAL RICE RESEARCH INSTITUTE (IRRI)

TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

May 1987

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

The Chairman

Paris, 26 August 1987

Dear Dr. Hopper,

I am pleased to transmit to you the Report of the Third External Program Review of IRRI which, together with the External Management Review, was discussed by TAC at its 43rd meeting in Nairobi, Kenya.

This external review initiated a third round of such Center reviews, and its Terms of Reference reflected current thinking in the System that reviews should be more strategic in nature and less concerned with the minutiae of individual program elements. TAC considers that the Panel has fulfilled this objective admirably in undertaking a critical analysis of the Institute and preparing a forward-looking, constructive report.

During its discussions, the Committee noted that the Center did not have a Board-approved strategic plan, although a Strategic Planning Committee composed of Center staff, had been working for about a year, and their latest draft had been given to the Panel. However, without the endorsement by the Board, and without program leaders to discuss the implications of the recommendations, the Panel could comment only in very general terms. As far as TAC was concerned, in the absence of a Center strategy, it found it could not comment meaningfully on some of the Panel's recommendations.

The Committee decided therefore to prepare an interim commentary concentrating on those issues which were controversial or required clarification. This interim commentary is attached to the Panel's Report which is forwarded to you in advance of our final conclusions because it raises a number of issues which have implications for the whole System, especially for those Centers reaching maturity.

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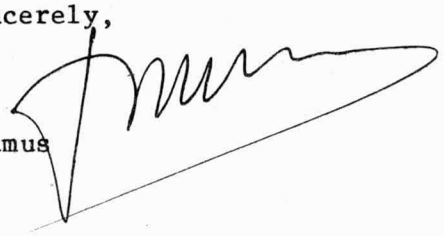
Some of these Centers have successfully attained their original objectives of strengthening the research and training capacities of those national systems that are the largest producers of their mandated crop or crops. Such issues as institute size and administrative capacity, narrow focus or broad diversity, and of whether one institute can be expected to meet the needs of the full range of all potential clients, especially if it is moving towards upstream research, are all touched upon.

IRRI is now at a crossroads. There is no question of the quality of IRRI's past achievements nor of its ability to continue to provide leadership and direction in the science of rice in the future. The question is rather in what manner and how should its mandate be implemented in the future. The evident strength of the national systems of the major rice producing countries requires IRRI to move into more upstream research with all deliberate speed if it is to bring new knowledge rapidly into the service of rice producers and consumers. In this view TAC is in complete accord with the Panel. TAC, and the Institute itself I am sure, would welcome a discussion of the Group's views on these topics before the strategic plan is in its final form.

The Institute has assured the Committee that its strategic plan will be completed prior to TAC's meeting in March 1988. The Committee therefore expects to present its final conclusions and recommendations on the external review of IRRI to the Group in May 1988.

Yours sincerely,



Guy Camus

TAC INTERIM COMMENTARY ON THE EXTERNAL REVIEWS OF IRRI

TAC is most grateful to the two Chairmen, Sir Ralph Riley and Professor Lowell Hardin, and their Panels for the penetretating reviews and excellent reports. TAC shares the views of the two Panels on IRRI's outstanding leadership in rice research and the contribution it has made to the well-being of millions of people in developing countries.

Both Panels have commented on the limitations imposed on their conclusions by the fact that IRRI had not completed its strategic planning exercise. The plan made available to the Panels was a draft document, prepared by staff, but for which the Board had not assumed responsibility.

TAC considers that one object of strategic planning is to inject rigour and transparency into the planning process. An approved strategic plan is consequently essential to an external review. TAC recognizes that the Centre will need time to develop its revised long-term plans but a review cannot be considered complete until the strategic plan has been presented for TAC's consideration and endorsement. Consequently, the reviews will remain on TAC's agenda until a final strategic plan has been cleared by the Board and presented to TAC for its endorsement.

Much of the material in both reports gives valuable insight into the changes that IRRI must make as it charts its future course. In general, TAC commends both reports to the IRRI Board and management for careful consideration as the Centre refines its strategic plan.

To assist in clarifying some of the issues that appeared to be controversial from the preliminary reactions of the Board, TAC offers the following interim commentary on the EPR and EMR reports. TAC considers that there is much in the report that the Board should consider carefully, but comments here are limited to those points that were drawn to its attention by the Panel, or that require additional clarification.

- The External Programme Review

In its analysis of IRRI's past successes and present character, the Panel has touched on some controversial issues to which the Board has responded vigorously. Nonetheless, TAC is pleased to note the Board's general acceptance of many of the suggestions the Panel has offered for its consideration.

Programme Balance

The Panel drew TAC's attention to the trade-offs IRRI is facing in adjusting its programme to meet the agreed CGIAR priorities and particularly to the choice between "productivity and livelihood". In discussing the need identified in the TAC Study on Priorities and Strategies to devote more effort to improving non-irrigated systems, the Panel commented:

> "If, within fixed budgets, this means that IRRI should substantially reduce maintenance research on the irrigated crop, considerable potential for further increase will be placed at risk unless the national systems can confidently be expected to take over the responsibilities."

TAC accepts that future strategies for the CGIAR Centres will depend heavily on the rate and extent to which national research systems can increase their own capabilities. The Committee agrees with the repeated emphasis given by the Panel, on the need for IRRI to keep its relationships with national research systems under critical review in order not to prejudice their ability to become self-reliant. In particular, TAC endorses the Panel's view that adaptation of varieties to local environments should increasingly be left to national programmes, enabling IRRI to accelerate its upstream approaches to research and thereby continue to contribute effectively to maintenance research.

TAC notes the somewhat divergent views of the Panel and the Board on the release of finished varieties, but sees the issue primarily as one of scale. While breeders will naturally wish to continue to release homozygous lines, both as potential varieties and as parents for crossing, the Committee agrees with the spirit of the Panel's recommendation that the scale of this activity should be selectively and progressively reduced. Clearly, weaker national programmes will continue to require homozygous lines on a scale adequate for the selection of finished varieties. Stronger programmes, however, will require only segregating populations or parents for crossing, for which prior fine-tuning is not necessary and thus the scale of supply can be very much less.

All-in-all, therefore, TAC sees in the Panel's report an endorsement of the feasibility of the strategy agreed by the Group. While accepting that there will be difficult trade-offs to be resolved, TAC considers that the move upstream should enable IRRI to continue to make major contributions to maintenance research for the irrigated crop. This would complement the work of the stronger national systems, leaving IRRI with the capacity to continue to assist the weaker programmes and tackle important problems in the rainfed environments.

Interpretation of Global Responsibilities

The Panel clearly recognized IRRI's status as the principal world research institute for rice, with similar status as a repository for knowledge. In considering how its global responsibilities should be interpreted, the Panel suggested the following:

- rice germplasm conservation and enhancement;
- library information services;
- network coordination;
- increasing knowledge on tropical rice.

In its response, the Board accepted this interpretation of global responsibilities and TAC agrees.

However, TAC recognizes that there are different interpretations of how these global responsibilities should be implemented. The Panel commented that TAC had not yet made recommendations on the overall sharing of responsibilities for rice research among the four Centres supported by the Group. It therefore took a rather conservative position with respect to IRRI undertaking research outside Asia.

TAC, in its current discussion on the sharing of responsibilities among Centres considers that as a basic principle a Centre with global responsibility for a given commodity should collaborate scientifically and in the most beneficial manner with other Centres that have regional or agro- ecological responsibilities for the same commodity. In these circumstances, however, the primary responsibility for coordination with the national programmes should be vested in the Centre best placed logistically to fulfill that function.

In areas, such as eastern and southern Africa, where no other Centre has responsibility for rice, IRRI should feel free to cooperate with national programmes. It should do so, however, in strict accordance with the Board's strengthened criteria taking due account of the strengths of the national programmes concerned.

With regard to IRRI's distribution of effort between Asia and other regions, TAC broadly accepts the Board's interpretation given in its response to the Review that its primary responsibilities lie in Asia, but that it also has obligations to other regions.

International Rice Testing Programme (IRTP)

TAC recognizes the important role the IRTP has played in the development of national capabilities in rice breeding and related research, but agrees with the Panel on the need for a critical and objective assessment of the programme's scope and future direction. Such an assessment should include consideration of the question of the posting of IRTP staff outside Asia and their integration with the host Centre's research activities. TAC sees obvious advantages in an arrangement whereby an IRRI scientist works at a host Centre as an equal member of an integrated research team. There is not only the need to assess the degree of integration but also ways of exploiting the advantages of a global Centre.

A Centre with a global commodity mandate has at its disposal a unique combination of the breadth of its germplasm collection and the array of environments to which that germplasm can be exposed. IRRI should ensure that its scientists continue to use this powerful research tool as effectively as possible to define new ideotypes and evaluate their potential.

Farming Systems Research

TAC endorses the Panel's comments that IRRI's research with a farming system's perspective could become too all-embracing and diffuse, that the focus should be on component research and that the location-

specific elements could best be done within national programmes. TAC considers that a Centre's involvement in the adaptive element of farming systems research should be limited to developing research methodologies, training, and stimulating awareness of the benefits of this approach. Centres should also maintain active linkages with national programmes as a means of channelling critical feed-back to their scientists.

In relation to considerations such as sustainability and the growing importance of diversification in Asian production systems, TAC acknowledges the need to design, analyze and evaluate improved cropping sequences, intercrops and relay-crops. It is also important that any new cropping patterns should take into account the various socio-economic and resource constraints of the range of rice environments, especially the unfavourable ones.

Although TAC therefore sees the need for IRRI to explore the use in rice-based systems of crops other than rice, it should strictly limit its own research on them. Because of the occurrence of genotype-environment interactions, evaluation of varieties of crops other than rice is essentially a task for national programmes. TAC considers that most of the required work on individual alternative crops could be undertaken through collaboration with other institutions, both national and international. IRRI should therefore actively search for such opportunities.

The consensus reached at the recent Workshop on Farming Systems Research (FSR) in the IARCs was that FSR is a multi-disciplinary approach rather than a distinct discipline. TAC shares this view and concurs with the EPR Panel that IRRI should reconsider the organization of its work on multiple cropping. If the future organization of IRRI is to be based on strong disciplinary departments, with research conducted and funded through projects, then it would seem logical that the staff working on multiple cropping should be absorbed into the most relevant disciplinary department.

Research on Soils and Water

From further elucidation of the Panel's views on IRRI's research on surface and floodwater hydrology, TAC understands that the Panel recommendation was based more on considerations of management than of science. Each department, or discipline, in IRRI's organizational structure must be strong enough to develop its own critical mass. The Panel's view, which is not clearly expressed in the report, is that a critical mass of scientists in a water management department would be tempted to stray into areas of research that lie outside IRRI's mandate. Consequently, it would be preferable, in the Panel's view, to maintain a critical mass on both water and soils within a single department. Accordingly, TAC draws this recommendation to IRRI's attention for consideration in the organizational adjustment required for its revised strategy.

The Committee recognizes that IRRI reorganized its water research programme in 1985 in consultation with IIMI and agrees that IRRI should limit itself to research on problems of on-farm water management, leaving the broader problems of irrigation management to IIMI.

Biological Nitrogen Fixation

The Panel's reservations about the future of IRRI's programme on biological nitrogen fixation were discussed during the TAC meeting. It became clear that the Panel was concerned about the potential for impact of the technologies being developed, bearing in mind the likely benefits and costs. For example, Azolla requires high levels of phosphate in the water, blue-green algae need to be protected with biocides and Sesbania has high labour or power requirements for incorporation. TAC considers that, on the basis of the research already completed, these technologies should be assessed in terms of their economic viability and the future of the programme determined accordingly.

TAC agrees with the Panel that IRRI should not do research on leguminous crops per se. If additional research is required to support investigations on their use as components of production systems, it should be done in collaboration with other institutes.

Agricultural Engineering and Development of Farm Machinery

TAC has fully recognized in its priorities and strategies the importance of mechanization in agricultural development. It did, however, anticipate less work on mechanization within the CGIAR System as greater responsibilities for development and adaptation were assumed by private manufacturers and national systems.

TAC acknowledges the excellent work done by IRRI in this field which has resulted in a number of low-cost small-farm machines and tools which have been adopted in many countries. As pointed out by the EPR Panel, the recently-developed continuous-flow/rotary dryer has the potential to overcome a major constraint in the post-harvest management of rice in many areas of the world.

Increasing labour productivity on small farms is a valuable means of achieving CGIAR goals. This is particularly true in small, labour-intensive rice farms. Undoubtedly, the small-farm machinery for irrigated lowland rice farming that IRRI has developed, together with the Institute's experience in Asia, could be extremely useful in other regions of the world. TAC endorses the Panel's recommendation that IRRI should continue to conduct work on agricultural engineering. The aim should be to increase cropping intensity (e.g. facilitating double cropping) and labour productivity, reduce production costs and post-harvest losses, and conserve grain quality. TAC encourages IRRI to analyze the reasons for its success in this area of research and development and examine how the benefits could be extended to other regions, outside Asia.

Socio-Economics

TAC agrees with the Panel's recommendation that the Economics Department should place more emphasis on inter-disciplinary research in areas such as resource management and the economics of sustainability in different rice-growing environments; the economics of pest management;

and the impact of new rice technologies on the role of women in rice production and rice-farming families. However, TAC agrees with IRRI that it is essential to maintain some capacity for the analysis of aggregate sectoral and policy issues. Both will be needed for several purposes:

- to assess the global rice situation;
- to assess the potential impact of IRRI technologies, as an important input into the process of strategic planning; and
- to assist national programmes to analyze issues in rice research and policy.

Training

In its recommendations on IRRI's role outside Asia, the Panel apparently limited training to candidates from Asia. Given the differences between Asia and Africa, TAC considers that the Panel's comments on training African scientists are appropriate for western and central Africa but may leave a gap for downstream training of candidates from eastern and southern Africa.

In general, however, TAC suggests that IRRI should limit its training of candidates from outside Asia to those who are experienced scientists needing to extend their experience of rice environments, or who require training in new research techniques.

- **The External Management Review**

TAC is pleased to note the constructive spirit in which the IRRI Board has reacted to the report of the Management Review Panel. In general, the Committee strongly endorses the Panel's recommendations, but recognizes that the implementation of some of them will have to be considered very carefully by the Board. In particular, those relating to restructuring the organizational relationships of the scientific staff will require a balanced and somewhat cautious approach in order not to disrupt the research programs or seriously damage staff morale.

As the Panel observed, many of the problems it identified are not unique to IRRI, but are common to many research institutions that have reached maturity. IRRI was the first Centre to be created and there may well be lessons in the Review that should be heeded by other Centres as they approach a comparable age. The Panel's analysis of the problems created by the rapid and somewhat unrestricted expansion of a successful Centre is particularly relevant to the System as a whole.

TAC notes that the Board has already formed a Management Committee to monitor and advise on management issues. This Committee will relate to management matters in the same way that the Programme Committee relates to program matters. TAC agrees with the Panel that the formation of a Management Committee should, at least in the first instance, be regarded as temporary and experimental. Later on, the position could be reviewed, both in the context of IRRI and with respect to its usefulness for other Centre Boards.

The Panel emphasized the need for a more pronounced move towards programme and project management, a view that is reiterated in the report of the EPR and also alluded to in IRRI's draft strategic plan. TAC agrees that the suggested system of matric management is appropriate to target the growing disciplinary research towards well-defined agricultural needs. TAC also agrees with the Panel that the present organizational structure should not be permitted to influence judgement on the direction of future strategies, nor should the present structure be altered until the strategy has been finalized.

The Panel recommended that IRRI should study the implications on future flexibility of its heavy dependence on restricted funding (restricted core plus special projects). TAC considers this recommendation to be timely, particularly in view of the additional restrictions very recently introduced by one of IRRI's major donors. These have the effect of increasing IRRI's restricted funding to 70 percent (compared with the figure of 53 percent referred to by the EMR for 1986).

While donors varied in the restrictions they imposed on the use of funds by Centres, each restriction added another constraint to a Centre's choice of strategy. TAC considers it essential for IRRI to explore its strategic options, at least in the first instance, without regard to restrictions on the use of funds.

- **Next Steps**

In conclusion, TAC welcomes the constructive discussion that the two reports have stimulated among the members of the IRRI staff, the Board and TAC. The recommendations and suggestions of the Panels need to be carefully considered by the Board and management. TAC looks forward to receiving the final version of IRRI's strategic plan which should accompany the Institute's mid-term budget proposal.

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THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

REPORT OF THE

THIRD EXTERNAL PROGRAM REVIEW

OF THE

INTERNATIONAL RICE RESEARCH INSTITUTE

Review Panel: Sir Ralph Riley (Chairman)
Dr. Kazi M. Badruddoza
Dr. Ivan Buddenhagen
Dr. Cornelis T. de Wit
Dr. James Russel McWilliam
Dr. Setijati Sastrapradja
Dr. Montague Yudelman
Dr. D.L. Plucknett (CGIAR Secretariat)
Dr. P. Roberts-Pichette (TAC Secretariat)

TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

May 1987

SIR RALPH RILEY, D.Sc., F.R.S.

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England.
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12 May 1987

Dear Professor Camus,

It is my pleasure formally to submit to you the Report of the Third External Review Panel appointed by the Technical Advisory Committee to study the work of the International Rice Research Institute. My colleagues and I have done our best to advise TAC on the future of a Center which is at a new point of departure as it tries, through its plans, to address the recently formulated CGIAR goal statement and priorities. IRRI is placed in the dilemma of choosing quantitatively between the goals of productivity and livelihood when both have the objective of helping to provide food for the disadvantaged. TAC may need to consider how it can help IRRI in the resolutions of this uncertainty.

IRRI has had a most distinguished history in the service of Asia and it has been an honour for the Panel to assist TAC in the consideration of its future. However, IRRI's route to its future will be unclear so long as no decisions are taken on the regional responsibilities for rice of different Centers. To avoid confusion ahead of this decision, which I hope will soon be taken, the Panel has advised constraint on IRRI's acceptance of responsibilities outside Asia.

During the Panel's time at Los Baños, both for the Internal and External Reviews, the Panel has received the fullest help and every kindness from the Board of Trustees, the Director General and the staff of IRRI at all levels. We are most grateful.

I have personally received great help and support from Dr. Patricia Roberts-Pichette who has deployed her knowledge of the external program review procedures with skill and diligence.

Prof. Guy Camus
TAC Chairman
c/o World Bank
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France

The Panel that it was my honour to chair was made up of members with broad knowledge and wide experience, without which it would not have been possible to complete the daunting task that TAC put before us. I am personally extremely grateful to every one of them.

With this, Sir, I pass to you the Report of the External Program Review Panel of IRRI.

Yours sincerely,

Sir Ralph Riley
Chairman
IRRI External Program Review Panel

TABLE OF CONTENTS

EXECUTIVE SUMMARY

IRRI entered its second quarter century with a distinguished record. Its contributions to rice production in Asia have been outstanding. Now, as with all mature institutions, it faces change, not just in a program sense, but also in the way it approaches new challenges and demands. As a mature institution, it may face some common problems of aging: the threat of blurred or impaired vision, a slower pace and a more conservative manner. The Panel was asked to assess IRRI's capacity to achieve its vision for the future that will meet the needs of rice-growing countries. Those needs include a continued and steady increase in rice supplies without sacrificing the sustainability of the production system. The question today is, will IRRI's vision for the future and the strategies that it adopts result in new knowledge to help meet the needs of rice-growing countries? A summary of the major concerns perceived by the Panel and relevant working principles are given below.

1. Priorities, Strategies

IRRI's early priority was to increase the production of irrigated tropical rice. Its primary strategy to achieve this was to increase yield potential through breeding high-yielding, nitrogen-responsive varieties. Both the priority and the strategy were successful. Because of this success, demands on the Center have increased greatly, and IRRI has tried to respond. Today IRRI must choose more carefully what it will do. A committee of IRRI has prepared a draft Strategic Planning Report. This document does not contain a clear set of priorities or the strategies to achieve them.

Working Principle:

> IRRI should develop a realistic and flexible plan in close consultation with the national programs. In doing this, IRRI must remember it cannot do everything nor work everywhere.

2. Equity, Production, Sustainability

TAC and the CGIAR have stressed the need to increase productivity without compromising the important goals of equity and sustainability. Attempting to balance these goals places a heavy burden on a center. As a single commodity institute, IRRI can make only a partial contribution to these goals. The goals are so complex and far-reaching that they will require major contributions from many institutions involved in education, policy, development and research.

Working Principles:

IRRI should not be expected to shoot at every goal. Its comparative advantage lies in research to improve rice production and stability, and it is here that IRRI should concentrate its efforts.

3. Size, Focus

IRRI made some of its greatest contributions when it was younger and smaller. Some people say IRRI is too large - both in size and program boundaries - others say it just needs better focus and management. IRRI's successes brought increased demands and a belief that the Institute could do almost everything. The expansion of IRRI's programs into areas where it has little comparative advantage endangers the quality and rigour of its science.

Working Principles:

IRRI's worldwide responsibilities are:

- rice germplasm conservation and enhancement;
- library and information services;
- network coordination;
- improving the knowledge base for tropical rice.

IRRI's advantage lies in Asia, where it should focus its activities. It should not become involved in on-site research outside Asia except in collaboration with other centers. It should limit the scope of its research to problems that bear directly on productivity and stability of rice. IRRI must move upstream in research and strengthen its disciplinary base.

4. Research Management

IRRI research is mostly conducted and managed in departments. Departments are needed as disciplinary homes for research and education. Research management in IRRI needs strengthening. Previous interdisciplinary program-based research has been successful sometimes, but has also met with difficulties, partly because program leaders had little control over personnel or budgets. Backup support for outposted staff is inadequate.

Working Principles:

To improve and strengthen its research, IRRI should:

- retain a strong disciplinary structure;
- conduct and finance research through projects, within interdisciplinary programs;
- strengthen its research management by appointing a senior member of the directing staff, who would administer the research programs;
- improve backup support for outposted staff by appointing a member of the directing staff to administer international collaboration activities;
- disband the Multiple Cropping Department and place its staff and essential activities in the Agronomy Department;
- disband the Water Management Department, and combine the soil water hydrology component with the Soils Department;
- develop more rigorous criteria for choosing special projects to avoid the risk of diverting the Institute from its central purpose.

5. Quality, Balance

Continued vigilance to ensure quality and rigour of its research is a major task for IRRI. There can be little doubt that this task has never been so important as it is today, when IRRI's research boundaries appear to be expanding. IRRI is constantly pushed and pulled by demands from donors, the CGIAR, and others to become involved in a great array of interesting, but disparate, causes. IRRI must continue to move upstream in disciplinary research, to deal with certain complex problems more effectively. At the same time, it must keep one foot firmly in applied research, using a multidisciplinary research approach to produce component technology of value to national programs.

Working Principles:

IRRI should:

- continue to move upstream in all aspects of its research to keep abreast of explosive growth of relevant science;
- act as a bridge between the "new" science and the needs of national programs;

- ensure disciplinary strength through departments that are committed to excellence, and use periodic peer reviews to ensure rigour and quality;

- increase the research effort on rainfed lowland rice, and give priority to upstream and yield-sustaining research for irrigated rice;

- for the less favourable upland, deepwater and tidal wetlands, emphasize research to evaluate their potential for increased production without sacrificing long-term sustainability;

- orient its genetic improvement program toward more basic aspects of germplasm enhancement and devote much less effort to perfecting finished varieties;

- encourage on-site breeding by national programs to satisfy local needs and maximize genetic diversity;

- intensify research to increase genetic yield potential of rice, using integrated teams involving plant physiologists, geneticists and plant breeders;

- acquire the necessary skills to undertake more creative research on durable and stable disease and insect resistance;

- cease its support of farming systems research, but continue to invest in component research with a farming systems perspective; new technology should be evaluated in the Asian Rice Farming Systems Network;

- focus socio-economic research on microeconomic aspects of technological change and sustainability.

6. National Capability

IRRI has had a considerable impact on the number and capability of rice scientists in Asia. Some national programs are now strong, while others still require continuing support. IRRI's training and collaborative programs - including networks - have contributed to these developments and must continue to evolve. This will require doing more with rather than for the national systems.

Working Principles:

IRRI's training program should:

- move upstream to improve research education;

- make the non-degree research training courses more specialized;

- encourage the stronger national programs to take responsibility for general non-degree training;

- to sustain IRRI's vigour and dynamism, encourage candidates for advanced degrees from institutes at the forefront of their disciplines to undertake thesis work at IRRI;

To make its network activities more effective, IRRI should:

- use the networks to stimulate more creative and independent research;

- recognize the need for IRRI network coordinators to maintain a low profile so that maximum credit will accrue to national scientists.

7. Report

All of these issues are dealt with in greater detail in the Panel's report, with the aim of contributing to the future of this important world asset.

CHAPTER 1. INTRODUCTION

1.1. The External Review Process of the Consultative Group on International Agricultural Research (CGIAR)

From its inception, the CGIAR was concerned that the research efforts it supported be effective in achieving its objectives. Therefore, its Technical Advisory Committee (TAC) was specifically charged with undertaking "independent external assessments on the overall scientific quality and effectiveness of each Center". Commencing with the International Rice Research Institute (IRRI) in late 1975, TAC established a pattern of periodic, external reviews (originally known as quinquennial reviews) of centers funded by the CGIAR.

Over time, the objectives and terms of reference of these reviews have been refined to take into account the experience and the needs of members of the Group. The establishment of separate external program and management reviews in 1983, which had been undertaken simultaneously, was part of this evolutionary process.

In its review of the CGIAR Priorities and Future Strategies during 1983-1985, TAC developed a goal statement and eight program objectives as a framework for reviewing the diverse research and related activities in the System. TAC also called for a thorough study of the external review processes, with the goal of making them more effective tools for the management of the System.

Even though the study process had not been completed, TAC decided that the periodic review process could not be interrupted. Therefore, Terms of Reference for the interim period were developed, using some findings of the study and the outcome of the reviews of CGIAR priorities and impact.

1.2. The CGIAR Goal, Objectives, and Program Approaches

The goal: "through international agriculture research and related activities, to contribute to increasing sustainable food production in developing countries in such a way that the nutritional level and general economic well-being of low income people are improved", was accepted by the CGIAR in May 1986.

Eight "program approaches", describing all research and related activities, represent the program objectives of the System. An analysis of how resources are being allocated, and their proposed allocation, is shown in Table 1.

Table 1: Current and proposed resource allocation for the CGIAR Program Approaches.

PROGRAM APPROACH	Allocation of CGIAR Resources (%) Current	Proposed (Long-Term)
Resource Management and Conservation Research	7	13
Crop Productivity Research	57	48
Livestock Productivity Research	13	15
Commodity Conversion and Utilization Research	<1	2
Analysis of Human Nutrition Linkages	<1	2
Food and Agricultural Policy Research	2	3
Strengthening National Research Capacities	18	15
Integration of Efforts	<1	2

Crop productivity research remains the largest program approach, but over the long term should decline relative to others. Resource management and conservation should receive increased attention; a major shift in emphasis toward rainfed agriculture also was recommended.

The Impact Study showed that significant progress had been achieved in rice research, especially for favourable environments, and that strengthened research capacities were enabling several of the national systems of major rice-producing countries to undertake some of the adaptive and applied rice research needed. Therefore, it was suggested that research efforts could be reduced for such commodities as rice and wheat. As this trend accelerates, CGIAR efforts on those difficult problems requiring the collaboration of basic research institutions, the generation of new knowledge, and the use of specialized techniques should be increased.

A TAC analysis of global and regional expenditures of the CGIAR Centers showed that, in 1983, approximately 25% of the System's resources devoted to crop and livestock productivity research were allocated to rice, nearly triple the amount devoted to any other commodity. Therefore, the recommendation was that there should be a reallocation of resources among

commodities, and that the proportion of resources allocated to research on rice should decline relative to other commodities, although rice would remain the System's highest priority commodity. Analysis of the regional distribution of rice research revealed that 30% of the CGIAR expenditures on rice research were being devoted to Sub-Saharan Africa, and that a reduction in the proportion of resources directed to this region was warranted.

With respect to future rice research, TAC recommended that the CGIAR increase its efforts in two areas: (a) on rainfed rice production systems, because non-irrigated rice systems - which comprise almost half the global area under rice production (36% of total rice area is devoted to upland rice and rainfed lowland rice) - have yield constraints more complex than those of irrigated systems and a more limited knowledge base; and (b) on strategic and basic research for rice, in collaboration with specialized institutions. For both irrigated and non-irrigated rice, TAC indicated that it would be necessary to develop new breeding techniques and to increase the knowledge of factors which determine the various resistances and tolerances to insects, diseases, and stresses.

The problems of rainfed lowland and upland rice are location-specific, and close collaboration with national systems is necessary to find solutions. High priority should be given to ensuring that as complete as possible a range of germplasm diversity be represented in the International Rice Germplasm Center (IRGC), characterized and replicated for storage in other germplasm banks, and that the information be made easily available to breeders, especially in the developing countries.

1.3. The Third External Review of IRRI

At its 40th meeting in June 1986 TAC, in consultation with the IRRI Director General and the CGIAR Secretariat, decided that the third External Program Review (EPR) of IRRI should be undertaken between 23 April and 12 May 1987, with a simultaneous External Management Review (EMR).

Following agreement on the timing of the review, and in consultation with the Board of Trustees and management of the Center, TAC constituted a seven-member EPR Panel with Sir Ralph Riley as Chairman; the CGIAR Secretariat constituted a three-member EMR Panel with Dr. Lowell Hardin as Chairman. Membership of both Panels is given in Annex I.

1.4. Terms of Reference and Background Documentation

The EPR Panel was formally charged with evaluating the relevance and appropriateness of IRRI's programs, its past achievements and scientific stature, and - in the context of the CGIAR goal - assessing IRRI's priorities, policies, and strategies in achieving the objectives set out in IRRI's mandate. In considering the implications of this charge, the Panel decided that it should attempt a much more forward-looking review than had hitherto been conventional for EPR Panels.

In accordance with the interim Terms of Reference (Annex II), questions and issues specific to IRRI were raised by CGIAR members, the IRRI Board and management, the Chairman of the Panel, and the Chairman and members of TAC. The list of questions is part of the Terms of Reference.

Background documents on the mandate, history, program evolution, and previous external reviews were provided to Panel members by IRRI and the TAC Secretariat. The list of documents available to the Panel is given in Annex III.

1.5. EPR Activities

The Chairman of the Panel and the TAC Deputy Executive Secretary were invited to attend an international consultation organized by the International Fund for Agricultural Development (IFAD) on "Strengthening National Agricultural Research Systems to Assume an International Role in Specific Areas of Wheat and Rice Research and Training", 26-28 January 1987. This consultation brought together scientific leaders in rice research from developing countries with strong national research programs and broadened the perspective of the Panel on the directions national agricultural systems were taking or might take.

The EPR Panel first assembled at IRRI's headquarters at Los Banos, the Philippines, 22 February-2 March 1987, to attend IRRI's annual Internal Program Review and to become acquainted with the Institute. On 3 March 1987, the Chairman and four members of the Panel left for field visits to Thailand, Burma, and Bangladesh. Subsequently, the Chairman and one Panel member visited Madagascar and Tanzania. Details of these visits are set out in Annex IV. All Panel members reassembled at IRRI headquarters on 22 April 1987 to undertake the main phase of the Review, complete their evaluation, and prepare the report. Throughout the review, members of the EPR Panel were in frequent contact with their colleagues in the EMR Panel. On 12 May 1987, the Panel Chairman presented the observations and recommendations contained in the report to the Board of Trustees, the Director General, and the senior staff of IRRI. The detailed program of the main phase of the Review is given in Annex V.

1.6 The Structure of the Report

The Panel has structured its report so that this introduction is followed by a series of analytical chapters dealing with the evolution of IRRI's mandate since the 1982 review and its current research and research-related programs, research management and support services, interactions with other institutions, and strategies for the future. These chapters are followed by the Panel's overall assessment of IRRI's relationships with its clients, its program content and direction and the likely effectiveness of proposed directions, and the size and scope of its activities in the future.

The Panel has felt free to make any observations or recommendations it considered significant. It recognizes that the report it has prepared, for which it accepts sole responsibility, in no way commits TAC or the CGIAR to consequential action. It wishes to emphasize that Panel

members were unanimous in support of the report and its recommendations. The final chapter, "An Overview and Recommendations" presents the Panel's main conclusions and recommendations. An Executive Summary has been provided.

1.7 Follow-up to the Report

On completion of the review and oral presentation of the findings to the IRRI Board and senior staff, the Chairman of the Panel formally transmitted the Panel's report to the Chairman of TAC. TAC subsequently requested the Chairman to present the Panel's findings, and IRRI its reactions, to the 43rd TAC meeting at ILRAD, Nairobi, 22-30 June 1987. TAC considered the report in the presence of the IRRI Board Chairman, the Director General, and a number of IRRI senior staff. Following the preparation of a written commentary, the Chairman of TAC transmitted the report to the CGIAR, together with the TAC Commentary and the reactions of IRRI.

CHAPTER 2. IRRI'S MANDATE AND ITS INTERPRETATION

2.1. The International Rice Research Institute

IRRI was established in 1960 at Los Banos, the Philippines, by the Rockefeller Foundation and the Ford Foundation, in cooperation with the Government of the Philippines, as a research, training, and information institution for the study and improvement of rice. It was considered that an internationally-supported institution, knowledgeable about the needs of those countries whose populations depend on rice as a staple food, could develop the improved varieties and new technologies which would increase the total production of rice in the tropics, especially the output of the low-income tropical rice farmer. From the beginning, training was an important responsibility of the Institute, as it was considered that new technologies could best be extended by those who knew and understood them, and that national systems needed stronger research capacity if they were to take responsibility for their own needs.

IRRI had its first success in rice research as a result of the release, in the mid-1960s, of semi-dwarf, high nitrogen-responsive variety IR8. That release resulted in rapidly increased rice production in Asia. Since that time, other varieties have been released which have had qualities much in demand by farmers. Many IRRI lines have also been used by national systems as parents in their own breeding programs. With time, IRRI's work has extended to include research into many of the major constraints affecting rice production. Simultaneously, the Institute has grown to include 74 senior core and special project scientific staff and a total annual expenditure of about US$ 30 million in 1986.

2.2. IRRI's Mandate

2.2.1. The Evolution of IRRI's Mandate

The Articles of Incorporation for IRRI were formally signed on 18 and 29 February 1960, following the signing on 9 December 1959 of the Memorandum of Understanding, whereby IRRI was initially established by the Ford and Rockefeller Foundations in cooperation with the Government of the Republic of the Philippines. The second of the Articles of Incorporation, which sets out the objectives of the Institute, is commonly recognized as IRRI's "mandate".

Unlike many commodity centers, which have operational mandates somewhat more limited than their formal mandates, the formal and operational mandates of IRRI are virtually identical.

The Articles of Incorporation have been revised on a number of occasions, the last after the second Quinquennial Review in 1982 in response to the Panel's recommendation to update the interpretation of the mandate to reflect IRRI's dual role in basic and applied research, its supportive role and servicing functions for national systems, its involvement in rice-based farming systems research and technology development, and its responsibilities for the conservation of rice germplasm, and to reflect IRRI's responsibilities for geographical regions outside Asia. The Panel also indicated that changes in the interpretation of IRRI's mandate required further attention with respect to post-harvest problems at farm and village level. Following the completion of the Review, the Board and Members of the Corporation formally approved changes to the Articles of Incorporation on 19 October 1982 and filed them with the Securities Exchange Commission of the Republic of the Philippines. Neither TAC nor the members of the CGIAR considered the changes made to the mandate and, although both had agreed that some changes were necessary, both also had agreed that precise definition of some aspects of IRRI's responsibility would have to await the settlement of issues related to other Centers. Nevertheless, the net effect of the changes to the Articles of Incorporation referring to IRRI's research and research-related responsibilities was to broaden the mandate geographically.

The second Article of Incorporation describing the mandate as amended and filed with the Philippine Securities Exchange Commission is reproduced below with the changes marked - square brackets for deletions, underlining for additions.

That the Institute is organized as an autonomous entity and the purpose of the [Corporation] Institute is to establish, maintain and operate an international rice research institute designed to pursue any and/or all of the following objectives:

(i) To conduct [basic] research on the rice plant, on all phases of rice production, management, distribution and utilization with a view of attaining nutritive and economic advantage or benefit for the people of Asia and other major rice-growing areas of the world through improvement in quality and quantity of rice;

(ii) To publish and disseminate research findings and recommendations of the Institute;

(iii) To distribute improved plant materials to national, regional and international research centers where they might be of significant value or use in breeding or improvement programs;

(iv) To develop and educate promising young scientists [primarily] from [South and South-east] Asia and other major rice-growing areas of the world along lines connected with or relating to rice production, distribution and utilization, through resident and joint training programs under the guidance of well-trained and distinguished scientists;

(v) To establish, maintain and operate an information center and library which will provide, among others, for interested scientists and scholars everywhere a collection of the world's literature on rice;

(vi) To establish, maintain and operate a rice genetics resources laboratory which will make available to scientists and institutions all over the world a global collection of rice germplasm;

(vii) To organize or hold periodic conferences, forums, and seminars, whether international, regional, [local] national or otherwise for the purpose of discussing current problems and for developing research strategies for elevating and stabilizing rice yields under different environments.

2.2.2. Issues Relating to IRRI's Mandate

From the above, it is clear that there was a confusion of purpose between TAC and the Trustees of IRRI. The mandate now makes clear what has always been the de facto situation, namely that IRRI is the principal world repository for knowledge on rice and has the principal world capability for research and training on rice. IRRI is enabled to contribute to rice research and training anywhere in the world, but is given no exclusive responsibilities. It can bring its unique resources to bear wherever it is able or willing to deploy them, provided that it does so with appropriate sensitivity to the regional responsibilities of other Centers. Furthermore, although the absence of a positive mandate had not inhibited IRRI from launching a major involvement in germplasm conservation, it is appropriate that reference to this activity should be made in the Articles of Incorporation. Reference there now implies that the study of genetic resources and the conservation of germplasm may be obligatory to IRRI.

In certain respects, IRRI interprets its "mandate" broadly. It does research on crops and products other than rice in farming systems. This arose from a concern that resource-poor farmers whose staple crop is rice may not be able to provide for their families from the rice crop alone. Although, work on the non-rice components of farming systems can help such people, it does not necessarily have a natural place on IRRI's agenda.

In education, IRRI is required to ensure that it is carried out "under the guidance of well-trained and distinguished scientists". "Distinguished" is impossible to define in this context, but "guidance" is not interpreted as meaning that a great deal of student contact must be with senior staff. Indeed, this would be an impossible burden, in view of the scale of training. However, senior staff take part in the formulation of teaching programs and in the supervision of junior staff who are in regular contact with students.

The EPR Panel debated whether agricultural engineering research fell within the scope of the "mandate" and concluded that it could be subsumed under Article 2(i) and that, in any case, it was a necessary and sensible part of IRRI's activities.

The Panel concluded that no amendments to the Articles of Incorporation are required at present, nor would any be needed on the basis of the draft SPC report on strategic planning.

2.3. Strategies for the Future and Overall Priorities

The EPR Panel was exposed to the 3rd draft of the Report of IRRI's Strategic Planning Committee (SPC) in two versions issued in February and April 1987. The 3rd draft did not constitute the formal policy of the Institute, nor had it received the endorsement of the Board. Consequently, the Panel found itself in the anomalous position of being asked to address planning proposals which were not in their final form. Furthermore, the plan contained no assessment of priorities except in relation to rice environments, nor any indications of the timescales over which the objectives that it contained might be attainable. Neither was it clear how progress toward these objectives might be measured against "mileposts".

The plan proposes that the division of the Institute into Departments be maintained, but that the work of the Institute be organized into six Program Areas (PA's), with sub-programs. Those program areas are set out as follows:

PA 100 Germplasm Improvement

- 101 Genetic resources
- 102 Yield potential
- 103 Grain quality
- 104 Disease resistance
- 105 Insect resistance
- 106 Drought tolerance
- 107 Excess water tolerance
- 108 Adverse soils tolerance
- 109 Adverse temperature tolerance
- 110 Rice genetics
- 111 Innovative breeding networks
- 112 Seed science and technology
- 113 International Rice Testing Program
- 114 Integrated Genetic Improvement Program (addressing in an integrated way the five principal environments in which rice is grown).

PA 200 Crop and Resource Management

- 201 Soil and nutrient management
- 202 Water management
- 203 Crop management
- 204 Pest management
- 205 Farm machinery and post-harvest management
- 206 Rice-based farming systems

PA 300 Socio-economics and Environmental Impact

301 Environmental impact (with soil, water, and biotic components)
302 Production impact (dealing with the volume and stability of production changes and with prices and trade)
303 Livelihood impact (with income, employment, nutritional, health, policy, etc. components)

PA 400 Education and Communications

401 Training
402 Communications and publications
403 Library and documentation

PA 500 International Collaboration

501 Collaborative research and training
502 Strategic research cooperatives
503 Global research networks
504 Regional and country programs

PA 600 Research Support Services

601 Experimental farm
602 Phytotron
603 Analytical Services Laboratory
604 Pesticide Residue Laboratory
605 Seed Health Unit
606 Environmental Data Service
607 Computer Center
608 Data Base Services
609 Statistical Services
610 Information Services

Finally, the SPC's analysis considered the ways in which the activities over PA 100 to 600 were concerned with the major environments in which rice is grown, namely:

Irrigated, wet and dry season

Rainfed lowland, no single constraint, drought or submergence prone or medium-deep flooding

Tidal wetlands

Deepwater, 0.5-1.0 m and > 1.0 m

Upland, all permutations of long- or short-growingseasons and fertile or infertile soils.

The Panel was conscious that the SPC had formulated its views on the basis of a consensus of opinion among the present staff of IRRI and that close attention had been paid to the CGIAR goal statement. It recognizes that the group of scientists contributing to the plan is certainly the most knowledgeable set of people anywhere in the world on rice science and rice farming. Yet, at the same time the Panel is anxious because such a "bottom-up" approach to strategic planning is likely to be protective of the status quo; it will probably produce a cautious and conservative plan. This is the case in the present plan, except that the proposal to work on the distinct environments in which rice is grown is a shift in emphasis.

If the objective of strategic planning is to establish the likely framework of a research organization in relation to the objectives that it will need to meet at some time (say, ten years) in the future, it is unlikely that the conservative results of the process used will provide for the changes that will inevitably occur. The demands that the client countries will articulate ten years hence will have been modified by their accelerating advance to technical self-sufficiency. By that time, the research agenda will have been modified by the scientific advances that will inevitably have replaced, to some extent, present concepts and procedures. In relation to IRRI, it may be anticipated that the microprocessor will have obviated the need for many operations that are currently manual; biotechnology will have made possible many experimental interventions that are not now possible, and so on.

The Panel does not wish to exaggerate the manner in which the research agenda of the next decade may change. However, in the formulation of a strategic plan, it is unwise to assume that the future must be an automatic extension of the present. Consequently, we conclude that the research agenda for tomorrow should also be set by a "top-down" approach. It is necessary to look at the total framework of the institute and at the resources likely to be available for research. The absolute size of the budget need not be known, percentages of the budget can be used as efficiently. The major components of the Institute's scenario on this view of the future should be given a scale within the total resources available - thus establishing major divisions of the budget. Then, among the activities which are in this way given priority, ask what sub-sets of priorities should be planned for under each major priority activity. In turn, numerical priorities can be attached to each sub-priority.

In this way, especially if new minds are brought to bear, exploratory and radical views may emerge of the ways in which IRRI can best serve the needs of its customers - the rice-dependent economies of Asia and the world - into the 1990's and beyond, using the most useful science then available. There should then be an assessment of the two approaches, "bottom-up" and "top-down", so that questions can be asked about their congruences and their divergences. The Institute would then be in the position to make a judgment among its alternative futures, or in some way to make an amalgam of them. The final decision on the plan should lie with the Board of Trustees.

So far as the rice environments are concerned (see above), the Panel noted that IRRI proposes to change the percentage of its expenditures, as measured by the time allocations of the senior staff, in the following ways:

	Now	Future
Irrigated	51	42
Rainfed shallow	22	26
Upland	14	16
Tidal Wetlands	12	15
	100	100 (rounded up)

Comment on this will be made later in the Panel's report; suffice it to say at this stage that judgments on the scale of the redeployments of effort were based solely on the expectations of the senior staff as to the subjects on which they would spend their time.

Training is given very full attention in the draft strategic plan, matching the high importance which it has always had at IRRI, as is displayed by the 5,000 alumni who have been educated there. Among the proposals that seem particularly important are those aimed at encouraging national programs to take responsibilities for production training when it is appropriate for them to do so, and those involving the preparation of training manuals and auto-tutorial modules. In degree-level training and in the visiting scientist and fellowship programs, research will generally concentrate on topics of practical relevance in the national system from which the participants come. Those from non-rice growing countries can also make highly relevant contributions.

In international collaboration, plans are described that aim at encouraging a range of linkages, involving joint work in either upstream institutions or in what IRRI calls "research cooperatives" from which results of wide applicability may emerge. The research networks in existence at present are to continue and IRRI will work in partnership with country programs in essentially the current manner. The choice by IRRI of the countries with which to work is based on: the request of a country for joint work; where there is a commitment to the improvement of rice production, where IRRI can assist in defined areas, and where an understanding can be reached about a work plan. Whether this is a wholely adequate decision process will be dicussed later. The plans for international collaboration do not seem to differ greatly from present practices.

The Panel considered that the present effectiveness of IRRI in training, in research work, in contributing to the building of country research capabilities and institutions lies in its being one of the highest scientific caliber. The future effectiveness in these endeavours will depend in IRRI's maintaining and earning a high reputation by the quality of its research.

A general point about the SPC's proposals is that they apparently leave little scope for flexibility. The plan should not be so rigid that there is no contingency plan to deal with the unexpected, whether the changed circumstance is favourable or unfavourable for rice research. To

use a well-worn phrase, the only thing of which we can be certain in the future is that it will be different.

Finally, a strategic plan is not made once and for all. It should be reconsidered on a regular basis, and if necessary, revised in the light of changed conditions, either internal or external to the Institute. Provision for updating should be included in the plan.

2.3.1. The Strategic Plan and the CGIAR Priorities and Strategies

The SPC's objectives display great concern for the CGIAR's goals and priorities. The plan predicates that research will take place on rainfed crops, that there will be work on basic science in advanced institution with which IRRI has links, that post-harvest storage and processing will continue to be part of the program, and that germplasm collection, conservation, and utilization will continue on a considerable scale and with increased staffing. All of these activities are included among CGIAR program approaches. Similar comments can be made about IRRI's intention to encourage the stronger national systems to take more responsibility for their own applied and adaptive research and to aim at enabling such systems to take on a wider, more international role in research and training.

However, the Panel thinks that IRRI has been placed in a dilemma because it cannot respond simultaneously on an adequate scale to all of the responsibilities that the System has placed on the CGIAR Centers. Indeed, it may be that TAC should rethink whether it can expect each Center to shoot at every goal without stumbling. In IRRI's case, its major achievement has been to enable the production of irrigated rice to increase strikingly. It is estimated that more than 50% of the area used for rice cultivation globally employs irrigation. This area apparently provides in excess of 70% of the rice consumed world-wide. The maintenance of the production gains that IRRI has helped to make possible must be sustained if the world is to have any prospect of matching food supply with population growth and of keeping the price of rice at a level affordable by poor people. Yet, TAC recommends that ". . . the CGIAR System devote more effort toward improving non-irrigated systems". If, within fixed budgets, this means that IRRI should substantially reduce maintenance research on the irrigated crop, considerable potential for further increases in production will be placed at risk unless the national systems can confidently be expected to take over the responsibility. If IRRI is to address the goal of increasing "the economic well-being of low income people", it could be interpreted that its attention must turn away from irrigated toward rainfed and upland conditions - as is favoured in the CGIAR definition of priorities. To achieve equity and to increase concern for sustainability, it may be necessary to compromise maintenance.

IRRI has made valiant efforts to respond to the goals and priorities of the CGIAR. The Panel accepts the importance of the goals of sustainability and equity, but wishes TAC to know of the trade-off that IRRI is trying to make to reorient its program.

The Panel considers that strategic planning should continue at IRRI, with regard for the matters discussed in Chapter 2 and for the draft paper by Dr. Selcuk Ozgediz entitled "A Strategic Planning Process Model".

The Panel considers how priorities can be established in research in Chapter 4, international activities and training in Chapter 6, and the priorities for modification of the structure of IRRI in Chapter 7.

CHAPTER 3. IRRI'S APPROACH TO GENDER QUESTIONS

53. The second quinquennial review did not discuss the "gender issue." Since that time, the gender issue or questions about the role of women and the returns to women working in agriculture have become an increasingly important item on the development agenda. Much of the attention has been, and continues to be, on the impact of technological change on the welfare of women. Since IRRI is concerned with technological change in rice production - an activity that employs many millions of women - it is clear that IRRI has every reason to be concerned about the "gender question". IRRI has recognized this. As early as 1979, a few IRRI studies deliberately gathered data on the role of women in rice production. It was in 1983, though, that IRRI first gave explicit attention to evaluating the role of women in rice farming systems by convening a conference of biological scientists, social scientists, and policy makers to discuss, inter alia, how women might benefit more from emerging technologies.

In March 1985, IRRI joined the International Service for National Agricultural Research (ISNAR) to host an inter-center conference in Bellagio at which there was considerable discussion among the participants about the impact of the research programs of the CGIAR Centers on the welfare of women. It was emphasized that the neglect of attention to women leads to inefficient technology development and transfer programs - in those cases where the users are women - and that new technologies can well have negative consequences for women. It was agreed that the CGIAR Centers and national agricultural research systems should develop long-term strategies to take the role of women into account - where possible - in all phases of research and technology development work. Finally, in April 1985, a project design workshop was held at IRRI as a follow-up to the Bellagio meeting. It was proposed that IRRI organize a collaborative effort and undertake action/research projects in five general areas:

(i) women and technology development - to integrate the concept of women's various roles within the household and the farm into farming systems research;

(ii) women and extension - to include women in various extension programs dealing with agricultural technology development;

(iii) impact of technologies on women and the household - to evaluate the effects of technologies on women and children, including socio-cultural, institutional, and economic considerations;

(iv) complementary studies - to include studies such as the dynamics of household behaviour; the functioning of rural labour markets; and the policy environment which affects farm and household decisions;

(v) sensitization - to "synthesize" relevant experience, data, and analysis generated from projects of this network (Women in Rice Farming Systems) and elsewhere to sensitize agricultural scientists, policy-makers, development adminstrators, farmers, and women themselves.

The ultimate aim of this collaborative work is to institutionalize women's concerns within agricultural research and extension programs on rice farming systems. Hopefully, this will be achieved by:

(i) incorporating rural women's concerns into on-going programs, both in IRRI's outreach programs and at IRRI itself;

(ii) stimulating interest in Women in Rice Farming Systems (WIRFS) research in the national agricultural research systems, in non-specialist universities, national development research institutions, and in non-government organizations; and

(iii) establishing a network to promote a concern for WIRFS under the Asian Rice Farming Systems Network (ARFSN).

IRRI has been a leader among the International Agricultural Research Centers in incorporating women's issues into the agricultural research process. Nonetheless, this effort is still a modest and somewhat compartmentalized effort rather than an Institute-wide effort.

3.1. IRRI's Program on Women in Rice Farming

IRRI has initiated project work that deals specifically with women in rice production and processing. The project is a collaborative venture with the University of the Philippines at Los Banos (UPLB) and IRRI's Rice Farming Systems Program and Department of Agricultural Economics, and is a component of the Farming Systems program. The project first involved selecting several villages in the Philippines for an analysis of specific ways and means whereby women's productivity and incomes could be enhanced. Some opportunities have been identified - such as the introduction of mushroom farming and improved techniques for processing foods sold at certain seasons of the year. Further opportunities related to women's role in rice production are being examined in such activities as seed selection, integrated pest management, low cost irrigation pumps, pedal threshing, and paper making from rice straw.

During the past year, some experience in analysis techniques has been gained in farming systems research that can help determine further opportunities for gender-specific improvements. In the coming years, it is planned to extend the program to neighbouring countries as part of the expanded farming systems network; much of the expanded program will be based on the techniques developed within the first phase of this project.

Other facets of IRRI's programs bear directly on women's role in rice production. The "Prosperity through Rice" project, which attempts to find ways of using the whole rice plant (including straw and other by-products), is also expected to lead to expanded opportunities for women to raise their incomes. At a different level, the on-going macroeconomic and microeconomic research on the "livelihood impact" of the direct and indirect consequences of new rice technologies in a number of contexts. This macroeconomic analysis will, for example, attempt to develop methodologies to determine the overall effects of changes in the labour market, including the impact on women; the microeconomic analysis will focus at the village as part of the farming system.

3.2. Women in Research and Management of IRRI

The Board of Trustees of IRRI consists of 15 members, of whom two are women. No other CGIAR Center has more. Between 3% and 5% of the senior scientific posts are occupied by women.

IRRI's training programs provide training and fellowships for men and women. In 1986, around 30% of the research fellows and 20% of the non-degree trainees were women (Table 2). These are impressive numbers that augur well for an increase in the number of women professionals in rice-related activities.

Table 2. Numbers of male and female scholars, by region and type of training at IRRI in 1986

Region	Male	Female	Total
A. Post-doctoral fellows			
Asia/Pacific	18	3	21
North Africa/Near East	1	0	1
Sub-Saharan Africa	2	0	0
Developed countries	3	1	4
Total	24	4	28
B. Ph.D. and M.Sc. candidates			
Asia/Pacific	34	16	50
Sub-Saharan Africa	2	2	4
Latin America & Caribbean	1	1	2
Developed countries	6	2	8
C. Short-term trainees			
Asia/Pacific	262	43	305
North Africa/Near East	3	1	4
Sub-Saharan Africa	16	3	19
Latin America and Caribbean	7	1	8
Total	288	48	336
GRAND TOTAL	355	73	428

3.3. Assessment

IRRI is ahead of many other CGIAR Centers in focussing on gender questions. It is to be commended for its initiatives; it is expected that there will be a much greater understanding of the impact of technological change in rice production on women's welfare and a greater appreciation of the "trade offs" between some of IRRI's technological innovations (e.g. direct seeding) and the opportunities for women. It is also expected that IRRI's pilot effort will show ways and means whereby women's incomes can be enhanced. However, there are other important opportunities for IRRI to demonstrate its concern for and commitment to raising incomes for women in agriculture on a broader basis. For example, IRRI conducts a substantial number of training courses, many of which are for extension agents. Steps should be taken to build into these courses more information about the importance of gender-specific issues in rice production and the need and importance of addressing these issues. Special course material should be developed for this purpose; such material could also address methods whereby women could be reached as groups.

IRRI's response to questions related to gender are still somewhat tentative and its activities have not been without opposition in a largely male dominated organization. The management is to be given credit for initiating programs to take into account the fact that women do much of the work in rice production in Asia - as is attested to by IRRI's own logo. It is expected that this effort will expand through the "hands on" and socio-economic research and training programs outlined at the Bellagio meeting, as discussed earlier.

CHAPTER 4. THE RESEARCH PROGRAMS

It is useful to analyze the reasons for IRRI's considerable accomplishments in order to advise better on its future.

From its inception, IRRI concentrated on rice breeding. The idea was to repeat for rice what the Rockefeller Foundation had already catalyzed for wheat, with Norman Borlaug and his small group in Mexico, breeding for nitrogen-responsive and broadly adapted wheats for favourable environments. Higher yield potential was the focus, and to realize the potential, better agronomy was needed. So, good agronomic science, concentrating on fertilizer needs and weed control, became a partner in the advance.

Protection of the higher yield potential became important, and the entomologists adopted the Western world's approach of the 1960s, which was to kill the damaging insects with chemical sprays as efficiently as possible. The new area of insect resistance was added to breeding objectives as well, but the new rice technology changed the rice-insect dynamics in unanticipated ways. Most notably, "new" insects became pests and they vectored viruses; so "new" diseases were found. Diseases needed to be understood to determine how the new yield potential could be sustained in relation to pathogens and, as in the West for extensive field crops, the focus was on finding and incorporating disease resistance.

So, IRRI research - focussed as it was around breeding for the major target, the irrigated rice environment - assembled germplasm and the necessary skills in agronomy, plant pathology and entomology, to attain, sustain and protect the yield potential contributed by the N-responsive dwarf character brought in from Taiwan. This character was incorporated into tropical rice and pushed vigorously across Asia following the Rockefeller Foundation philosophy of clearly identifying high-leverage agricultural changes to solve the perceived imbalance between population growth and agricultural stagnation. The execution of this philosophy in Asia was to develop a center for rice research with international scope which had a high caliber staff with high ethics and zeal for the cause given freedom and inspiration, and lacking the stultifying bureaucracy and the debilitating shortage of operational funds which characterized most of the agricultural research systems in Asia at that time.

The philosophy, the approach, and the execution were appropriate and effective, and the "miracle" rices were quickly attained and pushed hard by the breeders, the directors, and the superb communications machine developed. The practical and pragmatic approach to research as a payoff-oriented activity requiring researchers to get their feet dirty in the field was reflected in the training programs, and Asian rice researchers became less isolated from farmers' problems. The new technology was so powerful that it affected millions and then billions of people, and its impact on economic and social interactions was so complex that analysis was required, resulting in expansion of the social sciences at IRRI, initially in a very focussed and intimate way with biological research. How to lighten the

drudgery of rice farming became a concern and agricultural engineering was needed. Research in soils and then in water was added.

But the heart of the matter was rice breeding, it was "new" varieties; and the quest - largely attained for the irrigated rice environment - was broadened by a new look at the reality in the field and in analyzing the different types of rice culture and rice environments. New breeding targets representing the more difficult environments were developed as foci around which the other disciplines were molded. A large effort on multiple cropping and farming systems involving many crops other than rice, and even animals was added.

Obviously, innovative developments have not been happening for the other environments; hence, the frustration and the present difficulty in determining what IRRI can or should do and what local policy-makers can or should do. More than 2.5 billion people in Asia are involved in a kaleidoscope of economic and ethnic variation. Beyond Asia, agricultural development in relation to rice is even more complex, and the question of IRRI's efficiency, comparative advantage or disadvantage, and potential effectiveness outside Asia remains unresolved.

The long, hard-slogging work of agricultural development - so dependent on national commitment, policy reform, investment in infrastructure, education, and responsibility for funding the integration of research and extension - can be compromised, if further unlikely miracles are predicted by the plant breeders.

The direction IRRI has taken in recent years has been to expand into other rice environments. However, quick and large payoff for the more adverse environments had proved elusive, yet this is what the CGIAR System and the donors appear to expect. The question is, what should be the direction and scope of IRRI's research and related activities in the future?

4.1. Rice Environments

4.1.1. Agro-Ecological Characterization

In recent years, IRRI's growing involvement with the great diversity of rice-growing situations has indicated a need for better agro-ecological characterization of rice environments. Climate, soil, landform, hydrology, and other factors of the environment that affect production need to be characterized, to determine better how the natural resource base should be managed. This information can be used to identify locations suitably representative as research sites and to determine ways in which products of research are developed and used.

At an inter-center workshop on agro-ecological classification and mapping in 1986 in Rome, it was recommended that the CGIAR Centers should combine and coordinate their work in this field and strengthen their efforts by cooperating with national institutes and international organizations like Food and Agriculture Organization (FAO), World Health Organization (WHO), World Meteorological Organization (WMO), and the International Soil Science

Society (ISSS). Regional responsibilities have been divided among CGIAR Centers and an inventory of the existing data bases has been made. South-east Asia was assigned to IRRI and South Asia to the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT). Work should continue in this framework.

Earlier efforts led by IRRI resulted in a widely-accepted classification of rice-growing environments on the basis of five major agro-ecological environments. However, a much better definition of target areas and their critical constraints is necessary to enable a quantitative analysis of production possibilities. It would be useful to include data on crop area, yields, farming systems, and population density in agro-ecological data bases. However, such data are usually classified according to administrative or political units which may involve a number of very different natural environments. This poses serious problems of disaggregation.

4.1.2. Synopsis of Rice Environments

The five major rice environments are: irrigated, rainfed lowland, deepwater, upland, and tidal wetlands. By the year 2000, IRRI estimates that rice production in the Asian tropics will have doubled. The contributions of the various rice environments to this increase are estimated to be as follows: irrigated, 57%; lowland rainfed, 29%; upland, 4%; deepwater, 8%; and tidal wetlands, 2%. The above estimates are extrapolations based on many assumptions by IRRI.

The rice environment classifications are based on crop-water status which in turn is governed by rainfall, soil type, landscape position, seasonal flooding and past modifications of topography. These are divided into 13 sub-systems on estimates of "favourableness" of the physical environment for rice productivity. The major factors governing these groupings are, again, crop-water status, and also soil characteristics and temperature. Inhibitory biological factors which may differ among the major rice environments, by continent or by geographical location within a region, are not part of the classification outlined above.

4.1.2.1. Irrigated Environment

Irrigated rice accounts for 50% of the ricelands and 70% of production. It is the key ancient environment of sustainable food crop agriculture evolved in the lowland tropics. As latitudes or altitudes increase, its problems, research needs and potential, change. Irrigated rice is grown in diverse conditions: adverse soils, the great antiquity of the system in some locations, sites in arid areas, all affect the system adversely by influencing soil/crop nutritional relationships. Research can help address these site-specific problems as well as sustain yield gains already made. However, major increases in farm yields are potentially available now with existing technology, but social, economic and educational problems limit the application of such technology. Profitability and drudgery considerations by the farmer will probably dominate the degree of actual change.

4.1.2.2. Rainfed Lowland Environment

Rainfed lowland accounts for 20% of the area and 25% of rice production. This environment is quite diverse, with very different problems, depending on location. These may range from drought, to submergence and stagnant water and their ancillary effects. This system ranges from upland areas with bunded fields to lowland areas that are flooded up to 50 cm. The on-and-off standing water causes problems in nitrogen availability and loss and availability of other elements, inducing various nutritional problems and fungal diseases. Insect pests and viruses can be severe in this rice environment in Asia.

4.1.2.3. Upland Environment

Upland rice accounts for 15% of total rice area and 5% of the production. It comprises free-draining soils without phreatic water (available groundwater) and without bunds or surface levelling. Traditionally, rice is grown in such soils only in locations with predictable high rainfall and temperature for a period of at least four months. These are mainly in areas originally in tropical lowland forests in Asia and Africa, but in Brazil a special upland rice system exists in the "cerrado" where rainfall is less predictable and the original ecosystem supported only a scrub, fragmented, forest.

Most lands available for upland rice are tropical forest lands, and thus they represent the most fragile ecosystem in terms of soil erosion hazard. They also represent the most primitive agriculture, that known as "slash and burn" or "swidden". Additionally, in India and Bangladesh, some of the "Aus" rice is grown as upland, on more level, non-forested sites. Levelling and bunding of the flatter land is often the first step in getting upland areas to be more productive for rice, and may be the first step taken to expand rice areas in the future. Where upland soils are of recent volcanic origin, they may be sufficiently fertile to support substantial yields until they are eroded. Where soils are of ancient continental exposure, they are usually highly impoverished of nutrients as well as being highly erodable.

4.1.2.4. Deepwater Environment

Deepwater rice amounts to 10% of the area and a few percent of the production. This environment includes areas of water depth of 50-100 cm and of areas of water depth exceeding 100 cm. IRRI's emphasis is on the 50-100 cm target. Countries with substantial areas of rice in such environments are Thailand, Bangladesh, India and Vietnam. In addition, such areas exist in Mali.

What is not clear is a reasonable estimate of the gap in existing yields and in yields that could be attained with further research input in varietal improvement, and agronomic or pest management.

4.1.2.5. Tidal Wetlands

Tidal wetlands account for a few percent of the area and hardly contribute to the total production. Most tidal wetlands have soil problems, but many other "soil problems" lie outside the tidal rice environment. Typically, tidal wetland rice may be affected by salinity and/or toxicities and deficiencies associated with acid sulfate soils. Some peat soils, with their unique problems, are present in tidal wetlands, and some are not. Deep water may be a problem.

The countries with tidal wetland rice are mainly Indonesia, Thailand, Vietnam and the Philippines. Some rice is grown in Sierra Leone and neighbouring West African countries in such an environment, where it is designated "mangrove swamp rice". Yields are generally low, but stable. It is not clear how much rice is grown in such environments, but extensive lands of this type do exist which are either remote, or for other reasons not occupied.

4.2. Strategy for Selecting Research Priorities

The report of the SPC lists a comprehensive and relevant series of research activities for increasing the yield, efficiency and sustainability of rice and rice-based farming systems in the various rice environments. The report discusses some agro-ecological and socio-economic information useful for setting priorities. However, it does not attempt to clarify the strategic choices that have to be made by the CGIAR, the Board, the Director General and the scientists themselves, in developing a coherent, dynamic research program.

The strategic questions concern: resource issues, equity and production, environmental priorities, and research balance. These will be considered in the following discussion.

4.2.1. Resource Issues

Although the major thrust of the CGIAR is directed to increasing food production in the developing world, improving sustainability is also an explicit goal. A major concern for agricultural research is to help achieve gains in productivity while at the same time, helping to improve sustainability of the agricultural production system. Intensification of agricultural production without degradation of the natural resource base has become a key measure of technological progress: ecological stability should not be sacrificed for short-term gains.

The more favourable rice environments, where research has been focussed in the past, will continue to contribute significantly to further increases in rice production. However, the continuing need to increase agricultural production could result in processes of intensification which cause chemical and physical degradation of soils, siltation of waterways, environmental pollution and the build-up of pests. Therefore, IRRI's responsibility is to develop technologies that can be applied in the environments for which they are intended without sacrificing sustainability.

IRRI should not compromise its position by supporting the application of technologies in situations where they threaten sustainability.

A major concern is the need to maintain and, to the extent possible, to increase the productivity of rainfed agriculture in the unfavourable lowland and upland environments. Many of these environments are fragile and have already suffered significant resource degradation through soil erosion, nutrient exhaustion, and vegetation loss and landform changes. These regions are under increasing pressure from resource-poor farmers, many of whom have little option but to sacrifice ecological stability for short-term gains. Even with the judicious use of external inputs, it is a formidable task to develop technologies that can help reverse this trend. As a commodity institute, IRRI can make only a limited contribution to solving this problem through the application of its research technology, integrated through a farming systems approach with strong participation of social scientists. Possibly the most constructive assistance IRRI can give is through collaboration with national programs and with agricultural universities, especially in developing methodologies for assessing economic implications of strategies for sustainability.

The CGIAR is now stressing the sustainability issue, but that emphasis does not imply that sustainability research should be undertaken only at or by the Centers. Rather, the Centers should intensify their interactions with organizations actively working in these fields and with institutions doing research on land and soil conservation and on water management, such as the International Board for Soil Research and Management (IBSRAM), to ensure that problems are addressed and new information is incorporated effectively into the CGIAR Center programs. Centers should also provide creative leadership in transferring technology that improves sustainability through close collaboration with national programs.

4.2.2. Equity and Production

The concerns about equity are made abundantly clear from the debate and analysis about who has benefitted from the generation, adaptation and diffusion of modern high-yielding varieties of rice. The debate continues, but socio-economic research, including that undertaken at IRRI, indicates that:

- The rapid spread of the new varieties increased average yields and the supply of rice. The price of rice has fallen in much of the world. The principal beneficiaries from falling prices have been rice consumers, especially the poorest consumers who typically spend 60% of any added income on basic foods.

- The initial adoptors of the new technology were the larger farmers; however, over time, smaller producers have taken up the new varieties. Consequently, both large and small producers have benefitted, although the larger producers may have gained more than the smaller producers by virtue of being able to plant larger areas to the high-yielding varieties.

- There is, as yet, no comprehensive analysis of the distribution of gains among different categories of producers: farm owners, tenants, share croppers and labourers. Currently, this is being analyzed at IRRI and the International Food Policy Research Institute (IFPRI).

- The limiting factor on the spread of the new technology is the availability of water. The benefits of the new technology have been confined, in large part, to producers in well-watered, irrigated areas and favourable rainfed lowlands. The producers who have not gained have been those in less favourable rice-growing environments. Indeed, they may have lost in the process, as falling rice prices reduced their incomes and even may have made their rice production uneconomic.

In conclusion, the main gains from rice technology during the last 25 years have gone to consumers, and to rice producers in favourable environments. To what extent emphasis should be shifted to research to benefit the resource poor farmers in more unfavourable regions, is, in the final analysis, a political decision which should not be left to scientists.

The CGIAR may wish the balance to be adjusted in favour of resource poor farmers in more unfavourable areas. IRRI has already made some moves in this direction. The scientists' responsibilities are now to provide information so that policy-makers can know better where opportunities lie for the development and application of technology to improve socio-economic and environmental conditions. With this as a basis for an informed dialogue, international and national policy-makers should determine in what specific environments their priorities can be best exercised. CGIAR donors can then allocate their funds appropriately.

4.2.3. Priorities for Environments

IRRI has estimated the value of expected benefits from research focussed on each of the major environments. Although the expected benefits are very approximate, it appears that returns from rice research in South and South-east Asia can be very large and that on the basis of efficiency considerations, investment in research for irrigated environments should be afforded priority in the future.

However, the yield gap between existing yield and the yield that may be obtained with varieties and technologies currently available for irrigated rice, is still very large. Moreover, many national programs have by now considerable experience in breeding and in developing management practices to increase the efficiency of their irrigated rice.

The Panel confirms, therefore, that IRRI should reduce its efforts for irrigated rice, although there remain important, more upstream tasks centered on the germplasm bank, germplasm improvement, insects, pathogens, weeds and soils, water and nutrients.

The favourable rainfed lowland areas profitted considerably from research for irrigated environments, but also in the less favourable rainfed lowland environment there may be opportunities for increasing production and productivity. The Panel supports, therefore, IRRI's emphasis on these environments.

Increased production and sustained productivity are far more difficult to achieve in many upland areas, where drought, weeds, blast, and other diseases, acid soils and phosphate and nitrogen deficiencies in various combinations, are the most critical constraints. It is, however, the environment where many poor farmers who were by-passed by, or even suffered from, the green revolution. The Panel endorses the research effort to mitigate the constraints and to evaluate where the opportunities lie for the development and application of technology in this environment. This endorsement holds also for the deepwater areas with water depths up to 100 cm.

Tidal wetlands and some other problem soils form a large, mostly untapped land area, but the problems of reclamation and subsequent sustainability are immense and require a second look at research needs. More analysis on research and development is needed to evaluate the production, economic and equity implications by rice environment and region. A logical approach is to analyze each rice environment, country by country and district by district, to judge the gap between existing farm yields and yields possible with the best varieties and technology now available for each environment. Then a further analysis is required, based on experience and sober judgement, of what gains could accrue from further plant breeding alone and with further research into crop and soil management. Analysis should also be made of the degree to which yield fluctuations could be stabilized by having higher levels of disease and insect resistance, which are also long-lasting. Unfortunately, these are very subjective topics, since very few hard data are available. It requires a comprehensive agro-ecological characterization, and the use and further development of process-based simulation techniques, complemented by statistical information and the subjective but invaluable input of farmers, extension workers and specialists who know the region.

Such work provides the agricultural economist and social scientist with the basic technical information, to evaluate the progress that can be made in the rice environments, relate potential programs to the available labour and external resources, and estimate the economic and social consequences.

4.2.4. Research Balance

Expansion of the early focus on irrigated rice at IRRI has continued in recent years, with the development of a more comprehensive approach to soil, water and nutrient interactions and their roles in rice-based cropping systems. The socio-economic consequences and constraints, and more recently, the impact of IRRI's technologies on productivity and more efficient use of resources in the context of the whole farm system, have added a new, but complex dimension to the research program. This has been further extended by targeting research more specifically to the five major rice environments.

The Panel, while endorsing the general interdisciplinary approach to the complex interactive problems of the rice production systems, was concerned at the breadth of the program objectives outlined in the SPC report. There is a danger of compromising the quality and rigour of the research by broadening the scope of the Institute. In particular, research quality and rigour are almost certain to suffer when IRRI takes on problems for which it has little comparative advantage or which would be more appropriately undertaken by national agricultural research and other organizations.

Rice production technologies differ widely across environments, but the underlying physiological, physical and chemical processes are, to a large extent, the same. This is the rationale for organizing applied research institutes along disciplinary lines, in departments with a sufficient critical mass to be intellectually stimulating. For IRRI, this has proven to be useful in the past and will be even more so in the future because it catalyzes the necessary working contacts with institutes doing advanced basic research. IRRI is large enough to maintain, at the same time, sufficient thrust in its applied and component research.

This disciplinary organization should not be confounded with program-oriented departments. These create unnecessary barriers between research workers with the same disciplinary orientation, and between disciplinary departments and field problems, reducing organizational flexibility. The interdisciplinary thrust is better achieved by formulating interdisciplinary research projects and by financing the departments through these projects.

Farming systems research is not the task of a single-commodity international research institutes, because it is location-specific and requires intimate knowledge of the many elements of the system such as other arable crops, livestock, fish, and trees.

However, adaptive research, which may be termed downstream research, includes on-farm component research to evaluate and improve new technologies, and to assess socio-economic impact in the environment for which they are intended. Applied research, which in general lies between upstream and on-farm component research, requires interdisciplinary process-oriented efforts that develop a quantitative understanding of the processes that govern agricultural production and its management. This knowledge can be applied to develop a range of technologies for a range of environments.

Simulation models are an important tool to achieve the much needed interaction between more disciplinary, process-oriented research and component research under field conditions. These models, to be useful, should form a bridge between the results of disciplinary research and the performance of component technologies in the field. By comparing simulated output with experimental results at the systems level, it is possible to evaluate how the model operates and to determine whether the treatment of the processes that form the basis of the simulation model is satisfactory. In this way, process-oriented research can be guided to areas where research most usefully fills gaps in our understanding, and in this way builds confidence in the use of the model to extrapolate to larger domains.

As IRRI's program develops, there is an increasing need to undertake component research at locations away from Los Banos that are representative of the major rice environments being studied. These sites provide opportunities to link local scientists with the Institute's home-based scientists and facilitate the evaluation of new technology in on-farm research.

In summary, the Panel supports a multidisciplinary approach to research, and stresses the need to limit the scope of component research to problems that bear directly on the productivity and stability of rice in the important Asian rice environments. IRRI management should not be tempted to expand this focus, particularly in areas of research where the Institute has little comparative advantage and where the national agricultural research systems and other organizations are able to undertake the work.

4.2.5. Recommendations

The foregoing section contains topics on Selection of Research Priorities, Resource Management, Equity and Production, and the Setting of Research Priorities for the Different Rice Environments. Under each of these headings, the Panel made suggestions which should be consulted for details.

The Panel emphasizes some of the suggestions with the following recommendations:

- IRRI should be pro-active and make a more detailed analysis of the potential impact of new technology on production and sustainability of rice environments.

- IRRI should give more attention to the rainfed lowland environments while increasing upstream and yield sustaining research for irrigated rice. In the less favourable deepwater and upland environments, research should continue to probe for opportunities to increase production without sacrificing long-term sustainability.

- IRRI should continue interdisciplinary approaches in addressing complex interactive problems of rice production systems. This requires well-balanced disciplinary departments which should not be confounded by program-oriented departments. Research should be conducted and financed through a project system.

- IRRI should undertake on-farm component research to improve and evaluate new technologies in the environment for which they are intended. Such research involves analysis of the potential socio-economic consequences for women and children, and for the sustainability of production systems.

- that IRRI continue to collect and analyze information for making better estimates on technology payoff for varietal improvement and for crop management research in each rice

environment, and that the Board of Trustees and the Director General reassess at intervals policy issues in relation to revised estimates, in setting priorities.

4.3. Germplasm Improvement

IRRI has a fine record in developing high yielding rice varieties for the irrigated environments of Asia and in assisting breeders of other countries to develop excellent varieties of their own. This latter achievement has occurred largely through supplying germplasm, but also through training and example-setting by IRRI scientists.

Some progress is being made in improving rice for more difficult environments, but the gains are still limited and it is unclear what level of improvement can be realized.

Although disease and insect resistant varieties have been developed and released by both IRRI and national breeders, their resistance often has proved to be short-lived or restricted geographically. This is because both pathogens and pests have "adapted" to varieties released as resistant, sometimes quite quickly. The pathogens and pests of importance twenty years ago are still important problems, and some new ones have developed.

With the training of hundreds of Asian rice breeders who now wish to breed their own varieties, and who have the capacity to do so, it is appropriate to ask what exactly IRRI should do in regard to germplasm improvement. Overall, it would appear most appropriate for IRRI to orient its genetic improvement program toward more basic aspects of germplasm enhancement. IRRI has already begun to do so and the Panel strongly endorses this move. Probably an even greater shift would be wise, entailing much less effort in perfecting finished varieties. National breeders are very competent and are located in many different places, thus they are ideally situated to achieve maximum adaptation for local areas by on-site breeding, magnifying genetic diversity.

In addition to nuclear 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.

The Panel believes there are sound scientific reasons for moving in this direction, not least of which is the lessening of the genetic vulnerability created when a single or a few varieties are planted over large areas. Having more genetic diversity in Asian rice lands is probably a wise objective.

Several other issues will be discussed below, in relation to germplasm enhancement, under specific sub-topics.

4.3.1. Breeding for Different Rice Environments

The Panel endorses the strategy of IRRI to breed for the specific difficult environments of lowland rainfed, upland, and deepwater, in that order of priority, and urges that these programs be developed with greater collaboration with national and international organizations. The Panel also considers that certain soil problems merit attention of breeders, working closely with soil scientists for better definition of the problems and better predictive estimates of success, based on good science.

The Panel has the most difficulty judging whether attempting to improve rice for tidal wetlands is a worthy investment. It suggests that IRRI reexamine this target, emphasizing a judgement based on a realistic expectation of yield improvement over the best varieties now existing. In the unlikely event this gain turns out to be substantial, then a better judgement of the socio-economic feasibility of bringing new tidal lands into production should be made.

The Panel considers that for rainfed lowland and upland environments, and for stress soils, more innovative science from several disciplines as well as from breeding/genetics should be sought.

The IRAT/IRRI upland program is endorsed for two major reasons. One is that it appears to be the program that has enabled rice breeding innovation and germplasm from outside Asia to enter Asia in a potentially substantial way, and the second is that it appears likely that the stable disease and stress resistance of this genetic material may be useful directly or indirectly in lowland rice environments in Asia. The innovations and genes contributed by this IRAT/IRRI program may even help improve irrigated rice.

The Panel cautions, however, that promoting upland rice for forest-hill lands could lead to severe damage to these ecosystems. Also, at present, there appear to be two separate upland rice breeding programs at IRRI, and these should be consolidated.

4.3.2. Breeding and Upstream Research

The breeding of rice, as of any other crop, is a technology that draws knowledge from pathology, entomology, soil science, grain chemistry, and numerous other disciplines. However, since breeding involves changing the genotype to create prospective varieties in order to match some goal the breeder has set, the principal discipline needed is genetics. So genetic and related studies must figure large in an institution like IRRI that has genetic enhancement as one of its principal objectives. The prime need is to understand the genetic structure of rice itself. This has, and should have, an important place in IRRI. Until recently, no system of rice genetic and cytogenetic chromosome mapping acceptable to the rice geneticists of all countries existed. Rightly, IRRI has taken, and should continue to take, a leading role in the international coordination of rice genetics.

Oryza sativa is a diploid species with twelve haploid chromosomes and a very small genome of only about 1.5 pg of DNA. Numerous genes have already been assigned to chromosome locations, so that development

of an understanding of conventional genetics of rice is advancing quite rapidly. Also, IRRI has played a useful role in creating a set of lines in which, in turn, each chromosome instead of being represented only twice is in triple dose. Such sets of lines are essential if conventional genes are easily to be assigned to chromosomes. They are also necessary for certain studies in molecular biology.

Rice is a marvelously diverse crop species genetically, but for certain attributes there is limited variability, including resistance to some insects, diseases, environmental stresses and physiological traits that influence yield. Consequently, if the future of breeding programs is to be assured, the range of genetic diversity must be extended. This can only be done by bringing into cultivated rice, genes from wild rice species (wide-crossing), or from species unrelated to rice (genetic engineering), or by a form of mutation in cell culture (somaclonal variation). IRRI has had a program on wide-crossing for some time and promising results have been obtained. For example, apparently new genes for insect resistance have been incorporated into rice from the wild species O. officinalis. Fortunately, the Rockefeller Foundation, in establishing its network on upstream genetics and molecular biology of rice, is supplementing the wide-crossing research at IRRI.

IRRI is closely linked with the Rockefeller Foundation network and will benefit from research aimed at genetic engineering of rice. In addition, this network is devising methods that will enable breeders to profit from molecular biological techniques to supplement more conventional approaches to breeding, making the overall process more efficient. This is likely when a molecular map of the rice genome using DNA markers on the chromosomes enables genes to be tagged that previously could not be recognized in single seedling plants. Many of these genes are those that affect agronomic traits, such as growth duration or environmental stress. Consequently, in breeding programs, lines that have a genetically desirable makeup can be extracted without delay and the breeding process made more precise and rapid.

An appropriate posture for IRRI would be to have the competence to follow the work of the molecular biology network, so that it can know when it should participate directly - and establish full molecular biological capabilities in-house - or know when to pick out potentially useful novel genetic variants and diagnostic tools for use in its breeding programs. It is wise to monitor the molecular biological research done in advanced laboratories, but in the long run it may be necessary to have such in-house research capacity. Already, it is worthwhile having in-house pathologists who can use molecular probes that will enable the precise identification of the resistance status of rice genotypes.

4.3.3. Disease and Insect Resistance Research

This is an area where IRRI should have a comparative advantage, at least for most of the pests and pathogens of Asia. The rice pest and disease problems of Asia have not been solved by past or existing approaches to resistance research and breeding. Some resistances have been very useful in new varieties, at least over the short term. Some problems have changed in

importance, and resistances incorporated have worked only locally or temporarily; however, major problems still exist and there is no guarantee that any of the resistances used previously will last.

Creative research is needed towards the key issues of durability and stability of resistance, pest/pathogen dynamics as affected by varietal and technology deployment, improved screening methodologies, epidemiological principles as applied to resistance research or development, and varietal deployment patterns or varietal mixture effects on pest/pathogen evolution and population structure.

The work currently being initiated in pathogen/pest variability is good, and results should be used to predict for varietal deployment and to influence breeding strategy. The advances in modern science in various fields of biology in the rest of the world should be incorporated to influence resistance development to a greater extent than at present.

The standardization of screening techniques and scoring methods, carried out years ago at IRRI, appears to have been uncritically accepted. Modernization of these procedures would make for more effective screening. This is especially important because IRRI trains nearly all Asian rice breeders and many of those in disciplines that should influence breeders, and who should become partners with them in developing new varieties and new research approaches. A genuine partnership between scientists in plant pathology, entomology, and breeding and genetics, is needed in developing improved genotypes and in creative research on resistance. Recent appointments in the Plant Pathology Department offer the opportunity for strengthening upstream science and should help advance resistance research.

Teamwork is still needed in creative research on strategies and methods to develop durable disease and insect resistance as part of the breeding and selection process. This is an area of special concern because new varieties, if genetically vulnerable, are usually revealed as susceptible only after being grown on large areas. The subsequent epidemics affect large numbers of farmers and consumers. Moreover, because of past experience with risk and damage, farmers tend to overspray pesticides and to become cautious in accepting new and potentially better varieties.

4.3.4. Selection for Tolerance to Environmental Stress

Unrealized yield potential due to adverse effects of the physical environment - caused by unfavourable water relations, temperature or edaphic conditions - is a loss that is often many times greater than the losses caused by biological factors such as disease, insects, and weeds.

As IRRI's focus shifts to include less favourable rice environments, a greater effort will be required to manipulate the genetic background and management of rice to increase its tolerance to environmental stress. The areas in which IRRI has devoted the most effort are drought, low temperature, excess water and soil constraints.

One of the strengths of IRRI's stress program has been the close cooperation of breeders, physiologists, and agronomists in developing

effective screening methods. This has been especially true for chilling tolerance in rice. However, the results of this effort have been somewhat disappointing, for indica rice. There is also a need to obtain better descriptions of the rice environments where cold tolerant rice varieties are needed, in order that priorities can be established for this work.

Selection for drought tolerance in rice for rainfed environments remains an important but very difficult problem. Despite the ad hoc screening approach adopted at IRRI, few better methods are available. The progress in drought resistance claimed by IRRI for rice is encouraging, but it is not known if this would be reflected in terms of yield and stability in farmers' fields.

Continued support for the program on screening for elongation ability and submergence tolerance to escape or tolerate flooding problems is desirable. With the decision to move more of the deepwater rice research away from headquarters, closer collaboration with the national programs in Thailand and possibly Bangladesh should be encouraged, so that the facilities and staff in national programs and at IRRI can be integrated in a more effective partnership. Screening for tolerance to various soil constraints, including aluminum, boron and manganese toxicity, salinity, and general problems of adaptation to acid soils, has made progress. Much of the variation has come from rice populations adapted to these conditions, and continuing interaction with the breeders and use of the germplasm collection will be essential. Another factor that could be important for rice in poorer soils is the ability to recover phosphorus.

4.3.5. Yield Potential

To prepare for the future, increasing yield potential with a focus on irrigated rice is a worthwhile objective, despite the gap between existing and potential yields. For this purpose, the Department of Physiology should strengthen its basic research on growth and development, especially on factors that determine sink-size and the duration of the reproductive period. Exploration of yield potential in rice could profit from the experience with wheat and other cereals. Manipulation of yield components would appear to offer little scope, but a fundamental change to extend the grain filling period should be sought. Simulation might provide more insights for this research. It appears there is little genetic variation in some of the physiological properties that determine potential yield, but genetic variation for these traits should be explored further.

Therefore, more effort should be devoted to developing genetic variation for traits affecting yield potential in rice, including genetic engineering and heterosis, without worrying too much about perfecting varieties for commercial use.

In relation to breeding, it would appear that innovative strategies used for other crops need further exploration for rice. Some of these have already been started, in a limited way, at IRRI. Research on bulk breeding, with greater emphasis on recurrent selection, and research on hybrid rice, wide crossing and other techniques, should continue in a more basic way, in relation to studying the problem of increasing yield potential.

The Panel concluded that IRRI should not attempt to breed F1 hybrid varieties although it should help to improve the efficiency of this technology. F1 hybrids are useful in the assessment of the possibility for the genetic improvement of yield in conventional varieties. In addition, the study of hybrids can contribute to the understanding of the physiological constraints to yield improvement in rice.

4.3.6. Recommendations

The foregoing Section "Germplasm Improvement" covers topics on Breeding for Different Rice Environments, Breeding and Upstream Research, Disease and Insect Resistance, Tolerance to Environmental Stresses and Yield Potential. Under each of these headings, the Panel has made suggestions which should be consulted for details.

The Panel emphasizes here some of the suggestions and makes the following recomendations:

- IRRI should place much less effort on perfecting finished varieties and give more encouragement to on-site breeding in national programs in order to satisfy local needs, maximize genetic diversity, and enable local breeders to be more successful.

- IRRI should acquire the necessary skills to undertake more creative research towards the goal of developing disease and insect resistance that is durable and stable. A critical and continuing need is to reduce fluctuations in productivity and profitability caused by diseases and insect pests.

- IRRI's present involvement in genetic engineering and biotechnology is commended and, as needs and opportunities become apparent in the future, there should be further expansion at the expense of more routine breeding activities.

- research to increase yield potential should be intensified, with greater in-depth research in plant physiology, integrated closely with genetics and plant breeding. In this regard, heterosis should also be explored in greater depth.

4.4. Crop and Resources Research

4.4.1. Water and Nutrient Management

Excellent work has been done by the Agronomy Department on the dynamics of nitrogen transfer losses in flooded soils and by the Soils Department, on organic matter turnover in flooded soils. The work of the Department of Soil Microbiology on biological nitrogen fixation by Azolla,

blue green algae and Sesbania is also of good scientific standard, but the value of the nitrogen may be overestimated because of the inputs required and the costs of management. The work by the Department of Plant Physiology on low input agriculture in irrigated areas is also directed towards the efficiency of nitrogen use in fertilized and unfertilized situations.

In comparison, little work is done on phosphate, although there are many points of interaction between phosphorus and nitrogen in the soil and in the plant. Moreover, the move to less favoured environments requires that much more attention should be given to the management of these elements. The work would gain in relevance and depth, if better interaction between departments could be achieved to undertake a process-oriented study of nitrogen and phosphate dynamics in the soil-plant system.

An important constraint for upland crops and second crops after flooded rice is that water and nutrients are often not available at the same time and place. In experimental situations, this may be overcome by sprinkler irrigation, or by very deep placement of fertilizer, but it is urgent to develop economically viable management options that can be used under farm conditions. This requires an analysis of the combined dynamics of nutrients and water as influenced by crop growth, soil structure and tillage. Here again, the knowledge base to do so should be mobilized in a project that involves several departments.

Other important areas that require upstream research involving various departments concern the rotation of flooded rice with dry land crops, the alternation of anaerobic and aerobic situations in unfavourable rainfed and upland soils, and nutrient, water and oxygen interactions in the rhizosphere of rice in flooded and upland situations. There is also a need for research involving soil water hydrology, especially in relation to crop growth, water use efficiency and soil drainage.

The Panel considers that research involving surface and floodwater hydrology lies outside IRRI's mandate. Soil water hydrology research in the Institute should be associated with the Soils Department, removing the need for a separate Department of Water Management.

4.4.2. Agronomy

Agronomy has been one of the more dynamic and productive disciplines at IRRI. In considering the coverage of crop agronomy in the Institute, the Panel considers that the department should assume responsibility for the closely-related crop research of the Multiple Cropping Department, including the agro-ecological and simulation modelling research. The remaining activities which relate to cropping systems technology should be incorporated in the ARFSN.

Because of the strong focus on process and component research relating directly to productivity of rice-based farming systems, the Agronomy Department has a responsibility to develop strong linkages with the breeders developing genetic material and, at the other end of the scale, with the scientists evaluating the improved agronomic practices.

Recent work on direct seeding of rice, a technology likely to be more widely adopted in the future, is a good example of such research. The technology needs help from the breeders and soil physicists to improve establishment, from the weed ecologists to devise means of weed control for poor farmers in the less favourable environments, and from the agricultural economists to measure the overall socio-economic impact of the technology, particularly on the employment of women.

In addition to off-site work in the Philippines, IRRI's decision to shift some resources to cover less favoured environments should involve the relocation of some staff members and research programs to a limited number of rice environments outside the Philippines.

The work on difficult environments offers some special opportunities for IRRI. It will provide an incentive for small interdisciplinary teams to come together to focus on the important problems of these environments. Also, it will help promote the integration of the Institute's research and will provide a further opportunity for closer collaboration with the research staff of the national programs.

The Panel strongly supports this shift in approach and agrees that it should be seen as an essential part of IRRI's core program.

Simulation modelling should become an important activity within the Agronomy Department. Areas of immediate application are calculations of yield potential and opportunities for double cropping, as determined by weather and water supply. Furthermore, simulation may assist research on potential yield, on genotype/environment interactions, on nitrogen transformations in the soil-plant system, on the interaction between water and nutrient availability, on epidemiological problems and integrated pest management. The first attempt to disseminate simulation techniques to national systems appears promising, but it should be realized that there is still a long way to go.

4.4.3. Pathology Research

There are many good pathologists in Asian countries working on rice diseases. Thus, it is pertinent to ask what pathologists at IRRI can do that would be both useful and additional to what national pathologists are doing, or could do. Although there are advantages to conducting pathology research at IRRI, there are also disadvantages.

Some of the advantages are the excellent equipment, facilities, educated assistants and funding, the potential opportunity for scientific interaction among different disciplines, and the possibilities for Ph.D. thesis research. Finally, the opportunities for linking research to surveillance and technology transfer activities supported by others within the Philippines are very great.

However, there are some negative factors which may affect the research output: the artificial nature of the IRRI farm with its many varieties, plots and sprays; the lack of a good blast disease environment; the

varieties, plots and sprays; the lack of a good blast disease environment; the established service-nature of the relationship with the breeding programs, and the absence of various pathogen races and vector biotypes.

Good research on disease etiology (identification and description of the causal pathogen) has been done at IRRI both in the beginning and more recently. The finding that tungro disease is really caused by two different viruses is especially interesting.

Much research is still required to understand disease intensity/yield loss relations, the interactions of various diseases and pests with yield loss, pathogen biology, and disease epidemiology. The crop physiological basis of yield losses also requires investigation.

Few data are available on micro-evolution of pathogens, as influenced by genotypes. Virulence population structure and pathogen genetics are wide open fields. The effect of changing cropping intensity or technology on diseases has been little studied.

The need for creative research on disease resistance development was stressed in Section 4.3.3. Many of the above topics would have predictive value in relation to both developing resistance and in more rational deployment of varieties. Since many of these topics need to be investigated on a wider basis than just in the Philippines, it is suggested that very selective scientist-to-scientist collaboration be established with pathologists in other Asian countries on an informal basis to explore researchable topics. Projects could be established with common goals and procedures to investigate an interesting topic in several different environments, with results published jointly. Such an approach could go a long way to expand the knowledge base on rice pathogens and diseases.

Recent expansion of the department in areas of fungal pathogen genetics and disease epidemiology has created new possibilities for plant pathology research at IRRI. The need for creative research in disease-resistance development remains a very important potential area of work.

4.4.4. Entomology Research

The recent emphasis at IRRI on insect biology and ecology and on work on integrated pest management is welcome. The Panel considers that IRRI is now in a position to take full advantage of modern entomological and ecological concepts and knowledge and apply them to rice. The natural checks and balances so affecting insect pest populations in the humid tropics can once again develop, provided past policy and practices on insecticide use can be reversed. Links should be encouraged and strengthened with other organizations, such as FAO and Deutsche Gesellschaft fur Technische Zusammenarbeit (German Agency for Technical Cooperation) (GTZ), which have programs for the same objectives, but at a grass-roots level through surveillance and threshold identification work.

It appears that the biological studies on integrated pest management at IRRI lie wholly within the Entomology Department. It is suggested that a more holistic approach be taken to include both weeds and

pathogens, as well as insects in an Integrated Pest Management (IPM) research program.

As in pathology, little is known of pest population dynamics and of development shifts in population biotypes in relation to varietal deployment and host resistance genes. Little is known of the effects of crop rotations, cropping intensity and post harvest field management on pest dynamics. Little is known about losses in relation to pest mixtures and pest/disease mixtures as they affect rice during its growth cycle.

The Panel supports the idea of research on different avenues that may lead to reduction of artificial and expensive pesticide usage. Botanical pesticides may offer one possibility. But, caution needs to be exercised in extrapolation from limited data from small experiments. It is important that the general public should not be led to false expectations, especially in trendy areas. Expectations that are too high may place researchers and institutions in a difficult position.

As in plant pathology, many of the key researchable areas in entomology are holistic, and can be approached simultaneously, with advantage, in different countries. The development of informal scientist-to-scientist collaboration with good entomologists elsewhere is to be encouraged. In this regard, advantage should be taken of the large untapped resource of good scientists in Asian universities.

4.4.5. Agricultural Engineering

A number of the small farm machines developed at IRRI by the department over the last 15 years have been highly successful. The group has also made a valuable contribution by designing equipment for laboratory use to support the Institute's research programs.

The department requires skills in the basic areas of market research, product planning, machinery design, development and evaluation. With these elements and with collaboration among the senior staff, it can play an effective role in the development of small farm machinery at IRRI.

If adequately staffed, the group can continue to plan and design farm machines, such as the recently-developed continuous flow, rotary dryer, which has the potential to overcome a major constraint in post-harvest management of rice. This dryer causes a rapid reduction in the moisture content of rice, harvested in the wet season, before storage on the farm or in village or district facilities. In this respect, the department should continue to work closely with small entrepreneurs to increase the opportunity for the commercialization of its products. IRRI has no comparative advantage in atempting to reduce post-harvest losses of rice in the distribution network beyond the village.

In addition to its work at IRRI, the department can continue to have a valuable role by collaborating with national agricultural research systems to design suitable farm implements, such as direct seeders for rice, and to facilitate the development and testing of these machines in the farming systems network. The past record of the Department, and the need for new,

innovative machinery to assist with the special problems to be encountered in the more fragile and unstable rainfed environments, provides a strong case for the continued support of this discipline. It is claimed that IRRI's interaction is important in maintaining the viability of farm machinery research groups in a number of developing countries.

4.4.6. Socio-Economic Research

IRRI has gained a well-earned reputation for the high quality of its research on the consequences and constraints of the introduction and spread of modern rice varieties. The "constraints network" generated valuable information and insights on the importance of irrigation and fertilizers and of economic policy as factors promoting the spread of this new technology. IRRI publications on consequences and constraints have become authoritative sources on many aspects of the spread of modern rice varieties in Asia, and have contributed to the Institute's reputation as a "Center of excellence".

In recent years, there has been some reorientation of economics research at the Institute. Increasing attention is being given to equity issues, especially to the economic consequences of introducing new rice technologies in disadvantaged areas or less well-endowed regions. IRRI economists have also analyzed the economic impact of components of the Institute's research, and have defined disadvantaged rice-growing areas to assist in setting priorities.

The program can be described as emphasizing three major study areas, plus smaller studies. The major study areas are: (a) macroeconomic analysis, to examine the impacts of technical change on different groups in various rice environments, (b) the economics of pest management, and (c) economic analysis of farming systems, in collaboration with other departments. The small studies mostly relate to analyses of changing inputs to raise productivity.

IRRI economists are involved in 13 of the Institute's sub-programs. At present, these activities do not appear to follow an established set of priorities, but rather to be a response to internal and external pressures. Circumstances change, and there is need for an overall strategy to take account of this. Future priorities may need to change. For example, IRRI's macroeconomic work on the analysis of the impact of the introduction and spread of the modern varieties of rice has been outstanding; so has its work on the analysis of the distribution of benefits from the new technology. But now there are other institutions that appear to have a greater comparative advantage than IRRI in undertaking macro-policy-oriented analyses. IFPRI, which has a staff member at IRRI, would be one such institution. Additionally, many of the larger rice-producing economies now have their own trained economists and economic research institutions that can and do undertake analysis of this type.

IRRI's comparative advantage seems to lie in its opportunities for multidisciplinary analysis of the economics of rice production. In this context, the Economics Department serves other disciplines at IRRI by bringing an economic dimension to their work. In addition, the department should provide leadership among the economists and social scientists concerned with

analyzing rice-related problems in Asia. The requirement for leadership among rice economists is becoming more demanding as the rice producing nations have developed their own cadre of well-trained economists (frequently with the help of IRRI). To do this, IRRI economists must be at the cutting edge in economic analysis and they must generate useful and innovative research results.

Two areas of work in which IRRI could play this role are the emerging field of resource management under different environmental conditions, and on-farm input-output analysis at a time of falling rice prices.

However, the Panel was concerned that the department appears to be responding to many requests having little direct relationship with its role, as described above. As a result, it seems that the department's resources are spread too thinly. Consequently the Panel concluded that the Economics Department should redefine its program and priorities and narrow the scope of its activities.

The department should keep abreast of global and regional developments in rice production, and it should publish an annual report on the rice situation. This should be IRRI's view of the global rice situation and it should become recognized as the authoritative publication on the subject.

The work on the economics of pest management (including integrated pest management) is important, not only as a means of educating IRRI scientists, but also as a means of developing methodologies which can be used by researchers elsewhere. Also, IRRI's work on the role of women in rice production is important and should produce methodologies and technology prototypes that will have wide use.

The Panel considers it is time for IRRI to phase out its work on the macroeconomic analysis of the impact of the rice technology on different regions of the world. Other institutions, notably IFPRI, should be in a better position to undertake studies of this kind.

The Panel suggests that emphasis be given to resource management with a view to generating methodologies for analyzing the economics of sustainability under different rice environments and practices, and that the department should make a special effort to seek post-doctoral and Ph.D. fellows from institutions that provide intellectual leadership in the area of resource management. For the foreseeable future, economists will continue to be concerned with how to measure the relationship between new technologies, the environment, and sustainability. IRRI is in a favourable position to play a leading role in developing methodologies and generating information in these areas vis-a-vis rice.

4.4.7. Recommendations

The Section "Crop and Resources Research" contains topics on Water and Nutrient Management, on Agronomy, Pathology, Entomology, Agricultural Engineering and Socio-Economics. Under each of these headings, suggestions were made by the Panel which should be consulted for details.

The Panel emphasizes here some of the suggestions and makes the following recommendations:

- IRRI should strengthen its research on yield loss as affected by disease/pest intensity in relation to rice genotype and environment, and give more attention to pathogen/pest microevolution in relation to development of resistance and deployment of different resistance genes. These needs are revealed by the continuing importance of diseases and pests regionally, and their unpredictable devastating epidemics locally.

- IRRI should vigorously pursue the goal of stabilizing pest populations below yield loss thresholds via all possible avenues.

- IRRI should continue its work on abiotic stresses with more of an upstream approach involving soil chemistry and physics, nutrition, plant physiology and genetics.

- since research involving surface and floodwater hydrology lies outside the IRRI mandate, these activities should be phased out and the remaining soil water hydrology research should be integrated into the Soils Department, removing the need for a Department of Water Management.

- in view of the extensive research that has been undertaken on biological nitrogen fixation by Azolla, blue green algae and other microorganisms, the work in this area should not continue beyond the completion of the existing special projects.

- the Department of Agronomy should assume responsibility for the closely-related crop research currently undertaken by the Multiple Cropping Department, including agro-ecological and simulation modeling work. The remaining farming systems activities should only continue within the Asian Farming Systems Network, thus removing the need for a separate Department of Multiple Cropping.

- IRRI should concentrate on interdisciplinary work in socio-economics where it has a comparative advantage and which would serve the interests of rice producing countries: resource management to generate methodologies for analyzing the economics of sustainability in different rice environments, and the economics of pest management.

- IRRI should phase out its on-going macroeconomic analysis on the impact of rice technology in different regions of the world because, though excellent, it is now more appropriately undertaken by national and other international institutions.

- IRRI should continue its good work on agricultural engineering to address the needs of many Asian Countries.

- IRRI should continue and expand, as appropriate, analyses and programs related to the impact of new technology on the role of women in rice production.

CHAPTER 5. GERMPLASM BANKS

5.1. International Rice Germplasm Center

The conservation of crop genetic resources ranks very high in the priorities of the CGIAR. In line with this policy, IRRI has emphasized the importance of rice genetic resources for crop improvement. The conservation of rice genetic resources has been an integral part of IRRI's breeding activities.

One major task for IRRI is the development of rice technology. From its inception, rice improvement as a component of rice technology has been emphasized. This program, formulated as the Genetic Evaluation and Utilization Program (GEU) in 1973, involved not only the breeders but also scientists from other departments. One of the GEU research activities has been germplasm collection, conservation, and dissemination.

The early success of IRRI was marked by the release of IR5 and IR8. Further development of the new high-yielding varieties required genetic resources of rice, which were gathered from many places. As a consequence of the spread of IRRI varieties in rice-growing countries in Asia, many traditional varieties are endangered. Therefore, germplasm collection has been speeded up. New accessions were originally stored in the germplasm laboratory of the Plant Breeding Department, but in November 1977 a new building to store rice germplasm was completed and inaugurated as the Germplasm Bank.

Following the establishment of the International Board for Plant Genetic Resources (IBPGR) in 1974, IRRI was identified as the leading institute in rice genetic resources, and the Board assigned global responsibility for rice germplasm collection and conservation to IRRI. In 1983, the IRRI Board of Trustees reorganized the Genetic Resources Program of IRRI as the IRGC, with an International Advisory Committee to broaden its working base. The IRGC has been designated as one of IRRI's Global Research Services and is directly responsible to the Director General.

5.1.1. Program Activities

The principal objective of the IRGC is to be the central repository of the world's rice genetic resources, for use by rice researchers and growers anywhere in the world. Its primary functions are collection, characterization, documentation, conservation, and dissemination of rice germplasm. In addition to these standard activities, the IRGC also provides training and technical assistance to national germplasm centers.

The IRGC conserves and distributes rice genetic resources in the form of seeds. The center maintains cold storage facilities at three levels of temperature and humidity so that seeds can be kept in short-term (3-5 years), medium-term (20-60 years), and long-term storage (more than 70 years). A data base management system has been established to enable retrieval of information about the accessions held.

Although research is not the major function of the IRGC, several staff members are involved in research carried out with other departments. The IRGC cooperates with the Department of Cereal Chemistry in the evaluation of varietal differences in seed storage characteristics, and with the Tissue Culture Laboratory in research to rescue non-viable seeds by tissue culture.

Seed distribution is the major workload of the IRGC, with the consumers being researchers at IRRI and in other countries. The total number of accessions processed and distributed to researchers amounts to 50,000 per year. Table 3 illustrates the number of requests for seeds. Requests for seeds are increasing. In addition to those for O. sativa, those for wild rices and "exotic types" are also increasing due to interest of workers in biotechnology. The steadily rising numbers have resulted in a need to expand the physical facilities.

Table 3. Distribution of seed of Oryza cultigens and wild species by IRGC, 1982 to 1986

Year	No. of O. sativa samples distributed (no. of requests)		No. of O. glaberrima/genetic testers/ wild rices distributed (no. of requests)	
	Inside IRRI	National Programs	Inside IRRI	National Programs
1982	33,975 (279)	11,075 (154)	378 (26)	438 (20)
1983	28,443 (287)	3,756 (150)	342 (20)	972 (38)
1984	28,170 (277)	6,619 (146)	83 (17)	448 (29)
1985	30,709 (306)	4,736 (172)	1,138 (24)	1,174 (36)
1986	39,135 (327)	9,897 (187)	2,253 (13)	595 (28)

The IRGC also provides formal training to gene bank managers. A comprehensive, 12-month Genetic Resources Conservation and Management Training Course held in 1985-1986 was attended by 12 germplasm scientists from eight Asian countries and two African countries. In addition to this kind of training, the IRGC provides assistance to those who take graduate degrees on research related to rice germplasm. In the past five years, students from China (5), Bangladesh (2), and Sri Lanka studied for M.Sc. degrees as part of the program.

To stimulate in-country collection of rice germplasm, the IRGC conducts in-country training for field collectors. Such training has been organized in Bangladesh, Burma, Indonesia, and Thailand.

Technical advice to other gene banks concerning architectural and engineering designs, choice of laboratory equipment, and selection of seed processing methods and types of seed containers was rendered to the International Institute of Tropical Agriculture (IITA), the International Maize and Wheat Improvement Center (CIMMYT), the West Africa Rice Development Association (WARDA), the Asian Vegetable Research and Development Center (AVRDC), the National Bureau of Plant Genetic Resources (NBPGR), the Central Rice Research Institute (CRRI), the Chinese Academy of Agricultural Sciences (CAAS), the China National Rice Research Institute (CNRRI), the Bangladesh Rice Research Institute (BRRI), Fiji, and Sri Lanka. In this way, the IRGC serves not only gene banks in the CGIAR System, but also those of regional and national institutions.

The center is well equipped to meet its functions. A second senior scientist has been recruited and will join IRRI in July 1987. The center has its own budget, but provision for the costs of collection is not specifically spelled out.

Today, more than 90% of the accessible rice-growing areas in the tropics have been covered by collecting missions. The focus of future collection will be on assembling wild species from South and South-east Asia.

Seed rejuvenation will dominate IRGC activities in the years to come, as only one-third of the total collection has been sealed in cans for long-term conservation.

5.1.2. Achievements

During the period 1971-1986, the center acquired 43,652 accessions from 15 countries, of which 11,500 were collected with IRRI's direct participation and the remainder from local national efforts. In 1985, 29 states, nations, and international centers sent 4,300 seed samples of *O. sativa*, 83 accessions of *O. glaberrima*, and 292 of wild species. At the end of 1986, the total number of accessions was as follows:

a)	*O. sativa*	: 72,960
b)	*O. glaberrima*	: 2,983
c)	wild species	: 2,268
d)	genetic testers and mutants	: 700
e)	newly received samples	: 200

A few samples of 20 of the 21 wild species of rice have been assembled, therefore, wild rices are only a small part of the total collection.

Almost 90% of the total collection has been characterized botanically in the field, but only 80% has been characterized in the laboratory.

The IRGC routinely records 45 agro-morphological characters, in addition to information on 39 GEU traits. The master file contains close to 3 million records of 64,744 accessions. The recently installed GEU - SQL/DS data handling system is expected to provide users with access to the GEU integrated data base. In addition to the gene bank master file, a seed inventory system and a microbased gene bank system are used to monitor seed in-flow and out-flow and rejuvenation and re-identification. The microbased system is compatible with the central GEU system on the main frame and can be accessed by national gene banks.

During the past five years, at the request respectively of Kenya, Nepal and Pakistan, and two Indian States, the IRGC has been able to supply duplicates of materials originally deposited by them in the IRGC. In addition, the IRGC is making progress in providing the same service to Kampuchea and the Philippines. The fact that the IRGC is able to provide this service demonstrates the importance of countries depositing, for security reasons, duplicates of national collections with designated germplasm banks so that in the event of loss or damage they can be replaced.

In addition to ongoing effort on seed increase, processing new accessions is a continuing activity. Duplicates of processed accessions - 27,838 in all - have been sent to the National Seed Storage Laboratory (NSSL), Fort Collins, Co., USA. One-third of the total collection has been processed and placed in aluminum cans for medium- and long-term storage.

In 1982, the EPR identified backlog in processing accessions as a problem. Farmers' fields 10-12 km away from IRRI have been rented to grow out the accessions. In spite of the increase in planted area (totalling 33 ha), the production of uniform and healthy seeds fit for canning for long-term storage has been slower than expected. Factors affecting good seed production include: diseases and insects on the IRRI farm, zinc deficiency in some of the rented fields, mixtures in many samples, and unfavourable weather in successive wet seasons. However, seed quality is improving. The rejuvenation efforts have overloaded the existing staff.

In 1985, a head-house for seed processing and a double screened area were constructed for rejuvenation of wild rice and difficult-to-grow accessions. Wild rice is grown in pots for seed increase and reidentification.

The IRGC has continued to conduct informal training of varying durations for gene bank technicians and engineers and for seed production workers. During the last five years, 22 persons of various nationalities were trained.

5.1.3. Impact

The IRGC has been instrumental in the development of modern varieties. Through the GEU, germplasm from the IRGC is screened and developed into improved germplasm for all the major rice-growing environments. These materials are in turn used in the IRTP program, which serves in part as an interface between national programs and IRRI's GEU program.

Because of the impact of the modern varieties on increased rice production, the importance of rice germplasm has begun to be better understood. Many national programs request traditional varieties from the IRGC for use in their breeding programs. The IRGC's activities in collecting samples from many areas have stimulated the national programs to gather their own traditional varieties and land races and to establish their own germplasm banks.

5.1.4. Assessment and Issues

The IRGC is one of the finest germplasm facilities in the world and is greatly admired within the scientific community. Through the IRGC, rice genetic resources flow freely to and from countries, regardless of political differences. Moreover, the IRGC provides all sorts of information on rice germplasm whenever needed. It is comforting to know that almost all cultivated rice germplasm and some wild rice accessions are now available for breeding purposes and will be available for future utilization.

Although the total collection of germplasm in the IRGC today is about 80,000 accessions, about 10% of the remote areas of cultivated rice lands remain uncollected. Furthermore, wild rice populations are under represented. The potential of wild rices for use in wide crosses cannot be overemphasized; because wild rices suffer from genetic erosion, their collection and conservation are urgently needed. Considering the importance of assembling the remaining germplasm, the Panel is pleased to note that the new senior scientist will give priority to collecting wild rices and the remaining uncollected primitive cultivars. In the past, several donors contributed funds for collecting rice germplasm. IRRI should make sure that funds for collecting are available preferably from the core budget.

Although field characterizations have been completed on 90% of the collection and the agro-morphological and GEU traits have been fed into the gene bank master file, ecogeographical information is often lacking. Efforts should be made to incorporate such information into the files, including either use of the trip reports of collectors or secondary sources to maximize information for breeders.

Each country should maintain its own working collections for use in breeding. It is also desirable that indigenous materials be kept locally for long-term conservation. However, in many countries, long-term storage facilities do not function well, especially where the electricity supply is unreliable and maintenance funds difficult to obtain. To avoid future problems, the IRGC is in a position to offer advice on setting up long-term storage facilities.

Although the IRGC deposits its duplicate rice collection in the NSSL, it is desirable that replicated collections be distributed to other reliable long-term storage facilities, provided that the free exchange philosophy prevails.

Each year large amounts of redundant materials are donated to the IRGC from various sources. The IRGC should develop rapid screening methods to sort out unnecessary material.

At present, the conservation of cytoplasmic genomes is not considered specifically by the IRGC. 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.

Finally, with respect to the responsibilities of CIAT, IITA and WARDA for rice germplasm conservation, the Panel noted that TAC had established a joint Center-TAC sub-committee to facilitate classification of the shared responsibilities of the CGIAR Centers for all activities related to the efficient use and conservation of germplasm collections. The Panel also noted that an Inter-Center Consultation/Workshop on this subject would take place in the second half of 1987. Therefore, the Panel has not commented.

5.1.5. Recommendation

With regard to the IRGC, the Panel recommends that IRRI should:

- continue its work on the storage of germplasm, with a more selective acceptance of new material into the collection (although importance should be attached to the assembling of further collections of wild rice species); include agro-ecogeographical information in the passport data of accessions whenever possible; and conduct research relating to the germplasm collection.

5.2. The Proposed International Biofertilizer Germplasm Center

5.2.1. Assessment and Recommendation

In its Strategic Planning Committee Report, IRRI proposes to conserve and share germplasm of green manures, biofertilizers, and biocontrol agents of pests (p. 14). A proposal to establish a center for biofertilizer germplasm at IRRI was approved by the Board of Trustees in 1986.

The Panel discussed at length the need to establish a biofertilizer germplasm center at IRRI, and wishes to point out that the collections are not true germplasm collections, but are working collections of organisms of interest to some researchers. It would be desirable to hold them as reference organisms for scientists at IRRI and elsewhere. However, as there is little evidence of their genetic erosion, and as the number of samples and the space required for their storage are not large, the Panel is of the opinion that these working collections could be accommodated at IRRI without elaborate provision.

The Panel recommends that IRRI:

- does not require a biofertilizer germplasm center to prevent genetic erosion nor to store the small collections.

CHAPTER 6. INTERNATIONAL ACTIVITIES

6.1. Cooperation with National Research Systems

IRRI works extensively with a large number of national agricultural research systems, usually through country projects on problems of national interest.

6.1.1. Program Activities

IRRI's international research activities are broad based. Collaborative research may be cost-free joint enterprises between individual scientists on problems of mutual interest, cost-shared on the basis of an agreement between IRRI and an institute, and/or specially funded by a particular donor. Collaborative research, primarily concerned with the generation of new knowledge as the result of mutual collaboration among peers, is considered in Chapter 4.

The main focus of the Regional and Country Programs is on the country programs which usually are financed by bilateral or multilateral development agencies. Programs which are mainly regional are discussed in Section 6.4. Country Programs are IRRI's main channel (apart from training, which is discussed in the next section) for strengthening the capacities of national agricultural research systems. In general, it is the recipient country's invitation to IRRI to assist with the implementation of technical assistance which opens the way for IRRI's participation in projects having research and training components.

6.1.2. Consultation/Decision Making

A country program is developed as a result of the expressed commitment by a national government to improve its rice production and on the invitation of that government for IRRI to be associated with a development project. IRRI participates in the planning as well as the execution of projects. Once a detailed cooperative research and training work plan is formulated, a Memorandum of Understanding is signed by the IRRI Director General and the head of the concerned national research system. The memorandum normally is an umbrella agreement, with provision for the joint preparation of detailed annual and biannual work plans which spell out the responsibilities of the participants. In the case of large rice-growing countries, annual planning meetings are held, either at Los Banos or in the country concerned; in the case of countries with smaller rice areas, work plans are finalized by correspondence or during visits of scientists. Progress on the agreed work plan is monitored by the IRRI scientist/director having primary responsibility for overseeing the implementation of the

project. IRRI core staff and resources are not directly involved in these country programs. Rather, staff are appointed for the duration of the project and governed by any special regulations that a donor agency may stipulate.

IRRI has grouped developing countries into four categories, based on current average rice yield. It is not clear, however, what criteria IRRI uses in deciding to accept requests from client countries, but considerations include: the status of the country's research and research manpower, commitment of the country to rice production, the nature of the problem to be solved and IRRI's ability to assist. In addition, whether the gap in production can be filled by research.

6.1.3. Achievements and Impact

There can be no doubt that IRRI has played a very important role in helping national agricultural research systems increase their rice research capacity. Only a few examples can be cited here.

BRRI has grown into a premier rice research institute with a well trained staff. It not only conducts its own in-country rice production courses, but also organizes training courses for rice scientists from other countries of Asia and Africa. Rice production in Bangladesh has substantially increased as a result of technology generated by BRRI with continuing support from IRRI.

In the initial stages of the Burma-IRRI collaboration, considerable emphasis was placed on improving yield per hectare, and both a rise in productivity and increased total production resulted. Outreach IRRI scientists working with their Burmese colleagues have helped develop early maturing varieties, opening opportunities for new cropping patterns. The work on the design and adaptation of bullock-drawn implements and farm machinery has introduced improved prototypes for practical application, much to the interest of small farmers.

In addition to assisting China to develop a national rice research institute, IRRI has actively participated in the design and development of a National Plant Genetics Resources Conservation Center in Beijing. A wide range of collaboration now takes place between China and IRRI in rice genetics and breeding, hybrid rice research, and germplasm collection and conservation.

IRRI-Indonesia collaboration has strengthened that country's rice research program. A dramatic increase in rice production has taken place and the nation has moved from being the world's largest importer of rice to being self-sufficient.

Cooperation between Korea and IRRI in indica-japonica crosses has led to the development of some outstanding varieties.

6.1.4. Assessment and Recommendations

It was clear to the Panel that IRRI's cooperative country programs are contributing in a positive way to the overall strengthening of national capacities, especially in the major rice-growing countries of Asia. However, the Panel identified a number of issues which it wishes to bring to the attention of IRRI as deserving further attention.

The Panel was concerned that the criteria IRRI uses in accepting requests from countries, and their relative weighting, are not explicit. It suggests that the following elements might be some of those used in determining priorities among countries:

- the project should be centered to IRRI's objectives;
- IRRI's capacity and comparative advantage to undertake the project;
- the capacity of the country's research and extension services and the need for strengthening them;
- IRRI's estimate of the probability of success of the project and the availability of suitable staff to participate.

The Panel proposes that further detailed criteria should be added to the decision process so that IRRI can improve the way it deploys its finite resources.

As a result of close collaboration with IRRI, institutions of several developing countries now have the capacity not only to conduct applied and adaptive research to meet their own needs, but also to extend benefits to countries with similar environments. The Panel suggests that IRRI should encourage these stronger national agricultural research systems to share the responsibility for certain aspects of research and training at the regional level. This cost-effective division of responsibility will not only ensure a flow of knowledge from international systems to the national systems, but also stimulate national systems to participate in upstream research activities and to share knowledge gained with other national systems.

Funding is likely to be a major constraint to this type of collaboration. The Panel considers that endeavours of this nature should be arranged through bilateral channels and should not be the responsibility of IRRI. The Panel has been advised by some national systems that they would be willing to share the responsibilities at the regional level if arrangements could be made.

There is much to learn from the wide range of field problems in different rice environments. The Panel was concerned that IRRI headquarters staff is insufficiently exposed to the real constraints to advances in rice productivity in many of its cooperating countries. To remedy this, members of IRRI's headquarters staff should periodically spend several months working with national scientists in the field. Similarly, national scientists and IRRI outreach scientists would benefit from extended visits to IRRI headquarters.

In the process of integrating efforts of IRRI and rice scientists in the national programs to achieve the common goal of increased sustainable production, the scientists from the developing countries must be able to participate and to discuss their particular requirements and achievements during the process of program planning and review. One way of permitting them to do so would be to provide for wider participation of leaders of national programs in IRRI's internal review. Participants could be selectively invited from countries actively involved in rice research.

The heavy load of activities in the management of special projects is likely to distract from IRRI's main task. The Panel, therefore, believes that as a national system grows in strength and is capable of assuming full responsibility, it would be appropriate for donors to work directly with the nations to enhance national confidence and relieve IRRI of a further distraction.

The Panel, therefore, recommends that IRRI should

- develop strong collaboration between its scientists and capable partners in national programs to help address priority problems of mutual interest.

- facilitate the exchange of IRRI-based scientists with outreach staff and selected national scientists for periods of several months; consult with appropriate national rice research leaders in IRRI's planning and priority-setting activities; and encourage participation of involved national scientific leaders on a selective/rotational basis in internal program reviews.

- continue to support national rice programs and encourage direct donor support for the stronger national systems, thereby encouraging self-reliance.

- encourage those national systems with the appropriate capacity to take some responsibility, in partnership, to assist weaker national systems in building rice research.

6.2. Host Country Relationship

The Panel recognizes the importance of the relationships between the Philippines and IRRI and the role of the Philippine Government in the establishment and continued support of IRRI.

Filipino staff have made valuable contributions at IRRI. The long and close partnership with Filipino institutions, notably the Ministry of Agriculture and Food (MAF) and UPLB, has contributed greatly, certainly to IRRI and, the Panel was told, reciprocally. The objectives of IRRI's host-country programs have been consistent with those of other country programs. Almost from its inception, IRRI, located on the campus of UPLB, has undertaken joint training programs leading to the awarding of M.Sc. and Ph.D. degrees by UPLB.

The Philippines had not had a separate rice research institute. In 1986, the Philippines National Rice Research Institute (PhilRice) was set up at Los Banos. A detailed Memorandum of Understanding between PhilRice and IRRI that identifies the areas of their respective responsibilities will be developed. Meanwhile, ongoing collaboration with universities and research institutes in the Philippines will continue to be strengthened. The Panel was told that, until recently, rice research had not been given the highest priority in agriculture research in the Philippines.

The foregoing indicates the wide spectrum of collaborative relationships that exists between the national agriculture research system and IRRI. With the establishment of PhilRice, a still closer linkage is envisaged between national rice programs and IRRI.

6.3 Training and Technology Transfer

Training is a major activity at IRRI. The stated objective of IRRI's training and professional advancement program is "to provide relevant training to national scientists and production specialists in order to strengthen research on rice and rice-based training systems".

The training program has evolved as IRRI's scope of activities have widened, IRRI's earliest goals were to "provide solutions to some of the most pertinent challenges in tropical rice production". In the process of fulfilling its early objectives through the generation, adaptation, and diffusion of improved varieties of rice in many different environments in Asia, it became apparent that there was a shortage of the special skills needed to fulfill those objectives. Consequently, IRRI embarked on a program of human resource development to increase the supply of skilled persons needed to develop national rice research programs. The first course for rice scientists from the Asian region held in 1962 was a mixture of practical and theoretical aspects of rice growth and production. Since that time, as IRRI's own research program has become more comprehensive, IRRI's training programs have widened in scope and taken on new dimensions. In addition to on-the-job training, IRRI began to develop programs to provide for the more specialized needs of post-graduate rice researchers from universities and national

research institutions and of scholars seeking advanced degrees on rice-related issues. Over the last several decades (1962-1986) some 4,676 individuals (see Table 4) from 78 countries have received some training at IRRI. This training has ranged from the mundane, hands-on laying out of rice research plots in the field to the study of advanced concepts of rice production and biotechnology. The program has grown to the point that in 1986, there were 550 trainees including 250 fellows, 85 working for M.Sc. degrees and 69 for Ph.Ds, another 25 were post-doctoral fellows. In April 1987, 275 students and scholars were present at IRRI (Table 5).

6.3.1. Program Activities

The programs for human resource development include three major spheres of activity: (a) research-oriented programs, (b) short-term courses, and (c) special training programs. These are discussed in some detail in the publication "IRRI's Training and Professional Advancement Programs". The main features of these programs are:

A. Research-Oriented Programs

The research-oriented training programs comprise the post-doctoral fellowship program, the M.Sc. and Ph.D. degree programs, and the special non-degree research programs. All participants in these programs are closely associated with a particular department and, depending on their level, receive guidance or close direction from IRRI senior scientists. Table 6 shows the range of research-oriented programs among the departments and the distribution of participants.

Post-doctoral fellows work on specialized projects directly relevant to problems in their home countries. Usually they receive minimal guidance or assistance from IRRI senior scientists. The program provides competent scientists from national programs with opportunities to enrich and enlarge their research experience.

The degree programs include the M.Sc. and Ph.D. studies. In general, scholars working for the M.Sc. complete their degree programs at developing countries and conduct thesis research at IRRI under the direction of IRRI scientists. Most of them take courses under the joint IRRI-UPLB agreement. Similar arrangements have been made with 36 universities in developed and developing countries (Table 7).

In general, the arrangement for students working for the Ph.D. is similar to that for the M.Sc. But when more specialized studies require a broader curriculum than is usually offered at universities in developing countries, the students complete part or all of their course requirements at a university in a developed country. In every case, thesis research is done at IRRI. After completing the thesis research, the scholar either returns to the university abroad to take the final examination or the Chairman of the Student's Academic Committee is invited to IRRI to conduct the final examination with a locally constituted examination committee.

Table 4. Numbers and Origins of Scholars and Trainees by Region and by Type of Training Program Studying at IRRI, 1962-1986

Training Program	Participants					
		Regional Distribution				
		Asia & Pacific	Latin America/ Carib.	N.Africa/ Near East	Sub-Saharan Africa	Developed Countries
Research Orientes						
- Post-doctoral fellowships	330	258	5	4	5	58
- Degree programs(MSc & PhD)	770	660	25	4	18	63
- Non-degree training	650	505	19	16	30	80
Short-term Courses	2,926	2,728	30	40	102	26
TOTAL	4,676	4,151	79	64	155	227

Table 5. Regional Origin of Visiting Scientists, Post-Doctoral Scientists, Collaborative Research Scientists/Fellows, Degree Scholars and Trainees Present at IRRI in April 1987

Region	VS 1/	PDS 2/	CRS/F 3/	PhD	MSc	ND 4/	Short-Term Courses	Total
Asia/Pacific (15 countries)	10	22	5	46	59	9	75	226
Latin America/ Caribbean (3 countries)	0	1	0	0	2	1	2	6
North Africa/ Near East (2 countries)	0	0	0	0	1	2	0	3
Sub-Saharan Africa (8 countries)	1	3	0	2	2	2	6	16
Developed Countries (8 countries)	0	1	10	11	1	1	0	19
TOTAL	11	27	15	59	65	15	83	275

1/ Visiting scholar
2/ Post-doctorate scholar
3/ Collaborative research scientists and fellows
4/ Non-degree

Table 6. Distribution of Visiting Scientists, Post-Doctoral Scientists, Collaborative Research Scientists and Fellows, Research Fellows and Research Scholars Among Research Departments, 1986

Department	VS[1/]	PDS[2/]	CRS/F[3/]	PhD	MSc	ND[4/]	Total
Plant Breeding	1	3	4	13	13	1	35
Plant Pathology	3	1	2	10	9	7	32
Plant Physiology	3	4	2	5	4	6	24
Entomology	1	1	3	6	8	3	22
Agronomy	-	3	2	7	7	1	20
Agricultural Economics	1	1	1	6	8	1	18
Multiple Cropping	2	2	2	2	5	2	15
Rice Farming Systems Program	2	2	-	7	1	1	13
Soils	2	2	3	2	3	-	12
Soil Microbiology	-	3	3	3	2	1	12
International Rice Germplasm Center	1	-	1	-	4	2	8
Agricultural Engineering	-	1	-	-	6	-	7
Irrigation Water	-	1	-	2	4	-	7
Statistics	-	2	-	1	2	-	5
International Rice Testing Program	1	1	-	2	-	-	4
Training and Technology Transfer	-	-	-	2	2	1	5
Cereal Chemistry	-	1	-	-	1	1	3
Communications and Publications	-	-	-	-	1	-	1
Library and Documentation	-	-	-	-	-	1	1
Abroad	-	-	-	1	5	5	6
TOTAL	17	28	23	69	85	28	250

1/ Visiting scholar
2/ Post-doctorate scholar
3/ Collaborative research scientists and fellows
4/ Non-degree

Table 7. List of Universities With Which IRRI Has Collaborative Graduate Programs

Location	Universities with formal agreement	Universities without formal agreement
Australia	Australian National	Adelaide, La Trobe, Queensland
Canada		Alberta, McGill
Germany	Hamburg	Hohenheim, Munchen
India	Andhra Pradesh Agricultural, Sher-E-Kashmir	Jawaharlal Nehru Agricultural Himachal Pradesh, Kerala Agricultural, Lucknow, Madras
Indonesia		Gadjah Mada
Japan	United Nations	Kyoto, Kyushu, Hokkaido, Tokyo, Tohoku
Korea	Chonnan Agricultural	Kyungpuk National, Gyeongsong National, Seoul National
Malaysia	Pertanian Malaysia	
Philippines		Ateneo de Manila, Diliman, Xavier, Gregorio Araneta Agricultural
Thailand	Asian Institute of Technology, Thammasat	
United Kingdom		Birminghan, Cambridge, Nottingham, Imperial College
United States	Florida, Cornell, Wisconsin-Madison, Utah State	Arkansas, Bowling Green State, Colorado State, Illinois, Iowa, Kansas State, Kentucky, Michigan, Michigan State, Minnesota, Mississippi State, Mississippi, Missouri, Nebraska, North Carolina State, Ohio State, Oregon State, Penn State, Purdue, Stanford, Davis, Berkeley, Riverside, Texas A&M, Yale

Table 8. Total Number of IRRI-Trained Scientists from the Main Rice-Growing Countries of the World, 1962-1986

Country	Total rice area (thousand ha)	Trainees at IRRI (number)
India	39,800	511
China (Mainland)	33,200	279
Bangladesh	10,500	384
Indonesia	9,400	531
Thailand	6,854	488
Brazil	6,000	5
Burma	4,800	176
Vietnam	4,631	143
Philippines	3,112	678
Japan	2,278	87
Pakistan	1,503	137
Malagasy	1,200	20
Korea, South	1,203	126
Nepal	1,182	92
China (Taiwan)	776	45
Sri Lanka	719	360
Malaysia	697	132
Nigeria	600	35
Egypt	425	27
Colombia	413	15
Cuba	210	19
Senegal	81	13

The participants in non-degree training programs come to IRRI to work on special problems, usually for six months to one year. The duration of this apprenticeship-type training is based on the time needed to enable each trainee to conduct at least one well-planned experiment developed under the direction of a senior IRRI staff member, to analyze the data, and to prepare a scientific report on the results.

B. Short-term Courses

Most short-term courses are highly oriented to research methodology and production. Participants spend about half of their time in classrooms, learning the basic aspects of the problem, and the other half in the field or laboratory. They plan and conduct experiments with minimum supervision from instructors. Such programs emphasize the integration of formal and informal methods of curriculum organization, giving equal importance to learning through classroom lectures and learning through work experience. Courses range in length from two weeks, e.g. Agricultural Engineering Training Course, to five months, e.g. the Cropping Systems and Rice Production Training Courses. Details of course content can be found in the publication on training.

C. Special Training Courses

Special training courses that have been developed to meet the needs of a wide range of clients include such topics as N15 studies, varietal improvement for upland rice crops, and statistical methods and procedures. These courses are described more fully in IRRI's publication on Training.

IRRI, in collaboration with the national rice research programs, also offers certain short-term courses away from headquarters, especially on biological or physical constraints that do not occur in the Philippines. Also, in certain cases, IRRI scientists offer a series of lectures, generally on methodology, at national programs. An example of this arrangement was the course on Agricultural Economics Research Methodology held at BRRI in November 1982.

6.3.2. Consultation/Decision-Making

In 1983, the IRRI Academic Council was organized to serve as an advisory body on all matters relating to academic and professional training of scientists associated with national programs on rice and rice-based farming systems. The Council's mandate includes the nature and composition of courses, servicing training programs, selection procedures, guidelines for evaluating programs, and the transfer of courses to national programs. The Council also reviews arrangements for collaborative graduate programs with universities in rice-growing countries and recommends measures that ensure that IRRI's manpower development programs are both relevant and of high quality.

The Academic Council is chaired by IRRI's Director General. Its membership also includes senior management of IRRI concerned with training; two senior scientists in IRRI Cooperative Country Programs; the Presidents/Chancellors of nominees of UPLB, U.N. University, the Association of Asian Agricultural Colleges and Universities, the South-east Asian Regional Center for Graduate Study and Research in Agriculture, and the Asian Development Bank (ADB); the Resident Representative of the United Nations Development Program (UNDP), and five other distinguished members nominated by the Director General of IRRI.

The Academic Council's goals are being implemented with the help of four standing committees that deal with collaborative research scientist programs, degree and non-degree training programs, - extension/ production and related training courses, and scholars welfare and cultural programs.

6.3.3. Staff and Resources

As far as can be estimated, around 20% of IRRI's manpower budget is used for training. All research-related training for fellows is done in collaboration with a senior scientist who might supervise the work of up to six scholars. IRRI contributes about half of the cost of these research-related fellowship programs, the other half is funded by special projects.

Implementation of the non-degree training courses is coordinated by the Training and Technology Transfer Department, which also arranges logistical support. This department, with a small staff, is reponsible for the development of instruction materials and has the responsibility for assisting national programs to develop and offer their own courses. Additional staff may be needed to help in this effort toward decentralization.

6.3.4. Determination of Priorities

IRRI has always given high priority to training; the priorities within the training sector have evolved over the years in response to technological developments and to changing needs among IRRI's clients. Initially, IRRI offered two basic non-degree courses, in rice production and cropping systems. During the last ten years, 13 non-degree courses were added to fit the changing needs of national programs. Over time, courses such as the genetic evaluation training program, the integrated pest management training course, and courses in statistical methods have been added in response to requests from national programs. At the same time, the demand for basic production courses has continued, as "new" client countries, such as Bhutan and those of Indo-China, have started to strengthen their research efforts.

Some priority elements appear to have evolved in the research related and degree training. Initially, the emphasis was on training post-graduates to the M.Sc. degree. To some extent, this is still the case, but as the university systems of developing countries have expanded and the number of candidates for Ph.Ds has grown, so greater priority now seems to be given to providing training for Ph.Ds and to providing facilities for post-doctoral fellows.

In the selection of candidates for training programs - degree and non-degree - weight is given to national needs as well as to the relevance of the training and research.

6.3.5. Working Relationships

Over time, the almost 5,000 alumni of IRRI have formed a very valuable network of rice researchers and government officials. This network has provided opportunities for access, information, and exchange that are an integral part of a support system for both IRRI and the Asian rice research community. This has facilitate working relationships among members of the community working on rice research, but on a geographically selective basis. More than 90% of the alumni are from Asia, with only 4% from Africa and less than 2% from Latin America.

6.3.6. Achievements and Impact

Of the nearly 5,000 scholars and scientists who have participated in IRRI's training programs since 1964, close to 800 candidates were in M.Sc. and Ph.D. programs, with 320 post-doctoral fellows and 650 non-

degree trainees respectively. The largest number of trainees were enrolled in the rice production, cropping systems, and genetic evaluation and utilization programs. By far the largest numbers of trainees (4,151) came from Asia, with relatively few (155) from Sub-Saharan Africa. Within Asia, the largest numbers came from the Bangladesh, India, Indonesia, Philippines, Sri Lanka and Thailand. Table 8 shows the distribution of numbers and countries of scientists from the main rice-growing areas of the world trained at IRRI between 1982-1986.

There can be little doubt that IRRI has played and continues to play an important role in the scientific manpower development programs in many countries, particularly in Asia. This is especially so in Bangladesh, Indonesia, and Thailand, where 60-70% of the personnel of the major rice research institutes have been trained, at least in part, at IRRI. A 1983 survey confirmed that scientists who had received some training at IRRI are making major contributions to research on the production of rice and associated crops in their respective countries.

The TAC review "Training in the CGIAR System" welcomed IRRI's efforts, especially its relationships with research scientists at the post-graduate level. The TAC review made some suggestions about future directions - especially with respect to assisting with manpower planning for future research needs and for greater cooperation among the international centers at the country level. The Panel noted these recommendations and leaves it to IRRI to decide on their acceptablility.

In the main, it is the judgment of this mission that the IRRI training program has evolved in a fully satisfactory manner. This evolution has been well-suited to the needs of Asia and there can be no doubt that many of the scientists working on rice in the region have benefitted. The programs have helped endow the region with a very valuable pool of talent and skills. The well-conceived and effective programs also have contributed a great deal to institutional development for rice research in Asia as well as to the great increases in yields in parts of Asia over the past several decades.

The training program, especially the research-related and degree program, has also been beneficial for IRRI. Researchers working on rice-related topics have provided an important source of manpower to supplement the work of the senior scientists. They have contributed to the work of IRRI while enhancing their own overall skills.

6.3.7. Issues and Recommendations

The main issues vis-a-vis the program are much more a matter of emphasis rather than substance. They concern the need for further evolution to take into account the growth in educational capacity in the region and a need for greater decentralization of some of the training activities so that more emphasis on meeting the needs of the 1990's and beyond can be placed in programs at Los Banos.

In the first instance, there will always be a demand for training facilities for practitioners and scientists concerned with rice research. Much effort will be needed to maintain current rates of increase in

rice production to meet the needs of an additional billion people in the rice producing and consuming areas in the next two decades. A considerable proportion of the scientific effort and trained manpower will come from national research systems and national institutions that have been developed over the last 25 years. Over the next two decades, the numbers of graduates in agricultural sciences in many countries will increase substantially. There will be a relatively large increase in the numbers receiving masters degrees. At the same time, it is unlikely that there will be a comparable increase in doctoral candidates or in post-doctoral researchers.

IRRI is at the forefront in rice research and has a well earned reputation as a "Center of excellence". It should continue along this path. To this end, it should concentrate on attracting high caliber candidates for Ph.Ds and post-doctoral fellowships to do research at the Institute. Consequently, it should reduce the emphasis on fellowships for lower degrees. The latter will be increasingly accommodated by national universities. Both IRRI and the national rice programs would gain if IRRI were to focus more on providing advanced training for the rice research community.

At the same time IRRI - and its Academic Council - should view the whole fellowship and training program as an important element in sustaining the vigour and dynamism of IRRI's own program. The fellows, at the degree and post-doctoral level, can bring new concepts, approaches, and ideas to IRRI. For this to happen, the fellows coming to IRRI should have had their academic training in institutions that are at the forefront of their disciplines. In this regard, IRRI might wish to take in and provide facilities for self-motivated private students at universities with leading departments in the disciplines of concern to rice production.

At the same time, as IRRI elevates its goals for research scientists, it should shed some of its standard non-degree training courses. IRRI should help selected national centers that have suitable facilities to become focal points for sub-regional and national training in such areas as rice production, cropping systems, and the like. By decentralizing some of these activities, IRRI can upgrade some of its non-degree training courses to take account of technological advances. In brief, the non-degree training should move upstream. In this context, it would seem appropriate that the non-degree courses as a whole be reviewed, including evaluating the relevance of training programs for non-research groups. Any such review might wish to examine the regions' needs for "refresher" courses for workers trained at IRRI (and elsewhere) in the 1960's and early 1970's.

Three other points warrant mention. The first relates to the sensitive issue of the selection of candidates for the various training programs, especially the fellowship programs. IRRI and the country concerned should jointly select candidates. IRRI uses core funds for some of these programs, so should be in a position to influence the nomination and selection process. Every effort should be made to ensure the high caliber of degree candidates and research fellows. All degree candidates should be interviewed by a senior staff member and, where possible, the candidates prospective supervisors should be involved. IRRI should exercise its right to veto fellowships when candidates are deemed to be unsatisfactory. While the right to veto should be used judiciously, IRRI should bear in mind the importance of maintaining high standards and the costs of failure to all concerned.

The second point is the importance of fulfilling the spirit and intent of IRRI's mandate vis-a-vis training. IRRI's objectives state: "To develop and educate promising young scientists . . . . through resident and joint training programs under the guidance of well trained and distinguished scientists" (emphasis added). It is only too easy for many scientists to relegate their training activities to others. At the same time, it is necessary to repeat the warning given in the last review, that the senior scientists should not be "overburdened" and deflected from important research. There appears to be a case for a review of how senior scientists allocate their time between research and training to ensure that the balance is satisfactory.

A third point is that the second review suggested that more Africans be trained at IRRI. Although there has been some increase in the numbers trained, they still represent a very small proportion of the total number. However, there appear to be ample training facilities in Africa. Consequently, the Panel suggests that IRRI be very selective in its training and fellowship programs for Africans. Emphasis should be given to broadening and deepening the scientists' capabilities for rice research.

The thrust of the preceding suggestions are broadly in line with the ideas in IRRI's strategic plan. The intention is that IRRI should maintain its preeminence as the world's center on research in rice. At the same time, due account has to be taken of the advances in education and training at the national level. Consequently, IRRI should focus more on fellowships for the future scientific leaders - doctoral candidates and post-doctoral fellows. These Fellows should be an important element in infusing vigour into IRRI's own programs. National centers have developed training capabilities - many with IRRI's help - and technology has advanced. Non-degree training should be modified to take this into account. Some basic courses should be decentralized, with national programs that have the facilities encouraged to take the responsibility, backstopped by IRRI as appropriate. IRRI should move its program upstream to give more attention to Ph.D. candidates and to the development of specialized courses on new techniques and other areas resulting from IRRI's research. Such a change would require revamping the programs, including questioning the continuation of training programs for non-research personnel.

The Panel, therefore, recommends that:

- the training and fellowship programs should be shaped to take into account the expansion of educational and training facilities of the national systems. To this end, greater emphasis should be given to Ph.Ds. IRRI's training program should move upstream, and, therefore, some programs should be dropped and national institutions encouraged to take the responsibility for others.

- every effort should be made to maintain the highest caliber of fellows; to the extent possible, encouragement should be given to those post-doctoral candidates who have done thesis work in first-class universities. Fellowship selection should be made with a view to

bringing fresh ideas to IRRI and sustaining vigour and dynamism of the Institute.

- IRRI should be more assertive about screening applications for its fellowship programs; it should use its right to veto applications judiciously.

- IRRI should review the burden carried by senior scientists in their capacities as researchers and educators to ensure that they are in a position to fulfill their functions adequately.

6.4. Networks

IRRI currently coordinates three collaborative networks: the Asian Rice Farming Systems Network (ARFSN), the International Network on Soil Fertility and Fertilizer Evaluation for Rice (INSFFER), and the International Rice Testing Program (IRTP). These three networks, together with the International Germplasm Resources Center, make up IRRI's Global Reseach Services. Each reports directly to the Director General.

The three networks were initiated by IRRI in the mid 1970's to evaluate germplasm and component technology developed by IRRI scientists and others over a wide range of environments and production systems. They have provided valuable feedback on varietal performance and have acted as a vehicle to deliver rice genotypes and technology to scientists in the national programs. In addition, each network has an associated training program and conducts periodic workshops and monitoring tours.

6.4.1. Asian Rice Farming Systems Network

ARFSN is designed to test and identify component technologies for increasing the productivity of rice-based farming systems for small-scale farmers in different countries of Asia. The major aim of the network is to increase and sustain farm production as well as on-farm and off-farm employment. The network was started in 1975 as a cropping systems network in collaboration with five countries. In 1984, the name of the network was changed to "farming systems" to allow for the inclusion of livestock and fish. The number of sites increased from the original five in 1975 to 236 located in 13 countries in 1986.

A structure for international collaboration has been established through ARFSN. Component technology from IRRI and other sources, including improved varieties of rice and other crops, are distributed and shared among the participating countries. ARFSN aims to provide a better awareness of the farming systems approach and represents a practical mechanism for communication and interaction among scientists from participating countries and IRRI. It also provides a valuable mechanism to gain more information about farmers' problems and to feed this back to the scientists in the national systems and IRRI.

Farming systems studies at network sites concentrate on designing and testing: a) cropping systems, b) crop-livestock systems,c) rice-fish farming, d) women in rice farming, and e) rice-wheat systems.

Some of the technologies being tested in the network include varietal improvement and testing, green manuring, long-term fertilizer studies based on cropping patterns, prosperity through rice, and farm implements for intensive cropping. Some valuable new cropping patterns have emerged from these trials.

6.4.1.1. Issues and Assessment

ARFSN appears to have played a useful role in disseminating technology and in facilitating interaction, exchanges, and training in farming systems among participating countries. The Panel was not able to obtain clear evidence of the impact of the network activities, but suggests that this should be investigated.

The Panel's suggestions for improving ARFSN include membership in the network for national institutions involved in research on components other than rice, such as upland crops, livestock, and fish. Participation by relevant national institutions (not members of the network) and IRRI scientists, should provide additional ideas. Participation of these scientists would encourage feedback on production constraints to scientists in the national programs and IRRI's research programs.

The Panel also considers that the appointment of a social anthropologist to the Agricultural Economics Department would provide a valuable input to any analysis of the social and economic factors influencing farming practices.

An important factor in the operation of the network is the role played by IRRI's scientists. To be successful, they should recognize that they must maintain a low profile, acting as facilitators and catalysts to help the national scientists develop effective trials and thus gain recognition for their efforts within their own national programs. This, coupled with training conducted in-country to develop research methodologies and a better awareness of the benefits of the farming systems approach among the participating national scientists, is by far most important function of the network. Expensive monitoring tours and large workshops should be conducted sparingly.

The Panel considers that IRRI's scientists should limit the number of sites on which they work, so that they have time to give effective support to the national scientists at each site. Moreover, the role of IRRI in the ARFSN should be played down, with the focus on the activities and success of the scientists in the national farming systems programs. Any success IRRI's support might have generated should be seen in its correct perspective, as success for the national programs.

The Panel, therefore, recommends that:

- the Asian Rice Farming Systems Network should not expand further so that more time is available for interaction

between IRRI staff and the national scientists to improve the quality of the program.

- IRRI should act as a facilitator and catalyst to help the national scientists to develop effective trials and thus gain recognition for their efforts within their own national programs.

- IRRI should consider appointing a social anthropologist to the Agricultural Economics Department to provide an input to any analysis of the social and economic factors influencing farming practices.

6.4.2. The International Network on Soil Fertility and Fertilizer Evaluation for Rice

INSFFER was founded in 1976 to initiate research on soil fertility and to stimulate such activities as training, site visits, and workshops related to the fertility efficiency of rice soils.

After 10 years of operation, results have shown that in many situations nitrogen(N) remains the most limiting nutrient. The responses to phosphorous (P) alone have not been clear, but on many sites, combinations of N and P have produced significantly higher rice yields than N alone. In general, slowly-soluble rock phosphates appear to be as effective as more expensive soluble P-fertilizer in acid lowland rice soils.

The N-efficiency trials, with deep placement of slow release urea granules, have shown that the efficiency of N-fertilizer uptake can be increased above the best split and broadcast applications of urea in about 50% of the irrigated sites and 35% of the rainfed lowland sites. The effectiveness of both rock phosphate and N-fertilizer is very much dependent on growth conditions and soil type.

INSFFER proposes to characterize the INSFFER sites in greater agro-ecological detail. This would permit better interpretation of the agro-economic results and greater confidence that the technology generated can be successfully transferred to farmers.

Over the past ten years, INSFFER has concentrated most of its efforts on irrigated lowland rice culture, but is beginning to direct its efforts to less favoured environments where the soil fertility problems are more severe and more difficult to solve. As part of this effort, the Panel suggests that attention should be given to the use of legume or other green manure crops to supplement the use of N-fertilizer. Closer interaction could be encouraged with ARFSN, particularly by planning and conducting research on the same sites.

The Panel noted with concern that INSFFER's main point of contact with IRRI scientists is only with the Agronomy Department, and suggests that linkages with the Soils Department be strengthened.

The Panel noted that a number of countries feel that simple fertilizer trials no longer meet their needs. Some of these countries could very well contribute to more in-depth studies, similar to those on integrated nutrient management. Technically, the leadership of INSFFER could now be transferred to one of the more advanced national systems. Because international responsibility helps strengthen national systems, there are good arguments for financing the coordination, of INSFFER through a regional programs.

6.4.3. International Rice Testing Program

The IRTP was formalized in 1975 to distribute rapidly and extensively the products of the IRRI breeding program. It has been financed by UNDP since 1976 and is now a restricted core project. The project as revised in 1985 now includes biological nitrogen fixation and greater IRTP activities in East Africa and the Caribbean. It has been renamed "The International Rice Testing and Improvement Program" (IRTIP). Only the rice testing (IRTP) activities will be considered here.

The IRTP is now used as the means by which breeders in country systems can learn about the performance of their plant materials in comparison with entries from IRRI and other countries over many sites and without charge. Currently, about 50% of the entries come from country breeding programs, 40% from IRRI, and about 10% from germplasm banks or other centers.

6.4.3.1. Program Activities

The major activities are to distribute germplasm to breeders in different countries and to conduct tours to monitor materials and discuss a particular subject. Recent tours have covered salinity, upland rice and deepwater rice sites. Nurseries are targetted for each of the five major rice environments. In addition, separate nurseries are used to check reactions of lines to several different insects, diseases, problem soils, and low temperatures. In 1986, 1,464 sets of 29 types of nurseries were sent to 51 countries. More than one-third of these nurseries were in India, the Philippines, and Thailand.

Post-graduate and short-course training is part of IRTP, and, currently 15 post-graduates are at IRRI, two working with IRTP scientists.

6.4.3.2. Organizational Aspects

The IRTP "global coordinator" is at IRRI and the program is guided by an advisory committee which includes, *inter alia*, the IRRI coordinators, representatives from eight national programs in Asia, and one representative each from Egypt, Brazil, and WARDA. The IRTP activities in Africa and Latin America, carried out in collaboration with IITA, WARDA, and the International Center for Tropical Agriculture (CIAT), have been regionalized and regional advisory committees have been established.

At IRRI, in addition to the global coordinator, there are two senior scientists, two visiting scientists, and support staff. In Africa,

coordinator is at CIAT. For the Caribbean, the coordinator is in the Dominican Republic.

6.4.3.3. Achievement and Impact

The program has dispersed much genetic material in Asia, Latin America, and Africa. Most of these materials emanated from Asian breeding programs. By the end of 1986, 125 lines from 15 national programs and IRRI had been released as varieties in 46 countries. A portion of these varieties originated outside the country of release; the IRTP should be credited with providing the impetus for many of those releases. In addition, IRTP has enabled rice breeders in many countries to examine a wider range of genetic variability and thereby identifying either ready-made varieties or potentially useful parents. Many lines introduced through IRTP have been utilized as parents. Moreover, it has been very influential in forming rice breeders into a community, across Asia and beyond. This community is now a powerful force in rice activities.

Different biotypes of the brown planthopper in Asia have been detected through the IRTP, alerting breeders to the direction that selection should take. In addition, results from international yield trials have been useful in preparing regression models relating yield with variation in temperature and solar radiation.

6.4.3.4. Issues and Recommendations

The Panel considers that the maximum benefit is not being obtained from the IRTP, as it is currently structured. As the program approaches its fourth phase, the Panel urges that it be reviewed in the context of the CGIAR's overall investment in rice research, in particular taking the following points into consideration:

(i) IRTP has a very large number of nurseries and sites which may mean that the fullest knowledge is not being derived from each. A smaller number would allow each to be studied in greater detail and would increase the precision of the results. This would be particularly true if it were possible to encourage other country specialists, such as physiologists, entomologists, and pathologists to become involved. IRTP would then foster multilocational interdisciplinary research in ways that could profoundly affect IRRI's on-campus program.

(ii) Those in the national programs who work with IRTP might more usefully concentrate on breeding for the specific physical, biological, and soils problems of their own areas, rather than to hope for salvation from the IRTP nurseries sent in every year. Consideration could be given to receiving the nurseries every second year, or at some other interval. Of course, opportunities to introduce new genotypes into national hybridization programs would still be necessary. What is

really at issue is whether IRTP has become a habit, distracting attention from other solutions to local problems.

(iii) The IRTP staff posted in Latin America and Africa might provide more benefit to rice research in their regions and on behalf of the peoples of Latin America and Africa if they were wholly members of the staff of those Centers (CIAT amd IITA) that have regional responsibilities for rice on those continents. Possibly in this way the goals of IRTP could be addressed better for Latin American and African requirements.

(iv) The principle of using "hot spots", where a particular biotic, soil or climatic hazard is strongly expressed is good, and greater emphasis should be given to this. Agronomists, physiologists, pathologists and entomologists, as well as breeders, should have strong voices in this activity.

(v) IRRI is proposing to develop IRTP nurseries of japonica rice for exchange among temperate countries, a move which the Panel considers should be reexamined. Exchange of germplasm among such advanced countries is probably best left to informed exchange among the breeders concerned.

(vi) There is a danger that responsible administrators and others who are not acquainted with the limitations of genetic variation may hold exaggerated expectations of what IRTP can realistically achieve. This may lead to less attention being paid to other possible solutions to their rice production problems, which need to be addressed through problem analysis and research in such areas as agronomy, soils, pest management, etc., as well as by technology transfer activities.Finally, the review of IRTP should consider how the community of scientists that it has fostered can be extended to include people drawn from a wider range of disciplines.

The Panel recommends that IRRI should review the IRTP with the aim of:

- decreasing routine nursery screening of little relevance to national rice needs; increasing collaborative research between IRRI scientists and national scientists in projects on pathology, entomology, physiology and genetics within the IRTP framework; and considering whether IRTP staff outposted in Latin America, the Caribbean and East and West Africa could be appointed to the staff of CIAT and IITA, respectively, and thus be integrated fully into the rice teams of the Institutes having responsibility for rice research in those continents.

6.5 IRRI Outside Asia

IRRI receives many requests to become involved in Asia and elsewhere. Requests come not only from developing countries, but also from donors with particular interests. It is difficult for the Institute to decide which requests it should try to fulfill. It was obvious to the Panel that the number and range of requests place a heavy burden on IRRI at a time when it needs to move upstream in research and to concentrate its activities in fewer, but very important, areas.

The Panel recognizes that IRRI has a global responsibility for rice, but does not consider that this responsibility means it should become actively involved in on-site research on all continents. Rather, IRRI should concentrate on those areas in which it has a comparative advantage.

There remains a major job for IRRI in tropical Asia, where the great majority of rice producing and consuming people live. Asian populations will continue to grow, and - notwithstanding the current, apparently favourable food supply - will continue to require larger supplies of rice. IRRI can and should be heavily occupied in applied and strategic research that will help rice-producing nations to sustain present yields, while concurrently working on ways to improve future yields and yield stability. IRRI's comparative advantages then, lie in upstream research and in collaborative research and education activities with its partners in tropical Asia.

Outside Asia, IRRI has little comparative advantage in relation to the other international centers working on rice, except in upstream research and in supplying basic and enhanced germplasm. In Africa and Latin America, IRRI could be most helpful by supporting the other international centers which would assume continental or region responsibility for the areas in which they are located and by offering to help them as requested. Through their own rice programs, centers with long experience on those continents could address the needs of areas in which they work, where they are historically and culturally experienced.

Activities in North Africa and the Near East and where rice is grown in Mediterranean and temperate zones, are seen as inappropriate for IRRI. These distant locations have little in common with tropical Asia and with IRRI's experience. IRRI's efforts to broaden its activities into such environments are viewed by the Panel as diverting the Institute from its primary focus on the needs of rice and peoples in tropical and sub-tropical Asia.

The Panel recommends:

- that IRRI should concentrate its research and training in Asia, and that it should only work elsewhere at the request of, and in collaboration with, CGIAR Centers that have regional or continental responsibilities for rice.

CHAPTER 7. RESEARCH MANAGEMENT, ORGANIZATION, AND SUPPORTING UNITS

7.1. The Institutional Setting

A plaque in front of IRRI headquarters that commemorates its establishment summarizes well the unique nature of the Institute. It begins, "an educational and research center devoted to the study and improvement of rice...". IRRI is unique in that in some ways it operates like an institution of higher learning, not just as a research-for-development institute. Its special nature has contributed significantly to its success, for it has combined its dual nature in education and research well. Thousands of rice scientists have been educated at IRRI, learning to conduct research on rice as partners with IRRI senior scientists. To a large extent, IRRI has operated with the goal of doing excellent research for rice.

7.2. Research Management and Organization

The heart of the IRRI program has always been the departments which have served as homes for both education and research. In the early years, most research was carried out in the departments. However, in the early 1970s a partial matrix structure was begun which placed scientists from different departments together to collaborate in multidisciplinary programs. The success achieved was probably due primarily to the commitment and drive of the Director General at that time.

The strong departmental system has always affected research management at IRRI, including management of the multidisciplinary programs. Resources for research rest in the departments, which can make allocations to cross-discipline programs difficult. Program leaders have not controlled resources but have depended on reasonable allocations by the departments involved. Because funds were not allocated to programs, program leaders have not been as effective as they might have been. In spite of this, some multidisciplinary research has been successful at IRRI. For example, the research on constraint identification and analysis and on GEU have been accomplished successfully using departmental resources for multidisciplinary programs.

At present, the research management structure is rather loose, probably as a result of the departmental resource allocation system. There is a Director of Research and Training, but that position seems to have no real responsibility for the research program or in determining its overall priorities.

Research priorities at IRRI are largely established within the departments and efforts to develop priorities on an institute-wide basis have met with mixed success. The priorities established on a departmental basis may or may not add-up to an integrated institute-wide program.

The SPC report proposes that IRRI should work in the future using a matrix system "to maintain a discipline-based departmental structure

coupled with a program-based research organization ....to achieve a desirable blend of disciplinary depth and excellence and problem-solving inter-disciplinary effort". The Panel agrees with this general approach and considers that there should be departments, but within and across departments there should be programs and projects. Budget control should be done through programs and projects. Program leaders with wide responsibilities should be appointed at the Director or Deputy Director General level. These positions will require stronger leadership abilities.

Each scientist in a department should be assigned to one or more research projects. With respect to the definition of a project, the Panel agrees with the EMR report, that a project may be defined as a "definable set of research or related activities with a beginning and an end....it may be a sub-program, research area, or an experiment, or even a training activity..."

Upstream research and the necessary accompanying advanced education are best served by the strong disciplinary departments. Professional development, post-graduate education, and intellectual growth coupled with strong disciplinary participation in multidisciplinary research programs should be the role of the department. External peer reviews should be the mechanism used periodically to ensure disciplinary excellence.

Given this rationale, all departments at IRRI should be organized along a disciplinary, and not a program, basis. The number of scientists in a given department should be sufficient to provide an intellectual base for the discipline to ensure the necessary interaction. For example, the Panel considers that multiple cropping research should be addressed by scientists from different disciplines and departments. It should not be a separate department with scientists isolated from those with similar disciplinary interests elsewhere in the Institute. Similarly, one senior scientist does not have sufficient intellectual support when he is alone in a separate department. In situations where one person represents a discipline, the Panel would suggest that the department concerned be joined with a closely-related department. The major departments IRRI might consider retaining include Agricultural Economics, Agronomy, Entomology, Genetics and Plant Breeding, Plant Pathology, Plant Physiology, and Soil and Water.

A major strength of IRRI is its high quality junior staff. These capable junior scientists are assigned to departments according to their educational background; it is the departments that make their research assignments. In the proposed program structure, junior scientists should be assigned to research projects, according to institute-wide priorities and their own individual skills. Some departments seem to have many more junior scientists than others, and this is a source of some discontent in the Institute.

In any reorganization, there should be an attempt to assign junior scientists more equitably among disciplines according to research priorities. Also, it might also be useful to broaden the scientific experience of junior scientists by rotating them among programs so that they learn new skills. In addition, junior scientists might be assigned with great benefit to projects conducted outside the Philippines.

7.2.1. Research Projects

To carry out research in a multidisciplinary program structure using departmental personnel, an improved system of research planning and resource allocation will be necessary based on programs and projects. Research projects within multidisciplinary programs should be used as the means for research planning, resource allocation, and accountability. Project plans would be drawn up with objectives, a research plan, milestones to be reached, and a reporting system. The project leader would control the budget for the project, with the oversight of the responsible director and frequent consultation with the department heads involved. The portfolio of projects should be flexible, so that projects may be added or removed according to the changing research agenda.

Resources would be allocated among the programs and projects according to institute-wide priorities. From a zero-base, as proposed by the EMR Panel, departmental budgets would be established on the basis of research projects planned according to the priorities established and implemented, either along disciplinary lines (mostly upstream research) or along interdisciplinary lines. Research funds would be administered by the departments, following the budget allocation for the projects.

In the program/project system, the department head must be actively involved in determining the strengths and weaknesses of the discipline and the department and in assuring high quality performance in Institute programs.

7.2.2. Committees

IRRI has committees for almost everything. Indeed, the number appears to be excessive. It is, of course, necessary to use some committees for research planning and implementation - especially in a departmental/program matrix structure - but the number should be kept to a minimum. Over-reliance on committees drains away precious staff time.

7.2.3. Global Research Services

IRRI has designated several of its activities as Global Research Services. These are: the IRGC, the IRTP, the ARFSN, INSFFER and Training and Technology Transfer. To designate activities such as the IRGC as global services is a good concept, and clearly identifies the nature and purpose of the work. At present, these individual services report to the Director General.

In the future, the Panel suggests that the head of each Service should report directly to the Director or Deputy Director General responsible for the related program area. However, the ARFSN is clearly not global, and should probably come under the Director who administers the Crop and Resource Management Program and be administered in the Agronomy Department.

7.2.4. Outreach Staff

Liaison scientists, researchers assigned to national programs, and research administrators or facilitators assigned to national programs make up the outreach staff. In discussons with the Panel, such staff members often referred to themselves as "second-class citizens", stressing that back-up support from headquarters was inadequate. The Panel also learned that the status of staff on special projects is quite insecure, and that they are often treated differently from core staff.

Some outreach staff members who are visited infrequently can become lonely and isolated unless they are able to make regular visits to headquarters for interaction with scientists and administrators. This is an old problem which was pointed out by both previous reviews. To assure that outreach staff receive support and encouragement, a member of the directing staff should be appointed to administer outreach programs and to fulfill the backup support role.

7.2.5. Assessment and Recommendations

IRRI should strive to be a "Center of excellence" and should move further upstream in some areas of strategic research.

Heretofore, research management has operated largely within the departments; hence, Institute-wide research management has been rather loose. The need now is to preserve the intellectual stimulus of disciplinary departments while carrying out an Institute-wide integrated research program, mostly through multidisciplinary projects comprising both applied and strategic research. Some program or project research will necessarily be carried out entirely within a single department. The Panel considers it essential that each disciplinary department should be involved in some upstream research.

This structure will require strong leadership, first at Institute level, to ensure that Institute-wide priorities are receiving due attention, and second, at department level, to ensure disciplinary strength and intellectual growth. This arrangement should also stimulate the spontaneous coming together of scientists from different disciplines to work on problems of joint interest in the priority framework.

The Panel was concerned about the inadequate backup support and encouragement for outreach staff mentioned.

With regard to research management, the Panel recommends that IRRI should:

- have a departmental organization based on major disciplines; organize its research in programs and projects; ensure departments have sufficient senior scientists for stimulating intellectual interaction; make programs and projects the basis for funding;

- conduct regular peer reviews for each departments to achieve high scientific standards and quality research;

- appoint a member of the directing staff to administer outreach programs and to provide backup support for outreach staff, and explore ways of ensuring that all outreach staff can visit the headquarters regularly to interact with scientists and other colleagues.

7.3. Supporting Services for Research

As a major research institution, IRRI has found it necessary to establish a number of research support units. Some are outstanding. A brief description of the support units will be given, along with a brief assessment of their needs.

7.3.1. Information

7.3.1.1. Publications, Communications, Information Services

This outstanding unit provides valuable services for IRRI scientists and administrators. IRRI publications are of a very high standard, and today IRRI is a world leader in publishing agricultural research literature. New and innovative publication procedures have been developed. The department emphasizes scientific publication, copublication in other languages, building public awareness, communication studies, and information services. Also the department conducts innovative training for editors and communications specialists. Improving the capability in public relations is also necessary. In the future, the unit needs the capability to provide video news clips and documentation.

The Panel endorses the efforts made in improving the image of IRRI, considering that such efforts can provide feedback to the Institute and its staff. The Panel understands there is currently an effort underway to improve public awareness of the CGIAR System. Related IRRI activities might well be integrated into this larger effort.

7.3.1.2. Library and Documentation Services

The IRRI library has gained a well-deserved reputation as a major world repository of rice literature. The library provides a worldwide service to rice scientists and scholars. Although not fully computerized, the library does have a computerized rice literature search service. The library might improve its services in the future by increasing computerization. This option should be explored.

As IRRI moves upstream in research, it may be necessary for the library to acquire more specialized, discipline-related materials. This requirement may compete with its primary goal of acquiring all literature

concerning rice. Some special mechanism may be required to obtain the necessary disciplinary materials without significantly altering the library. As access to world data bases improves, perhaps such data bases might help achieve this purpose.

7.3.2. Computing, Statistics and Data Bases

7.3.2.1. Computer Center

IRRI installed an IBM 4361 in 1983 and is now working to complete an internal computer network. Several problems exist that need solution. One is the impermanent nature of the appointment of the person nominally running the center. The second is the need for an experienced software specialist for the main frame. A Computer Center Manager should be appointed so that the center can operate independently, and standing alone. The Computer Center will then be able to contribute to the research and training programs of the Institute and scientists need not rely largely on personal computers, as they appear to at present.

7.3.2.2. Data Base Services

All data base development, management, and operation will become the responsibility of the computer software specialist when appointed. Such activities will be vital to the efficiency of IRRI as it increasingly turns to simulation and modelling, and needs to draw data from complex sources. This service will become pivotal to much of the future research of IRRI and must stand alone in the Computer Department. It should no longer be controlled from the Department of Statistics.

7.3.2.3. Statistical Service Unit

This unit is part of the Department of Statistics. Services provided are consultations with researchers and scholars concerning research design. Such services are essential for a research institution such as IRRI. Some statistical analysis of results is now handled by the Department of Statistics. Some work in the department has been directed toward developing a statistical software package for microcomputers, called IRRISTAT. The Panel questions whether it is desirable for IRRI to spend resources on developing such a statistical package, since similar packages are commonly available.

7.3.3. Seed Health Unit

Because the global exchange of germplasm has increased rapidly and can be expected to remain an active enterprise, IRRI has set up a Seed Health Unit. Staff members of the Seed Health Unit perform crop health inspection in the field, inspection of dry seed, routine seed health testing, and seed treatment. The unit has three sections: Seed Processing (varietal verification, purity analysis), Quarantine (certification and phytosanitation of seeds coming from or going to cooperating countries), and Shipping

(assembling all phytosanitized, certified seeds for packing, documentation, and shipping). All IRTP materials are checked by the Seed Health Unit. The unit uses procedures established by the International Seed Testing Association.

The Seed Health Unit is housed in a new, modern facility, with all the latest equipment and with careful procedures. The Panel commends IRRI for establishing such an important facility to ensure the movement of clean, high quality seeds. Research on seed health should be conducted through the Plant Pathology Department.

7.3.4. Phytotron

The phytotron was set up in 1974 as a specialized research facility. It has been used to screen materials for tolerance to various stresses and for physiology research. The facility is well run and quite well utilized. IRRI proposes to improve or upgrade it, including computerization of its operation. The Panel considers the present operating system as satisfactory, and doubts that computerization is necessary. The Panel understands the need for the phytotron, especially since IRRI plans to move upstream in some of its research.

7.3.5. Analytical Services Laboratory and Pesticide Residue Laboratory

A Central Research Service Unit was established in 1977. In 1981, this unit was reorganized to include mass spectrometric analyses and radioisotope handling facilities and was renamed the Analytical Services Laboratory (ASL). The ASL has three laboratories: Chemical Analysis, Mass Spectrometry and Radioisotope. Routine analysis is the function of the ASL, which suffers from a shortage of space, resulting in delayed turn-around time for samples.

IRRI has another analytical laboratory, the Pesticide Residue Laboratory (PRL), which is attached to the Cereal Chemistry Department. This laboratory analyzes for pesticide residues in soil, water, crop, and animal samples submitted by IRRI researchers. A related activity is monitoring pesticide levels in IRRI waterways. Like the ASL, the PRL faces a space constraint.

The Panel can see little reason why the PRL is not part of the ASL, other than the fact that the ASL, as now constituted, carries out inorganic analyses while the PRL carries out organic analyses. It may be preferable to make the PRL part of the ASL.

7.3.6. Climate Unit

This unit was established to service Institute weather stations and to compile and analyze weather and climate data for all IRRI departments and some outreach sites in the Philippines. Data are collected and analyzed on a monthly, annual, and decade basis. Archives of weather data for Asia are

stored as monthly means for each country. These data are used in a general way to describe the climate of particular places.

The draft SPC report suggests that the Climate Unit should be replaced by an Environmental Data Service. The Panel agrees with the need to collect environmental data with the aim of agro-ecological zoning, but considers such work should be a sub-program rather than a service unit.

7.3.7. Experimental Farm

The Experimental Farm has two major sections: Grounds and Rat Control and Experimental Farm Operations. The principal activities of the Experimental Farm are crop management, supplying of agricultural chemicals, irrigation, crop drying, seed multiplication, grounds and farm maintenance, and training. Provision of simulated stress environments, installation of specialized equipment, and monitoring, conserving, and even improving soil and environmental conditions on the farm, constitute part of the service. Although there are some problems, the farm appears to be well-run and provides valuable services to IRRI scientists.

CHAPTER 8. IRRI: AN OVERVIEW AND RECOMMENDATIONS

8.1. Rice Research in the Context of Food Supply

The international context of IRRI's work in enabling adequate supplies of food to be available to people of the world is shown in Figure 1. From this, it is clear that Asia harvests more than 90% of the world's rice and now has about 60% of the world's people. Table 9 shows the wide range of average yields between nations and that some of those yields are desperately low.

Table 9 .Classification of rice growing countries according to average national rice yields (after IRRI 1985, p. 185).

	Group I (yield > 5 t/ha)	
Australia	Egypt	Italy
Japan	Korea, Republic of	USA
	Group II (5 t/ha > yield > 3 t/ha)	
Burma	China	Colombia
Cuba	Dominican Republic	Ecuador
Indonesia	Iran	Mexico
Peru	USSR	
	Group III (3 t/ha > yield > 2 t/ha)	
Afghanistan	Bangladesh	India
Malaysia	Nigeria	Pakistan
Philippines	Sri Lanka	Venezuela
Vietnam		
	Group IV (yield < 2 t/ha)	
Brazil	Guinea	Ivory Coast
Kampuchea	Laos	Liberia
Mali	Madagascar	Nepal
Sierra Leone	Tanzania	Thailand
Zaire		

Source: National yield estimates derived from FAO Production Yearbooks.

Looking ahead, there will have to be a substantial increase in the supply of rice to meet the needs of the burgeoning population of Asia. Projections of future supply and demand vary a great deal, depending on the underlying assumptions regarding the progress of the global economy. Table 10 shows projections made by FAO and IFPRI based on different economic scenarios. These projections - as with all projections of this nature have to be treated with some reserve. Nevertheless, they do indicate the order of magnitude of rice requirements by the year 2000. They also indicate that the balance between supply and demand could be precarious. There has to be a sustained and steady increase in supply, or else rice prices could well rise, leading to great suffering among those millions of poor consumers who typically spend more than 60% of any increase in their income on basic food.

IRRI's own analysis - based on the best judgements of its scientists - is that continued investment in research will contribute significantly to meeting the projected demand in 2000. Steady, but modest increases in yields and cropping intensities are projected to double rice production between 1980 and 2000. More than 60% of the increase is expected

Figure 1. World rice production, trade, and stock (1986), compared with world population (1984). Less than 5% of global production is traded internationally; stocks represent about 15% of production.

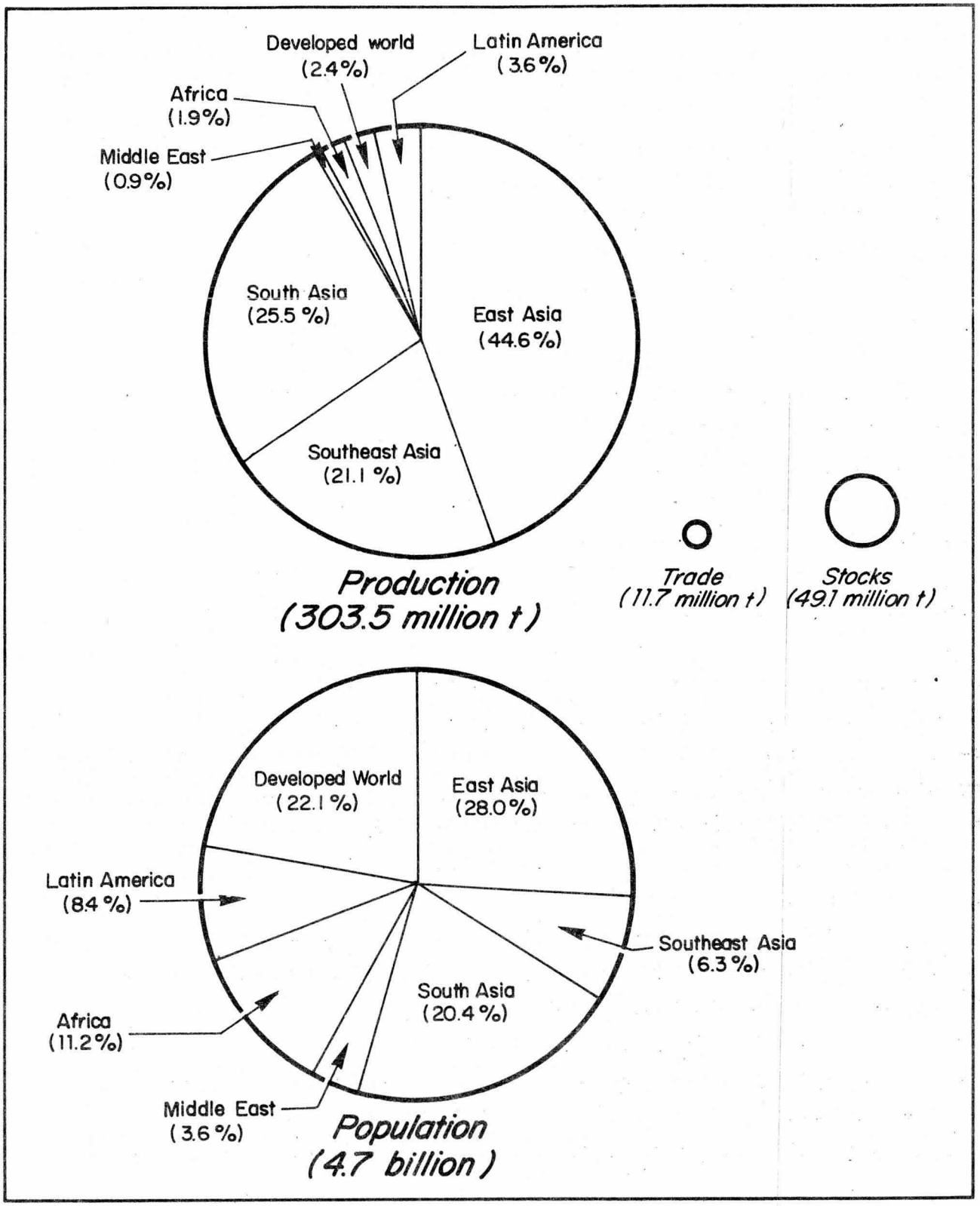

Table 10. Commodity Balance for Paddy Rice - Past and Projections by FAO and IFPRI for 2000 /1

	Production	Demand	Net Balance	Self-sufficiency Ratio
	--------million metic tons--------			
FAO (90 developing countries of the world)				
Past				
1961-1965	144.5	144.4	-	100
1975-1979	207.4	209.4	-2.0	99
Projected (2000)				
Scenario A /2	388.9	387.7	-	100
Scenario B /3	363.3	374.8	-11.5	97
IFPRI (20 developing member countries of the Asian Development Bank)				
Past				
1966-1970	144.7	142.4	2.3	102
1976-1980	187.3	185.6	1.7	101
Projected (2000)				
Trend /4	309.9	327.9	-18.0	95
Low demand /5	309.9	322.5	-12.6	96
High demand /5	309.9	336.8	-26.9	92

/1 FAO = Food and Agriculture Organization of the United nations, IFPRI = International Food Policy Research Institute.

/2 Scenario A = with optimistic assumptions using the following percent growth rates: population (2.4%); Gross Domestic Product (GDP) (7.0%); total domestic demand for food, feed and agricultural raw materials (3.7%); and total production of food, feed and agricultural raw materials (3.7%).

/3 Scenario B = a modest improvement of trends with the following growth rate assumptions: population (2.4%); GDP (5.7%); total agricultural domestic demand (3.2%); and total agricultural production (3.1%).

/4 Based on 1960-81 trend income growth.

/5 Low and high income growth rates are based on 75 and 125 percent, respectively, of 1961-80 trend GNP per capita in each country with minimum and maximum levels of 0.5 and 6.0 percent a year.

Sources: FAO, Agriculture: Towards 2000, 1981.
IFPRI, Assessment of Food Demand/Supply Prospects and Related Strategies for Developing Member Countries of the ADB, 1984.

to come from irrigated agriculture with the level of production depending, in part, on the rate of expansion of irrigation. IRRI's projections show that there is a potential for a very high return on fairly modest investments in international and national research. They also show that, provided there is sufficient commitment by all concerned, it is indeed possible to reach the level of demand projected by FAO for the year 2000.

From this, it is apparent that there must be no relaxation or reduction in vigorous, practical and effective research on rice like that carried out by IRRI over the past 27 years and which is now increasingly being done in the national systems. IRRI must ensure that the resources made available to it are used in ways that produce the maximum benefit for rice farming. The resources must also be used to extend the knowledge base of rice science without which long-term progress will not be made.

IRRI's activities have transformed the supply of rice over the past two decades. In 1982-83, high yielding varieties were grown on more than 50% of the rice areas of the developing world according to D.C. Dalrymple. Also more than 80% of the area of rice in the centrally managed economies of Asia was in HYV, although all of these may not have had an origin from IRRI germplasm.

The new varieties and associated agronomic changes have turned what could have been a desperate situation of widespread hunger in Asia into a state of marginal self-sufficiency in most countries. But recognizing and applauding the successes of past must not lead to complacency about the future.

IRRI is not complacent.

8.2 Quality

How did IRRI achieve its past successes? It was by having tightly focussed, pragmatic work carried out by people who were not deterred by the limited benefits of earlier research. They were generally young and were not prepared to accept that the difficulties were insurmountable. They overcome them and millions of people benefitted. Twenty years later many of these scientists are still in IRRI: Now full of wisdom, they are handing on to the next generation of scientists the new challenges to rice science. The challenges are as great as those of the past and, so far, no quick returns can be predicted. As the baton is handed over, the Panel wishes to express its confidence in the.next generationn of rice scientists.

The achievements of IRRI and its staff members have been recognized in so many ways that only a few can be mentioned. However, it is appropriate to record that IRRI was awarded the Third World Prize in 1982. A Certificate of Honour and a bronze medal was presented to the IRGC in 1983. A great many awards have been made to individual scientists including the Albert Einstein World Science Award to Dr. Swaminathan in 1986. Also in 1986, Dr. A.V. Khan received the International Award of the American Association of Engineering Societies and the International Inventors' Award of the Swedish Inventors' Association. While in 1985, an Indian rice variety was named SESHU after Dr. D.V. Seshu, Global Coordinator of IRTP. Particular reference must

be made to the award of the Japan Prize, in 1987, jointly to Dr. H.M. Beachell, formerly head of the Plant Breeding Department and to Dr. G. S. Khush, its present head. They are the first biologists to receive this distinguished award.

Only the future will show whether the next generation will achieve success in the same way as their predecessors.

A very considerable advantage that IRRI has compared with many other Centers derives from the high quality of the Filipino middle level research and managerial staff and the secretarial staff. It is clear that they will respond with dedication to good leadership and their intellectual contributions, enthusiasm and commitment have a significant multipler effect on the output of the Institute. However, the Panel concluded that the potential value of the Filipino staff has not been shared uniformly across the Institute.

8.3. Challenges

The needs for applied and adaptive research by IRRI and by the national systems are apparent from the prospects for the demand and supply of rice set out in Section 8.1. Increasing the potential for rice supply by research is overriding. The major challenge for IRRI in the future is to sustain and increase the productivity of the irrigated rice crop. There are, however, divergent views in the Institute: some hold that nothing has been added to the genetic yield potential of rice since the release of IR8: others hold that IR64 added further to IR8's yield potential. Nevertheless, it is clear that much work has been done to stabilize yields of the semi-dwarf varieties by incorporating genes giving protection against biotic and environmental hazards.

Another breakthrough corresponding to the introduction of the semi-dwarfing gene is unlikely in irrigated rice varieties. Yet, steady incremental advances on the genetic yield potential should be possible which, when summed over a decade or more, would make a significant overall contribution to rice production. Together with improved disease and pest control, more efficient use of fertilizer inputs, and the reduction of harvest and post-harvest losses, increasing the returns from irrigated rice should be a challenge that IRRI can meet.

TAC and the CGIAR have very properly brought to the attention of the System the need to consider sustainability and equity in setting research priorities. IRRI's future course is being planned by its staff to take account of these important objectives. The challenge is to undertake research to help resource-poor farmers. In IRRI's case these are seen to be those who farm in unfavourable rainfed, upland, deepwater or tidal swamp environments. A proportion of the Institute's work is moving in towards these unfavourable rice-growing conditions. The next challenge is to undertake research to help resource-poor farmers without compromising research to maintain the yields of favoured irrigated environments. The importance of the irrigated environment is that it provides the majority of the supply which must be on a scale large enough to hold the price down for the poor. Great care is necessary in selecting how much effort should be devoted to these

alternative causes, but above all the interests of the disadvantaged farmers must not be neglected. Sustainability of production is a principle that IRRI can accept fully and IRRI must not recommend the use of technologies that are not sustainable in the area for which they are intended. IRRI cannot control the use of technologies. Resource-rich as well as resource-poor farmers may sacrifice ecological stability for short-term gains but only the latter are driven by the imperative of survival.

8.4. Priorities and Strategies

At the time of writing, the process of strategic planning is on-going at IRRI. The Panel has pointed out alternative routes to a strategic plan that should be considered by IRRI. Moreover during the time of writing our report, we have had the opportunity of seeing a draft of a paper by Dr. Selcuk Ozgediz entitled "A Strategic Planning Process Model", which contains ideas that will be helpful to IRRI as it continues to develop its plan. The Panel considered that the draft plan - derived largely from a consensus of the views of the staff - is protective of the status quo.

The priorities so far incorporated in the draft plan concern the balance of effort that will go to the various environments in which rice is grown. It proposes a shift of about 10% of the total effort away from irrigated rice and into the rainfed-lowland, upland, deepwater, and tidal environments. This is a recognition of the goals of the CGIAR and of the priorities set by them. The Panel questions, however, whether any Center can address all of the goals of increasing supply, sustainability, equity, livelihood and nutrition with adequate strength.

Other than for the rice environments, priority issues do not figure in the plan, but the Director General told the Panel that the SPC Report is "an exercise in consolidation and concentration of programs and resources and provides an excellent basis for priority setting."

IRRI must continue its strategic planning with vigour and imagination, with a clear perception of what it expects its future to be a decade from now, recognizing the changing needs of its clients and that the scientific and technical environment will also have changed. The planning process should actively involve leaders of the national programs and external consultants to bring in new thinking.

The Panel considers that research priorities should be formed on the basis of scientific and economic definitions of possible goals. Irrigated and favourable rainfed environments would benefit from research on genetics, breeding and on durable insect and disease resistance. For upland environments, drought stress should have particular priority while tolerance of prolonged submergence and flooding should be priority targets for unfavourable rainfed environments. A further immediate priority should be the socio-economic analysis of the potential for adoption of the technology generated.

8.5. Women

IRRI's leaders were in the forefront of those anxious to understand, from research, the consequences for women of new technology. It now has research directed to developing methods that will enable women to contribute to and benefit more from rice production and processing and from rice by-product utilization. These activities must be further expanded through research and training.

8.6. Research

The centerpiece of IRRI's research activities is its breeding program which has had such dramatic consequences over the recent past. The provisional strategic plan proposes a close integration of breeding work, for five agricultural environments, with research on the selection for tolerance of many biotic, physiological, physical and chemical hazards. This is not unlike the old GEU program but in the late 1980's, it is not sufficient simply to screen for tolerance. Entomologists and pathologists are developing new thinking about durable and partial resistance and about infection levels and the dynamics of pest populations; all of which should be integrated with breeding. In this way, breeding will become multidisciplinary with genetics operating in the closest possible partnership with other disciplines. Genetics and plant breeding are vigorous at IRRI but the Panel has stated that there should be less activity on finishing varieties and more on upstream research if recalcitrant problems are to be solved for the national programs.

Many new scientific opportunities are beginning to emerge for the use of upstream research in crop improvement. IRRI is in a favourable position to stand within reach of them and should foster its links with advanced institutions for this purpose. It has already organized conferences on some of these topics and has some practitioners of the disciplines on campus.

The management of the crop, the soil and the water in which it grows, its incoming nutrient supply and the control of the pests, diseases and weeds with which it competes are all complementary to whatever attributes can be built into the genotype of the variety. Most studies outside rice have considered that approximately equal yield benefits derive from improved varieties and from improved agronomy and higher inputs. So the study of management practices, including land preparation and harvest related technologies should rightly have a high place in IRRI's research agenda. Agronomy is becoming especially vigorous in the study of nutrient availability and the Panel has said that further work on soil phosphorous is essential and it must be related to studies on available nitrogen.

The Panel is convinced that for livelihood and equity and also for certain technical reasons, it is appropriate to work on the components of rice-based farming systems. However, the verification and validation of any total system should be the responsibility of national research systems in some cases working in partnership with IRRI. The appropriateness, or otherwise, of a particular farming system recommendation by a country will depend upon a knowledge of the environments in which it has so far been shown to be effective and the coincidence of those environments with the new conditions

for which a recommendation is sought. Consequently, accurate environmental data assembled by IRRI provide a necessary back-up to the transfer of technology.

Ideally all the technology related to genotypes, management or farming systems will require ex-ante economic and social analysis to determine whether a research investment can have a worthwhile pay-off and a ex-post analysis to determine the extent of the derived benefit. All of this should be carried out in terms of the effects of physical and biological factors of the environment. It is also desirable to analyze economically, socially and anthropometrically what the impact of the new technology will have, or has had, on the people who should benefit. Clearly, IRRI will only be able to take a small part in such analyses.

8.7. Socio-Economics

IRRI's high reputation in socio-economics came from its seminal contributions to understanding the consequences and contraints relating to the introduction of new rice varieties. Future activities in these disciplines should involve continued work with agriculture scientists on the prospective and retrospective assessments of the benefits of new technology. It would be of great help to the "rice world" if there were annual and authoritative publications on the global rice situation. With an expansion of concern for environmental matters, IRRI should be a trend-setter on the economic analysis of "sustainability" in terms of resource management. The trade off for this would be the phasing out of studies by regions of the macroeconomic impact of rice technology.

8.8. Upstream - Downstream?

The national research systems are coming of age; some will soon be entirely self-reliant in adaptive and applied research in rice. An explosion in plant biotechnology, microelectronics, and molecular and cell biology will soon impact with considerable force in crop science. Where should IRRI stand, faced by these prospects?

IRRI could remain wholly devoted to the role in which it has been highly successful in the past: working in closely applied research for the immediate benefit of the hungry of Asia. Or it could rely on such work now being done to a considerable extent - if not entirely - in the institutions that it helped to create in Asian countries and by the people that it has helped to train. In which case, on their behalf, it could introduce modern scientific - upstream - research for the solution of some of the many intractable problems still facing agricultural development in the tropics.

The Panel is clear that, in the interest of developing country agriculture, every possible technical stratagem should be deployed for the solution of its problems. And this as speedily as possible.

IRRI should be a bridge helping to bringing modern science to the aid of developing countries. It has already taken the first steps in that

direction by assessing the issues in conferences and by starting some work in advanced biology and on simulation modelling on-campus.

Should IRRI do more or wait to see the outcome of its initial tentative steps?

As far as biotechnology is concerned, IRRI is fortunate in having a special relationship with the rice molecular biology program created by the Rockefeller Foundation. This provides a special view of the rapidity of the progress in research. So IRRI can quickly assess when the band wagon is rolling with such certainty that practical benefits can be obtained. In the meantime, IRRI can be the agent by which the problems of rice are brought to the attention of scientists in advanced institutions. Already, we know how to regenerate whole rice plants from naked cells - the first step to engineering them genetically. The next steps should quickly follow. IRRI must be up with the game.

IRRI is already collaborating with colleagues in the Netherlands on the computer modelling of the complex interactions of factors in the rice environments that affect production. This approach offers great potential for understanding the ways in which the growth of the rice plant is conditioned by environmental factors over a wide range of growing conditions. This means that much greater precision than was previously possible will be incorporated in the advice given to rice farmers and the points in the production cycle where research is still necessary will be identified.

IRRI's role into the 21st century should be as the pace setter in the application of science to rice farming, so emulating the philosophy of its founding fathers.

8.9. Internationalism

There are excellent links already between IRRI and advanced laboratories in other countries. This is the main spring of the innovative thinking upon which IRRI lives. With the movement of science, these links must be dynamic; continuously renewed, replaced and strengthened.

In working with its client countries, IRRI may have staff members who undertake liaison work in a region, may place people in specific countries or have Los Banos-based scientists work closely with a particular country. When asked to join a country in a research partnership, IRRI describes its decision process as ensuring there is a clear commitment by the country to improve its rice economy; observing that a technical gap exists that can be closed; and determining that satisfactory working arrangements can be reached.

The Panel suggested additional criteria that would help the Board of Trustees in determining where IRRI's limited capabilities could best be deployed. Furthermore, the Panel has made recommendations aimed at encouraging national self-reliance and self-confidence in indigenous rice research programs. This is the future.

8.10. Relations with Other Centers

IRRI collaborates with many institutions, including other international agricultural research centers, both inside and outside of the CGIAR. IITA, WARDA, and CIAT have continental or regional responsibilities for rice, and IRRI has collaborated with them in the past. IRRI can work with other centers working on rice in several ways, including supply of basic and enhanced germplasm, upstream research, and providing library services. However, the future collaboration with those Centers depends, at least in part, on decisions of the CGIAR and TAC on rice research in Africa and in Latin America. The Panel has concluded that until a conclusion is reached on the global allocation of responsibilities for rice research, IRRI should only work in Africa, and Latin America in collaboration with, and at the invitation of, an appropriate center in the region.

IRRI's collaborations with IFPRI and IFDC have provided useful models for collaborative research between centers where the programs of each is enriched by the gifts and strengths of the other. IRRI and CIMMYT plan to work more closely on problems of the rice-wheat rotation in Asia.

8.11. Training

Training has been, and is, one of IRRI's great successes. That there are now almost 5,000 IRRI alumni back working in their countries is one of the reasons why national self-reliance in rice research is possible. National self-reliance in training capacity is also growing, which means that some of IRRI's short-term training can be greatly reduced at Los Banos. This movement has already begun and it will enable IRRI to move the balance of training in the direction of more advanced instruction.

It is particularly necessary to increase Ph.D. education to produce the advanced researchers and leaders who will be needed so much in Asian countries over the near future. In many countries, while university systems are developing well, and M.Sc. level instruction has begun, few will have the capacity to produce Ph.Ds very soon. A side effect of training at the post-graduate level and of encouraging visiting scientists to spend time at Los Banos is that new thinking is brought into IRRI to add stimulus to the research environment.

8.12. Global

IRRI has several global activities. One of these is the IRGC which has assembled a very large number of diverse rice genetic forms. This is so to such an extent that it should now became selective in further acceptances, but it should expand the collection of wild rice species.

The ARFSN should continue to assist countries with their research on total farming systems particularly by suggesting ways by which the rice component can contribute. There should also be assistance with research on the socio-economic consequences of adoption.

The IRTP has been very successful in the past, but now it should be reviewed as it enters its next phase of funding in 1989. IRRI should assess, inter alia, whether more precise, fuller and more informative results would be produced by providing fewer nurseries at fewer sites. Greater benefit could result if scientists of other disciplines participated with breeders, and the Panel was anxious that IRTP should not distract national breeders from attempting to solve local problems by their own breeding efforts. The use of "hot spots" to select for particular resistances in particularly favourable places is sensible and economical.

8.13. Concentration

IRRI's mission is to be highly focussed on the rice crop. This is a big enough challenge and of such importance that it should not be diluted. But there is a danger of this happening. For example, current activities in farming systems that could include considerable work with non-rice crops and with animals. The Panel concluded that work on farming systems should be concerned with the rice component and with the provision of assistance to national programs that have rice-based agriculture. This should include help with both proactive and retroactive socio-economic analysis.

Risks of distraction also attach to the programs on biological nitrogen fixation, the benefits of which have yet to be clearly demonstrated. The Panel was told that research on Azolla, Sesbania and on blue green algae should be concluded within five years. This would remove a further piece of peripheral work: there is much other relevant microbiology still to do.

One cause of the widening spread of IRRI's interests is the very considerableproportion of its money that is provided in the form of restrictive core or special project funding. Welcome though such generous support may be to IRRI, the Board of Trustees should always ask whether a new activity is central to the purposes of the Institute. Unless it is, despite the attraction of a new resource, they should - probably with regret - refuse.

8.13. Organization

Following a study of the draft strategic plan, some principles of organization at IRRI can be articulated by the Panel. The basis is a concern for the scientific efficiency and research productivity of the Institute. (The EPR Panel was in close touch with the External Management Review Panel in relations to organizational matters.)

Strong disciplinary departments are necessary to provide for sharp and rigorous intellectual discipline among IRRI scientists. All departments should have intellectual coherence and should never be based on multidisciplinary projects such as multiple cropping. There should be fewer departments than now and to provide a critical intellectual mass, cognate disciplines should be merged.

Research work should be carried out in projects which are grouped together in programs. Many programs and projects will involve staff members from several disciplinary departments: they will be "multidisciplinary". Other projects may fall entirely within a single

department: they are "unidisciplinary". The portfolio of projects must not be static because individual projects will fall out us they are completed or fail, others will be added as new opportunities arise and as new research needs are perceived. For this reason resource allocation will be on a project basis and departmental costs covered by overheads.

Each department should have a Head, each program a Director and each project a Leader. Some scientists will find themselves in all of these roles, some in two, others in only one. Some will be employed creatively in projects without management responsibilities.

At regular intervals, external peer reviews of departments should be carried out: hitherto, such reviews have been sporadic. Their purpose is to ensure that the scientific caliber of the discipline is maintained and to make IRRI scientists aware of advances in scientific concepts and methods elsewhere.

Program and project monitoring should be subject to the current practice of internal reviewing which should include, in addition to the Program Committee of the Board, external research workers with wide experience in the sector being reviewed. Special programs or project study should be undertaken by appropriate conferences. External reviews of programs corresponding to peer reviews should take place frequently.

This should reinvigorate the work of IRRI.

8.14. Future

IRRI will extend its distinguished career if it continues to bring science into practice on behalf of rice farmers. It does not matter whether the science is upstream or downstream so long as the first objective is application. This can only be achieved by science of high disciplinary quality - it should be of world quality - which will address practical needs through a project system in which agricultural objectives are well defined. An appropriate balance must be made between the maintenance of past gains and the need to conduct research into providing livelihood with the maximum possible equity for disadvantaged farmers, for the landless poor and for those suffering misery in the cities. Alongside this, and with equal force, must be placed the importance of the conservation and preservation of the world's capacity to continue to produce food without risk of endangering environments.

All of these objectives place heavy responsibilities on the Trustees and staff of IRRI. The Institute will be best able to face the challenges of the future if it keeps up with the modernization of science, with the changing purposes of agriculture development and with a determination not to be distracted into the ineffectual dispersal of its talents.

We are confident that IRRI can do this.

8.15. Recommendations

The Panel recommends, with respect to strategies for selecting research priorities (Section 4.2), that:

- IRRI should be pro-active and make a more detailed analysis of the potential impact of new technology on production and sustainability of rice environments.

- IRRI should give more attention to the rainfed lowland environments while increasing the upstream and yield sustaining research for irrigated rice. In the less favourable deepwater and upland environments, research should continue to probe for opportunities to increase production without sacrificing long-term sustainability.

- IRRI should continue interdisciplinary approaches in addressing complex interactive problems of rice production systems. This requires well balanced disciplinary departments which should not be confounded by program-oriented departments. Research should be conducted and financed through a project system.

- IRRI should undertake on-farm component research to improve and evaluate new technologies in the environment for which they are intended. Such research involves analysis of the potential socio-economic consequences for women and children, and for the sustainability of production systems.

- IRRI should continue to collect and analyze information for making better estimates on technology payoff for varietal improvement and for crop management research in each rice environment, and that the Board of Trustees and the Director General reassess at intervals policy issues in relation to revised estimates, in setting priorities.

The Panel recommends, with respect to germplasm improvement (Section 4.3), that:

- IRRI should place much less effort on perfecting finished varieties and give more encouragement to on-site breeding in national programs in order to satisfy local needs, maximize genetic diversity and enable local breeders to be more successful.

- IRRI should acquire the necessary skills to undertake more creative research towards the goal of developing disease and insect resistance that is durable and stable. A critical and continuing need is to reduce fluctuations in productivity and profitability caused by diseases and insect pests.

- IRRI's present involvement in genetic engineering and biotechnology be commended and, as needs and opportunities become apparent in the future, there should be further expansion at the expense of more routine breeding activities.

- IRRI should research to increase yield potential should be intensified, with greater in-depth research in plant physiology, integrated closely with genetics and plant breeding. In this regard, heterosis should also be explored in greater depth.

The Panel recommends, with respect to crop and resources research (Section 4.4), that:

- IRRI should strengthen its research on yield loss as affected by disease/pest intensity in relation to rice genotype and environment and give more attention to pathogen/pest microevolution in relation to development of resistance and deployment of different resistance genes. These needs are revealed by the continuing importance of diseases and pests regionally and their unpredictable devastating epidemics locally.

- IRRI should vigorously pursue the goal of stabilizing pest populations below yield loss thresholds via all possible avenues.

- IRRI should continue its work on abiotic stresses with more of an upstream approach involving soil chemistry and physics, nutrition, plant physiology and genetics.

- since research involving surface and floodwater hydrology lies outside the IRRI mandate, these activities should be phased out and the remaining soil water hydrology research should be integrated into the Soils Department removing the need for a Department of Water Management.

- in view of the extensive research that has been undertaken on biological nitrogen fixation by Azolla, blue green algae and other microorganisms, the work in this area should not continue beyond the completion of the existing special projects.

- the Department of Agronomy should assume responsibility for the closely-related crop research currently undertaken by the Multiple Cropping Department, including agro-ecological and simulation modelling work. The remaining farming systems activities should only continue within the Asian Farming Systems Network thus removing the need for a separate Department of Multiple Cropping.

- IRRI should concentrate on interdisciplinary work in socio-economics where it has a comparative advantage and which would serve the interests of rice producing countries: resource management to generate methodologies for analyzing the economics of sustainability in different rice environments, and the economics of pest management.

- IRRI should phase out its on-going macroeconomic analysis on the impact of rice technology in different regions of the world because, although excellent, it is now more appropriately undertaken by national and other internatioal institutions.

- IRRI should continue its good work on agricultural engineering to address the needs of many Asian Countries.

- IRRI should continue, and expand as appropriate, analyses and programs related to the impact of new technology on the role of women in rice production.

The Panel recommends, with respect to the International Rice Germplasm Center (Section 5.1), that:

- IRRI should continue its work on the storage of germplasm, with a more selective acceptance of new material into the collection (although importance should be attached to the assembling of further collections of wild rice species), include agro-ecogeographical information in the passport data of accessions whenever possible, and conduct research relating to the germplasm collection.

The Panel recommends, with respect to the proposed International Biofertilizer Germplasm Center (Section 5.2), that:

- IRRI does not require a biofertilizer germplasm center to prevent genetic erosion nor to store the small collections.

The Panel recommends, with regard to cooperation, with national research systems (Section 6.1), that:

- IRRI should develop strong collaboration between its scientists and capable partners in national programs to help address priority problems of mutual interest.

- IRRI should facilitate the exchange of IRRI-based scientists with outreach staff and selected national scientists for periods of several months; consult with appropriate national rice research leaders in IRRI's planning and priority-setting activities; and encourage participation of involved national scientific leaders on a selective/rotational basisin internal program review.

- IRRI should continue to support national rice programs and encourage direct donor support for the stronger national systems, thereby encouraging self-reliance.

- IRRI should encourage those national agricultural systems with the appropriate capacity to take some responsibility, in partnership, to assist weaker-national systems in building rice research.

The Panel recommends, with respect to training and technology transfer (Section 6.3), that:

- the training and fellowship programs should be shaped to take into account the expansion of educational training facilities of the natonal systems. To this end, greater emphasis should be given to Ph.Ds. IRRI's training program should move upstream, and, therefore, some programs should be dropped and national institutions encouraged to take the responsibility for others.

- every effort should be made to maintain the highest caliber of fellows; to the extent possible, encouragement should be given to those post-doctoral candidates who have done thesis work in first-class universities. Fellowship selection should be made with a view to bringing fresh ideas to IRRI and sustaining vigour and dynamism of the Institute.

- IRRI should be more assertive about screening applications for its fellowship programs; it should use its right to veto applications judiciously.

- IRRI should review the burden carried by senior scientists in their capacities as researchers and educators to ensure that they are in a position to fulfill functions adequately.

The Panel recommends, with respect to the Asian Rice Farming Systems Networks (Section 6.4.1), that:

- the Asian Rice Farming Systems Network should not expand further so that more time is available for interaction between IRRI staff and the national scientists to improve the quality of the program.

- IRRI should act as a facilitator and catalyst to help the national scientists to develop effective trials and thus gain recognition for their efforts within their own national programs.

- IRRI should consider appointing a social anthropologist to the Agricultural Economics Department to provide an input to any analysis of the social and economic factors influencing farming practices.

The Panel recommends, with respect to the International Rice Testing Network (Section 6.4.3), that IRRI should review the IRTP with the aim of:

- decreasing routine nursery screening of little relevance to national needs; increasing collaborative research between IRRI scientists and national scientists in projects on pathology, entomology, physiology and genetics within the IRTP framework; and considering whether IRTP staff outposted in Latin America, the Caribbean, and East and West Africa could be appointed to the staff of CIAT and IITA, respectively, and thus be integrated fully into the rice teams of the Institutes having responsibilities for rice research in those continents.

The Panel recommends, with respect to IRRI's role outside Asia (Section 6.5), that:

- IRRI should concentrate its research and training in Asia and that it should only work elsewhere at the request of, and in collaboration with, CGIAR Centers that have regional or continental responsibilities for rice.

The Panel recommends, with respect to research management and organization (Section 7.2), that:

- IRRI should have a departmental organization based on major disciplines; organnize its research in programs and projects; ensure departments have sufficient senior scientists for stimulating intellectual interaction; make programs and projects the basis for funding.

- IRRI should conduct regular peer review for each department to achieve high scientific standards and quality research.

- IRRI should appoint a member of the directing staff to administer outreach programs and to provide backup support for outreach staff, and explore ways of ensuring that all outreach staff can visit headquarters regularly to interact with scientists and other colleagues.

CONCLUSIONS AND RECOMMENDATIONS

The key management challenge facing IRRI is how to balance the need for greater efficiency, discipline, and accountability against the goal of maintaining an environment conducive to innovation and creativity.

Research is IRRI's main business. Doing good mission oriented research requires a setting that is conducive to good idea generation, innovation, risk-taking, and strategic thinking, Such a setting contributed to IRRI's early success. In the IRRI of tomorrow, that early tradition should be enhanced by: providing adequate resources to scientists, instituting an effective project management system that delegates decision-making to those closest to problems, fostering a disciplinary structure that facilitates collegial interaction, and maintaining a functional support system that serves scientists, not itself. The board and management's task is to create and maintain such an environment.

IRRI needs to sharpen its vision of its future. The strategic planning exercise carried out by a staff committee is a good start, but more needs to be done. The bottom-up approach taken so far needs to be complemented and reinforced with a top-down process that moves from macro considerations toward the micro. IRRI's future clients, their needs, and the Institute's future environment should be defined more clearly. Goals, strategies, and priorities need to be spelled out with convincing rationale.

Some tough staffing decisions may have to be made. Strategic planning gives IRRI an excellent opportunity for Institute-wide reform, including improvements in administrative and support services. IRRI's future organizational structure should follow from its strategy, not vice versa. The chosen strategy and structure may point to a need for a mix of talents different from those of the present. This may require some painful decisions, but they should be made for the future excellence of the Institute.

Leadership is the key. IRRI has a tradition of strong research leadership; a tradition ably perpetuated by the current DG who has broadened IRRI's vision in notable ways. However, strong research leadership must be balanced by strong organizational management. This demands clearly defined and adequately communicated goals, well developed plans, effective feedback and control mechanisms, and decisive action. Leadership and management skills should be strengthened throughout the Institute, not just at the top layer.

IRRI needs to strengthen its program flexibility. More than half of IRRI's funds have some conditions attached to them. This may threaten IRRI's future flexibility. The current set of special project and restricted core activities may not complement IRRI's core program under a new strategic direction, such as upstream research.

IRRI needs to maintain its strong external orientation. IRRI's partnerships with the University of the Philippines at Los Banos, the national research systems, and a growing number of donors are among its greatest assets. Management must nurture and sustain them while strengthening linkages with upstream research institutions and continuing IRRI's solid public relations efforts.

People are IRRI's greatest asset... This cliche is especially true at IRRI, where there are many world-class scientists and a highly qualified local staff in both research and administration. Many are dedicated and hard-working. But there are opportunities for improved productivity. When mediocrity gets in the way of excellence, the Institute must find ways to raise staff quality.

...But many staff members are not properly nurtured, developed, and motivated. Part of the fault lies in IRRI's personnel management system and part lies in the way supervisors manage people. Job description and classification, selection, training, salary administration, performance planning and evaluation, and termination procedures are either outdated or are not implemented vigorously. The current DG's policies to upgrade the status and professional growth opportunities for junior researchers should be continued.

Information management also needs attention. Timely, relevant information is the life blood of science, finance, and administration. IRRI's scientific data bases and management information systems need to be updated and developed. An early reorganization of the Computer Center to give scientists and administrators the support they need is essential.

IRRI should strive to get higher value for its money. Donor funds are more scarce now than ever before; pressure is mounting for greater efficiency. Some improvements in financial systems and procedures have been made in the last six years, but more work needs to be done. Better controls are necessary to improve discipline in finance and administration and to strengthen accountability. Administrative and financial operations need further reorganization.

These management challenges require that IRRI's board give them higher priority. Closer monitoring of progress in management is called for. Some reorganization of the board's structure may be necessary. Trustees with professional management expertise should be recruited.

These are our main conclusions. In our report we make 10 recommendations and many more specific suggestions. We consider 3 of the recommendations high priority. They are listed first.

We strongly recommend that:

- IRRI consider the draft report of the Strategic Planning Committee only as initial input to the formulation of its long term strategy.

- IRRI's board elevate management considerations to a par with program matters.

- the board and incoming director general give early and close attention to reforming IRRI's human resource management function.

In addition, we recommend that :

- IRRI consider the adoption of a project planning and management system with the aim of increasing the challenges, responsibilities, and accountability of individual scientists.

- IRRI devise and implement a fair and equitable scheme for staffing the organizational structure that emerges from the strategic planning process.

- IRRI:

  - study the implications of its heavy dependence on restricted funding (restricted core plus special projects) on future program flexibility,

  - reform the organization and staffing of the Accounting Department to enable it to carry out future responsibilities efficiently, and

  - place high priority on computerization and the formalization of financial systems and procedures.

- IRRI give high priority to bringing a new computer center manager on board and, with his/her help, move with dispatch toward effective computerization of administration and research operations.

- IRRI help staff at all levels understand more clearly what the Institute administrative policies are and how they are to be implemented.

- IRRI review its short term planning and review processes in the light of its strategic plan and the medium-term program and budget review mechanisms initiated at the system level.

- personnel policies concerning outposted scientists be brought more closely into line with those that apply to headquarters-based staff.

ACKNOWLEDGEMENTS

The External Program Review Panel wishes to thank IRRI and its directing staff for the highly efficient way in which the Review was planned and supported and the research staff for the valuable overview of IRRI's plans and accomplishments.

The Panel is especially grateful for the assistance of the outreach staff during visits to Bangladesh, Burma, Thailand, Madagascar, and Tanzania, and to the many government officials from these countries, and from the Philippines, who were very helpful during the Panel's visits.

It also appreciated the invitation by the Chairman of IRRI's Board to discuss the report with the Trustees prior to the Chairman of the Panel making his presentation to the senior staff.

Finally, the fact that there was a report is due largely to the round-the-clock efforts of Franca Zodda, from the TAC Secretariat in Rome, and her two able supporters, Sol Balthazar and Letty Ledesma from Manila, who together with Sean O'Connor, Manager of the Computer Center at IRRI, moved mountains and produced the report on time. Their help is gratefully acknowledged.

ANNEX I

COMPOSITION OF THE EXTERNAL REVIEW PANELS

A. External Program Review Panel

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INTERIM 1/ TERMS OF REFERENCE

FOR EXTERNAL PROGRAM REVIEW

OF THE INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

The Consultative Group on International Agricultural Research (CGIAR) has charged its Technical Advisory Committe (TAC) to conduct External Program Reviews (EPRs) of the CGIAR-supported International Agricultural Research Centers (IARCs) 2/ to determine their efficiency and effectiveness in reaching the CGIAR goal:

> "Through international agricultural research and related activities, to contribute to increasing sustainable food production in developing countries in such a way that the nutritional level and general economic well-being of low income people are improved."

The Objectives of EPRS are:

1. - to evaluate for the CGIAR the program of the Center, in particular with respect to:

   (a) the current and future relevance to the CGIAR goal of the Center's mandated activities;

   (b) the appropriateness for support by the CGIAR of the Center's research and other activities, and the amount and scope of the Center's efforts devoted to them;

   (c) the past achievements of the Center and the probable dimensions of the return to further efforts in research and related activities or, where appropriate, the introduction of new activities;

2. - to assess for the CGIAR, in the context of its goal:

   (a) the appropriateness and effectiveness of the Center's policy and strategy for the development of its program;

1/ The Interim Terms of Reference were developed to take account of the findings of the TAC Review of CGIAR Priorities and Strategies, the Impact Study, and the progress made by the study on the external review process of the CGIAR currently under way.

2/ "Center" for the purpose of this document comprises the Board, the Director and staff of all CGIAR institutions, whether designated as Association, Board, Center, Institute, Laboratory or Service.

(b) the standing in the world of the Center's program and staff in research, training, and related activities, and its relationships with other IARCs, national and international organizations, and private interests concerned with the research;

(c) the priorities for research, training and related activities of the Center and the means to address them;

(d) the progress of the Center's efforts to assist appropriate institutions in developing countries in their efforts to assume responsibility for location-specific research, training, and related activities, including networks or wider research where feasible;

3. - in light of 1 and 2 above, to review and comment on the effectiveness of the Center's provisions for:

(a) developing and updating of its objectives and of the strategies to reach them (operational mandate, long-term plan, medium-term projections);

(b) measuring results and impact of past efforts and, as a consequence, adjusting priorities by dropping, adding or modifying activities as required;

(c) ensuring appropriate allocation of resources to: research programs; training; assistance to NARS; networks; genetic resouces conservation, if appropriate; data processing and other forms of research support; information and documentation; etc.;

(d) ensuring staff competence and quality;

(e) ensuring operational efficiency and effectiveness;

4. - to advise the CGIAR on:

(a) the Center's actions on the recommendations of the previous review as approved by the Group;

(b) constraints to achievements of stated objectives at the Center, program, and activity levels, and means to overcome them;

(c) the need for any monitoring, interim, or supplementary review, and on the objectives, dates and schedule of such review;

(d) the following specific questions or issues:

Priorities and Strategies

1. Within the context of the CGIAR priorities and strategies, are the conclusion and recommendations as defined in IRRI's strategic planning document 3/, sound, relevant and useful in the determination of its research priorities?

2. What are the views of collaborating national programs on IRRI's strategic plan? To what extent have they been involved in shaping the Institute's long-term strategy?

3. Is IRRI giving sufficient consideration within its research program and priorities to (a) the role of women in rice farming; (b) ensuring that the technologies it is developing benefit women; and (c) ensuring that the rice farming systems it is promoting are ecologically and economically sustainable? How are these considerations affecting IRRI's research activities?

4. Given the expansion over the last ten years of IRRI's research from a primary focus on irrigated rice, is IRRI beginning to spread its research interests to encompass too much? What are the areas of its comparative advantage? Should further changes (e.g. reduction and greater concentration on few areas, or expansion to other crops important in rice farming systems) be contemplated?

Research

5. Is there scope for better identification of research needs for the different rice cultivation systems - i.e. irrigated, rainfed and/or rice growing environments (humid tropics, cool, temperate, deep-water, etc.)? What is the role of national agricultural research systems in determining needs in these areas? To what degree do IRRI's research programs (a) duplicate, or (b) support and complement those of national programs? What is IRRI's comparative advantage for undertaking site-specific research, especially in less favoured rainfed areas? How should other CG Centers be involved?

6. What is the specific nature and magnitude of the basic and strategic research activities conducted by IRRI? What are IRRI's priorities for determining which of these should be undertaken in-house, subcontracted or undertaken in cooperation with other agencies. How far should IRRI go into upstream research? To what degree should IRRI provide leadership to national programs, and to other CG Centers doing strategic or basic rice research?

7. What internal and external peer review processes are in place to maintain and enhance the quality of IRRI's research staff and of its research programs? To what degree are IRRI's programs evaluated in terms of innovation, uniqueness and repetition?

8. What consideration does+ IRRI give to post-harvest losses, and to the utilization of products of the rice plant? What comparative advantage does IRRI have in these areas? Should IRRI extend its research further into

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3/ Draft report of IRRI's Strategic Planning Committee - 1987.

possible rice-based income-generating activities which could be utilized by rural people?

Cooperation with National Programs

9. How effective is the dialogue and influence of research leaders in rice-growing developing countries, on the program development of IRRI? How are specific needs of target groups reflected in the formulation of research programs? Are the national program leaders satisfied with IRRI's response to their identified and changing requirements in research, training, and information flow?

10. Does the management of breeding programs inhibit the free expression of research ideas and the free use of alternative methodologies by national programs?

11. How are responsibilities for rice maintenance research being shared among collaborating national programs and IRRI? How are the roles determined, and how are the activities coordinated? What are the major constraints to further collaboration and how can they be alleviated?

12. What is the nature and magnitude of research activities that collaborating national programs have agreed to undertake? Which national programs have accepted such research responsibilities? What is the nature of support from IRRI?

13. Given the shift in emphasis toward the less favourable environments and the increasing amount of adaptive and applied research undertaken by national agricultural research systems of developing countries, how does IRRI intend to adapt its training strategy?

14. Given the variation in capability of national agricultural research systems, how does IRRI see the evolution of its dual role as a service organization and as a research leader? How should these roles be related?

15. How much direct contact does IRRI have with national programs outside Asia? In this context is IRRI's interpretation of its mandate appropriate? Are the needs of African and Latin American countries being given adequate consideration or should there be further involvement by IRRI?

Collaboration with CG and Non-CG Centers, and Advanced Institutions

16. What is the nature and magnitude of interactions between IRRI and other CG Centers, e.g. CIAT, IBPGR, IFPRI, IITA, ISNAR and WARDA; and with non-CGIAR research institutions?

17. What is the extent of IRRI's collaborative research with advanced institutions? What are the funding arrangments for such collaboration? Does IRRI make the fullest possible use of suitable collaborative or contractual arrangements for undertaking research at advanced

research institutions, or is IRRI entering fields where others already have the comparative advantage?

Technology Transfer and Impact

18. In view of the location specificity of farming systems research, what emphasis is there on development and transfer of FSR methodology?

19. How does IRRI monitor the effectiveness of technology transfer and the impact of its research and related training on its target groups in its client countries? Does the need to show impact distort the balance of activities in a Center's Program? How is the information used in the Center's program development?

Genetic Resources

20. Given the designation of IRRI as a base Center for the collection and conservation of rice germplasm what is the role of IITA, CIAT, WARDA and IBPGR in germplasm collection and conservation? What is the role of IRRI in strategic/basic research on rice germplasm conservation? How are the responsibilities for germplasm conservation shared with national institutions?

21. What is the rationale for the biofertilizer germplasm bank? Is IRRI the appropriate location for such an initiative?

Future Size of IRRI

22. As national systems assume more responsibility for global rice research, which areas of research are likely to remain within IRRI's comparative advantage?

23. In light of the CGIAR priorities on rice and the growth in capacity of national systems, what are the Panel's views on IRRI's plans with respect to the long-term development of the Center, and size and scope of its program for the next 5-10 years?

24. What are the Panel's views on the programs of highest priority and the appropriate strategy IRRI should pursue should there be a no-growth funding situation over the next five years?

ANNEX III

DOCUMENTATION FOR REVIEW PANEL

A. Documents Provided by TAC and CGIAR Secretariats

- Report of the Second Review of the CGIAR. 1981
- CGIAR Priorities and Strategies. 1986
- Report of the first (1976) and second (1982) IRRI QQRs
- Training in the CGIAR System
- Relevant extracts from TAC Reports. 1982-1987
- Terms of Reference for the EMR

B. Documents Provided by IRRI

- Articles of Incorporation (original, and as subsequently amended in 1982)
- Actions taken on the second QQR Panel Recommendations, as of 1987
- Descriptions of the main achievements, constraints and impact of the Center during the past five years. 1987
- IRRI Strategic Planning Committee Report. February 1987, April 1987
- Executive Summary of Proposed Budget for 1988
- Internal Program Review Documents. (PA 100 - PA 600), 1987 (mimeo)
- Terminology for Rice Growing Environments. IRRI, 1984
- Accomplishments and Future Research Needs of the Hybrid Rice Program at IRRI, 1987 (mimeo)
- An overview of Upland Rice Research. IRRI, 1984
- Annual Report. 1985
- World Rice Statistics. 1985
- Publication lists (various departments)
- Progress in Rainfed Lowland Rice. 1986
- International Rice Research: 25 Years of Partnership. 1985
- Development and Spread of High Yielding Rice Varieties in Developing Countries. Dalrymple, D.G., USAID. 1986
- Crop-Livestock System Research. IRRI Report, 1985
- Strengthening National Agricultural Research Systems to Assume an International Role in Specific Areas of Rice Research and Training. Paper prepared by IRRI for an international consultation on the same subject held at IFAD, 26-28 January 1987 (mimeo)
- Collaborative Research Projects. 1987

- Rice Improvement in Eastern, Central and Southern Africa. 1985
- IRRI Highlights. 1985
- The Flowering Response of the Rice Plant to Photoperiod. Vergara, B.S., and T.T. Chang. IRRI, 1985
- Copublication: IRRI design, procedures, and policies for multilanguage publication in Agriculture. Hargrove, T.R., R.C. Cabrera, and F.E. Manto. IRRI, 1983
- The International Bibliography of Rice Research. 1985 Supplement, IRRI, 1985
- Miscellaneous Memoranda of Understanding
- Gene Banks and the World's Food. Plucknett, D.L., Nigel S.H. Smith, J.T. Williams, and N. Murthi Anishetty. 1986
- Global Aspects of Food Production. Swaminathan, M.S., and S.K. Sinha (Editors). IRRI, 1986
- Small-Farm Equipment for Developing Countries. IRRI, 1986
- Varietal Improvement of Dryland Legume Crops for Rice-Based Cropping Systems. Phase One - Terminal Report. IRRI, 1986
- Mimeo reports on the activities of the different departments and support units. 1987
- IRRI's Training and Professional Advancement Programs. IRRI, 1985
- Schedules of Conferences/Workshops/Meetings. 1981-1987. IRRI (mimeo)

ANNEX IV

PROGRAM OF EPR PANEL COUNTRY VISITS

I. COUNTRY VISITS

3-12 March 1987

Panel Members: Sir Ralph Riley, Drs. K.M. Badruddoza, S. Sastrapradja, D. Plucknett, P. Roberts-Pichette

Thailand: 3-4 March

Team accompanied by Dr. D.W. Puckridge

3 March:	Arrival at Bangkok
4 March:	
09:00-11:00	Meeting with research leaders and scientists from several agricultural research institutes and divisions of the Department of Agriculture.
11:00-12:00	Meeting with Deans of Agriculture from Thai universities.
13:30	Meeting at the Land Development Department.
14:15	Meeting at the Department of Agricultural Extension.

Burma: 4-9 March

Team accompanied by Dr. R.K. Palis, Team Leader, BIFS Project

4 March:	Arrival at Rangoon. Welcome by Deputy Minister of Agriculture and Forests.
5 March:	
10:00	Briefing on agricultural research activities in Burma.
12:00	Lunch at the Agriculture Corporation.
15:30	Courtesy call on the Minister of Foreign Affairs.
19:00	Dinner hosted by the Minister of Agriculture and Forests.
6 March:	
06:00	Departure from Rangoon for Yezin, Pyinmana, by car.
11:00	Lunch at Nyaungbintha Seed Farm
15:00	Arrival at Yezin.

16:00	Discussion with researchers of the Agricultural Research Institute.
19:00	Dinner hosted by the Managing Director Agriculture Corporation.
	Night stop at the Agriculture Research Institute Guest House.

7 March:

07:30	Breakfast.
08:00	Visits to laboratories and experimental fields of the Agriculture Research Institute.
10:00	Departure from Yezin for Mandalay.
12:30	Lunch at Meiktila.
16:30	Arrival at Mandalay.
19:00	Dinner hosted by Panel.

8 March:

07:30	Departure from Mandalay for Maymyo.
07:45	Visit to Aungpinle Paddy Production Camp. Discussion with extension personnel and farmers.
09:30	Visit to Dockwin Horticultural Station.
11:00	Visit to Maymyo Botanical Garden.
11:45	Lunch at Nanmyaing Hotel and discussion.
15:30	Departure from Mandalay for Rangoon by air.

9 March:

10:00	Wind-up discussion at Agriculture Corporation.

10 March:

09:00	Departure from Rangoon. Flight of 9 March delayed due to technical problems.

Bangladesh: 10-12 March

Team accompanied by Dr. Frank W. Sheppard, Jr., retiring IRRI Representative in Bangladesh, and Dr. J. McIntosh, newly appointed IRRI agronomist.

10 March:

09:30	Arrival at Dhaka and stranded at airport due to transport strike.
15:30	Meeting with Secretary of Agriculture.
16:30	Discussion of BRRI-IRRI Linkages: Past, Present, Future.
19:00	Dinner offered by Bangladesh Government.

11 March:

08:00	Meeting with the regional representative to the CGIAR of Asia and the Pacific.
09:30	Departure for Jaydebpur.
10:00	Discussion BRRI-IRRI Research Linkages: Present and Future. - Varietal improvement - Irrigation management and crop protection
11:00	- Rice Farming Systems - Integrated Pest Management - Cultural Practices Research Program
13:00	Lunch offered by BRRI.
14:00	Walking tour of BRRI.
14:30	Visit to BARI.
15:30	BRRI Manpower Training Program.
16:00	Final BRRI discussion.
17:00	Return to hotel.
19:00	Dinner hosted by IRRI.

12 March:

08:00	Meeting at Bangladesh Water Development Board: present and future linkages with IRRI.
09:00	Exit interview with the Minister of Agriculture.

11:15	Meeting at Department of Agriculture Extension.
12:30	Meeting with International Center Scientists working in Bangladesh.
13:45	Lunch with ex-Directors General of BRRI and present and former IRRI Board members.
15:15	Meeting with bilateral donors supporting BRRI-IRRI Project.
16:30	Departure to hotel. Departure of Panel.

22-31 March 1987

Panel Members: Sir Ralph Riley, Dr. I. Buddenhagen

Madagascar: 22-27 March

Team accompanied by Dr. J. Hoopper III, IRRI agronomist, and Dr. B.B. Shahi, IRRI rice breader; Dr. J. Flinn, IRRI Economist at Los Banos.

22 March:	Arrival at Antananarivo
23 March:	
09:00	Meeting with Directeur Scientifique and Rice Team Coordinator of FOFIFA.
09:45	Meeting with USAID representative.
11:45	Lunch.
13:15	Tour of on-farm research at Manjakandriana.
19:00	Dinner at Dr. Hoopper's house
24 March:	
07:00	Tour of National Rice Center at Mahitsy and on-farm research trials near Mahitsy, Amasinomby, and adjacent areas.
12:00	Lunch.
13:00	Departure of Sir Ralph Riley for Antsirabe and Dr. Ivan Buddenhagen for Fianarantsoa.
25 March	Visits to on-farm trails in Antsirabe (Sir Ralph Riley) and return to Antananarivo. Visits to Centre Semenciar at Fianarantsoa and to on-farm trials at Betafo and Antsirabe (Dr. Buddenhagen) and return to Antananarivo.

26 March:

08:30	Meeting with the Chef de Departement Recherche-Developpement and staff.
0:45	Meeting with FAO Representatives.
11:00	Meeting with Secretary General, MRSTD.
11:45	Lunch hosted by UNDP Representative.
14:00	Meeting with Service Protection Vegetable.
14:30	Meeting at Departement Recherche Agronomique, Ambatobe.
	Tour of facilities.
16:00	Meeting at Departement Recherche Technologiue, FOFIFA, Ambatobe.
16:45	Meeting with ISNAR staff member.
27 March:	Arrival at Nairobi on the way to Tanzania
09:00	Meeting with the "Equip Riz" at FOFIFA, Ambatobe.
11:00	Meeting with Chef de Mission, IRAT in Madagascar.
14:55	Departure from Antananarivo.
19.55	Arrival at Nairobi on the way to Tanzania.

28 March-2 April 1987

Panel Member: Dr. I. Buddenhagen

Tanzania: 28 March-2 April 1987

Team accompanied by Dr. K.G. Pillai, IRTP coordinator for East Africa.

28 March: Depart Nairobi (evening).

29 March: Arrival at Dar-es-Salaam. Meeting with Chief Research Officer (crops), Ministry of Agriculture and Livestock Development.

30 March: Visits to Morogoro, Sokome University, and Dakawa Rice Station.

31 March: Visits to Ministry of Agriculture and the UNDP office at Dar-es-Salaam.

Departure from Tanzania.

Kenya: 31 March-2 April

31 March: Arrival Nairobi (evening)

1 April: Visit to USAID REDSO office, Nairobi. Met with Dr. S. Armstrong III officer in charge of USAID/Madagascar project.

2 April Departed Nairobi

II. PEOPLE MET DURING COUNTRY VISITS

Thailand: 3-4 March

- Mr. Chak Chakkaphak, Director, Agricultural Engineering Division
- Dr. Damkheong Chanrapanya, Director, Technical and Planning Division
- Mr. Songkran Chitrakon, Geneticist, Pathumhani Rice Res. Center
- Dean Graduate School, Kasetsart University
- Dean, Faculty of Agriculture, Khon Kaen University
- Dean, Faculty of Agriculture, Chiangmai University
- Dean, Faculty of Agriculture, Kasetsart University
- Mr. Somkid Disthaporn, Chief, Rice Pathology Section
- Dr. Chob Kanareugsa, Asst. Director, Soil Science Division
- Mr. Narong Minanandana, Department of Agricultural Extension
- Mr. Suvit Pushpavesa, Asst. Director and Plant Breeder, Rice Research Institute
- Mr. Chanuan Ratanawaraha, Director, Farming Systems Res. Inst.

- Dr. Sanarn Rimwanich, Director-General, Land Development Department
- Mr. Montri Rumakom, Director, Entomology and Zoology Division
- Mr. Prathes Sittiyos, Plant Breeder, Rice Research Institute
- Mr. Nopporn Supapoj, Plant Breeder, Pathumthani Rice Res. Center

Burma: 4-9 March

- U Khin Win, Managing Director, Agriculture Corporation
- U Htay Aung, Personal Secretary to U Khin Win
- U Toe Aung, Deputy Assistant General Manager, Corn and Cereal Division
- Dr. Thomas Bloch
- U Maung Maung Bo, Direcor, Ministry of Agriculture and Forests
- U Ye Goung, Minister, Ministry of Foreign Affairs
- U Aung Gyi, Director, Ministry of Foreign Affairs
- U Theing Han, Assistant General Manager, Food Legumes Division
- U Tun Hlaing, Deputy General Manager, Sugar Crop
- Dr. Sain Htun, Deputy General Manager, Chemstry Division
- Dr. Lloyd Johnson
- U Aung Khin, General Manager, Liaison Officer
- Mr. K. Kitatani, UNDP Representative
- U Ohn Kyaw, Deputy General Manager, Rice Division
- U Saw Win Kyi, Deputy General Manager, Oil Seed Division
- U Ngun Lwe

- U Mya Lwin, Assistant General Manager, Botany
- U Sett Maung, Foreign Economic Relation Department, Ministry of Finance (Advisor)
- Dr. A. H. Mazano, Team Leader, BARD Project
- U Hla Moe, Director General, Ministry of Agriculture and Forests
- U Arthur Mundt, Assistant General Manager, Small Scale Farm Machinery
- Brig. General Than Nyunt, Minister, Ministry of Agriculture and Forests
- Dr. Sam Portch
- Dr. Tun Saing, General Manager, Agriculture Research Institute, Yezin
- U Kyew Shiun, Assistant General Manager, Agronomy
- Dr. Sirohi
- U Ral Lian Sun, Director of Forest Institute
- U Hla Than, Deputy General Manager, Plant Pathology
- Dr. Selai Tun Than, Professor of Agronomy
- U Hla Thein, Assistant General Manager, Information
- U Mya Thein, Assistant Director, A.M. Department
- U Soe Thwin, Director General, Foreign Economic Relation Department, Ministry of Finance
- U See Tint, Assistant Director, A.M.Department
- U Aung Win, Deputy Minister, Ministry of Agriculture and Forests
- U Khin Win, Managing Director, Agriculture Corproration
- U Sein Win, Divisional Manager, Mandalay
- Dr. Kyaw Zin, Advisor

Bangladesh: 10-12 March

- Resident Representative, ADB, Dhaka
- Ms. T. Abdullah, IRRI Board Member
- Dr. Ekramed Ahsan Member Direcor (Ag. Econ) BARC and regional representative to theCGIAR of Asia/Pacific
- M. Mirza Ruhul Amin, Minister of Agriculture
- M. A.M. Anisuzzaman, Secretary of Agriculture, Ministry of Agriculture
- Dr. N. I. Bhuiyanm, Head, Soil Chemistry
- Dr. Larry Butler, Wheat Pathologist, CIMMYT
- Dr. A.N.M. Rezaul Karim, Head, Entomology Division
- Dr. K.A. Haque, Head, Agricultural Engineering
- Mr. Allan Hurdus, Agricultural Development (Research), USAID
- Dr. Amirul Islam, Ex-Director General of BRRI
- Dr. Md Ashraf Ali Khan, Director of Research, BAU
- Mr. Anwarul Kibria, Director Field Operations, Dept. of Agricultural Extension
- Mr.Noel Magor, IRRI Rice Farming Systems Specialist
- Dr. M. A. Mannan, Director General, BRRI
- Ms. Gillian Mellsop, Second Secretary Develpoment, Australian High Commission
- Dr. Nur Md. Miah, Head, Plant Breeding Division
- Dr. S. A. Miah, Head, Pathology Divison
- Dr. M. H. Mondol, Director General, BARI
- Mr. Ken Moots, IFDC
- Mr. M. L. Rasul Munshi
- Mr. Kevin Rushing, Agricultural Research Project Officer, USAID

- Dr. S.B. Siddique, Head, Agronomy Division
- Mr. Lyle Sikka, Potato Breeder, CIP
- Mr. Hans Peterson, Chief Food and Agriculture Division, USAID
- Mr. David Smart, Development Officer, Canadian High Commission
- Dr. S.M.H.Zaman, Ex-Director General of BRRI

Madagascar: 22-28 March 1987

- Mr. Jose Bronfman, World Bank Representative at Tsaralalana
- Mr. Chabane, Climatology
- Mr. Dechanet, Plan Breeding
- Mr. A. de la Porte
- Mr. A. Dodelya
- Mr. Roland Guiss, Chef de Mission IRAT
- Mr. Andre Hupin
- Mr. Rakotobe Rabehevitr, Chef de Service Protection Vegetale
- Mme J. Rabelolala
- Mme Y. Rabenantoandro, Chef de Department Recherche Technologique
- Mr. R.Rabeson
- Mme. J. Raharinirina
- Mr. J. B. Rajaonarison
- Mr. R. Rakotonirainy
- Mr. Rasolo, Chef de Department Recherche-Development
- Mr. Rasolofo
- Dr. Ravohitrarivo Pascal, Director Scientifique and Rice Team Coorindator, FOFIFA

- Mr. H. Razafindrabe, Secretary-General, MRSTD
- Mr. L. Razanfinjara
- Dr. Sam Rea, USAID Representativ at the US Embassy
- Dr. Pierre St. Claire, ISNAR Representative, FOFIFA

Tanzania: 29-31 March 1987

- Prof. A. I. Dotto, Senior Lecturer, Plant Breeding
- Ms. A.I. Kihupi, Rice Breeder (TARO) at Morogoro
- Dr. R. Kikopa, Acting Director (Research and Training)
- Prof. A.N. Minjas, Head, Crop Sciences Department
- Prof. G. R. V. Mmari, Vice Chancellor, Sokoine University of Agriculture
- Dr. Mukhibar, IIRA Scientist
- Dr. G. H. Samuguruka, Acting Director General, Tanzanian Agricultural Research Organization (TARO)
- Dr. F.M. Shao, Chief Research Officer (Crops), Minitiry of Agriculture and Livestock Development
- Ms. Steven A. Ursino, Assistant Resident Representative, UNDP

ANNEX V

EPR PANEL PROGRAM - MAIN PHASE

23 April-12 May 1987

Thursday, 23 April

08:00-09:00	Strategic plan (Overview)	M.S. Swaminathan
09:00-10:30	Socio-economic and Evironmental Impact	J.C. Flinn (Ag. Economist)
10:30-10:45	Coffee	
10:45-12:15	Socio-economic and Environmental Impact (cont.)	Ag. Economists: C.C. David, B. Duff, L.A. Gonzales, A. Orr, K. Otsuka, K. Kanungo
12:15-12:45	Panel Review - Issues	
12:45-14:00	Lunch	
14:00-15:30	Education and Communication	M.D. Pathak (Director, Research and Training)
15:30-17:15	Education and Communication (cont.):	
	Training & Technology Transfer Staff (15:45-16:45)	D.R. Minnick (Training Specialist)
	(16:45-17:15)	G.L. Denning (Assoc. Agronomist)
17:15-17:45	Panel Review - Issues	
17:45	Depart for Guesthouse	
17:45-19:00	Open Bar. Informal discussion with Agricultural Economists and the Training and Technology Transfer Staff	
19:00-20:00	Dinner	
20:00	Return from Guesthouse. Report writing	

Friday, 24 April

09:00-10:30	Germplasm Improvement	G.S. Khush (Principal Plant Breeder)
10:30-10:45	Coffee	
10:45-12:15	Germplasm Improvement (cont.)	Breeders: S.S. Virmani D. HilleRisLambers D.J. Mackill D. Senadhira F.J. Zapata T. Ogawa M.A. Arradeau C.H. Kim L. Sitch J.C. Glaszmann T.T. Chang
12:15-12:45	Panel Review - Issues	
12:45-14:00	Lunch	
14:00-15:30	Crop and Resource Management	S.K. De Datta (Principal Agronomist)
15:30-15:45	Coffee	
15:45-17:15	Crop and Resource Management (cont.)	Agronomists: K. Moody K.T. Ingram D.P. Garrity R.J. Buresh C.P. Mamaril H.U. Neue (Soil Chemist)
17:15-17:45	Panel Review - Issues	
17:45	Depart for Guesthouse	
17:45-19:00	Open Bar. Informal discussion with Breeders and Agronomists	
19:00-20:00	Dinner	
20:00	Return from Guesthouse. Report writing	

Saturday, 25 April

09:00-10:00	International Rice Germplasm Center	T.T. Chang (Principal Geneticist)
10:00-10:30	Data Base Development for IRGC	T.T. Chang K.A. Gomez
10:30-10:45	Coffee	
10:45-12:00	Multiple Cropping and Farming Systems Research	V.R. Carangal D.P. Garrity R.K. Pandey F.W. Penning deVries D.V. Seshu C.P. Mamaril
12:00-13:00	Lunch	
13:00-14:00	Crop and Resource Management:	
	Networks: IRTP (13:00-13:20)	D.V. Seshu M.A. Akbar
	ARFSN (13:20-13:40)	V.R. Carangal R.K. Pandey
	INSFFER (13:40-14:00)	C.P. Mamaril
14:00-15:30	Germplasm Improvement and Crop and Resource Management (cont.):	
	Entomology	B.M. Shepard (Entomologist)
15:30-15:45	Coffee	
15:45-16:45	Entomology (cont.)	J.A. Litsinger R.C. Saxena A. Jilani A.A. Kareem K. Benigno M. Rombach
16:45-17:45	Panel Review - Issues	
17:45	Depart for Guesthouse	
17:45-19:00	Open Bar. Informal discussions with the staff of the Germplasm Bank, Networks, and of Entomology	
19:00	Dinner	
20:00	Return from Guesthouse. Report writing	

Sunday, 26 April

	Germplasm Improvement and Crop and Resource Management (cont.):	
09:00-10:30	Plant Pathology	T.W. Mew (Plant Pathologist)
10:30-10:45	Coffee	
10:45-12:15	Plant Physiology	B.S. Vergara (Plant Physiologist)
12:15-12:45	Panel Review - Issues	
12:45-14:00	Lunch	
14:00-15:30	Soils	H.U. Neue (Soil Chemist)
15:30-15:45	Coffee	
15:45-17:15	Soil Microbiology and Biofertilizer Germplasm Bank	I. Watanabe (Soil Microbiologist)
17:15-17:45	Panel Review - Issues	
17:45	Informal discussions with Dr. M.S. Swaminathan and Dr. Lowell Hardin	

Monday, 27 April

	Germplasm Improvement and Crop and Resource Management (cont.):	
09:00-10:30	Plant Pathology	H. Hibino J.M. Bonman H. Leung S.W. Ahn P.S. Teng
10:30-10:45	Coffee	
10:45-11:45	Plant Physiology	S. Akita G. Wada F.W. Penning deVries
11:45-12:45	Soils	T. Woodhead P.R. Bloom
12:45-14:00	Lunch	
14:00-14:30	Panel Review - Issues	
14:30-15:30	Soil Microbiology	J.K. Ladha P.A. Roger

Monday, 27 April (cont.)

15:30-15:45	Coffee	
15:45-16:45	Cereal Chemistry/Pestide Residues Laboratory	B.O. Juliano (Chemist)
16:45-17:45	Depart for Guesthouse	
17:45-19:00	Open Bar. Informal discussions with the staff of Plant Pathology, Plant Physiology, Soils, Soil Chemistry, and Soil Microbiology	
19:00-20:00	Dinner	
20:00	Return from Guesthouse. Report writing	

Tuesday, 28 April

09:00-10:30	Crop and Resource Management (cont.):	
	Agricultural Engineering	A.U. Khan (Ag. Engineer) Y.W. Jeon (Assoc. Ag. Engineer)
10:30-10:45	Coffee	
10:45-12:45	Water Management	S.I. Bhuiyan (Ag. Engineer) G. Moridis (Assoc. Ag. Engineer)
12:15-12:45	Statistics and Data Management	K.A. Gomez (Statistician)
12:45-14:00	Lunch	
14:00-15:00	Computer Center	S.E. O'Connor
15:00-16:00	Germplasm Improvement	(continuation of discussion)
16:00-16:15	Coffee	
17:15-17:45	Panel Review - Issues	
17:45-19:00	Open Bar - Informal discussions with staff of Water Management, Computer Center and Statistics	
19:00-21:00	Reception cum dinner in honour of Drs. H.M. Beachell and G.S. Khush and the EMR and EPR Panels	

Wednesday, 29 April

09:00-10:00	Core-related cooperative and contracted research (Overview)	D.J. Greenland
10:00-10:30	Rice Crop Modelling	F.W. Penning deVries
10:30-10:45	Coffee	
10:45-12:00	Cooperative Country Programs	M.S. Swaminathan D.J. Greenland M.D. Pathak G.L. Denning
12:00-13:00	Lunch	
13:00-14:00	Library	L.M. Vergara (Librarian)
14:00-15:40	Communications and Publications	T.R. Hargrove (Editor)
15:30-15:45	Coffee	
15:45-17:15	Communications and Publications (cont.)	Editors I. Montagnes L.R. Pollard S.J. Banta W.H. Smith
17:15-17:45	Panel Review - Issues	
17:45	Depart for Guesthouse	
17:45-19:00	Open Bar. Informal discussions with core-related researchers, and with the staff of the Library, Communications and Publications	
19:00-20:00	Dinner	
20:00	Return from Guesthouse. Report writing	

Thursday, 30 April

Sir Ralph Riley, Dr. Kazi Badruddoza, and Dr. Lowell Hardin together visited in turn: Dr. Ramon V. Valmayor, Executive Director, Philippine Council for Agriculture and Resources Research Development; and Mr. Cesar C. Jesena, Jr., Deputy Director, Southeast Asian Regional Center for Graduate Study and Research in Agriculture.

Thursday, 30 April -
Sunday, 10 May

Panel was occupied with report writing, discussions and interacting with the EMR Panel. Further contact was made with IRRI scientists to clarify issues. Early drafts of the report were made available to IRRI senior management starting from 5 May.

Saturday, 9 May

14:00-15:00 Meeting with the Hon. Carlos Domingues, Secretary of Agriculture (Minister of Natural Resources before Cabinet reorganization) and Dr. Santiago Obien, Director of PhilRice

Sunday, 10 May - Monday, 11 May

The final version of the report was typed, duplicated, bound and distributed.

Tuesday, 12 May

13:50-15:30 Presentation of EPR and EMR Reports to the Board of Trustees, followed by discussion

15:45-18:00 Oral presentation of the EPR and EMR reports to senior management and scientific staff

Departure of Panel

OUTREACH STAFF

The Panel, while attending IRRI's Internal Review, took the opportunity of meeting the outreach staff posted to the following countries:

Bangladesh	Frank W. Sheppard, Jr.
Burma	Rosendo K. Palis
East/Central/ Southern Africa	K.G. Pillai
Egypt	Jack Swagerty
India	H.D. Catling B.P. Ghildyal
Indonesia	Jerry L. McIntosh Walter Tappan
Latin America	Federico Cuevas Manuel Rosero
Madagascar	James R. Hoopper B.B. Shahi
Thailand	D.W. Puckridge
West Africa	K. Alluri

ANNEX VI

GLOSSARY OF ACRONYMS

ADB	Asian Development Bank
ARFSN	Asian Rice Farming Systems Network
ASL	Analytical Services Laboratory
AVRDC	Asian Vegetable Research and Development Center
BRRI	Bangaldesh Rice Research Institute
CAAS	Chinese Academy of Agricultural Science
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CNRRI	China National Rice Research Institute
CRRI	Central Rice Research Institute
FAO	Food and Agriculture Organization of the United Nations
EMR	External Management Review
EPR	External Program Review
GEU	Genetic Evaluation and Utilization Program
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Agency for Technical Cooperation)
IBPGR	International Board for Plant Genetic Resources
IBSRAM	International Board for Soil Research and Management
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IFPPRI	International Food Policy Research Institute

IITA	International Institute of Tropical Agriculture
INSFFER	International Network on Soil Fertility and Fertilizer Evaluation for Rice
IPM	Integrated Pest Management
IRAT	Institut de Recherche Agronomique Tropicales et des Cultures Vivries
IRGC	International Rice Germplasm Center
IRRI	International Rice Research Institute
IRTIP	International Rice Testing and Improvement Program
IRTP	International Rice Testing Program
ISNAR	International Service for National Agricultural Research
ISSS	International Soil Science Society
MAF	Ministry of of Agriculture and Food (Philippines)
NBPGR	National Bureau of Plant Genetic Resources
NSSL	National Seed Storage Laboratory
PA's	Program Areas
PhilRice	Philippines Rice Research Institute
PRL	Pesticide Residue Laboratory
SPC	Strategic Planning Committee
TAC	Technical Advisory Committee
UNDP	United Nationals Development Program
UPLB	University of the Philippines, Los Banos
WARDA	West Africa Rice Development Association
WHO	World Health Organization
WIRFS	Women in Rice Farming System
WMO	World Meteorological Organization