TECHNICAL ASSISTANCE FOR IRRIGATION MANAGEMENT FOR DIVERSIFIED CROPS IN THE PHILIPPINES: A PROPOSAL TO THE ASIAN DEVELOPMENT BANK

INTERNATIONAL IRRIGATION MANAGEMENT INSTITUTE
Digana Village via **Kandy.** Sri **Lanka**

September 1986

International Irrigation Management Institute

Digana Village via Kandy, Sri Lanka

PROPOSAL TO THE ASIAN DEVELOPMENT BANK

FOR

TECHNICAL ASSISTANCE FOR

IRRIGATION MANAGEMENT FOR DIVERSIFIED CROPS

IN THE PHILIPPINES

Phase II Study

I. INTRODUCTION

Background

1. The IRRI-IFPRI Study[1] on food demand and supply for Developing Member Countries, using the Philippines as a case study, concluded that the Philippines has comparative advantiige in producing both irrigated rice and irrigated diversified (non-rice) crops. A second phase of the study is now underway to further refine strategies for agricultural development for the Philippines and to assist in the formulation of plans to attain optimum productivity in rice, corn and othor crops in the different regions of the country. The analysis will include the development of regional agricultural development strategies, estimating levels of investment for alternative irrigation options, assessing the possibilities for crop diversification, and recommending appropriate agricultural and irrigation policies for the country.

---

[1] The International Rice Research Institute (IRRI) and the International Food Policy Research Institute (IFPRI) jointly conducted a regional survey of 20 developing member countries. The survey, financed by the Asian Development Bank (ADB), was entitled "Study on Food Demand and Supply and Related Strategies for DMCs: Regional Technical Assistance No. 5116, Phase I

2. An important aspect of the second IFPRI-IRRI study is to assess the technical and socio-economic constraints to irrigated crop diversification. A Technical Assistance (TA 654-PHI) was granted by the Asian Development Bank (ADB) to the Government of the Republic of the Philippines for this purpose. This TA entitled "Study on Irrigation Hanagement for Crop Diversification" is being implemented by the International Irrigation Hanagement Institute (IIHI) since February 1985. The IIHI study is designed to provide detailed information about the prospects of diversified cropping under irrigated conditions.

3. The IINI study (hereafter referred to as the Phase I Study) examined: (1) constraints to crop diversification, with special attention to the irrigation constraint; *(2)* way!; in which the management of irrigation systems, particularly their operation and maintenance (O&M), can overcome these constraints and thereby promote crop diversification; **(3)** preliminary agronomic and economic comparisons of different irrigation management alternatives with various crops; (4) assessment of O&M institution-building requirements resulting from crop diversification, and *(5)* required follow-up actions.

4. The results of the IIHI Phase I Study have been compiled in a Draft Final Report and are briefly summarized below. **(See** Annex 1 for the Executive Summary of the Draft Final Report from this Study). The results from the Second Phase IFPRI-IRRI study are not yet available in published form, but the preliminary findings have not supported the earlier conclusions which strongly supported irrigated crop diversification in the Philippines.

5. In short, the prospects for efficient and profitable production of irrigated crops other than rice remains highly questionable in the Philippines. Technical (in respect of both agricultural and irrigation technologies), economic, and institutional factors affecting the performance of irrigated non-rice crops are no'; yet adequately understood to permit definitive assessment of future cropping trends. The Phase I Study utilized field studies to examine the more important of these issues in depth.

Results and Assessments of the IIMI Phase I Study

6. Irrigation water management. The study showed that to effectively irrigate diversified crops, large canal capacities are needed, particularly in areas of sandy soils. Existing rice gravity systems designed for rice can accommodate these large and intermittent demands by extending the duration of water delivery periods, but only if appropriate control of water deliveries is maintained.

7. On-farm irrigation facilities built for rice require modifications to provide the proper water regime for diversified crops. Continuous flows of irrigation, the norm for rice, result in water-logged conditions which harm the prospects of non-rice crops. Irrigation of diversified crops require scheduled water deliveries on an intermittent basis and an intensive system of field channels and drains. On-farm irrigation methods involve basin flooding in **some** cases and furrow irrigation in others.

8. Agronomic practices for irrigated diversified crops. Timing of cultivation for diversified crops is particularly important. In areas where there is dry season rainfall, most diversified crops can be grown inexpensively without irrigation. Two major problems remain unanswered: how to irrigate without saturating the soil around the crops, and how best to convert the soil from puddled condition in the wet season when rice is grown, to a well-structured and aerated condition for diversified crops in the dry season, and vice versa.

9. Economic and institutional aspects of irrigating diversified crops. Unstable prices and high input costs of non-rice crops discourage farmers from adopting irrigated diversified cropping. Expectations of profitability is one of the foremost considerations of farmers in making their cropping decisions. Prices for most diversified crops are normally less stable and often at lower levels at the farm level. Where prices are stable and at profitable levels, there is clear evidence that diversified cropping can be achieved under irrigation.

10. Improved market prospects for diversified crops will result from, among others, better market structure, more post-harvest facilities, and other indirect incentives such as reduced costs of production. One important cost item is that of the irrigation fee, which is normally the same for rice and other crops.

11. Close communication between the farmers and the operators of irrigation systems is critically important in the case of diversified crops because of the intermittent nature of irrigation for those crops. New organizational forms such as joint management between farmers and system authorities may be necessary to fully utilize the irrigation potential.

Rationale for a Phase II Study

12. The results of the initial study showed that there are important technical and socio-economic aspects to irrigation management for diversified cropping which are not understood, and which exert a profound effect on tne profitability of cultivation and the return on investment in irrigation. Several constraints to successful diversified cropping in irrigated areas were identified, together with suggested ways to relax those constraints.

13. These results must be considered preliminary, however, due to the limited study period (22 months and only one dry season) during which the study was oonducted. This period was understood at the outset as sufficient only to open up the issues for further study with sharper focus, and to establish administrative and substantive relationships at several field sites which could lead to conclusive results over a longer period. To capitalize on the investment in the phase-one project, a more detailed study is needed.

14. The Study Advisory Committee (SRC), comprising representatives of three Philippine Government agencies, the Bank and IIMI, strongly endorsed the extension or second phase of the study at its 13 August 1986 meeting. To

ensure that the study contribute tc the larger goals of agricultural productivity in irrigated areas of the Philippines, the Committee recommended that priority be given to the extension of studies on (1) managing the main and distribution network of irrigation systems, (2) on-farm irrigation methods and facilities, (3) agronomic practioes, and (4) economic and institutional aspects of irrigated crop diversification.

II. CONCEPTS AND OBJECTIVES FOR THE PHASE II STUDY

15. The Phase II study is proposed as an extension of IIMI's initial work on irrigation management for crop diversification in the Philippines (TA 654 PHI).

Concepts

16. It is not the purpose of the proposed study to promote a major shift in cropping pattern from irrigated rice to other crops. Such shifts, when they occur, are responses to a range of factors such as relative prices, national policies, and technologicrl innovations, and not LO field studies of limited scope.

17. It is clear, however, that. many Philippine farmers are producing non-rice crops in the command of irrigation systems and with highly variable results. Reasons for successful or unsuccessful cultivation are not well understood either by irrigation or agriculture officers, nor sometimes by the farmers themselves. Practical guidelines for farmers, extension agents and irrigation staff to grow non-rice crops more successfully through irrigation simply do not exist. It is the broad purpose of this proposed study to generate some of the more important of these guidelines.

18. Virtually all public irrigation systems in the Philippines were designed, built and operated for lowland rice in the wet season. The great majority of the irrigated area is supplied from run-of-the-river barrages on streams and rivers. These systems provide quite stable sources of water during the wet season, but essentially none of them has enough water to irrigate rice throughout the full command in the dry season. Typically, the limited water available in the dry season is used to irrigate rice on a small part of the command of each system.

19. During the past twenty years technological change has resulted in a gradual increase in the value of irrigation in the dry season. The main reason for this shift is the sdoption of modern rice varieties whose yield potential is much higher in the dry season than in the wet. The economic viability of farming and of investments in irrigation systems is increasingly dependent upon dry-season cultivation.

20. Competition for the limited supply of dry-season water has increased greatly as a result. Because it takes almost twice as much water per ha to grow rice in the dry season as in the wet, the systems do not have adequate canal capacities to deliver the full dry-season water requirement for rice even to the limited areas planted in the dry season. Head-end farmers take whatever measures they can to appropriate more water to their fields. This system of irrigation is characterized by disorder, inefficiency and inequity.

21. Other sources of inequity stem from variable soil conditions. Irrigation commands comprise areas ranging from coarse river-levy soils to heavy clay backswamps, often within a few hundred meters. The coarser soils are usually located near the source of water where dry-season farming is concentrated. The result is that farmers attempt to grow rice on the areas least well suited for that crop. Ihese areas require much larger rates of water supply than the system is designed to carry because of the high seepage losses from such light soils. It has been estimated that some irrigation systems supply over 60 percent of their total water to only 15 percent of their commands for this reason.

22. Farmers have begun trying to grow crops other than rice on such soils in the dry season. Where successful, they have made possible a large increase in the area irrigated because those crops use less water for crop growth and less for seepage than does rice. Experience, however, has been generally disappointing. Conflict!; between rice and non-rice farmers result in too much water for non-rice crops. Markets do not exist to absorb the product of most new crops. Farmer!; experience converting their lands from puddled soil condition to upland for the dry season, and back again for the wet season. In short, although irrigation of diversified crops requires less water than that for rice, it requires substantially greater management control over the water.

Objectives

23. The primary objective of this Proposal is to determine those irrigation practices most likely to enhance the cultivation of selected non-rice crops in limited parts of irrigation systems during the dry season, and to field-test the most promising of those practices in selected commands.

24. Associated objectives are to:

(1) Develop a criteria or methodology for identifying those parts of irrigated commands with comparative advantage for selected diversified crops;

(2) Compare the profitability of selected diversified crops under irrigated and rainfed conditions, and to compare their irrigated performance with that of irrigated rice;

(3) Determine the primary factors and their interaction which condition how farmers prepare land for irrigated rice in the wet season and for one or more diversifisd crops in the dry season,

(4) Develop on-farm irrigatior methods for at least one upland crop;

(5) Design and field-test operating procedures for publicly-managed portions of irrigation systems; and

(6) Recommend those policies likely to support more profitable farming practices and more profitable investment in irrigation development as related to diversified crops.

25. It is important to be clear what the study does not propose to do. It is not proposed to undertake varietal or agronomic trials of crops, nor to compare different diversified crops with the objective of finding optimum crops or cultivation practices. It is not proposed to undertake macro-economic analyses of market prospects for any crops. The study is not designed to carry out research on irrigation structures at either the system or on-farm levels. It is the objective of the proposal to develop and field-test practices which will make diversified cropping with irrigation more profitable, but it is Government's prerogative if it wishes, not IIMI's objective, to press rice-growing farmers to adopt them.

III. SELECTION OF FIELD SITES

26. The studies will be conducted at seven irrigation systems on Mindanao and Luzon Islands. A11 ttree systems selected in Mindanao were included in the Phase I Study. Some Phase I work was carried out in the Luzon systems too, but the Phase II proposal envisages an extension of the work to include both Mindanao and luzon with roughly equal weight.

On Mindanao Island:

(1) Allah River Irrigation Prcject (ARIP),

(2) Eanga River Irrigation System (BARIS), and

(3) Mani River Communal Irrigrtion System (MCIS);

On Luzon Island:

(1). Bustos-Pandi Pump Irrigation System (BPIS) or a similar pump system in Bulacan,

(2). Laoag-Vintar River Irrigation System (LVRIS),

(3). Upper Talavera River Irrigation System (Upper TRIS), and

(4). Tarlac-San Miguel-O'Donnel River Irrigation System (TASMORIS).

21. These systems provide a range of climatic and soil conditions representative of the two most important irrigated regions of the Philippines. Their selection was based on many factors including the availability of NIA field and counterpart staff who will assist in carrying out the studies.

IV. TERMS OF REFERENCE

28. The Study will be carried out according to these terms of reference, which follow closely the stated objectives above. The Study will:

(1). Determine for one system in Mindanao and one in Luzon those limited areas for which selected diversified crops are particularly well suited, taking into account the nature of the soils, topography, distribution system, rainfall, and other relevant factors. From this information a more generalized methodology for identifying such areas will be developed and field tested on one or more additional systems;

(2). Determine for each of the seven sample systems the dry-season yield levels, costs of production, gross returns, and net returns, taking into account actual and imputed labor costs, for (a) one or more irrigated diversified crops, (b) the same crop grown under nearby rainfed conditions, and (c) irrigated rice. Differential effects, if any, on the performance! of wet-season rice will be imputed. Costs will take due consideration of the cost and availability of credit, and prices received will take into consideration marketability of the crop(s). From this information a comparison will be made to place the economics of irrigated diversified cropping within the context of alternatives available to the farmer. For two of the systems, the results will be further analyzed according to different assumptions or data on the management of irrigation supplies;

(3). Determine for one Luzon system the primary factors and their interaction which condition how farmers prepare their land for a diversified crop following wet-season rice, and how they manage their land to prepare for wet season rice again, giving special attention to labor and power requirements for tillage, timeliness, moisture regimes, provision for field channels, and other relevant factors;

(4). [A]. Determine and field-test appropriate cost-effective irrigation methods at both the field level and system level in one system in Nindanao and one in Luzon, to find practical values for recommended (a) intervals between, (b) duration, and (c) stream size of irrigations. The field-level studies will give special attention to (a) extent and management of seepage from adjacent ricefields as a source of water for diversified crops, (b) basin flooding vs. different forms of furrow irrigation, (c) density and placement of on-farm channels and structures, and (d) means to communicate and relate between the on-farm and main-system practices. The systems-level studies will give special attention to cost-effective and manageable means of providing irrigation on an intermittent basis, keeping in mind the need to irrigate both rice and diversified crops from the same system;

[8]. Document and analyze current methods in use during the dry season for irrigating diversified crops in the five other sample systems, and analyze them for more general applicability; and

(5). Recommend appropriate irrigation management practices from the above, giving special attontion to associated institutional and management arrangements including (a) structure of irrigation service fee charges, (b) system staffing plan and staff training, (c) irrigation associations and their relation to publicly-managed systems, (d) adherence to a cropping schedule and group planting in selected areas, and (e) such other information and documentation as will be available to the project coordinator from the studies cr from other sources.

V. IMPLEMENTATION ARRANGEMENTS

29. The executing Agency for this Technical Assistance Phase II Study will be the International Irrigation Management Institute (IIMI). IIMI will carry out the studies in close collaboration with the National Irrigation Rdministration (NIA) which is the lead government agency, together with the Philippine Council for Agriculture and Resources Research and Development (PCARRD) and the Ministry of Agriculture and Food (MAF).

30. NIA will be the lead agency for the two irrigation projects and other irrigation systems in which the study sites will be located. NIA will also be the executing agency for agricultural development in ARIP, while for the others the NIA irrigation systems offices will be the cooperating agencies. MAF will also be a cooperating agency in respect of trials with vegetables. Studies involving crop production in all of the selected study sites will be carried out in close coordination with the lead research agencies of the PCARRD consortium. These agencies are the University of Southern Mindanao in Kabacan for ARIP, BARIS and MCIS; the University of the Philippines in Los Banos; the different state colleges and universities under the Central Luzon Agricultural Research Center in Munoz for the Upper TRIS and TASMORIS; and the Mariano Marcos State University in Batac for the Laoag-Vintar RIS. It is intended that the component studies be conducted in association with IIMI. The research studies in the Phase II Study will be included in the annual review and evaluation being conducted by PCARRD as part of its regular coordination of agricultural research projects. An organizational chart of the Phase II Study is illustrated in Annex 2.

31. The IIMI Coordinator for the Phase I Study or his replacement will direct and coordinate the Phase II Study Implementation. The IIMI local (Philippine) staff will continue to carry out on-site studies and data collection for each of the selected study sites. These include one Research Associate and four Research Assistants. Consultants and research assistants will be hired as needed to supplement this manpower. IIMI will provide a consulting Agricultural Economist at the international level to coordinate and provide guidance to the economic studies. Some research staff from the

cooperating agencies c universities belonging to the PCARRD network of research consortia wil be engaged as local consultants. To facilitate implementation, NIA wi 1 continue to provide site office accommodation and assistance in data col ection through its field personnel.

32. The Phase II Proposal is planned for a 29-month period commencing January, 1987. However, in order to cover 3 dry seasons within this period, data collection will begin in November 1986 which is the beginning of the dry season in most of the study sites.

VI. ACTIVITIES RND WORKPLAN

33. Some Phase II Activities will begin in November 1986, before the formal opening of the Phase II study, because the dry-season crop begins during that month at many of the study sites. See Annex 3 for a schedule of the Activities across the 29 months of the Study.

34. Assignment of manpower to the five Study Activities described in the Terms of Reference are proposed as follows, subject to possible modification.

Study Activity	Sites	Methodology	Manpower (man-months)			
			IIMI Proj Coord	IIMI Local Staff	IIMI HP Staff	Local Cons. Staff
1. Development of methodology to identify areas	1. ARIP 2. TASMORIS or SPIS	-- Conceptual work; -- Field measures; -- Photogrammetry.	4	36	1.5	2
2. Economics of diversified and rice crops.	A11 Sites	-- Interviews; -- Record-keeping; -- Limited crop-cuts.	2	15	2.0	8
3. Land management practices.	Upper TRIS or SPIS	-- Monitoring; -- Field measures.	4	20	0.5	6
4. Irrigation system practices.	A11 sites	-- Flow measurement; -- Field monitoring; -- Historical records; -- Field test (select).	9	144	2.5	6
5. Institutional arrangements & recommendations.	A11 sites	-- Interviews	5	17	1.5	6
Totals:			24	232	8.0	28

35. The Project Coordinator will spend a total of 24 months on the Study, all but five of them in the Philippines. Two months will be allocated to leave and three to Project-related work in Sri Lanka. The distribution of these months against the different Activities is approximate.

36. IIMI Headquarters or Headquarters-contracted Staff include all internationally-recruited Staff assigned to Project work. They will include engineers, economists, agricultural scientists, management staff and social scientists totalling eight months of time.

37. Local consultants associated with the Study will be as follows:

A. Univ. of Southern Mindanao (USM), for all Activities at ARIP, BARIS, and MCIS;

B. Central Luron State Univ. (CLSU), for all Activities at TASMORIS & BPIS;

C. Univ. of Phils. at Los Banos (UPLB) for Activities 2, 4 and 5 at TASMORIS and BPIS;

D. Mariano Marcos State Univ (MMSU) for all Activities at LVIS;

38. PCRRRD staff will collaborate with the Study at Sites and in Activities for which PCARRD has special interost. PCARRD and IIHI are signing a Memorandum of Agreement to facilitate this collaboration.

VIII. REPORTS

39. A first or initial progress review report will be presented by IIMI after 6 months, a second progress review report after 14 months, an interim report after 18 months, a workshop report after 22 months, a draft final report after 28 months, and a final report on completion of the 30-month period.

40. The first or initial progress review report will consist of the completed activities for the first dry season and proposed studies and plans for the next 12-month period.

41. The second progress review report will consists primarily of the completed activities and on-site evaluation report (February 1988) of the review mission from the Bank and other members of the SAC.

42. The interim report will include the accomplishments and adjustments (if any) of the Study after two dry seasons (June 1988). It will also provide the materials for the workshop scheduled for September 1988.

43. The workshop report will consolidate the results of the two dry seasons and assessment of data and information from studies conducted by other agencies relevant to irrigated crop diversification in the Philippines. The report is intended to be used in formulating recommendations and policy-oriented suggestions. It will also provide an opportunity for adjustments, if necessary, before carrying out the field-test activities during the last dry season.

44. The draft final report will consolidate all the accomplishments of the Study and document the results of the field tests.

VIII. COST ESTIHRTE AND BUDGET

Cost Estimate.

45. The cost of the proposed Phase II Study technical assistance is estimated at $410,000 of which 5350,000 will be financed by the Bank and $60,000 by IIHI (See Schedules 1-4). There will be no counterpart funding required from the Government; however, as noted above, NIA and HPF staff already employed at the project sites and in related research activities will assist and cooperate in the study and NIA will provide site office accommodation. These activities will not involve additional expenditure by the government.

46. Since there will be a two-month (November and December 1986) advance on start-up time in 1986 for the first dry season activities, IIMI will provide interim support during this period contingent upon the Phase II Proposal being funded beginning January 1987.

Schedule 1. Estimated budget for Phase II Study

I. Financed by the Bank:

		Year 1	Year 2	Year 3 (5 mo)	Total
1.	Salaries and allowances 1/	$92,000	99,000	39,000	230,000
2.	Local Travel	7,000	9,000	2,000	18,000
3.	International Travel	5,000	6,000	2,000	13,000
4.	Research Equipment	2,000	2,000	-	4,000
5.	Supplies & Services	6,000	7,000	3,000	16,000
6.	Contract Research	10,000	8,000	-	18,000
7.	Contingency (15%)	21,000	22,000	8,000	51,000
Total		143,000	153,000	54,000	350,000

II. Financed by IIMI:

1.	full support during November 1986 - January 1987	$40,000
2.	Workshop up to	20,000
Total		60,000
Grand Total		5410,000

1/ Includes salaries of Project Coordinator, Consultants, Local Staff and associated costs.

Schedule 2. Estimate of Phase II Study Staff Time

		Year 1	Year 2	Year 3 (5 mo)	Total
		(man-months)			
1.	1) Project Coordinator Time spent at:				
	a) Philippines	11	11	2	19
	b) Sri Lanka	1	1	1	3
	c) Home leave	1	1		2
	Total				24
2.	Local IIMI Staff:				
	1) Research Associate (one)	12	12	5	29
	2) Research Assistant (six)	72	12	31	174
	3) Clerk Typist (one)	12	12	5	29
	Total				232
3.	International Staff 1/	3	3	2	8
4.	Local (University) Consultant:,:	14	14		28
	Grand Total				268

1/ International support staff includes IIMI HP staff time and short term consultants time spent in the Philippines and in Sri Lanka in direct support to the Project Coordinator.

Schedule 3. Details of Estimated Budget

I. Bank-Financed salaries and allouances:

	Year 1	Year 2	Year 3 (5 mo)	Total
1. Salaries and allowances:				
a) Project Coordinator	$ 37,000	41,000	20,000	$ 98,000
b) International support staff and short term consultants1/	16,000	16,000	2,000	34,000
c) IIMI Overhead2/ (30% of a+b)	16,000	17,000	7,000	40,000
d) Local staff	23,000	25,000	10,000	58,000
Total	$ 92,000	99,000	39,000	$ 230,000

1/ International support staff time computed at $200/day.

2/ IIMI headquarters' cost!; associated with accounting and other services rendered in the administration of the project.

Schedule 4. Description of Line Items in Schedule 1

Local Travel:

a) Fares (land and air travel within the Philippines)
b) Neals and accommodation incurred during travel

International Travel:

a) Air fares of Project Coordinator to and from Sri Lanka
b) Air fares of IIMI HO staff to and from Philippines
c) Legitimate travel expenses with above.

Research Equipment:

a) One microcomputer IBM compatible to be donated to PCRRRD after the Phase II Study
b) Fabrication of water measuring devices (measuring flumes, evaporation pans, rain gauges, etc.)

Supplies and Services:

a) Office supplies (papers, pens, computer supplies, etc.)
b) Travel supplies (gas, oil, vehicle spare parts and maintenance, etc.)
c) Communication (postage, telex etc.)
d) Legal fees
e) Honoraria for NIA, NRF, PCRRRD staff
f) Rental of offices, equipment and vehicles
g) Other needed supplies and services

Contract Research:

a) Research grants to universities as local consultants on component studies
b) Research grants to post-graduate, MSc and/or PhD students on their thesis research relevant to Phase II Study

Contingency:

Computed at approximately 15% of all budget items 1 to 6.

Irrigation flanagement for Crop Diversification (TR 654 PHI)

Annex 1. Executive Summary and Recommendations from the Phase I Study (Draft)

Introduction

1. The Bank-supported IRRI-IFPRI study on "Food Demand and Supply for Developing Member Countries" concluded that the Philippines has comparative advantage in the production of both irrigated rice and non-rice crops. A second phase of this study is underway to further define appropriate strategies for agricultural development for the Philippines, with special. reference to the formulation of plans to achieve optimum productivity in rice and corn, with emphasis on irrigated crop diversification.

2. A critical issue in that study is the need to examine the technical and socio-economic constraints to profitable production of irrigated upland (diversified) crops. This became the basis for a Technical Assistance (TA 654 PHI) by the Bank to the Government of the Philippines in association with the International Irrigation Management Institute (IIMI) entitled "Study on Irrigation Management for Crop Divsrsification."

3. The Terms of Reference for this study are to (a) examine the constraints to irrigated crop diversification, with special attention to the irrigation management constraints; (b) examine ways in which the management of irrigation systems, particularly operation and maintenance (O&M), can overcome these constraints thereby promoting crop diversification; (c) make preliminary agronomic and economic comparisons of the different management alternatives with various crops; (d) assess O&M institution building requirements resulting from the preliminary results of the study; and (e) determine required follow-up actions recognizing that the 2-year program is limited in making definitive conclusions.

4. With these objectives, the IIMI staff together with local oonsultants undertook various component studies to fulfill the terms of reference. The studies were undertaken under the following headings: irrigation constraints, agronomic constraints, economic constrrints, and institutional constraints.

5. Collaboration with the IRRI-IFPRI Study on Food Supply and Demand (Phase II), was close at all stages of the research, particularly in studying the economic constraints. Data collected by IIMI for these studies are being provided to the IRRI-IFPRI team.

6. This Draft Final Report presents the study results and assessments of the constraints to irrigated crop diversification. The assessments point to follow-up actions in a proposed second phase of the study.

7. There are existing irrigation systems in the Philippines that irrigate diversified crops, particularly in the dry season. Main system and farm level practices have evolved through ad hoc procedures undertaken to cope with limited water supply in the dry season. Corresponding agronomic practices for growing non-rice crops have been developed to the extent that production of these crops hase beceme profitable for the farmers.

8. The sources of moisture for these diversified crops are derived from rainfall, diverted river flows for irrigation, and groundwater. Information on crop-water use and production technology for diversified crops is available. However, there is very little information and few guidelines on effective irrigation management for diversified crops in large systems in the dry season. There is a clear need to examine the constraints and to identify critical factors for promoting irrigated crop diversification.

9. IIMI is concerned with irrigation management practices that will alleviate the irrigation and associated factors that inhibit the profitability of irrigated diversified cropping in the service areas of systems with suitable soils during the dry season. One of the objectives of the study is to develop a suitable technology for managing irrigation at the main and distribution systems levels, as well as at the farm level.

Study sites and component studies

10. The primary study sites were in Allah Valley (South Cotabato), Isabela and Cavite. Secondary sites were in Nueva Ecija, Pangasinan and Ilocos Norte. Primary sites had more intensive data collection requirements than secondary sites.

11. Allah Valley Site. Three irrigation systems were studied at this site, namely: (1) Lateral R-extra, which incorporated the Pilot Testing and Demonstration Farm No. 2 (PTDF # 2) of the Allah Valley Irrigation Project (ARIP), (2) Banga River Irrigation System (BARIS), and (3) Mani River Communal Irrigation System (MCIS). Farm level, agronomic and institutional studies were conducted at these locations, but system level and economic studies were undertaken only at tho BARIS and MCIS.

12. Isabela Site. Field studies at the Magat River Integrated Irrigation Systems (MARIIS) were conducted at: (1) SIBESTER IA area served by Lateral A-3 of Division II and (2) CPPL IR area served by Lateral A-2-A12 of Division IV. Lateral level system studies were conducted at both these locations. Other studies undertaken included on-farm irrigation methods, agronomic testing of alternative non-rice crops, economics of irrigated and rainfed non-rice crop production and operations and management of irrigators associations.

13. Cavite Site. At the Bankud River Irrigation System, part of the Second Laguna Bay Irrigation Project (SLBIP), a study on farm level irrigation methods for white beans was conducted. A crop-water use study on consumptive use, drought and water-logging tolerances of the white bean crop

was conducted at the UPLB experiment station at Los Banos, Laguna

14. Secondary Sites. These sites were selected to provide additional information on irrigation systems which support diversified crops in the dry season. They include: (1) Upper Talavera River Irrigation System (Upper TRIS) in Nueva Ecija, (2) San Fabian River Irrigation System (SFRIS) in Pangasinan, (3) Agno River Irrigation System (Agno RIS) also in Pangasinan, and (4) Laoag-Vintar River Irrigation System (LVRIS) in Ilocos Norte. A study of successful irrigated non-rice crop production was conducted on these sites.

15. The studies focussed on assessing irrigation, agronomic, economic and institutional constraints to irrigated crop diversification.

Irrigation Constraints

16. Farm level studies. Although the amount of water needed for growing diversified crops is less than that for rice, the volume and timing of water delivery are more critical. At ARMP, PTDF#2 results showed that supplemental irrigation of corn is important in meeting the full moisture requirements for crop growth. Due to factors such as unfamiliarity with non-rice technology, perceived higher risks associated with planting non-rice crops, and the need for more precise water control for diversified crops, farmers plant rice when rainfall or irrigation water is abundant. This was confirmed at all sites where continuous irrigation was practiced.

17. Lack of irrigation facilities such as water control devices and an absence of guidelines in supplying larger volume flows at intermittent periods discouraged farmers from adopting crop diversification. It was found that irrigation of corn requires larger lateral canal capacity to provide large flow rates at intermittent periods. The computations showed a minimum rate of 2.25 lps per ha for PTDF#2. For lighter soils, appropriate density and lining of main farm ditches and provision of gated turnouts are recommended to reduce erosion and conveyance losses.

18. In coarser textured soils, horizontal seepage of water affects the moisture regime of diversified crops. In non-rice crop fields adjacent to rice paddies, seepage provides indirect irrigation. Farmers are sometimes reluctant to irrigate their corn fields for fear of water-logging and, to some extent, to avoid payment of irrigation fees. As shown at BARIS and MCIS, irrigation through seepage is sufficient to meet the full moisture needs of corn. Further study is needed to determine the role of seepage as an irrigation alternative and its implications on the operational procedures of irrigation systems.

19. Comparative irrigation methods were studied. Results showed that furrow irrigation for corn was more effective in terms of shorter times to complete an irrigation and less water use, compared with basin flooding. The furrow method reduced the time it takes to irrigate one ha to one-third that

of the basin method. However, there are additional labor costs incurred to guide the water to the furrows.

20. Further refining the furrow method for corn, we found that triple-row was better than double-row furrow irrigation in terms of labor use, but both methods showed the same water use and yield. In irrigating white beans, furrow irrigation was found to be better than basin flooding, but it took more labor. The double-row method used less water than the single-rows. These irrigation methods will become more effective when appropriate farm level facilities are installed to provide more precise control of irrigation and drainage.

21. System level studies. The existing practice of continuous irrigation at the system level discourages farmers from planting diversified crops. If water is delivered in sufficient quantities to grow rice, there is less incentive to grow upland crops. Particularly at BARIS and MCIS, lateral seepage affects corn fields adjacent to rice paddies. At the Isabela site, where water is delivered at 2 to 3 times the designed rate, farmers are not motivated to grow any crops other than rice.

22. Irrigation management techniques have yet to be developed that will allow more precise supply of water, Results from all sites showed that continuous irrigation in the main system promote rice cropping. Lack of measuring devices and inadequate control facilities make it difficult to deliver large volumes of water at intermittent periods, which is optimal for diversified crops. Monitoring of water demands as part of irrigation management will be useful in providing guidelines on water supply to crops.

Agronomic Constraints

23. Testing of alternative irrigated non-rice crops. The great majority of non-rice crops in the Philippines are grown under rainfed conditions. To promote irrigated crop diversification, several non-rice crops were tested for adaptability in an irrigated environment. Irrigated non-rice crop production technology in the primary sites was not as widespread as expected. Problems associated with timing of crop cultivation were encountered. Late planting of crops resulted in low yields due to crop vulnerability to the build up of pest and diseases, and also in some cases to sensitivity to high temperatures. However, higher production and profitability can be achievsd if proper crop practices are adoptrid. At the Allah Valley and Isabela sites, irrigated hybrid corn and peanuts showed potential for adoption, while at the Cavite site, successful adoption of irrigated white bean resulted from appropriate crop care and extension support.

24. Crop-water use of selected diversified crops. Corn and white bean were studied for their crop-water use characteristics. Moisture sensitive stages of crop growth were identified. For corn, optimum water use was shown to be effective for grain yield when irrigated at the tasseling and grain formation stages in areas with shallow water table.

25. There is widespread unfamiliarity with non-rice crop production under irrigated conditions. At the Allah Valley, corn is grown under rainfed conditions or through seepage from adjacent rice fields. In drier areas, there is some acceptance of irrigated crop diversification, but in areas with significant dry season rainfall, the benefits of irrigated non-rice production must be demonstrated. l'iming of diversified crop cultivation is important because the factors of temperature, incidence of pests and diseases, and risk of waterlogging through heavy rainfall are critical. The results from Cavite show that agroriomic constraints can be mitigated with appropriate extension efforts.

Economic and Institutional Constraints

26. The profitability of irrigated rice and non-rice crops was assessed. At the BARIS site, the returns to irrigated rice production were higher than those of irrigated corn because of higher yields and price of rice. Moreover, input cash costs relative, to yield were higher for corn than rice. This is primarily due to lower production levels of corn. Comparing yields of irrigated and rainfed hybrid corn, yields of the former were higher, but the differences were not pronounced due to the rainfall that occurred in the 1985 dry season which masked the expected effects of irrigation on corn.

27. The availability of a market lor, and price of non-rice crops are not stable enough to encourage irrigated non-rice crop production. At the Isabela site, unstable price of corn discouraged farmers from growing that crop. Indirect incentives like reduced irrigation fees and non-payment of land rent for tenants can help to promote irrigated crop diversification.

28. The main economic constraints identified were unfavorable market prices and high input costs for non-rice crops. Where market prices are assured and stable, farmers might be motivated to diversify. In Isabela, the unstable price of corn exacerbated farmers' reluctance to adopt non-rice crops. Similarly, at the Allah Valley site, the price of non-rice crops was perceived by farmers as the leading problem in crop diversification.

29. The institutional component studies showed that the operation of the communal system was no better than the NIA systems. The disregard of farmers for irrigation schedules resulted in inequitable distribution favoring upstream farmers. This occurred in both BARIS and MCIS. There was a discrepancy between what farmers said and what they practiced with respect to their responsibilities to irrigators associations (IAs).

30. Stated responsibilities ranged from payment of fees, attending meetings, and adhering to agreed policies and decisions, while in practice the majority regarded maintenance or group work as their most important responsibility. However, the overriding consideration of farmers choosing whether to join an IA is the adequacy of irrigation water. Communication between farmers and system operators should be improved if uncertainty over water delivery schedules is to be reduced. Adherence to the irrigation schedule should be

enforced more strictly.

31. Ways to improve communication between farmers and system operators regarding water delivery schedules should be investigated to fully utilize the capabilities of the IAs. Studies to improve joint management of IAs with NIA should be conducted to attain better communication and reduce farmer uncertainty over water delivery schedules.

Summary and Recommendations

32. Irrigation water management. To effectively irrigate diversified crops larger canal capacities should be provided, particularly in areas with sandy soils. However, existing rice gravity systems can accommodate these large volume and intermittent demands by extending the water delivery periods provided appropriate control and monitoring of water deliveries are undertaken. The absence of established system management guidelines makes it difficult to irrigate diversified crops effectively.

33. On-farm irrigation facilities require modifications to provide the proper water conditions for diversified crops. Continuous flows of irrigation water result in water-logging, especially in areas where lateral seepage is high. The effects of seepage on irrigation and drainage of crops should be investigated further. To overcome these problems, it is recommended that irrigation deliveries be rescheduled to allow large and intermittent volumes which would reduce the time of irrigation from 3 days to 1 day per hectare. Additional stucies in determining optimal ditch density for on-farm irrigation and drainage ditches and development of less erodible farm channels should be carried out. It is recommended that farmers adopt furrow irrigation rather than basir flooding to speed up the time of irrigation, to reduce the water recuirement, and to promote uniformity of application.

34. Agronomic practicer for irrigited diversified crops. Farmers in the primary sites are not familiar witt irrigated non-rice crop production technology. Timing of cultivation for diversified crops is particularly important in respect of factors such as temperature, incidence of pests and diseases and risk cf water-logging through heavy rainfall. In areas where there is dry season rainfall, greater efforts should be made to demonstrate the benefits of irrigation on diversified crops, especially in identifying critical moisture-sensitive growth stages of the plant. This should be complemented by development of irrigation management practices more responsive to crop water requiremerts. It is recommended that more studies be conducted to alleviate the agroromic constraints so that production can be raised to levels attractive enough to justify additional input costs such as fertilizer, seeds, pesticides, crop care and irrigation.

35. Economic and institutional aspects of irrigating diversified crops. Unstable prices and high input costs of non-rice crops inhibit farmers from adopting irrigated diversified cropping. Profitability of non-rice crop

production is the foremost consideration of farmers in irrigated agriculture. Where market prices are assured and have comparable stability to rice prices, there is clear evidence that crop diversification can be achieved. In order to alleviate the marketing problem!; for non-rice crops, it is recommended that investigations On the market structure and post-harvest facilitiss be undertaken. Other indirect incentives such as reduction or removal of irrigation fees should be further studied.

36. Better communication between farmers and systems operators should be established. This will reduce the uncertainty over water delivery schedules for irrigating diversified crops which need large and intermittent volumes of water. Studies on the joint managsment of systems between the irrigators associations and NIA should be undertaken to fully utilize the capabilities those of organizations in providing effective irrigation service to the farmers.

Proposed Phase II Study on Irrigation Management
for Crop Diversification

31. Rationale. The results of the initial study showed that there are inportant technical and socio-economic aspects to irrigation management for diversified cropping that should be addressed. Several constraints were identified, together with suggested strategies for promoting irrigated crop diversification. However, these results must be considered preliminary due to the limited study period (22 months and only one dry season) during which the study was conducted. To arrive at more definitive conclusions, further and more detailed study is needed.

38. The Study Rdvisory Committee (SAC), at its 13 August 1986 meeting, strongly endorsed the extension or second phase of the study to fully capitalize on the indicative results obtained thus far. Continuation of the studies on (1) the management of the main and distributions network of systems, (2) on-farm irrigation methods and facilities, (3) agronomic practices and (4) economic and institutional aspects of irrigated crop diversification is envisaged in thf second-phase study to contribute to the larger goals of agricultural productivity in irrigated areas in the Philippines.

39. Objectives. Continuing from the Phase I Study (TA 654 PHI), the Phase II Proposal focusses primarily on irrigation system management for crop diversification, with a view to assessing the technical and socio-economic feasibility of several crops grown in limited parts of irrigation systems during the dry season. The Phase II Proposal will examine (1) the factors that constrain irrigated crop diversification with special attention to the irrigation constraints, (2) ways in which irrigation practices at the farm and system levels can overcome these constraints (3) agronomic aspects particularly identifying and testing practices for converting puddled to upland soil, (4) the economics of irrigated non-rice crop production in comparing irrigated rice with rainfed non-rice crops, (5) O&M institution-building requirements necessary for. developing and managing irrigated crop

diversification, and (6) existing irrigation management technology for crop diversification and its feasibility for adoption.

40. The Phase II Proposal is designed to develop a suitable irrigation technology package that takes into account the multi-faceted aspects of irrigated crop diversification.

41. Proposed Sites. The Primary sites proposed for the Phase II Study are: (1) the Allah Valley River Irrigation System (ARIP) (including the PIDF# 2, Lateral A-extra), (2) Banga River Irrigation System (BARIS) (3) Mani River Communal Irrigation System (MCIS) and (4) Second Laguna Bay Irrigation Project (SLBIP).

42. Secondary sites to provide additional documentation are proposed at: (1) Laoag-Vintar Irrigation System (LVRIS), (2) Upper Talavera River Irrigation System (Upper TRIS), (3) Tarlac-San Miguel-O'Donnel River Irrigation System (TASMORIS), and possibly one additional site to be selected with concurrence of the SAC. The LVRIS and Upper TRIS currently provide for significant diversified cropping in the dry season. TASMORIS is the site of NIA's present pilot program in dry season irrigation water management.

43. Implementation Arrangements and Reports. IIMI will be the executing agency. The main cooperating agency will be the NIA. PCARRD and MAF will also collaborate in the implementation of the Phase II Study. Universities under the PCARRD research consortir will also be involved in conducting some component studies.

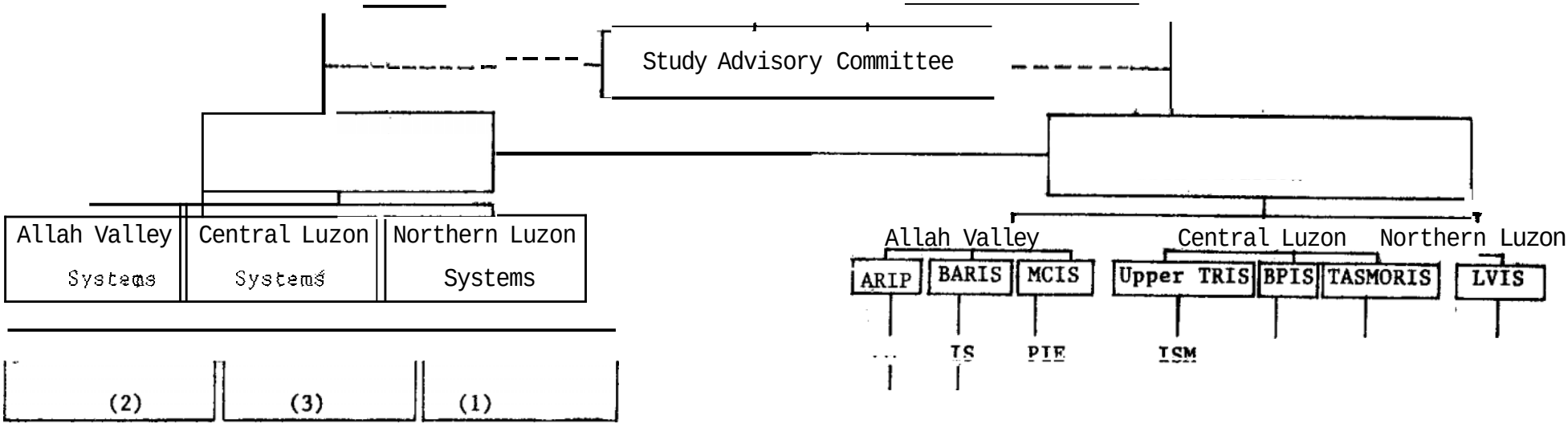
44. The Phase II Proposal is planned for a 30-month period commencing January, 1987. However, in order to cover 3 dry seasons within the 30 month period field, data collection will commence as early as November 1986 which is the beginning of the dry season in most of the study sites. An initial progress report will be presented rfter 6 months, an interim report after 18 months, a workshop report after 22 months, and a draft final report after 28 months. Within one month of the initial, interim, workshop, and draft final report submissions, tripartite meetings of the Study Advisory Committee (SAC) will be held between the Bank, the Government and IIMI. A final report will be submitted before completion of the 30th month.

45. Cost Estimate. The cost of the proposed Phase II Study technical assistance is estimated at $370,000 of which $350,000 will be financed by the Bank and $20,000 by IIMI. There will be no counterpart funding required from the Government; however, as noted above, NIA and MAF staff already employed at the project sites and in related research activities will assist and cooperate in the study and NIA will provide site office accommodation. These activities will not involve additional expenditure by the government.

46. Since there will be a two-month (November and December 1986) advance on start-up time in 1986 for the first. dry season activities, IIMI will provide interim support during this period contingent upon the Phase II Proposal being funded beginning January 1987.

Annex 2.

Organizational Chart for Phase II Study



_____ Direct line of Coordination

---------- Advisory linkage

* NIA staff closely coordinating with the IIMI Site Research Assistant

** NIA staff seconded or assisting in the full implementation of research for each site

Annex 3. Workplan Schedule for Proposed Phase II Study.

Activity	1987 J F M A M J J A S O N D	1988 J F M A M J J A S O N D	1989 J F M A M
> Reports	1st	Int	Wkshp DFR FR
1. Development of methodologies to identify areas.	XXXXXXXXXX AAAAAA	XXXXXXXXXXXXX AAAAAAAA	FFFFFFFFFFF AA
2. Economics of diversified and rice crops.	XXXXXXXXXX AAAAAA	XXXXXXXXXXXXX AAAAAAAA	XXXXXXXXXXX AA
3. Land management practices.	XXXXXXXXXX AAAAAA	XXXXXXXXXXXXX AAAAAAAA	FFFFFFFFFFF AA
4. Irrigation system practices.	XXXXXXXXXX AAAAAA	XXXXXXXXXXXXX AAAAAAAA	FFFFFFFFFFF AA
5. Institutional arrangements & recommendations	XXXXXXXXXXXXXXXXXXXXXXX	AAAAAAAAAAAAAA	XXXXXXXXXX AAAAA

Key: XXXXX = Data collection
AAAAA = Data analysis
FFFFF = Field test