SECOND PROGRESS REPORT

for

STUDY ON IRRIGATION MANAGEMENT FOR DIVERSIFIED CROPS (TA No. 859 PHI)

The International Irrigation Management Institute
Digana Village via Kandy, Sri Lanka

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ABBREVIATIONS AND ACRONYMS

ACD	-	Agricultural Coordinating Division
ADB	-	Asian Development Bank
ARIP	-	Allah River Irrigation Project
BARIS	-	Banga River Irrigation System
BP#2	-	Bonga River Irrigation System Pump No. 2
CLSU	-	Central Luzon State University
CY	-	Crop Year
DA	-	Department of Agriculture
DSIMP	-	Dry Season Irrigation Management Project
FRSRD	-	Farm Resources and Systems Research Department
IA	-	Irrigators Association
IIMI	-	International Irrigation Management Institute
IRRI	-	International Rice Research Institute
LVRIS	-	Laoag-Vintar River Irrigation System
MCIS	-	Mani Communal Irrigation System
MMSU	-	Mariano Marcos State University
NIA	-	National Irrigation Administration
PAC	-	Pampanga Agricultural College
PCARRD	-	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PIE	-	Provincial Irrigation Engineer
PIO	-	Provincial Irrigation Office
RIARS	-	Regional Integrated Agricultural Research Station
RWS	-	Relative Water Supply
SAC	-	Study Advisory Committee
SAE	-	San Agustin Extension
SMCIS	-	Sta. Monica Communal Irrigation System
SOA	-	State of the Art
TA	-	Technical Assistance
TASMORIS	-	Tarlac San Miguel O'Donnel River Irrigation System
UTRIS	-	Upper Talavera River Irrigation System
UPLB	-	University of the Philippines at Los Baños
UPRIIS	-	Upper Pampanga River Integrated Irrigation Systems
USM	-	University of Southern Mindanao

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EXECUTIVE SUMMARY

Introduction

The International Irrigation Management Institute (IIMI) in collaboration with the National Irrigation Administration (NIA) implemented the "Study on Irrigation Management for Diversified Crops." This study is a technical assistance grant (TA No. 859 PHI) to the Government of the Philippines, largely funded by the Asian Development Bank (ADB). Some of the component studies are being undertaken in collaboration with state universities located within the study sites.

The overall objective of the study is to determine irrigation practices most likely to enhance the cultivation of selected non-rice crops in limited parts of irrigation systems during the dry season, and field test the most promising of these practices.

The study which started in February 1987 covers 29 months. The First Progress Report was submitted tc ADB and NIA in September 1987. Among the selected sites, the Mani River Communal Irrigation System (MCIS) was excluded due to the physical rehabilitation of the system. Thus, only six of the original seven sites are now being studied. This Second Progress Report is an update of the on-going activities in the study. A summary of the recently concluded review mission (16-20 February 1988) by the representatives of ADB, NIA and IIMI is presented. The current status of the component studies as well as the expected output to be presented in the Interim Report are also included. The schedule of activities of the study for the next 12 months is likewise presented.

Summary of the Review Mission

The review mission is part of the monitoring procedure intended to assess the progress of the study. Representatives from ADB, NIA and IIMI comprised the mission team. The review mission also provides the project staff the opportunity for making mid-term adjustments in the study in case serious shortfalls are evident based on the findings of the review mission.

The first day of the review mission was spent visiting the Upper Talavera River Irrigation System (UTRIS) and discussing with both the NIA staff and the research staff of the Central Luzon State University (CLSU) involved in the study. Three component studies are being undertaken by CLSU, namely: the land conversion from puddled rice soil to upland soil conditions, irrigation of onion, and the economic aspect of diversified cropping at UTRIS. The irrigation management study at the system level is directly managed by IIMI through its research assistant at UTRIS. Three sample onion farms were visited by the mission group. A farmer cooperator was also informally interviewed about his perceptions on growing irrigated onion in the dry season.

At the Mariano Marcos State University (MMSU), a briefing was held with the MMSU, NIA and IIMI staff on the second day of the review mission. The highlights of the study activities at Laoag-Vintar River Irrigation System (LVRIS) and the Bonga River Pump No. 2 Irrigation System (BP#2) were discussed.

The research staff of MMSU is undertaking component studies on the methodology for identifying parts of the irrigation system suitable for diversified crops, irrigation of garlic and wheat and the economic aspects of irrigated diversified cropping at LVRIS and BP#2. The system level irrigation management study is being undertaken by IIMI. Two sample sites in the irrigation study for garlic was visited. Informal discussions with the cooperating farmer were also held. The current farm gate price of garlic was considered attractive by the farmers. The reasons given for the high price were a reduction in the area planted and the absence of imported Taiwan garlic in the market.

A brief stop was also made to see the wheat crop field being monitored for irrigation water use.

The third day was mostly spent traveling from Laoag City to Manila to Cebu and then to Gen. Santos City. On the fourth day, the visit to the Allah River Irrigation Project (ARIP) commenced with a briefing at the ARIP Office in Surallah, South Cotabato. The NIA-ARIP, University of Southern Mindanao (USM), Department of Agriculture (DA) and IIMI staff presented the various study activities at ARIP. The activities at the testing and demonstration farm at lateral A-extra are being jointly undertaken by the staff of NIA, IIMI and DA. This activity is intended mainly to test and demonstrate the effectivity of furrow irrigation of hybrid corn, The demonstration effort is necessary since farmers at ARIP prefer to grow irrigated ripe rather than irrigated corn. The usual practice at ARIP is to grow rainfed corn when irrigation is not available in the *dry* season. The economic aspects of diversified crops at ARIP are being evaluated by the research staff of USM. The irrigation management at the system level component study is being implemented by IIMI.

A visit was made to the two field sites testing the furrow irrigation of hybrid corn. Farmer cooperators were available for discussions. The farmers were generally responsive when asked questions. They indicated satisfaction with the tested method of irrigation. High yields were being predicted for the stand of corn during the visit.

A visit was also made to the Banga River Irrigation System (BARIS). A briefing about, the activities of NIA, IIMI and USM was held at the system office. The issue of a third crop was also discussed. Around 250 ha of hybrid corn will be planted as a third crop in a section of BARIS. This is possible at BARIS since the rainfall pattern in this area is bimodal with no distinct dry season.

A brief stop was made at, the only testing site in BARIS. Furrow irrigation of hybrid corn was also being tested in this site. Discussions with the farmer cooperator were also held.

The wrap-up session was the final activity of this visit. During the discussions, overly optimistic expectations from IIMI were expressed by the NIA-ARIP officer in charge. However, these expectations were later clarified. The role of IIMI or the results of the studies being conducted at ARIP were further explained, so that project staff would not have unrealistic expectations about the project.

As a reminder to IIMI, the ADB representative said that the irrigation management guidelines should be presented in the interim reporting stage of the study. This will not only cover ARIP and BARIS but a more general application for gravity systems with potential for irrigating diversified crops in the dry season. These guidelines then will be reviewed during the forthcoming workshop and tested in the last dry season of the study. With these discussions, the review mission was adjourned.

Status of the Component Studies and Expected Output for the Interim Report

Most of the component studies are presently in the data collection stage, particularly for the 1987-88 dry season cropping period. The studies on the methodology for identifying parts of a system suitable for diversified crops and for determining the primary factors and interaction that condition the farmer to prepare land from puddled paddy soil to upland soil conditions are in the analyses and evaluation stages. However, there are still a few data items being gathered for this current dry season. Thematic maps and appropriate descriptions for their use will be made available in the Interim Report for the methodology study. A completed report on the land conversion study will likewise be presented in the Interim Report.

The irrigation management practices at both the farm and system levels are still in the data collection stage in the current dry season. However, guidelines for the irrigation management practices for onion, garlic, and corn will be presented in the interim report. At the systems level, guidelines on irrigation management will also be presented in the interim reporting stage. These guidelines will be reviewed and improved in the forthcoming workshop slated for October 1988. These guidelines will then be tested in the last dry season of this study.

In the economic aspects of diversified cropping, only the land utilization survey together with land preparation expenditures were gathered for this current dry season in all sites. The farm survey on the yield, gross income and other farm expenditures will be undertaken after harvest. Analysis of data and evaluation will subsequently be done. This evaluation will involve cost and returns analysis for two dry seasons in five system sites and three dry seasons in one system site. This analysis will firm up earlier findings and also confirm the farmers' perception on the constraints as well as the incentives for growing irrigated non-rice crops.

These findings are expected to lead to the identification on a preliminary basis in the Interim Report of projects which will facilitate adoption of diversified cropping in rice-based irrigated arqas. These proposed projects can be categorized into research and development, support. facilities for

production and post-production activities, policy studies and redesign/ rehabilitation of irrigation systems to meet specific requirements of non-rice crops.

Schedule of Activities in the Next 12 Months

The significant events scheduled in the study are the training of watermasters at ARIP and BARIS (May 19881, submission of the Interim Report (August 1988), the second meeting of the Study Advisory Committee (September 1988), and the workshop (October 1988). The Workshop will discuss the results of studies conducted during the previous two dry seasons, review results from relevant studies by other institutions and provide a forum for reviewing the draft guidelines and planning the field testing of these guidelines for the next dry season of the study. The next dry season starts in November 1988.

Stud.. on Irrigation Management for Diversified Crops1/

I. Introduction

1.1 The International Irrigation Management Institute (IIMI) in collaboration with the National Irrigation Administration (NIA), the consortium of state colleges and universities (SCUs) as coordinated by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) and also the Department of Agriculture (DA) has implemented the "Study on Irrigation Management for Diversified Crops". This is a technical assistance grant (TA No. 859 PHI) to the Government of the Philippines (GOP) primarily funded by the Asian Development Bank (ADB). The main objective of this study is to determine irrigation practices most likely to enhance the cultivation of selected non-rice crops in limited parts of irrigation systems during the dry season, and to field test the most promising of these practices.

1.2 The associated objectives are: 1) to develop methodologies or criteria for identifying parts of irrigation systems most suitable for selected diversified crops; **2)** to compare the profitability and performance of selected diversified crops under irrigated conditions; **3)** to identify the primary factors and their interaction which condition how farmers prepare their land for irrigated rice in the wet season and for one or more irrigated diversified crops in the dry season: 4) to develop on-farm irrigation methods for at least one upland crop; **5)** to design and field test operating procedures for publicly managed portions of irrigation systems; and 6) to recommend policies most likely to support profitable farming practices and investments in irrigation development for diversified crops, and to suggest guidelines for irrigation management practices. The terms of reference for this study follow closely these objectives and can be found in Annex 1.

1.3 This study was started in February 1987. A First, Progress Report was submitted to **ADB** and NIA and presented to the Study Advisory Committee (SAC) in September 1987.

1.4 The First Progress Report presented the study background and results from the 1986-87 dry season. The report also contained the implementation arrangements, detailed description of the selected study sites and the plans and schedule of activities for the succeeding months. The study sites are located in the provinces of Nueva Ecija, Ilocos Norte, Tarlac and South Cotabato (Fig. 1). Two of the study sites were recommended for exclusion after the 1986-87 dry season. However, only the Mani River Communal Irrigation System (MCIS) was finally dropped. This was due to the physical rehabilitation that the system was undergoing. The other site, the Tarlac-San Miguel-O'Donnell River Irrigation System (TASMORIS), was retained despite the termination of the Dry Season Irrigation Management Project (DSIMP) of NIA in this site. The agro-economic survey component. of this study at this site was continued for the 1987-88 dry season. The site was retained to have a

1/ Second Progress Report for TA No. 859 PHI submitted to the Asian Development Bank by the International Irrigation Management Institute.

continuity of data base for diversified crops at TASMORIS and to obtain some indications of the impact of DSIMP, if any, in the 1987-88 dry season.

1.5 This Second Progress Report will primarily present the summary of the findings of the study review mission composed of representatives from ADB, NIA and IIMI. It will also include the current status of the project, expected results to be presented for the interim report (August 1988) and the schedule of activities for the next 12 months.

11. The ADB-NIA-IIMI Review Mission (16-20 February 1988)

2-1 The review mission was conducted as part of the monitoring procedure to assess the progress of the project. It also provided the mission the opportunity to review the study through field visits and discussions with the NIA, SCU and IIMI field staff and also farmers involved in the various component studies. The participants and the srhedule of the review mission can be found in Annex 2.

2-2 Visit to Upper Pampanga Integrated Irrigation System (UPRIIS) and Central Luzon State University (CLSU), 16 February:

2-2.1 A courtesy call at the Office of the Operations Manager (Engr. Wilfredo Tiangco) at NIA-UPRIIS, Cabanatuan City was made around 9 AM. Dr. Leonardo Lucero of the Institutional Development Division also met with the mission members. The purpose of the mission, including the relevant aspects of the IIMI-IRRI project, was explained2/. Engr. Tiangco and Dr. Lucero accompanied the mission team to the Upper Talavera River Irrigation System (UTRIS), one of the selected study sites. On the way to UTRIS, a brief stop was made at Perias, Talavera. Perias is a potential site for piloting irrigated diversified cropping within UPRIIS in the dry season. This area (approx. 50 ha) can be served by a canal from the Murcon Creek Irrigation System.

2-2.2 At the District I (UTRIS) Office, the NIA staff3/ headed by Engr. Manuel Collado briefed the mission members on the status of operations at UTRIS for the 1987-88 dry season. The main problems cited by the NIA staff in the dry season is 'the limited water supply and siltation. In areas where irrigation water is difficult to deliver (downstream and elevated areas) and the soils are coarse in texture,, farmers are encouraged to plant non-rice crops. In this system, the dominant non-rice crop is onion. Around 50% of the dry season area is planted to non-rice crops mainly onion. Rice is planted mostly in the upstream areas and also in areas lower in elevation relative to the canals.

2-2.3 The IIMI research assistant (Engr. Arturo Francisco) gave a presentation after the NIA briefing. This presentation was mainly on the current activities of IIMJ at UTRIS. Maps indicating the areas planted to rice and other crops were given to the team members. The presentation highlighted the experiences of the NIA field staff in providing irrigation water for both rice and non-rice farms for the entire UTRIS dry season.

2/ The IIMI-IRRI Collaborative Project is a complementary study on the problems of irrigation management. for r-ice-based farming systems. This study will build on the ADB supported study (TA No. 859 PHI) to arrive at comprehensive results with regard t.o the optimal use of limi l ed water supply in the dry season. For more details on thin study see Annex 2.

3/ A listing of all. persons that attended the briefings and meetings in the course of this review can be found in Annex 3.

2-2.4 The reports indicated that the present practices of the system personnel are satisfactory. However, more effective management of the system can be attained with more effort on the part of the field staff and also the constructive involvement of the farmers in utilizing the limited water supply at UTRIS. It is expected that with the completion of this current dry season, a set of recommendations or guidelines for the improvement of the system in irrigating rice and non-rice crops will be formulated.

2-2.5 After the briefing at the NIA Office, the group proceeded to the College of Engineering of CLSU. The CLSU research staff headed by Dr. Honorato Angeles welcomed the group. After lunch, a briefing was held at the conference room of the College of Engineering. Dr. Miguel Aragon started the presentation with a status report on his study on the conversion of puddled lowland rice soil to upland soil condition for. onion, from wet season to dry season and vice versa. Preliminary results of the study indicated that only the coarser textured soils in higher elevations could possibly be converted for growing onions. Other rice soils are also being evaluated for possible conversion. This component study will provide the necessary information on the physical requisites of irrigated diversified cropping at the farm level.

2-2.6 Dr. Ireneo Agulto presented the preliminary results of the study on the irrigation method for onion. His three sample sites were located in UTRIS. Two methods of planting were being observed, namely the bedded and mulched methods. Initial observations indicated that the mulched samples used lesser amounts of water compared to the bedded samples. However, the mulched samples required more labor and materials. Comparative information on the stream size and farm ditch discharges are expected to be gathered after the completion of this study.

2-2.7 For the economics component of the study, Dr. Eduardo Marzan presented the results of a survey made in the 1986-87 dry season and the land utilization results in the current dry season. One interesting aspect of his report is the minimal net income derived from producing onions when family labor is accounted for. This indicates the near zero opportunity costs of labor in the service area of UTRIS during the dry season. However, when onion prices are relatively higher, farmers derive higher net income if other factors remain constant. This has been the experience of some farmers interviewed. Thus, there is the expectation that maybe there is a chance that prices will be favorable every year.

2-2.8 After the briefing at CLSU, the group, together with the CLSU research staff, visited two sample farms in UTRIS. In one of the sample farms, the farmer indicated concern regarding the late rains. The farmer said that the quality of the onion will be affected due to the excess moisture brought, about by the late rains. Experiences of the farmers in growing onion indicated that timely irrigation is indeed important and that it should not be in excess nor lacking. Unexpected rains will bring about spoilage of maturing onions in the field. This field visit completed the first, day of the schedule for the review mission.

2-3 Visit to Laoag-Vintar River Irrigation System (LVRIS) and Mariano Marcos State University (MMSU), 17-18 February:

2-3.1 The review mission team spent the night of 16th February at Bauang, La Union. Next day, on the trip to Ilocos Norte, a brief stop at Sta. Maria, Ilocos Sur was made to refuel the NIA vehicle the mission team was using. In the Office of the Provincial Irrigation Engineer (PIE), the team was briefed on the current activities of the Provincial Irrigation Office (PIO). The PIO takes charge of all the NIA supported communal projects in the province. One interesting aspect of the briefing was the finding that cost of irrigation development was escalating. According to the PIE, there are systems in the province where the cost of development is as high as P36,000/ha.

2-3.2 It took 4 hours to drive from Bauang, La Union to Batac, Ilocos Norte. At MMSU, the Irrigation Superintendent of LVRIS (Engr. Lorenzo), his staff and the MMSU research staff headed by Dr. Salud Baroga, Director for Research welcomed the mission team. After lunch, a briefing was held at the MMSU guest house. Engr. Lorenzo initially briefed the team on the operations of LVRIS in the current dry season. He also presented the 1987-88 wet and dry season statistics of LVRIS. The procedures of programming of non-rice crops at LVRIS aroused interest. This was pursued particularly by Dr. Miranda (IIMI).

2-3.3 According to Engr. Lorenzo, allocation of water or designating areas to be planted to rice and non-rice crops is an activity undertaken by NIA with the farmers' irrigation associations. The process starts with NIA staff estimating the available water supply and then presenting these data to the farmers during a meeting before the onset of the dry season. Any changes or modifications on the allocation of water is agreed upon by both NIA and the irrigators' associations. Schedule of water deliveries is also finned up.

2-3.4 In times of scarcity, rotational deliveries are made and the farmers are consulted accordingly. In the current dry season, more farmers planted rice than garlic. One reason cited for this was the Occurrence of a late typhoon which damaged the wet season harvest, This encouraged more farmers to plant rice in the dry season to supply their yearly rice requirement. Another reason provided was the availability of more water at the start of the dry season. The prices of garlic in the previous dry season discouraged the farmers from planting larger areas presently.

2-3.5 In the Bonga Pump No. 2 system, there was a delay in the dry season cropping period. This was attributed to the damage done by a typhoon in October. The pump had to be cleaned and properly oiled and fanners were unable to pay for the use of the pump due to poor harvest. Thus, the dry season was started late. Some farmers started planting non-rice crops (watermelon and garlic) using the shallow well pumps. Only a few farmers planted rice in the current dry season.

2-3.6 With the farmers organized into an association, the financial viability of the association will have to be examined further before the irrigation system is turned over to the farmers. For a more detailed description of this system, refer to the First. Progress Report.

2-3.7 **Engr.** Carlos Pascual presented the results of the study on the methodology for identifying soils suitable for diversified cropping in parts of a system. This study is arriving at an interesting stage. Maps generated by a microcomputer indicating soils, canals and other physical characteristics **of** the service area of LVRIS were presented. Mr. Salandanan (NIA) was particularly interested. **The** methodology used thematic maps for easy assessment and configuration.

2-3.8 The next study presented was the irrigation method for garlic and wheat. For the mulched garlic crop, the basin flooding method was being documented in seven field sites. However, for the wheat crop only two field plots are being observed. The density of farm ditches is also being studied. Factors affecting density of fann ditches are being examined to find out their significant effects on the length of farm ditches.

2-3.9 The economic aspects of crop diversification at LVRIS and **BP#2** was presented by Mrs. Charito Acosta. Besides garlic the other non-rice crop found profitable based on the survey **was** peanut. However, the data used was only for small land holdings less than 0.3 ha.

2-3.10 **Dr.** Baroga said the data collected were sufficient. Economies of scale will not affect the actual costs of production even if production is projected into a one hectare fann or a larger area. According to a study made at RIARS in Region I, projections made **on** field plots measuring not less than 0.1 ha are accurate enough for larger estimates in terms of cost and returns. Peanut **was** not widely grown in the LVRIS service area since it requires a dry soil before planting and it takes a longer time to grow **(120 days).** This longer growing period will not allow farmers to grow a third crop.

2-3.11 The IIMI research assistant (Mr. Alexis Elegado) explained the IIMI activities at LVRIS and BP#2. He said the objectives of the study are to document and improve the operational procedures in these two systems. The existing procedures in cultivating irrigated non-rice crops in the dry season, particulary LVRIS, may be suitable for adoption in other systems. Presently the study is finding out possibilities for improving the effectivity of the system. The preceeding wet season data were presented in terms of water adequacy and equity. However, the water supply in the wet season was more than adequate and the equity issue was not critical.

2-3.12 In the current dry season, more areas were planted to rice. This led to the recent rotation of water among the four divisions at LVRIS, as previously explained by Engr. Lorenzo. The initial data collected indicate that the upstream portion or Division 1 gets more than its share of irrigation water. This inequality is exacerbated by seepage losses in the main canal in conveying water to other parts of the system. It is expected that with the completion of this dry season, sufficient data will have been collected to enable the making of guidelines which can be tested in the next dry season. These guidelines will be presented in the next reporting stage.

2-3.13 After the presentation, Dr. Baroga thanked the mission team and excused herself for not accompanying the group in the field visit. There were two garlic field sites visited. In the **first** site, garlic would be harvested

the next day. On the second site, harvesting had just been completed, with the garlic bulbs being placed in a bullock cart and tricycle. According to the fanners, the prevailing selling price of garlic is attractive but the quality is quite low. The bulbs were not as big as expected. The higher price was attributed to low supply and absence of the Taiwan variety of imported garlic.

2-3.14 The last stop was the wheat field site. Two adjacent wheat field sites were visited. Unfortunately, the research staff in charge of the agronomic aspects was not present. Nonetheless, the mission members observed the farmer's wheat field. The component study in this case is only documenting the actual water use of the fields selected. Other information like yield, costs and returns will also be collected. Mr, Walter (ADB) requested for a copy of the temperature data in the locality where wheat is currently being pilot tested. This field visit ended the second day of the mission. Next day, the mission team boarded flights on their way to South Cotabato for the final part of the mission.

2-4 Visit to Allah River Irrigation Project (ARIP) and Banga River Irrigation System (BARIS), **19-20** February:

2-4.1 The briefing at the Allah River Irrigation Project (ARIP) was started with a welcome address by the officer-in-charge, **Engr.** Santiago Eslaban Jr. This was followed by a presentation by Engr. Apolinario Mempin, Agricultural Coordinating Division (ACD) **Manager.** The accomplishments and current activities were presented in detail by one of his staff, Engr. J. Gregorio. The accomplishments in the Pilot Testing and Demonstration Farm No. **2** Lateral A-extra, were presented by Engr. Reynaldo de Guzman. Lateral A-extra is designed for growing irrigated non-rice crops in the dry season. The testing of irrigated non-rice crops in parts of the service area **of** lateral A-extra indicated mixed results. During the first dry season **1985-86,** approximately 15 ha of corn were irrigated. During this time IIMI together with ACD and the staff of the University of Southern Mindanao (USM) were testing irrigated corn, mungbean and peanuts. In the next dry season only around **14** ha of irrigated corn and mungbean were planted. In this current dry season around **27** ha **was** planted with irrigated corn.

2-4.2 Fanners were still hoping to plant a **second** crop of irrigated rice due to the abundance of irrigation water supply. This abundance can be attributed to the on-going construction within the service areas of Dams I and II, which presently are not being irrigated. Moreover, the indicated inflow into the main canal of Dam I was underestimated by as much as **40%. Thus,** there is actually more water available than expected, discouraging more farmers to plant irrigated non-rice crops. However, this situation is only temporary. Only upon full developnent of all the areas in both Dams I and **II** will the shortage of irrigation water in the dry season be felt. It will thus be too late to convince fanners of the necessity to plant irrigated non-rice crops.

2-4.3 Farmers located in the areas (laterals A, B **and** C-extras) with soils very suitable to non-rice crops have been requesting for an irrigated second rice crop. So far, actual water shortage has not yet occurred, which is the only convincing argument for cultivating irrigated non-rice crops.

2-4.4 Engr. Julio Antenor explained the operation of the system. He described the allocation *and* distribution procedures being implemented at ARIP. As previously discussed, farmers at ARIP prefer to irrigate rice then non-rice crops in the dry season. To most farmers, irrigation is synonymous to irrigated rice. The plan for the next dry season will be to partition the service area of Surallah Dam into two zones. Zone I will be irrigated at an earlier period and Zone II a month and a half later. This schedule of irrigation water delivery will enable NIA to schedule the "flushing" of non-rice crops at Laterals A-extra and B-extra, both belonging to Zone 11. Hopefully, the fanners in these two laterals will accept this schedule upon its presentation during the meeting with farmers before the start of the wet season.

2-4.5 The next report was presented by IIMI as introduced by Dr. Valera. The details of the IIMI activities at ARIP were presented by Engr. Rufino Soguilon. Calibration of measuring points, monitoring of flows and fanning activities and documenting operations at ARIP are the main system level activities being conducted by IIMI. This is done in collaboration with the field staff of NIA. These activities are deemed important in arriving at practices that will be useful in finally operating the system to irrigate non-rice crop if farmers will finally be convinced to do so.

2-4.6 The other component of the IIMI study is on the testing of furrow irrigation for hybrid corn. Two test sites were selected within the service area of lateral A-extra. This testing activity is jointly undertaken by the NIA-ACD staff and the DA-RIARS staff. Results *so* far indicate that a hectare of hybrid corn using furrows can be irrigated in only 7-8 hours. This is definitely more efficient than the usual practice of "flush-flooding" which takes 3 days to irrigate one hectare. There were also differences observed between the plots previously planted to rice and corn. These differences were attributed to the presence of the hard pan developed in puddling the rice crop in the wet season. More water was observed to be used by the plot previously planted to rainfed corn in the wet season.

2-4.7 The economics portion of the study was presented by Mrs. Purisima Bayacag, Assistant Professor of USM. Based on the previous dry season's survey, fanners at ARIP are not keen on irrigating non-rice crops. Fanners still prefer to grow irrigated rice in the dry season. In this current dry season, samples of irrigated and rainfed corn will be available for the survey of crop production. This study will provide financial and economic information on the viability of irrigated non-rice crop production at ARIP.

2-4.8 The last to report was Mr. Abelardo Zorilla, the team leader of the Provincial Technology Verification Trials at Marbel, South Cotabato for the Department of Agriculture (DA). He explained the program of DA in connection with the on-going IIMI-NIA project at ARIP. The main bulk of their work was mostly with rainfed environments. However, their present program was able to include testing of cropping patterns, variety and fertilizer trials in irrigated areas, particularly at ARIP. This is one rare occasion wherein NIA and DA are working together in a particular field project,. He said that this

present activity should he the start of joir undertakings between the two agencies. Mr. Zorilla provided support services for the agronomic aspects of the testing sites for furrow irrigated hybrid corn.

2-4.9 After lunch, the mission team, together with the staff from NIA, DA and USM proceeded to the two testing sites for the furrow irrigated hybrid corn. In the first site, the farmer cooperator indicated a good harvest for hi6 crop. The corn crop was t.o be harvested in two weeks time. All of the inputs were jointly provided by IIMI, NIA and DA but will be reimbursed by the fanner after harvest, including tbe irrigation fee. The estimated yield based on the stand of the crop was around 4.5 tons/ha which is considered a good yield. The adjacent rainfed corn crop was totally wiped out by lack of water. This site was used by the ACD staff to demonstrate the impact of irrigation on hybrid corn during one of their training visits for the fanners from the Dam II service area. Another aspect demonstrated was the utility of detasseling or tassel removal to prevent the proliferation of corn borers.

2-4.10 In the next test, site, the farmer cooperator was duly impressed with the kind of corn crop he has. According to him this is the first time he has grown irrigated hybrid corn. He said that one of the main advantages of hybrid corn is its ability to withstand strong winds. This, he says, can be attributed to a larger and more stiff corn stalk. Adjacent to this location is the site where the DA fertilizer trial was conducted. Among the macro nutrients demonstrated to have an impact was phosphorus. Plots with no phosphorus had a stunted stand compared to the other plots with phosphorus applied. This site was also visited by the farmers brought in by the ACD staff from the neighboring towns of ARIP.

2-4.11 The group then proceeded to the office of the Banga River Irrigation System (BARIS). A short, briefing! was held in the office. Engr. Orlando Tibang, Assistant Irrigation Superintendent reported on the operations and problems in the system. The main problem is still the siltation coming from the river. Flushing of silt; requires two hours daily. Removal of the accumulated silt in the settling pond ia also a regular activity at the headworks. Payment of the irrigation fee is slowly decreasing though the system as a whole is still financially viablr. Viability is reckoned as the total yearly collection which is equal to the yearly operation and maintenance expenditures (O&M). . Any excess will be divided among the staff of NIA including the office staff.

2-4.12 A question was raised by Mr. Walter on the presence of hybrid corn seeds inside the office. According to Engr. Tibang, the seeds are actually for some members of the Irrigators Association who opted to plant a third crop of corn after two crops of irrigated rice. Farmers have indicated their intention to plant a third crop of hybrid corn in approximately 250 ha, but not necessarily irrigated. Farmers wishing to avail of irrigation water will have to forward a signed request to the NIA office. This is the only way by which fanners at BARIS will pay irrigation fees for non-rice crops.

2-4.13 The IIMI research assistant (Engr. Isidro Teleron) reported on the activities of IIMI at BARTS. A prepared text of the report was distributed and presented. Questions were raised regarding the observed and planned operation

of the system. Mr, Salandanan (NIA) raised the point that *any* discrepancy between the planned and actual operation of the system should be the basis for improving the effectiveness of the system. Dr. Valera (IIMI) clarified that if the system is already operating satisfactorily, then there should be no difference between the planned and the actual targets. Based on the report of Engr. Teleron and Engr. Tibang, it was apparent that the system was operating optimally in terms of effective use of the available water supply and in collection of irrigation fees from the farmers. Mr. Walter suggested that planting the third corn crop or its monitoring should be undertaken to provide a basis for coming up with procedures or guidelines which may be useful in other systems like ARIP in effectively utilizing irrigation water. Dr. Valera agreed that this be included in the activities of IIMI at BARIS and accordingly reported in the Interim Report.

2-4.14 The final report was delivered by Mrs. Bayacag of USM. Based on the survey of the previous dry season, the production of irrigated hybrid corn had a significantly higher profit compared to rice at BARIS. The corn planted within the service area of BARIS is provided with moisture through rainfall and seepage from adjacent irrigated paddy fields. Fanners are not being billed for irrigation water. However, only 10% of the area is planted to corn in the dry season. Mr. Walter (ADB) pointed out that according to the IFPRI study, policy directions should be set for the production of irrigated improved open-pollinated native corn. The marginal benefit ratio analysis derived for the variety was highest compared to other corn varieties. He requested that all data gathered on this be analyzed according to this analytical technique and compared to the irrigated hybrid corn data.

2-4.15 The next stop was the site for testing of the furrow irrigated hybrid corn at BARIS. The group visited the site which the farmer cooperator explained has been used for the last three years for growing rainfed hybrid corn. Due to insufficient irrigation water for rice, rainfed hybrid corn was raised instead. According to the farmer, when there is sufficient rain, 6 ton/ha of hybrid corn is easily attainable. He also expressed interest in learning an alternative way to irrigate corn with this present testing exercise on his farm. The corn stand looked impressive. It will be harvested in about one and a half month's time.

2-4.16 The group went back to the conference hut at the ARIP Office in Surallah for the wrap-up session of the mission. Engr. Mempin summarized the planned activities of ACD for the remaining months of the project. Dr. Valera (IIMI) also summarized the accomplishments of IIMI in ARIP and also the forthcoming activities in the coming year, particularly the training for water masters slated in May. With the impending completion of the construction phase of ARIP, Engr. Eslaban expressed optimism that somehow IIMI will be able to provide the necessary help in realizing the intention of the project for implementing diversified cropping in the dry season in suitable areas. Mr. Walter (ADB) said that IIMI is expected to provide at least, tho outline of the procedures for managing irrigation systems for diversified cropping by the interim reporting stage. The tacit cooperation of the farmers in the suitable areas for diversified cropping will be a necessary condition for implementing the guidelines particularly at MIP.

2-4.17 Dr. Miranda (IIMI) cautioned Engr. Eslaban regarding unwarranted expectations about IIMI's role at ARIP. Dr. Miranda said that IIMI will do whatever it can along the lines of providing technical assistance or advise about alternatives in operating ARIP for diversified crops. Furthermore, he said that IIMI should not be credited nor blamed for any responsibilities of the ARIP project staff regarding the implemention of diversified cropping in the dry season. With this clarification, Engr. Eslaban expressed his appreciation for the mission in understanding the situation the project staff is in regarding implementing crop diversification at ARIP and for the project as a whole.

2-4.18 Dr. Valera ended the session by expressing gratitude to the NIA-ARIP, USM and DA staff in preparing for the visit of the ADB-IIMI-NIA mission. Next day the mission team departed for Manila.

111. Study Status and Expected Output for the Interim Reporting Stage

3-1 Methodology for identifying parts of irrigation system suitable to diversified crops

3-1.1 The methodology basically relies on the geographic information system concept (GIS). With this concept, geographic or physical information can be stored, analyzed and spatial data on maps particularly geared towards identification of optimum uses of land resources can be produced. There are two programs being used to arrive at the appropriate mapping technique for identifying parts of the system suitable for diversified crops. The Map Analysis Program *(MAP)*, a microcomputer based program package is being used in testing the methodology for the Laoag-Vintar River Irrigation System (LVRIS), the test site. The other program being developed is a BASIC language program based package using the Allah River Irrigation Project (ARIP) as the test site.

3-1.2 The activities for this component study centered mainly on gathering all available base or source and thematic maps for both LVRIS and ARIP. These maps include the general layout of the system, location of actual turnouts, canals, ditches, soil series, land use/land cover, *and* topography. These are currently being verified. Preliminary output displays or thematic maps using the two programs have been made.

3-1.3 For the Interim Report, a complete set of the output maps will be available, together with a write-up on the procedures for producing these map. Both programs will be validated using other systems as test sites to further verify the utility of this methodology in identifying parts of a system suitable for diversified crops.

3-2 Land conversion from puddled paddy soil to upland soil conditions

3-2.1 The research staff of CLSU is currenly undertaking the study on land. conversion. Fifteen sample farms are currently being monitored particularly for land preparation. Soil characteristics and land preparation practices data are being collected. These will be analyzed and evaluated to determine the primary factors and their interaction which condition the farmer to prepare his land both in the dry and wet seasons.

3-2.2 The completed results of this study will be presented in the Interim Report. However, this study will. only cover the range of soil conditions at UTRIS. There might be a need to expand this component study to other sites. The soil characteristics and the corresponding land preparation practices in other sites are also worth looking into. These data will be evaluated during the interim reporting stage. The two other possible sites for this study are LVRIS and ARIP.

3-3 Irrigation management practices at the farm level

3-3.1 Observations on farm level irrigation management practices are being undertaken in four system sites, namely: LVRIS, UTRIS, ARIP and BARIS. At LVRIS in Ilocos Norte, the irrigation method used by selected fanner cooperators for garlic, the dominant crop in the dry season is being evaluated and documented. Preliminary results indicate that the flow rate used by farmers ranges from 9 to 41 lps. The range of field plots is from 700 to 2,000 sq. m. The average duration for irrigating the farm plots ranges from 1 to 2.5 hours. Irrigation intervals were 2 to 3 weeks. The estimated application efficiencies were from 30 to 80% (from first to third irrigation). In addition to these observations, preliminary water use measurements are being made for tropical wheat (Trigo 3 variety) at Solsona and Pasuquin in cooperation with the MMSU Wheat Pilot Project.

3-3.2 In the UTRIS in Nueva Ecija, farm level irrigation management practices for three varieties of onion are being evaluated. There are six sample field plots being observed. The field plot sizes range from 208 to 1,298 sq. m. Irrigation intervals ranged from 2 to 6 times with two Occurrences of rainfall. Draining of field plots was necessary. Data on water use have yet to be analyzed by the CLSU research staff. The expected harvest will be on the middle of April.

3-3.3 In ARIP, different furrow lengths for irrigating corn were utilized depending on paddy sizes previously used in irrigated lowland rice culture. The shortest furrows were about 20 m and these were irrigated by furrowed basin flooding concentrating 15 lps flow rate for 30 minutes per paddy, measuring about 400 sq. m. The intermediate length furrows were about 50 m and were irrigated with flow rates of 1 to 2 lps per furrow for 30 minutes. The longest furrows were 200 m and had flow rates of 3 to 5 lps for an hour per furrow. The test sites were irrigated three times during corn growing period. The irrigation interval was 2 to 3 weeks.

3-3.4 In BARIS the furrow length used was 100 m. The corn plants were irrigated twice before tasseling at intervals of 2 to 3 weeks. At the time of writing this report the corn plants are still at late flowering stage and will still be irrigated if adequate soil moisture is not supplied by rain. The 1.28 ha test site was irrigated with flow rates of 1 to 1.5 lps per furrow for 4 hours using 30 lps total flow rate. During irrigation the total flow was concentrated to 20 to 30 furrows. Only one man supervised the irrigation throughout the field. The furrows had slopes of 0.001 to 0.002. Application ranged from 40 to 80 mm of water over the field.

3-3.5 The irrigation management practices at the farm level will be analyzed and evaluated based on the current practices of the fanners for the garlic, onion and corn crops. The results of the evaluation will be presented in the Interim Report together with the recommended practices. The recommended practices will also be presented in the forthcoming workshop for comments. These will then be tested in the last dry season of this study and further evaluated for its utility and packaging as a farm level irrigation management technology.

3-3.6 In the determination of the optimum farm ditch density for irrigating diversified crops, a physical survey is currently being undertaken to increase the number of samples. This component study is being undertaken by the MMSU research staff. The preliminary results indicated that turnout service area and field shape factors showed a significant effect on the farm ditch length among the samples obtained so far. More samples will be surveyed and additional regression models will be tried out to finally obtain the optimum farm ditch density under existing conditions in gravity irrigation systems. A regression model will be selected and presented in the Interim Report. This model will be further validated in other sites in the next dry season.

3-4 Irrigation management at the system level

3-4.1 The Banga River Irrigation System. The operation of this system for wet season 1987 was planned to have started on May 15, 1987. This was decided in a joint NU-IA meeting on April 8, 1987. It was programmed that 485 ha be served initially, 210 ha at the upstream and 275 ha at the downstream areas. Another 530 ha at the upstream area was to be served by June 1, 1987. The area served was to be increased by 900 ha from the downstream area by June 15, 1987. The total programmed area according to the plan was 1915 ha. The plan also included the rotation schedule per area served. In June 1987, the system experienced low water supply from the dam because of breakdown of the bulldozer being used for desilting the dam intake. 'The planned schedule was thus revised thru a joint NIA-IA meeting on July 24, 1987.

3-4.2 For the dry season cropping the plan was discussed in a joint NIA-IA meeting on September 28, 1987. 'The plan specified that 665 hectares were to have started dry season irrigation on November 1, 1987, 320 ha of which were from the downstream area and 345 ha from the upstream area. Another 1480 ha, 602 ha from the upstream and 878 ha from the downstream area were to have been served by December 1, 1987. The total programmed area for the dry season was 2145 ha. The downstream area of BARIS was foreseen to avail of drainage reuse coming from irrigated areas of the Allah River Irrigation project. Because of this expected additional water supply, all areas were programmed to be irrigated for lowland rice planting. The plan agreed upon included the schedule of water delivery. Becsuse of water supply problems the plan was again revised on October 6, 1987 and on November 30, 1987 and again on January 25, 1988 thru joint NIA-IA meetings.

3-4.3 For the wet season. actual operation started on June 1, 1987, two weeks later than the plan because of desiltation of the dam intake. The plan was therefore adjusted according to when the operation started. The total planted area for the wet season was 1930 ha, 15 ha more than in the plan. Peak planted area was attained by early August. In the dry season 1750 ha were planted which was 395 ha less than the programmed area. Peak planted area was attained early January 1988. For the wet season, the average water use efficiency (WUE) for the whole system from June to December was 62% (Table 1).

3-4.4 A survey was conducted in January 1988 to find out how much area was planted to corn within the service area of BARIS. It was found that, about 52 ha mostly at the upstream area were planted to corn (Fig. 2). These areas were

irrigated mostly thru seepage from adjacent lowland irrigated rice areas. In these areas the water table depth was 40 to 80 cm according to auger hole observations. Corn roots can penetrate as deep as 100 cm in an ideal soil column. They draw most of their water requirement within the 60 cm soil depth. This means that corn planted beside lowland rice have sufficient water supply from the phreatic water table created by irrigation in adjacent rice fields. There are also areas which are now being planted to corn as third crop in the upstream section of the system (Fig. 2). These areas will be irrigated by flushing in case of drought.

3-4.5 The Allah River Irrigation Project (ARIP). The plan for wet season 1987 was prepared by the system's personnel as early as February 1987. It was presented in a joint NIA-IA Meeting on March 12, 1987. The plan presented specified that the start of operation of ARIP was May 1, 1987. The programmed irrigated area was only 4,000 ha because most on-farm delivery canals were not yet completed. The plan also specified that the start of delivery was to be staggered one week beginning at the tail section. It was planned that on the first week of May, 1/3 of the service area would have been served and on the third week the whole service area would have been able to get water.

3-4.6 The dry season plan was developed starting with a NIA-IA consultative meeting on September 22, 1987. The areas planned to be served were only 3,000 ha lowland rice and 200 ha diversified crop. The irrigated diversified crop areas were identified as Lateral A-, B- &'C-extras. The farmers were told that the irrigated area reduction was due to expected low water supply from the Allah River. The farmers were reminded that even at the start of IA organizations they were already told of this deficiency of the system during the dry season.

3-4.7 During the meeting the farmers covered by the area planned for diversified crops complained that they were about to harvest their wet season rice crop. If they plant corn they would have to wait till December to ensure that their corn crop would not be damaged by heavy rains. This means that their farms would be laid fallow for two months. Thus, they requested for the extension of irrigation delivery,

3-4.8 The plan for wet season 1988 was also discussed to avoid the *same* mistakes from happenning. It was agreed that areas scheduled for irrigated diversified crops on dry season 1988-89 will start operation at a later date, i.e., June 15, 1988, a month and a half later than the other areas. For this purpose the whole service area was divided into two zones. The first zone was identified as the upstream area from headgate to Lateral A including Lateral B-Extra and covered the whole service area of Lateral A. The second zone was the downstream area from Lateral A. The second zone will be served first starting May 1, 1988 and the first zone starting June 15, 1988. The areas programmed for crop diversification during the dry season are found in the first zone. The later planting date will result in a dry season operation to start at about the last week of November which is more adaptable for corn planting.

3-4.9 According to the plan, ARIP started operation for wet season 1987 on May 1, 1987. The final programmed area to be irrigated was 4,581 ha. Though the dry season irrigation was programmed to start November 1, 1987, some

farmers started second planting of rice by September, 1987 because of early harvest. This became a problem in scheduling the Lateral Extras A, B & C for diversified crop planting. Farmers insisted that corn planted as early as October or November is prone to be waterlogged if rain occurs. Most farmers in these areas petitioned for the extension of water delivery until December 31, 1987. The programmed cut-off of irrigation water in these laterals was October 31, 1987. Because *many* farmers had already planted or land prepared for a second crop of lowland rice their petition was granted. For the wet season, the system delivered an average of 183 mm/week (23 mm/day) to the irrigated area. Rainfall averaged 50 mm/week (Table 2). The system had average water use efficiency of 45%. Water adequacy observations showed no water shortage in any part of the system.

3-4.10 Some laterals of the system were scheduled for closure in the dry season for completion of on-farm delivery channels. These were Laterals A-1, A-3 and D. The reduction in area served due to these closures enabled the extension of irrigation delivery in the other remaining laterals. A meeting of the presidents of the different IA's with NIA system personnel was held to inform them of the NIA plan. The area programmed for the dry season was about 3500 ha. The farmers in the extra laterals were encouraged to plant diversified crops. Only some of the farmers in Lateral A-Extra followed the advice of the systems personnel. The farmers who planted corn were promised that they would be given irrigation water for flushing their corn when needed. As of December 1987 there were already 27 ha of corn land who requested for irrigation in Lateral A-Extra.

3-4.11 Even the areas scheduled for closure planted rice. Most farmers were able to plant their rice crop before the closure of the canals on October 31, 1987. When the canals were closed they availed pf flows from creeks adjacent to their area. They checked the creeks to raise the water level to irrigate their farms. Lateral A3 and A3a were previously served by a communal system before ARIP was constructed. They made use of their original water s o m e to be able to plant rice. The area served for irrigation for lowland rice during this dry season was not yet fully known because of an on-going area survey being conducted for the whole of ARIP to assess its actual service area. The survey is scheduled to be finished before the end of the dry season.

3-4.12 On February 29, 1988, a NIA-IA joint meeting was held to discuss the irrigation plan for crop year 1988-89. Most of the second crops were already harvested. Starting March 1988, only diversified crops in the extra laterals would be given flush irrigation. According to the proposed plan which was presented on September 22, 1987, the upstream area would have been served starting June 15, 1987. The fanners in the area complained that their farms would be idle for more than 4 months. They requested an earlier start of irrigation service to reduce the fallow period. NIA personnel acceded to their demand. Zone II will be served starting April 1, 1988 instead of May 15, and Zone I will be served starting May 15 instead of June 15, 1988. This is foreseen to create problems again for areas programmed for diversified crops. If such areas could plant their rice crop in late May, they would harvest in late September. These farmers might again complain of untimely planting of diversified crops and might again try to plant a second crop of rice. With the larger programmed service area of more than 7000 ha, the system might not then

be able to comply with farmers' requests for water delivery extensions as in the previous season.

3-4.13 In Lateral A-Extra, one of the laterals designed to irrigate diversified crops in the dry season, the areas developed for irrigation as of the previous season were only 130 ha out of the possible service area of 277 ha. Most of these areas were planted with second crop of rice in the previous dry season as early as September 1987. Farmers said that September was too early for corn planting and December was more ideal. The irrigation delivery in the lateral was extended until December 31, 1987 instead of the planned cut-off date of October 31, to support these areas. Farmers in areas where the wet season rice crop were harvested in November, planted corn. A total of 27 ha requested irrigation for their corn crop (Fig. 3). There are also farmers in areas not shown in the map who harvested their second crop of rice in February and are in the process of preparing their land for late corn planting.

3-4.14 The Laoag-Vintar River Irrigation System (LVRIS). The irrigation plan for crop year 1987-88 was discussed in a joint NIA-IA meeting on May 26-27, 1987. Only farmer members of the LABASA attended the meeting. The LABASA area covers the downstream areas of LVRIS beginning at Lateral F. The LABASA area is 1,669 ha, 70% of the total LVRIS service area which is 2,371 ha. In the meeting only the schedule for the LABASA area was discussed.

3-4.15 The plan was to stagger the start of delivery from the upstream to downstream. Irrigation delivery was to have started on June 1, 1987. The first week of delivery was to have been devoted to the area of the Vintar IA. In the second week the LABASA area was to have been served starting at the upstream. The downstream area was to start operation in the last week of June 1987.

3-4.16 For the dry season, the LABASA area was programmed to have 422 ha irrigated rice area (Fig 4). Programmed diversified cropped area was 397 ha. This was only 49% of the total LABASA IA area of 1,669 ha. The remaining areas were not programmed for irrigation. The operation for the dry season was scheduled to start on the last week of October.

3-4.17 Irrigation delivery for wet season 1987 in LVRIS started on June 1, 1987, according to the plan. Planting of rice crops only started on the first week of July. This coincided with the number of days required for seedbed preparation and seedling maturity which is almost one month. On the 9th week of water delivery 80% of the programmed area was planted. The total programmed area for the wet season was 2,318 ha. Only 2,220 ha was planted which was 96% of the programmed area. The system delivered an average of 104 mm/week of irrigation water to its service area (Table 3).

3-4.18 From June to August 1987, insufficient water delivery was observed in the tail end of the main canal, lateral F1 and its sublaterals, tail end of Lateral F and in Lateral H and its sublaterals. This was due to the on-going rehabilitation work on some delivery structures, silted canals which limited water delivery to these canals and illegal checking by farmers. Rotation of water delivery by laterals and section of sublaterals was implemented to solve

the problem. Compared to other years the water flow at the LVRIS dam during these months was also much lower because of lower rainfall occurrences.

3-4.19 The mean annual rainfall. in Ilocos Norte from 1975 to 1986 was 1904 mm (Table 4). The total rainfall for 1987 was only 1282 mm, 67.5% of the mean. This shows that 1987 was a drought year. The first rain for 1987 occurred in June (Table 5). There were only 9 weeks wherein rainfall was more than 50 mm for June to October. On the average the weekly rainfall from late May to late September was more than 50 mm. The monthly rainfall from June to August was very much lower than the mean for the previous years.

3-4.20 For the dry season LVRIS served 889 ha lowland rice area and 574 ha diversified cropped area. The total planted area was 1,463 ha, 64% of the total service area. Division 1 had 516 ha irrigated lowland rice and 50 ha diversified crop area with a total planted area of 91% of its service area. The typhoons that occurred in September and October 1987 destroyed brush dams and irrigated rice areas located upstream of the LVRIS Dam. This led to the unusually high volume of water available in the LVRIS dam during November and December. The Irrigation Superintendent was worried during those months about the effects of such Occurrences. There were indications then that a larger area was being prepared by farmers for lowland rice during the 1987-88 dry season than what the system could support. To discourage farmers, he scheduled desilting works on the LVRIS main canal in December, closing the system for one week. The destroyed brush dams were already being restored and the Irrigation Superintendent was expecting lower volume of water available at LVRIS dam starting January 1988. Before Christmas of 1987, farmers with brush dams downstream of the LVRIS were also requesting some spillage of water from the LVRIS Dam for their area.

3-4.21 Bonga Pump No. 2 (BP#2). The irrigation plan for crop year 1987-88 was presented during an IA general. assembly meeting on May 28, 1987. The meeting was attended by NIA personnel and the newly elected congressman in the area. The plan was to irrigate 450 ha lowland rice during the wet season. During the dry season the area programmed was 100 ha irrigated lowland rice and 110 ha irrigated diversified crops. The diversified crops planned were 50 ha corn and vegetables, 30 ha garlic, and 30 ha mungbean. The plan specified that the start of pump operation was May 19, 1987. The cut-off for the wet season was planned to have been on October 15, 1987. For the dry season the planned start was November 3, 1987 and the cut-off March 29, 1988.

3-4.22 For wet season 1987, irrigation operation started on the second week of July. This was due to the late onset of rains and to late compliance of IA in paying their obligations to NIA. Most of the fanners in the area use dry seedbed preparation. They only irrigated their seedbed by flooding before pulling out the seedlings. When there were no rains they hand irrigate their seedbeds from shallow dug wells. If there was no water in shallow wells they requested pump operation to irrigate their seedlings. Most of the farmers also used dry land preparation. This .resulted in shorter land soaking and final land preparation period. which is only a week for most areas.

3-4.23 Only 375 ha out of the programmed 450 ha were served during the wet season. The system attained 80% planted area 6 weeks from the start of

operation. Irrigation cut-off was on November 30, 1987. The system delivered a total of 1.2 m of irrigation water to its service area or an average of 82 mm/week (Table 6). The mean W E was 71%. For the dry season they started operation only in January 1988. This is due to late compliance with paying the pump operation cost to NIA. The planted area as of March 1987 is shown in Fig 5.

3-4.24 The Talavera River Irrigation System (UTRIS). The planned start of operation for wet season 1987 was June 16, 1987. The total area that was programmed waa 3,629 ha. The main canal headgate was not closed during the break between dry season 1986-87 and wet season 1987, but the flow was minimal until the onset of rains in early June. By the middle of June, the available water flow increased to not less than 3,000 lps from a low base flow of 400 lps before the rains occurred. The actual start of planting waa middle of July 1987, and 80% of the planted area was attained in mid-September. In other years 80% planted area was usually attained by mid-August. This was mainly due to late onset of heavy rains. It was only in mid-August when rainfall exceeded *100* mm/week. For the whole system, the average weekly irrigation water diversion was 170 mm/week during wet season 1987. The system had a mean WUE of 51% (Table 7).

3-4.25 In Nueva Ecija the mean annual rainfall from 1974 to 1986 was 1886 mm (Table 8). In 1987 the rainfall was 1313 mm, 70% of the mean and even lower than the annual rainfall for the drought pear of 1983. Rainy daya were also lower by 19 days, 102 days compared to 121 days on the average (Table 9). There were only *10* weeks from May to October where the weekly rainfall surpassed 50 mm and this did not occur continuously. It was only in late August when the weekly rainfall has consecutively greater than 50 mm. On the average year the weekly rainfall from late May to early October is more than 50 mm. All the months of the rainy season had lower rainfall than the average year.

3-4.26 There was shortage of hater specially at the downstream areas during the months of June and July as gathered from canal flow observations and farmers' feedback due to low water availability at the dam. Some kind of rotation among laterals and section of the system was developed to solve the problem, but it was never strictly implemented. Some of the downstream farmers resorted to pumping from shallow tube wells during the month of June to enable them to plant early. The overuse'of water in the upstream was aggravated by lack of control gates and defective gates on some laterals and turnouts and illegal checking by farmers.

3-4.27 For dry season 1987-88, the programmed area for irrigation service was *1,000* ha. At present the total reported planted area is 927 ha; 462 ha are planted to rice and 465 ha to diversified crops, mostly onions Fig. 6. This is higher than the area served in the previous dry season where only 770 ha were served. The rice area served decreased from 611 ha, but the diversified crop areas increased from 159 ha. The actual planted area is much more than the reported area because there are many farmers who planted rice in unprogrammed areas. This was possible because of the large volume of water flows available in November and December. Downstream farmers who were not programmed were able to use this water for land preparation and crop establishment. During the

month of January and February they used pumps to draw water from shallow tube wells to supplement whatever is available from the canals.

3-4.28 Starting in January a water rotation scheme was again planned but was not strictly implemented. The presence of lowland rice crops in unprogrammed areas was creating low water supply at the downstream programmed areas. The unprogrammed areas were able to get the water intended for the downstream laterals by illegal opening of checks especially during the night.

3-4.29 During a NIA-IA meeting in February 1988 the downstream farmers requested the irrigation personnel to give them a share of irrigation water because the cost of pumping was raising their production cost. The irrigation personnel did not accede to their request. The presence of a brush dam on the Talavera River, upstream of the TRIS dam is aggravating the water shortage. The farmers are requesting that this should be regulated. There is doubt whether the brush dam has a water right. The fanners also complained that the water rotation schedule is not being strictly implemented. The Water Management Technician claimed that even though the rotation schedule was being altered, it was not to favor certain groups of farmers, but to enhance equity of distribution and that the real problem was the low water supply.

3-4.30 For San Agustin Extension (SAE), the left bank service area of TRIS, only 306 ha was served in the wet season 1987, 52% of the programmed area of 592.1 ha. The rest were also planted but under rainfed condition, because the canal systems were silted and in need of rehabilitation. The areas served by SAE were located near the banks of the Talavera River, especially the areas served by the main canal. This was mainly responsible for the low water use efficiencies for the whole system. The mean WUE is 56% for the whole SAE service area (Table 10).

3-4.31 The silt in the canal systems come from landslides along the main canal which was carved on the hillsides. Whenever it rains, a large amount of silt is washed into the canals. The only feasible solution is to construct a separate canal system beside the main canal to carry the silt through culverts under the main canal into the river. Some provisions of such sort were made when the system was constructed. At present, these canals are already filled with silt thus silt enters the main canal and is carried thru the canal systems.

3-4.32 For this dry season, the main problem of onion growers in SAE and UTRIS is the untimely Occurrence of rainfall. Late rainfall caused poor quality bulbs, due to excessive moisture.

3-4.33 An analysis and evaluation of the irrigation management practices will be undertaken based on the observations and documentation on the study sites. The data collected for the past 3 dry seasons at BARIS and 2 dry seasons at the other sites are expected to be the basis for formulating guidelines in managing irrigation systems for diversified crops. The resulting guidelines will be presented at. least in an outline form in the Interim Report. Furthermore, these guidelines wi 11 be presented in the forthcoming workshop (see schedule of activities, chapter IV). The comments and suggestions are expected to improve the guidelines which will be tested in the next dry season.

3-5 The Economic Component Study

3-5.1 As of mid-February, farmers in the six irrigation systems have planted their dry season crops for crop year 1987-88. Since the available data do not yet allow complete economic analyses for the different crops planted, this status report is limited and focuses on land utilization in the system. The cost and returns in the production of rice and non-rice crops will be included in the Interim Report.

3-5.2 Overall profile. The levels of land utilization, as measured by the proportion of the dry season area planted to crops to the total farm area, show increases in crop year (CY) 1987-88 compared with CY 1986-87. A summary of the overall land utilization in the different systems is given in Table 11.

3-5.3 Among the different irrigation systems, land utilization increases substantially in the TASMORIS, while slight increases are observed in UTRIS, ARIP and BARIS. Large decreases in land utilization are indicated for LVRIS and BP#2. Meanwhile, MCIS is under rehabilitation this dry season and therefore, is excluded from the systems surveyed. Although a range of broad factors (e.g. water, input, and market) are reported to have influenced the degree of land utilization, the El Nino drought which occurred during the wet season of CY 1987 may be the most critical factor that affected the level of land cultivation in LVRIS, BP#2, and UTRIS. Delays in planting the wet season crop caused the delays in planting of the dry season crop.

3-5.4 Laoag-Vintar River Irrigation System (LVRIS). Table 12 shows the present land utilization of farm areas planted to selected diversified crops in LVRIS. Comparison is limited to the land utilization for the first dry season crops only.

3-5.5 The broad factors which have been reported to influence land utilization include availability of water, input-related factors, and farmers' experience during the previous dry season. The degree of importance of these factors, however, varies in accordance with the location of the farm plot in the lateral. Under the Rice-Garlic-Mung(RGM) cropping pattern, for instance, the availability of water is cited by farmers as the most critical for farmers with plots at the middle and tail end of the laterals. Meanwhile, farmers' experience and/or risk factors are considered critical by farmers with plots at the head laterals. These factors are also similarly cited in the Rice-Rice-Mung(RRM) cropping pattern.

3-5.6 Bonga Pump NO. 2 (BP#2). As in the LVRIS, comparison of land utilization is limited to that of the first dry season crop. In terms of importance/necessary requirements, the broad factors affecting land utilization in BP#2 are fanners' experience, water and market-related factors for the RGM pattern, and water, risk-and input-related variables for the RGM pattern.

3-5.7 Upper Talavera River Irrigation System (UTRIS). A slight increase in the overall land use is noted. Such an increase can be fully appreciated by looking at the gains posted under the various cropping patterns. There was, on the average, at least, a 1-month delay in the planting of onions this dry season. Despite the critical supply of water during CY 1987-88, the percentage

of farm areas devoted to onions increased. A summary of the percentage of land utilization of farm areas planted to diversified crops in UTRIS is given in Table 14. Onion growers in UTRIS consider the size of the market. and farmers' experience during the previous dry seasons as the two critical factors which determine the size of the areas to be planted to onions during the dry season. The supply of water is reported only as a third factor.

3-5.8 Tarlac-San Miguel-O'Donnel RIS (TASMORIS). A significant increase in the overall land utilization is observed in TASMORIS. This is reflected in the various cropping patterns being followed within the system as shown in Table 15.

3-5.9 The relatively high land utilization posted in TASMORIS is rather unique. Rice is preferred under the Rice-Rice(RR) cropping pattern because of the availability of sufficient water and suitability of the soil to the crop. These are the areas nearest the dam. On the other hand, corn is grown under the Rice-Irrigated Corn(RIC) cropping pattern in areas with less water. The perceived favorable price for the commodity has been identified as an important factor in the farmer's decision to plant corn. Mungbean, which requires less water compared to corn, is grown in rainfed areas.

3-5.10 Allah River Irrigation Project (ARIP). The extent of land utilization in the ARIP is by far the most extensive among the systems **(99%).** Practically the entire cropland is cultivated during the dry season to hybrid corn and/or native corn in the same area. The high level of land utilization in ARIP is attributed to an ample supply of irrigation water supplemented by an even distribution of rainfall, the availability of inputs, and the suitability of the soils to corn planted in the area. Table 16 presents the percentage of land utilization of farm areas planted to diversified crops in ARIP.

3-5.11 Banga River Irrigation System (BARIS). As in ARIP, the level of land utilization in BARIS is also high. The same factors such as availability of water, suitability of the soils, and the level of technology known by the farmer influence the high level of land utilization. A summary of the percentage land utilization planted to diversified crops in BARIS is shown in Table **17.**

3-5.12 Clarification on the Issues Raised in the Review Mission.

3-5.13 On the relatively greater profitability of peanut production compared to garlic production at LVRIS. The mean returns above variable cost of irrigated peanut exceeded that of garlic by P **2,993.74** per hectare during the dry season, crop year **1986-87** (Table **2,** page 30, First Progress Report to ADB). However, the decision of the fanner in choosing which crop to plant between peanut and garlic is constrained by the required 120-day growing period for peanut. Fanners in LVRIS follow a cropping pattern of three crops, which starts with a wet season crop of rice. Given the average farm size of less than one hectare in the area, farmers maximize the use of their land by planting at least two crops in sequence during the dry season. Planting, peanut as one of the two crops in the relay would subject the establishment of the second non-rice crop to the peak **dry** season weeks starting in mid-March to April.

3-5.14 Farmers at LVRIS strongly suggest the need for plant breeders to come up with a variety of peanut with a required growth period of about 105 to 110 days. With a shorter growth period, more farmers may shift to the planting of peanut during the dry season since their choice will not prevent the planting of a second dry season non-rice crop.

3-5.15 Other factors which tend to favor peanut production over that of garlic are (1) the significantly lower total variable cost (i.e., hired labor/power cost and material cost) incurred in producing peanut; (2) less post-harvest problems associated with the primary processing and long-term storage of peanut; and (3) less Fluctuations in the price received by farmers for peanut compared with other non-rice crops produced in the area (Table 4, page 32, First Progress Report).

3-5.16 On the returns to family labor in onion production at UTRIS. The average residual returns to the farm family, mostly due to labor and family-owned resources (e.g., carabao and implements), is P 64.30 per manday of family labor for the dry season, crop year 1986-87. The net returns to the farm family over and above that paid for family labor is measured by the extent to which the P 64.30 per manday exceeds the prevailing agricultural wage received by farm laborers. The data indicate that for onions planted in farm plots at the middle and tail-end of the laterals, the average residual returns to the farm family is only P 71.64 per manday for farmers who planted onions in plots located at the head of the laterals. The difference is due to the higher returns above variable cost to onion farmers who had better access to irrigation water both in quantity and timeliness of application since their farm plots were at the head of the laterals.

3.5.17 The significant factors for consideration about family labor input in onion production are the following: (1) on the average the contribution of family labor is about 375 mandays per hectare, or about five times that for rice production; (2) there is a lot of unemployment and underemployment in farms during the dry season, especially in areas where only a small proportion of the farms are irrigated; and (3) the labor-intensive characteristic of onion production partly determines the size of the farm plot to be planted to it. Depending on the employment alternatives available to the farmer and the members of his farm family, the opportunity to be able to convert the available family labor into returns to family labor and resources is equivalent to the agricultural wage.

3-5.18 On the production of improved native corn at BARIS. The cost of seeds per hectare for hybrid corn is at least seven times that for native corn. In addition, farmers on the average apply 30 percent more fertilizer in the production of hybrid corn than in the native corn. While average total variable cost for irrigated hybrid corn is significantly higher than that for irrigated native corn during the dry season, crop year 1986-87, the differences in the means of the returns above variable cost between hybrid corn and native corn were not significant. Improved varieties of native corn, which allow corn farmers to obtain seeds from their harvests and produce higher yields than the ordinary native corn varieties, can thus reduce the cost of seeds and increase the returns to corn farmers.

3-5.19 The Interim Report would include the farm operations data of rice and non-rice crops for two dry season croppings for five systems and three croppings in one system. The costs and returns analyses for the different crops and/or cropping patterns would firm up the findings in the 1986-87 dry season data.

3-5.20 Aside from the gross and net returns and costs of production of rice and non-rice crops in irrigated and non-irrigated areas, the 1987-88 dry season survey will also confirm the farmers' perceptions on the constraints as well as incentives for growing non-rice crops.

3-5.21 Based on the interim Findings of the studies, it would be possible to identify on a preliminary basis in the Interim Report, projects which would facilitate the adoption of divecsifed cropping in rice-based, irrigated areas. These proposed projects could be categorized into research and development (R & D), support facilities for production and post-production activities, policy studies, and re-design/rehabilitation of the irrigation systems to meet the specific requirements of non-rice crops.

IV. Schedule of Activities for the next 12 months

4.1 The major activities in the nest 12 months will be led by the analyses and evaluation of the 1987-88 dry season data for all sites. This activity will be instrumental in the formulation of the draft. guidelines to be presented in the Interim Report. The draft guidelines in turn will be presented in the Workshop slated for October 1988.

4.2 The workshop will be divided into three portions. The first portion will be the presentation and discussion of results from the study sites for the previous dry seasons. Moreover, relevant studies from other institutions and agencies will be invited for presentation. The second portion of the workshop will be the review of the draft. guidelines on irrigation management for diversified crops. The review will focus on the improvement .of the draft guidelines for field testing in the nest dry season. The last portion will be the planning for the field testing of the draft, guidelines.

4.3 With these activities, it is envisaged that shortfalls in the implementation of the project, in the next dry season will be minimized. Furthermore, at the onset of the next dry season, a final project. review is slated. This review will consists of visits and discussions on all sites to further insure the proper implementation of the project. Any significant suggestions or additions can still be accomodated at this stage of the dry season. All of these efforts are geared towards the identification of existing and/or proposed policies that will suppport more profitable fanning practices and investment in irrigation development as related to irrigated crop diversification.

4.4 A summary of the project activities for the coming 12 months is presented in the next page.

4.5 The activities for the next twelve months with their corresponding time periods are summarized below:

Activities	'--1989-- A	M	J	J	A	S	Θ	N	D	J	F	M
Data summary and analyses for 1988 dry season all sites	xxxxxxxxxxxx											
Guidelines and interim report preparation	x	▬▬▬										
Training of watermasters at ARIP and BARIS (May)		xx										
Submission of Interim Report (August)				xx								
Preparation for workshop		xxxxxxxxxxxxxxxxxxxx										
SAC meeting (September)					xx							
Workshop and planning for 1989 dry season (October)						xx						
Workshop report subnission (November)							xx					
Final project review (December)								xx				
Preparation for 1989 dry season					xxxxxxxxxxxx							
Data collection for 1989 dry season							xxxxxxxxxxxxxx					

Table 1. Programmed Area (PA), Irrigated Area (IA), Irrigation Diversion Requirement (IDR), Rainfall (RF), Pan Evaporation (EV), Actual Irrigation Flow (AIF), Relative Water Supply (RWS) and Water Use Efficiency (WUE), June to December 1987, Banga River Irrigation System (BARIS), Whole System .

Wk of Yr	Date	Prog. Area ha	Irrig Area ha	IDR mm	RF mm	EV mm	AIF mm	RWS	WUE %
22	28-Jun	1968	0		71	30			
23	Jun4-10	1968	400	121	62	25	617	5.6	18
24	11-17	1968	700	118	7	30	356	3.1	33
25	18-24	1968	1310	117	46	28	212	2.2	45
26	25-Jul	1968	1800	114	177	28	68	2.1	47
27	Jul2-8	1968	1880	108	55	25	52	1.0	100
28	9-15	1968	1930	100	47	24	84	1.3	77
29	16-22	1968	1930	98	14	29	111	1.3	79
30	23-29	1968	1930	93	23	26	84	1.2	86
31	30-Aug	1968	1930	91	32	26	79	1.2	82
32	Aug6-12	1968	1930	91	103	36	77	2.0	50
33	13-19	1968	1930	91	85	31	32	1.3	77
34	20-26	1968	1930	91	96	31	50	1.6	62
35	27-Sep	1968	1930	91	6	28	50	0.6	100
36	Sep3-9	1968	1910	91	0	18	100	1.1	91
37	10-16	1968	1'780	91	8	29	95	1.1	89
38	17-23	1968	1630	91	11	29	138	1.6	61
39	24-30	1968	1513	91	78	27	197	3.0	33
40	Oct1-7	1968	1368	91	71	24	36	1.2	85
41	8-14	1968	1356	93	57	25	36	1.0	100
42	15-21	1968	1430	9'7	35	23	163	2.0	49
43	22-28	1968	1282	99	69	24	259	3.3	30
44	29-Nov	1968	1174	102	68	29	231	2.9	34
45	Nov5-11	1968	1264	102	71	29	106	1.7	57
46	12-18	1968	1070	105	41	29	73	1.1	93
47	19-25	1968	820	110	19	27	170	1.7	58
48	26-Dec	1968	580	103	0	27	389	3.8	26
49	Dec 3-9	1968	825	105	0	29	330	3.2	32
50	10-16	1968	1175	102	60	28	201	2.6	39
51	17-23	1968	1450	98	36	30	142	1.8	55
52	24-31	1968	1550	95	76	32	67	1.5	66
	Total	1968		2989	1524	856	4607		
	Mean	1968	1457	100	49	28	154	2.0	62

RWS = (AIF + RF) / IDR WUE = 100/RWS, %

Table 2. Programmed Area (PA), Irrigated Area (IA), Irrigation Diversion Requirement (IDR), Rainfall (RF), Pan Evaporation (EV), Actual Irrigation Flow (AIF), Relative Water Supply (RWS) and Water Use Efficiency (WUE), Allah River Irrigation Project (ARIP), Whole System Wet Season 1987.

Week no.	Date	PA ha	IA ha	IDR mm	RF mm	EV mm	AIF mm	RWS	WUE %
17	Apr 23-29	4581	0		11	51			
18	Apr 20-May 06	4581	114		21	36			
19	May 07-13	4581	429		26	38			
20	May 14-20	4581	723		109	53			
21	May 21-27	4581	1220	113	50	47	359	3.6	28
22	May 28-Jun 03	4581	1830	110	78	29	254	3.0	33
23	Jun 04-10	4581	2299	106	52	34	265	3.0	33
24	Jun 11-17	4581	2824	103	1	31	216	2.1	48
25	Jun 18-24	4581	3332	100	42	44	151	1.9	52
26	Jun 25-Jul 01	4581	3731	98	60	35	174	2.4	42
27	Jul 02-08	4581	4043	96	13	27	147	1.7	60
28	Jul 09-15	4581	4185	94	61	36	161	2.4	42
29	Jul 16-22	4581	4300	92	42	37	176	2.4	42
30	Jul 23-29	4581	4395	92	48	30	145	2.1	48
31	Jul 30-Aug 05	4581	4405	92	40	40	136	1.9	52
32	Aug 06-12	4581	4405	91	50	32	130	2.0	51
33	Aug 13-19	4581	4250	91	91	43	100	2.1	47
34	Aug 20-26	4581	4009	91	74	29	48	1.3	74
35	Aug 27-Sep 02	4581	3663	91	9	34	212	2.4	41
36	Sep 03-09	4581	3243	91	4	36	211	2.4	42
37	Sep 10-16	4581	2684	91	0	35	215	2.4	42
38	Sep 17-23	4581	2086	91	68	45	201	3.0	34
39	Sep 24-30	4581	1517		32	38			
40	Oct 01-07	4581	1056		40	24			
41	Oct 08-14	4581	646		44	33			
42	Oct 15-21	4581	336		162	34			
43	Oct 22-28	4581	181		50	34			
44	Oct 29-Nov 04	4581	107		120	29			
45	Nov 05-11	4581	25		89	34			
46	Nov 12-18	4581	0		44	23			
47	Nov 19-25	4581	0		12	27			
	Total	4581		1731	1542	1095	3301		
	Mean	4581	3384	96	50	35	183	2.3	45

RWS = (AIF + RF) / IDR WUE = 100/RWS, %

Table 3. Programmed Ares (PA), Irrigated Area (IA), Irrigation Diversion Requirement (IDR), Rainfall (RF), Fan Evaporation (EV), Actual Irrigation Flow (AIF), Relative Water Supply (RWS), and Water Use Efficiency (WUE), Laoag Vintar River Irrigation System (LVRIS), Whole System, Wet season 1987.

Week No	Date	PA ha	IA ha	IDR mm	RF mm	EX mm	AIF mm	RWS	WUE %
19	May 07-13	2319	0		0	41			
20	May 14-20	2319	8		0	36			
21	May 21-27	2319	53		0	38			
22	May 28-Jun 03	2319	82		1	45			
23	Jun 04-10	2319	213		125	46			
24	Jun 11-17	2319	230		105	36			
25	Jun 18-24	2319	556	121	31	45	377	2.4	42
26	Jun 25-Jul 01	2319	908	120	28	36	279	1.7	60
27	Jul 02-08	2319	1300	117	78	37	227	1.8	54
28	Jul 09-15	2319	1924	113	22	31	133	0.9	100
29	Jul 16-22	2319	2153	104	48	35	131	1.1	88
30	Jul 23-29	2319	2179	99	87	34	137	1.6	63
31	Jul 30-Aug 05	2319	2194	95	0	33	124	0,9	100
32	Aug 06-12	2319	2204	93	16	33	117	1.1	95
33	Aug 13-19	2319	2204	92	71	32	127	1.6	62
34	Aug 20-26	2319	2222	91	24	32	123	1.2	83
35	Aug 27-Sep 02	2319	2222	91	127	32	110	2.0	50
36	Sep 03-09	2319	2222	91	348	24	95	3.8	27
37	Sep 10-16	2319	2220	91	3	26	77	0.9	100
38	Sep 17-23	2319	2220	91	6	26	121	1.4	71
39	Sep 24-30	2319	2220	91	0	31	112	1.2	81
40	Oct 01-07	2319	2220	91	4	29	128	1,5	69
41	Oct 08-14	2319	2217	91	0	27	121	1.3	75
42	Oct 15-21	2319	2139	91	0	29	145	1.6	62
43	Oct 22-28	2319	1793	91	309	25	40	5.0	20
44	Oct 29-Nov 04	2319	1484	87	0	26			
45	Nov 05-11	2319	933	83	0	30	288	3.5	a9
46	Nov 12-18	2319	703	74	2	34	285	3.9	26
47	Nov 19-25	2319	749	81	0	28	310	3.8	26
48	Nov 26-Dec 02	2319	760	72	0	30	289	4.0	25
49	Dec 03-09	2319	943	80	0	32			
50	Dec 10-16	2319	1168	87	12	26			
51	Dec 17-23	2319	1221	85	2	28			
52	Dec 24-31	2319	1363	85	0	29			
	Total	2319		1987	1451	1103	2047		
	Mean	2319	1748	83	22	29	104	2.0	63.1

RWS = (AIF + RF) / IDR WUE = 100/RWS, %

Table 4. Frequency of Occurrences of Different Ranges of Daily Rainfall, Laoag City, Philippines, 1975 to 1986 as Compared to 1987.

Year	Rainfall Range (mm/day)							Days with R'fall >0.0	Total R'fall mm
	0	0 to 5	5 to 10	10 to 25	25 to 50	50 to 75	75 to 100	100 to 300		
1975	281	32	14	19	9	5	4	1	84	1562
1976	280	42	17	12	10	1	2	1	86	1157
1977	276	38	13	17	11	4	2	4	89	2043
1978	266	38	18	15	22	3	1	2	99	1844
1979	281	30	12	17	16	3	2	4	84	1884
1980	287	32	14	15	8	3	4	2	78	1597
1981	272	39	12	16	16	6	2	2	93	1866
1982	279	29	13	20	14	3	2	5	86	2027
1983	294	29	7	17	8	3	5	2	71	1616
1984	274	42	14	15	12	2	3	3	91	1711
1985	263	40	14	16	16	5	1	10	102	2768
1986	262	41	17	14	16	4	4	7	103	2778
Mean	278	36	13	16	13	3	3	3	87	1904
1987	284	43	12	11	4	6	2	3	81	1282

Table 5. Frequency of Occurrences of Different Ranges of Daily Rainfall by Month, Laoag City, Philippines, 1975 to 1986, as Compared to 1987.

	Rainfall Ranges							Days with R'fall	Mean R'fall
	0	0 to 5	5 to 10	10 to 25	25 to 50	50 to 75	75 to 100	100 to 300	>0.0	(mm)
Jan	28	0	0	0	0	0	0	0	0	7
Feb	31	0	0	0	0	0	0	0	0	1
Mar	29	1	0	0	0	0	0	0	1	2
Apr	22	4	1	2	2	1	0	0	10	33
May	14	6	2	3	3	1	0	1	15	186
Jun	16	7	2	2	2	1	0	1	16	338
Jul	10	7	3	4	4	1	1	2	22	340
Aug	17	5	2	3	1	1	0	0	13	608
Sep	23	4	1	1	1	0	0	0	8	262
Oct	27	2	0	1	0	0	0	0	3	92
Nov	30	1	0	0	0	0	0	0	1	32
Dec	30	1	0	0	0	0	0	0	1	3
Mean	23	3	1	1	1	0	0	0	7	159
1987										
Jan	31	0	0	0	0	0	0	0	0	0
Feb	28	0	0	0	0	0	0	0	0	0
Mar	31	0	0	0	0	0	0	0	0	0
Apr	30	0	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0	0
Jun	10	10	3	4	0	3	0	0	20	290
Jul	10	10	5	4	1	0	1	0	21	235
Aug	15	8	2	3	1	2	0	0	16	238
Sep	19	6	1	0	1	1	1	1	11	357
Oct	25	3	0	0	1	0	0	2	6	314
Nov	26	4	0	0	0	0	0	0	4	3
Dec	28	2	1	0	0	0	0	0	3	13
Mean	24	4	1	1	0	1	0	0	7	121

Table 6. Programmed Area (PA), Irrigated Area (IA), Irrigation Diversion Requirement (IDR), Rainfall (RF), Pan Evaporation (EV), Actual Irrigation Flow (AIF), Relative Water Supply (RWS), and Water Use Efficiency (WUE), Bonga Pump No. 2, Whole System, Wet Season 1987.

Week no	Date	PA ha	IA ha	IDR mm	RF mm	EV mm	AIF mm	RWS	WUE %
19	May 07-13	450			0	30			
20	May 14-20	450			0	36			
21	May 21-27	450			0	37			
22	May 28-Jun 03	450			2	39			
23	Jun 04-10	450			143	36			
24	Jun 11-17	450			37	30			
25	Jun 18-24	450			30	34			
26	Jun 25-Jul 01	450			40	29			
27	Jul 02-08	450	0		95	32			
28	Jul 09-15	450	10		16	35			
29	Jul 16-22	450	257	120	66	33	190	2.1	47
30	Jul 23-29	450	297	102	43	25	107	1.5	68
31	Jul 30-Aug 05	450	375	97	0	26	111	1.1	88
32	Aug 06-12	450	375	93	6	29	95	1.1	91
33	Aug 13-19	450	375	92	46	39	110	1.7	59
34	Aug 20-26	450	375	91	14	25	194	2.3	44
35	Aug 27-Sep 02	450	375	91	101	27	76	2.0	51
36	Sep 03-09	450	375	91	486	23	0	5.4	19
37	Sep 10-16	450	375	91	10	26	0	0.1	100
38	Sep 17-23	450	375	91	13	26	0	0.1	100
39	Sep 24-30	450	375	91	0	25	61	0.7	100
40	Oct 01-07	450	361	91	9	26	67	0.8	100
41	Oct 08-14	450	363	91	0	22	117	1.3	78
42	Oct 15-21	450	315	91	0	22	101	1.1	90
43	Oct 22-28	450	262	91	316	22	0	3.5	29
44	Oct 29-Nov 04	450	153		0	20			
45	Nov 05-11	450	51		0	27			
46	Nov 12-18	450	30		2	24			
41	Nov 19-25	450	30		0	25			
48	Nov 26-Dec 02		0		0	35			
49	Dec 03-09				0	29			
50	Dec 10-16				6	24			
51	Dec 17-23				0	29			
52	Dec 24-31				0	34			
	Total	450		1411	1480	982	1230		
	Mean	450	349	94	44	29	82	1.7	71

RWS = (RF + AIF) / IDR WUE = 100/RWS, %

Table 7. Programmed Area (PA), Irrigated Area (IA), Irrigation Diversion Requirement (IDR), Rainfall (RF), Pan Evaporation (EV), Actual Irrigation Flow (AIF), Relative Water Supply (RWS), and Water Use Efficiency (WUE), Upper Talavera Irrigation System (UTRIS), Whole System, Wet Season 1987.

Week no	Date	PA ha	IA ha	IDR mm	RF mm	EV mm	AIF mm	RWS	WUE %
19	May 07-13	3627			5	59			
20	May 14-20	3627			50	52			
21	May 21-27	3627			49	39			
22	May 28-Jun 03	3627			6	47			
23	Jun 04-10	3627	0		13	44			
24	Jun 11-17	3627	33		100	30			
25	Jun 18-24	3627	126		18	41			
26	Jun 25-Jul 01	3627	726	120	64	31	262	4.8	21
27	Jul 02-08	3627	1327	120	5	34	165	1.5	67
28	Jul 09-15	3627	1705	119	96	25	96	2.5	39
29	Jul 16-22	3627	2004	116	31	27	148	1.8	57
30	Jul 23-29	3627	2206	113	19	31	125	1.4	72
31	Jul 30-Aug 05	3627	2392	110	9	34	73	0.8	100
32	Aug 06-12	3627	2712	108	116	26	154	2.9	35
33	Aug 13-19	3627	3108	106	201	37	124	3.4	30
34	Aug 20-26	3627	2396	103	54	27	152	2.0	49
35	Aug 26-Sep 02	3627	3615	92	86	22	163	2.7	37
36	Sep 03-09	3627	3626	96	34	21	146	1.9	54
37	Sep 10-16	3627	3621	87	153	26	133	3.3	30
38	Sep 17-23	3627	3598	91	40	32	135	1.9	52
39	Sep 24-30	3627	3571	91	16	29	150	1.8	54
40	Oct 01-07	3627	3484	90	58	39	135	2.2	46
41	Oct 08-14	3627	3386	90	1	35	120	1.3	75
42	Oct 15-21	3627	3128	90	12	31	133	1.6	62
43	Oct 22-28	3627	2742	90	34	26	172	2.4	42
44	Oct 29-Nov 04	3627	2208	90	11	32	214	2.6	39
45	Nov 05-11	3627	1750	90	0	42	211	2.3	43
46	Nov 12-18	3627	1208	90	7	26	305	3.6	28
47	Nov 19-25	3627	736	90	11	32	435	5.4	18
48	Nov 26-Dec 02	3627	454		13	32			
49	Dec 03-09	3627	143		33	38			
50	Dec 10-16	3627	56		0	42			
51	Dec 17-23	3627	9		17	33			
52	Dec 24-31	3627	9		0	37			
	Totals	3627		1515	1365	1159	2357		
	Means	3627	2557	68	40	34	107	2.5	47

RWS = (RF + AIF) / IDR WUE = 100/RWS, %

Table 8. Frequency of Different Ranges of Daily Rainfall Occurrences by Yew, San Jose City, Philippines, 1974 to 1986 as Compared to 1987.

Year	Rainfall Range (mm/day) 0	0 to 5	5 to 10	13 to 25	25 to 50	50 to 75	75 to 100	100 to 300	Days with R'fall >0.0	Total R'fall (mm)
1974	236	39	24	30	25	6	1	4	129	1558
1975	241	44	15	40	15	5	2	3	124	2163
1976	254	43	13	24	20	4	1	6	111	2651
1977	259	42	15	32	11	4	1	1	106	1505
1978	223	54	27	11	11	5	4	0	142	1998
1979	251	52	16	27	15	3	0	1	114	1523
1980	257	56	17	13	15	4	0	3	108	1794
1981	237	51	22	35	12	6	1	1	128	1787
1982	236	60	26	23	13	4	1	2	129	1789
1983	269	46	12	19	14	3	2	0	96	1347
1984	234	55	21	33	15	5	0	2	131	1891
1985	244	41	24	27	20	3	3	3	121	2213
1986	236	50	16	32	20	7	3	1	129	2298
Mean	**244**	**49**	**19**	**29**	**16**	**5**	**1**	**2**	**121**	**1886**
1987	**263**	**41**	**25**	**21**	**11**	**2**	**1**	**1**	**102**	**1313**

Table 9. Frequency of Different Ranges of Daily Rainfall Occurrences, by Month, San Jose City, Philippines, 1974 to 1986 as compared to 1987.

	Rainfall Range (mm/day)							Days with R'fall >0.0	Mean R'fall (mm)
	0	0 to 5	5 to 10	10 to 25	25 to 50	50 to 75	75 to 100	100 to 300		
Jan	30	1	0	0	0	0	0	0	1	7
Feb	27	0	0	0	0	0	0	0	1	4
Mar	30	1	0	0	0	0	0	0	1	10
Apr	27	1	0	1	1	0	0	0	3	23
May	20	5	1	3	1	0	0	0	11	206
Jun	14	6	3	4	2	1	0	0	16	298
Jul	12	7	4	5	2	1	0	0	19	298
Aug	7	8	4	6	4	1	0	0	24	456
Sep	11	8	2	5	3	1	0	0	19	285
Oct	17	6	3	3	2	0	0	0	14	172
Nov	24	3	1	1	1	0	0	0	6	107
Dec	27	2	1	1	0	0	0	0	4	20
Mean	20	4	2	2	1	0	0	0	10	157
					1987					
Jan	31	0	0	0	0	0	0	0	0	0
Feb	28	0	0	0	0	0	0	0	0	0
Mar	31	0	0	0	0	0	0	0	0	0
Apr	28	1	0	1	0	0	0	0	2	13
May	21	5	2	2	1	0	0	0	10	110
Jun	17	2	3	6	2	0	0	0	13	196
Jul	19	5	5	1	0	0	1	0	12	160
Aug	12	4	7	2	5	0	0	1	19	392
Sep	10	8	5	3	2	2	0	0	20	243
Oct	22	3	0	5	1	0	0	0	9	118
Nov	21	9	0	0	0	0	0	0	9	22
Dec	23	4	3	1	0	0	0	0	8	58
Mean	22	3	2	2	1	0	0	0	9	109

Table 10. Programmed Area (PA), Irrigated Area (IA), Irrigation Diversion Requirement (IDR), Rainfall (RF), Pan Evaporation (EV), Actual Irrigation Flow (AIF), Relative Water Supply (RWS), and Water Use Efficiency (WUE), San Agustin Extension Area, Whole System, Wet Season 1987.

Week no	Date	PA ha	IA ha	IDR mm	RF mm	EV mm	AIF mm	RWS	WUE %
19	May 07-13	592			5	59			
20	May 14-20	592			50	52			
21	May 21-27	592			49	39			
22	May 28-Jun 03	592			6	47			
23	Jun 04-10	592			13	44			
24	Jun 11-17	592	0		100	30			
25	Jun 18-24	592	44		18	41			
26	Jun 25-Jul 01	592	105	121	64	31	263	2.7	37
27	Jul 02-08	592	155	117	5	34	189	1.7	60
28	Jul 09-15	592	214	113	96	25	136	2.1	49
29	Jul 16-22	592	263	111	31	27	112	1.3	78
30	Jul 23-29	592	302	108	19	31	97	1.1	93
31	Jul 30-Aug 05	592	306	105	9	34	94	1.0	100
32	Aug 06-12	592	306	103	116	26	66	1.8	56
33	Aug 13-19	592	306	101	201	36	86	2.8	35
34	Aug 20-26	592	306	101	54	27	9	0.6	100
35	Aug 26-Sep 02	592	306	99	86	22	55	1.4	70
36	Sep 03-09	592	306	96	34	21	174	2.2	46
37	Sep 10-16	592	306	91	153	26	49	2.2	45
38	Sep 17-23	592	306	90	40	32	97	1.5	66
39	Sep 24-30	592	304	91	16	29	113	1.4	70
40	Oct 01-07	592	285	91	58	39	120	2.0	51
41	Oct 08-14	592	252	91	I	35	130	1.5	69
42	Oct 15-21	592	223	91	12	31	150	1.8	56
43	Oct 22-28	592	175	91	34	26	246	3.1	32
44	Oct 29-Nov 04	592	136	91	11	31	268	3.1	32
45	Nov 05-11	592	108	91	0	42	277	3.1	33
46	Nov 12-18	592	85	91	7	25	306	3.5	29
47	Nov 19-25	592	70	91	11	32	412	4.7	21
48	Nov 26-Dec 02	592	15		13	32			
49	Dec 03-09	592	0		33	38			
50	Dec 10-16	592	0		0	43			
51	Dec 17-23	592	0		17	33			
52	Dec 24-31	592	0		0	37			
	Totals	592		2174	1365	1159	3450		
	Means	592	233	99	40	34	157	2.1	56

RWS = (RF + AIF) / IDR WUE = 100/RWS, %

Table 11. Land Utilization (ratio of dry season area planted to total farm area) at Study Sites for Crop Year 1986-88.

STUDY SITES	DRY SEASON AREA (%) Crop Year 1986-87	Crop Year 1987-88
Laoag-Vintar RIS (LVRIS)	61% *	41% **
Bonga Pump No. 2 (BP#2)	63%	52% **
Upper Talavera RIS (UTRIS)	61%	63%
Tarlac-San Miguel-O'Donnel RIS (TASMORIS)	74%	95%
Allah River Irrigation Project (ARIP)	96%	99%
Banga RIS (BARIS)	97%	99%

* Data for the first dry season crop only
** Pertain to the first dry season crop only. A second crop is expected/programmed to follow.

Table 12. Land Utilization at Laoag Vintar River Irrigation System (LVRIS), Cropping Years 1986-88.

LAND USES	DRY SEASON (%) Crop Year 1986-87	Crop Year 1987-88
Overall	61%	41%
Rice-Garlic-Mungo (RGM)*	35%	29%
Rice-Rice-Mungo (RRM)*	56%	79%

* Data for the first dry season crops of garlic and rice only. Farmers have identified their plans for a second-dry season crop of mungbean.

Table 13. Land Utilization at Bonga Pump N 2(BP#2), Cropp ıg Years 1986-88.

LAND USES	DRY SEASON AREA (%) Crop Year 1986-87	Crop Year 1987-88
Overall	63%	51%
Rice-Garlic-Mungo (RGM)*	42%	44%
Rice-Rice-Mungo (RRM)*	47%	67%

* Data is for the first dry season crop of garlic and rice only.

Table 14. Land Utilization at Upper Talavera RIS (UTRIS), Cropping Years 1986-88.

LAND USES	DRY SEASON AREA (%) Crop Year 1986-87	Crop Year 1987-88
Overall	61%	63%
Rice-Onions (RO)	36%	60%
Rice-Onion-Other Crops (ROO)	85%	100%

Table 15. Land Utilization at Tarlac-San Miguel-O'Donnel RIS (TASMORIS), Cropping Years 1986-88

LAND USES	DRY SEASON (%) Crop Year 1986-87	Crop Year 1987-88
Overall	71%	95%
Rice-Rice (RR)	72%	99%
Rice-Irrigated Corn (RIC)	58%	90%
Rice-Rainfed Mungbean (RM)	58%	76%

* Supplemented with pump irrigation.

Table 16. Land Utilization at Allah River Irrigation Project (ARIP), Cropping Years 1986-88.

LAND USES	DRY SEASON AREA (%) Crop Year 1986-87	Crop Year 1987-88
Overall	96%	99%
Rice-Rice	95%	98%
Rice-Irrigated Hybrid Corn	-	100%
Rice-Irrigate4 Native Corn	-	100%
Rice-Rainfed Hybrid Corn	-	98%
Rice-Rainfed Native Corn	-	100%

Table 17. Land Utilization, Banga RIS (BARIS) Cropping Years 1986-88.

LAND USES	DRY SEASON AREA (%) Crop Year 1986-87	Crop Year 1987-88
Overall	97%	99%
Rice-Rice	97%	99%
Rice-Irrigated Hybrid Corn	98%	100%
Rice-Irrigated Native Corn	100%	100%

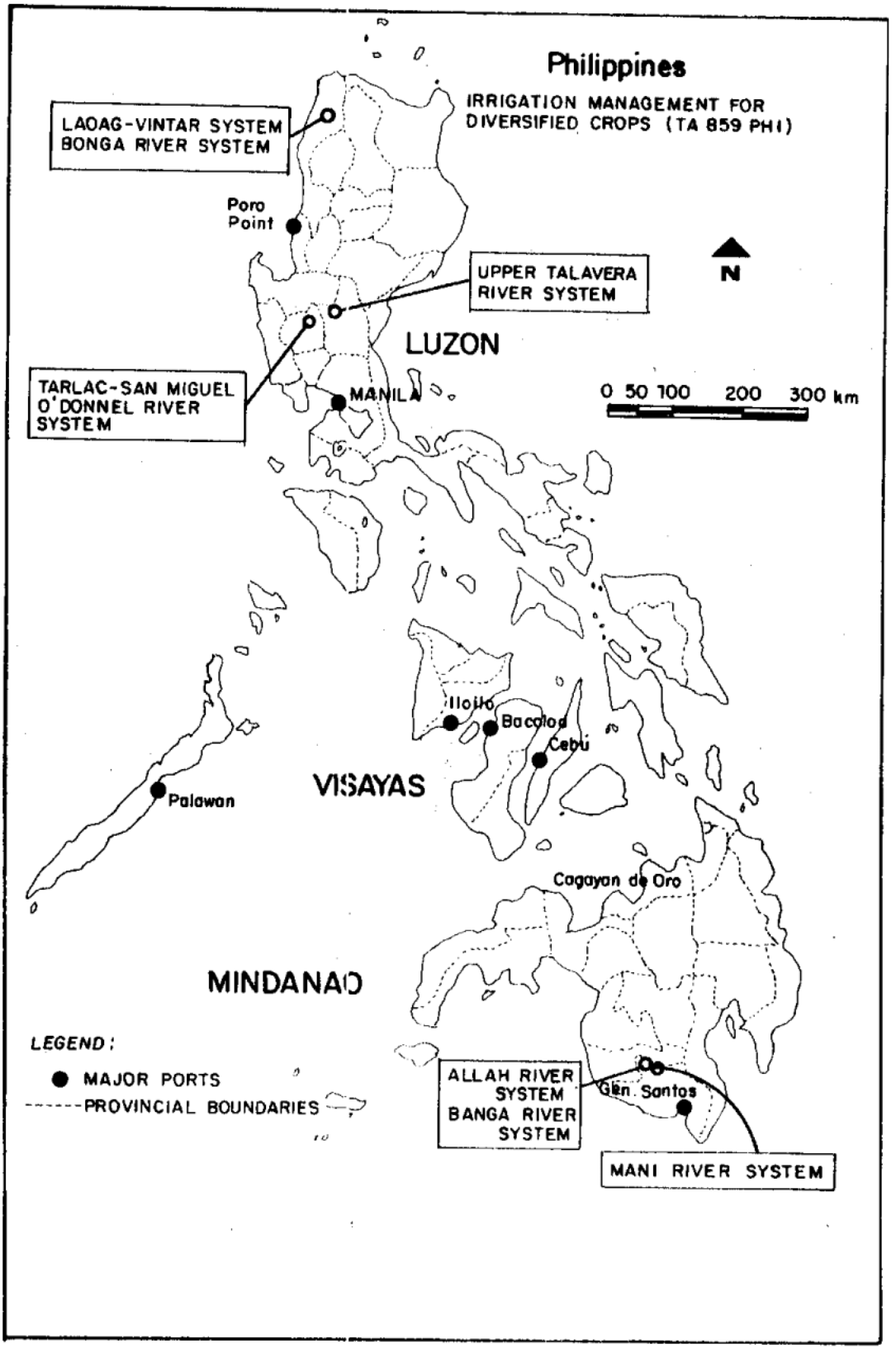

Figure 1. Location of Study sites for TA 859 PHI in the Philippines.

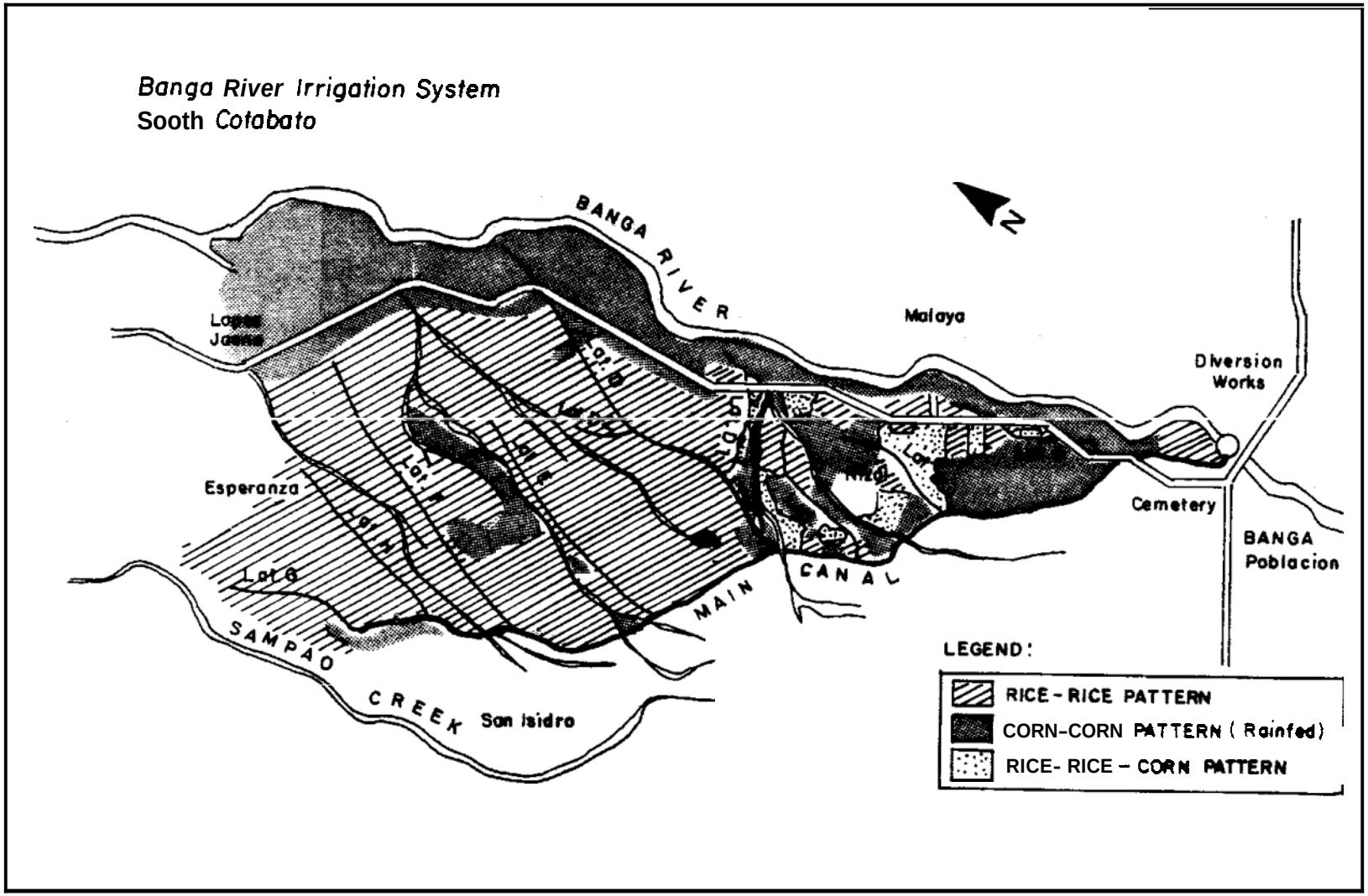

Figure 2. Map of the Banga River Irrigation System (BARIS) in Allah Valley, South Cotabato and cropped areas €or dry season 1987-88.

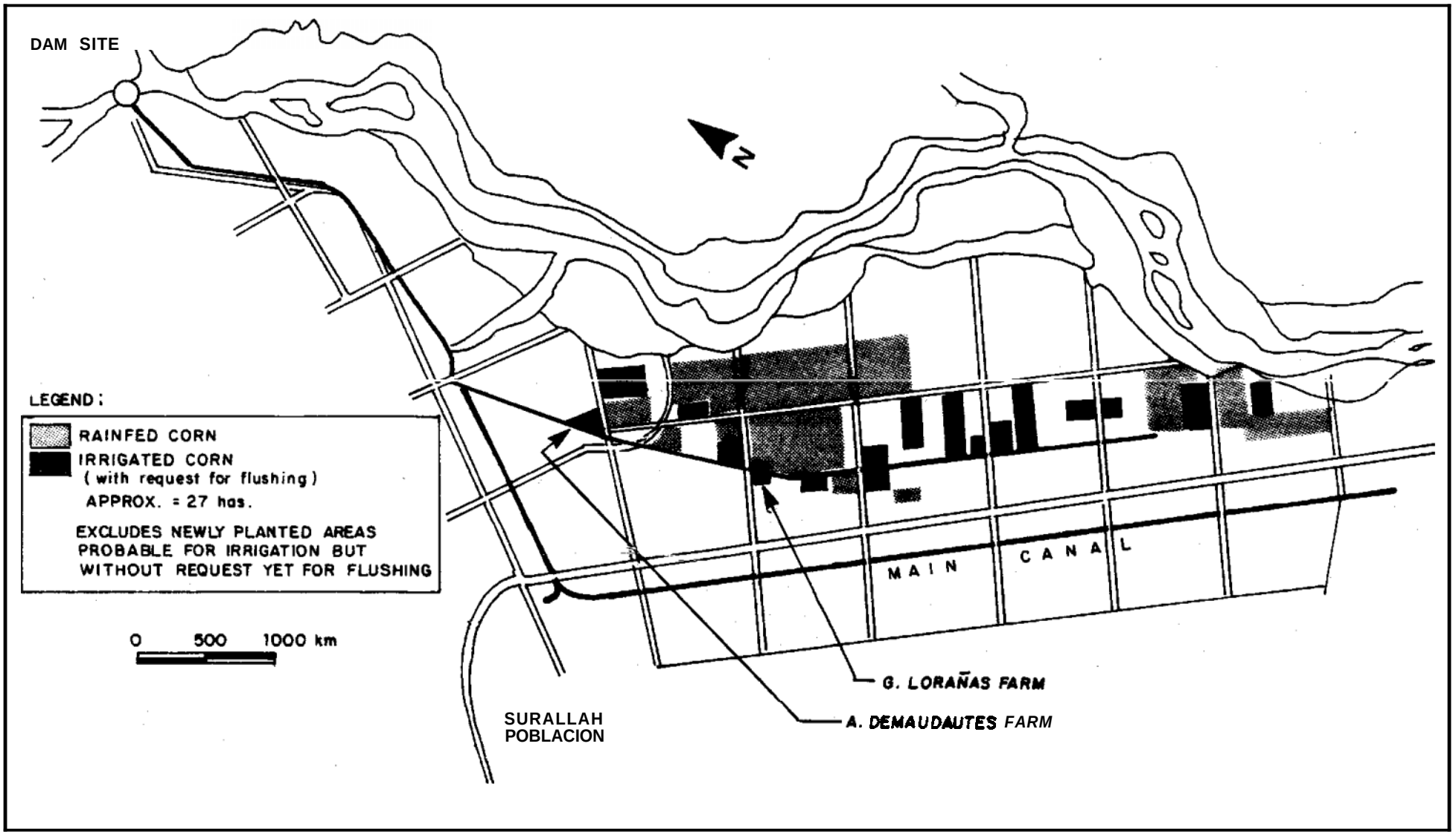

Figure 3. Map of Lateral A-Extra, Allah River Irrigation Project (ARIP), in Allah Valley, South Cotabato and cropped areas for *dry* season 1987-88.

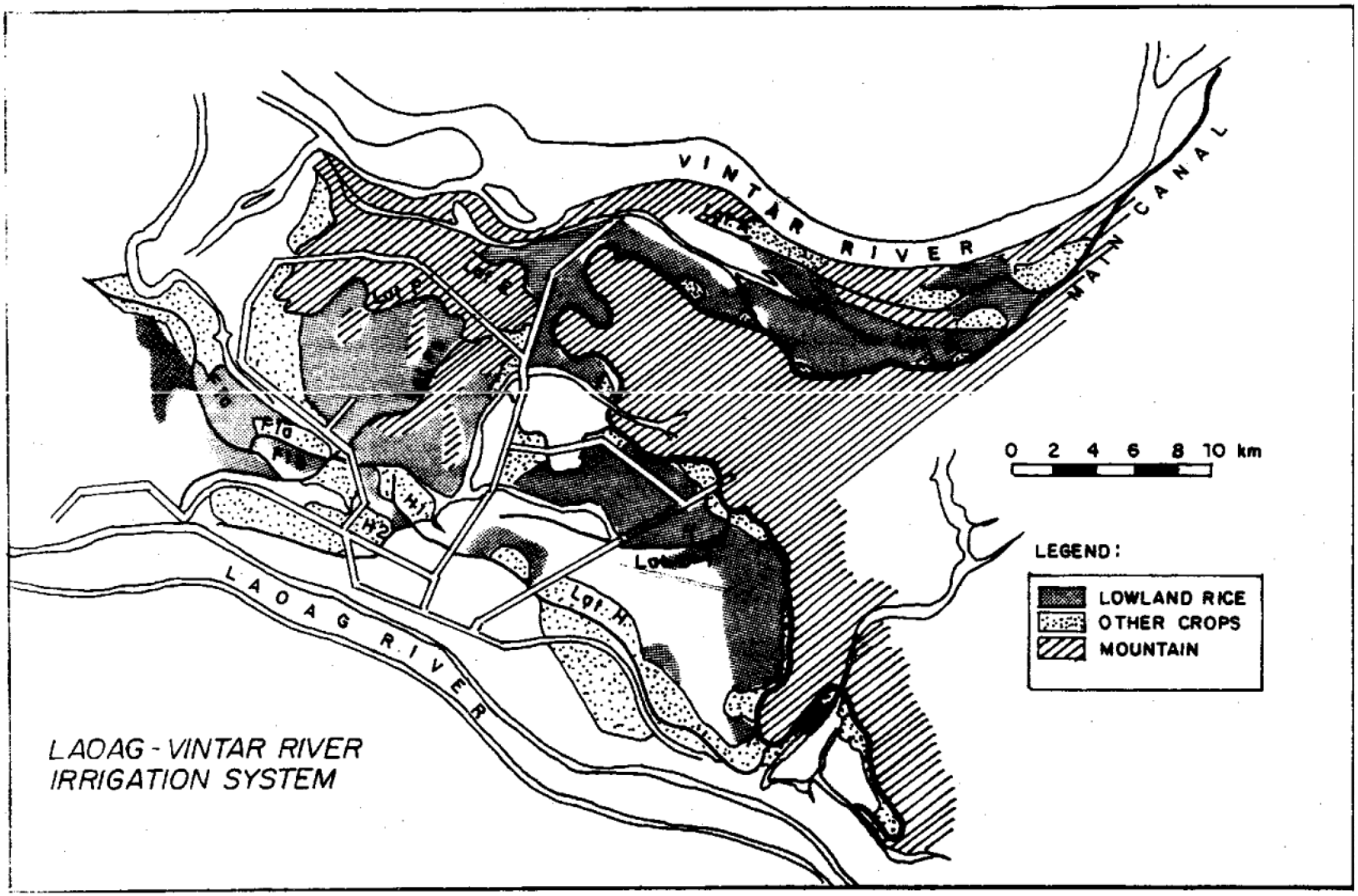

Figure 4. Map of the Laoag-Vintar River Irrigation System (LVRIS) in Ilocos Norte and cropped areas for *dry season* 1987-88.

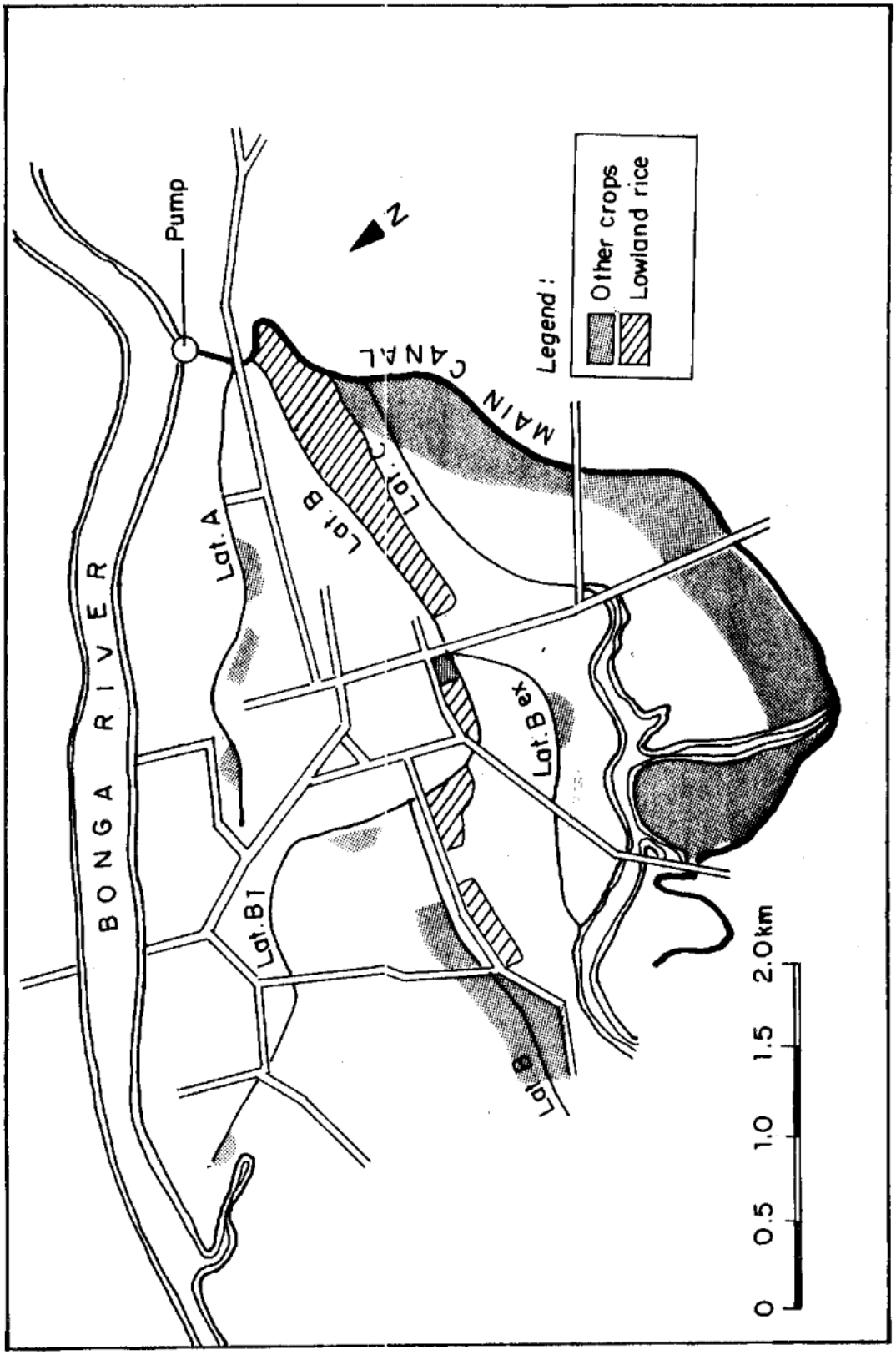

Figure 5. Map of the Bonga Pump No. 2 (BP#2) in Ilocos Norte and cropped areas for dry season 1987-88.

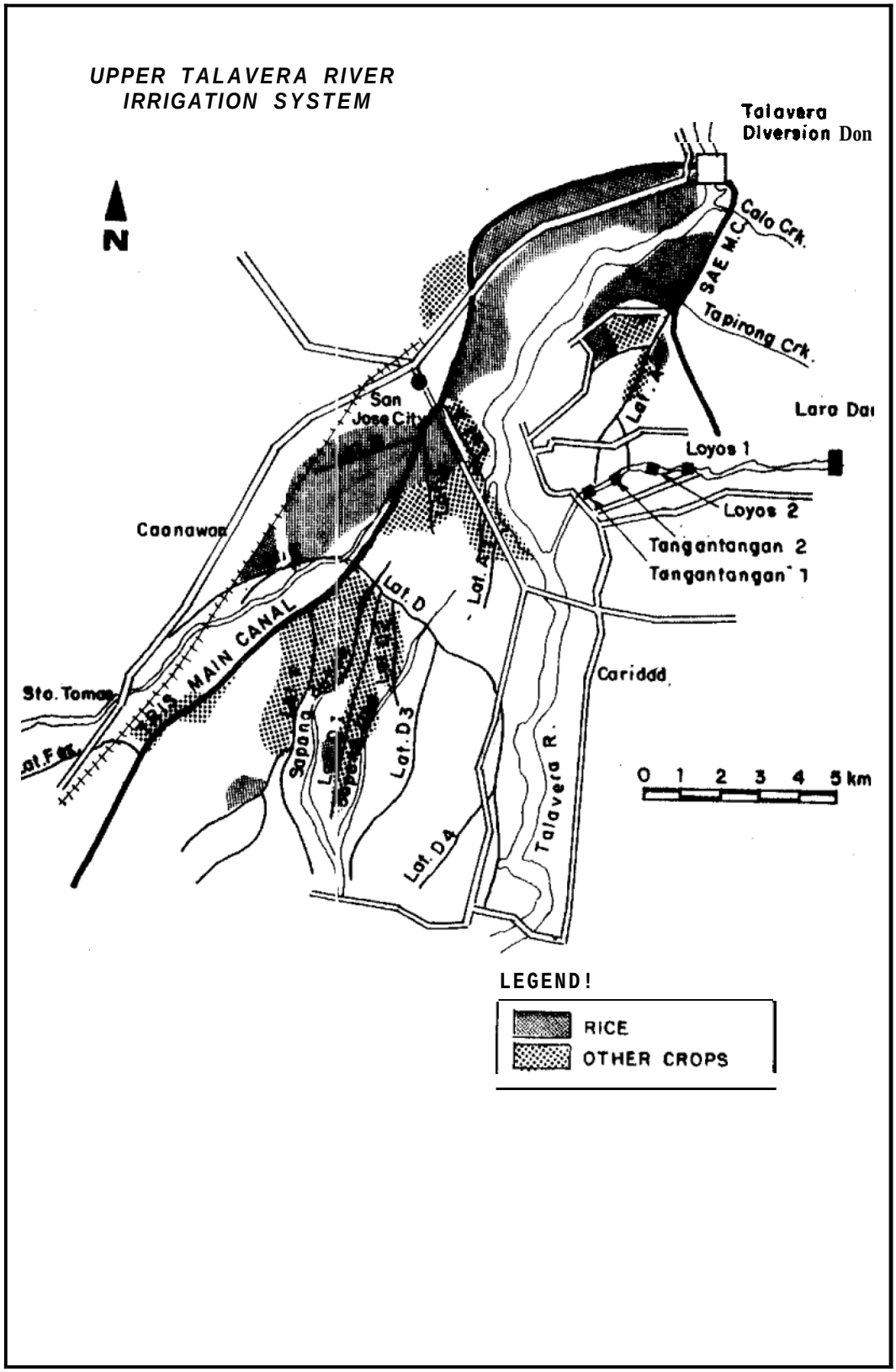

Figure 6. Map of the Upper Talavera River Irrigation System (UTRIS) in Nueva Ecija and cropped areas for dry season 1987-88.

Excerpts from the Technical Assistance Agreement - T.A. No. 859 PHI (Study on Irrigation Management for Diversified Crops - Phase II) between Government of the Republic of the Philippines, National Irrigation Administration, International Irrigation Management Institute and Asian Development Bank, schedule I section II no. 10.

General Terms of Reference

10. The general terms of reference for the Phase II Study to be carried out by IIMI through its staff, research associates to be recruited, and consultants to be engaged will include but not be limited to the following:

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

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

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

(iv) Determine and field-test appropriate cost-effective irrigation methods in one system in Mindanao and one in Luzon to find practical recommended values for : (a) intervals between, (b) duration and (c) stream size of irrigations. These studies will be undertaken at both the field level and systems level.

1) The field-level Studies will give special attention to (i) the extent and management of seepage from adjacent rice fields as a source of water for non-rice crops, (ii) basin flooding vs. different forms of furrow irrigation, (iii) density and placement of on-farm channels and structures, and (iv) the relationship between these on-farm practices and the main-system operations. Farm-level sites will be selected that are representative of head, middle and tail locations within each system.

2) The system-level studies will give special attention to cost-effective and manageable means of providing irrigation on an intermittent basis, bearing in mind the need for irrigation of both rice and diversified crops from the same canals. These studies will include determination of recommended; (i) critical points within the system for monitoring and control of flows; (ii) irrigation intervals and schedules; (iii) canal capacities; (iv) manpower for operating the system; and (v) improvements in physical facilities that allow implementation of irrigation management practices for both rice and diversified crop during the dry season.

(v) Document and analyze current methods in use during the dry season for irrigating diversified crops under the four Luzon systems included in the Study, and analyze the results for more general applicability.

(vi) Recommend appropriate irrigation management practices from the above, and make arrangements for PCARRD to publish a series of guidelines in the form of "Philippine Recommends for Irrigation Management for Diversified Crops". This series of guidelines will outline 'he specific practices found to be appropriate for diversified crcps. The draft version of these guidelines will be the subject of a workshop and selected on-the-job training activities carried out in the Phase 11. The series will have significance for projects in the Philippines other than those taken up in the Phase II Study, and for projects outside the Philippines.

ANNEX 2

The International Irrigation Management Institute

and

The International Rice Research Institute

for

A Program of Collaboration Relating to the Problems

of Irrigation Management for Rice-based Fanning System

Background:

In recognition of the mutuality of interest and the complementarity of strengths and capabilities relating to problems of irrigation management, the International Rice Research Institute (IRRI) and the International Irrigation Management Institute (IIMI) entered into a Memorandum of Agreement in the later 1985. This Memorandum outlined areas of mutual concern, gave wide latitude to the pattern of potential relationships and, in general, reflected a strong willingness to explore ways in which the human resources of the respective institutes could be combined to more effectively and more efficiently address the problems of the irrigation sector. This combination of latitude and willingness provides the conditions for exploring a range of relationship, including new types, to determine the most appropriate for the various problems of concern.

IRRI, as a world center for research and training related to rice and rice-based farming systems, has multidisciplinary capability to deal with all aspects of rice production. Its Water Management Department, while small, has extensive experience in questions of irrigation and a special mandate to increase understanding of on-farn water problems and their solution. It draws upon the wide range of expertise in the biological and physical sciences at IRRI as it addresses those problems. The major portion of the irrigation-related program is concentrated in the Philippines, but IRRI has carried out work in many other countries including Indonesia and Bangladesh.

IIMI, while relatively new, has assembled an excellent multidisciplinary staff of engineers, economists, agronomists and sociologist/anthropologist. In recognition of the fact that most irrigation management problems are not bounded by any one discipline, this staff is grouped into interdisciplinary teams based on problem areas. Resident staff currently are located in Indonesia, Nepal, Pakistan, Philippines, Sri Lanka and U.S.A. (IFPRI), with research and professional developnent activities.

Thus, IRRI brings to a collaborative and cooperative relationship the major strengths of its concerns and expertise related to the agricultural system, and IIMI brings its concerns and expertise related to irrigation systems. The boundary blurs at the interface of the two systems with both institutes having concerns and activity relating to common problems. This combination permits an integration that would enable consideration of a broad range of water-related problems from a more holistic perspective.

The mechanism to effect this integration, identified in the Memorandum, is a Work Plan which defines the focus of joint concern and the methods for interaction. The Work Plan that follows is the result of a series of very productive discussions held at IRRI April 9 - 10, with participation by scientist and administrators from both institutions. It has the objective of enhancing the character and utility of research addressing some critical irrigation-related questions, and the additional objective of fostering long time collaborative by providing pilot opportunities for cooperative activity in a variety of spheres and problem areas. In arriving at these activities, the participants were guided by the sense of strong administrative support for the collaboration, and by a set of principles which were intended to ensure success of the joint endeavor. These principles included:

-- collaborative activity should be concentrated on problems of mutual concern to the two institutions.

-- the activity should capitalize on the complementary strengths of the two institutions. These strengths include disciplinary expertise as well as geographic (national) experience, contacts and logistic capabilities.

-- the expected output should be greater and/or "better" than the efforts of the institutions working separately.

— the problem addressed should be of significant scope, i.e. the potential practical impact should be large.

-- detailed planning of specific activities should be programmed to permit effective input from staff of the appropriate agencies in the countries in which the work will be carried out.

The work plan which follows identifies the general objective, the broad problem area and the major research questions. It indicates the probable geographic locations for the work, the modes of interaction and general budget estimates. Specifics of research methodology, of dates and types of workshop and other meetings will be developed by the scientist directly concerned and in conjunction with their national colleagues.

WORK PLAN 1987-89

Problem Area:

Irrigation has been, and continues to be considered a critical factor in the ability of the developing countries of the tropics to meet their food needs. As such, it draws major fractions of development investment resources and this is no more apparent than in the rice producing countries of Asia. Yet, as world, regional and individual country grain production increases there is a corresponding decrease in the profitability of rice production and a consequent decrease in the output value of the land and water used in that production. In addition to the direct effect on individual and national economies, this often leads to less effective management of both resources. This frequently is reflected in reduced investment in irrigation system operation and maintenance, resulting in an accelerating cycle of further reductions in production and resource use of efficiency.

Irrigation is seen to reduce risks associated with rainfall variability, to extend potential growing seasons, and to permit a wider range of cropping and farming options. The degree: to which one or more of these benefits is achieved is dependent upon the availability of the basic water supply and the degree of control which can be exercised over its delivery. Most irrigation system experience changes i.n supply availability, many seasonally, others within longer time frames. There may be a general pattern to these changes, but usually there is a significant degree of uncertainty associated with them.

The farmers and organizations associated with rice-based irrigation systems have developed a variety of physical and institutional mechanisms for dealing with the changes and uncertainties in water supply. These mechanisms have achieved equity, productivity and efficiency objectives with varying degrees of success. The crop-response/water supply functions associated with rice and such that the range of options for dealing with water shortage and severely constrained, and the irrigation systems reflect these constraints. By contrast, the response functions for many non-rice crops permit a wider range of options, but changes in farmer and irrigation organization practice are necessary before these potential opportunities can be utilized.

Three basic options, inextricably linked, exist to address the problem of reduced economic return from irrigated rice lands: (1) increasing the economic yields of rice per unit area'; (2) increasing the area served by the scarce water resource through more effective and efficient irrigation system management and (3) introducing crops of higher value than rice into the irrigated farming system. However, these options have major unknowns associated with them. IRRI has the first objective -- to increase the economic yields of rice -- as a major element of its core program. IIMI has a direct mandate to improve irrigation system management. Both institutes have concerns for getting higher economic and more equitable social returns from the water and its associated land. The program proposed in this work plan addresses the three options presented here, with major emphasis on the agricultural and irrigation system management issues related to the introduction of non-rice crops into irrigated fanning systems.

Objectives:

Six broad objectives are identified for this work plan:

1. To characterize the factors which influence the options for changes in rice-based farming systems, and to identify the important options in selected geographic locations.

2. To determine the degree to which different levels of irrigation system performance influence the ability to effectively incorporate changes in the farming system.

3. To develop efficient and economical methods for managing irrigation water delivery, and use of post-rice residual water, for rice-based system in which non-rice crops arc grown, with special reference to implications for agronomic practice and for institutional performance and change.

4. To transmit and interpret the research findings to agricultural and irrigation system managers, planners and policy makers to encourage informed and better decision-making.

5. To enhance the development of trained professionals in the area of irrigation problems, through provision of graduate research opportunities.

6. To provide the opportunity for IRRI and IIMI staff to interact in a variety of collaborative activity which would permit the developnent of an effective and mutually supportive long-term relationship.

These objectives can be classed into three program elements: research, professional developnent, collaboration development.

Research Program:

The research objective will be addressed in operating system, necessarily influencing the broader research questions with site specific aspects. These site specific factors and their associated questions are by their nature identifiable only in the context of the specific locations. To develop the work plan to maximum feasibility at this stage, and based on the principles described earlier, three countries have been identified as probable locations for the collaborative efforts: Bangladesh, Indonesia, and the Philippines. The rationale for their selection and the types of research questions which are anticipated (specific identification and selection must await the detailed discussions among the scientific staff of the institutes and national programs) are as follows:

Bangladesh. IRRI has had an on-going research and technology development and extension program in Bangladesh for a number of years. A unique part of this program has been the work of the IRRI Water Management Department, carried out in conjunction with the Bangladesh Water Development Board (BWDB) and the Bangladesh Rice Research Institute (BRRI). This work, of an applied research/ extension nature has demonstrated the value of improved agricultural practices when coupled with relatively modest changes in irrigation management. The work has emphasized the physical and biological modifications, but has not fully address the implications for necessary institutional changes both within the BWDB and in the farming community. Thus, the longer term viability of the improvements and the maintenance and extension of the program of improvement are uncertain. In addition, the methodologies and approach need testing in other irrigated production environments.

Three basic hypotheses will guide the collaborative work in Bangladesh: 1) the need for rice production in Bangladesh will continue at a level sufficient to maintain the basic economic value of rice production in irrigation systems. Thus, a focus on increasing the efficiency and equity of rice production is logical. 2) The agricultural and irrigation techniques to increase in rice productivity already demonstrated to be successful can be extended more widely in the government irrigation system, with adaptation to site-specific conditions, utilizing existing governmental extension mechanisms; 3) organizational and institutional changes in the Bangladesh Water

Development Board will be necessary to permit an effective shift from the current "input" philosophy of water delivery to the "output" or "utility" focus necessary for implementation and maintenance of the revised irrigation procedures.

These hypotheses lead to a set of more specific research questions:

1) What constraints are placed on the adoption of improved rice technology by current irrigation institutions and practice?

2) **What** physical and operational options exist for eliminating or reducing these constraints?

3) What procedures should be used to identify site-specific adaptations in rice and irrigation technology that will lead to improved equity, production and efficiency?

4) **How** is the **BWDB** currently organized with respect to water delivery, information feedback and response capability?

5) What changes will be necessary within the **BWDB** and between the BWDB and the fanners to effect the transition from,"input" to "output" management?

The policy implications associated with these questions are important, both for the BWDB and the agricultural extension system. The need for closer interaction among the government departments can be anticipated, and the research can be expected to suggest the degree and forms of that interaction. While the research will search for ways to minimize the need for interaction (the BWDB and the Ministry of Agriculture interact only slighty at the present time), how to effect coordination is likely to expose relatively difficult policy issues. Changes in tho internal organization and in the institution rules of the BWDB probably will. be indicated by the research -- or obvious research team **and** the concerned government departments will be utilized to foster consideration of the policy issues as the findings are developed.

As indicated earlier, specific decisions about project organization **and** methodology must await effective inputs from the personnel for the research teams will be derived from **six** sources: BRRI/IRRI staff resident in Bangladesh, IIMI staff resident in Bangladesh; staff of the BWDB; extension staff of the Ministry of Agriculture; consultant staff from IRRI/Los Banos; consultant staff from IIMI/Digana. Dr. Bhuiyan, Senior Water Management Scientist/IRRI, has been the project leader in the existing IRRI/BRRI/BWDB effort and will continue to be in a leadership role, particularly with respect to the agricultural and on-farm irrigation issues. **IIMI** anticipates the placement of a resident social scientist in Bangladesh (with basic support from other sources), to be closely associated with this program. Until this staff member is in place, Dr. Merrey, Senior Social Scientist/IIMI will act as co-Principal Investigator with primary responsibility for the institutional and organizational questions. While it is not possible to predict the availability of graduate students for the program, provision is made for the participation of at least four, representing engineering, agricultural, economic and behavioral sciences.

It is anticipated that the detailed planning for the research will take place during the fall of 1987, with an initial phase starting in July, 1987. The planning will be done with full participation of the national staff. The research will be planned as an entity, though it is expected that specific research questions will be addressed in subprojects, with individual project leaders. This will facilitate the effective utilization and development of local capability, especially that of graduate students. Regular reporting meetings will be held, probably at a twice per year schedule, but more frequent interaction are to be planned.

In summary, the work in Bangladesh addresses two of the three basic options identified earlier -- increasing the economic efficiency with which the water is used.

Indonesia. IIMI currently is engaged with the Directorate General of Water Resources Development (DGWRD) in studies of the problems and practices of diversification of cropping in rice-based irrigation systems in Indonesia (and is undertaking comparable research in the Philippines and Sri Lanka). These studies have focused on identifying farmer and system practices in areas where such diversification is taking place, on evaluation of the economics of this diversification and on developing an understanding of the decision-ding calculus that leads fanners to undertake these changes. In addition, IIMI is analyzing the impact of irrigation system practices in terms of the opportunities or constraints on the ability of the farmers to make changes in their fanning systems. Work to date has revealed additional significant questions about agronomic practices associated with the changes from flooded rice to upland crops, as well as questions relating to the management of water deliveries within the irrigation turnout areas.

IRRI has conducted research and extension work in Indonesia for a number of years, though the irrigation-related work has been primarily focused on developing the research capacity of staff at the Sukamandi research station.

The collaborative research program in Indonesia is based upon the following hypotheses: 1) economic pressures and market opportunities will be such that non-rice crops will be utilized to increasing extent in the irrigation systems of Indonesia: 2) the types of non-rice crops and their yields are being inhibited by the agricultural practices associated with alternation of puddled and non-puddled conditions: 3) the types of non-rice crops and their yields are being inhibited by the types of irrigation service provided to the farmers; 4) changes in water delivery service are feasible, both at the government level and at the village level.

Based on these hypotheses, the following research questions have been identified:

1) What factors influence farmer cropping decision?

2) To what extent can these factors be mapped in terms of agro-climatic zones?

3) What soil factors are significantly affected by the alternation between puddled and non-puddled conditions, and how do these changes affect the soil water regimes?

4) How do the soil changes influence the growth of the rice and different types of non-rice crops?

5) To what extent, and in what ways can irrigation delivery be modified in government managed systems?

6) What are the organizational and institutional implications associated with desired changes in water delivery?

The basic hypotheses and associated research questions have significant implications for the agricultural, irrigation and governmental planning agencies. The results from the studies can be expected to influence the direction and scope of agricultural research, decisions about the makeup of physical and institutional components in irrigation rehabilitation projects as well as organizational changes in the DGWRD, and financial allocations relating to agricultural and irrigation developnent.

It is anticipated that collaborative work will take place with three IRRI departments (Multiple Cropping, Soils, and Water Management), IIMI, the Directorate General of Water Resource Development (DGWRD) and the Ministry of Agriculture. The government agencies currently are represented on the IIMI-Indonesia Advisory Committee. As suggested on the context of Bangladesh, specifics of the Indonesia-based efforts will be determined in consultation with the concerned government departments and cooperating scientists. In addition to their contact with the government departments, both Institutes have working relationships with research colleagues.

The proposed research efforts will be organized as subprojects, with individual Principal Investigators, but with active participation from the range of team members. Overall leadership will be shared by Dr. Bhuiyan/IRRI and Dr. Johnson/IIMI-Indonesia; it is anticipated that Dr. Carangal/IRRI-multiple cropping, will play the leadership role in exploring the agro-economic mapping of diversification oppotunities; Dr. Woodhead/IRRI- soils, will direct the studies of farmer "calculus" in close collaboration with Dr. Carangal and Dr. Woodhead; Dr. Berthery/IIMI will be responsible for the studies of system operation and Dr. Groenfeldt/IIMI will have primary responsibility for the studies of organization and institutions. Planning for the specific research will start in early 1988, with a two year active research program time frame.

There is an expectation of significant involvement of graduate students and post-doctoral fellows. Provision is made for six graduate students and two fellows, but actual numbers are dependent upon availability of qualified individuals.

The Indonesia program complements that in Bangladesh by addressing the third basic option identified in the background problem statement -- the introduction of non-rice crops into the rice based farming system -- and by

exploring in this very different context the factors affecting the increase in equity and efficiency in the use of the water.

Philippines. IRRI has had an extensive program relating to irrigation water management for many years. Its program covers a number of problem areas, with internal cooperation with many departments. Emphasis has been on the problems of the rice crop, with relatively less emphasis on other crops in diversified farming systems. More recently, IIMI has been carrying out studies similar to those in Indonesia, again with a focus on the irrigation systems in which diversified cropping is being practiced or encouraged. It is anticipated that the experience, broad discipline, scientific and logistic strengths of IRRI will provide a rich resource for collaborative research addressing the major questions associated with the need for more economic and equitable use of scarce irrigation water. A base for this collaboration will be a set of questions similar to context of the Philippines. This is particularly true of the institutional and organizational questions, since Philippine irrigation history and current practice are very different from those of Indonesia.

Leadership of the sub projects will be the same as those indicated for the Indonesia studies, except that the IIMI Resident Scientist, Dr. Valera, will provide major IIMI leadership, to be assisted by the Digana staff. Detailed planning for the studies will be initiated on the fall of 1987, and are anticipated to continue for two and one-half years.

As in the earlier described situations, graduate students and post-doctoral fellows will be important participants in the research.

Estimated budgets are as follows:

IRRI		
Research planning and reporting	$	35,000
Collaborative research		50,000
Professional development		30,000
Sub Total	$	115,000
IIMI		
Research planning and reporting		40,000
Collaborative research		200,000
Professional development		70,000
Sub Total	$	310,000
TOTAL	$	425,000

Professional Development:

Staff of both IRRI and IIMI are committed to the enhancement of national capabilities to address the issues of irrigated agriculture. Experience has shown that this can be effectively and efficiently accomplished through the involvement of nationals in the research and technology development efforts, especially in the context of graduate research. This is reflected in the significant fraction of the resources from this collaborative effort that have been identified to support graduate student participation in the individual research efforts. It is also anticipated that staff from both institutes (and from the parent Universities) will be associated with the students, thus increasing their own interaction. Examples of the value of this type of relationship exist currently, with students supported by IIMI working with and under direction from IRRI staff.

In addition to the related graduate student program, one or more workshops are to be conducted, to present findings and to explore implications with higher level irrigation and agricultural professionals. These workshops will be planned and implemented through coordination of staff at IRRI and IIMI.

Modes of Operation:

It is recognized that effective research planning and implementation must be carried out by the scientist and technical staffs directly concerned. While the problem of concern and the research questions identified in the proposal were identified in intensive discussions in Los Banos, additional planning will be necessary before specifics of methodology and working patterns can be determined. Thus, resources are identified to facilitate communication and interaction among these scientist. However, given the multiple aspects to be involved in this program, one individual at each institution has been identified as the primary contact for on-going communication, oversight and general administration. Dr. Senen Miranda has been designated for IIMI, and Dr. Sadique Bhuiyan for IRRI.

Budget:

Indicative budgets have been determined for each of the country programs, and these are summarized here. Detailed budgets will be prepared as the research program is developed mo-e fully.

The allocation to IIMI includes a significant allocation of support for a research director who will have responsibilities for fostering the collaborative relationship with IRRI and with anticipated programs with other international centers.

The budgetary allocation to IRRI is intended to cover all new costs associated with the collaborative effort and does not indicate the actual contribution of IRRI resulting from the utilization of its existing staff resources, facilities, etc.

It is understood that no additional permanent senior scientific staff are to be hired by either institution through the use of these program funds, though shorter term scientific expertise may be needed to carry out the objectives of the program.

The budget is based upon a three year period.

IRRI		
Research planning and reporting	5	60,000
Collaborative research		170,000
Professional development		70,000
Sub Total	5	300,000
IITA		
Research director	$	450,000
Research planning and reporting		80,000
Collaborative research		500,000
Professional development		170,000
Sub Total	5	1,200,000
TOTAL	$	1,500,000

ANNEX 3

List of ADB-IIMI-NIA Review Mission members:

Mr. Graham Walter - Senior Project Economist, ADB

Mr. Salvador Salandanan - Manager, Research and Developnent Division, NIA

Dr. Senen Miranda - Senior Scientist/Engineer, IIMI

Dr. Christopher Panabokke - Agronomist, IIMI

Dr. Edward Martin - Ag. Economist, IIMI

Dr. Alfredo Valera - Resident Scientist/Project Coordinator, IIMI

List of persons visited during the mission:

Visit at UPRIIS (Cabanatuan City) and UTRIS (Munoz, Nueva Ecija), (16 February):

Engr. Wilfredo Tiangco - Operations Manager, NIA-UPRIIS

Dr. Leonardo Lucero - Manager, Institutional Developnent Division, NIA

Engr. Manuel Collado - Manager, District I, NIA-UPRIIS

Engr. Max Quiming - Hydrologist, District I, NIA-UPRIIS

Engr. Cecile Francisco - Zone I Engineer, District I, NIA-UPRIIS

Engr. Arturo Francisco - Research Assistant, IIMI

Engr. Nael Cruspero - Graduate Student, AIT

Visit at CLSU (Munoz, Nueva Ecija):

Dr. Honorato Angeles - Dean College of Engineering, CLSU

Dr. Eduardo Marzan - Asst. Professor, CLSU

Dr. Ireneo Agulto - Asst. Professor, CLSU

Dr. Miguel Aragon - Asst. Professor, CLSU

Visit at MMSU (Batac, Ilocos Norte) and LVRIS (Laoag City, Ilocos Norte) 17-18 February:

Dr. Salud Baroga - Director of Research, MMSU

Engr. Carlos Pascual - Acting Head, Ag. Engineering Dept., MMSU

Ms. Charito Acosta - Instructor, MMSU

Engr. Rudolfo Natividad - Graduate Student, CLSU

Engr. Alfredo Lorenzo - Irrigation Supt., NIA-INIS

Mr. N. Ines - Agriculturist, NIA-INIS

Mr. Alexis Blegado - Research Assistant, IIMI

Mr. Edgar Barot - Field Assistant, IIMI

Visit at ARIP and BARIS (Surallah and Banga, South Cotabato), 19-20 February:

Engr. Santiago Eslaban Jr. - Officer-in-charge, NIA-ARIP

Engr. Honorio Bienes - Irrigation Superintendent, NIA-Marbel-Banga RIS

Engr. Apolinario Mempin - Manager, ACD, NIA-ARIP

Engr. Orlando Tibang - Assistant Irrigation Superintendent, NIA-BARIS

Engr. Julio Antenor - Acting Asst. Irrigation Superintendent, NIA-ARIP

Engr. Juan Gregorio - Section head, ACD, NIA-ARIP

Engr. Reynaldo de Guzman - ACD staff, NIA-ARIP

Ms. Purisima Bayacag - Assistant Professor, USM

Ms. Shirley Labadia - Research Assistant, USM

Mr. Abelardo Zorilla - Team leader, RIARS South Cotabato, DAF

Mr. Simeon Cagalda - Crop specialist, RIARS-DAF

Engr. Danilo Cablayan - Research Associate, IIMI

Engr. Isidro Teleron III - Research Assistant, IIMI

Engr. Rufino Soguilon - Research Assistant, IIMI

Farmer Cooperators in all sites

ADB Review Mission Schedule on TA 859 PHI:Study on Irrigatim Management for Diversified Crops (February 16-20,1988)

Day 1
16 Feb (Tuesday)

- 6:00 AM - Departure from Manila
- 8:00 AM - Breakfast at San Miguel Bulacan
- 9:30 AM - Arrival at NIA-UPRIIS Cabanatuan City
- 10:00 AM - Departure for District I Munoz, Nueva Ecija
- 10:30 AM - Arrival at District I Munoz, Nueva Ecija
- Briefing by NIA staff on operation of UTRIS
- Briefing by IIMI staff on study at UTRIS
- 12:00 Noon- Lunch at CLSU
- 1:30 PM - Briefing by CLSU Irrigation Program Staff on Research Component Studies at UTRIS
- 2:30 PM - Departure for field visits to study sites
- 4:00 PM - Departure for La Union
- 7:00 PM - Overnight at Bauang, La Union

Day 2
17 Feb (Wednesday)

- 8:00 AM - Departure for MMSU, Batac, Ilocos Norte
- 12:00 Noon- Arrival and Lunch at MMSU
- 1:00 PM - Briefing by MMSU staff on Research Component Studies at the LVRIS and BP#2
- 2:00 PM - Departure for NIA Office at Laoag City
- 2:30 PM - Arrival and Briefing at NIA Office by NIA and IIMI staff
- 3:00 PM - Field visit to study sites at LVRIS
- 5:00 PM - End of field visit and departure for Laoag City
- Overnight at Laoag City

Day 3
18 Feb (Thursday)

- 8:00 AM - Departure for Solsona
- 9:00 AM - Arrival at Solsona (Wheat Study Area)
- 10:00 AM - Departure for Laoag City
- 11:00 AM - Arrival at Laoag City Airport
- 11:20 AM - Departure for Manila Flt 221 (Laoag-Manila)
- 12:45 PM - Arrival at Manila Domestic Airport
- 2:00 PM - Departure for Cebu Flt 853 (Manila-Cebu)
- 3:05 PM - Arrival Cebu
- Overnight Cebu (Magellan Hotel)

Day4
19 Feb (Friday)

5:50 *AM* - Departure for Gen. Santos City
Flt **451 (Cebu-Gen.** Santos City)
7:35 *AM* - Arrival at **Gen. Santos** City
Airport
7:45 *AM* - Departure for Marbel, **South** Cotabato
8:30 *AM* - Arrival and Breakfast at Marbel
9:30 *AM* - Departure for Surallah
9:45 *AM* - Arrival and Briefing at Surallah **NIA** Office by
NIA, **IIMI,** DA and USM staff.
11:00 *AM* - Field visit ARIP Surallah area **(Dam** site,
Lateral A extni **and** testing farms)
1:00 HY - **Lunch** at Marbel
2:00 PM - Field visit to BARIS
4:00 HY - **Wrap-up** session at Surallah NIA Office
5:00 HY - Adjournment of activities
- Overnight at Marbel

Day5
20 Feb (Saturday)

8:00 *AM* - Departure for **Cebu** Flt **452 (GSC-Cebu)**
9:45 *AM* - Arrival Cebu City
11:25 *AM* - Departure Manila Flt 852 (Cebu-Manila)
12:30 PM - Arrival Manila