CHAPTER 5

Irrigation Management for Crop Diversification: IIMI/IRRI Studies

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INTRODUCTION

IRRIGATION IS NORMALLY seen as a means of reducing risks associated with rainfall variability, extending potential growing seasons, and creating a wider range of cropping and farming choices. The degree to which one or more of the benefits is attained is dependent upon the availability of the basic water supply and the degree of control which can be exercised over its delivery.

Due to government policy initiatives to expand rice production, the primary objective of irrigation projects implemented since the mid-sixties in the humid tropical areas of Asia has been to provide a more reliable supplementary supply of water during the wet season for the cultivation of rice under wetland conditions. Even the reduced water supply during the dry season is used to grow an additional crop of rice on a more limited area. The heavy investment in irrigation has provided the controlled flooded water environment considered necessary to take advantage of the full potential of the new high yielding and early maturing rice varieties. However, the success in rice production which has enabled the attainment of self-sufficiency in a number of countries in Asia has also resulted in a reduction in the economic returns from irrigated rice lands.

Theoretically, there are at least three ways by which this problem could be addressed: by increasing the economic yield of rice, by increasing the area served by scarce water resources through more effective and efficient irrigation system management, and by introducing crops of higher value than rice into the irrigated rice farming systems. The Rockefeller Foundation provided a grant, effective 1 July 1987, to the International Irrigation Management Institute (IIMI) and the International Rice Research Institute (IRRI) for the two international institutes, with their complementary strengths, to conduct a joint study of the three options. IRRI clearly has an interest in the first option. The second is part of IIMI's mandate to improve irrigation system management. Both institutes are concerned with the third option of getting higher economic and more equitable social returns from the water and its associated land. In addressing the three options, the Project attempts to look at the problem from a comprehensive point of view to include agronomic, socioeconomic and institutional issues related to rice and nonrice crops in irrigated rice-based farming systems.

This tri-country collaborative Project has been conducted in Bangladesh, Indonesia, and the Philippines which are all in the humid tropics of Asia. The six broad objectives of the Project are:

- To characterize the factors influencing the options for changes in rice-based farming systems, and to identify the more important options in selected geographic locations.
- To determine the degree to which different levels of irrigation system performance influence the ability to incorporate changes in the farming systems effectively.
- To develop efficient and economical methods for managing irrigation water delivery and the use of post-rice residual water for rice-based systems in which nonrice crops are grown, with special reference to the implications for agronomic practice and for institutional performance and change.
- To transmit and interpret the research findings to agricultural and irrigation system managers, planners, and policymakers to encourage informed and better decision making.
- To enhance the development of trained professionals in the area of irrigation problems through the provision of graduate research opportunities.
- To provide an opportunity for IRRI and IIMI staff to interact in a variety of collaborative activities permitting the development of an effective and mutually supportive long-term relationship.

The initial activities consisted of discussions at IRRI, in April 1987, among scientists and administrators from both institutions. These were followed by consultation meetings in early October 1987 with national agencies in the Philippines and Indonesia. Because of the unstable political situation in Bangladesh, only limited consultation could take place there in late January 1988. In all three countries, scientific staff from IIMI and IRRI met jointly with officers of appropriate national agencies and universities to identify the research areas and strategy for the Project's implementation.

PROJECT IMPLEMENTATION PROCESS

While the broad project objectives were defined early on, the different implementing activities in the identification of problem areas, the selection of research sites, and the various modes of interaction between the two institutes and national agencies had to be done on a country to country basis. The process adopted was guided by the following agreed set of principles:

- Collaborative activity should be concentrated on problems of mutual concern to the two institutions.
- The activity should capitalize on the complementary strengths of the two institutions. These strengths include disciplinary expertise as well as geographical (national) experience, contacts, and logistic capabilities.
- The expected output should be greater and/or "better" than the efforts of the institutions working separately.

- The problems and opportunities addressed should be of significant scope, i.e., the potential practical impact should be large.
- Detailed planning of specific activities should be programmed to permit effective input from staff of the appropriate agencies in the countries in which the work would be carried out.

Setting Country Specific Objectives

Bangladesh

Full details of the Bangladesh component of the IIMI/IRRI collaborative project are covered in the following Chapter 6 ("Studies on Rice-Based Irrigation Systems Management in Bangladesh," Donald E. Parker). Only the work in Indonesia and the Philippines will therefore be discussed in this chapter.

Indonesia

In Indonesia, planning meetings held in June and October of 1987 and March 1988 involved IIMI, IRRI, the Directorate General for Water Resources Development (DGWRD), the Agency for Agricultural Research and Development (AARD) and the University of Gadjah Mada (UGM). The research activities of the Project and the detailed workplan for each of the collaborative institutions were determined during a workshop held at Cirebon, West Java, in June 1988.

The primary objective of the Project in Indonesia is to develop and test irrigation system management strategies that take into account variations in the physical environment, crop management, water availability, and farmers' crop decision making. Current irrigation system management practices, largely based on the *pasten* system or derivatives thereof, already respond to certain aspects of demand and supply but are relatively insensitive to variations in physical conditions. Through the Irrigation Committee, a seasonal cropping plan is drawn up based on previous experience, but it is clear that there are significant deviations from this plan during each season. Biweekly estimates of planted area and average water demand are obtained and compared with estimates of water availability during the same time period. As long as supply exceeds demand, the systems operate largely on a continuous flow basis to all parts of the irrigated area, leaving farmers to make local adjustments where needed. When supplies are inadequate, rotational irrigation is implemented between tertiary blocks along a secondary canal and, under more severe conditions, between secondary canals.

For the irrigation management system to be effective, two different time frames should be taken into account: within season system operation and seasonal planning.

Within Season System Operation: Initially, research was concentrated on responses to existing irrigation management practices before moving on to innovations later in the Project. The following specific objectives were identified:

- To determine optimal rotational irrigation schedules to be adopted when water supplies are inadequate to meet demand through continuous and simultaneous deliveries to all tertiary blocks. The institutional arrangements and supporting information flows required to implement alternative water delivery practices, including modifications to rotational irrigation, will be evaluated.
- To evaluate the relationships between irrigation system operation and groundwater fluctuations that may be detrimental or beneficial to nonrice crops, and to develop methods for the productive use of residual soil moisture and the prevention of overirrigation during periods of abundant water supply that may lead to an untoward buildup of groundwater that may in turn inhibit cultivation of nonrice crops in subsequent seasons.

Annual Planning of Irrigation Schedules: Since the annual Crop Plan involves several components relating to the assessment of water supplies that are based on ten-year moving records — soil and crop water demand, allocation of cropping patterns within the system, and the development of a set of operational plans to accommodate variations in both supply and demand — the following objectives were addressed:

- To develop methods of better assessing water availability, from both rainfall and rivers throughout the year, with particular emphasis on simple methods of predicting the periodicity and intensity of water deficit during the dry season.
- To obtain better estimations of probable cropping decisions made annually by farmers that can be integrated into seasonal cropping plans, to evaluate cropping choices of farmers and assess the constraints on cropping practices or crop establishment, and to develop alternative cropping patterns that better suit variations in physical conditions.
- To improve procedures for dry-season allocation of areas to be irrigated and the crops to be grown, based on predictions of water availability at system level and on assessments of field-level demand.
- To develop plans for operationalizing system management under the Annual Plan and to accommodate anticipated demand and probable water supplies to the system, including assessment of the capability of the system to accommodate alternative rotational irrigation practices.
- To propose modifications of the annual and seasonal planning processes that incorporate more site-specific information including feedback from performance in previous seasons.

The Philippines

In the Philippines, consultation meetings were held in October 1987 with the National Irrigation Administration (NIA), the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), the University of the

Philippines at Los Banos (UPLB), the Central Luzon State University (CLSU), the Bureau of Soils and Water Management (BSWM), the Bureau of Agricultural Research (BAR) and the Philippine Rice Research Institute (PhilRice). It was decided that IIMI and IRRI, either separately or together, should take major responsibility for developing and facilitating research with collaborating national agencies in the following areas:

- Documentation and analysis of the management procedures of irrigation systems with rice-based cropping (IIMI). The analysis should include an assessment of factors that influence the management and decision-making process of systems managers, central office staff and farmers, as well as policymakers. The analysis should also focus on the changes that may have to be introduced in the systems designed for the monocropping of rice.
- Assessment of the physical characteristics and design of an irrigation system with regard to its suitability for rice-based farming systems, with the possibility of introducing modifications in the present design to support mixed cropping (IIMI/IRRI).
- Exploration of strategies and recommendations for irrigation managers, farmers, and policymakers on how to manage irrigation systems for crop diversification efficiently and effectively (IIMI/IRRI). These include water resource augmentation to extend the dry-season irrigated area in different types of systems, and opportunities for alternative water allocation to establish higher efficiency of water use and greater equity among farmers (rice and nonrice). The results will help to formulate policy recommendations that will support the government's effort in both maintaining self-sufficiency in rice and enhancing farmers' income through crop diversification.
- Identification of the physical infrastructural requirements for effective water control at the farm level to support mixed cropping after wet-season rice and the methods for their optimal use (IRRI).
- Determination and analysis of the factors influencing farmers' decision making in crop selection and management during the dry season within the context of the household socioeconomic situation (IRRI). Factors such as water supply, soil type, farm location, profitability of various crops, availability of off-farm employment, input supply, credit availability, markets, and irrigation service fees for different crops will be investigated.
- Assessment of the status and behavior of dry-season groundwater regimes in nonirrigated areas, particularly in areas adjacent to irrigated rice (IRRI/IIMI). The problems and opportunities that these regimes present for the production of nonrice crops should be evaluated. Soil and crop management and irrigation inputs that can maximize the benefits of both matric and groundwater reserves for nonrice crops should be identified.
- Assessment of drainage options for rice and upland crops under different hydropedological, topographical, and local cropping environments, and their implications for system design and management (IRRI/IIMI). Benefits and costs of investments in drainage facilities should also be addressed.

Research Site Selection

The selection of research sites was greatly influenced by ongoing research conducted by IIMI and/or IRRI in each of the three countries.

In Bangladesh, the research sites chosen initially were the Ganges-Kabodak lift-cum-gravity irrigation system and the North Bangladesh deep tubewells where IRRI has been conducting collaborative research for a number of years with the Bangladesh Water Development Board and the Bangladesh Rice Research Institute. Later, Bangladesh Agricultural Development Corporation deep tubewells in Rajshahi constructed with Grameen Bank participation were added. While the IRRI research has resulted in some significant improvements in the management of irrigation water in the two earlier systems as well as in the crop production practices of farmers, the present Project is conceived to enhance the process of internalizing the available results and to generate relevant new information in support of the Project's objectives.

In Indonesia, two sites were chosen in Cirebon, West Java where IIMI has been conducting research because of their proximity to the Sukamandi Research Institute for Food Crops of AARD. The bulk of the fieldwork is done in the Maneungteung Irrigation System which is a run-of-the river diversion. The second diversion system is at Ciwaringin. Because of its past research activities there, IIMI has established a good database in irrigation management activities at these two sites. Eleven separate studies were conducted in Indonesia.

In the Philippines, the research sites chosen, all in Luzon, are the same systems where IIMI conducted studies on irrigation management for crop diversification with funding from the Asian Development Bank. These are the Upper Talavera River Irrigation System (UTRIS), the Laoag-Vintar River Irrigation System (LVRIS), and the San Fabian River Irrigation System (SFRIS), which are all run-of-the river diversion types. Three other sites are used by IRRI to conduct parallel component studies. Most of the work by both IIMI and IRRI is done in UTRIS where IRRI has had even a longer research presence. Eleven separate studies were conducted in the Philippines.

Professional Development

The Project provided opportunities for graduate research fellowships/scholarships (4-Indonesia, 7-Philippines), attendance in relevant training programs (24-Bangladesh, 3-Indonesia, 19-Philippines), and study tours and conferences for national staff (8-Bangladesh). Active participation in actual research by irrigation, agricultural, and research agency staff has contributed to their gaining on-the-job training experience. One senior staff member in the Philippines and another in Bangladesh were seconded to assist in the day-to-day coordination of the Project and to conduct their own research for their further professional development.

Activities in 1990

With the Project due for completion by the end of 1990, final national workshops were held from 13 to 14 June in Yogyakarta, Java, Indonesia, and from 10 to 12 September in Los Banos, Laguna, in the Philippines, to disseminate and receive feedback on the research findings. In Bangladesh, a workshop scheduled for 23-24 September 1990 could not take place because the necessary government permit was not obtained.

As a final activity, an intercountry workshop was held between 12 and 14 November in Colombo to review and integrate research findings in each country and across the three countries, and to deliberate on the recommended course(s) of future action.

FINDINGS: A SYNTHESIS

The intercountry workshop was able to produce a consensus on an integrated set of findings, recommendations, and the future course of action. These were categorized into: a) Main irrigation system management for rice-based farming systems; b) Farm-level water management for rice-based farming systems; c) Economics and institutional issues in irrigated rice-based farming systems; and d) Critical issues discussed. The following questions were used as a guide in sorting out the findings and recommendations from the Project:

- What are the factors that influence the options for changes in rice-based farming systems?
- What are these options and how do the different factors affect them?
- What are the implications of these changes on irrigation management, at system and farm levels?
- How could these implications be addressed? What recommendations are already utilizable? Is there a need for further research? What should be done next?

Main irrigation system management. Some background issues were considered, such as the differences in the type of irrigation systems used as research sites (large gravity direct diversions in the Philippines and Indonesia, and lift and deep tubewell systems in Bangladesh). It was recognized that there were lessons that could be learned from drier environments (e.g., Egypt, Morocco, Pakistan) where diversification is widespread and where management issues may be simpler or better understood. It was also recognized that the main issue is the irrigation agency's ability to respond, in terms of water allocation and delivery in the main system, to diversification once the external environment is encouraging farmers to do so. It was agreed that changes should be introduced in the planning, implementation, monitoring, and evaluation procedures being followed by the irrigation agency.

With regard to water distribution, reliability of timing may be more important than trying to meet adequacy. Rotational irrigation in some form is almost inevitable because of the risk of overirrigation and the need to maintain the hydraulic head, and because rationing by time is easier than rationing by discharge.

Irrigation systems that are properly designed and constructed for implementing irrigation for wet-season rice, and that can meet the land-soaking and land preparation requirements, do have sufficient canal capacity for irrigating nonrice crops, although the need for greater canal water regulation is apparent.

Rotation plans should be known by all concerned. Irrigation system managers should have different plans for different levels of water deficit. The level of rotation at different levels of the irrigation system, depending upon the nature and severity of the water shortage, needs further rationalizing to improve reliability and equity. It was clear that the development of new rotational plans is a gradual process involving negotiation and testing. The selection of alternative rotation plans is a contract between the irrigation agency and the farmers. The activities should be based on suitability for farmers (time of delivery/nondelivery), manageability by agency (staff, number of gates, etc.), and technical feasibility (conveyance capacity, cross-regulation provision).

There should be an early warning in case of a change in the rotational plan, and this should be done through a concerted effort to maintain communication between the agency staff and the farmers.

The information management required should include the monitoring of the dynamic situation at the intake (available river flow and diverted flow to the system), and the overall implementation of the plan. Regular meetings between the irrigation staff and farmers or their representatives during the implementation of the plan should serve as a means for monitoring the operations of the system. The meetings could provide the feedback mechanism needed to make the schedule more realistic and to settle conflicts in water distribution.

The involvement and participation of farmers as early as the planning stage (annual seasonal planning) is implied, and should be institutionalized to minimize problems during implementation. The active participation of farmers in decision making and in managing the system increases their awareness of the system's capabilities and helps them to understand the plan and the reasons for actions taken.

The objectives of the plan (in terms of production, equity, sustainability, etc.) should be clear to all concerned and need to be translated into clear operation rules.

Water availability prediction must be accurate. If available water is below the demand, rotation between years (i.e., 2-3 year planning cycle rather than 1 year) may be appropriate.

Farm-level water management. There are many factors influencing the options for changes in rice-based farming systems, and these include availability of adequate water, land suitability, climatic condition, availability of management technology, time constraint caused by the presence of rice crop, farmers' preferences, resource base, influence of neighboring farmers or extension agents, and land tenure status. Income stability, however, was identified as the major consideration that influences the farmers' decision whether or not to diversify.

In responding to the changes, it is implied that farmers must assume greater responsibility in water sharing to bring about the desired changes in water management. Some checking facilities may have to be added to provide the hydraulic head

required at certain points, in order to implement the flush basin flooding method for irrigating a number of crops such as onions, tobacco, etc. Additional facilities are needed during the dry season, in the form of extra field channels to facilitate the distribution, application, and removal of excess water for nonrice crops. The resulting density of the field channels can be more than three times that presently retained for rice cultivation during the wet season.

The use of groundwater to supplement canal supplies in the dry season was significant and economically attractive in both the Indonesian and the Philippine sites. The same result is expected in similar groundwater use for rabi (dry) season cropping in the Ganges-Kobadak Irrigation System area in Bangladesh (see Chapter 6).

The use of residual soil water is significant in Bangladesh for growing wheat, onion, garlic and legumes after the aman (wet) season in the Ganges-Kobadak Irrigation System (Bangladesh) area. While the potential is present in Indonesia and the Philippines, the use of residual soil moisture, especially for mungbean, has not been systematically documented.

The challenge of managing a high water table, resulting from seepage from adjacent unlined canals and surrounding fields, has been addressed in the Upper Talavera Irrigation System (UTRIS) site in the Philippines. A properly designed interception-cum-drainage channel was established around and across the average-sized fields to convert an unsuitable area to produce maize of 7.3 tons/ha, compared with 3.3 tons/ha in the control area.

It was found that a cropping pattern of rice-mungbean-maize, replacing rice-rice-nonrice, has higher productivity than rice-maize-mungbean for systems without adequate irrigation. In Bangladesh, green manure-rice-legume is recommended to replace rice-rice.

Optimal yields for nonrice crops are obtained if soil moisture depletion is not allowed to go beyond 40 percent of the available soil moisture.

Economics and institutional issues in irrigated rice-based farming systems. Different cropping options that the farmers may consider during the dry season were identified. These include leaving the land fallow, planting only nonrice crops, growing combinations of nonrice crops or rice and nonrice crops, and planting a dry-season rice crop. These options are influenced by a variety of factors such as crop scheduling/timing, tenural status, prices of inputs, product (market) prices, land suitability, drainage constraints, farmer experience/attitudes, agency staff skills, labor/farm power, farmers' ability to control water, access to technology, government policies, and the presence of residual soil moisture.

The implications of changes in irrigation management, as earlier indicated, include the need for better coordination among farmers, between farmers and agency staff, and among agency staff to increase the reliability of irrigation delivery. The conjunctive use of surface water and groundwater needs to be enhanced, and information on drainage should be considered.

These implications could be addressed through a pilot testing of management changes and an assessment of successful cases. These would involve the agency, farmers, and researchers interacting to fine-tune management procedures in the

internalization process while the participation of the researchers is gradually phased out. The budget implications of the new management changes need to be assessed.

Critical issues discussed. Irrigation service fees: Policies on irrigation service fees should be reviewed in relation to the differences in managing the system for rice versus nonrice crops. Consideration should be given to farmers who use water more efficiently, or who practice water conservation measures such as mulching and water augmentation. It was suggested, however, that the review might also look at strategies to encourage farmers to pay irrigation fees.

Tenural status: The status of land tenure has implications for farmers' attitudes towards improving land productivity. Not owning the land appears to deter farmers from using the recommended technologies in their farms. Landlord-tenant arrangements also cloud the issues of membership in Irrigators' Associations and payment of irrigation service fees. Is the landlord or the tenant responsible? Similar confusion will arise over improving land productivity through crop diversification.

Farmers' decision to diversify: As the report indicates, several factors influence the decision of the farmers to plant rice or nonrice crops, and some degree of flexibility is needed. However, this flexibility should take into account not only the farmer's own advantage but also the effects on other farmers and the flexibility of the irrigation system itself. It may be necessary for the irrigation agency and other support services to be ready with options that match the requirement of not individual farmers but of a group of farmers. The agency should also have some kind of mechanism to influence the farmers.

Farmer organizations: Organizing farmers is not an absolute necessity for effective irrigation management. In Pakistan, the farmers use the water as they see fit. However, this cannot happen in the Philippines, Indonesia or Bangladesh, where farmers have no fixed water rights. Here, responsibility needs to be shared between the farmers and the agency. The specific sociopolitical situations must be taken into account.

PLANS FOR THE IMMEDIATE FUTURE

The preparation and publication of the national and the intercountry workshops proceedings will be done during the first half of 1991. An end-of-project report will also be prepared.

Outstanding or unresolved issues such as the following may be addressed in future research:

- Is the design of the irrigation system with flexibility for crop diversification more complex?
- How can assessments of available water supply and water demand be improved to match the demand under diversified cropping conditions?
- Should the government become directly involved through such mechanisms as crop plans?
- How should the agency and farmers cope with different soils/drainage environments, considering zoning and water requirements?

- For both rice and nonrice production, how should better techniques be developed for improving water use efficiency and productivity?

RECOMMENDATIONS FOR FUTURE ACTION/RESEARCH

The various papers presented, the reports of the workshop groups, and the discussions throughout the workshop all highlighted one point — the Project may be completed but much remains to be done. Useful information and technologies have emerged and these are expected to enhance irrigation management. The participants strongly felt that these should be further evaluated through some kind of piloting activity. It is anticipated that a gradual internalization process will be needed for the impact of the recommended innovations to be really felt.

An action plan is needed to put the findings into operation. Stronger and more active participation by the irrigation agencies and the farmers is envisioned. Other agencies involved in agriculture (from production to marketing) should also be included. The involvement of the research group will become less and less as the recommendations are adopted and institutionalized.

Research is a dynamic process, and the Project has provided ideas and areas for further research. The question of drainage, in particular, requires further study, as the provision of basic drainage facilities is essential, especially for upland crops. Farmers' motivation to participate in irrigation management should be studied more deeply than the need to form associations. The agency-farmer relationship is a necessary part of diversification, and it still has a long way to go. A measure of reliability in water delivery is also important for crop diversity, and this remains to be developed. Market forces and postharvest facilities should also be given due consideration.

In implementing these recommendations, the role that IIMI and IRRI have to play is still apparent. Collaboration between agencies has proved to be very positive, and this should be sustained. Other agencies have been suggested as potential participants, particularly in the piloting activity. Interested donors should also be identified.

Research Network on Irrigation Management for Crop Diversification (IMCD)

DURING ITS THREE years of activities, the tri-country IIMI/IIRI collaborative Project has addressed important and comprehensive issues of irrigation management for nonrice crops in rice-based systems. The next step is to evolve strategies to operationalize the recommendations that have come out of the present findings, and to disseminate the information as widely as possible to irrigation and agricultural agency officials. The research network on Irrigation Management for Crop Diversification (IMCD), organized on IIMI's initiative, will be very useful for this purpose.

The idea of forming this network was approved in principle by the participants in a regional workshop on irrigation management for crop diversification organized by IIMI in Sri Lanka in November 1986. Eight countries had already signified their interest in joining the Network - namely Bangladesh, India, Indonesia, Nepal, Malaysia, the Philippines, Thailand, and Sri Lanka. The planning and organization of the Network took place later during an ADB-funded workshop held in early December 1988 in Bangkok. The Network links researchers, irrigation and agricultural agency officials, and others concerned with irrigation management for crop diversification. With financial assistance from the Government of Japan, the Network attempts to serve as a mechanism for research and information exchange in:

* Comparing differences and similarities in national objectives concerning irrigated crop diversification in rice-based farming systems.
* Determining existing irrigation management technologies for nonrice crops at the main system, tertiary system, and farm levels.
* Identifying technical, institutional, and economic potentials for diversified cropping in general, and for selected crops in each country or region under irrigated conditions.
* Determining and evaluating alternative practices and technologies to match national objectives and goals.

A Steering Committee, consisting of selected representatives from each of the eight countries and IIMI, oversees the operations of the Network. The elected Committee Chairman, with the heads of the subcommittees on research and development, information and dissemination, and funding, presents for the committee's review and approval, the program of the activities for the year. IIMI provides the secretarial support.

The inaugural meeting of the Steering Committee was hosted by the Department of Irrigation and Drainage (Malaysia) in Kuala Lumpur in 1989, and it paved the way for putting into operation the objectives of the network as agreed during the 1988 Bangkok workshop. The subcommittees on research and development, information and dissemination, and funding presented their respective programs of activities for 1990.

The maiden issue of the IMCD Newsletter came out in August 1990. The Newsletter will be published annually to facilitate information exchange and dissemination on the subject of the Network. It is intended as a forum for Network members to exchange experiences, views, news of new publications, workshops, etc., as well as for publishing short abstracts of relevant research. The first issue featured highlights of the committee meeting in Kuala Lumpur, and such ongoing projects as the Crop Diversification Project for Non-Granary Irrigated Areas in Malaysia, the NIA Diversified Crops Irrigation Engineering Project and the IIMI-IRRI Collaborative Project.

The formation of national committees such as the National Committee on Crop Diversification (NCCD) in the Philippines, is being catalyzed to link up with the Network. The memorandum of agreement binding five national departments was signed recently.

The Network's activities in 1990 culminated in its first annual review and coordination workshop during 10-14 December in Manila, under the theme of "Management Arrangements for Accommodating Nonrice Crops in Rice-based Systems."

FUTURE PLANS

Future plans include the holding of the second annual review and coordination workshop in Indonesia. The venues for subsequent meetings will rotate among the network countries to give the participants a chance to visit and observe the activities in each country. Publication of the second volume of the IMCD News and the Proceedings of the December 1990 Manila workshop is planned. The formation of parallel national committees on crop diversification, similar to the NCCD in the Philippines, will be promoted in the other member countries. It is expected that one will be formed in Bangladesh soon.

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