INTERIM REPORT ON THE TECHNICAL ASSISTANCE STUDY (TA 654 PHI)

on

IRRIGATION MANAGEMENT FOR CROP DIVERSIFICATION (Philippines)

Submitted by:

The International Irrigation Management Institute

May 1986

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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 corn-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 obtain self-sufficiency in rice and corn with emphasis on irrigated crop diversification.

A critical issue in this 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 Diversification".

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 institutional building requirements resulting from crop diversification; and e) determine required follow-up action.

With these objectives, IIMI staff together with local consultants (research staff of three universities) undertook the various component studies to fulfill the terms of reference. The approach used was to group the constraints to irrigated crop diversification under the following headings: irrigation constraints, agronomic constraints, economic constraints and institutional constraints. For each of the constraint components, corresponding studies are underway to provide information and data to make possible alleviation of those constraints.

Collaborative arrangements with the IRRI/IFPRI Study on Food Supply and Demand (Phase II), are in place, particularly in studying the economic constraints. Data gathered from these studies is being shared with the IRRI/IFPRI team.

This Interim Report summarizes progress of the study and preliminary assessments regarding the constraints to irrigated crop diversification. The assessments are tentative in nature due to the absence of complete data and analysis at this time. Indicative trends are presented however, to provide direction to follow-up activities.

Summary of progress

The primary study sites are in Allah Valley (South Cotabato), Isabela and Cavite. The literature review incorporated experience from these and other areas to document existing irrigation systems that have successfully practiced crop diversification during the dry season. Preliminary results are presented for each site.

The Allah Valley location comprises three study systems; 1) Lateral A-extra (site of the Pilot Testing and Demonstration Farm No. 2, PTDF # 2) of the Allah Valley (ARIP), 2) Banga River Irrigation System (BARIS) and 3) Mani River Communal Irrigation System (MCIS). At ARIP PTDF # 2, the proposed water management scheme was studied, including the redesign of farm level irrigation facilities. The study was aimed in assisting the NIA-ARIP Agricultural Coordinating Division (ACD) staff in the development of a pilot water management scheme to grow non rice crops during the dry season.

This study showed that rice can be grown satisfactorily during the wet season and irrigated corn during the dry season. Water supply at PTDF # 2 is sufficient to meet both wet and dry season crop needs. However, due to the very sandy and porous soils, excessive conveyance losses at the main and supplementary farm ditches must be expected.

The redesign of the farm level irrigation facilities proposes an increase from 8 to 11 turnouts and the extension of the lateral by 800 M. An increase in the main and supplementary farm ditches is also recommended. Reduction of seepage and percolation losses by lining with suitable clay materials is proposed, and farmer involvement in locating and constructing farm ditches is highly recommended.

Irrigated mungbean, peanut and an improved early maturing corn variety are the crops being tested at PTDF # 2. Results from another study conducted at this site show that fields with furrows are quicker to irrigate compared with furrowed basins on 1/4 ha demonstration plots.

With the campaign of the ACD staff and demonstration plots, 8% of the farmers irrigated corn (10 ha) during the 1985-86 dry season.

At BARIS, the irrigation management study documented the O&M procedures in use during the 1985-86 wet and dry seasons. Irrigation supplies are rotated among sections of the system. There are irrigation associations (IA) that assist the NIA in implementing rotational schedule. The IA decides which areas to irrigate for rice, but NIA informs and implements those decisions. Meetings are held before the start of every season with the IA and NIA to decide on water allocations and scheduling.

For areas not scheduled for rice, irrigated corn is the main crop. Due to some rainfall during the dry season, farmers do not normally irrigate corn. Especially where it is planted adjacent to rice. Corn planted early enough will have sufficient water from rainfall. However, corn planted adjacent to rice take advantage of seepage water. The study shows that 50 percent of the sampled corn areas received seepage from adjacent rice areas and have a yields from 0.5 to 1.5 t/ha higher than rainfed corn.

The study of furrow and basins indicates shorter time to irrigate using furrows, (4 hrs versus 6hrs to irrigate 0.25 t/ha). This can be compared with farmers' experience of 3 days to irrigate 1 ha. using level basin flooding.

The study of profitability and labor use of different cropping patterns in the wet season indicates highest returns to rice farms followed by rice-corn farms and then corn farms. Corn used the least labor. The corn crop was attacked by corn borer when planted late. The mungbean and peanut were perceived by farmers as good alternative crops provided seeds and marketing outlets were available. Farmers were impressed with the furrow irrigation methods used for these crops.

At MCIS, corn and other non-rice crops are also not irrigated, and irrigated non-rice cropping is not widely accepted. Irrigation technology for non-rice crops has to be demonstrated to be profitable, and additional irrigation costs will have to result in benefits before being accepted by farmers.

The profitability analysis at MCIS shows that irrigated rice outperforms rainfed corn production. Another study underway at this site assesses horizontal movement and spatial distribution of soil moisture, and is expected to provide information on seepage water movement.

At the Isabela site, the lateral A of the Magat River Irrigation System supplies 2 to 3 times the normal irrigation water supply for rice due to high percolation losses (20 to 30 mm/day), through the soils (dual and diversified land classes) in this area. Even during the dry season, however, rice is planted and the continuous delivery of irrigation water inhibits production of diversified crops. The corn planted at this site subsists mainly on rainfall; however, when there is in sufficient rainfall, at most two irrigations are provided by NIA upon request of farmers. NIA does not bill these farmers as long as they pay their irrigation fees for irrigated rice.

A study conducted at this site indicates that farmers irrigate corn using furrows with sufficient slope. Two irrigation treatments were tested using double-row and triple-row furrows. There is no significant difference in water use and yield between treatments, but less labor is used in irrigating with triple row furrows.

Another study at this site evaluated irrigated peanut or an alternative crop after rice. The irrigated plots showed slightly higher yields than rainfed plots. The occurrence of rainfall during the critical growth stages of the peanut crop reduced the impact of irrigation in this study.

An economic study on crop diversification at this site showed that a rice-corn combination during the dry season is more profitable than mono cultivation of rice or corn. Another identified constraint at this site is the unstable price of corn relative to rice; this is the major reason cited by farmers in preference of rice to corn production.

At the Cavite site, white bean was programmed to be planted in an aggregate area of 100 ha, but only 21 ha were planted due to farmer reluctance to plant an unfamiliar crop. Lack of available credit was attributed to this non-acceptance. Studies undertaken at this site evaluated the single-row and double-row furrow irrigation method for white bean. The double-row furrow uses less water but has the same yield as the single-row furrow method.

The drought and flooding (waterlogging) study for white bean was done at the experiment station at the University of the Philippines at Los Banos (UPLB). Three days of continuous waterlogging resulted in total crop failure. The drought aspect of the study did not yield a significant result due to late rains during a drought treatment.

Four additional irrigation systems were selected in order to gain experience with successful irrigated crop diversification. They are in the provinces of Pangasinan, Nueva Ecija and Ilocos Norte. Data collection at these sites is still going on.

Associated activities

The study advisory committee (SAC) was formed in September 1985 after the presentation of the inception report. The SAC consists of the NIA Administrator as Chairman, and MAF-ARO Director, representatives from ADB, IIMI and IRRI-IFPRI as members. The next meeting of the SAC is planned immediately after the presentation of the Interim Report to the Bank. It is expected that a discussion on the progress of the study as presented in the Interim Report will be made.

A mission was conducted on March 4-8, 1986 to review the progress of the study. Representatives from NIA, ADB, IIMI and MAF comprised the review team. The team visited the Allah Valley, Isabela and Cavite sites. The IIMI and research staff of the locally contracted universities made presentations about the different studies at each site. A complete account of this review mission is provided in Annex VII of the Main Report.

A study tour to Taiwan was organized and conducted on April 6-13, 1986 to learn through observation and discussion with the staff about the present and evolutionary aspects of irrigation technology for crop diversification. It was envisaged that certain principles from the Taiwan experience may be applied in the Philippine studies. A detailed report of this trip is provided in the Annex VIII of the Main Report.

Preliminary assessments

The assessments reported here are tentative because of the preliminary nature of the results obtained at this stage of the study. The main irrigation constraints identified at this stage of the study are: dry season rainfall patterns, availability of irrigation water, limitations in irrigation management, and inappropriate farm level irrigation facilities. At the Allah Valley and to some extent the Isabela sites, rainfall is frequently sufficient to permit upland crop production. At BARIS and MCIS, seepage from adjacent rice fields is sufficient to sub-irrigate corn. Oversupply of irrigation inhibits crop diversification due to waterlogging. Irrigation is seen as synonymous with rice production. In Isabela, abundant irrigation water supply encourages farmers to grow rice rather than other crops.

Continuous irrigation is practiced in the main system at all sites. Inadequate control facilities and lack of measuring devices make it impractical to deliver large volumes of water for short periods of time, but this is required if optimal irrigation is to be provided for diversified crops. The close control over water is the foremost factor in developing farmer confidence in their water supplies for non-rice crops, as exemplified in the Taiwan experience. It is recommended that improvements be made in scheduling water deliveries for diversified crops and that more control structures and measuring devices are provided to achieve greater control over water deliveries.

Farm level irrigation facilities require modification to provide suitable water conditions for non-rice crops. This will entail additional studies on optimum farm ditch density, and the development of less erodible farm channels where soils are coarse in texture. Adoption of furrow irrigation rather than basin flooding methods will speed up irrigation time and provide uniform water applications.

There is widespread unfamiliarity with non-rice crop production under irrigated conditions. At the Allah Valley site, 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, effort must be made to demonstrate the benefits of irrigated non-rice production. Timing of non-rice crop cultivation is important where the factors of temperature, incidence of pests and diseases, and risk of waterlogging through heavy rainfall are critical. The results in Cavite show that agronomic constraints can be overcome with appropriate extension efforts.

The main economic constraints found in the study are unfavorable market prices and high input costs for non-rice crops. Where market prices are assured and stable, crop diversification can be attained. In Isabela, the unstable price of corn exacerbated farmers' reluctance to adopt non-rice crops. Similarly, in the Allah Valley site, the price of non-rice crops was perceived by farmers as the leading problem to crop diversification. Pricing incentives (direct price supports or indirect incentives such as significant reduction or waiving of irrigation fees for non-rice crops) during the dry season will alleviate the economic constraints.

Among the institutional constraints, better communication between the irrigation associations and NIA should be established so that irrigation schedules will be adhered to and uncertainty over timing of water deliveries will be reduced. The viability of the associations has to be viewed in the context of the farmers' need for irrigation water for both rice and non-rice crops. Data are still being collected for this component.

Interim Report for the Study on Irrigation Management for Crop Diversification[1] (Philippine Component)

1. Introduction

The IRRI-IFPRI study[2] on food demand and supply for developing member countries, using the Philippines as a case study, concluded that the Philippines have a comparative advantage in the production of both irrigated rice and non-rice crops. A second phase of the study will be carried out to further refine strategies for agricultural development for the Philippines. This is with a view in providing assistance for the formulation of plans in attaining the goals of self-sufficiency in rice and corn and crop diversification in the different regions of the country. The analysis will include the development of regional agricultural development strategies, setting the level of investments in alternative irrigation options, possibilities for crop diversification, especially crop with significant import-substitution potential and on appropriate agricultural policies and support activities.

One significant aspect of the study is the need to examine the technical and socio-economic constraints to irrigated crop diversification. This would focuses on the promotion of shifting from irrigated rice to irrigated non-rice crops during the dry season. With this intensified need, a technical assistance (T.A. 654 PHI) was granted by the Asian Development Bank (ADB) to the Government of the Republic of the Philippines. This technical assistance entitled "Study on Irrigation Management for Crop Diversification" is to be implemented by the International irrigation Management Institute (IIMI).

The study will examine: a) the constraints to crop diversification, with special attention to the irrigation constraint; ii) ways in w/c the management of irrigation systems, particularly operation and maintenance (O & M), can overcome these constraints thereby promoting crop diversification; (iii) preliminary agronomic and economic comparison of different irrigation management alternatives with various crops; (iv) assess O & M institution building requirements resulting from crop diversification and (v) required follow-up actions. These are the general objectives as set forth in the technical assistance agreement.

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[1]Interim report for T.A. 654 PHI submitted to the Asian Development Bank (ADB) by the International Irrigation Management Institute (IIMI) May 1986.

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

This interim report is presented as stipulated in the T.A. agreement. This report is divided into five parts:

a) conceptual framework of analysis
b) summary of progress and preliminary results
c) reports on related activities
d) preliminary assessments of the constraints to irrigated crop diversification
e) report on related activities, and
f) administrative details for the implementation of the study

2. Conceptual Framework of Analysis

2-01 This report emanates from the terms of reference. This entails examining the constraints to the management of selected irrigation systems. Irrigation management in this study means the operation and maintenance aspects of irrigation system whereby the interactions of the irrigation staff, farmers and physical resources are taken into account. This is viewed in the light of utilizing existing rice gravity irrigation systems to accommodate upland[3] crops during the dry season in places where soils are suitable.

2-02 Notwithstanding the significance of the irrigation constraints, it is not sufficient to view irrigated crop diversification simply as irrigation issues. Agronomic, economic and institutional constraints are also addressed in this report (Fig.2.1). The study examines these other constraints in relation to the irrigation issues.

2-03 The broad objective of this study is to examine and identify the constraints to irrigated crop diversification. However, emphasis in this study is placed on ways to overcome the irrigation constraints.

2-04 Under the irrigation constraints, the objectives are being fulfilled by studies on irrigation system management and on-farm water management. These component studies are being undertaken by the IIMI staff and by research staff of the universities collaborating as local consultants.

2-05 Under the agronomic constraints, irrigated crop management practices and plant-soil-water relationships studies are being conducted. For the economic constraints, the economics of irrigated and rainfed non-rice crop production component studies are being implemented. Finally, for the institutional constraints, institutional arrangements and farmer decision-making being studied.

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[3] Upland and non-rice crops are interchangeably used in this report to mean crops other than rice (i.e., corn, peanut mungbean, white-beans, etc.,).

2-06 Details of each study being conducted are presented in Table 2.1. These studies will lead to the identification of the specific constraints to irrigated crop diversification, and will provide information on ways to overcome these constraints.

2-07 Collaborative arrangements with the IRRI/IFPRI Study on Food Supply and Demand Phase II, are in progress, particularly on the economic constraints. Data gathered from studies on these constraints will be shared with the IRRI/IFPRI study, which will make recommendations for the mitigation of the economic constraints.

2-08 The study on the economics of overhead sprinkler has not started due to lack of equipement. Also, comparative studies of laterals with different cropping patterns is not possible because rice and non-rice crops are mixed together in patches.

3. Summary of progress and preliminary results from the study sites

3-01 Results are presented for each study site. The different component constraints studies will then be presented accordingly. A synthesis of the preliminary ~~results based~~ on the ~~component~~ constraints is discussed in the section 5.

3.A Allah Valley site

3-02 At Allah Valley, there are three study sites namely; 1) Allah River Irrigation Project (ARIP), (Lateral A extra, where the Pilot Testing and Demonstration Farm No. 2 (PDTF #2) site is located), 2) Banga River Irrigation System (BARIS), and 3) Mani River Communal Irrigation System (MCIS).

3.A.1 Allah River Irrigation Project (ARIP), Lateral A-extra Pilot Testing and Demonstration Farm No. 2(PTDF#2)

3-03 The terms of reference for this T.A. include component studies at the ARIP specifically the service area covered by Lateral A-extra, which was designated as PTDF #2. Several component studies are being conducted at this site. These are : 1) Proposed irrigation water management scheme for the rice-based cropping pattern at ARIP, Lateral A-extra (PTDF #2), and 2) Agro-socio-economic profile and problems of farmers at ARIP, Lateral A-extra.

3-04 Included in the first study was the redesign of farm level irrigation facilities. This study was done in collaboration with the research staff of USM as one of the local consultants engaged by IIMI in the implementation of the study at Allah Valley. The broad purpose of this study was to assist the Agricultural Coordinating Division (ACD) staff of ARIP in development of a pilot water management scheme to grow non-rice crops during the dry season. The completed report for this study is provided in Annex I. Highlights of the study are discussed below.

3-05 Water supply to Lateral A-extra, consists of the flow at the lateral headgate and available rainfall. The designed discharge of the lateral was 391 liters per second (lps). Field measurement shows the actual discharge capacity of the lateral canal is more than 500 lps. The rainfall contribution was based on the 18-year rainfall record of a station approximately 20 km. from the site. Weekly rainfall at ARIP was estimated using the incomplete gamma function to determine the 50% cumulative probabilities.

3-06 The rainfall distribution pattern at Allah Valley is relatively even. Even during the dry season significant rainfall occurs. The criteria used in differentiating one season from the other is the relative amount of rainfall that has occurred within a specified period of months (Fig.3.A.1).

3-07 The crop environmental demands based on evaporation measurements were used to estimate water demand. Sloping gages were installed on sample paddies to estimate seepage and percolation (S & P). At this site the range of pan evaporation is from 3-6 mm/day, while the S & P is about 10mm/day. Coupled with these physical parameters is the assumed cropping pattern that would reconcile farmers' preference and NIA's overall irrigation scheme.

3-08 Significant features of this site are the relatively very porous (sandy) soils and the low organic matter content. However, the presence of semi-permeable layer of "sandstone-like" material that ranges from 0.5- 1.5 m depth reduces the percolation. Investigation of this layers is still on-going to determine the influence on percolation rate. Notwithstanding the peculiar and difficult features, which might not be present in the rest of the ARIP service area, this site was considered the pilot site for demonstration purposes.

3-09 Based on the physical parameters and farmers' preferences, a rice-corn-legume cropping pattern was proposed by NIA. However, only the water delivery schedule for the rice-corn crop is presented in the completed study.

3-10 Farmer preference for planting rice during the wet season was noted during one of the meetings of the Irrigators Association organized by the ACD staff. Responses to the agro-socio-economic survey done by the USM research staff support this preference.

3-11 A component of this study was to recommend improvements to the farm level facilities to enable effective irrigation of upland crops during the dry season. A physical inventory of existing facilities was undertaken.

3-12 Several structural deficiencies were observed in the existing facilities. The concrete Parshall flume or measuring structure at the headend is defective. A calibrated staff gage is used to measure the water entering the lateral. An increase from 8 to 11 turnouts is recommended to effectively irrigate the entire service area. Furthermore, the lateral should be by extended by 800 m .

3-13 An increase in the density of main and supplementary farm ditches is recommended for irrigation of corn or upland crops although, it is adequate irrigation of rice using paddy to paddy flow. To fully develop the area for upland crop cultivation and to some extent also for rice, there is a need for land levelling in some portions. Lining of the main farm ditches with suitable clay materials (ribbon-fill) will reduce the seepage and percolation loss and reduce channel erosion. Finally, the involvement of the farmers in locating and constructing farm ditches is expected to lead to the effective utilization of both irrigation water and farm level facilities. This part of the study on the improvement of the farm level facilities recommended for this site has been presented to the NIA-ARIP staff.

3-14 Another study in this site is the agro-socio-economic survey undertaken by the USM research staff. Only the relevant findings of this study are presented in this report. The survey sampled 49 farmers representing different farm locations with respect to their distance from the lateral canal. This survey was in part to assist the ACD staff in getting benchmark information on the farming practices and attitudes to irrigation.

3-15 There were 7 cropping patterns being practiced. The most important being the corn-rice-corn pattern (35%) and corn-corn-rice pattern (30%). With the advent of irrigation 63% now prefer to plant rice rather than corn during the wet season. The higher cost of labor for rice production is major factor in farmers' decision to continue corn production. The lack of capital or unavailability of credit was perceived to be the leading problem in farming followed by the lack of farming equipment and facilities, absence of extension services and low price of farm produce. The survey shows farmers' desire to have more training in corn production. The study provides some insights on the perceptions and practices of the farmers which can be used as a starting point in the development efforts by the ACD staff.

3-16 Other studies conducted in this site are testing of alternative irrigated non-rice crops, (mungbean, peanut and improved early maturing traditional corn variety) and evaluation of furrow and furrowed-basin flooding irrigation. Preliminary results indicate the shorter time duration for irrigating the furrow irrigated plot (1/4 ha.) compared with basin irrigation (Table 3.A.1).

3-17 A few farmers at PTDF #2 have irrigated their corn crop, with 10 ha. irrigated this 1985 dry season. This response from the farmers in irrigating their corn can be attributed to the campaign by the ACD staff and the demonstration effect of the studies being undertaken by the USM staff.

3-18 In connection with the studies at ARIP, monthly meetings are held between IIMI, USM and the NIA-ARIP ACD staff. This regular meeting serves as the forum for updating NIA-ARIP staff on the activities of IIMI and USM at PTDF # 2. Assistance is also provided to the ACD staff in their other research activities by the IIMI staff, technical guidance in the research on conveyance loss study, hydrometeorology data interpretation and other water management studies.

3.A.2 Banga River Irrigation System (BARIS)

3-19 The BARIS is a run-of-the river type irrigation system. The dominant problem is the high amount of silt contained in the river flow. To minimize the silt intake, the spillway gates are opened everyday for 2 hours to clear the entrance to the main channel. This system also has a silting basin into which the water is diverted before entering the main canal. Despite these measures, the main canal still carries a high concentration of and this necessitates desilting the main canal and laterals during April.

3-20 The whole system is headed by an Assistant Irrigation Superintendent and is divided into three Water Master Divisions. The system has 9 irrigators association areas. For water distribution purposes the system is divided into 6 hydrologically separate sectors. These sectors are grouped into corresponding WMT Divisions (A,B and C) (Figs.3.A.1 & 3.A.2). The sector with their different areas and other description are presented in the following table.

Sector Group	Irrigable Area	WMT Division	No. of IA Covered	Laterals Covered
I	250	1(A)	4	A, B, C
II	400	2(B)	1	D
III	360	1(A)	1	E
IV	300	1 & 2 (C)	1	main canal (E-F)
V	350	3(C)	1	F
VI	270	3(C)	1	G
TOTAL	1,930	3(C)	9	7

3-21 The reported irrigable area has been reduced to only 1,930 ha. from 2,300 ha. because of limited available water supply. The 9 Irrigators Associations (IAs) covering the area were federated on September 1985 and was made a chapter of the South Cotabato and General Santos Federation of Farmers Irrigators Association Incorporated (SOCOGESAFFIA).

3-22 Before the start of each season, the board members of the federation and officers of the different IAs with barangay officials and government extension workers meet with the BARIS personnel to decide on the irrigation plan for the season(Annex III.A-C). They decide which areas are to be irrigated, the start and cut-off of irrigation deliveries and other management procedures. They also discuss problems and try to provide solutions during this meeting.

3-23 There is a monthly meeting of the federation board members with NIA personnel present to discuss problems and plan short-term strategies (Annex III.B). Each IA has also a monthly meeting to serve as a forum for gathering feedback from farmers. Some of the IAs already have a contract with NIA for maintenance of the laterals serving their area. Other laterals not contracted for maintenance by the farmers including the main canal are maintained by canal tenders paid by NIA as regular personnel.

3-24 Irrigation water supply is rotated among the sectors of the system. Each sector is provided with water for a specified number of days on a weekly schedule (Annex II.A & II.B). This system of rotation is decided and fixed during the pre-seasonal farmers meeting. Thus, the schedule can not be altered by the NIA management without consultation with farmers. NIA's role is to implement and enforce the rotation schedule. To prevent unscheduled water deliveries to any sector, unauthorized checks are removed and confiscated by NIA personnel during their daily rounds in the system and areas not scheduled for the season have their gates closed temporarily, sometimes with use of concrete to block the gates.

3-25 In areas where the farmers' association are functional and have contracts for the maintenance of the lateral, the farmers responsibility in water distribution starts at the lateral headgate. In areas where the association is not functional, the farmers responsibility starts at the turnout. Thus, responsibilities of the NIA personnel are to enforce the rotation schedule as decided during the seasonal meetings and implement alterations as decided during monthly meetings.

3-26 The irrigation of corn is done only at most twice every season when the rainfall amount is deemed insufficient. The method of irrigation is by "flushing" or basin irrigation. The NIA staff would only irrigate the corn fields upon the request of the farmers. Experience in this system indicate that with this method of irrigation it takes 3 days to irrigate a hectare of corn. This is due to the moderate flow of water into the main farm ditch and the nearly flat topography of the corn fields. The sandy texture of the soil cannot accommodate large volume of flows in the main farm ditches. Only a few farmers in the dry season of 1984 requested for flushing irrigation from the NIA staff. These farmers were billed 60% equivalent irrigation fee based on rice (i.e., cash equivalent of 60% of 3 cavans of rice for the dry season).

3-27 The prevailing practice of farmers is to plant their corn crop beside their rice plots. Due to lateral seepage,these corn plots do not require irrigation. The NIA staff in turn do not bill these farmers for corn as long as they pay their rice irrigation fee. However, strictly considering the water use, these corn fields are actually irrigated. For farmers not scheduled to receive water for rice irrigation, the rainfall would be deemed sufficient and only in cases of extreme drought will they request the NIA staff for "flushing" their corn fields as previously mentioned.

3-28 The IIMI study on irrigation management focused on the documentation of the operation and maintenance aspects of this system in relation to the identification of constraints to irrigated crop diversification.

3-29 A rainfall and evaporation station was established located at lateral D1. Staff gages were installed and calibrated at the headgate of the main canal, points along the main canal and lateral headgates (Figs.3.A.2 & 3.A.3). Rainfall and evaporation data are presented in Figure 3.A.4.

3-30 The system is basically operated to irrigate rice. The wet season data indicated relatively adequate water supply to irrigate the rice crop (Table 3.A.2). Although there were also patches of corn planted in some portions of the service area.

3-31 In the dry season, Group IV lateral E and areas served by the main canal portion from the headgates of lateral E to F were not scheduled to receive irrigation water for rice. This schedule was agreed upon during the pre-season meeting between the IA and the NIA staff (see Annex III.A). This was the result of the yearly rotational schedule agreed upon by the farmers. The NIA staff suggested that these farmers plant corn instead. However, even with this agreed upon schedule, some farmers still persisted in planting rice in this section. The area planted to corn were as follows: Division A (mostly at laterals C & E) 40 ha., Division B (lateral D, sub-laterals D-1, D-2) 100 ha., and Division C (mostly downstream of lateral F) 40 ha.

3-32 With the rotation scheme, there seems to be little effort by the NIA to measure inflows into the canal systems. Their main objective is to see that water flows to scheduled sectors at a rate satisfactory to the farmers as determined by the feedback from irrigators associations meetings. Under supply is easily monitored as farmers will complain immediately but oversupply is not reported unless farmers' fields are flooded. However, data gathered by the IIMI staff shows a real shortage of water during the dry season at the main diversion point and some inequitable distribution based from flow measurements within the irrigation network. These can be attributed to the frequent unauthorized diversion by farmers and also by the low and fluctuating water availability from the river. (Tables 3.A.3 to 3.A.5 and Annex III.A).

3-33 Data reported to the NIA central office are condensed on monthly average or total values which do not coincide with the weekly rotation of water. Areas planted are also assessed monthly. Water flow diversions to any sector are determined on weekly estimates of requirements though not recorded.

3-34 Most of the corn crop planted in late November (wk no. 46) relied on rainfall (see Fig. 3.A.4); corn planted later was irrigated especially when planted adjacent to rice plots. This can be seen from the schedule (Annex III.A). Results obtained from the soil moisture and yield samples show that approximately 50% of the sample farms were being irrigated or received seepage from adjacent paddy fields. A yield difference between irrigated and non-irrigated corn fields ranged from 0.5 tons to 1.5 tons depending on the variety planted, indicating the beneficial results of irrigation for corn during the dry season.

3-35 In spite of the irrigable area planted to corn and the obvious benefit derived from irrigation, it is unlikely that the farmers will pay for irrigation fee unless a very serious drought will occur.

3-36 Based on the experience of the NIA staff in irrigating corn and the preliminary results of the evaluation of irrigation methods, the identifiable irrigation constraints in this system at the moment fall into two categories: a) availability of rainfall during dry season and b) absence of appropriate farm level facilities.

3-37 The study on the evaluation of the furrow and furrowed basin irrigation methods at the farm level indicated shorter time duration for irrigation with 4 hours and 6 hours per 1/4 ha. respectively. This can be compared to the farmers' experience of 3 days for 1 ha. using level basin flooding (Table 3.A.1).

3-38 In the agro-socio-economic survey study, data were gathered on the demographic make-up of the farmers, farming practices (including irrigation) and preferences, farming problems and aspirations and expectations. A significant problem is the relatively high cost of farm inputs compared to the market price of corn (Table 3.A.6-7).

3-39 Based on the profitability and labor use of different cropping patterns study for the wet season, the gross and net farm incomes were highest for the rice farms followed by the rice-corn farm and corn farms The (Table 3.A.8). The lowest family labor used was for the corn farms, followed by the rice-corn farms and rice farms respectively. Man-animal labor use was lowest on the corn farm followed by rice farms and rice-corn farms.

3-40 These results show the highest production and income for rice even though less labor (man days) was needed for corn. Further study is needed on why corn is planted side by side with rice even during the wet season.

3-41 Three alternative crops were tested: mungbean, peanut and improved short-maturing traditional corn variety. Each crop was planted on 1/4 ha. in order to approximate the areas grown on the farmer's field. One shortfall of this study was the late planting of the corn crop, resulting in the infestation of pests (mainly corn borer).

3-42 The mungbean and peanut crops planted have developed well, although the results are not yet available. The demonstration plots were visited by farmers, with favorable reactions noted especially for the irrigation methods used. The mungbean and peanut crops were perceived as good alternative crops, provided seeds and marketing outlets were available.

3.A.3 Mani Communal Irrigation System (MCIS)

3-43 The MCIS is a communal irrigation system with a diversion dam located in Esperanza, Koronadal, South Cotabato. This system serves two villages, Mabini and Barrio 5 also of Koronadal. Its total service area is 700 hectares but only 200-400 hectares is served each season depending on water availability (Fig.3.A.5). It is managed by a communal irrigators association through its President Mr. Santiago Billanes and 9 Board of Directors. The system is divided into 5 sectors each having a sector leader and other officials responsible for distributing water within their sector. They also have a hired canal tender to oversee the distribution of water to the different sectors. They have hired a gate keeper for the main diversion point responsible for closing and opening the gates of the dam.

3-44 The association meets before the start of the season to decide on which sector to irrigate and the schedule of deliveries and cut-off dates for each sector. There are monthly meetings at the sector level to discuss problems. These problems are then presented at the meetings of the Board of Directors usually called by the President to plan short-term strategies. Each sector is given a schedule to plant to cope up with the limited water supply and the large amount required for land preparation (i.e., staggered planting dates by sector).

3-45 Everyday the canal tender patrols the canal to see that water is diverted to the scheduled sectors. In times of water shortage, rotation is practiced and each sector is given a fixed number of days per week. The canal tender adjusts the checks and cleans the intake structures of debris to ensure that water flows to the scheduled sectors. Within each sector the farmers share the water through the supervision of the sector leader.

3-46 In the case of corn areas, they are only irrigated when they formally request water from the association through the President. Farm ditches are maintained by the farmers. Laterals are maintained by the sector covered through group work whenever needed. The main canal is maintained also through group work and farmers participating are paid in terms of irrigation fee discount at the rate of P50/man-day.

3-47 IIMI's involvement in this system was premised on the assumption that farmers irrigate non-rice crops. However, the results show that only a few farmers irrigate their non-rice crop (mainly corn) and do so only in times of drought. There are also cases of irrigation through seepage from rice paddy fields. Lateral seepage is prevalent in the type of soil (sandy loam) in the service area of this system and farmers deliberately take advantage of this.

3-48 This system also offers the opportunity for a study site whereby irrigation management is carried out entirely by farmers. As part of IIMI's study on irrigation management, the system was instrumented for water flows on the main canal and laterals (Fig. 3.A.5). A rainfall and evaporation station was also installed in the area.

3-49 In the wet season, there were 732 ha. of irrigated rice. All the non-rice crops were rainfed. There was sufficient water supply coming from rainfall and irrigation (Figure 3.A.6 and Table 3.A.9). Four measuring points were installed and calibrated in the canals, to monitor the water flows entering the different sectors. Sector A includes lateral A and portions served by the main canal after lateral B. Sectors B, C, D, and E are served by lateral B.

3-50 At the start of the dry season, a special general meeting of farmers was called to discuss water distribution problems and solutions, irrigation and cropping schedule for 1986 (dry season) and hiring of one water tender for the whole system (Annex IV). The MCIS has basically a rice-rice-corn cropping pattern. Sector A and lateral B are rotated in growing rice and corn. There were approximately 442 ha. planted to rice and 156 ha. to corn. However, not all of the farmers followed the schedule and cropping pattern. Nonetheless, there was sufficient water supply except for the week nos. 4 and 5. (Fig. 3.A.6 and Table 3.A.10). A section of the main canal after the headworks washed out due to eroded embankments. Fortunately, there was a heavy rain (148 mm on wk no. 4).

3-51 Irrigation of non-rice crops during the dry season is still not a widely accepted practice. This can be attributed to the availability of rainfall during the dry season and low income derived from corn relative to rice. As far as irrigation technology for corn is concerned, it has to be demonstrated to be profitable and any additional farm level facilities to irrigate corn would have to result in significant benefits before being accepted by farmers.

3-52 The study on the evaluation of furrow and furrowed basin irrigation methods is also being conducted in this site. Results show that shorter time is needed to irrigate using furrows (4 hrs.) than by using the basin (6 hrs) based on a 1/4 ha. demonstration plot for each method (Table 3.A.1). However, there is additional labor required to irrigate using the furrow method since water flow has to be shifted from furrow to furrow.

3-53 The testing of alternative non-rice crops was also undertaken in this site. Mungbean, peanut and improved early maturing traditional corn (Improved Tinigib white flint) were the crops tested. Mungbean and peanut crops look impressive, while the corn was infested by corn borer due to the late planting of corn. Yield and economic analyses are under preparation.

3-54 Another study currently underway at this site is the documentation of the horizontal movement and spatial distribution of soil moisture. This would provide the information on the actual movement of seepage water beneath the soil surface.

3-55 A profitability analysis study was also conducted for the wet season crop at this site. Preliminary results indicate that irrigated rice production still out performs rainfed corn production (Table 3.A.11). The average net farm income per ha. for rice is P 5,520 while for corn is P 3,020, even though less family labor is used for corn production. At present production levels, corn prices must be much higher to encourage a shift away from rice production.

3.B Isabela site

3-56 With the completion of the reservoir dam, the Magat River Integrated Irrigation System (MRIIS), formerly the Magat River Multipurpose Project (MRMP), can irrigate a potential service area of about 97,000 ha. in the wet season. In the dry season of 1985 (1st cropping season 1986), the actual irrigated area is 74, 445 ha. About 11,000 ha. of its service are belongs to the dual and diversified land classes. The land classification used in the project area is based on the textural soil type and water holding characteristics. For Ist class rice soils, the textural type is clay with a percolation rate of 3-5 mm/day. For the dual land class, the textural type would range from clay loam to sandy loam with a percolation rate of 5-10 mm/day. For the diversified land class, the textural type would range from sandy loam to sand with a percolation rate of more than 10 mm/day. About 70% of these soils are found at Division II in the town of San Mateo and Cabatuan.

3-57 With suitable soil and farmer familiarity for crop diversification, several previous attempts were made pursue irrigated crop diversification. In 1973, under the Angat-Magat Integrated Agricultural Development Project (AMIADP) a crop diversification program was undertaken. Soybean, corn and sorghum were the crops promoted under irrigated condition. Marketing problems were encountered especially for the soybean and sorghum crops. The program was discontinued in 1975. This was due to farmers preference to irrigated rice production.

3-58 The second attempt was made to promote hybrid yellow corn production under the Maisagana Program of the MAF. This was in the years 1983 and 1984. A total program area of 350 ha. was targeted for this purpose. However, only 128 ha were planted to hybrid yellow corn and the rest of the area were planted to native corn and mungbean. The area planted was finally reduced to 60 ha. in the dry season of 1984. The reduction in area planted was due to the fluctuating farm gate price of corn (Table 3.B.1). The price of rice was relatively stable.

3-59 There were two study sites selected at Isabela : 1) Sibester IA area and 2) CPPL IA area. The Sibester area is served by lateral A-3. This area is managed by Division II with its office at San Mateo.

3-60 The CPPL IA area is served by lateral A-2-A-12. This area is operated by Division IV with its office at Cauayan. These two areas are part of the lateral A series with dual to diversified land classes.

3-61 Rainfall and evaporation stations were established at both of these sites. Irrigation water flow measurements are still being calibrated. Results presented are based on the recorded flows obtained from the NIA-MARIS staff. The irrigation water delivered to these sites particularly at the Sibester IA site was approximately twice the designed irrigation water supply (1.5 li/sec/ha.) due to the high percolation loss (30 mm/day). This is illustrated in Fig. 3.B.1 and Table 3.B.2.

3-62 At present continuous irrigation water delivery is practiced, which inhibits the planting of diversified crops. The reservoir dam still has sufficient water to irrigate rice on dual class land which demands 2 to 3 times the designed irrigation water supply. However, in 3 to 5 years time full land development will be completed 97,000 ha. will be irrigated. Decisions have to be made now regarding the irrigation deliveries being made to this area especially during the dry season because farmers will be used to receiving large amounts of water on soils ill suited for rice cultivation. The farmers that planted corn and other non-rice crops this dry season 1985 depended mostly on rainfall. Timely planting of these crops would not require irrigation water due to the sufficient rainfall (Fig. 3.B.1).

3-63 The other component studies being conducted in this site are being undertaken by the research staff of the Isabela State University (ISU). The first study deals with the evaluation of on-farm water delivery system for corn and peanut. Experimental plots on furrows were set up in the farmers field both at the Sibester and CPPL study sites. Existing farmer irrigation practices were documented through a survey. Results show that all sample farmers irrigate their corn using furrows with sufficient slope. Water application is intermittent with at least twice irrigations during the cropping season. Only 6 farmers out of 53 cited water shortage as an irrigation problem. Indicators of water stress are dry soils and wilted corn plant appearance.

3-64 Two irrigation methods are being tested : irrigating double row (every other row) furrows and triple row (every third row) furrows. Soil characteristics, slope and moisture content were documented. Preliminary results indicate that there is no significant difference in terms of water use and yield between treatments. The recommendation is therefore to irrigate using triple row furrows due to relatively less labor expenditure.

3-65 A separate study being conducted at this site to evaluate the relationships between soil moisture and root distribution of two corn varieties planted on 3 textural soil types under two different irrigation schedules. These experiments are in progress at both Sibester and CPPL sites representing course and fine textured soils, respectively. An additional site was selected to represent the medium textured soil located near the ISU campus. The results will be used in making recommendations for proper timing of irrigation, fertilization, planting, tillage operation and cropping sequence.

3-66 Another study at this site is the agronomic evaluation of peanut as an alternative crop after rice. The yield response of peanut to irrigation is included in the study, with both rainfed and irrigated conditions being tested. The irrigated plots resulted in higher yields based on the yield measures, but were found to be not statistically significant (Table 3.B.3). The occurrence of rainfall during the critical stage of the peanut crop growth greatly reduces the impact of irrigation except when prolonged dry spells occur.

3-67 The economic aspect of crop diversification at this site is also being studied. Results show that a rice-corn combination during the dry season is more profitable compared to monoculture of rice or corn (Table 3.B.4).

3-68 NIA is providing incentives to farmers to shift to corn production. Corn is not billed even if it is irrigated as long as the fee for the rice crop planted during the same or previous rice cropping season is paid up. Moreover, there is no land rent charged for corn production.

3-69 Another identified constraint for crop diversification is the unstable farm gate price of corn relative to rice (Table 3.B.1). This is the reason cited by farmers as the main constraint for crop diversification.

3-70 The institutional constraint study undertaken at this site is examining the management and operation of the Irrigators Association (IA) at the Sibester and CPPL study sites. The main aim of the study is to document the IA's performance in relation to water management self-reliance and their potential role for the promotion of crop diversification. Results obtained so far included demographic data about the 2 IA's and enumeration of problems relating to their organizational functions. The Sibester IA is currently more viable than CPPL IA which has problems of uncooperative membership.

3.C Cavite Site

3-71 The advent of the NIA-Second Laguna de Bay Irrigation Project (SLBIP) in 1981 will increase the irrigated area in the wet season to an aggregate area of 13,160 ha. and 9,600 ha. for the dry season. Approximately 2,500 ha. will be programmed for vegetable production as part of this increase in area irrigated. The increased irrigated area will be generated by pumping water out of the Laguna de Bay lake to supply portions of the Cavite Friar Lands Irrigation Systems (CFLIS) service area.

3-72 The proximity of Cavite to Manila (approximately 40 km) favors marketing of vegetable. Furthermore, the relatively heavy or finer (clayey) type of soil in this area can be used for vegetable production as long raised beds and ridges are used in the field plots. The rainfall pattern in this area indicates distinct wet and dry seasons. The wet season starts in May and ends in October. Rainfall usually ends in November up to April. With these geographic, soil and climatic conditions vegetable production would be the logical direction for crop diversification. With a sizeable area programmed for non-rice (vegetables) in the dry season, field studies were conducted in this site.

3-73 NIA and MAF had an on going project as part of the development efforts to utilize the programmed or planned area of 2,500 ha. for vegetable production. This project was the promotion of white bean production. A task force committee was established chaired by the NIA SLBIP Project Manager. IIMI's involvement in this white bean project was to conduct research studies on the crop-water-soil relationship aspects of white bean production. The studies were more on the agronomic constraints to crop diversification.

3-74 The plan of the white bean task force was to convince farmers to plant white beans on an aggregate target area of 100 ha. The marketing and credit services were assumed to be available. However, due to unforeseen difficulties in providing credit, only the marketing aspects was assured. In spite of the several farmer meetings and a training only 21 ha. were finally planted to white beans. Unfamiliarity with a new crop production technology was also mentioned as one of the reasons for farmers' reluctance to try out planting white bean. Credit was also promised in these meetings. However, partial credit mostly in terms of seeds were finally availed of. Thus, the white bean production fell short of its objectives.

3-75 The studies undertaken by IIMI are 1) the evaluation of the single-row and double-row furrow irrigation and 2) the drought and flooding (water-logging) tolerances of the white bean crop. The site for the first study was changed three times. This was due to the unforseen reluctance of farmers to plant white beans.

3-76 The site finally selected was at the Bankud Irrigation System, a part of the S.F. de Malabon estate, in the town of Gen. Trias, Cavite. The majority of the farmers who finally planted white beans are located in this area. This was due to the familiarity of the farmers with the white-bean production technology. It was at this area where white bean production was pilot tested a year ago. The successful outcome of this pilot experience contributed to their adoption of white-bean production the second time around. Incentives, in terms of credit on seeds and fertilizers, assured market and assistance on land preparation expenses, have contributed to their acceptance of planting white beans for the second time in a row.

3-77 Results of the furrow irrigation study indicated that double row furrow irrigation uses less water but has the same yield as the single row furrow irrigation (Table 3.C.1).

3-78 The drought and flooding tolerance study on the white bean crop is undertaken at the UPLB experiment station using pots and lysimeter tanks. Results show that flooding (water-logging) white bean on three consecutive days results in total crop failure. The drought tolerance aspects of the study did not yield any significant results due to December rains coinciding with the reproductive stage of the white bean crop planted.

3-79 Economic aspects of white-bean production are also being evaluated. An input and output survey of crop production was conducted on sample farms that planted white beans. Despite an all-out effort to promote white bean production a few farmers suffered a net loss (Tables 3.C.2 and 3.C.3). These were all farmers who planted white beans for the first time. The break even yield is supposedly at 528 kg/ha. Farmers who did not strictly follow the scheduled planting, fertilizer and pesticide dosage obtained low yields. The white-bean crop is sensitive to high temperature especially during pod formation stage and the recommended planting period is supposedly from early November to mid December, so that the pod formation is in cold periods in January and February. Fertilizer amounts and timing is critical so as to promote growth and for nodule utilization. Control of bean fly and root rot (fungal disease) are the two most common pest and disease that infest the white-bean crop. The survey results show that most farmers in the sample made a profit, demonstrating the viability of crop diversification when external conditions are favorable.

3.D. Other sites

3-80 In addition to the 3 sites selected for this study, 4 more sites were added to gain more insights and provide information as part of the literature review on irrigated crop diversification. These sites are at the San Fabian River Irrigation System (SFRIS), Agno River Irrigation System (ARIS)(both in Pangasinan), Talavera River Irrigation System (TRIS)(Nueva Ecija) and the Laoag-Vintar River Irrigation System (LVRIS)(Ilocos Norte).

3-81 These irrigation systems operate under favorable conditions for irrigated crop diversification because no rain is expected from October to April in the dry season. With this rainfall pattern, irrigation water from river flows consequently decreases in the dry season. Only a small portion (1/3) of the service area is programmed for rice irrigation. The rest of the area is programmed for non-rice crops (tobacco, garlic, onion, mungbean and cotton). The soils in these systems are also suitable for upland crop cultivation, ranging from clay loam to sandy loam. Farmers have long practiced crop diversification in the dry season and have developed considerable familiarity with irrigation methods.

3-82 The research staff of the Department of Agricultural Education and Rural Studies (DAERS) of UPLB were commissioned as local consultants for this study, which aimed at the economics (input and output), and farmer decision making aspects of irrigated crop diversification. O&M procedures at these sites are also being evaluated. Of particular interest in studying these systems will be the conditions that have made irrigated crop diversification successful. Limited irrigation water supply, no rainfall, soil suitability, familiarity with irrigated non-rice production technology and favorable market conditions all combine to provide a suitable environment for crop diversification.

3-83 The farmer decision making aspects of this study are being extended to cover the Allah Valley sites to complement the existing constraint studies. Data from this study will also be shared with the IRRI-IFPRI study.

4. Reports on related activities

4.A Collaboration with the IRRI-IFPRI study

4-01 As part of the study activities, collaborative arrangements with IRRI-IFPRI study staff have been carried out. After the presentation of the inception report, in the during formation of the study advisory committee.[4] in September 1985, the IRRI-IFPRI study was represented by Dr. J. Sison. Minutes of the first meeting can be found in Annex V Informal discussions between IIMI and the IRRI-IFPRI staff have been going on with regards to the sharing of data for this particular study. Joint farmer surveys have been undertaken at BARIS, Cavite and at Laoag-Vintar RIS. Operationalizing this collaborative efforts were even done in sharing the expenses incurred in the hiring of enumerators and related field expenditures. Two sets of questionnaires were filled in order that both IIMI and IRRI-IFPRI would have access to the raw data.

4-02 To formalize these arrangements, letters of intent were exchanged (Annex VI). The IIMI staff were also invited and participated during the presentation of the IRRI-IFPRI study interim report for the Philippine component to the ADB in November, 1985. In spite of the delay (3 months in the start of the IIMI study (T.A. PHI 654), the input to the IRRI-IFPRI study will still be fulfilled. Moreover, copies of IIMI and IRRI-IFPRI reports have been provided to each other. It is expected that no shortcomings on the part of the IIMI study, as far as sharing of information and data for the IRRI-IFPRI study will occur in the Philippine component.

4.B Study review mission report

4-03 As part of the technical assistance agreement for this study, a review mission was conducted on March 4-8, 1986. The main purpose of the review mission was to assess the progress of the study. The program for this review mission consisted of briefings, oral and written presentations of the different component studies being implemented by the IIMI staff and the local consultants (contracted research from the research staff of local universities). The participating agencies were ADB, IIMI, NIA, MAF-ARO, PCARRD, ISU and USM. The review team consisted of the staff from the above agencies that visited each study site,[5] namely; Isabela, Cavite and Allah Valley (South Cotobato). A detailed report on this study review mission is in Annex VII.

4.C Report on the Taiwan study tour

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[4]The (T.A. PHI 654) study advisory committee (SAC) was formed consisting of the NIA Administrator (chairman), MAF-ARO Director, representatives from ADB, IIMI and IRRI-IFPRI and the IIMI Project Coordinator (SAC secretary).

[5]. The study sites not included in this review mission were in the provinces Nueva Ecija, Pangasinan and Ilocos Norte. However, these sites are also part of this study whereby component studies on documenting "successfully" operated systems are being implemented.

4-04 The study tour to Taiwan was organized through the Council of Agriculture of the Republic of China. However, preliminary discussions with Mr. Ko Hai Sheng, Project Engineer ADB, were held before the final decision was made to pursue this study tour. The discussions were basically to determine what Taiwan can offer in terms of learning existing technologies in irrigated crop diversification. Thus, a study tour was finalized and the participation of Drs. Valera and Johnson were made known to Dr. Takase, IRDD Director ADB. However, Dr. Johnson was not able to join the group to visit Taiwan.

4-05 The main purpose of the study tour was to learn more through actual observations and discussions with the concerned staff about the present and evolutionary aspects of irrigation technologies for crop diversification. The participation of Dr. Valera to this study tour was in relation to the current ADB supported study on irrigation management for crop diversification. It was envisioned that there are certain aspects in the current Philippine study which will benefit from the experiences in Taiwan. Furthermore, the study tour can be viewed as contributing to the future directions of the current Philippine study or providing an alternative course for irrigation development in crop diversification. The details of this trip report is in Annex VIII.

4.D Literature review

4-06 The literature review for this study is still being undertaken. As part of the literature review, other sites were added on gain useful information on existing irrigation systems whereby crop diversification is being practiced during the dry season. The study on these systems was in reported in section 3.D. Nevertheless, a more comprehensive literature review on irrigated crop diversification will be presented in the next report.

5. Preliminary assessments of the study component constraints

5-01 The assessments made in this section of the report are tentative in nature and should be taken as initial impressions on the preliminary results obtained at this stage of the study. Final conclusions and recommendations will be made when the complete data set and analytical results are available. Any significant changes in results presented in this report will be specifically brought out in the next report.

5.1 Irrigation constraints

5-02 Four main irrigation constraints to crop diversification have been identified at this stage of the study: dry season rainfall patterns, availability of irrigation water, limitations in irrigation management and inappropriate on-farm irrigation and drainage facilities. These are discussed in detail in the following paragraph.

5-03 At Allah Valley and to some extent at Isabela sites, there is frequently sufficient rain to permit upland crop production without irrigation water. The benefits of providing irrigation facilities in such conditions promote rice cultivation because of the dangers of waterlogging when rainfall occurs after irrigation. The successful areas of crop diversification have occurred in areas with little or no dry season rainfall, as shown by the resalts at Pangasinan, Nueva Ecija and Ilocos Norte. Crop diversification programs must be sensitive to the difficulties of growing non-rice crops when dry season rainfall is generally reliable.

5-04 At the Allah Valley and Isabela sites, crop diversification is to a large extent discouraged by the oversupply of irrigation water. Irrigation is seen as synonymous with rice production. If water is delivered in sufficient quantities to grow rice, it becomes difficult to grow irrigated upland crops. This is true at the Allah Valley site, where lateral seepage affects plots of corn adjacent to rice fields. In Isabela, water is currently delivered at rates 2 to 3 times more than the designed, encouraging farmers to grow rice rather than other crops. It is difficult to achieve crop diversification under such conditions and it is essential that systems are better managed to deliver appropriate volumes of water for crop needs.

5-05 Irrigation management techniques have not yet been developed in any of the sites that allow more precise deliveries of water. Results in all sites show that almost all irrigation is continuous in the main system of the irrigation network, making farmers manage water moisture sensitive crops. Lack of measuring devices and inadequate control facilities make it extremely difficult to deliver large volumes of water at intermittent periods, which is optimal for diversified crops. The experience in Taiwan demonstrates clearly that strict control over water is the foremost factor in developing farmer confidence in their water supplies for crop diversification. It is suggested that improvements are made in scheduling water deliveries for diversified crops, and attention be paid to the need for increased control structures and measuring devices to allow greater control over water deliveries.

5-06 On-farm irrigation facilities require modifications to provide the proper water conditions for diversified crops. Continuous flows of irrigation water result in waterlogging on heavier soils and require long periods of management on fields. To overcome these constraints it is recommended that irrigation deliveries be rescheduled to provide large volumes to be delivered for shorter periods to speed up irrigation from 3 to 1 day(s) per hectare. To attain this, it will require additional investigations in determining optimal ditch density of farm irrigation and drainage ditches and development of less erodible farm channels. Farmers are recommended to adopt furrow irrigation rather than basin flooding to speed up the time of irrigation and provide more uniform water applications on their farms.

5.2 Agronomic constraints

5-07 There is widespread unfamiliarity with the non-rice crop production under irrigated conditions. In Allah Valley and Isabela most non-rice crops are grown under rainfed conditions, or through the utilization of seepage water from adjacent rice fields. Where dry season rainfall is adequate in most seasons, there is clearly unwillingness to risk waterlogging of non-rice crops using irrigation water. The result is that yields do not reach their full potential and production is much lower than rice. In the drier areas, there is a wider acceptance of crop diversification, and improved agronomic practices are evident. It is recommended that in areas where rainfall is more widespread in the dry season, a greater effort be made to demonstrate the benefits of irrigation of diversified crops, particularly in the timing of irrigations in relation to the growth stages of the plant, and the need to determine when irrigation is required to avoid moisture stress. This must supported by irrigation management more responsive to crop water requirements.

5-08 Timing of cultivation of non-rice crops is particularly important when there are factors such as temperature, incidence of pests and diseases and risk of waterlogging through heavy rainfall. Cropping patterns will have to be evaluated in light of these environmental factors that do not have such an impact on rice production. This in turn requires greater attention to cropping schedules and a clear identification of seasons in which non-rice crops should be promoted.

5-09 The results from Cavite demonstrate that agronomic constraints to crop diversification can be overcome with a proper extension effort, and assistance in procuring appropriate crop care technology. In other sites it is recommended that more emphasis be placed on agronomic constraints so that production levels can be raised to an attractive level.

5.C Economic Constraints

5-10 The main economic constraints identified in this study are the unfavorable prices for most crops in comparison to rice, and the higher costs of crop care for diversified agriculture. Even if irrigation constraints to diversification are alleviated there is no guarantee that the economic conditions will favor widespread adoption of diversified cropping.

5-11 Where market prices are assured, and have comparable stability to rice prices, there is clear evidence that crop diversification can be achieved. The Cavite study demonstrates that most farmers who have grown white beans in one season will continue to grow them in following seasons. At Sibester, one reason cited by farmers as the constraint to crop diversification is the unstable farm gate price of corn. In other sites marketing arrangements have not been so favorable, and diversification has been retarded. It is recommended that price incentives for diversification be increased, both in the form of direct pricing policies, and indirect incentives such as the reduction or waiving of irrigation service fees for farmers growing non-rice crops.

5-12 In all sites the overall costs of production for non-rice crops are higher than for rice production, although labor requirements are less. At present this is due to low production levels, and removal of agronomic constraints would raise the profitability of diversified cropping. Support for input costs, as in the Cavite case, is removing some of the risks for farmers and encouraging them to shift away from rice production. However, this has been specifically undertaken to generate guaranteed supplies for the bean processing industry. Similar total package support, including input and output considerations, is recommended in other areas in conjunction with improved irrigation and agronomic measures.

5.D Institutional Constraints

5-13 Despite the formation of Irrigator Associations and the creation of linkages between these organizations and NIA, there is a clear need for better communication between the two groups. Seasonal decisions are being ignored, making it harder to implement regular rotations and adhere to proposed cropping schedules. Deliberate breaks in irrigation schedules in response to rainfall, need to be better communicated to farmers to reduce the uncertainty over timing of irrigation deliveries. Finally the organizational viability of these organizations have to be viewed in the light of existing irrigation water needs of the farmers.

6. Administrat~~ive details for the implemetation of~~ the study

6.A Remaining activities for the study

6-01 This interim report provides the direction for the succeeding activities of the study. Data collection will be to continue until September 1986 (Table 6.1) at the Allah Valley site. The major activities remaining will be the data summary, analyses and final report preparation. In addition to the reports to be made for submission to ADB, preparation for research paper will also be undertaken for the international workshop on irrigated crop diversification.

6-02 IIMI will sponsor an international workshop on irrigated crop diversification in October 1986 at IIMI headquarters at Digana Village, Kandy, Sri Lanka. This will be an opportunity to present the findings or results of the studies undertaken primarily in the Philippines, Indonesia and Sri Lanka. Other countries will also be represented in this workshop. IIMI's broad objectives in this workshop is to bring together results of studies pertinent to irrigation management for crop diversification.

6-03 IIMI is required (Para 4.06 of the T.A. Agreement) to initiate consultations with ADB and the Government to decide whether related follow-up activities are needed after completion of the study at the end of 1986. Because the dry season begins in October, however, it is essential that this decision be made at the presentation of the draft Final Report and/or the meeting of SAC at that time.

6.B. Expected output for the draft of the final report

6-04 The expected output of the draft of the final report will be based on the studies undertaken to fulfill the objectives or terms of reference for this study. Completed analysis in the irrigation constraints and suggested ways to overcome these constraints will be presented. These will be in precise terms since all the data have been collected and analyzed. Likewise for the other constraints (agronomic, economic and institutional), examination of the constraints will have been completed. However, all of the findings and whatever suggestions or recommendations emanating therefrom, will be based on the indicative nature of the results from the studies undertaken.

6-05 Furthermore, a substantial presentation of the literature review on the factors affecting irrigated crop diversification will also be presented. Nevertheless, the draft of the final report will provide the basis for the extension or termination of the study.

6.C. Budget for the study

6-06 During the first year of the study expenditures on certain items have exceeded the budget (Table 6.2). However, it is projected that the second year budget will be adequate to cover the second year expenses and the excess expenditure in the first year. It is requested that the transfers of money from budget items be allowed to facilitate the implementation of the remaining activities for the study.

6.D. Staffing adjustments

6-07 Presently, there are (6) local staff directly hired by IIMI. Five of these are directly involved in the data collection and analysis. Recently, a clerk typist was hired to help out in the administrative portion of the study particularly in the preparation of reports and accounting activities.

6-08 Moreover, with the forthcoming termination of the data collection at the Cavite and Isabela sites, the research assistants will be utilized for data summary and partly for the gathering of materials for the literature review.

Table 2.1 Constraints and the corresponding component studies comprising the study on irrigation management to promote crop diversification.

1) Irrigation Constraints

Objective(s): To examine the irrigation constraints to crop diversification and find ways to overcome these constraints

Studies: Irrigation water management (on-farm and irrigation system levels) studies

1. System management studies at BARIS[1], MCIS and MRMP (Allah Valley and Isabela)[2]
2. Evaluation of furrow and furrowed-basin irrigation methods at ARIP-PTDF#2, BARIS and MCIS (Allah Valley)
3. Proposed water management scheme for the ARIP-PTDF#2 (Allah Valley)
4. Evaluation of double-row and triple-row furrow irrigation method for corn (Isabela)
5. Evaluation of single-row and double-row furrow irrigation method for white-beans (Cavite)

2) Agronomic Constraints

Objective(s): To examine irrigated non-rice crop management practices and plant-soil-water relationships affecting crop production

Studies: Identification of suitable high-yielding varieties of non-rice crops and appropriate crop management practices; Examination of plant-soil-water relationships affecting irrigated non-rice crop production

1. On-farm testing of alternative crops (mungbean, peanut and improved traditional corn variety) on rice-based cropping patterns at ARIP-PTDF#2, BARIS and MCIS (Allah Valley)
2. Agronomic evaluation of an alternative crop (peanut) for rice-based cropping pattern at MRMP (Isabela)
3. Simulation and validation of soil water and root distribution of corn (Isabela)
4. Consumptive use of white-beans and its tolerances to drought and flooding conditions (Cavite)
5. Documenting the horizontal movement and spatial distribution of soil moisture at MCIS (Allah Valley)
6. Agro-socio-economic profile survey of farmers at ARIP-PTDF#2 and BARIS (Allah Valley)

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[1] For the corresponding meaning of the abbreviations see Annex IX.

[2] The site where the study is being conducted

Table 2.1 continuation ....

3) Economic Constraints

Objective(s): To gather information on the economics of irrigated non-rice crop production that would lead to the identification of the economic constraints to crop diversification

Studies: Input and output aspects of irrigated and rainfed non-rice crop production

1. Profitability and labor use of the different cropping patterns at BARIS and MCIS (Allah Valley)
2. Economic aspects of crop diversification at selected sites within the MRMP service area (Isabela)
3. Successful irrigated crop diversification at SFRIS, ARIS, TRIS and LVRIS (other sites; Pangasinan, Nueva Ecija and Ilocos Norte)
4. Agro-socio-economic profile survey of farmers at ARIP-PTDF#2 and BARIS (Allah Valley)

4) Institutional Constraints

Objective(s): To gather information on the problems associated with the formation and operation of irrigators associations and on the farmer decision-making aspects relevant to irrigated crop diversification

Studies: Institutional arrangements and farmer decision making aspects on irrigated crop diversification

1. Agro-socio-economic profile survey of farmers at ARIP-PTDF#2 and BARIS (Allah Valley)
2. Management and operations of the irrigation associations at selected sites within the MRMP service areas (Isabela)
3. Successful irrigated crop diversification at SFRIS, ARIS, TRIS and LVRIS (other sites)

Table 3.A.2 Total water requirement (TWR), actual irrigation supplied (IR), actual rainfall (RF) and relative water supply (RWS), total available water (TAW) at Banga River Irrigation system, wet season, 1985.

Wk. No.	Date	TWR (mm/wk)	IR (mm/wk)	RF (mm/wk)	TAW (mm/wk)	RWS[1]
35	Aug 27-Sep 3,1985	77	39	80	119	1.55
36	3-9	77	39	140	179	2.32
37	10-16	78	17	69	86	1.10
38	17-23	79	52	34	86	1.09
39	24-30	81	41	38	79	0.98
40	Oct 1-7	73	39	34	73	1.00
41	8-14	64	37	63	100	1.56
42	15-21	56	29	87	116	2.07
43	22-28	47	18	38	56	1.19
44	29-Nov 4	39	44	16	60	1.54
Mean		67	36	60	95	1.44

[1] $RWS = \dfrac{IR + RF}{EV + S\&P}$ = Relative Water Supply

EV = Evaporation (4mm/day)
S&P = Seepage & Percolation (8mm/day)

Table 3.A.3 Total water requirement (TWR), actual irrigation supplied (IR), actual rainfall (RF) and relative water supply (RWS), total available water (TAW), Banga River irrigation system, dry season, 1985-86

Wk. No.	Date	TWR (mm/wk)	IR (mm/wk)	RF (mm/wk)	TAW (mm/wk)	RWS[1]
45	Nov 5-11,1985	91	104	0	104	1.14
46	12-18	91	74	11	85	0.93
47	19-25	91	54	30	84	0.92
48	26-Dec 2	91	65	3	68	0.74
49	Dec 3-9	91	76	28	104	1.14
50	10-16	91	60	121	181	1.99
51	17-23	91	65	11	76	0.83
52	24-31	91	95	10	105	1.14
1	Jan 1-7,1986	91	81	2	83	0.90
2	8-14	91	92	12	104	1.13
3	15-21	91	101	31	132	1.44
4	22-28	91	57	36	93	1.02
5	29-Feb 4	91	44	23	67	0.73
6	Feb 5-11	91	63	5	68	0.75
7	12-18	91	71	11	82	0.90
8	19-25	91	85	3	88	0.96
9	26-Mar 4	71	110	2	112	1.57
10	Mar 5-11	52	55	9	64	1.22
11	12-18	33	58	0	58	1.76
12	19-25	14	80	0	80	5.74

$$^{1}RWS = \frac{IR + RF}{EV + S\&P} = \frac{TAW}{EV + S\&P}$$

Table 3.A.4 Weekly rainfall and actual irrigation water supplies at the headgate (MC) and for the canals at groups I, II and III BARIS, wet season, 1985-86.

Wk. No.	Date	RF (mm/wk)	MC (lps)	Grp I (lps)	Grp II (lps)	Grp III (lps)
45	Nov 5-11, 1985	0	1892	1038	521	107
46	12-18	11	1356	561	369	79
47	19-25	30	992	377	203	66
48	26-Dec 2	3	1190	446	245	7
49	Dec 3-9	28	1384	298	623	0
50	10-16	121	1088	126	499	0
51	17-23	11	1190	193	455	0
52	24-31	10	1728	175	438	0
1	Jan 1-7	2	1473	286	706	0
2	8-14	12	1680	504	567	0
3	15-21	31	1850	351	397	0
4	22-28	36	1048	258	155	0
5	29-Feb 4	23	804	238	450	0
6	Feb 5-11	5	1151	112	400	0
7	12-18	11	1305	144	542	0
8	19-25	3	1556	236	589	0
9	26-Mar 4	2	2002	564	374	0
10	Mar 5-11	9	999	0	390	0
11	12-18	0	1066	23	574	0
12	19-25	0	1465	0	574	0

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