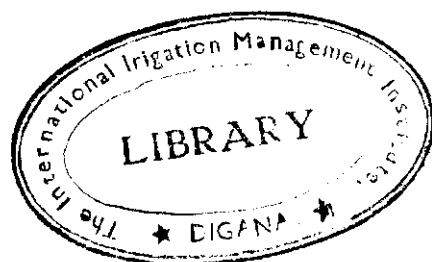


**INTERIM REPORT ON THE TECHNICAL ASSISTANCE STUDY
(TA 654 PHI)**

ON

**IRRIGATION MANAGEMENT FOR CROP DIVERSIFICATION
(Philippines)**



Submitted by :

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Executive Summary

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 insufficient 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 Diversification¹
(Philippine Component)

1. Introduction

The IRRI-IFPRI study² 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 focus 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 which 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.

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

²The 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 upland³ 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.

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 equipment. 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 (PTDF #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 (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 area 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 1st 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 coarse 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 as 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 unforeseen 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 Cotabato). A detailed report on this study review mission is in Annex VII.

4.C Report on the Taiwan study tour

⁴The (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 results 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 be 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. ~~Administrative 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 Isabelita 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 BARIS¹, 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)

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

² The site where the study is being conducted

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

$$^1\text{RWS} = \frac{\text{IR} + \text{RF}}{\text{EV} + \text{S\&P}} = \text{Relative Water Supply}$$

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

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

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

Table 3.A.5 Weekly rainfall and actual irrigation water deliveries at the headgate (MC) and lateral canals of groups IV, V and VI BARIS, dry season 1985-86.

Wk. No.	Date	RF (mm/wk)	MC (lps)	Grp IV (lps)	Grp V (lps)	Grp VI (lps)
45	Nov 5-11, 1985	0	1892	134	61	28
46	12-18	11	1356	281	40	28
47	19-25	30	992	339	21	0
48	26-Dec 2	3	1190	375	58	60
49	Dec 3-9	28	1384	0	311	233
50	10-16	121	1088	0	265	286
51	17-23	11	1190	136	346	294
52	24-31	10	1728	167	524	489
1	Jan 1-7	2	1473	0	228	253
2	8-14	12	1680	46	274	289
3	15-21	31	1850	0	298	347
4	22-28	36	1048	0	89	304
5	29-Feb 4	23	804	121	129	159
6	Feb 5-11	5	1151	205	154	228
7	12-18	11	1305	331	213	314
8	19-25	3	1556	294	299	316
9	26-Mar 4	2	2002	268	200	384
10	Mar 5-11	9	999	172	175	278
11	12-18	0	1066	253	136	261
12	19-25	0	1465	184	319	390

Table 3.A.6 Ranked production problems as perceived by sample farmers
(in percent) at BARIS, wet season, 1985.

<u>PROBLEMS</u>	<u>RANK</u>		
	<u>1</u>	<u>2</u>	<u>3</u>
High land rental or sharing percentage	9	12	4
Inadequacy of labor	0	8	0
High cost of labor	0	26	21
High cost of farm inputs	92	8	1
High costs of hiring mechanized services (e.g. tractor)	2	36	11

Table 3.A.7 Ranked marketing problems as perceived by sample farmers
(in percent) at BARIS, wet seasons, 1985

<u>PROBLEMS</u>	<u>RANK</u>		
	<u>1</u>	<u>2</u>	<u>3</u>
Low price of farm produce	85	21	0
Lack of marketing outlets	0	0	2
Marketing tie - up with landlord	0	1	3
Marketing tie - up with money lender	0	7	4
Lack of transport facilities	0	0	3
Far distance of farm to market	0	8	7
Poor roads from farm to market	0	6	20
High transporting cost	1	15	15
Lack of grading and standardizing of products	19	28	6

Table 3.A.8 Profitability and labor use of different cropping patterns at BARIS, wet season 1985.

	CROPPING PATTERN		
	RICE	CORN	RICE-CORN
Profitability/Labor Use	(n = 93)	(n = 7)	(n = 6)
1. GROSS FARM INCOME (GFI) (total value of produce minus paid cost in P/ha)	5,754	2,933	4,866
2. FARM PROFIT OR TRUE NET INCOME (GFI minus owned inputs in P/ha)	4,076	2,537	3,099
3. Availability of Labor			
Percentages who responded			
Enough	64	65	
Plenty	31	32	
Few	4	0	
No answer	1	3	
4. Labor requirements per ha.			
Man-days	70	49	57
Man-animal days	16	10	18
Man-machine days	7	6	6

Table 3.A.9 Weekly actual irrigation water flow and rainfall at Mani Communal Irrigation System, wet season, 1986.

Wk. No.	Date	IR (mm/wk)			RF (mm/wk)
		Total ¹ (732)	Section A(300)	Lateral B(432)	
35	Aug 27-Sep 2, 1985	30	54	14	59
36	Sep 3-9	45	76	23	45
37	10-16	35	63	15	65
38	17-23	44	79	19	38
39	24-30	41	72	20	115
40	Oct 1-7	44	78	20	43
41	8-14	42	77	19	82
42	15-21	36	66	14	51
43	22-28	30	58	10	10
44	29-Nov 4	26	48	10	2

¹Total irrigation water flow do not equal the amount entering section A and lateral B due to re-use or surface drainage flowing back into the canal.

Table 3.A.10 Weekly irrigation water flows (IR) and rainfall (RF) at Mani River Communal Irrigation System, dry season 1985-86.

Wk. No.	Date	IR (mm/wk)			RF (mm/wk)
		Total* (492)	Section A(300)	Lateral B(192)	
	Area (ha.)				
45	Nov 5-11, 1985	63	73	47	2
46	12-18	90	98	76	1
47	19-25	86	104	58	11
48	26-Dec 2	4	7	0	14
49	Dec 3-9	95	108	73	40
50	10-16	80	87	70	6
51	17-23	37	34	41	36
52	24-31	92	109	66	5
1	Jan 1-7, 1986	63	74	47	3
2	8-14	90	99	77	27
3	15-21	25	29	20	29
4	22-28	0	0	0	148
5	29-Feb 4	0	0	0	7
6	Feb 5-11	49	56	40	15
7	12-18	60	65	52	11
8	19-25	80	86	70	11
9	26-Mar 4	51	53	49	4
10	Mar 5-11	56	61	49	0
11	12-18	46	54	34	0
12	19-25	66	77	48	21

* Total irrigation water flows do not equal the amount entering section A and lateral B due to the reuse or surface drainage flowing back into the canal.

Table 3.A.11 Average input and output costs of production for rice and corn at MCIS, wet season, 1985

	RICE FARMS	CORN FARMS
I. No. of respondents	(n = 47)	(n = 10)
II. Average Farm Area (ha)	1.43	1.47
III. Average Yield per ha (kg)	4288.76	3325.10
IV. Economics of Production		
A. Average value of production per hectare (P)	11485.48	6817.33
B. Paid-out Cost (POC)		
a. Material & Other Expenses	969.33	825.44
b. Land Rent	940.28	667.06
c. Irrigation Fee	280.65	0.00
d. Hired Labor	1983.30	1360.61
Sub-total	4173.50	2853.11
C. Imputed Cost of Owned Inputs (COI)		
a. Family Labor	1297.16	821.31
b. Exchange Labor	73.65	112.24
c. Materials & Other Expenses	420.50	10.20
Sub-total	1791.31	943.25
D. Gross Farm Income (GFI)	7311.93	3964.22
E. Net Farm Income (NFI)	5520.62	3020.49

Table 3.B.1 Comparison between the prices of rice and corn SIBESTER IA
1981-1985

YEAR & SEASON	PRICE PER KILO		Difference
	Rice	Corn	
1981			
Dry	1.54	1.41	1.12
Wet	2.57	1.52	1.05
1982			
Dry	2.69	1.60	1.09
Wet	2.76	1.78	0.98
1983			
Dry	2.92	2.36	0.56
Wet	2.79	2.39	0.40
1984			
Dry	3.07	2.67	0.40
Wet	3.13	2.41	0.72
1985			
Dry	3.32	1.72	1.60
Wet	3.50	1.50	2.00

Table 3.B.2 Weekly irrigation diversion requirement (IDR), actual irrigation water supplied (IR), rainfall (RF) and relative relative water supply (RWS), Magat River Irrigation System, District II, Lateral A, dry season 1985-86.

Week No.	Date	IDR	IR	RF	RWS
		(mm/wk)	(mm/wk)	(mm/wk)	
40	Oct1-6 1985	256	213	21	0.91
41	7-13	244	213	13	0.93
42	14-20	206	124	146	1.31
43	21-27	220	75	145	1
44	28-Nov 3	257	214	63	1.08
45	Nov 4-10	209	234	30	1.26
46	11-17	207	244	20	1.28
47	18-24	201	251	34	1.42
48	25-Dec 1	198	249	41	1.46
49	Dec 2-8	188	250	44	1.56
50	9-15	185	257	5	1.42
51	16-22	176	260	9	1.53
52	23-29	174	261	7	1.54
1	30-Jan 5, 1986	172	255	1	1.49
2	Jan 6-12	179	248	8	1.43
3	13-19	173	252	7	1.5
4	20-26	178	249	12	1.47
5	77-Feb 2	178	236	52	1.62
6	Feb 3-9	186	234	3	1.27
7	10-16	187	248	2	1.34
8	17-23	187	243	0	1.3
9	24-Mar 2	187	231	9	1.28
10	Mar 3-9	173	223	3	1.31
11	10-16	114	201	24	1.97
12	17-23	102	177	0	1.74
13	24-30	79	167	12	2.27
14	31-Apr 6	60	163	0	2.72
15	Apr 7-13	52	116	23	2.67
Mean		175	217	26	1.5

$$RWS = (IR + RF)/IDR$$

Table 3.B.3 Preliminary results of mean yield and agronomic characteristics of peanut grown under irrigated and rainfed conditions (1986 dry season, San Mateo, Isabela).

Agronomic Characteristics	Treatment				C.V.:	LSD (0.05)
	: Raised Bed:	Furrow:	Rainfed :			
No. of pods/plant	22	16	10	11.97		
Plant height, cm	40 ^a	34.7 ^b	33.24 ^b	2.24		3.46
Straw Yield, ton/ha.	3.20 ^a	2.20 ^b	1.30 ^c	4.05		0.079
Pod Yield, ton/ha.	2.98	2.44	1.65	12.94		
Seed Yield, ton/ha.	1.86	1.56	1.08	12.47		
100-seed weight, grams	51.2	57.7	44.8	10.6		
Shelling percentage, %	74	76	76	2		

C.V. - Coefficient of Variation

LSD (0.05) - Least Square Difference at 5% level of significance

Row mean values with the same letter are not significant

Table 3.B.4 Average input and output costs of production for rice, rice-corn, and corn at SIBESTER IA area, dry season, 1984.

	RICE (N = 18)	RICE-CORN (N = 18)	CORN (N = 8)
Total Income (P/ha)	12,704	20,486	7,440
Expenses (P/ha.)			
Fertilizer	1,334	3,020	1,113
Pesticides	547	1,157	427
Seed	555	1,307	503
Hired Labor	1,824	5,813	1,578
Land Rent	1,657	1,315	-
Irrigation	243	268	-
Family Labor	393	553	295
Total Expenses (P/ha)	7,453	12,880	3,916
Net Income (P/ha)	5,251	7,606	3,524

Table 3.C.1 Preliminary results of the study on the evaluation of the single-row and double-row furrow irrigation methods for white-bean at Cavite, dry season 1985-86.

Treatments	Plant Height (cm)	No. of pods/plant	No. of seeds/pod	No. of seeds/plant
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SINGLE ROW

T1	45.6	6	4	24
T2	49.1	7	4	28
T3	43.8	8	4	28
Average	46.9	7	4	27

=====

DOUBLE ROW

T1	41.2	7	4	30
T2	42.0	7	4	27
T3	34.9	6	4	23
Average	39.4	7	4	27

=====

Rate of flows for each treatment:

T1 = 15 gpm
T2 = 22.5 gpm
T3 = 30 gpm

Table 3.C.2 Data on the white-bean production at Cavite as provided by the White-Bean Task Force Committee, March 5, 1986.

<p>A. Total Area Planted - 21.28 ha. No. of Cooperators - 31 a) Gen. Trias - 25 cooperators Area - 10.49 ha. b) Tanza - 2 Area - 5.75 ha. c) Ternate - 4 Area - 2.04 ha.</p>	<p>B. Funding: a) Source : SA 803 Foundation b) Total Amount = P 60,000 c) Utilized amount = P36,000</p>												
<p>C. Market linkage: Universal Robina Corporation (URC) a) Seed Variety - Great Northern b) Amount of seeds used - 1608 Kg.</p>	<p>D. Total area harvested - 10.39 ha. a) No. of farmers - 23 b) Average yield - 978 kg.</p>												
<p>E. Cost and Returns per hectare:</p> <hr/> <p>Production - 978 kg. Value (@ P13.25/kg) - P 12,958.50</p> <p>Expenses:</p> <table> <tr><td>Seeds</td><td>- P 2555.10</td></tr> <tr><td>Fertilizer</td><td>- 1169.75</td></tr> <tr><td>Insecticide</td><td>- 1742.58</td></tr> <tr><td>Labor</td><td>- 1020</td></tr> <tr><td>Misc.</td><td>- 1250</td></tr> <tr><td>Total</td><td><u>P 7717.43</u></td></tr> </table> <p>Net Cash Returns P 5,241.07</p> <p>Break-even production per hectare - 528.45 kg/ha. Break-even price - P 7.89/kg</p>		Seeds	- P 2555.10	Fertilizer	- 1169.75	Insecticide	- 1742.58	Labor	- 1020	Misc.	- 1250	Total	<u>P 7717.43</u>
Seeds	- P 2555.10												
Fertilizer	- 1169.75												
Insecticide	- 1742.58												
Labor	- 1020												
Misc.	- 1250												
Total	<u>P 7717.43</u>												

Table 6.1 Schedule of the remaining activities for the study (T.A. 654 PHI).

Activities	May	June	July	August	September	October	November	December	
1. Data collection at a) Allah Valley b) Isabela c) Cavite d) Other sites	***** ***** *** *****	***** ***** ***** *****	***** ***** ***** *****	***** ***** ***** *****	***** ***** ***** *****	***** ***** ***** *****	***** ***** ***** *****	***** ***** ***** *****	***** ***** ***** *****
2. Data summary and analysis	*****	*****	*****	*****	*****	*****	*****	*****	
3. Report preparation	*****	*****	*****	*****	*****	*****	*****	*****	
4. Reports a) Draft of final report b) Final report	*****	*****	*****	*****	*****	*****	*****	*****	
5. Meetings and Workshops a) SAC meetings ¹ b) Crop Diversification workshop ²	*** *****	*** *****	*** *****	*** *****	*** *****	*** *****	*** *****	*** *****	
6. Preparation & start of follow-up activities ³ (TA extension)	*****	*****	*****	*****	*****	*****	*****	*****	

1 The study advisory committee (SAC) meetings, follow every presentation of the report to ADB and will make recommendations for the extension or termination of the study.

2 IIMI will sponsor an international workshop on irrigated crop diversification at Kandy, Sri Lanka in October 1986.

3 This activity will only commence upon recommendations of the SAC and approval for funding by ADB.

Table 6.2 Estimated budgets and expenditures for the study
(TA 654 PHI).

Item	First Year		Second Year Budgeted
	Budgeted	Spent	
1) Salaries and allowances	\$ 40,000	47,094.86	47,000
2) International Travel	10,000	7,475.49	15,000
3) Local Travel	10,000	16,451.15	12,000
4) Equipment, research supplies and vehicles	26,000	29,323.98	-
5) Contract research and training	10,000	24,418.01	10,000
6) Office expenditures, Supplies and services	20,000	6,833.71	25,000
7) Workshop	-	4,254.40	5,000
8) Contingency	10,000	-	-
Total	\$ 120,000	135,851.60	124,000

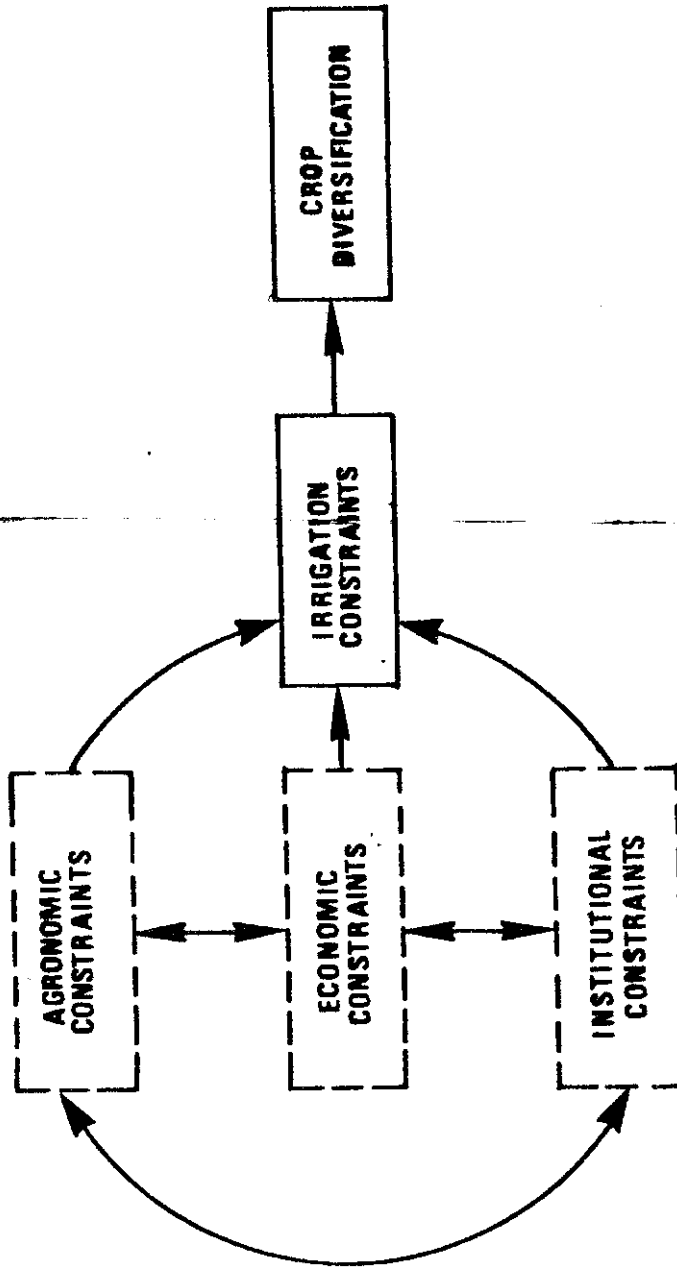


Figure 2.1 Schematic representation of the constraints to irrigated crop diversification

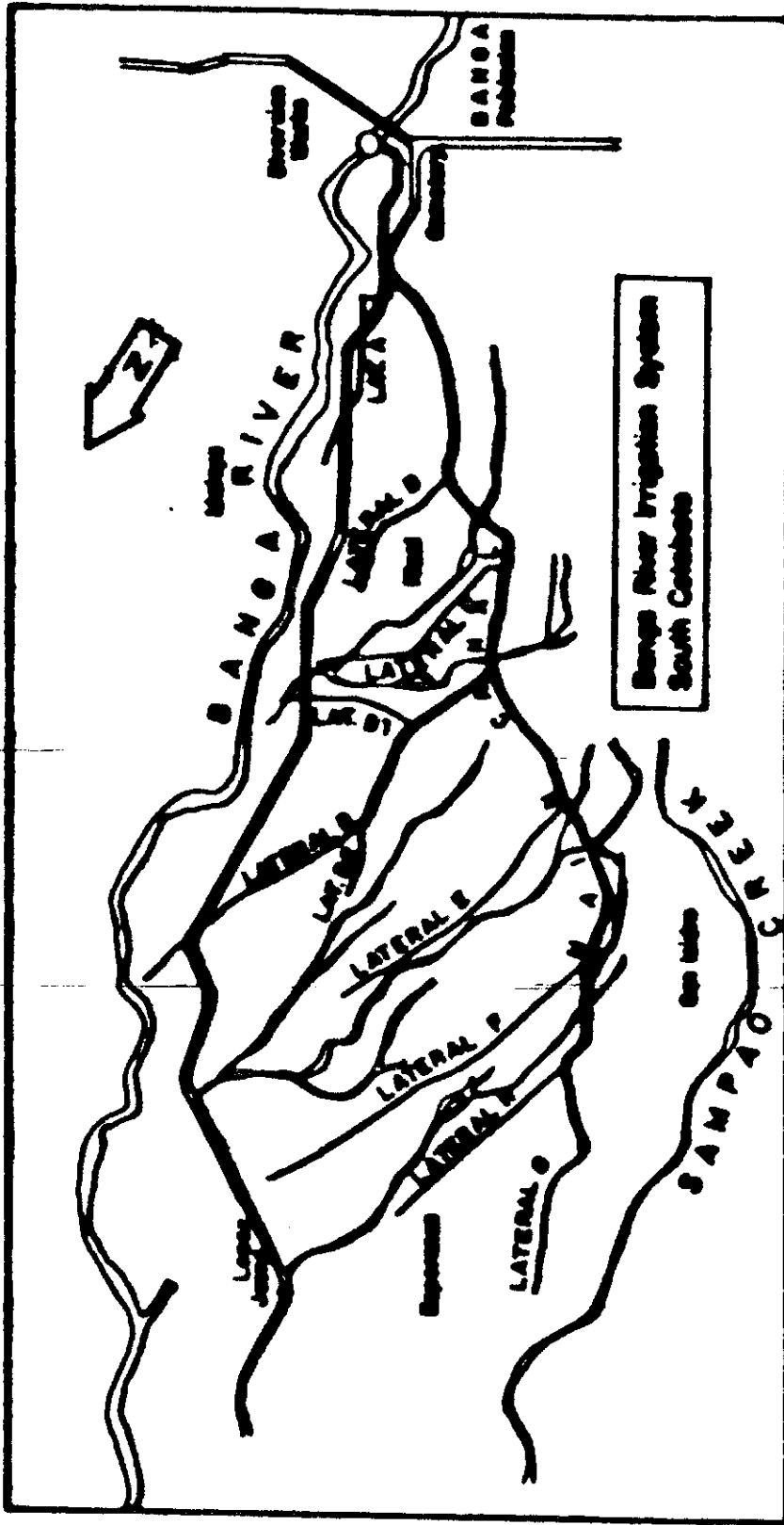


Figure 3.A.2 Schematic map of the service area of the Banga River Irrigation System (BARIS), South Cotabato.

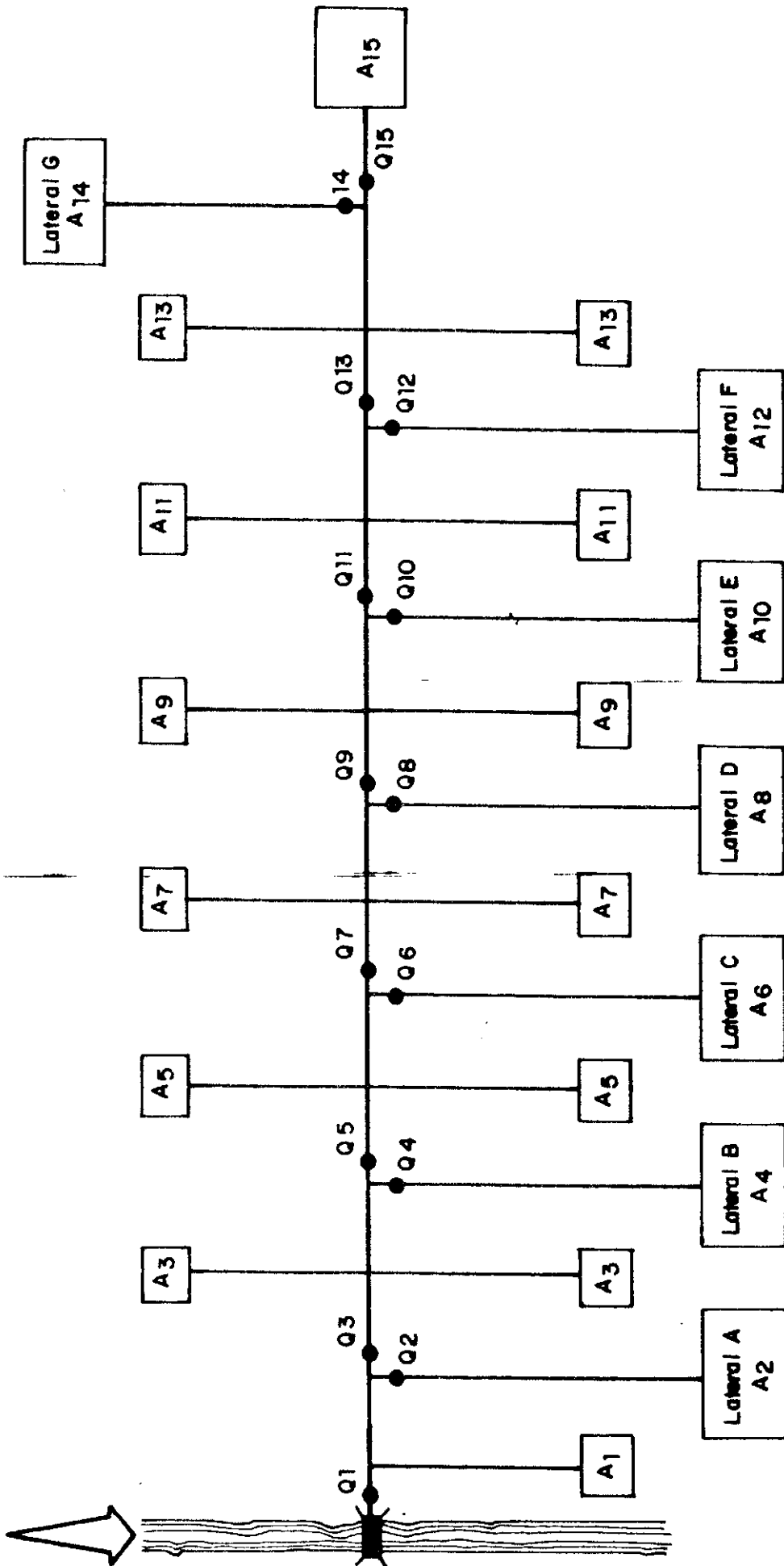
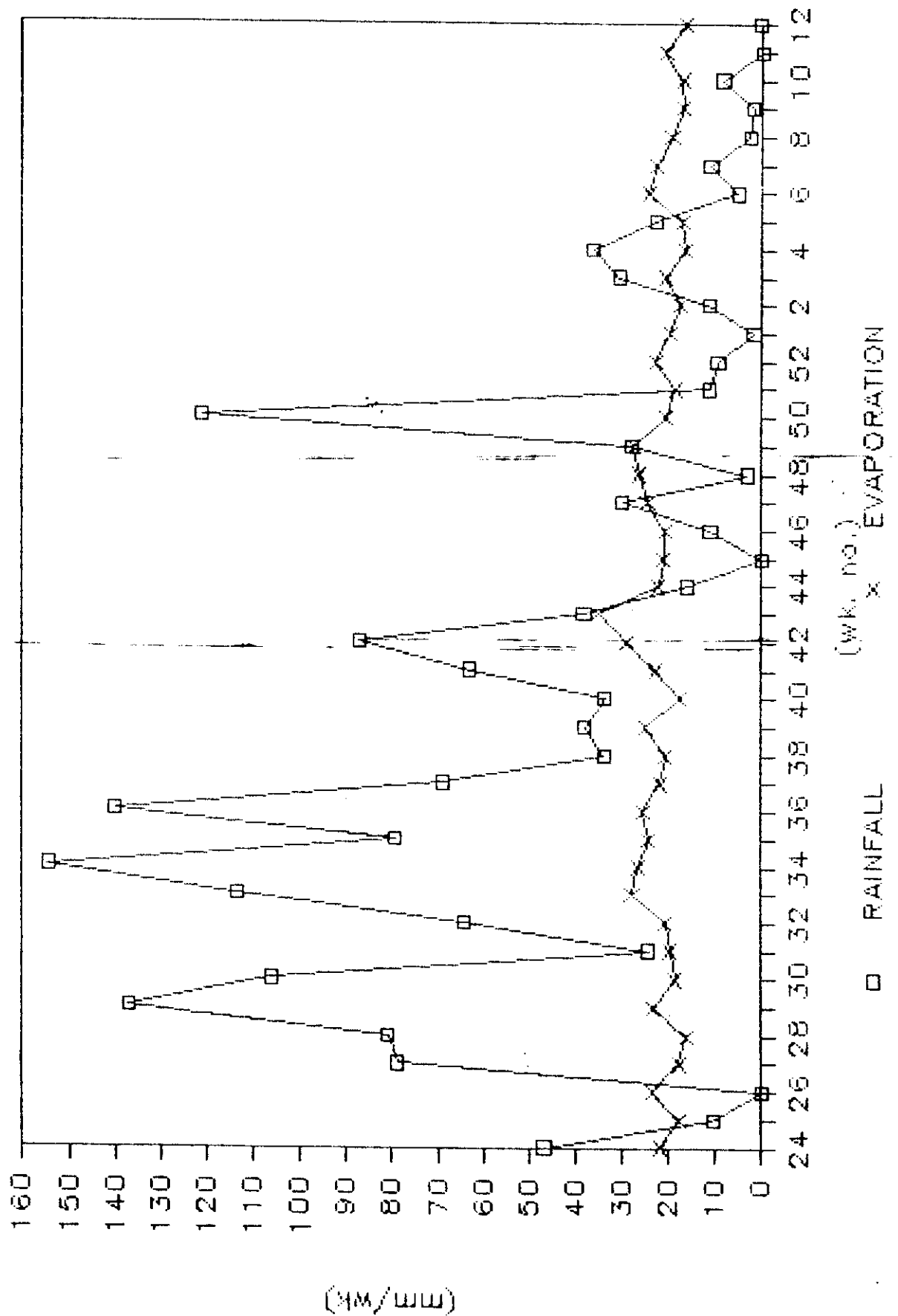


Figure 3.A.3 Schematic representation of the measuring points along the canal network of BARIS.

Figure 3.A.4 Weekly rainfall and evaporation at BARIS, wet and dry seasons, 1985-86.



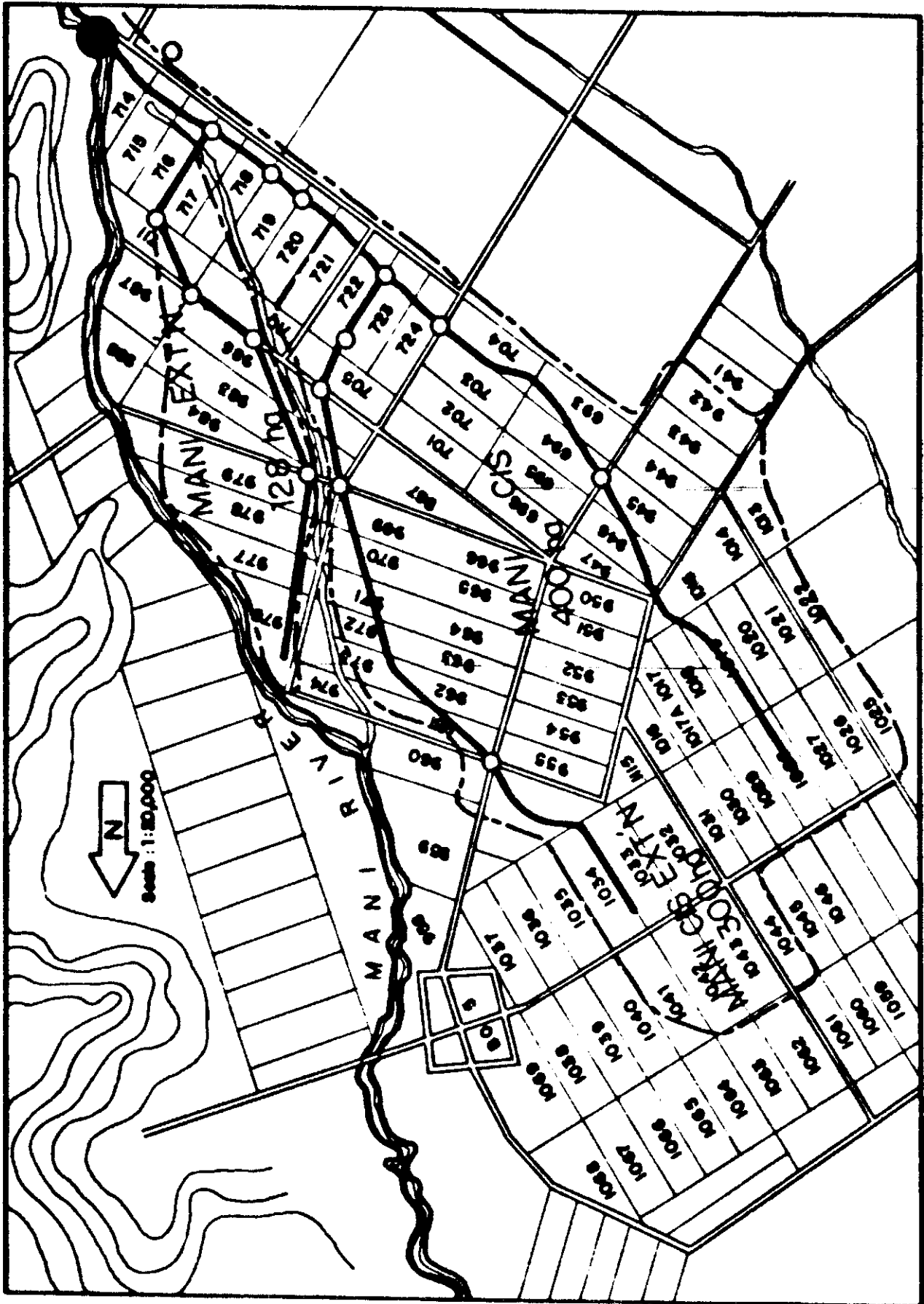


Figure 3.A.5 Schematic map of the service area of the Mani River Communal Irrigation System (MCIIS)

Figure 3.A.6 Weekly rainfall and evaporation at the MCIS, wet and dry seasons, 1985-86.

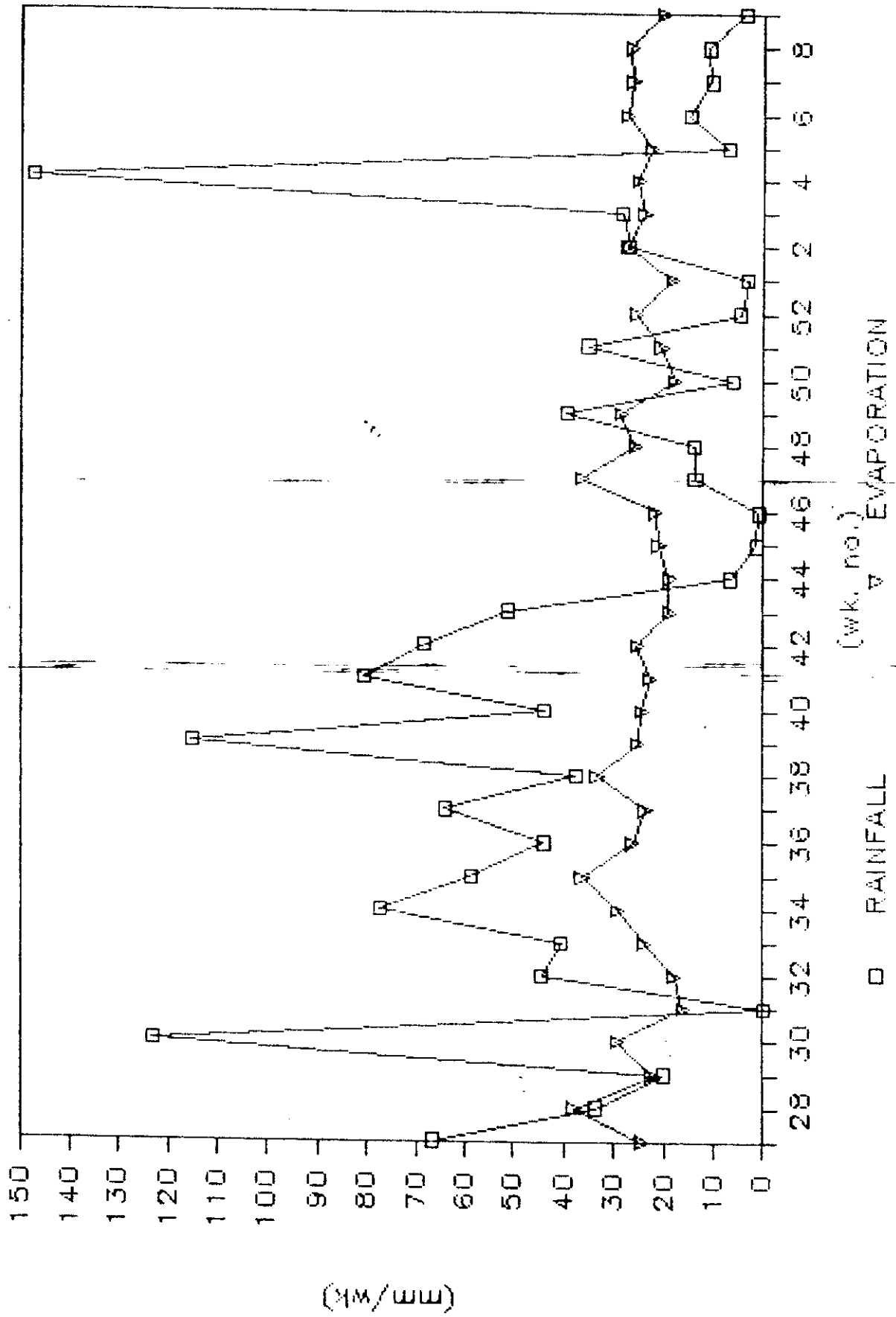
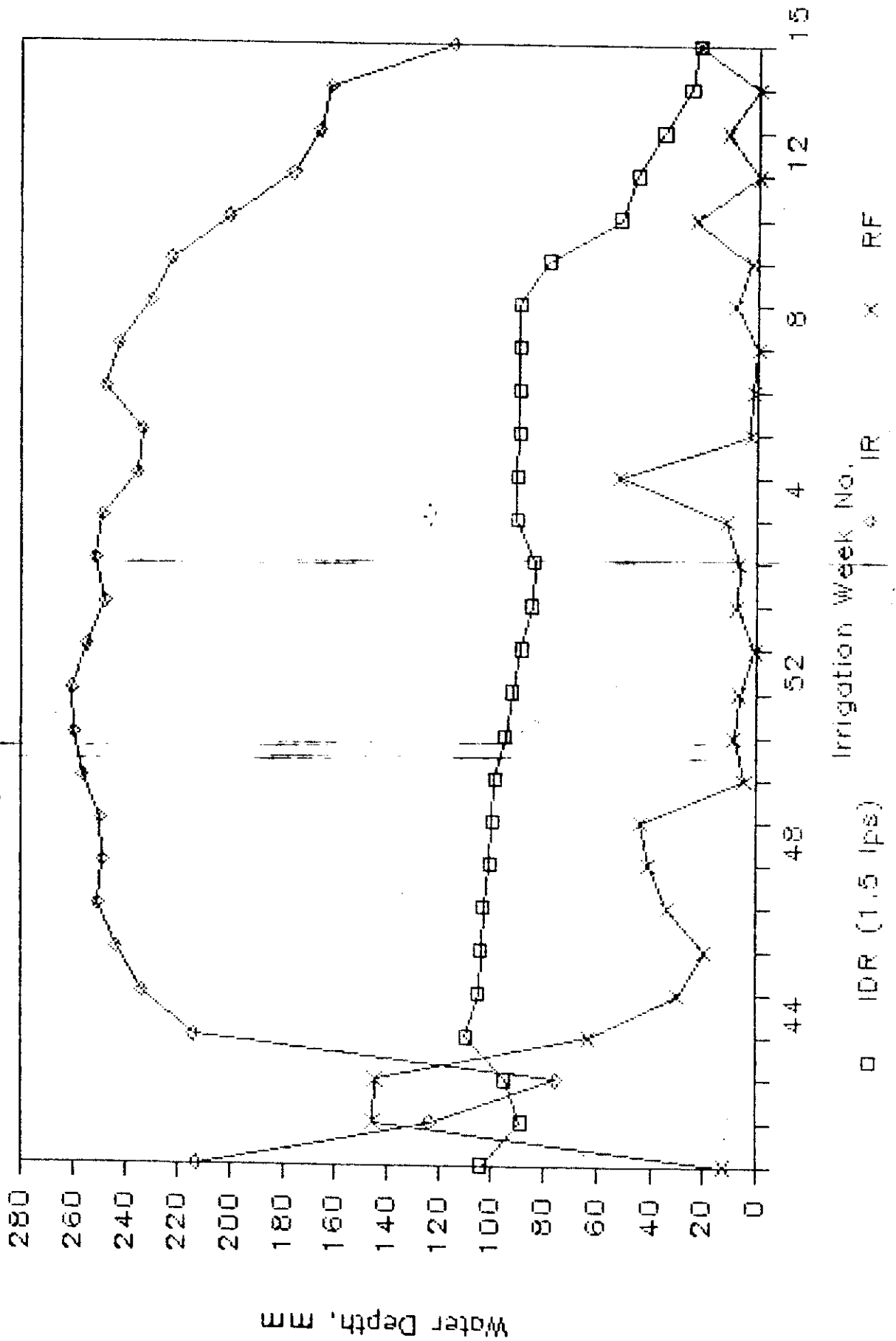


Figure 3.B.1 Weekly rainfall, irrigation water supply and designed irrigation water requirement for rice at Magat River Irrigation System, Lateral A, wet and dry seasons, 1985-86.



Annex I

PROPOSED IRRIGATION WATER MANAGEMENT
SCHEME FOR THE RICE-BASED CROPPING
PATTERN AT NIA-ARIP PTDF NO. 2
LATERAL A EXTRA¹

Introduction

Proper planning is necessary to ensure the efficient operation of an irrigation system. The main purpose of this preliminary study is to develop a water management scheme for the Pilot Testing and Demonstration Farm No.2 (PTDF #2) for irrigated lowland rice in the wet season and irrigated corn in the dry season. This planting schedule is a requisite for the improvement of operations in an irrigation system without doing major and costly revisions of already installed conveyance facilities and measuring structures.

Objectives

The two broad objectives of the study are:

1. To determine the irrigation water requirement of PTDF No. 2 specially at Lateral A-Extra; and
2. To be able to recommend a cropping calendar as a basis of developing a method for water scheduling of irrigated non-rice crops.

Determination of Irrigation Water Management Requirements

a. Technical Description of Lateral A-Extra:

Detailed topographic map of the area served by Lateral A-extra was obtained (Fig. 1). Other data included were the technical description of the area and irrigation facilities:

- 1) Length of lateral - 4.80 km
- 2) Design capacity - 0.391 cms
- 3) Number of double-gated turnouts - 8.0
- 4) Total irrigable area - 348.2 ha
- 5) Breakdown of service area (ha)

a. RA-1 = 43	e. RA-5 = 100
b. RA-2 = 35.2	f. SPL-1 = 27
c. RA-3 = 32	g. SPL-2 = 13
d. RA-4 = 47	h. SPL-3 = 21

¹ This component study was done in collaboration with the research staff of USM headed by Engr. R.Sarmiento, Asst. Prof..

6) Inventory of discharge measuring devices

- a) One concrete Parshall Flume = 122 cm throat width
(Non-Functional)
- b) Double-gated turnouts = 8.0 units
- 7) Soil type = Banga-sandy-clay loam
- 8) Average water table depth = 128 cm
- 9) Average slope = 0.2%

b. Analysis of Hydrometeorological Data :

1) Rainfall

Eighteen (18) years record of daily rainfall and evaporation were obtained from the nearby station of Norala, South Cotabato, total rainfall were analyzed using the Incomplete Gamma distribution function. The values of rainfall with 20, 50 and 80% cumulative probabilities are shown in Table 1.

2) Pan Evaporation and Potential Evapotranspiration

The average monthly total pan evaporation (E_p) data were obtained and the potential evapotranspiration was assumed to equal to this value.

A 60% distribution efficiency from lateral headgate to field is assumed. Since the lateral is lined negligible water loss is expected in but since the area is sandy it is expected that losses in farm ditches will be high. The recommended revision in farm ditch density and number of turnouts to reduce lengthy main farm ditches is expected to lower this loss but still we assumed a 60% efficiency because of the very porous soil texture in the area. If farm ditches are constructed with haul-borrow materials of appropriate texture this efficiency will be higher. Though the design flow of lateral A-Extra is 391 lps, there is enough freeboard to accommodate a higher flow.

Land Soaking Requirement (Lowland rice):

The following data were used for computing the land soaking requirement:

- Seepage and Percolation Rate (S&P) = 10 mm/day
- Residual soil moisture (M) = 10%
- Soil Moisture at saturation (M_s) = 30%
- Evapotranspiration (E_o) = 4 mm/day
- Apparent Specific gravity (A_s) = 1.50
- Soil depth to be saturated (D_s) = 300 mm

$$\begin{aligned}
 \text{Saturation Requirement (SR)} &= [(M_s - M_x) * (A_s) * (D_s)] / 100 \\
 &= [(30 - 10) (1.5) (300)] / 100 \\
 &= 90 \text{ mm}
 \end{aligned}$$

$$\begin{aligned}
 \text{Land Soaking Requirement (LSR)} &= \text{SR} + 7 (E_o) + 7 (S\&P) \\
 &\quad (1 \text{ week period}) \\
 &= 90 + 7 (4) + 7 (10) \\
 &= 90 + 28 + 70 \\
 &= 188 \text{ mm/wk}
 \end{aligned}$$

$$\begin{aligned}
 \text{Normal Irrigation Requirement (NIR)} &= 7 (E_o) + 7 (S\&P) \\
 &= 98 \text{ mm/wk}
 \end{aligned}$$

It can be seen from actual data that pan evaporation does not vary very much from a range value of 3-6 mm/day. Hence, for wet season rice crop it is safe to assume 4 mm/day as potential ET and for dry season crop, 5 mm/day PET.

Results

The proposed cropping schedule for wet season rice is shown in Table 2. It is proposed that irrigation delivery for this crop should be in the week May 7-13 or first or second week of May as it is indicated in the probability analysis of rainfall as the onset of the rainy season. It is assumed that there will be a lag time from land soaking to transplanting of about 4 weeks for seed-bed raising for transplanted rice.

The Irrigation Water Requirement computation is shown in Table 3. It is assumed that seepage and percolation is 10 mm/day from the data gathered at PTDF #2, land saturation requirement is 90 mm assuming a saturated depth of 30 cm, soil moisture saturation of 30% and 10% residual soil moisture. There is a 4 week cut-off of irrigation to enable desiltation at the dam site from October 22 to November 18 as required in the dam design to prevent silt accumulation. This will also give time to farmers for processing and marketing their wet season rice produce.

The proposed progress of farming activities and the water requirement computation, assuming 5 mm/day potential evapotranspiration from average pan evaporation and the prorated crop coefficients based on stage of crop growths are shown in Tables 4 and 5 respectively.

The change in area to be planted each week for corn was based on the progression of area harvested for the rice crop. The start of planting is in the first week of December and all of the area planted by the first week of January (Table 4). If 50% probability rainfall is assumed the irrigation requirement for each week will not exceed the design capacity of the lateral A extra (Table 5). Assuming a 400 lps delivery at the lateral headgate, the maximum time for irrigating the service area will occur in the 6th week of the year.

It is likely that this proposed water management scheme cannot be implemented immediately due to the land development required in order that irrigated lowland rice cultivation can be adopted in the wet season. Likewise, land development for irrigated corn cultivation for the dry season have to be established due to the undulating terrain in most parts of the service area.

~~————~~ The assumed 10 mm/day seepage and percolation rate was estimated for two paddy sites at PTDF #2. Sample soil borings in area, revealed a layer which is impenetrable by an ordinary soil auger. It is likely that this layer exists throughout the entire service area at a depth ranging from 0.5 m to 1.5 m. This layer maybe semi-permeable, thus reducing the value of seepage and percolation.

Another significance of this layer is that during the dry season, the corn crop will solely be dependent on surface water supply either through rainfall or irrigation. Water tables below the impenetrable layer will be inaccessible to roots.

In the above proposed cropping schedules the proposed re-design of on farm irrigation facilities for the lateral was considered. Irrigation delivery starts at the end of the lateral i.e., the tail enders prepare their land first. The turnouts are grouped to satisfy the required area to be prepared each week. The groupings for the dry season are presented in Tables 6 to 13.

To be able to come up with the actual irrigation delivery schedule for the whole lateral the 4 groups of turnouts are considered separately. A soil moisture water balance was prepared to come up with the time to irrigate each group, and are presented in Tables 6-13 and the summary is in Table 14. In these estimates the turnout capacity is set at 75 lps not because of turnout limitation but of farm ditch capacity limitations. For most of time, irrigation could be done for about 8-10 hrs/day on weeks 6 and 9, but there is still a leeway for adjustment. However, in weeks 7 and 10 no irrigation delivery is required hence, areas not irrigated on these weeks could be irrigated the following weeks. The problem of high irrigation flow diversion required at the lateral A headgate could be alleviated by the same procedure or extension of irrigation from 8 hours to 12 hours or more a day. It had been

observed that night irrigation of corn was done by farmers in lateral A-extra, this 1986 dry season. This was done to avoid being discovered by NIA personnel and thus avoiding the payment of irrigation service fee.

The combined field application and distribution efficiency of 40% assumed because of the very porous soils in the area. This was based on the estimated conveyance losses in the main and supplementary farm ditches at FTDF #2.

Proposed design of Farm Level Irrigation Facilities for Lateral A-Extra, at PTDF # 2²

Introduction

Lateral A-Extra, of ARIP which is the site of the PTDF #2 was basically designed for diversified cropping especially during the dry season. This lateral was selected as the site for PTDF #2 to develop experiences useful in operating ARIP. The whole ARIP was designed for large areas devoted to diversified cropping. The main purpose of this study is to analyze the on-farm facilities design of the lateral, considering the above criteria of irrigating diversified crops and provide suggestions for the redesign of the on-farm facilities for efficient management of the lateral. These objectives were implicit in the terms of reference in the T.A. PHI 654, whereby assistance to NIA in developing strategies for irrigating diversified crops will be provided by IIMI.

Methodology

Original design of Lateral A-Extra, including map layouts and location of turnouts were obtained from the design section of ARIP. Actual field verifications of the area were done to observe physical conditions of the irrigation structures. Observations were also made during trial operations of the lateral in the wet season of 1985. A contour map of the area was also obtained. All these data and observations were used in the analysis and development of recommendations for re-design of the on-farm facilities.

Results and Recommendations

There are eight turnouts constructed to serve the whole area. All these turnouts were designed as double gated (constant head orifice) with designed capacities of about 75 liters per second at 20 cm head. These turnouts are shown in Figure 2 and summarized in Table 15. The accompanying figures or maps in this report were reduced from the original maps of this study. The discussions on this report are based on the detailed original maps. The reduction of the figures was solely for the inclusion of this study in the interim report.

One major consideration in the re-design was to locate the supplementary farm ditches (SFD) and Main Farm Ditches (MFD) on property line boundaries for more accessibility of water for each farmer and to facilitate easier construction of internal farm ditches which are necessary for irrigating diversified crops.

² This report is the second part of the study on the proposed water management scheme at PTDF #2 and was jointly undertaken by the IIMI and USM staff.

The first turnout of the lateral is at RA SPL 1. It can be noted from Fig. 2 that it can not serve the area above the turnout and below the creek. From field observations, farmers in this area tried to irrigate the area above and hence excessive checking was done at STA 1 + 480 to force water flow upstream. The recommendation is to relocate the turnout about 220 meters upstream. The resulting farm ditch layout is indicated in Figure 3 and ditch lengths are shown in Table 16. There is a need for a checking structure for the relocated turnout.

The specifications will be:

Highest elevation to be supplied	-183.5 meters
Assumed Water depth at farm ditch	- 0.2 meter
Needed Hydraulic head	- 0.1 meter
Designed Water surface elevation at lateral (STA 1+260)	-183.6 meters
Head to be produced by check (A weir check may serve the purpose.)	- 0.2 meters

The second turnout is at RA 1. It can be noted from Fig. 2 that the first SFD of this turnout is flowing uphill hence the recommended modifications are shown in Fig. 3 and summarized in Table 16. The third turnout is at RA 2 and from Fig. 2, it appears that the proposed layout of farm ditches may not be enough for diversified crop irrigation specially at the upstream portion hence the proposed modification.

The fourth turnout for RA 3 shows the main farm ditch to go from a lower to a higher contour, so it is necessary to relocate the MFD at a higher elevation. To cover the whole area would then require a long farm ditch about 1.2 km long hence it is proposed to have two turnout for this area. The new turnout will be located at STA 3 + 605 or turnout number 6 in Table 16. The fifth turnout which is located at STA 2 + 805 left is serving RA 4 was considered as good hence it is recommended to retain the original design.

The turnout at STA 3 + 605 has also a very long MFD hence is also recommended to have two turnouts. The additional turnout should be located at STA 4 + 425. The turnout at STA 3 + 920 is at elevation 168.5 and the MFD as shown in Fig. 2 is to pass a contour line of 171.5 which is three meters higher. The recommendation is to relocate the turnout at STA 4 + 245. At the end check the area to be served is still 100 hectares which is considered too large especially for irrigation of diversified crops. It was also noted in the trial irrigation run that farmers can not maintain a main farm ditch because of the highly erosive flow. It is therefore recommended to extend the lateral for another 800 meters with cement lining and divide the area of RA 5 into three. The first two blocks will be served by the turnout at STA 4 + 245. The next three blocks will be irrigated by a new turnout at STA 4 + 980. The remaining portion will be served by the end check turnout.

It is suggested that no turnout will serve less than 15 hectares but not more than 50 hectares. The recommended supplementary farm ditches are not enough for diversified crop irrigation and there is a need for internal farm ditches. It maybe adequate for lowland rice irrigation as paddy to paddy flow could be used but such is not adaptable for upland crop irrigation. Hence there is a need for internal farm ditches.

There may also be a need for some landleveling especially at the upper half of the service area of the lateral which has a very undulating terrain in order to facilitate easier water distribution.

Before the final construction of the recommended farm ditches there is also a need to look out for drainability of the areas as upland crops are very sensitive to water logging. It is also recommended that the proposed new turnouts be constructed as single gated ones for economy.

The proposed revisions in farm ditch layouts were based on a contour map of 0.5 meter interval and not on a 0.2 meter interval which is desirable for such. Therefore, there is a need to interact or involve the farmers in constructing the ditches. The farmers could easily point out the low and high spots in the field which would be necessary to locate the ditches in the most desirable locations. It is also suggested that the sizes and construction materials for the main farm ditches follow design specifications developed by NIA.

Table 1. Probable Rainfall (Norala, South Cotabato), mm/wk.
Cumulative Probability¹

Week No.	20%	50%	80%
1	14	27	43
2	0	11	20
3	0	9	19
4	9	24	40
5	0	9	17
6	0	10	19
7	0	19	34
8	6	17	28
9	0	6	14
10	0	9	17
11	0	7	13
12	0	11	21
13	0	5	11
14	0	8	15
15	0	8	14
16	0	13	26
17	19	33	55
18	18	34	56
19	16	35	58
20	27	49	80
21	26	46	75
22	29	59	100
23	28	50	85
24	29	53	89
25	31	60	100
26	18	51	91
27	23	42	69
28	22	41	69
29	21	41	70
30	26	51	100
31	30	52	87
32	22	41	66
33	17	39	65
34	27	49	81
35	26	48	80
36	23	41	67
37	19	33	54
38	25	49	81
39	25	45	74
40	24	40	65
41	16	36	60
42	18	35	59
43	22	40	66

¹Using the incomplete gamma function

44	21	42	70
45	18	32	52
46	11	26	44
47	11	22	38
48	17	34	59
49	13	25	41
50	8	21	37
51	6	19	36
52	5	18	35

Table 2. Proposed progress of farming activities for Lateral A-Extra service area, PTDF#2 wet season, rice crop.

Wk. No.	Date	AULS (has.)	AULP (has.)	AUNI (has.)	AUTD (has.)
19	May 7-13	100			
20	May 14-20	85	100		
21	21-27	70	185		
22	28-Jun 3	22	255		
23	4-10		177	100	
24	11-17		92	185	
25	18-24		22	255	
26	25-Jul 1			277	
27	2-8			277	
28	9-15			277	
29	16-22			277	
30	23-29			277	
31	30-Aug 5			277	
32	6-12			277	
33	13-19			277	
34	20-26			277	
35	27-Sep 2			277	
36	3-9			277	
37	10-16			277	
38	17-23			277	
39	24-30			277	
40	Oct 1-7			177	100
41	8-14			92	185
42	15-21			22	255
43	22-28				277
44	29-Nov 4				277

AULS - Area Under Land Soaking

AULP - Area Under Land Preparation

AUNI - Area Under Normal Irrigation

AUTD - Area Under Terminal Drainage

Table 3. Irrigation water requirement computation at Lateral A-Extra, PTDF#2 wet season, rice crop.

=====					
Wk. No.	Date	Crop Water Req'm't		R'fall	IDR
		w/o Rain	w/Rain		
		lps	lps	mm/wk/	lps**
=====					
19	May7-13	311	253	35	422
20	May14-20	426	276	49	460
21	21-27	517	323	46	538
22	28-Jun3	482	211	59	352
23	4-10	449	220	50	367
24	11-17	449	206	53	343
25	18-24	449	174	60	290
26	25-Jul1	449	215	51	358
27	2-8	449	256	42	427
28	9-15	449	261	41	435
29	16-22	449	261	41	435
30	23-29	449	215	51	358
31	30-Aug5	449	211	52	352
32	6-12	449	261	41	435
33	13-19	449	270	39	450
34	20-26	449	224	49	373
35	27-Sep2	449	229	48	382
36	3-9	449	261	41	435
37	10-16	449	298	33	497
38	17-23	449	243	45	405
39	24-30	449	266	40	443
40	Oct 1-7	287	181	36	302
41	8-14	149	96	35	160
42	15-21	36	21	40	35
43	22-28	0	0	42	0
44	29-Nov4	0	0	32	0
=====					

IDR - Irrigation Diversion Requirement

** Assuming 60 % Efficiency

Table 4. Proposed progress of farming activities for the Lateral A-extra, PTDF#2, dry season, corn crop.

=====						
Wk. No.	Date	AULS (has.)	PA (has.)	VS (has.)	RS (has.)	MS (has.)
=====						
47	Nov19-25	79				
48	26-Dec2	74				
49	Dec 3-9	70	79			
50	10-16	54	74	79		
51	17-23		70	153		
52	24-31		54	223		
1	Jan 1-7			277		
2	8-14			277		
3	15-21			277		
4	22-28			198	79	
5	29-Feb4			124	153	
6	Feb 5-11			54	223	
7	11-18				277	
8	19-25				198	79
9	26-Mar4				124	153
10	Mar 5-11				54	223
11	12-18					277
12	19-25					198
=====						

AULP - Area Under Land Preparation
 PA - Planted Area
 VS - Area Under Vegetative Stage
 RS - Area Under Reproductive Stage
 MS - Area Under Maturity Stage

Table 5. Irrigation water requirement computation for lateral A-extra, PTDF#2, dry season, corn crop.

=====						
Wk. No.	Date	CC	R'fall	Crop Water Req'm't		IDR
				w/o Rain	w/Rain	
			(mm/wk)	(mm/wk)	(mm/wk)	(lps)
=====						
47	Nov19-25		22			
48	26-Dec2		34			
49	Dec 3-9	0.5	25	18	0	0
50	10-16	0.5	21	18	0	0
51	17-23	0.7	19	25	6	55
52	24-31	0.7	18	25	7	80
1	Jan 1-7	0.8	27	28	1	11
2	8-14	0.9	11	32	21	240
3	15-21	1	9	35	26	298
4	22-28	1	24	35	11	126
5	29-Feb4	1.1	9	39	30	344
6	Feb 5-11	1.2	10	42	32	366
7	11-18	1.2	19	42	23	263
8	19-25	1.1	17	39	22	180
9	26-Mar4	1.1	6	39	33	169
10	Mar 5-11	1	9	35	26	58
11	12-18		7	0	0	0
12	19-25		11	0	0	0
=====						

CC - Crop Coefficient to be multiplied by the pan evaporation to get crop consumptive use.

IDR - Irrigation Diversion Requirement assuming 40% efficiency.

Table 6. Proposed progress of farming activities for the turnouts 8, 9, 10 & 11, Lateral A-extra, PTDF#2, dry season season, corn crop.

=====						
Wk. No.	Date	AULS (has.)	PA (has.)	VS (has.)	RS (has.)	MS (has.)
=====						
47	Nov19-25	79				
48	26-Dec2					
49	Dec 3-9		79			
50	10-16			79		
51	17-23			79		
52	24-31			79		
1	Jan 1-7			79		
2	8 - 14			79		
3	15-21			79		
4	22-28				79	
5	29-Feb4				79	
6	Feb 5-11				79	
7	11-18				79	
8	19-25					79
9	26-Mar4					79
10	<u>Mar 5-11</u>					79
11	12-18					79
12	19-25					
=====						

AULP - Area Under Land Preparation
 PA - Planted Area
 VS - Area Under Vegetative Stage
 RS - Area Under Reproductive Stage
 MS - Area Under Maturity Stage.

Table 7. Irrigation schedule computation based on soil moisture balance, at Lateral A-extra, PTDF#2 Turnouts 8,9, 10, & 11, dry season, corn crop.

Wk. No.	Date	MC (%)	RF (mm/wk)	ET (mm/wk)	IR (cu.m.)	IR (lps)	TIME (hrs.)
47	Nov19-25		22				
48	26-Dec2	10	34		44438	300	41
49	Dec 3-9	15	25	18			
50	10-16	15	21	18			
51	17-23	15	19	25			
52	24-31	14	18	25			
1	Jan 1-7	12	27	28			
2	8-14	12	11	32	35550	300	33
3	15-21	15	11	35			
4	22-28	11	24	35	71100	300	66
5	29-Feb4	15	9	39			
6	Feb 5-11	12	10	42	53325	300	49
7	11-18	15	19	42			
8	19-25	12	17	39	53325	300	49
9	26-Mar4	15	6	39			
10	Mar 5-11	11	9	35			
11	12-18		7	35			
12	19-25		11	35			

MC - Soil moisture content at beginning of week
 RF - Rainfall
 ET - Evapotranspiration
 IR - Irrigation
 Time - Time to irrigate assuming 40% combined field conveyance and distribution efficiency

Table 8. Proposed progress of farming activities for the Lateral A-Extra, PTDF#2 turnouts 5, 6 & 7, dry season, corn crop.

=====						
Wk. No.	Date	AULS (has.)	PA (has.)	VS (has.)	RS (has.)	MS (has.)
=====						
47	Nov19-25					
48	26-Dec2	74				
49	Dec 3-9					
50	10-16		74			
51	17-23			74		
52	24-31			74		
1	Jan 1-7			74		
2	8-14			74		
3	15-21			74		
4	22-28			74		
5	29-Feb4				74	
6	Feb 5-11				74	
7	11-18				74	
8	19-25				74	
9	26-Mar4					74
10	Mar 5-11					74
11	12-18					74
12	19-25					74
=====						

AULP - Area Under Land Preparation
 PA - Planted Area
 VS - Area Under Vegetative Stage
 RS - Area Under Reproductive Stage
 MS - Area Under Maturity Stage

Table 9. Irrigation schedule computation based on soil moisture balance, at lateral A-Extra, PTDF#2 turnouts 5, 6 & 7, dry season, corn crop.

=====							
Wk. No.	Date	MC	RF	ET	IR	IR	TIME
		(%)	(mm/wk)	(mm/wk)	(cu. m.)	(lps)	(hrs.)
=====							
47	Nov19-25		22				
48	26-Dec2		34				
49	Dec 3-9	10	25	18	41625	225	51
50	10-16	15	21	18			
51	17-23	15	19	25			
52	24-31	14	18	25			
1	Jan 1-7	12	27	28	33300	225	41
2	8-14	15	11	32			
3	15-21	12	11	35	49950	225	62
4	22-28	15	24	35			
5	29-Feb4	14	9	39			
6	Feb 5-11	11	10	42	66600	225	82
7	11-18	15	19	42			
8	19-25	12	17	39			
9	26-Mar 4	10	6	39	83250	225	103
10	Mar 5-11	15	9	35			
11	12-18	12	7	35			
12	19-25		11	35			

=====

MC - Soil Moisture Content at beginning of week
 RF - Rainfall
 ET - Evapotranspiration
 IR - Irrigation
 Time - Time to irrigate assuming 40% combined field application and distribution efficiency.

Table 10. Proposed progress of farming activities for the Lateral A-extra
PTDF#2 turnouts 3 & 4, dry season, corn crop.

Wk. No.	Date	AULS (has.)	PA (has.)	VS (has.)	RS (has.)	MS (has.)
47	Nov19-25					
48	26-Dec2					
49	Dec 3-9	70				
50	10-16					
51	17-23		70			
52	24-31			70		
1	Jan 1-7			70		
2	8-14			70		
3	15-21			70		
4	22-28			70		
5	29-Feb4			70		
6	Feb 5-11				70	
7	11-18				70	
8	19-25				70	
9	26-Mar4				70	
10	Mar 5-11					70
11	12-18					70
12	19-25					70

AULP - Area Under Land Preparation
 PA - Planted Area
 VS - Area Under Vegetative Stage
 RS - Area Under Reproductive Stage
 MS - Area Under Maturity Stage

Table 11. Irrigation schedule computation based on soil moisture balance, Lateral A-extra, PTDF#2 turnouts 3 & 4, dry season, corn crop.

Wk. No.	Date	MC	RF	ET	IR	IR	TIME
		(%)	(mm/wk)	(mm/Wk)	(cu.m.)	(lps)	(hrs.)
47	Nov19-25		22				
48	26-Dec2		34				
49	Dec 3-9		25	18			
50	10-16	10	21	18	39375	150	63
51	17-23	15	19	25			
52	24-31	14	18	25			
1	Jan 1-7	12	27	28			
2	8-14	12	11	32	31500	150	50
3	15-21	15	11	35			
4	22-28	11	24	35	63000	150	100
5	29-Feb4	15	9	39			
6	Feb 5-11	12	10	42	47250	150	75
7	11-18	15	19	42			
8	19-25	12	17	39			
9	26-Mar4	10	6	39	78750	150	125
10	Mar 5-11	15	9	35			
11	12-18	12	7	35	47250	150	75
12	19-25	15	11	35			

MC - Soil Moisture Content at beginning of week
 RF - Rainfall
 ET - Evapotranspiration
 IR - Irrigation
 Time - Time to irrigate assuming 40% combined field application and distribution efficiency.

Table 12. Proposed progress of farming activities for the Lateral A-extra,
PTDF #2 turnouts 1 & 2, dry season, corn crop.

Wk. No.	Date	AULS (has.)	PA (has.)	VS (has.)	RS (has.)	MS (has.)
47	Nov19-25					
48	26-Dec2					
49	Dec 3-9					
50	10-16	54				
51	17-23					
52	24-31		54			
1	Jan 1-7			54		
2	8-14			54		
3	15-21			54		
4	22-28			54		
5	29-Feb4			54		
6	Feb 5-11			54		
7	11-18				54	
8	19-25				54	
9	26-Mar4				54	
10	Mar 5-11				54	
11	12-18					54
12	19-25					54

AULP - Area Under Land Preparation
 PA - Planted Area
 VS - Area Under Vegetative Stage
 RS - Area Under Reproductive Stage
 MS - Area Under Maturity Stage

Table 13. Irrigation schedule computation based on soil moisture balance, Lateral A-Extra, PTDF#2 turnouts 3 & 4, dry season, corn crop.

Wk. No.	Date	MC (%)	RF (mm/wk)	ET (mm/wk)	IR (cu.m.)	IR (lps)	TIME (hrs.)
47	Nov19-25		22				
48	26-Dec2		34				
49	Dec 3-9		25	18			
50	10-16		21	18			
51	17-23	10	19	25	30375	150	48
52	24-31	15	18	25			
1	Jan 1-7	13	27	28			
2	8-14	13	11	32			
3	15-21	10	11	35	40500	150	64
4	22-28	15	24	35			
5	29-Feb4	14	9	39			
6	Feb 5-11	11	10	42	48600	150	77
7	11-18	15	19	42			
8	19-25	12	17	39			
9	26-Mar4	10	6	39	60750	150	96
10	Mar 5-11	15	9	35			
11	12-18	12	7	35	36450	150	58
12	19-25	15	11	35			

MC - Soil Moisture Content at beginning of week
 RF - Rainfall
 ET - Evapotranspiration
 IR - Irrigation
 Time - Time to irrigate assuming 40% combined field application and distribution efficiency.

Table 14. Irrigation schedule computation based on soil moisture balance,
Lateral A-Extra, PTDF#2 dry season, corn crop.

=====					
Wk. No.	Date	RF	IR*	Time	IR*
		(mm/wk)	(lps)	(hrs.)	(lps)
=====					
47	Nov19-25	22			
48	26-Dec2	34	300	41	73
49	Dec 3-9	25	225	51	68
50	10-16	21	150	63	56
51	17-23	19	150	48	43
52	24-31	18			
1	Jan 1-7	27	225	41	55
2	8-14	11	450	50	104
3	15-21	11	375	64	140
4	22-28	24	450	66	163
5	29-Feb4	9			
6	Feb 5-11	10	450	157	333
7	11-18	19			
8	19-25	17	300	49	88
9	26-Mar4	6	425	125	278
10	Mar 5-11	9			
11	12-18	7	300	75	137
12	19-25	11			
=====					

RF - Rainfall
 IR* - Highest flow required at Lateral Headgate
 IR** - Irrigation flow required for 24 hours 7 day operation
 Time - Longest time that irrigation delivery will occur at lateral headgate.

Table 16. Farm ditch density for the proposed design of farm level facilities.

[illegible]

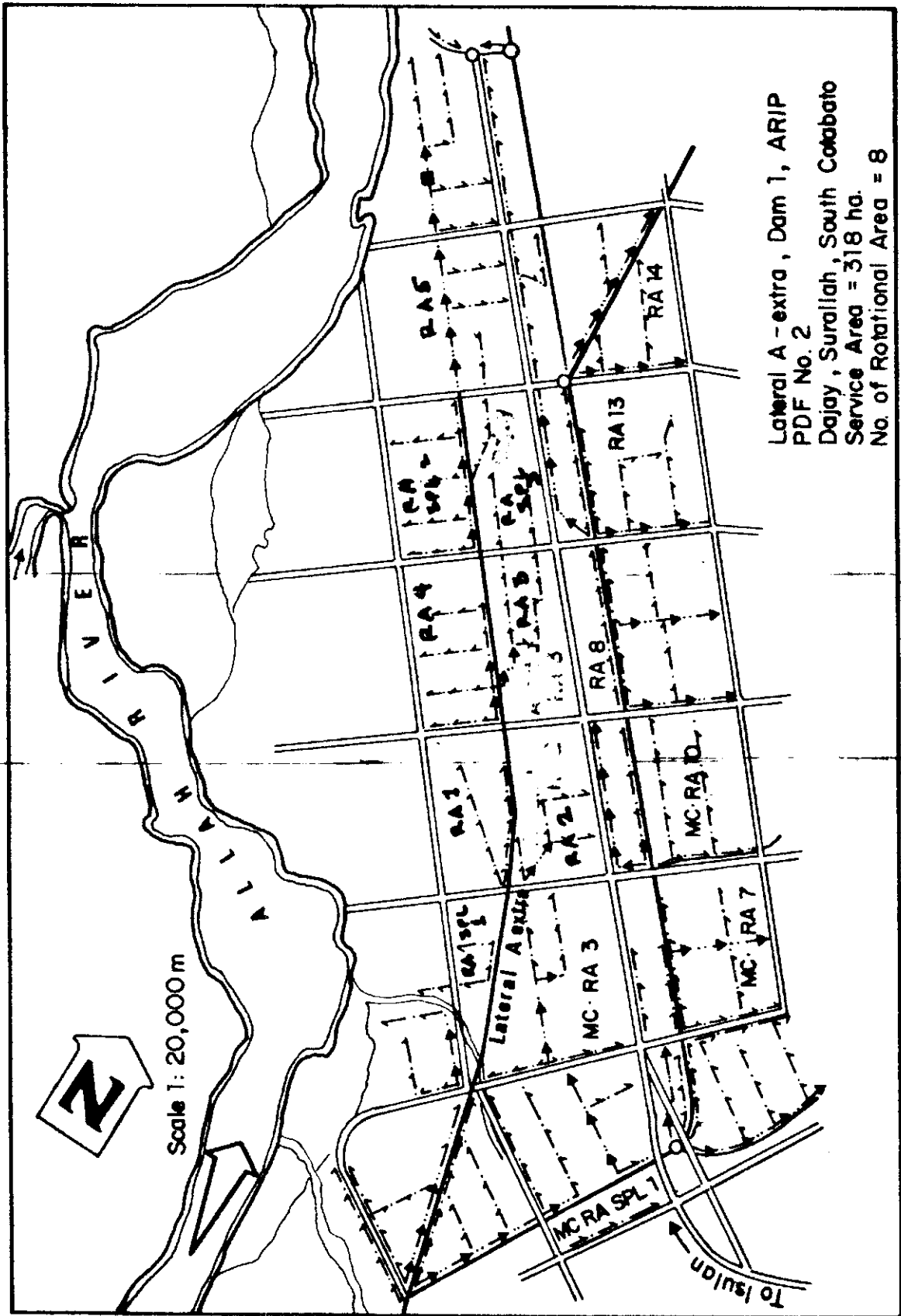


Figure 1 Schematic map of the service area of lateral A-extra, PTDF#2, ARIP

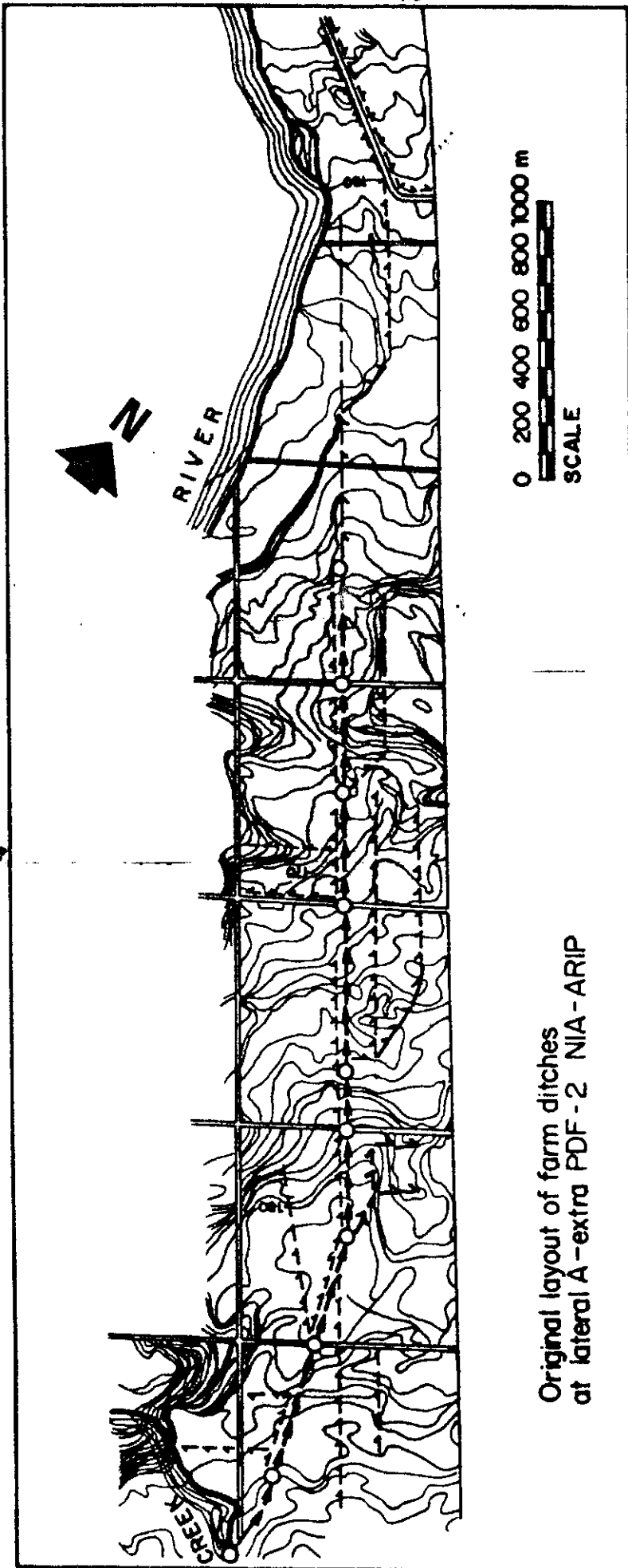


Figure 2 Reduced original map layout of the farm ditches at lateral A-extra, PTDF#2, ARIP

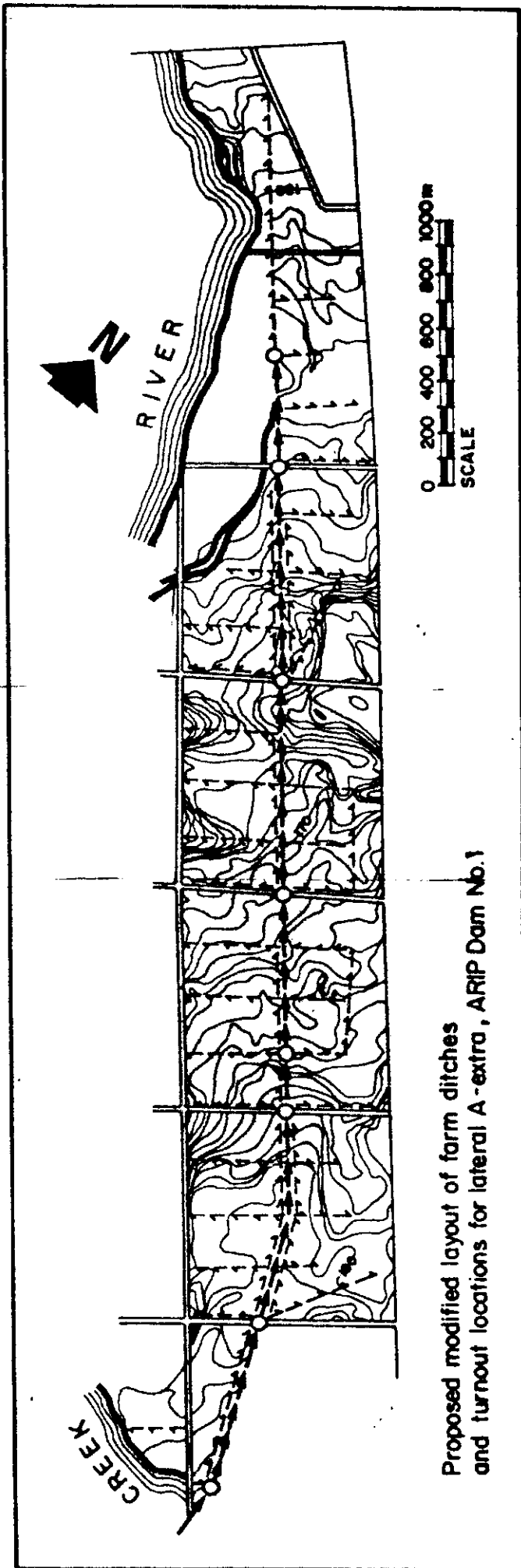


Figure 3 Reduced proposed map layout of the farm ditches at
lateral A-extra, PTDF#2, ARIP

Annex II.A

Republika ng Pilipinas
PAMBANSANG PANGASIWAAN NG PATUBIG
(National Irrigation Administration)
Region XI
BANGA RIVER IRRIGATION SYSTEM
Banga, South Cotabato

Oct. 30, 1985

Ginu-o/Ginang:

Suno sa guin-kasugtanan sa meeting nga guin-tambuñgan sang tanan nga mga Presidente sang Farmer Irrigations Association, mga FMT's, Brgy. Captains, kag NIA Personnels nga guin-hiwat sa Opisina sang NIA sadtong September 9, 1985, ang masunod amo ang water delivery schedule para sa 1986 Dry Cropping Season Sang Banga River Irrigation System:

Group	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
I	2-days Fri-Sat.	5-days Tue-Sat.	2-days Fri-Sat.	3-days Thur-Sat.	3-days Thur-Sat.	x	C
II	2-days Fri-Sat.	5-days Tue-Sat.	2-days Fri-Sat.	3-days Thur-Sat.	3-days Thur-Sat.	x	L
III	2-days Sun-Mon.	2-days Sun-Mon.	x	x	x	x	O
IV	5-days Sun-Thur.	2-days Sun-Mon.	2-days Sun-Mon.	x	x	x	U
V	2-days Wed-Thur.	x	5-days Sun-Thur.	4-days Sun-Wed.	4-days Sun-Wed.	4-days Sun-Wed.	E
VI	2-days Mon-Tue.	x	5-days Sun-Thur.	4-days Sun-Wed.	4-days Sun-Wed.	4-days Sun-Wed.	

Ini nga water delivery schedule guin-aprobahan sang Federation of Farmer Irrigator's Association, Inc., Banga Chapter sa atubangan sang mga nag-talam-bong.

Gani, guina-pangayo guid namon ang inyo ko-operasyon sa pag-implementar sini.

Ang matinsuron,

ORLANDO A. TIBANG
Officer In-Charge

NOTED:

FERNANDO S. JANUTO SR.
President - FFIA
Banga Chapter

HONORATO O. BIENES
Irrigation Superintendent II

FEDERATION OF FARMER IRRIGATOR'S ASSOCIATION INC.
Banga RIS Chapter, Banga, South Cotabato

OFFICE OF THE PRESIDENT

February 26, 1986

Sir/Madam:

This is to inform you that in connection with the joint meeting of all FIA President, AFT, Brgy. Captains, Farmer Leaders and NIA Personnels within the coverage area of Banga RIS and held at NIA Office at Brgy. Rizal, Banga, South Cotabato last February 24, 1986, hereunder is the approved Water Delivery Schedule of Banga RIS for Wet 1986 Cropping Season under Resolution No. 2 series of 1986 through the Joint Sponsorship of all FIA President, Banga RIS Chapter.

Group:Program:		MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
No. :	Area :						
: (Has.) :							
I	250	/ 5 days per week: / Sunday - Thursday			3	days per week / Sunday - Tuesday	
II	400	/ 5 days per week: / Sunday - Thursday			3	days per week / Sunday - Tuesday	
III	350	/ 7 days per week / Monday - Sunday		2 days per week: / Friday - Saturday	4 days per week / Wednesday - Sat.		
IV	300	/ 7 days per week / Monday - Sunday		2 days per week: / Friday - Saturday	4 days per week / Wednesday - Sat.		
V	350	/ 7 days per week / Monday - Sunday		2 days per week: / Friday - Saturday	4 days per week / Wednesday - Sat.		
VI	300	/ No water delivery schedule					

It is therefore earnestly requested your full cooperation in the implementation of the above water delivery schedule.

Very truly yours,

FERNANDO S. JANUTO, SR.
President

NOTED:

ORLANDO A. TRIBANG
ICG - Banga RIS

ENGR. HONORATO O. BIENES
Irrigation Superintendent II

cc:

1. SOCOGESAFFIA President
2. Regional Irrigation Director
Region XI

Report on Farmers' Meeting at BARIS

Date : Sept. 20, 1985

Place : Irrigation Superintendent Office, Bo. Rizal, Banga, South Cotabato

Agenda 1. Organization of Federation of Farmers Irrigators Association Baris Chapter.

2. Dry Season 1986 Irrigation Schedule or plans

Attendees :

1. Assistant Irrigation Superintendent BARIS - Engr. Tibang
2. Irrigation Superintendent Marbel - BARIS - Engr. Bienes
3. Irrigation Association Organizer Marbel - BARIS - Mr. Dumayas
4. President and officers of 6 Organized IA's
5. Barangay Captains of Barangay covered by BARIS
6. All NIA personnel of BARIS
7. Other Farmer representatives
8. MAF representative (1)
9. Visitor from chemical companies (2)
10. Visitor from IIMI (2)

Total attendance including visitors about 60.

The meeting was a formal one opened with the singing of the national anthem led by IA president and invocation prayer led by an IA secretary. The program emcee was Engr. Orlando Tibang. This was followed by welcome address by the acting mayor of Norala who was also an IA president, and another welcome address by the Barangay Captain of Bo. Rizal. In the welcome address the interruption of irrigation schedule due to inclusion of an area not programmed earlier was mentioned. It was stressed that this should be totally avoided in the future though this was decided in a general farmers' meeting.

The first agenda (organization of federation) was chaired by the IA organizer of BARIS. He introduced the six organized IA in the area. These are:

1. Banga-Norala Pilot Project Irrigators Association Pres. Fernando Canuto
2. Sto. Nino Irrigators Association Pres. Victorino Estrella
3. Bo. 11 Irrigators Association Pres. Cecilio Estabilla
4. Bo. 12 Irrigators Association Pres. Candido Beduma
5. Bo. 3 Lateral B. Irrigators Association Pres. Mr. Pedro Esnilla
Lateral B-1 Irrigators Association Pres. Alfonso Nueros
6. Lat A (Punong Grande Irrigators Association) Pres. Eduardo Camanay

There are two sectors not yet organized and these are laterals F and lateral C.

The introduction of the different presidents was followed by the formation of the Federation and it was unanimously approved that the 7 1A presidents will automatically compose the Board of Directors of the Federation. The Board of Directors then elected five members among them to compose the officers. The five elected officers then elected the President, Vice-President, Secretary, Treasurer and Auditor.

The Final set of officers were:

President	- Mr. Fernando Camito
Vice-President	- Mr. Alfonso Nueros
Secretary	- Mr. Cecilio Estrella
Treasurer	- Mr. Pedro Esnilla
Auditor	- Mr. Candido Beduma

The formation was followed by introduction of the research activities of IIMI and the importance of the consideration of farmers practices and involvement in the system management was quoted.

This was followed by a demonstration of a representative of a chemical company of the use of a chemical mixer for pesticides to make chemicals not only stick to the plant leaves but also penetrate the leaf structure. The penetrate was also quoted as useful for activating micro-organism in the soil to hasten decomposition of plant materials incorporated in soil.

The development of the irrigation schedule was begun with enumeration of problems encountered in the last dry season. The problem enumerated by Engr. Tibang were:

1. The plan approved by the farmers should be followed strictly.
2. Staggered planting should be avoided and all farmers should plant such that they will all harvest to conform to the cut-off schedule of water delivery.
3. Seminar on water management should be conducted with farmers.

This was followed by the presentation of the irrigation service fee collection status for dry season 1985 as of August 1985.

	Sector						
	I	II	III	IV	V	VI	TOTAL
<u>Current collection</u>	88.00	69.62	75.23	83.16	86.05	80.76	
<u>Total Collectibles</u>							
 <u>Current Collection</u>	112.15	95.80	82.87	88.81	95.44	95.42	

The financial status of the BARIS system for Dry season 1986 was also presented.

Total Income (ISF + Others)	P 393,000
O&M Expenses	P302,000
Desilting Expenses	123,396
Total Expenses	P 426,496
Deficit	P 34,504

It was then quoted that the system could only irrigate 1300 ha. for the dry season 1986. It was also mentioned that sectors I, I & V were previously cut-off from water delivery in the past dry seasons. It was mentioned that staggered planting is prevalent in sector III and that sector III and VI are under contract for canal maintenance.

The newly elected federation president was asked to chairman the discussion on the development of the irrigation plan for dry season 1986. He commented that NIA should present a proposed plan to the farmers to begin the discussion and facilitate easier plan development. Engr. Tibang presented a plan which became the basis of discussion. The plan presented included the wet season 1986 plan.

Plan Presented

Sector	Area	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
I	207	***	***	***	***	***	***	***	***	***	xxx
II	509	***	***	***	***	***	***	***	***	***	xxx
III	235	***	***	***	***	xxx	xxx	xxx	xxx	xxx	xxx
IV	248	***	***	***	***	***	***	xxx	xxx	xxx	xxx
V	309	***	***	***	***	***	***	***	***	***	xxx
VI	252	***	***	***	***	xxx	***	***	***	***	xxx

*** - with irrigation

xxx - without irrigation

Final Plan

Sector	Area	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
I	207	***	***	***	***	***	***	***	***	***	xxx
II	509	***	***	***	***	***	***	***	***	***	xxx
III	235	***	***	***	***	***	xxx	xxx	xxx	xxx	xxx
IV	248	***	***	***	***	***	***	xxx	xxx	xxx	xxx
V	309	***	***	***	***	xxx	***	***	***	***	xxx
VI	252	***	***	***	***	xxx	***	***	***	***	xxx

*** - with irrigation

xxx - without irrigation

April is for closure of the Dam and cleaning of silt for wet season 1986. Sector three proposed for extension of irrigation for their area up to end of December but they were only given up to end of November because of the staggered planting in their area.

In the closing remarks by the IA organizer he cited that NFA has opened trading season at palay price of P 3.50 per kilo and the I's were encouraged to register with NFA to avail of a certain percentage as incentives about 3 centavos per kilo sold to NFA by association.

From personal conversation with Marbel-Banga IS the same procedure is employed with Marbel I & II system and it is considered a success in dealing with farmers regarding water shortage. Engr. Bienes said that he started by obtaining governors and Mayors approval of the proposed system or plan then gradually changing to plan development by using farmers meeting. He started this scheme since 1975 using first government officials.

The farmers not scheduled for irrigation were assured of irrigation water for diversified crops in case there is drought by the I.S. (Engr. Bienes) and assistant I.S. (Engr. Tibang).

Description of Sectors

Sector	Lateral	Area (ha.)	Boundaries
I	A,B,C	207	Damsite to Dupit Creek
II	D	509	Lat. D
III	E	235	Lat. E and areas served by Main Canal from Dupit Creek to Katitisan Creek
IV	Main Canal from E,F	248	Areas served by Main Canal from Katitisan Creek to headgate 4 lateral F
V	F	309	Lateral F
VI	Main Canal after F,G	252	All areas after lateral F

Annex III.B

BANGA CHAPTER IRRIGATORS ASSOCIATION OFFICERS SPECIAL MEETING

Date : December 13, 1985

Place : BARIS Office, Bo. 3, Banga, South Cotabato.

Time : 0930 hrs.

Agenda :

1. Discuss matters regarding illegal putting of canal checks.
2. Holding of monthly regular meeting of Banga Chapter IA officers/Group presidents (BARIS)

Attendees :

1. Engr. O. Tibang - BARIS Asst. Irrigation Supt.
2. Mr. Januto - Banga Chapter IA president
3. Dr. J. Sison, Ph.D. - IFPRI-IRRI Representative
4. Engr. P. Bayacag - USM-SMARC Economics Dept.
5. Banga Chapter IA officers/BARIS sector leaders
6. NIA watermasters and ditchtenders
7. One IIMI Representative

TOTAL ATTENDANCE IS 21.

The meeting opened up by with a silent prayer lead by the IA president who is also the chairman of the meeting.

He introduced the visitors Dr. J. Sison Ph.D. of IFPRI-IRRI and Engr. P. Bayacag of the USM-SMARC.

The president informed the body that this meeting is called due to some complaints sent by some group presidents regarding the putting of illegal canal checks for the past months.

He presented the approved irrigation schedule and stressed that it could not be altered by only one person and that the authorize persons to put and remove canal checks are the NIA Watermasters and ditchtenders. He assured the officers that he could file a case to those violators of irrigation schedule if their IA Banga Chapter is already duly registered. He also added that because of siltation the total service area of BARIS is reduced.

In the case of Group IV (Irrigation water schedule until Dec. 31, 1985) through their group president is requesting Engr. Tibang to give an extension of irrigation until January 15, 1986 for their presently standing crops, which Engr. Tibang could not grant because according to him he had given a consideration group IV to irrigate last July 1985 even they were not scheduled for irrigation. Beginning January 1986 all turnouts which is not scheduled for irrigation will ne cemented Engr. Tibang further added.

The watermaster of Div. C which includes Group IV commented that a certain individual in group IV forcefully leading a group of putting illegal canal checked which could be the primary cause of water shortage downstream (Group V and VI).

The no. two agenda is holding a regular monthly meeting of BANGA CHAPTER IRRIGATORS ASSOCIATION OFFICERS/GROUP PRESIDENTS. The purpose of the regular meeting is to trace out problems regularly especially in irrigation schedule.

So that it won't conflict with other farmers meetings they set it every last Monday of the month, 9:00 a.m. at BARIS Office, Bo. 3, Banga.

The meeting adjourned at about 11:30 a.m.

Annex III.C

BARIS FARMERS' GENERAL MEETING

Date : February 24, 1986

Place : BARIS Office, Bo. 3, Banga, South Cotabato.

Time : 0900 hrs.

Agenda : Schedule of water distribution for the wet cropping 1986

Attendees :

1. Irrigation Supt. - Engr. H. Bienes
2. Asst. IS - Engr. O. Tibang
3. BARIS FIA Organizer - Mr. W. Dumayas
4. South Cotabato and Gen. Santos FIA Pres. (Prov'l Federation) - Mr. E. Nabong
5. Federation of FIA BARIS chapter Pres. - Mr. F. Januto
6. Federation of FIA BARIS chapter Board of Directors/and members
7. MAF Technicians (Two)
8. Barangay officers covered by BARIS
9. Farmers from different groups
10. Representatives from IIMI - (Two)

TOTAL ATTENDANCE IS ABOUT 30.

The meeting was chaired by FIA BARIS chapter Pres. Mr. Januto. He opened the meeting by saying that this one is a regular seasonal meeting to decide among themselves the schedule of water distribution for wet cropping 1986 which will start on May.

He further said that the approved schedule of water distribution could no longer be altered by the NIA personnel. Consideration or rescheduling could only be brought out through another farmers meeting.

Mr. Januto introduced the Provincial Federation Pres. for his remarks.

Mr. Nabong asked first the question - As a member what benefits could we derive from the federation? Let us not limit the federation only to the scheduling of water distribution. Members and officers must have future plans for the good of each member.

He (Mr. Nabong) cited a fact that farm inputs from the company when it reaches the farmers about 30 to 40 percent discount had already been given to the dealers.

"If we are organized and buy our farm inputs by a greater volume, we could demand a greater discount from the companies. With the cooperation and participation of everyone, we could do this. We have to start with a build-up capital to be taken from the demonstration farms to be sponsored by some of the Agricultural companies". Mr. Nabong added.

Before they took the main agenda, several problems of farmers were aired.

Farmers said that unlined Laterals are already silted.

Engr. Bienes answered by saying that there is already a schedule of desilting the Laterals sometime this March as soon as the trailer is repaired to transport the desilting equipment. he further added that for the information of everybody, a feasibility study is going on in putting up a small dam along Katitisan Creek to add supply of irrigation water.

Mr. Januto commented that in return to NIA's undertakings farmers should be encourage to pay irrigation fees promptly.

Mr. Januto gave the floor to Engr. Tibang to discuss the main agenda (Schedule of water distribution).

Engr. Tibang reviewed the previous schedule of water distribution.

In the wet season of 1985, NIA was hard up in the implementation of the agreed schedule. Group IV supposedly will not be supplied with irrigation water for that entire season but they (farmers) petitioned to avail of irrigation water, so a meeting was called in early July wherein a consideration was given to group IV.

In the dry season of 1986, another consideration to avail of irrigation water was given to groups III and IV.

He then elaborated that out of 1930 has. presently service by BARIS, only 1500 has. will be supplied with irrigation water for this wet season 1986. There must be group/s to be excluded from irrigation.

He presented the two main groups to be supplied with water.

GROUP	:	AREA	:	M	:	J	:	J	:	A	:	S	:	O	:
A	:	900ha	I	7 days a	I	Fri - Sat	I	Wed - Sat	I	:	:	:	:	:	:
				week		2 days									
B	:	600ha	:	I	Sun - Thu	I	Sun - Tue								
					5 days		3 days								

Those who will belong to Group A will be supplied with water 7 days a week beginning May 1 until June 15, 2 days/week (Fri-Sat) from June 16 to July 31, and 4 days/week (Wed-Sat) from Aug. 1 until Sept. 15.

While those who will belong to group B will be supplied with water 5 days/week (Sun-Thu) beginning June 16 until July 31, 3 days/week (Sun-Tue) from Aug. 1 until the end of October.

Engr. Tibang also presented the previous water distribution;

GRP/Cropping	:	Wet '84	:	Dry '85	:	Wet '85	:	Dry '86	:
I	:	W	:	NW	:	W	:	W	:
II	:	W	:	NW	:	W	:	W	:
III	:	W	:	W	:	N	:	W	:
IV	:	W	:	W	:	?	:	?	:
<u>V</u>	<u>:</u>	<u>NW</u>	<u>:</u>	<u>W</u>	<u>:</u>	<u>W</u>	<u>:</u>	<u>W</u>	<u>:</u>
VI	:	W	:	W	:	W	:	W	:

W - supplied w/irrigation

NW - not supplied w/irrigation

Each of the group had already one season without irrigation, except Group VI and Group IV which have two questionable cropping seasons.

Through a series of discussions and interactions among farmers a situation was brought out that since farmers belonging to Lat. F have no FIA organization, they will be the last priority to be given irrigation water as per statement by the Irrig. Supt., but the Barrio Captain won't agree.

However, Mr. Dumayas, made a condition through the Barrio Captain that, if until May 1 farmers of lat F are not yet organized they will not be supplied with irrigation water.

Mr. Nabong suggested that a committee will be formed to evaluate the performance/collection of irrigation fees which will be the basis who gets/does not get irrigation water. Mr. Januto added that he will try to implement it by Dry season 1987.

Finally to be fair to the other groups they agreed that group VI will not be supplied with irrigation this wet season 1986.

GRP	:	AREA	:	M	:	J	:	J	:	A	:	S	:	O	:
I	:	250ha	:		:	W	:	W	:	W	:	W	:	W	:
II	:	400ha	:		:	W	:	W	:	W	:	W	:	W	:
III	:	369ha	:	W	:	W	:	W	:	W	:	W	:	W	:
IV	:	300ha	:	W	:	W	:	W	:	W	:	W	:	W	:
V	:	350ha	:	W	:	W	:	W	:	W	:	W	:	W	:
VI	:	270ha	:	NW	:	NW	:	NW	:	NW	:	NW	:	NW	:

W- with irrigation

NW- without irrigation

There were no objections regarding the final scheduling of water distribution. Engr. Tibang will put into writing the approved schedule to be signed by the concerned parties.

The meeting adjourned at 12.30 p.m.

MINUTES OF THE MEETING AT MANI RIVER COMMUNAL IRRIGATION SYSTEM
MANI CIS (MCIS) Special General Meeting

Date: November 14, 1985.

Place: Bo. 5 Chapel, Koronadal, South Cotabato

Time: 900 hrs.

Agenda:

1. Water distribution problems and solutions
2. 1st cropping year 1986 (dry season 1986)
3. Hiring on one water tender for the whole system as approved by the Board of Directors 1st Nov. 10, 1985.

Attendees:

1. Mani CIS President - Mr. Santiago Billanes
2. Board of Directors (BOD)/Sector Leaders
 - Sector A Leader - Nestor Punsalan
 - Sector B Leader - Loreto Ebas
 - Sector C Leader - Albino Rodel
 - Sector D Leader - Venancio Patacsil
 - Sector E Leader - Cornelio Ledesma
3. Other farmer representatives from different sectors.
4. Ministry of Agriculture and Food technician
5. Provincial Irrigation Officer representative
6. Visitors from IIMI

Total attendance is about 50.

The meeting, started up with an introductory speech by the MCIS president. He said that "Irrigation is one of the most important part in their livelihood".

This special general meeting is being called to decide among themselves the irrigation schedule specially during this dry season and to air their problems related to the association, so that they will not blame one another particularly the BOD when water distribution problems arise.

He also mentioned that sector E farmers were inactive for the last two years. However, just recently (beginning this dry season 1986) they intend to participate with the activities and obligations of the association.

Finally, he said that last year (1984) they have completely paid their annual amortization to NIA.

The first agenda was chaired by the MCIS president (water distribution problems). Feedbacks were heard from the farmers of the different sectores.

In the past operations of the system, the irrigation schedule was not strictly implemented. Everyone placed out-of-schedule canal checks and as a result there was no definite cropping pattern for every sector. Whoever needs water can get it according to his own desire.

Based on their agreed irrigation schedule before, Sector B will not be supplied with irrigation this dry season 1986, but farmers began to prepare their fields for rice. Upon presenting this problem to the farmers, they have given sector B consideration to irrigate.

Farmers from Sector E, gave the reasons for not being active and not paying their irrigation service fees, for the last two years. They claimed that irrigation water did not reach their sector due to defective canals. Furthermore, there were a number of out-of-schedule canal checks upstream.

Some farmers pointed out that there is adequate supply of irrigation water for the whole service area even during the dry season. These can be done when canals are clean and all of the water be diverted from the river to the main canal.

In addition to this, the farmers agreed to have a "Bayanihan" (working together) work in cleaning the canals tomorrow (Nov. 15), beginning from the headgate and down particularly to sector E, in order to see whether water actually reaches there.

Their work is compensated by a fee of P50.00/day per person deductible from their irrigation service fee during harvest.

Other problems presented were:

- 1) The association must have the exact list/number of its members to facilitate collection of irrigation service fees.
- 2) Farmers attendance during general meeting will be encouraged because only few farmers were attending general meetings.

The second agenda (1st cropping 1986) was chaired by the MAF technician. He presented two cropping patterns together with irrigation schedules and let the farmers decide which one to adopt.

They are practicing three croppings a year. As usual the whole area of the system is divided into two sub-areas. Mabini comprises the area of the Sector B and a portion of Sector C, other areas belongs to Bo. 5 (Section A, portions of C, D and E)

In a series of discussions and reactions from the different sectors they came up to adapt the first cropping schedule presented.

CROPPING SCHEDULE TO BE FOLLOWED

:FEB:MAR:APR:MAY:JUN:JUL:AUG:SEP:OCT:NOV:DEC:JAN:

Bo. 5 : P : P : P : P : P : P : P : P : C : C : C : C :

Mabini : C : C : C : C : P : P : P : P : P : P : P : P :

P - Palay with irrigation

C - Corn without irrigation

The MAF technician remarked that since 1 1/2 years ago he had presented and approved by the farmers the same cropping schedule. However, it was not implemented. He hopes that beginning this dry season 1986 the approved cropping schedule will be followed.

For further information of the farmers, he recommended planting of either IR 60 or IR 62 rice variety beginning this cropping season. According to him, their office (MAF) discourages farmers to plant IR 64 variety because it is already susceptible to virus diseases. He warns also farmers to avail themselves of seeds from duly licensed and registered seed dealers.

The third agenda was chaired by the MCIS president (Hiring of one water tender for the whole system as approved by the BOD last Nov. 10, 1985.)

The duties of the water tender are:

1. To act as the gatekeeper of the Dam.
2. To see to it that water is given to the sector(s) scheduled for irrigation. This automatically relieves the sector leaders acting as water tenders for their respective sectors. To report to the BOD any person caught putting unscheduled canal checks.
3. To issue water service area bill (Required by P10 recently) at the beginning of each cropping season. However, he has no authority to collect irrigation fees. It is the duty of the sector leaders to collect.
4. To act as the president's messenger.

The salary of the water tender as approved by the BOD is 400 pesos a month. An allowance of P100.00 a month will be given at the end of the cropping season if he performs his duties well.

The qualifications of a water tender should be single and he has no farm lot within the service area of the system.

Lastly the president is inviting applicants to report for interview by the BOD.

Annex V.

Minutes of the Study Advisory Committee (SAC) for the Irrigation Management for Crop Diversification Study: First Meeting on September 18, 1985 at the NIA Boardroom 3:00 P.M.

1) The meeting actually started at 3:30 p.m.. The meeting was attended by representatives from NIA, MAF, PCARRD, IIMI and ADB (see list of participants, appendix A). An introduction regarding the formation of the SAC and the purpose of the study was given by Mr. Graham Walter (Sr. Project Economist, ADB).

2) The composition of the SAC was the first item discussed. Engr. Cesar Tech (NIA) was unanimously voted as the chairman, Dr. Ramon Valmayor (PCARRD) as the vice-chairman, and Dr. Alfredo Valera (IIMI Project Coordinator) as the secretary. Members of the SAC were Dr. Edgardo Quisumbing (MAF), Dr. Senen Miranda (IIMI), Mr. Graham Walter (ADB) and Dr. Jerry Sison (IRRI/IFPRI) as observer.

3) The terms of reference regarding the formation of the SAC were reviewed as contained in the Technical Assistance Agreement (TA 654 PH) between the Government of the Republic of the Philippines, the Asian Development Bank (ADB) and the International Irrigation Management Institute (IIMI). This T.A. agreement stipulates that IIMI will undertake the study in collaboration with NIA as the lead agency with cooperative assistance from PCARRD and MAF. The formation of the SAC is specifically called for in Article III sections (d) and (e) of the T.A. agreement. (see Appendix II of the Inception Report).

4) Included in the agenda for this meeting was the discussion of the Inception Report as presented by IIMI. Item by item review of the inception report was discussed.

- The inclusion of the Project Coordinator as an accomplishment for the staff hired in the study was raised by Dr. Miranda
- The problematic situation at the ARIP PTDF#2 as presented in the report precipitated an objection on the part of ADB (Mr. Walter). The statement regarding IIMI's concern in this study site was finally threshed out. This was explained by Dr. Valera as a way of letting the SAC aware of IIMI's opinion that maybe the site for the PTDF#2 with all its problems was not the most suitable location for this component of the study. This was done so that unwarranted expectations would not result upon completion of the study particularly in this site.
- The soil-plant-water relationship study was also noted down as not being included in the text of the inception report. However, clarification was made wherein this study was included in the updated workplan outline as presented in page 15 of the report.
- Thus, Mr. Walter raised that each component research study proposal as modified resulting from the workshop be compiled and submitted to ADB and the members of the SAC. Furthermore, a proposal for documenting successful

irrigation systems should also be included in this compilation of research proposals.

Finally, a summary text for this compilation should be made as a preface to be submitted before October 22, 1985.

5) Other matters were also discussed which had relevance to the study:

- The price of rice and corn were noted as fluctuating depending on the locality. These were observed from the recent trips and current information of Engr. Tech , Dr. Quisumbing and Dr. Valmayor particularly in Mindanao. Constraints in the procurement of grains by NFA were also discussed. Apparently, funds from loans for procurement of imported grains cannot be used for purchasing local produce. Untimely arrival of imported rice and corn exacerbated the situation.

The farmers were not getting the reasonable price of their produce but instead were making a loss due to these problems.

- The aforementioned constraints were noted down also in relation to the policy implications that was a part of the study being undertaken by the IRRI/IFPRI group.

- Marketing and post harvest technology aspects of crop diversification were the two main constraints that were identified and discussed.

6) The problems regarding the implementation of the study were also discussed:

- Vehicles purchased from abroad for use in the study have been cleared through the Bureau of Customs by Ministry of Finance for tax exemption

- Authorization for using the guarded parking area at NIA was also granted by the NIA Administrator

- Use of NIA vehicle at the MRMP site was also granted since no four wheel vehicle was assigned to this site coming from the T.A. funds. The operational and maintenance costs will be provided by IIMI for the use of this vehicle.

- A telex facility is already in place at PCARRD headquarters and its use was also granted to IIMI, charges of which will be on a per message basis. This is in addition to the already available telex facilities for IIMI's use at the NIA and Ford Foundation offices.

7) A proposal for the using the present SAC set up to review other irrigated crop diversification projects of MAF and NIA-JICA was raised by Dr. Quisumbing. This motion was agreed in principle. However, no details on its implementation was discussed.

8) Finally, the next meeting was tentatively set to review the interim report of the study sometime in April or May. The meeting was concluded at 4:30 P.M..

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February 26, 1986

Dear Fred,

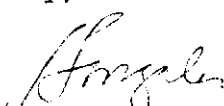
To formalize the series of discussions we had for the past months regarding the effective working collaboration between IFPRI and IIMI on the ADB financed Philippine research project, please find (Appendix), a summary of the data which we hope IIMI can provide us before we finalize our research report.

Our data requests revolve around the technical aspects of irrigating non-rice crops, particularly corn, soybeans, mungbeans, cotton and wheat. Firstly, we need an indicative description from IIMI on the technical constraints in irrigating non-rice crops. As you know the ADB views the Philippine project as one, with IIMI expected to provide a major research input on the engineering and agronomic aspects and IFPRI, the economic side of irrigating non-rice crops. Secondly, we also need estimates of actual and potential irrigable areas and yields of these non-rice crops (see Table 1 of Appendix) as input to our supply-demand projections from 1985, 1995 to 2000. Thirdly, we also need the input-output farm management data (Table 2, Appendix) from the IIMI research sites in 1985. If first and second seasons data broken down by with and without irrigation are available, it would be a tremendous help in assessing the economic regional comparative advantage of producing non-rice crops. Finally, we hope that you can provide us these sets of information on or before June 15, 1986 for incorporation in our final report to ADB due in the middle of August 1986.

If you have any questions regarding these requests, I would appreciate it very much if you could further discuss them with me the soonest possible time.

With warm personal regards.

Sincerely,


LEONARDO A. GONZALES
IFPRI Liaison Scientist for Asia

Dr. Fred Valera
Field Coordinator
IIMI-ADB Project
National Irrigation Administration
Diliman, Quezon City

cc: Graham Walter, ADB
M.W. Rosegrant, IFPRI

Encl.: a/s

Appendix. IFPRI data request from IIMI.

- 1) An indicative description of the technical constraints (design, management, agronomic factors, etc.) in irrigating non-rice crops.
- 2) Actual and potential irrigable areas and yields of non-rice crops (corn, soybeans, mungbeans, peanut and cotton) in the Philippines by region or agroclimatic zones for 1985-1990-1995-2000 (Table 1).
- 3) Input/output farm management data for non-rice crops from IIMI sites (1985) with and ~~without~~ irrigation (Table 2).
- 4) Target date: 15th of June.

Table 1. Actual and potential area irrigated and yields of corn, soybean, mungbeans, peanuts and cotton under irrigated and rainfed conditions.

Region/Agroclimatic Zones	Non-rice crops area irrigated (ha)				Non-rice yields (mt/ha)			
	1985	1990	1995	2000	1985	1990	1995	2000
	Actual				Potential			
					Irri- gated	Rain- fed	Irri- gated	Rain- fed
I Ilocos								
II Cagayan								
III Central Luzon								
IV Southern Tagalog								
V Bicol								
VI Western Visayas								
VII Central Visayas								
VIII Eastern Visayas								
IX Western Mindanao								
X Northern Mindanao								
XI Southern Mindanao								
XII Central Mindanao								

Table 2. Input use, costs of production and yields of irrigated and rainfed non-rice from IIMI sample study areas.^a

	Irrigated		Rainfed	
	Quantity	Cost	Quantity	Cost
Land rental				
Current inputs				
Seed				
Fertilizer: 45-0-0				
21-0-0				
25-0-0				
14-14-14				
16-20-0				
Organic fertilizer				
Pesticide				
Herbicide				
Tractor				
Labor:				
Land preparation and				
planting:				
Family				
Hired				
Crop establishment/care				
Family				
Hired				
Harvesting				
Family				
Hired				
Irrigation				
Interest				
Depreciation				
Tax				
Total cost				
Yield				
Price/kg				

^a To be prepared for corn, soybean, peanuts, cotton, mungbean.

Annex VII Study review mission report

7-01 As part of the technical assistance agreement for this study, a review mission was conducted on March 4-8, 1986.¹ 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).

7-02 The participating agencies were ADB, IIMI, NIA, MAF-ARO, PCARRD, ISU and USM. The review team consisted of the staff² from the above agencies that visited each study site,³ namely; Isabela, Cavite and Allah Valley (South Cotabato).

7-03 At the Isabela site, the briefings were held at the NIA Magat River Multipurpose Project Office at Cauayan, Isabela. In this session, an initial briefing on the operation of the MRMP was presented by Engr. Reyes of the Water Control Coordinating Center. He particularly pointed out the potential for irrigating non-rice crop in the 11,000 ha. area within the service area of MRMP. The soil in this area is classified as dual to diversified land classes suitable for non-rice production during the dry season.

7-04 However, due to the availability of irrigation water and other factors⁴ most farmers in this area prefer to grow rice even during the dry season. Due to the present land development in the MRMP service area, only 77% of potential area is irrigated. Irrigation water is abundant even to irrigate the dual land area inspite of its very demanding water use (3-4 li/sec/ha). Projections to full area development are anticipated in 3 to 5 years, that would compel the MRMP management to seriously consider limiting water supply to this dual land class area. Presently, only 600 ha. are planted to diversified crops.

7-05 The NIA presentation was followed by the IIMI study at selected laterals at MRMP. One significant item in the preliminary results is the continuous supply of irrigation water in this dual land class area. This in effect inhibits crop diversification and promotes rice production. As

¹. Schedule and Program for the Study Review Mission is in Appendix VII.A .

². The list of participants are in Appendix VII.B.

³. 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. Actually several attempts were made earlier (crop year 1975 and 1983) to promote crop diversification in this area. Difficulties were encountered namely in the marketing of sorghum and soybean.

previously mentioned, this abundance of irrigation water supply constraints the present program for crop diversification in addition to the other constraints that will be discussed later on.

7-06 The other component studies being conducted by the research staff of the ISU were then presented. These were on a) simulation and validation of soil-water and root distribution of corn, b) evaluation of farm water delivery systems for corn c) agronomic evaluation of alternative cropping patterns for rice-based area, d) study on the management and operation of two irrigators' association in the MRMP service area, and e) economic aspects of crop diversification in the MRMP service area.

7-07 After these presentations, an open forum was held. One question raised was regarding the actual contribution of the first study to irrigated crop diversification. The study is more academic in nature. However, preliminary results indicate valuable information regarding corn production. A suggestion was made that the final results should be translated into more of a layman's language comprehensible for actual information dissemination to the farmers. The other questions raised were regarding the last two studies (d) and (e). Unfortunately, the study leaders were not available to provide the answers. A comment on the integration of these component studies was raised by Mr. Walter of ADB. As presented in this report, these component studies are integrated in the overall objectives of the study.

7-08 After the briefings and lunch, the review team proceeded to the study sites part of the San Mateo and Luna towns. In the field sites, several farmers and also farmer cooperators were informally interviewed regarding their views on the constraints for crop diversification. Based on the responses of the farmers, the outstanding constraints gathered were the market price of corn and difficulties in rice land preparation with regards to the corn stubbles left over from the previous dry season crop. These two indicative responses will be verified upon completion of the studies particular to this site.

7-09 An extended session was held to further discuss the last two studies. The economic aspects study was again not discussed due to the absence of the study leader. Nevertheless, this extended session discussed the problems encountered in the operations of the irrigators' association.

7-10 The main problem discussed was the inactivity of the officers and members of the IA at the Luna site. Suggestions were made to focus on the cause and not the symptoms of the problems and thereby come up with viable solutions. The results of this study will be reported upon completion in July 1986. This extended discussion lasted up to 9 o'clock in the evening after dinner.

7-11 Next day, at the Cavite site, a meeting was held at the Second Laguna Bay Irrigation Project (SLBIP) in Tanza, Cavite. The meeting was organized by the White Beans Project Task Force⁵ in lieu of the briefing for the review mission. The meeting was presided by the SLBIP Project Manager.

5. The agenda was prepared by the White Beans Task Force chaired by the SLBIP Project Manager, Engr. Teofilo de Jesus.

He gave a brief overview of the project and also elaborated on the WBPTF. The original target for white bean production was 100 ha. However, due to the problems of farmer non-cooperation and unavailability of credit for farmers, the actual area planted was only 21 ha. These two problems were emphasized as the main stumbling blocks to successfully produce white-beans⁶ in Cavite.

7-12 The next item in the agenda was presented by the ADD chief, Mr. Olea regarding the institutional aspect of white bean production. The role of cooperatives was also presented by Ms. dela Cruz of the MAF. This was followed by the water management (particularly O & M) aspect presented by Engr. dela Cruz, the Irrigation Superintendent of the Cavite Friar Lands Irrigation Systems. The research on irrigation was presented by Dr. Valera and Mr. Manguerra of IIMI. There were two studies conducted in relation to this site namely; the drought and flooding (water-logging) tolerances of white beans and evaluation of the single and double row furrow irrigation. Preliminary results of the first study indicated that white beans are susceptible to flooding damage. Three days of continuous flooding will result in total crop failure. The result of the moisture stress or drought study was not significant due to the occurrence of late rainfall. This study was conducted in the experiment station at UPLB.

7-13 The preliminary results of the second study indicated that irrigating with double row furrow will be more effective in terms of water use. This was based in the actual water use for the single and double row furrow methods. Furthermore, the yield component comparison indicated no significant difference.

7-14 The next item presented in the meeting was the pests and diseases aspects of white-bean production. This was presented by Ms. Moreno, a plant pathologist from URC. She explained the common pests and diseases attacking the white-bean crop namely; bean fly and root rot. The damage inflicted by these pests and diseases can be minimized by the timely and proper application of pesticide and fungicide. Based on the observations made the white-bean crop planted were minimally affected.

7-15 A brief presentation on the transfer of technology to the farmers was presented by Mr. Ramos, the Project Manager of SLBIP Vegetable Component MAF. The last item presented was the credit problem as elaborated by Mr. Abejuela, the MAF consultant. Based on the meetings with and responses from farmers, the unavailability of credit to grow white-beans was the single most important constraint according to him. He even asserted that unless credit is provided, the other components of the project will be meaningless. In fact, he had to borrow from the Provincial Government in order to have funds for lending to the farmers. However, only P60,000 were made available. This amount was not sufficient and also the release of funds were already late. He chided the supposed lending agencies (Rural Bank, etc.) for not actually fulfilling their role in extending credit for the farmers. His

⁶. This white-bean production was an integrated effort between NIA, MAF and Universal Robina Corporation (URC). The latter provides the seeds and marketing facility. The white beans produced are actually used for manufacturing canned beans and pork.

misconceptions of ADB's role also was highlighted in his remarks. Nevertheless, Mr. Walter of ADB clarified the role of ADB and emphasized that ADB is not mandated to provide credit to the farmers.

7-19 The cost and return of white bean production was also presented. The only item raised was the non-inclusion of the interest charges on the loans or credit for the inputs. This was noticed by Dr. Merrey of IIMI. The Project Manager responded that the credit extended was mostly in term of goods (i.e. fertilizer, seeds) and only a portion of the credit was extended in cash for hired labor.

7-20 On the third day at the Allah Valley site, a briefing or meeting was held at the NIA-ARIP-ACD office at Bambad, Isulan, Sultan Kudarat during the afternoon of the review team's arrival from the Cotabato City Airport. The meeting was presided by Engr. Mempin, Chief of NIA-ARIP-ACD. He presented the activities of the ACD with particular attention to the cropping patterns being implemented at ARIP. He also discussed the activities in organizing the farmers in order to implement the water management scheme in the service area. In the pilot area, Lateral A extra, or PTDF #2, most of the farmers were already members of the IA, whose association papers are currently being processed for registration with the Securities and Exchange Commission. He also discussed the research being undertaken by his staff in conjunction with the IIMI and USM research studies at PTDF #2.

7-21 The next item in the meeting was presented by Dr. Valera of IIMI who outlined the involvement of IIMI at ARIP particularly at PTDF #2. Based on the accomplishments, two items were mentioned namely: a) the proposed or suggested water management scheme and b) the suggested design layout of the farm level facilities. These two items are included in this report which will be discussed in section 3.A.1. Assistance was also extended in helping the ACD staff in terms of carrying out their research activities (i.e. conveyance loss studies, S&P determination, interpretation of rainfall distribution) and also in analyzing the data collected from the ARIP service area. This assistance is provided through the IIMI staff assigned at the Allah Valley site.

7-22 The next item presented was the component studies being implemented by the research staff of USM. The first study presented was the Agro-socio Benchmark Survey of the farmers served by Lateral A extra or PTDF #2. Demographic, cropping patterns and farmer aspirations data were presented. The leader for this study is Prof. dela Cruz. This benchmark information was used to come up with the proposed cropping pattern and testing of alternative crops in the documentation farms at PTDF #2. Preliminary results of the evaluation of the on-farm water delivery methods were also presented. This was explained by Engr. Sarmiento, USM-IIMI Project Leader. The highlight of the study was that it takes less time for the furrow method than the basin irrigation method. Actual water use data was not yet analyzed.

7-23 The testing of alternative non-rice crop component study was still its vegetative stage. The crops tested were early maturing improved traditional corn, mungbean and peanuts. There was a question raised regarding the timing of corn crop planting. The question was raised by Mr. Godilano (IRRI-MAF-ARO). He pointed out that apparently the crop was planted late (January) which became susceptible to pest and disease damage.

This issue was not resolved but will be discussed again in the plenary session of this review mission in the later part of this report. The leader for this study (Dr. C. Clarete, USM) was absent during the review period at this site.

7-24 Several comments were also expressed in particular by the ARIP dam NIA consultant Mr. Baradan, regarding the operations of the system. He was requiring the research studies to provide the data for the operations manual which he was requested to accomplish in the next few months. The IIMI staff (Dr. Miranda and Dr. Valera) responded with the assertion that the research studies were not designed to provide data or information regarding the entire ARIP operations but rather provide information based on studies at Lateral A extra (PTDF #2). However, with the assistance provided to the ACD staff, somehow, Mr. Baradan's concerns can be accommodated.

7-25 After the meeting, the review team, the NIA staff and the USM staff proceeded to the service area of Lateral A extra. The first study site visited was the plot (1/4 ha) planted to peanuts. The group were treated to boiled peanuts by the farmer cooperator. At that time, the peanut crop was near harvest within one week. Yield estimates from the standing crop was relatively high. The next stop was the corn and mungbean plots (1/4 ha. each). These plots were the site for testing the furrow and basin irrigation methods.

7-26 The corn crop stand was not very vigorous which gave the credence to the comment of Mr. Godilano. The mungbean plot appeared to be damaged by water logging. This was explained by the over-topping of the farm ditch which was not immediately repaired by the farmer and the ACD staff assigned to assist in the USM demonstration plots. The final reports for these studies will be completed upon harvest of these crops.

7-27 The last stop for the day was the dam site whereby, the last bay of the silt ejector type dam was still under construction. The electric motors for opening and closing the gates were not yet in place. A crane was used to lift the temporary checks across the river and in the intake structure. The review team then proceeded to the NIA guesthouse at Marbel where the IIMI, NIA and ADB members of the review team were billeted. The rest of the team were accommodated at the local hotel at Marbel.

7-28 For the fourth day at the Allah Valley site, a briefing was held at the Banga RIS field office. The briefing was started with the present operations of the Banga RIS. The schedule of water deliveries was presented by Engr. Tibang, Asst. Irrigation Superintendent. One feature of this system was the joint management between farmer Irrigators Association and the NIA staff. With the exception of the areas served by Lateral C, all of the farmers are members of an IA. Water allocation is decided through meetings held before the cropping season. The schedule for the coming wet season can be found in Appendix III.B. The NIA staff presents the expected available water supply then the farmer leaders decide which area is to be served for rice irrigation. As for the dry season schedule, areas are rotated annually regarding areas to be irrigated for rice and other crops. The upland or corn crop is not scheduled for irrigation. However, if the farmers would request for irrigation water, these areas, will be considered. Promisory notes for

payment will have to be accomplished and contiguous area (i.e. areas in blocks) are the necessary conditions before NIA will consider irrigating these areas. Based on field observations, farmers who grow corn in patches adjacent to the rice crop actually irrigate their corn crop. However, it is difficult to verify these and accordingly bill the farmer for corn irrigation fee. Apparently, the main aim of the NIA staff is to collect as much as possible for the rice irrigation fee.

7-29 This system also suffers from excessive siltation which necessitates 2 hours of desilting, closing the intake gate at the dam. For more details of the operations, see section 3.A.2.

7-30 The next portion presented was the IIMI study on system management. Dr. Valera, Project Coordinator explained the objectives of the study. Based on the past two seasons, water flows, rainfall and evaporation and actual operational procedure have been documented. Staff gages were installed and calibrated to monitor to flows from the headgate to the different laterals in the system. The main objective of the study is to document the system operation or management whereby crop diversification is accommodated in the system. As mentioned, no planned nor schedule is carried out to irrigate upland crops or corn but somehow carried out on an ad hoc basis. One corollary aim of the study is to find out the benefits of irrigated corn vis-a-vis rainfed corn. Due to the relatively even rainfall distribution in this site, farmers are reluctant to irrigate corn. More details on this aspect is discussed in section 3.A.2.

7-31 The next study presented was the economic study on the profitability of the different cropping pattern at Banga RIS. Only the benchmark preliminary results were presented whereby the income for the rice-rice pattern had the highest income followed by the rice side by side with corn pattern and lastly the rice-corn pattern.

7-32 The next study presented was the agro-socio-economic survey by Prof. T. dela Cruz. Similar to the PTDF #2, the benchmark information are the sampled farmers' demographic, cropping practices and aspirations data collected in this study. The information gathered were useful in the subsequent research activities of the USM research staff.

7-33 The testing of alternative non-rice crop in irrigated areas study at Banga RIS was not presented since the study leader was absent. Nevertheless, the same crops (early maturing improved traditional variety corn, peanuts and mungbean) planted at the ARIP PTDF #2 were also tested in this system. Likewise, the study on the basin and furrow irrigation methods were superimposed on these crops tested for adaptability. The initial results indicated similar results whereby the furrow method took less time to irrigate relative to the basin method.

7-34 After the briefings, the team proceeded to the demonstration plots (1/4 ha for each crop). At the study site, same comments were made regarding the stand of the crops. The corn crop were not as vigorous as the adjacent hybrid corn crop. However, the mungbean crop looked very impressive. The question of fertilizer rate was raised by Mr. Godilano. Apparently, Engr. Sarmiento insisted that this crop received the same dosage as the corn crops. This more than enough dosage might have influenced its vigorous stand

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as commented by Mr. Godilano. With the absence of Dr. Clarete, no clear indication of the actual dosage can be verified. The peanut crop did not appear as vigorous as that in the PTDF #2 area. Nevertheless, the results of these crops planted will be analyzed and evaluated after harvest.

7-35 The last stop at this system was at the dam site. With the siltation problem, several earth moving equipment were present. These equipment were used to desilt the accumulated sand and silt at the silting basin. In fact, there was a sign board indicating NIA was selling the accumulated sand taken out of the silting basin. The silt problem is really acute, whereby, the ogee of the diversion structure is already at the same level as the silt. Only the intake portion of the dam is not covered by silt where the river water flows.

7-36 After lunch, the team proceeded to the Mani CIS. This site was selected to represent an irrigation system totally managed by the farmers. Basically, all of the component studies at Banga RIS are also being conducted at this system. The first stop in this system was at the demonstration plots whereby the testing of alternative crops and comparison of the basin and furrow irrigation methods were being implemented. The question of late corn planting was again raised by Mr. Godilano. The other crops planted were peanut and mungbean. Comparative yield analysis will be made regarding the benefits of irrigation, particularly with respect to irrigated corn. Similar to the Banga RIS, farmer at this site do not irrigate their corn due to apparent sufficiency of rainfall.

7-37 The IIMI system management study at this site documented the water flows and the actual operational procedures. Staff gages were installed and calibrated at the main canal and laterals. An evaporation pan and rain gage were also installed in this system.

7-38 The next stop was the dam site. The original dam was constructed through the PACD in 1975. Earlier on, a brush-type dam was constructed to divert water. With a loan from NIA, the association were able to build a cut and cover intake and lining portions of the main canal and laterals and also checking structures along the main canal. This loan is amortized at the rate of P12,000/ year for 25 years. The deterioration of the canal linings encouraged the farmers to request for additional loans from NIA. The recent washout of a section in the main canal prodded the association to pursue this request from NIA. The president of the Mani CIS, Mr. Billanes accompanied the team in this visit.

7-39 A plenary session for the review mission was held after the visit to the Mani CIS. This was held at the NIA Marbel office conference room. The first item on this session was the visit to the Allah Valley site. Comments and suggestions were made regarding the conduct of the study specially on the testing of alternative crops. Mr. Godilano remarked that the corn crop planted were late and was susceptible to the pests and diseases. Furthermore, he alluded to the excess fertilizer application on the mungbean crop. Engr. Sarmiento responded that the corn crop is not that late that it would invite pest and disease damage and furthermore the corn was an early maturing variety. He also insisted that the fertilizer dosage to the mungbean was the same as the corn crop. Dr. Valera cautioned

Engr. Sarmiento that no definite response can be given until the study leader can verify the actual dosage.

7-40 Mr. K L. Lim suggested some simple tests for crops due to the unhealthy appearance of the corn crop. He also suggested that maybe a smaller plot can be used for this purpose. He also asked for some commitments from MAF with regards to the current study on irrigated crop diversification. Mr. Godilano replied that he will make a report to Dr. Quisumbing (Director, ARO-MAF) about this review mission and let him decide about commitments.

7-41 Dr. Merrey of IIMI suggested that Prof. T. dela Cruz improve on the proposal for studying the dynamics of the IAs. He also made a suggestion with regards to the economic study in that it should include marketing and farmer decision making aspects of crop diversification. This will then provide a comparable data set together with the Isabela site.

7-42 Mr. Walter of ADB reminded Dr. Valera of the necessity of integrating all of these studies for the interim and final reports. He also suggested that a summary of the visits from Isabela, Cavite and Allah Valley sites be made. With this suggestion, Dr. Valera obliged and asked for the other participants indulgence to bear with him, since the Isabela and Cavite sites were not familiar to the other participants in the session. A summary was orally presented based on the foregoing visits made to the Isabela, Cavite and Allah Valley sites. With this summary, the review mission ended at 5:30 pm, March 7, Friday. The review team stayed for another night and then proceeded to Cotobato City Airport, the next morning.

Annex VII.A

ADB REVIEW MISSION ON IRRIGATION MANAGEMENT FOR
CROP DIVERSIFICATION STUDY MARCH 4-8, 1986¹

1. Participating Agencies:

The Asian Development Bank (ADB)
 The International Irrigation Management Institute (IIMI)
 The National Irrigation Administration (NIA)
 The Philippine Council for Agricultural and Resources Research and Development (PCARRD)
 The Ministry of Agriculture and Food, Agricultural Research Office (MAF, ARO)
 Isabela State University (ISU)
 University of Southern Mindanao (USM)

2. Purpose:

To review the progress of the technical assistance agreement (TA 654 PHI) on the Study on Irrigation Management for Crop Diversification between the Government of the Republic of the Philippines, IIMI and ADB.

The study have the following general terms of reference
 namely, to examine: -----

- i) the constraints to crop diversification in irrigated areas, with special attention to irrigation constraints
- ii) ways in which irrigation management of irrigation systems, particularly operation and maintenance (O&M) can overcome the constraints thereby promoting crop diversification
- iii) preliminary agronomic and economic comparisons of different irrigation alternatives with various crops
- iv) assess O&M institution building requirements resulting from crop diversification and
- v) required follow up actions.

Review Procedures:

The review team² will visit the study sites namely: Isabela (NIA-MRMP), Cavite (NIA-SLBIP) and South Cotabato (NIA-ARIP-BARIS and Mani CIS) on March 4-8, 1986. In each site, briefings on the on-going component studies and activities pertinent to the terms of reference will be presented. Studies conducted by IIMI and contracted research through the participating agencies will likewise be presented with summarized

¹ This is the schedule of activities prepared by IIMI (Philippines) in connection with the ADB review mission as part of the technical assistance agreement (TA 654 PHI) on the Study on Irrigation Management for Crop Diversification.

² The list of the members of the review team is in Appendix VII.B.

reports. After the briefings, field visits will be conducted at the study sites. Not included in this review program is the aspect of documenting the "successfully" operated NIA systems for crop diversification. However, on-going component studies are being conducted to document irrigated crop diversification as part of the literature review as envisaged in the technical assistance agreement. This documentation are located in the following sites: Pangasinan (San Fabian River Irrigation System and Agno River Irrigation System), Ilocos Norte (Laoag-Vintar Irrigation System) and Nueva Ecija (Upper Pampanga River Integrated Irrigation Systems, District I). This portion of study is being implemented through the research staff of the Dept. of Ag. Education and Rural Studies, University of the Philippines at Los Banos.

This review program also serves as the activity prior to the submission of the interim report, originally due on March 1986 but was postponed until May 1986.

4. Review Mission Schedule March 4-8, 1986

March 4 (Tuesday)

6:00 AM Departure from Manila Domestic Airport

7:15 AM Arrival at Tuguegarao Airport

7:30 - 10:30 AM Travel to NIA-MRMP Cauayan, Isabela
(NIA-Magat River Multipurpose Project)

10:30 - 12:00 NN Briefing at NIA-MRMP Office

12:00 - 1:00 PM Lunch

1:00 - 5:00 PM Field visits to San Mateo and Luna study sites

6:30 - 7:30 PM Dinner

Overnight at NIA- MRMP Guesthouse

March 5 (Wednesday)

7:00 - 8:00 AM Breakfast

8:00 - 10:30 AM Travel to Tuguegarao Airport

11:10 AM Depart from Tuguegarao Airport

12:25 PM Arrival at Manila Domestic Airport

12:30 - 1:30 PM Lunch at Manila

1:30 - 2:30 PM Travel to Tanza, Cavite

2:30 - 3:30 PM Briefing at NIA-SLBIP Office
(NIA-Second Laguna Bay Irrigation Project)

3:30 - 5:00 PM Field visit to Gen. Trias study site

5:00 - 6:00 PM Travel to Manila

March 6 (Thursday)

10:40 AM Depart from Manila Domestic Airport

12:10 PM Arrival at Cotabato City Airport

12:30 - 1:30 PM Lunch at Cotabato City

1:30 - 3:00 PM Travel to Isulan, Sultan Kudarat

3:00 - 4:00 PM Briefing at NIA-ARIP ACD Office
(NIA-Allah River Irrigation Project
Agricultural Coordinating Division)

* 4:00 - 5:00 PM Field visit at ARIP PTDF # 2
(ARIP, Pilot Testing and Demonstration Farms No. 2, Lateral A-Extra)

~~7:00 - 8:00 PM Dinner at Marbel~~

Overnight at NIA Guesthouse Marbel

March 7 (Friday)

7:00 - 8:00 AM Breakfast

8:00 - 8:30 AM Travel to Banga River Irrigation System
(BARIS)

8:30 - 9:30 AM Briefing at BARIS Office

9:30 - 11:30 AM Field visit at BARIS study sites

11:30 - 12:00 NN Travel to Marbel

12:00 - 1:00 PM Lunch at Marbel

1:00 - 1:30 PM Travel to Mani River Communal Irrigation
System

1:30 - 3:00 PM Field visit to Mani CIS study sites

3:00 - 3:30 PM Travel to NIA Marbel Office

* If more time is necessary to visit ARIP service areas, a portion of the time next day (March 7 Friday) can be allocated to this activity.

3:30 - 5:00 PM Review Mission Assessment Meeting at
NIA Marbel Office

6:00 - 7:00 PM Dinner at Marbel

Overnight at NIA Guesthouse Marbel

March 8 (Saturday)

7:00 - 8:00 AM Breakfast

8:00 AM Travel to Cotabato City

11:30 - 12:30 PM Lunch at Cotabato City

1:10 PM Depart from Cotabato City Airport

2:40 PM Arrival at Manila Domestic Airport

List of the members of the study review team:

Name	Agency	Designation
1. Mr. Salvador Salandanan	NIA-Central Office SMD	Chief Researcher
2. Mr. Graham Walter	ADB	Sr. Project Economist
3. Mr. K.L. Lim	ADB	Agronomist
4. Dr. Senen Miranda	IIMI	Sr. Scientist-Engineer
5. Dr. Douglas Merrey	IIMI	Social Scientist
6. Dr. Alfredo Valera	IIMI	Project Coordinator
7. Mr. Danilo Cablayan	IIMI	Research Associate
8. Dr. Amado Maglinao*	PCARRD	Director, FRSRD
9. Mr. Esteban Godilano	MAF	IRRI-ARO Coordinator

* Dr. Maglinao was not able to participate due to other pressing commitments

8-01 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 would 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

8-02 The study tour was headed by Dr. Miranda, Sr. Scientist-Engineer, IIMI¹. The study tour was conducted on April 6-13, 1986. The council of Agriculture, Executive Yuan of the Republic of China through its 3rd Department prepared the itinerary for this study tour. All of the five (5) days were spent visiting and discussing irrigated crop diversification strategy and implementation at the selected Irrigation Associations (IAs) field locations and concerned offices. This report will be presented in accordance with the chronological order by which the study tour was conducted.

8-03 There were other topics presented and discussed during the visit however, only the relevant significant issues which have bearings on irrigated crop diversification will be emphasized in this report. A copy of the prepared program and itinerary for the study tour can be found in Appendix VIII.A.

8.1 First day, (Monday) April 7, 1986

8-04 The morning portion for this day was spent at the Council of Agriculture office, specifically at the 3rd Department (Forestry) for which the Irrigation and Engineering Division belongs. The group was formally welcomed by Mr. Lin-Jen Wen, Deputy Director of the Third Department². After a brief welcome address, a slide show was presented which outlined the agricultural development in the Republic of China on Taiwan. Several briefing materials were handed out to each of the group member. There were booklets on the Agricultural Development in the Republic of China in Taiwan (by Ching-Ho Kuo) and Improvement of Irrigation Development and Management

¹. The other members of the study tour were Dr. Leslie Small, Ag. Economist, Dr. C. Panabokke, Sr. Scientist, Dr. Poh Kok Ng, Post Doctoral fellow and Dr. A. Valera, Philippine Project Coordinator, all of whom are from IIMI.

². The other members of the reception group were Messrs. Ching-Ho Kuo, Senior Engineer, 3rd Department, Cheng, Chun-Tse, Senior Engineer 3rd Department and Wen-Jung Hu, Engineer 3rd Department, Council of Agriculture, Executive Yuan.

Organization in Taiwan (by L. J. Wen). After the slide show, the briefing was continued by Mr. Ching-Ho Kuo and his colleagues.

8-05 The operation and maintenance (O & M) of irrigation systems in Taiwan is carried out by the Irrigation Association (IAs). There are 17 IAs presently formed. These IAs are corporate entities organized by farmers to manage the irrigation systems. Approximately, 400,000 ha. are covered by IAs comprising about 85% of the total irrigated area in Taiwan. These IAs were formed in the early 1920's which was heavily supported by the government in its operations. Since their formation, the farmers elected their member representatives, who in turn elected the chairman of the IA. The accountability of the IAs were directly to the farmers. However, due to financial difficulties, the election of the chairman by the farmer member representatives was terminated. Instead, the government through the Council of Agriculture (COA) as implemented by the Taiwan Provincial Water Conservancy Bureau (PWCB) designated the chairman. This was started in 1975 and lasted up to 1982 for a six year period. All of the water rights, procedures, rules, and regulation are legislated by the central government. However, these rules and regulations evolved from the initiative of the IAs through the years since their formation. In effect, to a large extent, the operation of the IAs are government controlled. Recalcitrant and non-conformist farmers are either fined or jailed depending on the gravity of the offense. However, the decision on which crop to plant in a given seasonal schedule is still left to the individual farmer.

8-06 The rotational irrigation method was adapted due to the shortage of water. This was made possible due to political will, financial government support and farmer recognition of the value of limited water supply.³ Up to the present time, rotational irrigation method is being practiced in the irrigated areas in Taiwan especially where land consolidation have been implemented. The farmers are charged with irrigation fees. There are three categories of irrigation fees namely; 1) membership fee, 2) Engineering cost fee and 3) additional irrigation. The membership fee is equivalent to (on the average) 250 kg/ha/year which is collected in cash. This fee meets the annual administrative expenditures of the IA's. The engineering cost fee is collected as repayment of partly subsidized loans (i.e. rehabilitation works, land consolidation, etc.) the government subsidizes as much as 70% of the actual engineering costs. For the current year, the total government subsidy is amounting to NT \$550 million, 200 M of which is for engineering construction and 350 M for maintenance (i.e., Dam Operators). The additional Irrigation fee is levied on special O & M situation such as groundwater pumps O & M. There are other modifications of the irrigation charges as will be presented in the later portions of this report.

8-07 Approximately 60% of the irrigated areas are planted to rice and 40% to upland crops. There are five major upland crops planted namely sugar, corn, sorghum, peanuts and sweet potatoes. These upland crops are irrigated as part of their rotational irrigation method. More on this aspect will be discussed in the succeeding portion of this report.

³. See Levine, G., L.T. Chin and S.M. Miranda. Requirements for the Successful Introduction and Management of Rotational Irrigation. Agricultural Water Management, Vol.1 pp 41-56, 1976.

8-08 After the briefing, minor adjustments were made regarding the itinerary. Instead of a visit to the Wushantou Dam, a visit to the Asian Vegetable Research Center was programmed. This visit was accommodated on the 4th day (Thursday) afternoon. The group then proceeded to have lunch hosted by the COA 3rd Department.

8-09 After lunch, the group proceeded to Taoyuan IA Office. The group was accompanied by Mr. Wen-Jung Hu, Engineer 3rd Department COA, who served as the guide and interpreter. The group were met by Mr. T. J. Huang, Engineer and Mr. Lee, General Manager of the Taoyuan IA. Mr. Lee gave a brief welcome remark then Mr. Huang took over the briefing. The briefing was mostly in Chinese (Mandarin) but was interpreted by Mr. Wen-Jung Hu, adequately. Dr. Poh Kok Ng, IIMI Postdoctoral Fellow, also assisted in the translations.

8-10 One outstanding feature of the Taoyuan IA is the presence of farm ponds, serving about 80-200 ha/pond. The Taoyuan IA covers 27,756 ha. this area derives its water supply from 3 sources namely: 50% from the Shihmen Reservoir Dam, 25% from local creek flows and 25% from effective rainfall. These sources supply the 269 units of farm ponds which can store around 50 million cubic meter of water. Each farm pond has an average area of about 10 ha. The main crop grown is rice with 2 rice crop every year. The other non-rice crops are vegetables planted on small patches adjacent to the rice crop. The main constraint for non-rice production is due to the heavier (clayey) type of soil. Moreover, due to the abundance of water supply, farmer tend to favor rice production. According to the IA engineer, one criteria for farm pond construction is the available slope in the immediate vicinity of the service area. The topography should have at least a slope of 1:120 or 0.83% gradient. The average yield in this area is 8-9 tons/ha. The presence of the farm ponds facilitate local storage and control of irrigation water. This concept of farm pond is sometimes called "melon on the vine" set-up which is also considerable in parts of mainland China.

8-11 The Taoyuan IA is one of the better financed IA's. The office building is new and the IA own other real estate properties in the city of Taoyuan. In fact, the hotel building where the group stayed is owned by the IA. This enabled the group to have a 50% discount on their hotel bill. Fortunately, the Taoyuan IA have an English version of their Taoyuan IA pamphlets. These were distributed to the group members.

8-12 At this IA, the team leader serves as the "common irrigator" who is responsible for the distribution of irrigation. This is done for every 50 ha. block on the average. This common irrigator is equivalent to the ditch tender in the Philippine irrigation systems. More on the common irrigator will be discussed in the other IAs visited by the group.

8.2 Second day, April 8, 1986

8-13 On the morning of the second day, the group proceeded to the Shihmen Reservoir Dam. The group was met by Mr. Chang, the Deputy Director of Dam Administration. The Shihmen Dam Administration is managed by the Taiwan Provincial Government. There are four competing purposes for the Shihmen Reservoir Dam. These are: 1) Domestic water supply, 2) Irrigation, 3)

Industrial water supply, 4) Power and 5) Recreation.

8-14 For irrigation, the Taoyuan and Shihmen IAs submit a seasonal water supply requirement to the dam authorities. The schedule of water deliveries is subject to the availability of water and approval by the dam authorities. The priorities are set in accordance with the order previously mentioned.

8-15 According to the briefings given, the Shihmen IA is charged for NT \$1,000/ha/year in irrigation fees while the Taoyuan IA is charged only for NT \$500/ha/year. The difference in charges is due to the cost of development whereby the Shihmen IA is newer relative to the Taoyuan IA. Approximately, 53% of the dam costs have been paid up through the collection of irrigation fees.

8-16 After the briefing, a movie depicting the construction and operations of the Shihmen dam was shown. One aspect that was not included in the briefing was the flood control function of the dam. The dam was completed in 1964. However, two additional spillways were built in the late 1970's when the original spill way was not able to accommodate the excess water during a typhoon season in the early 1970's. To prevent siltation, four upstream checks were also constructed. These checks reduced the siltation of the main dam which serves multi-purpose functions. A bilingual (Chinese and English) brochure was handed out to the group members.

8-17 The group then was brought to the Shihmen main dam. The different structures were then pointed out to the group. The dam appeared to be more of a recreation site due to the numerous facilities (i.e. hotels, pavillions, etc.,) present at the dam site.

8-18 After thanking the host, the group proceeded to Taichung located in the central part of Taiwan. The trip took 2 1/2 hours via the freeway that was from Taipei to the Southern most city of Kao-hsiung.

8-19 After lunch, the group proceeded to the Taiwan Provincial Water Conservancy Bureau (PWCB) head office in Taichung. The group was met by the PWCB staff headed by Mr. Juei-Lin Hsieh, Deputy Director. The other staff present were Mr. Tsu-Yang Wu, Deputy Chief Engineer and Mr. Chun-Yen Chien, Planning Division chief. There were other staff members present but somehow did not give their cards.

8-20 The briefing and discussions were preceded by a slide show of the functions and accomplishments of the PWCB. The show was impressive, however, more details will be discussed in the succeeding portions of this report. As presented by the PWCB staff, it plans and enforces government laws and regulations directly among the IAs. The PWCB actually implements government regulations concerning the operations of the IAs. From 1975-1982, the PWCB appointed the chairman of the IAs nationwide. This drastic measure was done due to the financial difficulties that majority of the IAs were facing. Apparently, although not discussed in detail, there were financial anomalies and other problems that occurred before 1975. It took the PWCB and the IAs six years to thresh out the difficulties. Subsidy for new projects and corresponding maintenance fund were provided by the COA through the PWCB with regards to irrigation development.

8-21 The group then asked for the PWCB role in crop diversification. According to the PWCB staff, there is no water savings if previously cropped rice be shifted to upland crops. According to the PCWB staff, due to the non-contiguous nature of planting upland crops. Apparently, the PWCB staff are not aware of the actual operations in the Yunlin and Chia-nan IAs which will be discussed later on. The awareness of the PWCB staff regarding crop diversification only stems from the current policy of shifting on the aggregate 60,000 ha. of rice area to upland crops, for both wet and dry seasons. In fact, the government is providing incentives for farmers to shift from rice to upland crops. This current policy is in response to surplus rice production which cannot competitively exported. A target reduction from 2.4 to 2.2 million tons is projected for this current policy. The incentives are providing 1-1.5 tons/ha/season of rice to farmers who will shift from rice to upland crops. Moreover, guaranteed prices for corn, soybeans, sorghum and other upland crops will be provided. Also seeds and machinery for planting and harvesting will be provided. This is presently done in a pilot scale level. There is still an argument that in the next few years, the population might come in par with the rice production.

8-22 The PWCB staff also argued that farmers would rather plant rice due to the following reasons: a) less labor due to mechanized rice production, b) tradition and familiarity with rice production technology, c) low risk and uncertainty and d) least calamity damage. The trend of decreasing farm labor is due to the departure of young people from the farm sector. Thus, old people remain and these age groups are more familiar with traditional rice production technology. The other reasons given for non-adoption of upland crops were a) high-cost of production, b) labor shortage and c) wet season unsuitability and d) higher rice yield in the dry season (30% higher than wet season). Furthermore, the PWCB staff argued that even in the dry season, there is no water shortage and if there will be, farmers will dig their own well to irrigate their rice crops. The foregoing arguments is surprising to note, since one reason for crop diversification in the IAs that will be visited is precisely the lack of water to grow rice. This will be discussed in the succeeding sections of this report.

8-23 Apparently, the PWCB staff are not aware of the actual field conditions existing in the IAs they are supposed to cater to. The discussions lasted until 5:00 in the afternoon. The group then proceeded to the Taichung hotel.

8.3 Third day, April 9, 1986

8-24 The group proceeded to the town of Tou-liu where the Yun-lin IA office was located. Mr. Chuang Cheu-fu, General Manager of the Yun-Lin IA headed the staff in welcoming the group. After a brief welcome address, in the office of the chairman, the group was asked to proceed to the conference hall. Since none of the Yun-Lin staff was fluent in English, our guide Mr. Wen-Jung Hu, Engineer from COA 3rd Department, became the official interpreter in the briefings. A mimeographed handout on the Introduction to the Yun-Lin Irrigation Association were given to the members of the group.

8-25 The briefing was mainly done by the supervising engineer of the IA, then translated by Mr. Wen-Jung Hu. The general features of the Yun-Lin IA

were presented. The IA serves approximately 67,590 ha. The water sources for irrigation were derived from diversion structures at the Cho Shui, Ching Shui, Bei Gang and New Hai Wei rivers, shallow and deep wells and from rainfall. The rivers have high sediment content characterized by high concentration of suspended silt. The ground water sources is underlain with a semi-confined aquifer. The large scale development of the groundwater aquifer started in the early 1960's. There are 501 deep wells and 65 shallow wells operated and maintained by the IA. However, in addition to these, there are approximately 20,000 shallow wells owned and operated by individual farmers. These farmer owned wells are used to supplement the irrigation water supplied by the IA specially in irrigating their rice crop.

8-26 There are approximately 66 km. of lined main canal serving 127 lined lateral and sub-laterals canals with a length of 555.3 km. Most of the farm ditches are also lined. However, no figure was given at the time of the briefing. Coupled with the irrigation canals, there are 4,500 km of drainage network consisting of main, sub-main and farm drainage canals. Most of these facilities were provided due to the land consolidation project accomplishments.

8-27 The operations of the IA were also outlined. From the intake structure down to the sub-lateral, there are working stations (WS) managed by the employees of the IA. At the farm or tertiary level, a common irrigator is hired by the irrigators group to provide plot to plot irrigation and also drainage. The common irrigator is hired by the Working station staff (sub-lateral WS) but paid by the irrigators group. The irrigators group consists of farmers with the 150 ha. block. These common irrigators are paid NT \$200/day and works 100 days/season. The hiring and selection of common irrigators are governed by the procedures set by the PWCB on IA rules and regulations. There are 503 Irrigators Groups, 47 Irrigation Working Stations, 6 canals WS, 4 main canal WS and 1 water source WS. These working stations are the field offices of the IA whereby the operation and maintenance of the irrigation and drainage systems are carried out. The drainage O & M is carried out from the main down to the farm drainage canals by Irrigators WS staff. Additional funds are provided by the country government to the IA in managing the drainage systems. At Yun-Lin IA, farmers pay an irrigation fee amounting to NT \$10,000/ha/year covering all the 3 categories of fees and payment for the common irrigator. According to the IA records, approximately 99% of the members have paid their irrigation dues.

8-28 The briefing and discussions continued even during lunch time which was provided by the COA. It was more of a working lunch. After lunch, the group registered at the local hotel and proceeded to the field at 2:00 pm. At this point there was a change of guide, Mr. Wen-Jung Hu was going back to Taipei and Mr. Cheng, Chun-Tse, Senior Engineer COA 3rd Department, was taking over.

8-29 The first stop in the afternoon was at the two intake structures along the Cho-Shui river. These intake structures were feeding into the main canal. As observed, the water was black in color or turbid, giving credence to the high concentration of suspended silt as presented in the briefings. Remedies for desilting are also carried out through the silting basins at the intake canals. Regular desilting procedures are undertaken during irrigation water delivery suspensions. One technological feature of the intake gates

is they were remote controlled. These gates can be operated from the IA office since there are electric motors attached to each of the intake gate.

8-30 The next stop was the deep well pump station. The group were met by the IA staff and the irrigation group leader (area covered approximately 150 ha.). The pump station was located beside the highway from the freeway leading to the town of Tou-Liu. One feature of the pump was the fountain-like discharge outlet. This was done more for aesthetic reasons. It also reinforces farmers belief that water is available at scheduled time periods. The area served by the pump irrigates mostly areas with 2 crops of rice every year. The pump is driven by an electric motor and is 50 meters in depth with a subvisible turbine pump mechanism. The irrigation fee charged for this area is around NT \$10,000/ha/year. This relatively high fee is due to the cost of operating and maintaining the pump station.

8-31 The next stop was the rubber dam return flow structure. However, on the way to this site, Dr. Miranda of IIMI suggested to make a stop along the way. This was to observe farm level operations and facilities at the farm level. There were plots planted to sugar cane, peanut, corn, vegetables (mostly Chinese cabbage) and rice adjacent to each other. This pattern of planting seem to be common in the farm along the road leading the groups next stop. Questions were raised about the cropping pattern being implemented by the IA. As explained by the Yun-Lin IA staff, there is an official cropping pattern or plan. However, it is up to the farmers to decide which crop to plant. The main concern of the IA is to limit the amount of water to be delivered to the farms. Thus, if the pattern and schedule is for upland crop irrigation and the farmer decides to plant rice, only upland irrigation water supply will be delivered. This explains the preponderance of farmer owned shallow well electric pumps. Apparently, even if the official cropping schedule is for upland crops, farmers almost always devote a plot to rice in the Yun-Lin IA area. With these observations, one significant aspect of irrigation management in Taiwan is in terms of water control. Irregardless of what the farmers plant, the IA pre-determines the water delivery schedule and implements the schedule accordingly. Another observation made in this stop was the presence of concrete lined farm ditches. It is indicative of how water is valued by the farmers at Yun-Lin.

8-32 The group then proceeded to the rubber dam return flow structure. The Yun-Lin office staff requested the Working Station Staff to inflate the rubber dam for demonstration. It takes about 30 minutes to pump water into the rubber dam across the canal. According to Mr. Cheng Chun Tse, there are five of these rubber dams at Yun-Lin IA. They are however expensive. No future acquisition of these rubber dams is being contemplated for the moment. Adjacent to this structure, were plots planted to corn, vegetable and sugar cane. In the vegetable plots or fields, it is noteworthy to observe the raised bed arrangement with head and drainage ditches provided. The corn fields were furrowed but each crop was separated by the previous paddy bunds. This observation also exemplifies the farm level irrigation technology for crop diversification in Taiwan.

8-33 After inflation, the pump was stopped and the group bid their farewell and thanks to the WS staff. On the way back to Tou-Liu, a farmer was observed to be using a transplanting machine mounted on a hand tractor. According to the guide some farmers prefer commercially grown seedlings for

ease of transplanting operations. The seedlings were planted in neat^t straight rows. Pictures were taken of the transplanting operation. The field visit lasted up to 6:00 in the evening.

8.4 Fourth Day, April 10, 1986

8-34 In the morning of the fourth day, the group was hosted to a traditional Taiwan breakfast. After breakfast, the group proceeded to the Yun-Lin IA conference room for the final briefings and discussions on cropping pattern and irrigation plan in the Yun-Lin area.

8-35 The briefing was done by the Supervising Engineer of the Yun-Lin IA. This time the translations were carried out mostly by Dr. Poh Kok Ng, Post doctoral Fellow IIMI and assisted by Mr. Cheng Chun-Tse. The Yun-Lin water sources are limited. The rainfall amounts to 1500 mm/year however, 80% of which falls in the months from May to September. This limits the surface water supply to the irrigated area. Thus, during the dry season rules are strictly enforced on irrigation water deliveries. The cropping pattern is determined by two major factors namely available water supply and water rights. Water rights are legislated and applied for through the IA and approved by the Country Government. Both surface and ground water rights are governed by legislation. These set the stage for the cropping pattern and irrigation plan for the IA.

8-36 There are five cropping patterns at Yun-Lin area depending on the relative location of the farms to the water source. These are as follows 1) 3 year rotation, 1 rice crop in 3 years, 2) 3 year rotation, 2 rice crop in 3 years, 3) 2 year rotation, 1 rice crop in 2 years, 4) 1 rice crop in every year and 5) 2 rice crops every year.

8-37 This cropping pattern has been practiced for the last 50 years. The 3-year rotation (1 rice in 3 years) was adopted during the Japanese occupation in the 1920's. The 2-year rotation was started in 1951 in the Tou-Liu subsystem. With the development of the ground water aquifer, the 3 year rotation (2 rice in 3 years) was adopted. The present cropping pattern has been the outcome in response to the water shortage as part of the government policy to optimize water resources utilization. The planning for water resources utilization is done on a regional basis. Decisions made are then published and disseminated to all of the farmers through the IA.

8-38 This portion of the briefing clarifies the actual situation in Taiwan with regards to irrigated crop diversification. Apparently, the official pronouncements coming from the PWCB were more in response to the overall nationwide policy regarding crop diversification. Nevertheless, the preceding explanation provides a clearer understanding of the reasons for the adoption of irrigated crop diversification in some part of Taiwan, in this case the Yun-Lin area.

8-39 Irrigation water delivery to upland crops amounts to 100-110 mm/season. The mode of delivery is from head to tail end of the 50 ha/ block and from tail to head for rice crops. Recent experiments are being done to try out sprinkler irrigation. Approximately, 12 ha. of upland crops are being irrigated by sprinklers, whereby, the equipment is owned by the Yun-Lin IA. This is still on a pilot stage. The official cropping pattern mentioned

is used to determine the water requirement for the upland crops and rice to arrive at irrigation plan. For the past 10 years, there have been a tendency for farmers not to adopt the official cropping pattern strictly. Thus, the sites in the field were examples of these patterns as observed from the previous days field visit. Alternative cropping patterns have been experimented on, and the results indicated 10 cropping patterns. This includes mostly the wishes of the farmers and the feasibility of which is still being studied by the IA.

8-40 According to the briefing, rotational irrigation for rice and upland crops was made possible through government policy which provides political will resulting in good water control with appropriate irrigation and drainage facilities. The land consolidation project is appearing to be the precursor of rotational irrigation in Taiwan.

8-41 Irrigation conflict resolution is governed by legislated rules and regulation common to all IAs. However, at the farm level, there appears to be a "social-contract" ~~among farmers that limits individual actions and solves conflicts immediately at the irrigation group level (i.e., 50 ha. block).~~

8-42 It was further emphasized that in order to shift from rice to upland crops, the provision of control for irrigation water supply and facilities (i.e., larger canal capacity due to the rotational method employed, lining of canals is necessary if water supply is to be used optimally).

8-43 The morning briefings and discussions session lasted until after lunch. The group had a working lunch again on this day. After lunch, farewells and thanks were made to the Yun-Lin IA staff and the group proceeded to AVRDC (Asian Vegetable Research and Development Center). It took an hour to travel from Tou-Liu to Shanhua (town close to AVRDC).

8-44 At AVRDC, the group was met by Dr. Sun, the acting Director-General and Mr. Castro, the training specialist. A brief welcome address was accorded to the group by Dr. Sun. Afterwards, a slide show presentation was made regarding AVRDC's functions and operations. After the slide show, Dr. Tsou, biochemist of AVRDC and leader of the Nutrition, Environment and Management Program (NEM Program) made the briefings on AVRDC's relevance to irrigated crop diversification.

8-45 AVRDC has three basic program in research and development namely: a) Varietal testing, b) Horticulture, and c) Production systems (i.e., NEM Program).

8-46 Dr. Tsou elaborated more on the Production Systems or NEM Program since he is the program leader. He was very impressive in presenting his program. A brief description of the Biological and Physical interactions was presented. Vegetable unlike cereal production needed more care. There are 120 varieties of vegetables. It is in training and testing of seeds that their current activities are focused. The program seeks to alleviate protein malnutrition, and deficiencies in Vitamin A, Iron and Iodine. The vegetables targetted to meet protein malnutrition are legumes (soybean and mungbean). For Vitamin A, the crops considered are sweet potato, tomato and chinese cabbage. The vegetables considered to offset the iron and iodine

deficiencies are cauliflower, pepper, snapbean, mustard and radish. However, this program is only aimed at home garden production level. The small plots measuring 4 m. x 4 m. devoted to each crop is more than enough to support a family of 5 persons to thwart above mentioned vitamin and mineral deficiencies.

8-47 Dr. Tsou also mentioned that in the tropics, there is a seasonal fluctuation of vegetable production. This is due to excessive moisture during the wet or rainy season where vegetable production is inhibited due to disease infestation. This is particularly critical for tomato production. He mentioned crop management practice that will prevent flooding damage by raising the crop beds or providing sub-surface drainage to vegetable plots. Dr. Miranda raised the issue of soybean production in Taiwan. The production cost is 2-3 times higher than the cost of imported soybean. However, presently AVDRC is doing research on increasing the yield of soybean from the present 2.1 tons/ha to 4 tons/ha in the farmers' fields. With price protection and mechanization, and yield of 4 tons/ha, only then will Taiwan farmers grow soybeans in a large scale. Presently, Taiwan imports 99% of the local demand. Lastly, Dr. Tsou emphasized that breeding and management will solve the problem of vegetable production in the tropics.

8-48 After the briefings, the group were given an overview of the AVDRC facilities by Mr. Castro. The group was brought to the roofdeck of the Administration Building. The group were still to travel 1 hour to Tainan. The group arrive at 6:00 p.m. in Tainan.

8.5 Fifth Day, April 11, 1986

8-49 The group proceeded to the Chia-nan IA office after breakfast. At the IA office, the group was met by the IA Engineer and his staff. The briefings and discussions were held at the IA conference room. A movie depicting the function, operations and accomplishments of the IA was shown. After the movie, the briefing was started. However, due to other commitments, Mr. Huang, a member of the financial staff implored to have the first session in the briefing regarding membership fees and related matters. The briefings were done in Chinese and again translated by Dr. Poh Kok Ng.

8-50 The minimum irrigation fee is from 20-30 kg/ha. which is based on 1) cropping pattern, 2) yield level, 3) cost of irrigation and 4) benefits derived from irrigation. The irrigation fee is submitted to the IA. The paddy rice basis for calculating irrigation fee is based on the farm gate price. The government price support amounts to NT \$18.8/kg. of paddy (unmilled rice). The average farm gate price as of July-October, 1985, that was collected from farmers is equivalent to NT \$13.04/kg. The difference between the government price support and farm gate price is subsidized by the government to the Chia-nan IA.

8-51 The Chia-nan IA serves approximately 81,000 ha. and is classified into 3 main irrigation areas namely 3 years rotation area, combined irrigation area and independent irrigation area. The 3 year rotation area is served by the Wushantou Reservoir Dam. The area under the 3 year rotation is basically of the loamy soil type land. In this area, 2 crops of rice are planted rotated every 3 years and 2 crops of sugar cane every 3 years. The sugar cane areas are managed by the Taiwan Sugar Corporation. In

the predominantly heavy clay soils area, 2 crops of rice is planted every year. In the coastal portions of the Chia-nan area where the soils are sandy, only 1 crop of rice is planted every year. The combined irrigation area has both farm ponds and reservoir dam sources of water supply. The independent irrigation area do not receive its water supply directly from the reservoir dam but through diverted flows from rivers and creeks. Only regular maintenance service from the IA is provided to this area. Thus only token membership fee is collected from the farmers in this area.

8-52 For the 3 year rotation area, approximately, NT \$ 3756/ha/year is charged from the farmers. This covers only the membership fee. The engineering fee amounts to NT \$496/ha/year for the next 15 years and any additional fee for new constructions. Small irrigation working group (150 ha.) fee is also collected to pay for the operation and maintenance of the farm level facilities done by the common irrigator. This would range from NT \$ 1,000-2,000/ha/year depending on the irrigation group decision. The collection period is in installments coinciding with the harvest period (July and November) lasting for 30 days each. The method of collection is done through payments to the Taiwan Land Bank or to the IA collectors. A grace period of 3 days is given and after which 1%-10% late payment charges is levied. Perennial non-payment of irrigation fees is brought to court for adjudication. For the Chia-nan IA, the collection efficiency has been 99% for the past few years.

8-53 The irrigation fee is waived in cases of disasters like flood, typhoon and pest and disease outbreaks. However, only the membership fee is exempted depending on the damage and land tax rates (i.e., reductions maybe 50% from land tax and 10% from membership fee). During land consolidation when the land is unproductive, the membership fee and land tax is totally exempted from payment.

8-54 Mr. Huang excused himself after an hour of briefing on irrigation fee. Another IA staff took over the briefing. The Chai-nan IA has 3 reservoir dams namely 1) Wushantou, 2) Paiho and 3) Tsengwen. Tsengwen reservoir is located upstream and feeds directly to the Wushantou Dam through a tunnel. Before the construction of the Tsengwen Reservoir Dam only 1 rice crop was planted in 3 years. After its completion in 1974 the present cropping pattern was implemented. More rice crops were planted depending on soil suitability. This further verifies the argument that with available water supply, rice becomes the foremost crop planted.

8-55 The most recent drought occurred in 1980. The decision for irrigation priority was based on a) location and b) soil characteristics. However, when the drought occurs after the crops have been planted uniform irrigation water delivery reduction and least damage to crop (critical crop stage for water use takes precedence) are the criteria. There are guiding rules and regulations for every contingency that might occur which the IA implements based on the official cropping pattern. At present, only 70% of the Chia-nan area have undergone land consolidation. The advantage cited were less conveyance loss, ease of drainage and farm roads for marketing and mechanization. The group was also handed out brochures entitled "Brief Introduction to Chia-nan IA". This publication was bilingual Chinese Mandarin with English translation.

8-56 The Chia-nan IA provided lunch at the conference room in order to continue the discussion during lunch time. After lunch, the group visited an Irrigation working station near the town of Matou.

8-57 The briefing at the working station was done by the station head who was also an assistant supervisor. The working station covers an area of 1,068 ha. In this area, there are 3 cropping patterns namely: 1) 2 rice crops in 3 years (278 ha.), 2) continuous sugar cane (303 ha.) managed by the Taiwan Sugar Corporation and 3) 2 rice crops/year (487 ha.). The main sources of water in this area comes from the Wushantou and Tsengwen Reservoir Dams with supplementary supplies from farmer shallow wells. These shallow wells are mostly used for winter crop irrigation. The service area of this working station is only 50 km from the Wunshanton Reservoir Dam. There are 10 km of laterals and sub-laterals and 105 km of farm ditches. The drainage network consists of 96 km of farm drains and 23 km of main drainage canal.

8-58 The service area is divided into 9 irrigation groups. Each irrigation group in turn is subdivided into 3 irrigation blocks with approximately 50 ha. for each block. At the start of every cropping season, a schedule of the irrigation water deliveries is provided to each individual farmer regarding his particular irrigation schedule. Blank irrigation schedule forms were given to the study tour group members and were explained its contents. The text of the form was in Chinese. There is one form for rice and another for sugar and upland crops. The forms contain the farmers name, plot no., area, time of delivery, crop planted and date. The allocation and determination of the farm water delivery is done at the Working Station by the IA staff. Notification slips or forms are distributed by the common irrigator to each individual farmer. The rice farmers are provided with the schedule at least 10 days before actual water delivery. However, only a day before actual water delivery or start of cropping season, is the notice slips provided to the upland farmers.

8-59 As mentioned in the other IAs, the common irrigator is responsible for providing irrigation water to each farmer's plot as long as it is within the official schedule. The common irrigator is also entrusted with the maintenance of the farm ditches and drains. In this particular working station area, the small irrigation group fee or payment for the common irrigators is as follows: NT \$1,600/ha/year for farmers with 2 rice crops in 3 years; NT \$2,100/ha/year for farmers with 2 rice crops every year and NT \$900/ha/year for sugar cane farmers. The large amount paid by 2 rice crops/year farmers is due to the larger O & M costs for providing service to farmers with 2 rice crop annually. In this area, no farmer is directly involved in the O & M. This is indicative of the acute shortage of farm labor in Taiwan. These were admittedly other areas with direct farmer involvement but only on a very minimal scale. For this working station 27% of the irrigation fee was paid by the farmers to the Land Bank of Taiwan and 73% paid to the IA collectors.

8-60 Another observation made was the presence of old men (50-60 years old) employed by the IA as common irrigators. This is also an indication of the farm labor shortage in Taiwan. After the briefings and discussions at the working station office, the group proceeded to visit sub-lateral canal gate structure. This was done on the way back to Tainan. The common irrigators were opening the turnouts and sublateral canal gates. It was

apparently the scheduled time for the rice fields to receive their irrigation water supply. Rectangular weirs and calibrated gages painted on the concrete wall were the means of measuring the water flows.

8-61 After this brief stop, the study tour group then proceeded to Tainan. This ended the fifth day of the study tour in Taiwan. Mr. Cheng, Chun-Tse, Sr. Engineer COA, encouraged the group to stay longer if more details are to be learned from the operation of the IA.

8-62 The next morning were basically spent for travelling back to Taipei. It took 4 hours of continuous travel through the freeway from Tainan to Taipei. Dr. Panabokke, Sr. Soil Scientist was dropped off at the CSK International Airport on the way to Taipei. Farewell and thanks were extended to Mr. Cheng Chung Tse upon arrival at the China Hotel at Taipei. The rest of the study tour group left on the morning of Sunday, April 13. Dr. Small and Dr. Valera headed for Manila, while Drs. Miranda and Poh Kok Ng left for Singapore.

8.6 Study tour summary and epilogue

8-63 The study tour as a whole was highly informative. The group was able to synthesize based on the brief field visits and discussions, the significant issues relevant to irrigated crop diversification. These issues can be interpreted in terms of factor sets namely a) physical control and b) social control factors both of these factor sets are necessary but neither one is sufficient if taken individually or if one is considered without the other.

8-64 In the physical control factors, the dominant component is the availability of irrigation water supply. Based on the discussions and observations made, this water supply factor takes precedence in determining which crop is to be produced. In all of the IAs visited, when water is available, rice is the primary crop planted. In fact, both at the Yun Lin and Chia-nan IAs, additional water supply as indicated in the preceeding portion of the report also would increase the area planted to rice. It is only in the areas with limited water supply and suitable soils, where upland crops are planted.

8-65 At Yun-Lin IA. after the groundwater aquifer development in the 1960's, the 2 rice in 3 years cropping pattern was adopted whereby previously it was only 1 rice in 3 years (Section 5.C.6, para.5-76). Meanwhile, at the Chia-nan IA, the previous cropping pattern was 1 rice in 3 years and increased to 2 rice crops in 3 years in loamy soils and 2 rice crops every year in heavy clay soils. This occurred after the completion of the Tsengwen Reservoir Dam in 1974 (see Section 5.C.7 para.5-93). However, for the past few years (1982-84) there has been a decreasing trend in area planted to rice at Chia-nan. The only crop apparently increasing in area is the corn. This is the indication of the government effort to discourage farmers from planting more rice and provide incentives to upland crops.

8-66 Another component of physical control factor is the provision of irrigation and drainage facilities. Nationwide, approximately 85% of the irrigated areas managed by the IAs have undergone land consolidation. With land consolidation, improvement in facilities like lined irrigation and

rainage canals, farm roads and control gate structures were provided. These facilities provided the efficient operation and maintainance of the irrigation systems. Moreover, for crop diversification, the presence of irrigation and drainage facilities afforded better water control at the farm level. These accomplishments were done mainly through the financial support of the government and the farmers. The government provided subsidy to land consolidation by as much as 50% from 1960-70 and 67% from 1972 to the present. The major maintenance and rehabilitation works are still subsidized by the government.

8-67 With these facilities, seasonal shifts from rice to upland crops are made possible, especially in areas with suitable soils (i.e., loamy and sandy sils). Based on the observations made, the previous paddy bunds are still retained even if upland crops are planted (section 5.C.5 para.5-71). However, raised beds for vegetables and furrow for sugar cane, corn and sorghum are the farm level practices being undertaken.

8-68 Furthermore, these facilities enables the IA field staff to implement rigidly, irrigation water delivery schedules to both rice and upland crops. The existence of multi-layered cropping patterns can then be implemented with adequate control facilities.

8-69 As observed and discussed, the irrigation systems in Tainan were designed and constructed to irrigate rice when the water supply was adequate⁴. However, when water supply becomes scarce, the facilities in the system can still accommodate upland crop irrigation. This was made possible with the facilities provided through the land consolidation accomplishments. From the primary to the tertiary levels (farm level), the irrigation system visited were apparently well-equipped in terms of irrigation and drainage facilities.

8-70 These facilities are not adequate without the full support of the government and the farmers. The agricultural development in Taiwan was made possible through the concientious efforts of the farmers as pronounced in the welcome address during the first day of the study tour in the Council of Agriculture Office. The role of the government particularly in irrigation development is clearly indicated in the preceeding sections of this report. These two components labeled as social control factors are instrumental in the present state of irrigation development.

8-71 The formation of the Irrigation Association dates back to the early 1920's, whereby farmers were organized and supported by the government. Natural calamities such as floods during the rainy seasons and drought during the dry seasons provided the vicarious experiences that made farmers realize the value of controlling water. With the realization, farmers were more receptive to the governments irrigation programs and projects. Financial as well as political support were provided by the government. The IAs were basically organized for rice irrigation. It is only when there is limited

4. L. J. Wen Oct. 14, 1984, pp. 1-3.

water supply that upland crops are planted.⁵ The different cropping patterns were developed to fully utilize the limited water supply especially where the soils are suitable. These are actually 7 cropping patterns practiced in Taiwan. However, only 5 were reported as a result of the limited IAs visited.

8-72 There is apparent government control in the IAs through the COA, PWCB and County Government. From resolving farmer conflicts up to new project financing, rules, regulations and procedures are either legislated or sanctioned by the concerned government agency.

8-73 Thus, policies to support crop diversification are also part of the planning scheme whereby subsidies (i.e., price protection, rice incentives, seed and machinery provision) (Section 5.C.4 para.5-56). As presented in the report, there are still gaps between official plans and actual field implementation. Nevertheless, there are governed mechanisms to promote crop diversification as part of the overall plan for agricultural production.

8-74 It would be very difficult to adopt Taiwan's present level of sophistication in irrigated crop diversification (i.e., land consolidation, functional IAs). However, there are certain principles that can be used to pursue irrigated crop diversification in the Philippines. Particularly in the aspect of physical control factors, there are lessons or features from Taiwan that can be adopted to the Philippine irrigation systems.

8-75 The facilities particularly the irrigation and drainage control networks, control gates and some extent the farm roads are some of the features that are present in the Philippine systems but needs rehabilitation. Maybe, not with the same sophistication as that in Taiwan but facilities with similar functions would be desirable. There need not be large scale rehabilitation like in land consolidation but rather modest rehabilitation in providing control gates in the main canals, laterals, sub-laterals and turnouts. Provision of irrigation and drainage ditches especially in relatively flat areas is necessary.

8-76 Coupled with these physical improvements is the management of irrigation water supply. Irrigation water deliveries for upland crops are intermittent however, their timing and amount are critical. Given the present level of facilities and management capability of the irrigation agency in the Philippines, modest investments in the improvement of the physical facilities and training can substantially contribute to the promotion of irrigated crop diversification in systems where the soils are suitable.

8-77 With regards to the other aspects of crop diversification like agronomic, economic (particularly marketing) and support services should be a part of the national programs to increase agricultural production of upland crops.

⁵. See L.J. Wen "Improvement of Irrigation System and Water Management in Taiwan" (revised) Oct. 24, 1984, pp. 22-23.

8-78 There may have been other aspects not covered in this report but nonetheless the major issues or points of significance have been noted. These then could be worthwhile considering in carrying out the ADB supported study in irrigation management for crop diversification in the Philippines.

Annex VIII.A
 Tentative Program and Itinerary of Study Tour for
 the Group of the International Irrigation
 Management Institute (IIMI)
 (April 6-13, 1986)

<u>Date</u>	<u>Program</u>
April 6 (Sunday)	Arrival in Taipei (RON: Taipei)
April 7 (Monday)	<p>9:00-12:00 Visit Council of Agriculture for briefing and discussion on: (1) Agricultural development in Taiwan, ROC. (2) Improvement of irrigation systems and water management.</p> <p>13:00-14:00 From Taipei to Taoyuan</p> <p>14:00-17:30 Visit Taoyuan Irrigation Association (IA) for briefing on functions of the IA, including: (1) Water sources and irrigation systems of the IA. (2) Major activities. (3) Organization before and after 1975, and typical management systems. (4) Financing of the IA, including membership fee assessment and budget allocation for irrigation operation and maintenance. (5) Distribution of irrigation water from the Shihmen Reservoir, farm ponds and creeks. (RON: Taoyuan)</p>
April 8 (Tuesday)	<p>8:00-10:00 Visit Shihmen Reservoir</p> <p>10:00-12:30 From Shihmen Res. to Taichung</p> <p>14:00-17:00 Visit Taiwan Provincial Water Conservancy Bureau for briefing and discussion on its organization and functions (movie) (RON: Taichung)</p>
April 9 (Wednesday)	<p>8:00-9:30 From Taichung to Touliu</p> <p>9:30-17:00 Visit Yunlin IA for study on: (1) Irrigation water from rivers in the Yunlin area. (2) Ground water development in the Yunlin area. (3) Canal system improvement and land consolidation. (4) Operation and maintenance of wells. (5) Field observation (RON: Touliu)</p>
April 10 (Thursday)	<p>9:00-17:00 At Yunlin IA for study on: (1) Cropping pattern and irrigation plan in the Yunlin area. (2) On-farm irrigation systems, and organization and functions of irrigation groups. (3) Field observation and enroute to Tainan. (RON: Tainan)</p>

April 11
(Friday)

8:30-17:00

Visit Chianan IA for briefing and study on:

- (1) Functions and organization of the IA.
- (2) Water sources and irrigation systems.
- (3) Crop rotation pattern in the Chianan area.
- (4) Water fee assessment and collection.
- (5) Operation and management of water distribution.
- (6) Visit a working station of the IA for study on its functions and activities.

(RON: Tainan)

April 12
(Saturday)

8:30-16:00

Visit Wu-Shan-Tou Reservoir and return to Taipei

(RON: Taipei)

April 13
(Sunday)

Departure

Annex VIII. B

Publications from the Taiwan Study Tour

I. Council of Agriculture

1. Agricultural Development in the Republic of China on Taiwan - A Graphic Presentation -
2. Briefing Material Agricultural Development in the Republic of China on Taiwan
3. The Second-Stage Farmland Reform Program
4. Farm Land Reform in the Republic of China on Taiwan
5. The Council of Agriculture; An Introduction to its Organizations, Functions, Policies and Operation
6. Improvement of Irrigation Systems and Water Management in Taiwan (L.J. Wen, COA, Oct. 24, 1984, mimeo.)
7. Review of Literature and Discussion of Some Practical Examples for Determination of Rice Irrigation System Capacities (L.J. Wen, COA, mimeo.)
8. Irrigation Development and Management Organization in Taiwan (Ching-Ho Kuo, COA, Dec. 1983, mimeo.)
9. Estimation of Canal Capacities for Paddy Irrigation Systems (Cheng, Chun-Tse, COA, reprint from ICID journal Twelfth Congress)
10. Further Study on Irrigation Operation and Water Distribution Planning for Rice Irrigation System (Cheng, Chun-Tse, COA, reprints from Taiwan Water Conservancy Quarterly Vol. 28, #2-3, June 1, 1980).

II. Taoyuan Irrigation Association

1. Brief introduction to Taoyuan Irrigation Association

III. Shimen Reservoir Administration Office

1. Shimen Reservoir

IV. Yun-Lin Irrigation Association

1. Brief Introduction to Yun-Lin Irrigation Association (brochure in Chinese)
2. An Introduction to the Yun-Lin Irrigation Association (mimeo July 1979 in English)
3. Yun-Lin Irrigation Association (mimeo in Chinese)
4. Planning Report on Shi Chuan District Land Consolidation Project in Yun-Lin Area (Monograph in Chinese)

V. Chia-nan Irrigation Association

1. Brief Introduction of Chia-Nan I.A.

VI. Asian Vegetable Research and Development Center

1. AVRDC Progress Report Summaries 1984
2. AVRDC Training Program (Brochure)
3. Centerpoint (AVRDC Newsleaf 2 issues July 1985 and December 1984)

Abbreviations and Acronyms

ACD	-	Agricultural Coordinating Division
ADB	-	Asian Development Bank
ADD	-	Agricultural Development Division
AIS	-	Assistant Irrigation Superintendent
AMIADP	-	Angat Magat Integrated Agricultural Development Project
ARIP	-	Allah River Irrigation Project
ARIS	-	Agno River irrigation System
BARIS	-	Banga River Irrigation System
CFLIS	-	Cavite Friar Lands Irrigation System
CPPL-IA	-	Concepcion, Pulac, Pulay and Lallog Irrigation Association
IA	-	Irrigation Association
IFPRI	-	International Food Policy Research Institute
IIMI	-	International Irrigation Management Institute
IRRI	-	International Rice Research Institute
IS	-	Irrigation Superintendent
ISU	-	Isabela State University
LABASA	-	Laoag-Bacarra-Sarrat Irrigation Association
LVRIS	-	Laoag Vintar River Irrigation System
MAF-ARO	-	Ministry of Agriculture and Food, agriculture Research Office
MCIS	-	Mani River Communal Irrigation System

MRMP	-	Magat River Multipurpose Project
NIA	-	National Irrigation Administration
NFA	-	National Food Authority
PCARRD	-	Philippine Council for Agriculture and Resources Research and Development
PRDF #2	-	Pilot Testing and Demonstration Farm Number 2
SFRIS	-	San Fabian River Irrigation Systems
SLBIP	-	Second Laguna Bay Irrigation Project
TA	-	Technical Assistance
TRIS	-	Talavera River Irrigation System
UPLB	-	University of the Philippines at Los Banos
UPRIIS	-	Upper Pampanga River Integrated Irrigation System
USM	-	University of Southern Mindanao
Sibester IA	-	Sinamar, Bellalug, Estella, Irrigation Association
cms	-	cubic meter per second
ha	-	hectare
lps	-	liter per second
mm/day	-	milimeter per day
mm/wk	-	milimeter per week
S & P	-	seepage and percolation
wk no.	-	week number