

Japan International Cooperation Agency (JICA)

**National Irrigation Administration (NIA)
Government of the Republic of the Philippines**

**THE STUDY
ON
JALAU IRRIGATION SYSTEMS
AND
RURAL AREA DEVELOPMENT PROJECT
IN
THE REPUBLIC OF THE PHILIPPINES**

**VOLUME-I
MAIN REPORT**

June 1998

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Aero Asahi Corporation**

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Exchange Rate

US\$ 1 = P 26.0 (As of March 1997)

US\$ 1 = P 35.1 (As of December 1997)

PREFACE

In response to a request from the Government of the Republic of the Philippines, the Government of Japan decided to conduct a study on Jalaur Irrigation Systems and Rural Area Development Project and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Philippines a study team headed by Mr. Isao AKIZUKI, Nippon Koei Co., Ltd., three times from January 1997 to March 1998.

The team held discussions with the officials concerned of the Government of the Philippines, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Philippines for their close cooperation extended to the team.

June, 1998



Kimio FUJITA

President

Japan International Cooperation Agency

June, 1998

Mr. Kimio Fujita
The President of
Japan International Cooperation Agency
Tokyo, Japan

LETTER OF TRANSMITTAL

Dear Sir,

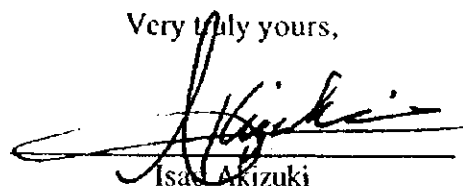
We have the pleasure of submitting herewith the Study Report on the Jalaur Irrigation Systems and Rural Area Development Project in the Republic of the Philippines, in accordance with the terms of reference issued by your Agency.

The Study was carried out for a total period of 19 months from December 1996 to June 1998 dividing into two phases, Phase I and Phase II. The Phase I Study was set to formulate a master plan for irrigation and rural development in the existing 5 national irrigation system areas and 6 potential irrigation areas and to evaluate and select the priority projects. The Phase II Study dealt with the feasibility study on two (2) priority projects selected in the Phase I Study. The final goal of the Project is to improve the rural economy through; (i) agriculture development; (ii) rehabilitation and improvement of irrigation and drainage facilities and road network; (iii) improvement of water management and O&M practices; (iv) institutional development; (v) improvement of agricultural support services; and (vi) watershed management. The Project also aims at establishing a pilot model project for revitalization of existing national irrigation systems in the Philippines.

The Project has been judged to be technically sound, economically feasible and financially viable. After implementation of the Project, the revitalized national irrigation systems will contribute to improve the regional economy through increase in the agricultural productivity as well as the enhancement of living standards of the people in the project area. Therefore, we would like to recommend that the Project soon be implemented in line with the conclusion presented in the Report.

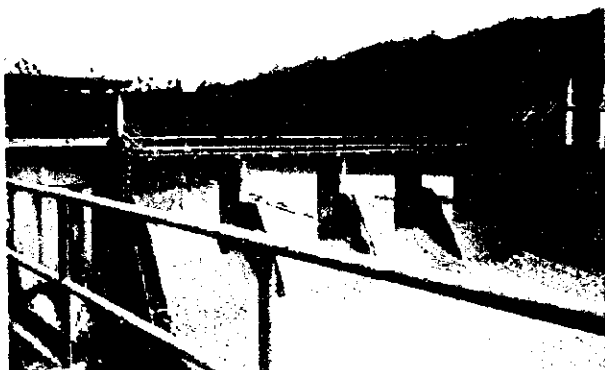
We wish to express our deep appreciation and gratitude to the personnel concerned of your Agency, the Embassy of Japan in the Philippines, and the Authorities concerned of the Government of the Philippines for the courtesies and cooperation extend to us during our field survey and study.

Very truly yours,



Isao Akizuki

Leader of Study Team for
the Jalaur Irrigation Systems and
Rural Development Project



Jalaur Diversion Dam (Jalaur Proper RIS)



Upstream of Main Canal (Jalaur Proper RIS)



Headgate of Lateral Canal
(Main Canal / Jalaur Proper RIS)



On-Farm (Jalaur Proper RIS)



Suague Diversion Dam (Suague RIS)



Headgate of Lateral Canal
(Main Canal / Suague RIS)



End Point of Suague Main Canal
(Connecting to Main Canal of Jalaur Proper RIS)



Public Consultation Seminar
(Municipal Level)



Public Consultation Seminar
(Suague RIS)



Interview Survey on IA members
(Suague RIS)



PRA Session

SUMMARY

PART-I GENERAL BACKGROUND OF THE PROJECT

INTRODUCTION

Authority

1. This Report is prepared in accordance with the "Implementing Arrangement on the Technical Cooperation for the Study on Jalaur Irrigation Systems and Rural Area Development Project (the Study)" agreed upon between the National Irrigation Administration (NIA) and Japan International Cooperation Agency (JICA) on August 8, 1996.

Background of the Study

2. The major reasons for unsatisfactory performance of national irrigation system (NIS) include improper water management due to institutional and technical weaknesses of NIA and irrigators' associations (IAs), insufficient water control structures to ensure equitable and timely water supply to all sections of irrigation systems, inadequate funding for operation and maintenance, and siltation in canal systems caused by the absence of silt excluders, watershed degradation and severe erosion during typhoons. The existing five (5) NIS such as the Aganan, Sta. Barbara, Suague, Jalaur proper, and Jalaur extension river irrigation systems (RISs) in the study area located southeast of Panay island are also properly maintained to ensure adequate, equitable and timely supply of irrigation water. The basic concept of the Study is to formulate a revitalization model plan of the existing NIS in the Philippines by means of rehabilitation and improvement of both hard and soft aspects of the said existing RISs.

BACKGROUND OF THE PROJECT

National and Regional Economy

3. Agricultural sector has been playing a very important role in the national economy, sharing 21.5% of GDP, providing 43.4% of the total employment, and contributing 14.4% of the total export value in 1995. Recent Philippine economic progress has been significant. Annual GDP changes in 1991, 1992, 1993, 1994 and 1995 were respectively -0.6%, 0.3%, 2.1%, 4.4% and 4.8%. GNP per capita was, respectively, US\$ 723, US\$ 831, US\$ 826, US\$ 958 and US\$ 1,089. Export growth in 1995 was 29.4%, while that of import was 23.7%.

4. Agriculture and service sectors are the two main industries in the Western Visayas (Region VI) occupying 33.7% and 43.5% of the Gross Regional Domestic Product (GRDP), respectively, in 1995. Agriculture is the most important sustainable

source of livelihood for the region. Economic growth in the region has been sluggish in recent years. Annual growth in GRDP in the region in 1991, 1992, 1993, 1994 and 1995 was respectively -0.6%, 5.7%, 4.0%, 2.8%, and 2.0%. Growth in agriculture has stagnated in recent years with respective growth rates of 5.3%, 7.6%, 2.8%, 2.0% and -2.9%.

Development Policies

5. The Philippine Government formulated the Medium Term Philippine Development Plan 1993-1998 (MTPDP) in the context of 1991-92 recession during which the country experienced a negative GNP growth and high incidence of poverty. The MTPDP set development goals and action plans which show the socio-economic dimensions of the country in the year 2000. Strategies of the MTPDP are human development, international competitiveness and sustainable development. The primary targets of the Plan are to get an average annual GDP growth rate of close 10%, per capita income of at least US\$ 1,000, and reduction of poverty incidence to 30% by the end of 1998. The Plan recognizes the importance of reducing poverty in the rural areas, and stresses improvement in productivity, increased value added and diversification of rural economy to reduce poverty in the rural areas.

6. The province of Iloilo made the Medium Term Development Plan for 1994-1998 in reference to MTPDP. The vision of Iloilo in 2000 is to become a center for integrated agriculture and other viable industries with a balanced and sustainable ecological system in the Visayas within the context of total human development, equity and social justice as expressed in the Medium Term Development Plan of the Iloilo province.

7. NIA's Corporate Plan (1993-2002) was formulated within the context of the MTPDP, planning nationwide to develop new service area of about 438,000 ha and rehabilitate existing service area of about 587,000 ha by 2002 for increasing food production and socio-economic development in rural areas. For attaining the above goals, the Plan seeks to:

- increase the average irrigated cropping intensity from a national average of 144% in 1993 to 162% by 2002,
- intensify income generation from Irrigation Service Fees (ISFs) and other sources by improving ISF collection through the restoration of irrigation systems and the provision of sustained improvement in the quality of services,
- develop a dynamic and viable NIA - IA partnership in system management for reducing O&M cost, and
- develop NIA's institution for improving efficiency and effectiveness.

PART-II MASTER PLAN FOR THE JALAU IRRIGATION SYSTEMS AND RURAL AREA DEVELOPMENT PROJECT

EVALUATION AND SELECTION OF PRIORITY PROJECTS

The Study Area

Location and Topography

8. The study area is located in Iloilo province in the island of Panay. Its borders are defined by the municipalities of Dueñas and Lambunao on the north, the municipalities of Leon and Maasin on the west, the city of Iloilo and Guimaras island on the south, and the municipality of Barotac Viejo on the east. The study area consists of the existing 5 RIS areas of 21,720 ha and the 6 extension areas of 8,700 ha. The study area is located in the alluvial plains of the two (2) rivers, namely Jalaur and Jaro rivers. Majority of the study area are covered by the irrigated paddy field and rainfed paddy field. The upland areas with small undulation and slopes are found around the northern and western boundaries of the study area. The undulation areas are not so much expanded in the alluvial plain areas.

Demography and Socio-economic Situation

9. The demographic characteristics of the study area are summarized in the following table, with comparative data at the provincial, regional and national levels:

Comparative Demographic Factors

Parameters	Study Area	Iloilo Province	Region VI	Philippines
Area ('000ha)	42.9	532.4	2,022.3	30,000.0
Population ('000, 1995)	392.2	1,876.0	5,777.0	68,614.2
Population density (Persons/ha, 1995)	4.2	3.5	2.8	2.3
Average family size (Number)	5.2	5.5	5.5	5.3
Population growth (%/year, 90'-95')	2.0	2.1	1.8	2.3

Source: National Statistical Coordination Board, 1996 Philippine Statistical Yearbook and 1995 Regional Social and Economic Trends: Region VI (Western Visayas).

Population density in the study area is 4.2 persons/ha, which is higher than the population density at the provincial, regional and national levels. Average family size is about 5.2 which is almost similar with the provincial, regional and national averages. Recently, the average population growth in all the 5 RISs is estimated at 2.0%/year and this growth rate is almost the same as that of Iloilo province, Western Visayas region and the country as a whole.

10. The economic indicators for the study area are summarized below, with comparative data for provincial, regional and national levels. Average annual family income is estimated at about 32,400 pesos compared to average annual family expenditures of 30,800 pesos, resulting in a very low net saving of about 1,600 pesos. Both the average family income and expenditures are relatively lower than the corresponding values at the provincial, regional and national levels. The share of

agriculture sector in employment generation is very high in the study area at 64% compared to that of Iloilo province as a whole at 43%.

Indicators		Study Area*	Iloilo Province	Region VI	Philippines
Labor force	('000)	239	1,200	2,551	28,057
Employed population	('000)	104	666	2,324	25,700
Share of agriculture sector	(%)	64	43	53	44
Employment rate	(%)	83	78	91	92
Average income	(Pesos)	32,400	43,104**	47,724**	65,186**
Average expenditures	(Pesos)	30,800	37,633**	42,671**	51,991**

Source: National Statistical Coordination Board, 1996 Philippine Statistical Yearbook for regional and national data; and NSCB, 1995 Regional Social and Economic Trends: Region VI (Western Visayas) for provincial data.

* Municipal-level data. ** 1991; others are in 1995.

Climate, Hydrology and Water Resources

11. The mean annual rainfall in the study area is estimated at about 2,100 mm. The rainy season is from May to November and about 90% of rainfall has been recorded in the season. Mean monthly air temperature varies from 26.2°C in January to 29.1°C in May. The average annual relative humidity is 81%, varying from 73% in April to 84% in August to November.

Runoff at the diversion site for each RIS is summarized below:

River for RIS	(Unit: m ³ /sec)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Jalaur	42.3	28.2	21.1	20.8	28.4	43.9	65.5	58.6	53.7	79.3	79.5	71.2
Suague	6.0	4.2	2.7	2.0	4.6	4.8	8.4	8.0	7.6	11.1	9.6	7.9
Tigum	4.4	2.8	2.2	1.9	2.8	4.0	8.6	6.8	8.3	11.0	10.9	7.0
Aganan	0.98	0.22	0.37	0.59	0.77	1.60	3.56	2.96	2.33	3.98	2.04	1.27

The Jalaur river basin is considered to be the best water source, having a large catchment area (1,065 km²) at the diversion dam and higher retaining capacity. The Aganan river has the worst watershed condition in the study area, considering runoff at the diversion dam (104 km²). The Suague and Tigum river basins have almost similar catchment conditions, considering runoff at the diversion dams (181 km² and 193 km², respectively).

12. There are irrigation areas to some extent by brush dams or pumps in the upper river basins of the existing RISs without obtaining water right (Jalaur river : 1,420 ha, Suague river : 1,035 ha, Tigum river : 259 ha, and Aganan river : 274 ha).

13. According to the investigation results of sedimentation for the Jalaur Multipurpose Dam Project, the sediment yield of the Jalaur river is 1.5 mm/km²/year. No other observed data being available on the sediment transport, the study team conducted sampling and laboratory analysis for the river bed materials in the vicinity of the proposed small reservoir sites. These data have also been used as supporting information. In addition, the maximum specific rate was estimated at 1.2 mm/km²/year based on an index for estimation of specific sediment rate for dams with catchment area of less than 100 km². Taking into consideration the proximity of catchment conditions

and safety factor, the yield rate of 1.5 mm/km²/year was assumed to be the specific sediment rate at the proposed small impounding dam sites.

14. Possibility of small impounding dams construction proposed by NIA was studied considering the following: (i) dam efficiency (storage-embankment volume ratio), (ii) location of proposed dam, (iii) catchment area, (iv) sediment load, and (v) sufficient effective storage for proposed irrigation service area. Through the study, it was concluded that all dams construction would be considered neither feasible nor sound from technical and economic viewpoints.

Geohydrology

15. A geohydrological investigation which consists of drilling of a test well with 100 m in depth, pumping test, and water level observation of existing wells at 25 places was conducted to evaluate the recharge storage and the development potential of groundwater in the Aganan RIS area. Although a relatively large amount of deep groundwater exists at the center of the Iloilo plain, its development has already exceeded the sustainable level. It would be very difficult to develop the deep groundwater in the other area because of its low potential as found out by the test well in the field survey.

Soils and Land Suitability

16. There are two types of soils of different landforms found in the study area such as the alluvial soils of the lowland and the residual soils of the upland. The alluvial soils are potential for paddy irrigation having fine-clayey and deep profile feature. The residual upland soils are also very deep, fine clayey and have fairly good surface drainage with materials originating from limestone and basic sedimentary associated with its formation.

17. Jalaur extension RIS area and the potential extension areas in Barotac Nuevo are highly suitable for paddy and cash crops. Other study areas are highly suitable for wetland rice, and marginally suitable for diversified crops because of poor drainability.

Rural Infrastructure

18. Rural infrastructure such as road networks, potable water supply, village electrification, public health care, communication facilities, etc. are generally maintained well in the study area by local governments. However, major constraints in rural infrastructure are found in the current road networks, especially farm - to - market road, and potable water supply.

Agriculture

19. A part of service area of Aganan and Sta. Barbara RISs has already been encroached by land developers for residential or commercial use due to urbanization. According to the land use survey, 500 ha of paddy field in Aganan RIS, and 400 ha in Sta. Barbara RIS have been converted into urban land use including illegally converted lands. About 64% of the total land in the existing RISs are occupied by paddy land.

Land planted to sugarcane covers 440 ha and 850 ha in Jalaur proper RIS and Jalaur extension RIS respectively. Almost all sugarcane area cultivated is under the hacienda estate of large landowners.

(Unit: ha)					
Name of RIS	Total Area	Paddy Field	Sugar-cane	Other Crops*	Non-agri. Land
Jalaur proper	12,930	8,820	440	40	2,650
Jalaur extension	5,670	2,620	850	80	1,830
Suague	4,280	2,960	50	0	940
Aganan	6,520	4,360	0	0	1,680
Sta. Barbara	4,820	3,000	0	0	1,490
Total	34,220	21,760	1,340	120	8,590

Note * : Major tree crops are mango and coconut

20. Year-round paddy cultivation is common in the RIS, and the present cropping patterns in the RIS areas are as follows:

- (a) Paddy (wet season) - Paddy (dry season),
- (b) Paddy (wet season) - Paddy (dry season) - Mungbean,
- (c) Paddy (wet season) - Paddy (dry season) - Watermelon, and
- (d) Paddy (wet season) - Paddy (dry season) - Paddy (third paddy).

21. The following table shows the average unit yield of paddy rice in benefited area by RIS and cropping season. The unit yield of paddy has been low in spite of rather high fertilization. Furthermore, the figures indicate that unit yield in the dry season paddy is lower than of the wet season due to the shortage of irrigation water during the dry season in spite of favorable solar radiation. Shortage of irrigation water is most important cause of low productivity. Average yield of Iloilo Province by the Bureau of Agricultural Statistics (BAS) is similar to or higher than of RISs in wet season paddy, however, the yield of dry season paddy is lower compared with the yields of RISs. It is supposed that CIS and private irrigation areas are more difficult in water resources in the dry season than RIS areas. Other than the yield of irrigated paddy, the yields are estimated at 2.24 ton/ha of rainfed paddy, 0.4 ton/ha of mungbean and 4.0 ton/ha of water melon.

RIS	Wet Season (1st paddy)	Dry season (2nd paddy)
Jalaur proper	3.40	3.30
Jalaur extension	3.70	3.43
Suague	3.64	3.41
Aganan	3.56	3.40
Sta. Barbara	3.86	3.56
Iloilo Province (average of irrigated)	3.97	3.19

Average in recent 5 years (1992 - 1996)

22. Based on the estimated unit yields mentioned above, the present crop production in the study area is summarized below.

	(Unit: ton)			
	Paddy Rice	Mungbean	Watermelon	Sugarcane
RIS				
Jalaur proper	49,580	240	400	-
Jalaur extension	16,490	40	40	-
Suague	18,090	60	80	-
Aganan	21,690	160	2,000	-
Sta. Barbara	19,150	80	600	-
Subtotal	125,000	580	4,680	-
Extension Areas	14,850	-	-	91,400
Total	139,850	580	3,120	91,400

Irrigation and Drainage System

23. Considering the following, the proposed extension areas are excluded from the development plan.

- i) Exclusion of small impounding dam construction for new water resources development which has been found to have low economic and technical viability,
- ii) Difficulty of gravity irrigation to the extension areas due to the topographic conditions, which would result in low economic viability of the development plan, and
- iii) Slow progress of the Comprehensive Agrarian Reform Program (CARP) implementation.

24. Irrigation water is off-taken at each diversion dam of the RISs, and Jalaur proper and extension RISs own jointly the same diversion dam. All the diversion dams are Ogce type and have scouring sluice of the open channel type. The Jalaur diversion dam has scouring sluice of the under sluice type. Except for Sta. Barbara diversion dam, all the diversion dams have high and low water channel sections. All the dams are still functional, but some portions of the dams have been damaged and deteriorated, especially gate lifting system.

25. The salient features of the RISs are shown below. Main canal system of the RISs ordinarily consists of a headrace, a main canal, and the lateral canals. Main drainage canal systems are natural rivers and creeks in the RIS areas and linked with secondary drainage canals which are being maintained by IAs. The service road is incidentally provided along main and lateral canals for inspection of canals and for transportation of agriculture inputs and outputs.

Description	unit	Jalaur Proper	Jalaur Extension	Suague	Sta. Barbara	Aganan
Water resources		Jalaur	Jalaur	Suague	Tigum	Aganan
Service area	ha	8,820	2,620	2,960	3,000	4,360
Approved water right	m ³ /sec		29.5	6.0	7.5	8.0
Design discharge at intake	m ³ /sec	13.5	4.0 (Max. 12.3)	4.5	7.8	7.3
Length of headrace	km	2.1	6.3	1.5	4.9	2.8
Total length of main and lateral canals	km	130.3	43.2	37.8	45.8	47.5
Total length of drainage canals	km	54.4	16.2	18.3	15.4	32.6
No. of turnout	nos.	261	93	76	136	271
Total length of services roads	km	47.4	32.4	20.5	42.7	45.0

26. Proper hydraulic flow is not always sustained in canals due to the over excavation of canal sections and backwater caused by siltation and the accumulated debris at in flow sections of related structures. Metric volume measuring system of irrigation water discharge is not established at diversion structure and/or turnout, and water management could not carried out properly. Design water level of turnout is not sustained properly due to the deterioration of check structure and improper installation of gates at turnout structure. Siltation also occurs in the main canal system due to lack of settling basin at the head race section. Spill-out operation system of irrigation water in emergency case can not be expected to function in the canal networks due to the lack of spillway around siphon and aqueduct structure.

27. The flood water gives inundation in the tail portion of the Jalaur proper RIS area for 2 to 3 days , but does not result in the deterioration of agriculture land. Another inundation also occurs in the irrigated paddy field along the highway Zarraga - Barotac Nuevo due to the lack of drainage culvert. The inundation of the Suague RIS area is found in the topographic depression area along the highway Zarraga - Pototan. The inundation is caused due to the poor drainage system of the highway.

28. Typical features of the on-farm irrigation system are shown below. On-farm irrigation canal system consists of main farm ditches and supplementary farm ditches, and all the canals are earth canals which are seasonally maintained by the IAs. At present, the farm ditches have usually double functions as irrigation canal in the upper stream of the canal, and drainage in the downstream of the canal.

Description	unit	Jalaur proper	Jalaur extension	Suague	Sta. Barbara	Aganan
No. of turnout	nos.	261	93	76	136	271
Average command area	ha	34.0	27.0	39.0	22.0	18.0
No. of Irrigation Division	nos.	11	4	4	4	6
No. of IA	nos.	14	6	5	3	6

Water Management and O&M

29. The national irrigation systems (NIS) are one of the main responsibilities of the NIA where the available service areas are over 1,000 ha. These NIS are under the direct supervision of the System Management Division of the NIA regional office. All NIS are managed by Irrigation Superintendents (IS) with their respective staff of the RIS office. Operation and maintenance of the field level activities are undertaken by Field Engineers backstaffed by Water Resources Facilities (WRF) Technicians (or Water Masters), WRF Operators (Gatekeepers) and WRF Ditch Tenders, in coordination with the IA Board of Directors and Officers.

At present, proper and effective water management and O&M in the study area are adversely affected by the following constraints:

- (i) Absence of proper measuring devices for canal and river discharge,
- (ii) Insufficient water delivery and distribution schedule for the farmer-beneficiaries,

- (iii) Insufficient O&M works due to shortage of fund and technical staff, and no regular training program for O&M staff,
- (iv) Insufficient cost for O&M due to low irrigation service fee (ISF) collection, and
- (v) Absence of proper and practical O&M manuals.

As for the ISF collection, the present ISF collection efficiency (20 - 40%) in the study area is lower than the national average (48%) of all RISs in the Philippines and such collection amount is not sufficient to allocate enough funds for the operation and maintenance cost.

Agricultural Support Services

30. The provincial agricultural office (PAO) and municipal agricultural office (MAO) belong the local government unit, and finance for activities and personal expenses depend on the budget of the local government concerned. Extension work at the municipality level is coordinated by MAO, and extension workers are technically supported by PAO personnel concerning crop and livestock. However, the transfer of agricultural extension function from DA to the LGUs in 1992 has encountered problems resulting in low level of extension activities to farmers due to budgetary constraints of most of the LGUs concerned and the lack of technical capabilities of municipal extension workers and agricultural technicians especially in diversified farming system.

31. The Western Visayas Integrated Agricultural Research Center (WESVIARC) is a regional research center under DA, located in Iloilo city. The center performs basic research and experiment for Western Visayas Region with three (3) sections: namely crop and soil system section, fishery system section, and animal system section. This center has technically competent researchers, but its research activities could not be properly conducted due to limited budget support for the purchase of necessary equipment and demonstration farm inputs as well as for the adequate maintenance of the center.

32. The municipalities covering the study area have an estimated excess rice milling capacity of 86,000 tons of paddy. This excess capacity is more than enough to absorb the additional production of 71,300 tons projected for the study area. Registered storage of warehouse is not enough to accommodate the production in the study area. Additional storage capacity for the incremental production of 71,300 tons in the future is estimated at 35,650 tons.

33. The sources of agricultural loans in the study area indicated an almost equal sharing between formal(51%) and non-formal institutions(49%). Among the formal sources were commercial and rural banks, credit cooperatives, and NGOs. Informal sources were input suppliers and traders and money lenders. Among the non-formal sources, the money lenders and farm input dealers and traders are the most preferred sources of the farmers in the study area. The farmers' cooperatives have been the retailer of agricultural credit coming largely from the LBP. There are about 176 cooperatives listed as active by the cooperative development authority (CDA) in the study area. The

CDA records indicate about 60% of these cooperatives as credit and 40% as multi-purpose. The data provided by the LBP on active cooperatives in the study area showed that only 20% of the cooperatives registered with the CDA are active with the LBP.

34. It is practically the private traders and millers (90%) that control the local trade of paddy. They have agents, known as middlemen, stationed along major highways or right at the farms to purchase any available paddy. There are two compelling reasons why farmers and IA members sell their paddy immediately after harvest. First is the very tight cash flow normally experienced by the farmers. With small farmholdings and low yields, the net reserves are simply not enough to satisfy even basic expenditures. Second, the farmers are heavily indebted due to virtual lack of savings. The cycle of borrowing during planting time and paying the loans during harvest time is the common practice.

Farmers' Organization and Other Rural Institution

35. In the study area, 35 irrigators' associations (IAs) have been organized by NIA and registered with the Securities and Exchange Commission (SEC). Based on their by-laws, each IA consists of 4 committees such as service, finance, audit and inventory, and membership, education and training. The IAs are being used by NIA for O&M works including the collection of ISF through the existing two O&M contracts. Out of the 35 IAs, 32 IAs are involved in Type I (canal maintenance) contract and only 7 IAs in Type II (system operation and ISF collection) contract in 1997. The inactiveness of the IAs is the most serious constraint due to non-functional IA committees, weak leadership/management skills, lack of discipline/cooperation among members, non-payment of ISF and membership fees and lack of access to formal credit.

36. According to the records of the Cooperative Development Authority (CDA), there are 256 registered farmers' cooperatives in the study area. About 21% of these cooperatives are engaged in credit relending mainly for crop production to their members. However, most of the farmers' credit cooperatives are faced with the problems of weak financial management, technically unprepared officers, lack of training and discipline of members, and lack of access to small credit for farm inputs.

37. Organization and training of the IAs are presently handled by the NIA-RIS offices through the Institutional Development Officers (IDOs). Six IDOs are assigned in the study area, 4 are in the Jalaur-Suague RIS and 2 in the Aganan-Sta. Barbara RIS. Each IDO is in-charge of 5-6 IAs, or an average area of 3,630 ha. Apart from the limited number of the IDOs and their contractual employment, the IDOs also lack skills on integrated and participatory development which is essential to the IA strengthening in the study area. Compounding this problem is the insufficient data base management due to lack of computers and communication system.

Watershed Area

38. Based on the present land use condition, slope and elevation condition, land category and the present government activities, the degree of degradation of the watershed area was evaluated as shown below.

Watershed	Land use	Slope	Land category	Erosion	Gov. activity	Overall
Aganan	3	3	3	3	3	3
Tigum	2	2	2	2	1	2
Suague	2	2	2	2 - 3	2 - 3	2 - 3
Jalaur	2	2	2	2	1 - 2	2

Remarks : Figures show the degree of condition of each aspect, i.e. 1=better, 2=moderate, 3=poor.

The result shows that Aganan watershed has relatively the highest degree of degradation among the watersheds. The physical condition of other watersheds are not found to have remarkable differences in terms of slope, land categories, etc. Suague watershed, however, is evaluated to have a relatively poor condition because of the low government activities on the area compared with those in the Tigum and Jalaur watersheds.

Environmental Condition in the Study Area

39. Environmental issues found in and around the study area are as follows:

- i) Siltation in scouring sluice and canals (in all schemes),
- ii) Watershed degradation (in all schemes),
- iii) Inequity of water distribution (in all schemes),
- iv) Seasonal inundation of services area (in Jalaur proper and Suague RIS areas),
- v) Deterioration of water quality (in Jalaur proper and extension RIS),
- vi) Urbanization in the RIS area (in Aganan and Sta. Barbara RIS).

Study on Development Plan

Basic Concepts for Project Formulation

40. The poor performance of irrigation services is generally common to most national irrigation systems (NIS) in the Philippines. Existing five (5) NIS such as the Aganan, Sta. Barbara, Suague, Jalaur proper, and Jalaur extension RISs in the study area also are not properly maintained to ensure adequate, equitable and timely supply of water. The major issues related to the performance of these RISs are summarized as follows:

- i) Low agricultural productivity,
- ii) Low irrigation efficiency,
- iii) Poor water management and O&M practice and low collection of ISF ,
- iv) Institutional and technical weakness of Irrigators' Association and NIA,
- v) Financial weakness of farmers, and
- vi) Watershed degradation.

In addition to the above issues, the following are also identified which are specific to the study area:

- vii) Illegal water use in the upper river basin, and
- viii) Conversion of agricultural land.

41. Of the eight (8) main issues identified in the study area, the issues on land conversion, illegal water use and watershed degradation are considered to affect the sustainability of the Project. To address these basic issues on the project sustainability, certain development policies are taken into consideration as briefly discussed below.

(a) Land conversion

To protect the agricultural lands of both the Aganan and Sta. Barbara RIS areas from further reduction and sprawl due to disordered land conversion, the following development policies will be adopted:

- (i) to ensure adequate, equitable and timely supply of irrigation water to all irrigation service areas of both the Aganan RIS and Sta. Barbara RIS through rehabilitation and improvement of existing irrigation facilities and strengthening of the skills of the NIA staff and IAs on water management and O&M practices, thereby revitalizing the irrigation system, and
- (ii) to introduce high value-added diversified crops in both the Aganan and Sta. Barbara RIS areas through the development of irrigated agriculture in order to improve the poor financial position of farmers and increase farmers' access to markets.

(b) Illegal water use in the upper river basin

Water users in the upper river basins utilize river water for irrigation without restraint by taking advantage of the location of their paddy fields. However, their irrigation facilities are inappropriate with low efficiencies, resulting in wasteful use of river water. Taking into consideration the importance of the basin-wide water management approach, the development policies to be adopted are as follows:

- (i) to enhance the irrigation efficiencies through improvement of water users' facilities and thereby reduce the wasteful use of river water, and
- (ii) to give water rights to their irrigation areas for legal authorization.

It is recommended that the said improvement of facilities be done by developing new communal irrigation system projects under the guidance of the NIA and LGU in the future. Only the required amount of irrigation water under the communal irrigation system projects would be allocated and accounted in the water balance calculation for the study area.

(c) Watershed management

Generally, proper management and rehabilitation of watershed require a high investment and considerably long time to recover the stable river water

flow, reduce sediment and sustain the project life and get significant effect. Taking this into account, the development policies for issues on the watershed degradation are as follows:

- (i) as a short term plan, to provide a settling basin at each head of the main canal to protect canal systems from siltation by sediment intrusion to the systems, and
- (ii) as a long term plan, to disseminate the sustainable upland farming system on sloping land, promote the social forestry program (reforestation program) such as community forestry management agreement (CFMA) and to develop the alternative energy sources such as introduction of biogas, improved stove, and establishment of community forest.

The short term plan would be implemented as the first step under the Project, while the long term plan would be in the form of recommendations to NIA and DENR under the Project.

42. To address the above common issues to NIS, the following projects financed by the World Bank have been, or are being implemented for the Aganan, Sta. Barbara, Suague, Jalaur proper, Jalaur extension RISs.

- The First Irrigation Operation Support Project (IOSP I)
- The Second Irrigation Operation Support Project (IOSP II)
- The Water Resources Development Project (WRDP)

These projects have aimed to improve and sustain the operational efficiency of the NIS to increase agricultural production (mainly rice), expand small farmer incomes and rural employment opportunities, and contribute to rural poverty alleviation. But, since the operations of these projects have been nationwide in scope and covered all the existing NIS, the project fund for each RIS has been limited. Due to this condition, the projects are not effective to solve the fundamental issues on the low agricultural productivity and low irrigation efficiency in the project areas.

The construction plan for the proposed small impounding dams and irrigation plan for the proposed extension areas would be excluded from the development plan mainly on technical consideration. Thus, the development of irrigated agriculture within the limited irrigation service areas of the existing RISs would be a main subject to increase agricultural productivity at the highest level, especially the yields of paddy. This would be achieved by enhancing irrigation efficiency for effective and maximum use of available water. To address the major issues in the areas and attain the above goal, the following plans are envisaged:

- Irrigated agriculture development plan anchored on increasing productivity, especially yield of paddy,
- Rehabilitation and improvement plan of existing irrigation facilities to enhance irrigation efficiency for maximum use of available water,

- Improvement and strengthening plan of present water management and O&M practice including improvement plan of ISF collection by NIA and IA to enhance irrigation efficiency for maximum use of available water and to protect the facilities to be rehabilitated and improved from deterioration,
- Institutional development plan of IA and NIA for sustainability of water management and O&M practice and implementation of partial system management,
- Strengthening and improvement plan of agricultural support services such as extension, research, credit, post-harvest facilities and marketing, and rural infrastructures including farm-to-market road network for effective implementation of the irrigated agriculture development plan to improve the financial weakness of farmers, and
- Watershed management plan to stabilize river water flow, reduce sediment and sustain the Project operations.

The integration of those prospective plans is necessary to reactivate the existing RISs, maximize the agricultural productivity, improve the financial position of farmers, and thereby improve the regional economy.

Irrigated Agricultural Development Plan

43. Paddy-based cropping pattern is employed considering existing crops in the study area and sustainability to climate and soil conditions. The proposed cropping pattern is summarized as below:

	Cropped Area (ha)				
	Jalaur prop.	Jalaur extn.	Suague	Aganan	Sta. Barnara
1st Paddy Irrigated	8,820	2,620	2,960	4,290	2,960
2nd Paddy Irrigated	8,820	2,620	600	500	800
2nd Paddy Rainfed	0	0	610	900	300
Vegetables	0	0	0	200	300
Perennial fruits crops	0	0	0	70	40
Total (ha)	17,640	5,240	4,170	5,960	4,400
Service Area (ha)	8,820	2,620	2,960	4,360	3,000
Cropping Intensity (%)	200	200	141	137	147

44. The anticipated crop yield is estimated on the basis of the results of the socio-economic survey on progressive farmers in well irrigated land, interview with MAOs of relevant municipalities, and data from the Medium Term Agricultural Development Plan (MTADP) in Iloilo province.

Target yield in near future in MAOs of relevant municipalities	5.5 - 6.3 ton/ha
Target yield of irrigated paddy of Gintong Ani Program	5.0 ton/ha
Present average yield in progressive area in Philippines	4.9 to 5.3 ton/ha
Average yield in good year in Iloilo province (Oct.- Dec, 1993)	4.83 ton/ha
Potential yield of HYV	7.00 ton/ha
Actual yields at demonstration plots (Techno-demo-farm) supervised by MAOs	4.8 - 5.5 ton/ha

Crop/Condition	Anticipated Yield (ton/ha)
1st paddy irrigated	5.0
2nd paddy irrigated	5.0
Eggplant irrigated	6.0
Mango irrigated	4.0

Crop production in the study area at full development stage under “with project” condition is estimated by multiplying the anticipated crop yield with the cropped area. Total production is estimated at 179,560 ton of paddy, 3,000 ton of vegetables, and 440 ton of fruits. The net incremental of crop production is expected at 71,300 ton of paddy rice, 3,000 ton of vegetables and 440 ton of fresh fruits.

Improvement Plan of Irrigation and Drainage Facilities

45. The main works to improve irrigation and drainage facilities will consist of repair of diversion dams; adding feeder canal with a total length of 26 km; canal lining for approximately 72 km in the main canal network of the 4 RISs excluding the Aganan RIS; improvement of existing canal and related structures by installing settling basin in each head race, about 150 turnouts, farm pond of 35 places, measuring devices at each head gate and turnout.

46. Since the inundation damage at the tail portion of the Jalaur proper RIS area due to floods by the big typhoon and heavy rainfall at the high tide is not severe, the specific plan to deal with the inundation is not proposed. Only for solution of the inundation problem caused by the insufficient flow capacity of the existing culverts and/or lack of drainage culvert of the highways in the Jalaur proper and Suague RIS areas, additional culverts, bridges and drainage canals will be constructed.

47. Development strategies on the rural road are to make smooth linkage system by improvement of the existing NIA's service roads, minor repair of the existing rurals road and addition of rural road, bridges and crossing structures in order to strengthen the farm-to-market road network.

Improvement Plan of Water Management and O&M Practices

48. For the effective and proper water management and O&M practices, the proposed approaches are (i) providing all control structures such as intake gates, head gates and turnouts with measuring devices and undertaking regular maintenance works to ensure accuracy of measurement, (ii) development of a monitoring system composed of the collection of field data and monitoring the field operation through communication system for the effective water management, (iii) preparation of practical and easy-to-use O&M manual and training to O&M staff, and (vi) the installation of communication system and provision of transport equipment for the efficient monitoring system.

49. It is proposed to improve the present system of ISF collection through the following approaches: (i) to facilitate the awarding of ISF collection and system operation contract (Type II contract) to the IAs, to reduce administration cost of NIA and

build up working capital for the IAs, (ii) improvement of record keeping system through the installation of computers for data recording and processing, (iii) computerization of the ISF billing and collection documents and training of NIA staff and IA officer for ISF collection, (iv) strict imposition of penalties for delinquent water users, and (v) increase of incentives for ISF collection to motivate the IA to improve the present level of ISF collection efficiency.

Agricultural Support Services

50. To achieve successfully the objectives of agricultural development, agricultural support services in the RIS areas need to be improved and strengthened which include the following:

(a) Agricultural research and extension services

- to organize farmers' group consisting of 30 to 40 members per group in one or two turnout service area (TSA) and to train them under extension workers of the MAO at demonstration plots for farming technology,
- to train municipal agricultural officers, extension officers and agricultural technicians, and
- to upgrade the extension and transport facilities of the MAO and equip the IAs with communication system.

(b) Agricultural credit

- to establish a loan restructuring program to consider a modified loan amortization of past due loans while at the same time allowing the farmer-borrowers to renew their loans for new production activities,
- to strengthen the farmers' cooperatives in terms of their financial base and technical capability on credit screening, evaluation and monitoring, and
- to expand the cooperatives' credit services.

(c) Marketing and post-harvest practices

- to perform an integrated buying/selling and processing of paddy by the cooperatives or IA, and
- to provide adequate post-harvest facilities and trucking fleet and working capital and to build up the necessary capability and skills on market information matching.

Improvement Plan for Strengthening of Farmers' Organization and NIA

51. The plan for strengthening of farmers' organizations is designed to improve the present institutional weakness of the IAs in the Jalaur-Suague RISs and Sta. Barbara RIS through the activation of the four standing committees at the IA and TSAG levels, development of continuing education program, development of records management system and construction of IA office. These activities will enable the IAs to effectively

and sustainably implement the existing O&M (Types I & II) contracts and to facilitate the partial turnover of irrigation system management to the IAs in the near future. Once the IAs are institutionally strengthened, they will be organized into IA federation for each RIS to carry out the system-wide water management and O&M activities, etc.

52. In the Aganan RIS, the plan envisages that the Aganan River Federation of Irrigators' Association (ARFIA) consisting of the existing 6 IAs will be able to maximize and sustain the operation and management of the existing post-harvest facilities. The strengthening of this federation will involve the following: (i) increasing credit access to government institutions such as Quedancor, (ii) diversification of capital sources through capital build up, etc., (iii) setting up of quota system for the utilization of the facilities, (iv) reduction of service charges for the utilization of the facilities by promoting group activities, (v) training of the ARFIA members, and (vi) promotion of rice milling and marketing.

53. The existing farmers' cooperatives in these RISs will be rehabilitated to re-start the provision of agricultural loan to their farmer-members, many of whom belong to the IAs. These cooperatives will also directly engage in bulk buying of farm inputs, and group buying/selling and processing of paddy to increase the farm income of the IA members. In the IA areas with no existing cooperatives, women service cooperatives (WSC) will be set up to provide similar loan.

54. Taking into consideration the present institutional constraints of NIA, the plan to strengthen NIA's capability will undertake the following activities: (i) training of NIA-RIS field staff, (ii) renovation of NIA Regional Training Center in Pototan, (iii) procurement of required equipment for training, communication and transportation, and (iv) provision of technical assistance such as consultants and NGOs to provide training and technical advice to NIA staff and IAs. Specifically, the NGOs will carry out the strengthening of the IAs, rehabilitation of farmers' cooperatives, and development of WSC whenever necessary.

Watershed Management Plan

55. The main issue on the watershed degradation is the low concern among individual rural household for the adverse impact on their welfare. This requires a development approach that considers not only the bio-physical aspect but also the social and cultural, and economical milieu of the rural people to improve their present condition and re-orient their attitudes toward proper resource use. The institutional development approaches such as social, cultural and economical aspects are strengthening of coordination with agencies, community organization and social development and training and extension. As for the technical aspects, the approaches are soil conservation measures, agro-forestry system and development of alternative energy source.

Future Environmental Issues with the Project

56. The preliminary result of initial environmental assessment reveals the following issues:

(i) Health hazard from agrochemical use (in all schemes)

Use of agrochemicals is anticipated to increase with the introduction of diversified agricultural systems particularly insecticide and fungicide and this may cause health hazard arising from mishandling of agrochemicals and improper disposal of used containers. Instructions, training and extension services will need to be ensured to mitigate the effect of the use of agrochemicals on human health.

(ii) Deterioration of downstream water quality (in all schemes)

Higher level of fertilizer application in intensive agriculture to obtain higher yields may result in nutrient loading in drainage water and/or groundwater, and affect downstream aquatic ecology especially fish culture and mangrove. The risk to water quality can be mitigated by using compost and green manure, promoting the integrated pest management system, and proper water management.

(iii) Loss of farm land

The farm ponds are planned to be constructed under the project. The loss on farm land is not expected to be large. It is, however, necessary to fully compensate owners and/or the tenant farmers whose lands will be converted into farm ponds.

(iv) Positive impact on farm household income and regional economy

Under the agricultural development plan, net incremental of crop production is expected at 71,300 tons of paddy rice, 3,000 tons of vegetables and 440 tons of fresh fruits at full development. In addition, the intensive agriculture is expected to generate additional labor. The increase in labor and crop production will create spill over effects in the other sectors such as investments in post-harvest processing and farm inputs. The initial construction investment would also expand effective demand increasing regional and national incomes.

(v) Reduction of excess use of groundwater

Ground water from shallow tube wells are widely used in the project area, and excessive use of ground water is reported in some places, particularly in the dry season. The number of shallow tube wells and pumps are still increasing at this time. If this situation continues, the ground water table will further decline, resulting in shortage of domestic water supply in the dry season and saline water intrusion near the seashore. Therefore, the excessive pumping of ground water

will be prevented by the proper supply of irrigation water in each RIS on the basis of the proposed cropping pattern and water management.

Evaluation and Selection of Priority Projects

57. The Project improvement works on the 5 RISs will consist of (i) civil works such as irrigation and drainage facilities, roads, post-harvest facilities, IA offices and NIA training center; (ii) procurement of equipment for agricultural extension and institutional strengthening; and (iii) the training programs of agricultural extension and institutional strengthening. In order to achieve the objectives of the Project, the following improvement works on the five RISs would be needed:

Description	Quantity
Civil Works	
Irrigation and Drainage Facilities	
- Canal lining	72 km
- Feeder canals	26 km
- Turnout	150 nos.
- Farm pond	35 nos.
- Settling basin	5 nos.
Rural Infrastructure	
- Farm and link road	106 km
- Bridges	7 nos.
- Culvert	210 nos.
Facilities & Equipment	
- Training center construction/renovation	2 nos.
- Post-harvest facilities (warehouse)	5 RISs
- IA office	35 nos.
- Communication system	2 RIS offices/35 IA offices
- Agricultural extension equipment	14 sets

Facilities for institutional strengthening will comprise the construction of IA offices and the construction of training center in the Aganan-Sta. Barbara RIS office and renovation of training center in the Jalaur-Suague RIS office. These facilities include the necessary communication and transport equipment for institutional strengthening.

Furthermore, the actual agricultural extension and institutional strengthening activities will cover both the (i) provision of training, guidance, information materials to the IAs and farmers including visits to demonstration fields, and (ii) training of NIA field staff and city/municipal agricultural officers, extension officers and agricultural technicians.

58. The estimated cost of these improvement works based on the price level of March 1997 is about 1,867 million pesos for all RISs consisting of 888 million pesos for Jalaur proper RIS, 435 million pesos for Jalaur extension, 167 million pesos for Suague RIS, 187 million pesos for Aganan RIS, 190 million pesos for Sta. Barbara RIS, respectively. This cost covers (i) civil works construction cost, (ii) engineering and administration cost including land acquisition cost, (iii) cost of procurement of O&M

and office equipment, (iv) cost of agricultural extension equipment, farm machinery and post-harvest facilities, and (v), physical and price contingencies estimated at 10% and 15% respectively.

59. The implementation of the Project is scheduled to be divided into three phases due to the big amount of improvement works and the wide project area. The prioritization of the RISs is decided on the basis of the selection criteria summarized in proceeding paragraph.

60. The economic internal rates of return (EIRR) calculated range from 10% to 22%. Among the five RISs, Aganan RIS has the highest EIRR estimated at 22%, followed by Jalaur proper; 18% ,Suague RIS; 16%, Sta. Barbara RIS; 15% and Jalaur extension RIS;10%.

61. The selection of priority projects is decided on the basis of the following six criteria: (i) effectiveness of model for revitalization of irrigation system, (ii) project scale and consistency in irrigation system (iii) effect on basic issues on project sustainability, (iv) effect on environment, and (v) progress of the Comprehensive Agrarian Reform Program (CARP) implementation. A three-point scoring system is adopted to rank the priority projects.

62. Based on the application of the selection criteria, the five RISs are ranked in full consideration of the different improvement plans, and the results are shown below.

Selection Criteria	Aganan	Sta. Barbara	Suague	Jalaur pro.	Jalaur ext.
1. Effectiveness of model for revitalization of system					
(1) Deterioration of system	1	3	3	3	3
(2) Low ISF collection rate	3	2	2	3	2
(3) Improper/poor O&M of system	2	2	3	3	3
Sub-total	6	7	8	9	8
2. Project scale and consistency with national irrigation system	2	1	1	3	1
3. Effect on project sustainability					
(1) Effect on land conversion	1	1	3	3	3
(2) Effect on watershed degradation	1	2	1	2	2
(3) Effect on illegal water use	3	3	1	2	2
Sub-total	5	6	5	7	7
4. Effect on environment	3	3	2	2	2
5. Progress of CARP	1	1	2	3	1
Total	17	18	18	24	19
EIRR(%)	22	15	16	18	10

63. As reflected in the above table, the highest score (24 points) is given to the Jalaur proper RIS, followed by the Jalaur extension RIS (19 points). The EIRRs of the improvement plans of these RISs are 18% and 10%, respectively. Thus, the Jalaur

proper RIS should be selected as the priority project. However, the Suague RIS is closely related to the Jalaur proper RIS due to the following factors:

- the irrigation canal system of the Suague RIS is connected with the irrigation main canal system of the Jalaur proper RIS, and
- flooding in the tail portion of the Suague RIS due to poor drainage system of the highway from Zarraga to Pototan runs along the boundary of the Suague RIS and Jalaur proper RIS.

Therefore, the irrigation and drainage canal systems of both the Suague and Jalaur proper RISs shall be integrally rehabilitated and improved at the same time for proper O&M of the systems for both RIS areas. Hence, the Jalaur proper RIS and Suague RIS shall be finally selected as the priority project(s) for the feasibility study in the Phase II.

The maximum utilization of the pre-project post-harvest facilities constructed in the Aganan RIS area under the Japan's Grant Aid Program is another priority concern of the Project. The strengthening plan for the Aganan IA federation will be formulated in the Phase II study to comprise the following activities for effective management of the said facilities:

- establishment of clear operation and management plan/procedures, and
- upgrading plan of federation capability to manage the facilities.

Conclusion and Recommendation

Conclusion

64. The Phase I study clarified the following:

- (a) The construction plan for the proposed small impounding dams and irrigation plan for the proposed extension areas would be excluded from the development plan mainly on technical and social consideration.
- (b) Instead, the development of irrigated agriculture to increase agricultural productivity at the highest level, especially the yields of paddy within the limited irrigation service areas of the existing RISs in the study area would be economically viable through enhancing irrigation efficiency for effective and maximum use of available water.
- (c) To address the major issues in the study area, the following prospective plans are envisaged to attain the development goal:
 - Irrigated agriculture development plan anchored on increasing productivity, especially yield of paddy,
 - Rehabilitation and improvement plan of existing irrigation facilities to enhance irrigation efficiency for maximum use of available water,

- Improvement and strengthening plan of present water management and O&M practice including improvement plan of ISF collection by NIA and IA to enhance irrigation efficiency for maximum use of available water and to protect the rehabilitated and improved facilities from deterioration,
- Institutional development plan of IA and NIA for sustainability of water management and O&M practice ,
- Strengthening and improvement plan of agricultural support services such as extension, research, credit, post-harvest facilities and marketing, and rural infrastructures including farm-to-market road network for effective implementation of the irrigated agriculture development plan to improve the financial weakness of farmers, and
- Watershed management plan to stabilize river water flow, reduce sediment and sustain the Project operations.

65. According to the results of the project evaluation, the irrigated agriculture development for the five (5) RISs in the study area is technically sound and economically feasible, showing the economic rate of return (EIRR) ranging from 10% to 22%. The Jalaur proper RIS and Suague RIS shall be selected to be implemented as priority projects for the feasibility study in Phase II.

66. The maximum utilization of the post-harvest facilities constructed in the Aganan RIS area under the Japan's Grant Aid Program is another priority concern of the Project. The strengthening plan for the Aganan River Federation of Irrigators' Association shall be formulated in the Phase II study.

Recommendation

67. It is recommended that the Project shall be implemented as early as possible following the priority sequence mentioned below .

- (i) Stage I: Jalaur proper RIS and Suague RIS
- (ii) Stage II: Sta. Barbara RIS and Aganan RIS
- (iii) Stage III: Jalaur extension RIS

68. It is recommended that the inappropriate irrigation facilities of illegal water users in the upper river basin shall be improved by developing new communal irrigation projects under the guidance of the NIA and LGU as soon as possible in consideration of the importance of the basin-wide water management approach and the water right shall be given to these areas for legal authorization

69. It is recommended that the presently slow progress of CARP program, especially in the Jalaur extension RIS area, shall be accelerated for successful development in the study area.

PART-III FEASIBILITY STUDY ON THE PRIORITY PROJECTS

THE PROJECT AREA

Location and Population

70. The project area covers the Jalaur proper and Suague RIS (JSRIS) areas. Its borders are defined by the municipality of Lambunao on the north, the municipality of Mina on the west, the municipalities of Dumangas and Zarraga on the south, and the municipality of Barotac Nuevo on the east. The total population of the project area encompassing 78 barangays is 89,075 in 1995, with a population density estimated at 7.5 persons per ha, or more than 210% higher than the provincial average. This situation can be explained by three socio-economic factors: the large number of farm workers (both resident and migrant) in the area, the small average size of farm (about 1.5 ha), and the existence of extended family members (e.g., parents and the family of one of their children) residing in one household. The average family size of 5.3 persons in the Project area, however, is comparatively smaller than the provincial average of 5.5 persons.

Agriculture

71. The current irrigation service area is reviewed using the results of field investigation and interview survey, the aerial photographs and topographic maps of scale of 1:4,000. The service area of the Jalaur proper and Suague RIS is respectively estimated at 8,820 ha and 2,900 ha. The irrigation area decreases 6 ha in the Jalaur proper RIS and 58 ha in the Suague RIS due mainly to land conversion.

72. The farmer households in the 78 barangays of the project area are estimated at about 7,850. The households represented as the farm workers is estimated at about 4,980. In terms of occupancy by tenure, the owner-cultivators, leaseholders and tenants occupy 40.0%, 28.4% and 31.6%, respectively of the project area. The traditional system of land rental is common among tenant farmers in the project area. Tenants receive only 10% of the net income from paddy production. On the other hand, the leaseholders pay about 630 kg/ha/crop season to the land owner. Under the Comprehensive Agrarian Reform Program (CARP), the tenancy is illegal. This kind of sharing arrangement should be avoided to protect the welfare of the tenants and leaseholders. The average farm size is estimated at 1.5 ha for both the Jalaur proper and Suague RIS.

73. The farmers in the project area are applying the following cropping patterns:

Pattern (a)	Paddy (irrigated) - Paddy (irrigated),
Pattern (b)	Paddy (irrigated) - Fallow,
Pattern (c)	Paddy (dry seeding/irrigated) - Paddy (irrigated), and
Pattern (d)	Paddy (rainfed) - Paddy (rainfed) or Fallow.

Additionally, third cropping such as cultivation of third paddy, watermelon and mungbean is being practiced in some irrigation areas by the farmers, when water is available. It should be noted that the cropping intensity of irrigated paddy in Jalaur proper RIS is about 124%, while in the Suague RIS, the cropping intensity is slightly higher at 152%.

74. Average yields of irrigated paddy in each RIS are estimated based on the NIA JSRIS office's data during the past five years, as shown below.

RIS	(Unit: ton/ha)			
	Average Yield (5 years)		Range	
	Wet	Dry	Wet	Dry
Jalaur proper	3.40	3.30	2.67 ~ 4.09	2.33 ~ 3.74
Suague	3.64	3.41	2.68 ~ 4.43	2.79 ~ 3.81

Source: JSRIS Office, NIA Region VI

The yield of rainfed paddy is estimated at 2.24 ton/ha including the yield of the 3rd paddy. On the other hand, the yields of mungbean and watermelon are estimated at 0.4 ton/ha and 4.0 ton/ha, respectively. Based on the estimated yields mentioned above, the present paddy production in the project area is calculated at 49,870 tons for Jalaur proper RIS, and 17,910 tons for Suague RIS. The production of watermelon and mungbean is respectively estimated at about 480 tons and 300 tons in the RIS areas.

Irrigation and Drainage

75. The majority of gates of both the diversion dams are manually operated. The intake gates installed at the left bank have technical problem on the cable suspension for lifting during gate operation. The manual operation system and technical problem on the gate lifting affect the proper operation of the gate.

76. The main canal networks of both the RISs consist of one (1) main canal and 28 lateral canals in the Jalaur proper RIS and one (1) main canal and 9 lateral canals in the Suague RIS. All irrigation canals are earth canals. The total length of canals is respectively estimated at 121.3 km in the Jalaur proper RIS and 40.9 km in the Suague RIS. All canals of both RISs have technical problems which are: (i) over-flowing of irrigation water at some canal sections due to the low embankment and the back water caused by improper operation of water level at head gates and/or turnout; and (ii) siltation in canals and open-cut of embankment due to provision of illegal turnout. These problems affect proper water operation primarily due to the lack of proper maintenance and illegal turnouts. The slow water run in the main and lateral canals and the insufficient water discharge to the irrigation service areas occur.

77. The existing related structures consist of head gates, turnouts, check structures, syphons, aqueducts, culverts, drop structures, etc. There are 9 head gates constructed in the Suague RIS and 24 in the Jalaur proper RIS. Parshall flume is constructed in the downstream from the a few head gates as the measuring device. However, all Parshall flumes are not functional and are abandoned due to complicated operation. In lieu of the Parshall flume, the staff gauge is used at several head gates. The staff gauge is curved in

the retaining wall in the downstream. The number of turnout is 70 in the Suague RIS and 246 in the Jalaur proper RIS. Majority of the turnouts are double-gate type. The gates have already been severely deteriorated and some gates and its parts were lost. The control and monitoring of irrigation water discharge is not conducted at all at the turnouts.

78. The existing pump irrigation projects (PIP) are operated at 2 sites with a total service area estimated at about 180 ha. The purpose of the pump irrigation project is to provide supplemental irrigation at the tail portion of the Jalaur proper RIS. The water source of these projects is the Jalaur river and the drainage water coming from the Jelicuon creek. On the other hand, a number of shallow tube wells are existing in both the RIS areas. Total number is about 80 tube wells in the Suague RIS area and about 600 tube wells in the Jalaur proper RIS area. Shallow ground water is the supplemental water source of irrigation. The irrigation area of shallow tube well is estimated at about 140 ha in the Suague RIS area and approximately 1,200 ha in the Jalaur proper RIS area.

79. The main drainage canal network is the 11 natural rivers and creeks excluding the 3 rivers, namely the Janipan-an river in the Suague RIS area, and Jalaur and Dumangas rivers in the Jalaur proper RIS area. The total length of the main drainage canals in both the RIS areas is estimated at approximately 90 km. The inundation occurs along the highways near Pototan, Pototan - Barotac Nuevo and Zarraga - Barotac Nuevo. The main reasons for the flooding near the Pototan are depressed topographic condition and limited flow capacity of the existing cross drain and drainage canal. The inundation occurring along the other highways is caused by the choking of the existing cross drains constructed at the high ways. The back water is caused by the insufficient flow capacity of the river section at the bridge of the highway, Pototan - Passi. The inundation has been reported to stay for 2 - 3 days. Similarly the lowland irrigation service areas within Zarraga - Dumagas is also affected by back water. This occurs in the simultaneous period of spring tide and heavy rainfall during the rainy season.

80. The service road of an irrigation canal has essentially two (2) functions: (i) inspection road for the irrigation facilities; and (ii) farm-to-market road for both the RIS areas. Total length of the road is approximately 36 km in the Suague RIS and 112 km in the Jalaur proper RIS. At present, majority of the road sections including the pavements have deteriorated. Total length of damaged road sections that render them impassable during the rainy season is estimated at about 31 km in the Suague RIS and approximately 73 km in the Jalaur proper RIS.

Water Management and O & M Practices

81. The Jalaur-Suague (JS) RIS office consists of six main sections headed by an irrigation superintendent, and the operation and maintenance section has responsibility on the O & M works for the Jalaur and Suague RISs. Two other sections, namely the equipment & project implementation section and ISF collection unit are also concerned with the water management and O & M activities. At the field level of the RIS, the irrigation service areas are normally divided into divisions of approximately 700-900 ha which are managed by the WRF Technicians with two or three WRF Tenders depending

on the size of the division and length of canals. The diversion dam area is managed by the WRF Operator. These staff are under the supervision of the Engineer in each RIS. Presently, the WRF Technicians are responsible for system operation, maintenance of canals, and also act as collectors of irrigation service fee (ISF) in their respective areas or division. The WRF Tenders are also deputized as assistant ISF bill collectors

82. Dam-site areas and gates at diversion dam are being operated and maintained by the WRF Operators assigned in the area. However, the recording of intake discharge is not being done properly due to the absence of proper measuring device. Control structures and gates along the main canal and laterals are being operated and maintained by the WRF Technicians and WRF Tenders within their areas of jurisdiction. No such records as discharge and water elevations are being maintained at present. Maintenance of main and lateral canals are being done by the existing WRF Tenders and the IAs with Type I contracts. The frequency of canal desilting work is also quite low.

Operation and maintenance of on-farm facilities such as main farm ditch is being done by Turnout Service Area (TSA). This is directly undertaken by the Turnout Service Area Groups (TSAGs) of the IAs and individual farmers of the concerned facilities in the area. However, the TSAGs (including the other farmers) in some areas do not perform this responsibility because of the absence of a contract with NIA and unclear definition of responsibilities among the IA members and farmers. According to the inventory survey conducted by the study team, 25% of main farm ditches are not maintained.

83. The average collection efficiencies of both the RISs are respectively 28% of the Jalaur RIS and 34% of the Suague RIS during the 5 years from 1992 to 1996 and lower than the national average of 48% in 1995.

Farmers' Organization and NIA

84. In the project area, there are 15 and 5 IAs in the Jalaur proper and Suague RIS, respectively, with a total membership of 3,785 farmers. These IAs are managed by the Board of Directors (BOD) which consists of the chairmen of the respective turnout service area groups (TSAGs). The BOD is mostly relied upon by 19 IAs with Type I contract and by 4 IAs with Type II contract due mainly to non-functionality of the present committees. Fourteen of the IAs involved in Type I contract are hiring non-IA members for in canal maintenance due to unavailability of IA members who are busy on their respective farming activities. As for the 4 IAs involved in Type II contract, only the BOD members are collecting ISF and the NIA collectors (WRF Technicians and Tenders) continue to collect ISF in the areas of the contracted IAs. Presently, the NIA training has been limited to the officers. The limited participation of IA members is caused by the lack of training and the unclear definition of the IA activities.

85. In the consultation meeting with the IAs, the institutional and technical weakness of the IAs has become evident due to weak financial position of the IAs and farmers, and unclear IA activities and benefits. The 15 existing farmers' cooperatives in the project area have provided agricultural credit to their members. About 30% to 90% of the members of these cooperatives are IA members. But, all existing cooperatives are also

financially and technically weak due to generally low repayment rates of the members. All of them could not apply for additional credit from LBP due to unsettled loans. Many IA members now go to private traders and input suppliers for credit which charge high interest rate.

86. The overall responsibility for O&M of the Jalaur proper and Suague RIS is carried out at present by the Jalaur-Suague RIS office. It has 4 contractual staff assigned as IDOs to facilitate the development of the 20 IAs. Most of these IDOs lack proper training and experience in community organizing, cooperative development and inter-agency coordination. The NIA training center in Pototan has also physically deteriorated. Present planning and monitoring system is weak due to insufficient database management and lack of skills for data collection and analysis.

Agricultural Support Services

Agricultural Extension

87. The transfer of agricultural extension activities from the DA to the LGUs in 1992 has created problems pertaining essentially to logistics such as support for demonstrations farms, propagation of seeds, and conduct of training for farmers. The average budget of the concerned MAOs in 1996 ranged from 61,000 to 91,000 pesos per extension worker including personal expenses. This amount is sorely lacking if one considers the magnitude of work of the agricultural extension agents. Such perception is evident in the poor outreach of the agricultural extension agents. The integrated pest management program (IPM) funded by the DA has also been reported to have a limited outreach on account of budgetary constraint from the MAOs. Presently, the agricultural extension activities of the MAOs have minimal involvement with the activities of the IAs. About 60% of the respondents of the farm household survey have not felt the activity of the extension worker in the area.

Agricultural Credit

88. In the project area, about 61% of the farms use credit and the remaining 39% do not use credit. The supply of agricultural credit in the project area is met by formal and informal sources. Among the formal sources are the LBP, rural and thrift banks, lending investor and NGOs. As for the informal sources, the private traders/millers and input suppliers are the dominant source of crop production loans.

On the demand side, the farmers' cooperatives are considered end-user of agricultural credit. The farmers' cooperatives, as credit retailers, obtain loan funds from the LBP and lend these funds to their members. There are 15 agricultural cooperatives serving the 20 IAs in the project area. Out of these 15 cooperatives, 9 or 60% have been reported to be inactive. This means that they have completely stop their lending operations for the simple reason that the members have not repaid their loans. The average past due loan (arrears) of a farmer-member has been estimated at about P5,000 as of end 1995. This reflects the poor credit discipline among the farmers and IA members. There are the three main problems of the demand sides, i.e., the low

repayment rates of credits, the low rates of use of formal credits, and divergent use of the formal credits.

Marketing and Post-harvest Facilities

89. The private traders and millers practically control the buying of paddy in the project area. It is estimated that 90% of the marketable surplus (production less consumption) are bought by these traders. In the selling of rice, the local traders locally known as "casa" in Iloilo market controls the distribution of rice to major institutional buyers. The traders and millers control paddy and rice prices and dominate the market because of their financial resources and availability of post-harvest facilities. In the Iloilo province, the mean farm gate price ranged from a low of 8.11 pesos/kg to a high of 9.58 pesos/kg during the past 21 months. The average farm gate prices have been over and above the current support price of 8.00 pesos/kg. This simply indicates that good quality of paddy can command prices higher than the support price.

90. There are two major problems faced by the farmers in the marketing of paddy.

(i) Low price of paddy and improper post-harvest handling

The common complaint of low prices received among farmers is normally a function of the relatively low quality of paddy. A number of the improper post-harvest handling are noticeable in the project area. First is the practice of selling wet paddy immediately after threshing. This condition prevails because of the tight cash flow experienced by the farmers. As such farmers normally lost 10% to 20% of the premium price for paddy. Second is the misconception about mechanical drying. The additional cost of about 5% of the purchase price is traditionally viewed by farmers as excessive. In reality, however, the advantages of mechanical drying far outweigh its costs. These include high milling recovery, less broken and longer storage efficiency.

(ii) Non farmers' participatory to integration of production cum processing stages of paddy

This situation is happening among the farmers because of the following: (a) fragmented selling and handling of paddy; (b) absence of processing thus foregoing additional value-added; and (c) poor linkage with market information. It is actually the private traders and millers that are taking advantage of the profit opportunities created by the integration of paddy production and milling. This is because of their ability to mobilize financial resources coupled with adequate rice mill, warehouse and hauling facilities.

Watershed Area

91. The population pressure in the watershed area is considered as the most serious threat at present. Salsh and burn cultivation in the sloping areas without proper soil conservation measures is conducted intensively to produce food and products necessary to sustain the people's needs. Policies and programs on the rehabilitation of forest and

watershed are generally established by the government agencies concerned. Several programs have already been launched within the Jalaur and Suague watershed areas. However, these programs need to be reinforced, improved and expanded to secure stable sources of water for the Project as well as enhance the welfare of the people in the Jalaur river basin.

Environment

92. The BOD values of water quality in the Jalaur river and Suague river are generally high, which could be attributed to the sampling period when the river flow was relatively low in the dry season (mid to late February 1997). There are two main sources for the high BOD values. One source is the domestic waste water from the populated area, and another is the waste water from the sugarcane mill factories in the upstream. Two sugar mill factories, namely Passi Sugar Central and New Frontier are located in Passi. The Passi Sugar Central has facilities of waste water treatment, and the treated water is utilized for its operation. This factory is not considered as the main source of high BOD. Crop damages caused by the low water quality of irrigation water have not occurred at all.

Fish ponds of about 7,000 ha are widely operated along the coastal area of the municipalities of Barotac Nuevo, Dumangas and Zarraga. The ponds are brackish type which use water from the creek, shallow well and sea. At present, drainage water from the Jalaur proper and extension RISs is used for the fish pond. While the drainage water might contain the residual fertilizers and agro-chemicals, damage on fish production has not been observed.

THE PROJECT

Participatory Rural Appraisal (PRA) and Public Consultation Seminars and Objectives of the Project

PRA and Seminars

93. The objectives of PRA were to facilitate irrigators' association (IA)-level planning based on the needs of IA member and non-IA member and to formulate IA-level operation and management plan for irrigation and drainage facilities. The PRA was executed for 19 IA areas covering the entire project area. The participants of the PRA was limited to farmers with farming area of less than 1.0 ha and farm workers. It was acknowledged by all participants that their identified solutions for problems in IA areas were mostly the same with the measures proposed in the prospective plans by the study team.

94. Following the PRA session, the Public Consultation Seminars were held to get a consensus among stakeholders such as national government agencies (DA, NIA, NFA, CDA, DAR, DENR, LBP, etc.), local government units (LGUs), non-government organization (NGOs), IAs and other farmer groups on the findings in the PRA sessions and the prospective plans prepared by the study team.

At the scheme-level Seminars, the prospective plans proposed by the study team were generally accepted by all participants with the following comments.

The proposed crop rotation for the Suague RIS was generally accepted if the following support services could be made available to the farmers:

- (i) extension services for proper diversified cropping practices,
- (ii) marketing support, and
- (iii) availability of certified seeds.

At the Municipal-level Seminar, the proposed prospective plans by the study team were generally accepted by all participants with the following specific comment:

presentation of a very strong justification in its recommendation for a maximum utilization of existing water in terms of increasing the cropping intensity and yields in the project area

Objectives of the Project

95. Considering of the identified problems and solutions through the PRA and comments in the Seminars, the main objectives of the Project are:

- (a) to increase agricultural productivity, especially yields of paddy through the development of irrigated agriculture, and thereby improve the poor financial position of farmers,
- (b) to enhance irrigation efficiency through the rehabilitation and improvement of existing irrigation facilities, and strengthening of the skills of the NIA staff and IAs on water management and O&M practices,
- (c) to sustain the water management and O&M practices through institutional development of the NIA and IAs, and
- (d) to stabilize river flow, reduce sediment and sustain the Project operations as a long - term objective through watershed management.

The final goal of the Project is to improve the rural economy. This is expected to be achieved through increase of agricultural productivity, revitalization of existing RISs, sustainability of water management and O&M practices, and improvement of poor financial position of farmers. Thus, the Project is expected to support the key agricultural development policies defined in the Medium Term Philippines Development Plan (MTPDP)

Integrated-phased Development Approach

96. An integrated-phased development approach will be adopted by the Project, divided into two phases. First phase covers the development of soft aspects of the prospective plans to carry out in advance the strengthening of the IAs, rehabilitation of farmers' cooperatives, development of women service cooperatives, and activation of agricultural extension services. The first phase also covers a part of rehabilitation/ improvement of irrigation facilities and improvement of O&M skills of NIA and the IAs

including the preparation of the O&M manual, using the rehabilitated/improved irrigation facilities. This phase coincides with the 4 years of the pre-construction period and partial construction period. Second phase will carry out the full implementation of hard aspects of the prospective plans and the further advancement of the soft aspects. By the time the improvement/rehabilitation of irrigation facilities are completed, the strengthened IAs would have adequate institutional and technical capabilities to effectively and sustainably use the irrigation facilities and start partial system management. This phase coincides with the construction and sustainability period of the Project.

Irrigated Agriculture Development Plan

97. In view of the limited supply of water coming from the Suague RIS during the dry season, rotational cropping system of diversified crop (mungbean) is being recommended. The proposed cropping pattern is summarized below:

	(Unit: ha)		
	Jalaur Proper	Suague	Total
1st Paddy Irrigated	8,820	2,900	11,720
2nd Paddy Irrigated	8,820	1,100	9,920
Mungbean Partially Irrigated	0	1,800	1,800
Subtotal	17,640	5,800	23,440
Cropping Intensity (%)	200	200	200
3rd Crops			
3rd Paddy	1,200	50	1,250
Watermelon	100	20	120
Mungbean Rainfed	600	150	750
Subtotal	1,900	220	2,120
Total	19,540	6,020	25,560
Service area (ha)	8,820	2,900	11,720
Total Cropping Intensity (%)	222	208	218

98. The crop production under the "with project" condition is estimated by multiplying the anticipated yield (paddy: 5 ton/ha, mungbean: 1 ton/ha, watermelon: 4 ton/ha) with the cropped area. Total production of crops is estimated as follows: 111,000 tons of paddy; and 1,860 tons of mungbean. The net incremental crop production is expected at 43,220 tons of paddy, and 2,100 tons of mungbean. The future total production of crops in each RIS is summarized below:

	(Unit: ton)		
	Paddy	Mungbean	Watermelon
Jalaur Proper			
Present	49,869	240	400
With Project	90,888	240	400
Increment	41,019	0	0
Suague			
Present	17,907	60	80
With Project	20,112	1,860	80
Increment	2,205	1,800	0
Total			
Present	67,776	300	480
With Project	111,000	2,100	480
Increment	43,224	1,800	0

99. The projected farm budget at full development is estimated assuming an average farm size of 1.5 ha per household. The net income of Jalaur proper and Suague RISs will increase from the present levels of P28,050 and 32,630 to P72,000 and 62,400 respectively.

The net income per household at 1.5 ha farm-size will also increase.

	(Unit: pesos/h.h.)		
	Jalaur proper	Suague	Note
Present			
Owner-cultivator	28,047	32,631	
Leaseholder:	11,831	16,415	Land fee: 30 sacks/ha/year
Tenant farmer	6,504	6,964	Given 10% of net production
Prospective			
Owner-cultivator	71,963	62,413	
Leaseholder:	53,972	46,810	Land fee: 25% of net income
Tenant farmer	35,982	31,207	Land fee: 50% of net income

Improvement Plan of Irrigation and Drainage Facilities and Road Network

Irrigation and Drainage Facilities

100. The gates and incidental facilities will be repaired to sustain proper water management for irrigation as summarized below.

RIS	Main Gate	Scouring Sluice Gate		Intake Gate
	Minor Improvement of Driven Lifting	Improvement of Driven Lifting	Minor Repairing	Improvement of Driven Lifting
Suague RIS	-	1 no.	1 no.	2 nos.
Jalaur Proper RIS	8 nos.	-	-	12 nos.

The trashracks of intake gate and communication facilities will also be provided to sustain the proper water management and maintenance.

101. The existing canal sections will be re-shaped to sustain sufficient flow capacity. The canal lining will be provided in the long canal which has the significant role of a water conveyance for both the RISs. Total length of canal lining will be about 35.6 km

consisting of 6.3 km in the Suague RIS area and 29.3 km in the Jalaur proper RIS area. A feeder canal will be provided to improve the water supply to the TSAs to cope with the problems on the slow water run from the lateral canals and/or the insufficient water discharge distribution due to illegal turnouts and improper canal layout. The feeder canal will be provided at about 7.5 km (7 canals) in the Suague RIS area and about 24.3 km (24 canals) in the Jalaur proper RIS area.

102. Main improvement works of related structures are as follows.

- (i) Construction of the settling basin at the head of main canal of both RISs.
- (ii) Replacement and new installation of gates at the head gates: 52 nos. in the Jalaur proper RIS area and 19 nos. in the Suague RIS area.
- (iii) Repairing of riprap in the outlet portion of the head gate in both RIS areas.
- (iv) Renewal of existing turnouts of 329 nos. in both RIS areas and additional turnouts of 117 nos. consisting of 51 nos. in the Suague RIS area and 76 nos. in the Jalaur proper RIS area.
- (v) Construction of measuring devices at head gates and turnouts.
- (vi) Repairing and rehabilitation of the damaged structures such as culverts, drop structures and aqueducts.

To address the problems on the acceleration of water run in the transition period of the improvement of water management skills and to deal with emergency water use for irrigation for both the RISs in the dry season, supplemental irrigation facilities such as farm pond and pond will be respectively constructed along irrigation canals and pond in main drains and creeks. The farm pond is proposed at 13 sites in the Jalaur proper RIS area and 7 sites in the Suague RIS areas. The total area is about 18 ha for both the RISs. The ponds will be constructed at 5 sites in the Jalaur proper RIS and 2 sites in the Suague RIS.

103. To cope with minor floods and inundation caused by the lack of secondary drains and drainage facilities, secondary drains of about 55 km (58 nos.) will be constructed in both the RIS areas. The creek sections of the Abangay will be improved to either enlarge the sections and/or construct river bank to sustain more stable paddy cultivation. The bridges of 2 nos. and cross drains of 12 nos. will be constructed at the highway crossing with the lateral canals in both the RIS areas.

Road Network

104. The improvement work of the service roads are divided into categories: (i) improvement of gravel pavement; (ii) improvement of road section and gravel pavement; and (iii) new construction of the service road. The total length of the work will be about 45 km for the Suague RIS and about 127 km for the Jalaur proper RIS. The proposed barangay roads for improvement are: (i) about 1.2 km (one road) for the Suague RIS; and (ii) about 2.1 km (one road) for the Jalaur proper RIS. The access road to the existing service road will be provided at about 0.7 km (one road) of the Suague RIS and about 2.8 km (5 roads) of the Jalaur proper RIS.

Improvement Plan of Water Management and O&M Practices

105. Improvement of water management and O&M activities of the JSRIS office will be carried out through the restructuring of the O&M sections, the hiring of temporary O&M staff for the first 4 years of the Project, and proper work load assignment for the O&M staff. The additional O&M staff will augment the existing staff for the O&M works including the strengthening of the IA technical capabilities. Once the IAs have started to undertake the partial system management, the new O&M staff will be terminated from the Project.

106. Water delivery and distribution schedule will be modified based on the actual farming activities and hydrological data by improving the present monitoring system through the installation of proper measuring devices, the new computerized system and communication system to be set up under the Project. The transmission of data will be facilitated by wireless radio from the O&M staff and IAs in the field to the RIS office on a regular basis. An irrigation scheduling system will be developed to support the monitoring system and speed up the proper scheduling of irrigation water delivery.

107. Increase of the collection of irrigation service fees (ISF) is the primary intent to generate sufficient O&M budget for both NIA and the IAs through improvement of the present ISF collection system and ISF evaluation policy for accurate and fair estimation of benefited area, establishment of proper databased management for ISF billing and collection, streamlining of legal procedure for penalizing delinquent water users, and improvement of incentives to the IAs for ISF collection. The O&M skills of NIA and the IAs will also be improved through the preparation of practical O&M manual, conduct of appropriate training program for O&M staff and IAs, and the installation of proper measuring devices for canal discharge.

Institutional Development

108. The plan for institutional development of the IAs seeks to resolve their weak institutional and technical problems through the two-phased approach to the institutional strengthening of the IAs and the rehabilitation of existing farmers' cooperatives in the project area. Phase I (first four years of the Project) will involve the following activities: (i) activation of the IA/TSAG committees through intensive training and on-site technical guidance by the proposed NGOs and consultants to be recruited under the Project, (ii) development of continuing education program through the establishment of 3 education clusters for each IA to be given specific area of assignment, (iii) organization of IA working groups for rotational O&M activities, (iv) development of records management system, (v) construction of IA office, and (vi) clarification of IA boundary and administrative responsibility.

109. The rehabilitation of the 15 existing farmers' cooperatives will also be done in Phase I to re-start the agricultural loan and provide post-harvest processing services to their members, many of whom are also IA members. These cooperatives will also carry out the group buying/selling of paddy, and the drying, storing and milling of paddy through business tie-ups with private owners or NFA for access of the cooperative

members to the required post-harvest facilities. The development of women service cooperatives (WSC) will be organized in IA areas with no existing cooperatives to supply mainly agricultural loan. The strong complementation of functions and resources between the IAs and cooperatives will be established during the Phase I.

110. In Phase II (starting on the fifth year of the Project), the institutionally revitalized IAs will carry out the following: (i) implementation of the partial system management to enable the IAs to manage and own sections of the irrigation system for the sustainability of O&M activities, and (ii) development of IA federation for each RIS for effective system-wide water management and O&M practices. The operation and management of owned post-harvest facilities among the farmers' cooperatives will also be promoted to control the integrated rice business in the project area and to increase real income of farmers.

111. The institutional development plan for NIA is designed to carry out proper and regular technical services to the IAs in relation to water management and O&M practices through the following activities: (i) training of NIA-JSRIS staff, (ii) renovation of NIA training center, (iii) computerization of database management, (iv) improvement of communication and transport system, and (v) provision of technical assistance through the recruitment of consultants and NGOs.

Improvement Plan of Agricultural Support Services

Agricultural Extension Services

112. The present agricultural extension services will be substantially activated by directly linking the Municipal Agricultural Offices (MAO) with the IAs in the project area and by focusing the extension service system to the TSAGs with the designation of MAO technicians to specific TSAGs. The MAO technicians will be trained on proper farming technologies and agricultural extension, and provided by transport and communication equipment to carry out regular farm visits and extension services to IA members. Contact farmers, consisting of progressive IA members, will be organized and trained in each TSAG to establish techno-demo farms and to act as trainers for other farmers. The contact farmers will form an education cluster to sustain the extension services both for IA members and other farmers.

113. In order to increase the supply of certified seeds for the IA members, 80 seed growers from progressive farmers will be selected, trained and technically guided on seed inspection, growing, drying and processing by MAO, PAO and BPI to produce the required quantity of certified seeds in the project area. Initial certified seed will be provided by BPI through Western Visayas Integrated agricultural Research Center (WESVIARC). Certified seeds to be produced by seed growers will be distributed to farmers through the farmers' cooperatives.

Agricultural Credit

114. Increase of farmers' access to existing formal credit program of LBP is the main purpose of the improvement plan of agricultural credit. This will be achieved by the

rehabilitation of existing farmers' cooperatives, restructuring of their loans, and strengthening of credit operation through improvement of loan monitoring system and loan support services. The loan restructuring would be planned to consider a modified loan amortization of past due loans while at the same time allowing the farmer-borrowers to renew their loans for new production activities, as a first step to improve the present financial position of farmers.

115. An irrigators' association development fund (IADF) is envisaged to be established as a twin mechanism for facilitating the release of credit at the same time a source of financial assistance for institutional development activities of the Project. Since loan rescheduling and institutional strengthening would be simultaneously carried out, the IADF would be deposited to LBP as a guarantee cover of the renewed loans of IA members through their respective cooperatives. The interest earnings of IADF would be used to fund institutional activities. The IADF is estimated at about 8.2 million pesos.

Post-harvest Processing and Marketing

116. The improvement plan of post-harvest processing and marketing envisages group buying/selling and processing scheme of paddy to be carried out by the farmers' cooperatives. This scheme will eventually become an integrated rice enterprise of the cooperatives. A two-phased approach is planned. The first phase will involve the group buying and selling of paddy by initially postponing the acquisition of new facilities such as rice mills. At this phase, business tie-ups with private owners and NFA for the use of existing post-harvest facilities will be established by the IAs. In the second phase, where the farmers' cooperatives have pooled their financial resources, the management and operation of integrated post-harvest facilities will be considered. The time frame for this plan coincides with the institutional development plan.

Watershed Management Plan

117. Since proper management and rehabilitation of watershed require a high investment and considerably long time to recover the stable river water flow, reduce sediment and sustain the project life and get significant effect, it is recommended to implement a model rehabilitation project on the selected micro-watershed area in order to demonstrate the effects to the surrounding areas. The model project is considered as a first step to the implementation of the watershed management plan, and will contribute to revitalization of the existing RISs in the project area. However, since the main implementing agency of the model project will be DENR and the beneficiaries will be the people in the watershed area instead of the farmers in the existing RIS area, it is recommended that the model project be implemented by using other project fund. As an alternative, it is recommended to implement the model project under the Forest Sector Project financed by OECF. The Suague sub-watershed area is considered as the most optimum site based on the selection criteria. The model project area of 4,766 ha is composed mostly of rolling hill to very steep mountain characterized by undulating topography, and is mainly covered by old growth and secondary forests. The required implementation period is estimated at 6 years with a total cost of 76 million pesos.

Environmental Consideration

118. Through the environmental screening and scoping, five (5) future environmental issues to be caused by the project works are identified in the project area. They are (i) health hazard from agrochemical use, (ii) deterioration of downstream water quality, (iii) loss of farm land, (iv) beneficial impacts on farm household income and regional economy, and (v) reduction of excessive use of ground water. However, the negative impacts on issues are not so serious and will be mitigated with proper measures under the Project.

PROJECT COST ESTIMATE

Implementation Schedule

Project Works

119. The proposed construction works are shown below.

Description	Unit	Jafaur proper RIS	Suague RIS	Total
Improvement Plan of Irrigation/Drainage and Rural Road				
1 Diversion Dam				
1.1 Replacement of slide gate for main gate, scouring sluice gate, intake gates	nos.	20	4	24
1.2 Trashrack	nos.	2	1	3
2 Main/Lateral Canals and Related Structures				
2.1 Improvement of canals	km	121.3	39.4	160.7
2.2 Feeder canals	km	24.3	7.4	31.7
2.3 Canal lining	km	29.3	6.3	35.6
2.4 Settling basin	nos.	1	1	2
2.5 Replacement and installation of gates at head gate/turnout	nos.	52	19	71
2.6 Additional turnout	nos.	76	41	117
2.7 Farm pond (supplemental facilities)	nos.	13	7	20
2.8 Pond (supplemental facilities)	nos.	4	2	6
3 Main/Secondary Drains and Related Structures				
3.1 Enlargement of Abangay creek	km		8	8
3.2 Bridge	nos.	1	1	2
3.3 Cross drain	nos.	11	1	12
4 Service road and rural road				
Service road				
4.1 Improvement of gravel pavement	km	36.1	8	44.1
4.2 Improvement of road	km	73.3	26.5	99.8
4.3 New construction	km	17.5	10.2	27.7
Rural road				
4.4 Improvement of road	km	3.6	1.2	4.8
4.5 New construction	km	1.3	0.7	2
5 Procurement of O & M equipment				
5.1 Construction equipment	nos.	16	common for both the RIS	
5.2 Vehicle and motorcycle	nos.	44	common for both the RIS	
Institutional Development Plan				
1 Buildings				
1.1 Renovation of NIA training center	m2	730	common for both the RIS	
1.2 IA office	nos.	20	common for both the RIS	
2 Procurement of equipment and facilities				

Project Implementation Schedule

120. The implementation of the Project is divided into three stages: (i) pre-construction period including detailed design and tender administration, etc., (ii) construction period involving the full implementation of the Project, and (iii) sustainability period involving the O & M of irrigation facilities by the IA, etc. Main components of the Project implementation are construction of civil works and institutional development.

121. Construction time schedule is made based on the estimated quantity of main works, workable days in the site, construction method and program, anticipated capacities of construction equipment, and physical site condition. The time required for the construction works is estimated at 3 years for the works of the Jalaur proper RIS and 2 years for the works of the Suague RIS.

122. Consistent with the basic concept of the institutional development plan, the implementation is scheduled gradually into two phases. The gradual phasing of the implementation of this plan is essential to give ample time for the IA members to develop their technical and business skills (such as marketing) and acquire the necessary financial resources.

The first phase will involve the setting up of the required facilities, organizations and management systems of the Project for the proper start-up of the IAs' institutional strengthening and rehabilitation of farmers' cooperatives. Renovation of the NIA training center and construction of IA offices will be done at this phase, together with the establishment of the Project Steering and Technical Committees, the activation of IA committees, etc. Technical assistance to the JSRIS office, IAs and other concerned agencies will also be provided with the hiring of consultants and NGOs. This phase is scheduled on the first 4 years of the Project.

The second phase is scheduled to start on the fifth year of the Project by which time most of the IAs would have been institutionally and technically strengthened, and will carry out the partial system management and the federation of the IAs for each RIS. The farmers' cooperatives are envisioned to procure and manage their owned post-harvest facilities to control the integrated rice business in the project area.

Organization and Management

123. The NIA will be the overall lead implementing agency for the implementation of the Project. The proposed organization of the Project is divided into three groups. The first group is the Project Management Office to be operated by the NIA-JSRIS office. This office will be responsible for the regular supervision and monitoring of the implementation of the Project's prospective plans. The second group is the multi-agency Project Steering Committee (PSC) to be composed of the implementing agencies mentioned above. This will serve as the main policy making body of the Project, and ensure regular coordination among the implementing agencies for effective Project implementation. The third group is the Project Technical Committee (PTC) to be composed of field officers of the implementing agencies in order to provide timely technical support to both the PSC and the JSRIS office.

Cost Estimate

124. The project cost includes: (i) construction cost; (ii) procurement cost for O&M equipment and institutional development & agricultural extension; (iii) training cost; (iv) consulting service cost for civil works and training; (v) administration cost; (vi) land acquisition; and (vii) physical contingency and price contingency. The total project cost of both the RIS is estimated at 1,573.3 million pesos, and each project cost is

respectively estimated at 1,186.2 million pesos for the Jalaur proper RIS and 387.1 million pesos for the Suague RIS.

PROJECT EVALUATION

Economic Evaluation

125. The Project was evaluated integrating the Jalaur proper and Suague RISs, because :

- (i) a part of the service area of the Suague RIS (200 ha) will be irrigated by a feeder canal from the main canal of the Jalaur proper RIS to be constructed under the Project, and
- (ii) the drainage improvement works will be implemented through constructing the drainage culverts under the highway from Zarraga to Pototan which runs along the boundary of the Suague RIS and Jalaur proper RIS.

The economic internal rate of return (EIRR) of the Project was estimated at 16.4 %.

Financial Evaluation

126. The financial evaluation of the Project from a view point of beneficiaries' capacity to pay was made taking off-farm work income and household expenditure into account. A typical farm with 1.5 ha farm land and 5.3 family size would have the net reserve from about 37,000 pesos to about 78,000 pesos by the Project. Farmer beneficiaries would have enough reserve after paying irrigation fees and taxes and show enough capacity for additional payments.

Indirect Benefit

127. After the implementation of the Project, the following indirect benefits are expected:

- (i) Increase of employment opportunity,
- (ii) Improvement of transport condition, and
- (iii) Generation of post-harvest business.

STRENGTHENING PLAN FOR THE AGANAN RIVER FEDERATION OF IRRIGATORS' ASSOCIATION (ARFIA)

128. The ARFIA presently consists of all the six (6) IAs in the Aganan RIS with a total membership of 1,502 farmers. It was registered with the Securities and Exchange Commission (SEC) in 1995, and is managing the post-harvest facilities built within the RIS area under the Japan Grant Aid Program. The primary facilities being operated by the ARFIA are the drying yards, two hauling trucks and two warehouses. Generally, these facilities are underutilized due to lack of working capital for farming activities of

the ARFIA members, expensive charges for the use of the facilities, farmers' low awareness of economic advantages of the facilities, low participation of members in the operation and management of the facilities, the first-come-first-served rule, and lack of rice mills and marketing operation of rice.

129. Improvement of the weak financial position of the ARFIA farmer-members is the immediate objective of the strengthening plan for the ARFIA in order that they will be able to actively participate in the integration of the post-harvest facilities' operation with their farming activities. This objective will be attained through the following measures: i) provision of government loan, ii) capital build up, iii) setting up of quota system for the utilization of post-harvest facilities, iv) reduction of service charges by the promotion of group activities, v) training of the ARFIA members, and vi) promotion of rice milling and marketing.

CONCLUSION AND RECOMMENDATION

Conclusion

130. The economic internal rate of return (EIRR) of the Project consisting of the selected priority projects is estimated at 16.4%. The Project is found to be technically sound, economically feasible and financially viable. The feasibility study has specifically clarified the following advantage of the Project:

- (a) Both the Jalaur proper and Suague RISs will be revitalized under the Project and the irrigation performance by both RISs will be remarkably improved. Thus, the revitalized RISs will contribute to improve the regional economy through increase in the agricultural productivity,
- (b) The farm economy will be remarkably improved and stabilized as compared with the present condition,
- (c) The Project will create a demand for farm labor due to the intensive farming activities, more intensive land use, and increase in the agricultural production. The Project will also improve the road network condition and generate the post-harvest business by farmers in the project area. All these will contribute to activating the regional economy, and
- (d) The farmers' income in the project area is expected to increase considerably about 2 to 5 times through increase in crop production, especially paddy rice, under the Project.

131. The sustainability of O&M activities will be considerably improved with the turn over of management and ownership for sections of the irrigation system of both RISs to the IAs through partial system management, and the direct incentives to farmers for owning the system would reduce future O&M cost by NIA.

132. In addition, the feasibility study has clarified that the Aganan River Federation of Irrigators' Association (ARFIA) should be strengthened through the following measures: i) provision of government loan, ii) capital build up, iii) setting up of quota system for the utilization of post-harvest facilities, iv) reduction of service charges by the promotion

of group activities, v) training of the ARFIA members, and vi) promotion of rice milling and marketing.

Recommendation

133. As mentioned above, the implementation of the Project is technically sound, economically feasible and financially viable. Moreover, the Project will give many direct and indirect social and economic benefits to farmers in the project area. Thus, it is recommended that the Project shall be implemented as early as possible.

134. In order to ensure the successful and effective implementation of the Project, it is recommended that the proposed integrated-phased development approach be adopted as follows:

First phase covers the development of soft aspects of the prospective plans to carry out in advance the strengthening of the IAs, rehabilitation of farmers' cooperatives, development of women service cooperatives, and activation of agricultural extension services. The first phase also covers a part of rehabilitation/improvement of irrigation facilities and improvement of O&M skills of NIA and the IAs including the preparation of the O&M manual, using the rehabilitated/improved irrigation facilities. This phase coincides with the 4 years of the pre-construction period and partial construction period. Second phase will carry out the full implementation of hard aspects of the prospective plans and the further advancement of the soft aspects. By the time the improvement/rehabilitation of irrigation facilities are completed, the strengthened IAs would have adequate institutional and technical capabilities to effectively and sustainably use the irrigation facilities and start partial system management. This phase coincides with the construction and sustainability period of the Project.

135. To sustain the Project, it is recommended that the following proposed activities be taken by NIA and other agencies concerned:

- (i) The model project for the watershed management and rehabilitation of the Suague sub-watershed area shall be implemented by DENR as early as possible to demonstrate the effects of the model project to the surrounding areas. The model project should be considered to be implemented under the Forest Sector Project, and
- (ii) The present quarry activity downstream of the Suague RIS diversion dam shall be restricted to prevent the degradation of the river bed.

**THE STUDY ON JALAU R IRRIGATION SYSTEMS
AND RURAL AREA DEVELOPMENT PROJECT
IN
THE REPUBLIC OF THE PHILIPPINES**

MAIN REPORT

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Abbreviation

(A)	ADB	Asian Development Bank
	ADS	Agri-industrial Development Strategy
	ASBRIS	Aganan-Sta. Barbara River Irrigation System
	ASC	Agriculture Service Center
	ATI	Agricultural Training Institute
	A&D	Alienable and Disposable
(B)	BAS	Bureau of Agricultural Statistics
	BEA	Barangay Extension Agent
	BOD	Board of Directors
	BOD	Biochemical Oxygen Demand
	BPI	Bureau of Plant Industry
	Brgy	Barangay
	BRS	Bureau of Research and Standards, DPWH.
	BUA	Barangay Users Association
(C)	CA	Compulsory Acquisition
	CARP	Comprehensive Agrarian Reform Program
	CDA	Cooperative Development Authority
	CE	Collection Efficiency
	CFMA	Community Forestry Management Agreement
	CIS	Communal Irrigation System
	CPU	Central Philippines University
(D)	DA	Department of Agriculture
	DAR	Department of Agrarian Reform
	DBM	Department by Budget and Management
	DBP	Development Bank of the Philippines
	DENR	Department of Environment and Natural Resources
	DCIEP	Diversified Crops Irrigation Engineering Project
	DPWH	Department of Public Works and Highways
(E)	ECA	Environmentally Critical Areas
	ECP	Environmentally Critical Project
	EIA	Environmental Impact Assessment
	EIS	Environmental Impact Statement
	EIRR	Economic Internal Rate of Return
(F)	FAO	Food and Agriculture Organization
	FIO	Farmer Irrigators' Organizers
	FIRR	Financial Internal Rate of Return
	FTC	Farmers Training Center
(G)	GAA	General Appropriation Act
	GDP	Gross Domestic Product
	GNP	Gross National Product
	GOJ	Government of Japan
	GOP	Government of the Philippines
	GRDP	Gross Regional Domestic Product
(I)	IA	Irrigators' Association
	IAPCC	Inter-Agency Project Coordinatory Committee
	IAS	Irrigators' Assistance Section
	IDD	Institutional Development Division
	IDO	Institutional Development Officers

	IEE	Initial Environmental Examination
	ILECO	Iloilo Electric Cooperative Incorporated
	IMU	Implementing Management Unit
	IOSP	Irrigation Operations Support Project
	IOTS	Irrigators' Organization and Training Section
	IPM	Integrated Pest Management
	IS	Irrigation Superintendent
	ISF	Irrigation Service Fee
	ISFP	Integrated Social Forestry Program
(J)	JICA	Japan International Cooperation Agency
	JOCV	Japan Overseas Cooperation Volunteers
	JSRIS	Jalaur-Suague River Irrigation System
	JRMP	Jalaur River Multipurpose Project
(K)	KCCA	Key Commercial Crop Area
	KFA	Key Fisheries Area
	KGA	Key Grains Area
	KLA	Key Livestock Area
	KPA	Key Production Area
(L)	LBP	Land Bank of the Philippines
	LGU	Local Government Unit
	LWUA	Local Water Utilities Administration
(M)	MAFC	Municipal Agriculture and Fisheries Council
	MAO	Municipal Agricultural Officer
	MAS	Municipal Agricultural Services
	MCM	Million Cubic Meter
	MEO	Municipal Engineer Office
	MIWD	Metro Iloilo Water District
	MPDD	Municipal Planning and Development Office
	MTADP	Medium Term Agricultural Development Plan
	MTPDP	Medium Term Philippines Development Plan
(N)	NEDA	National Economic Development Authority
	NFA	National Food Authority
	NFP	National Forestation Program
	NGO	Non-Government Organization
	NIHWL	Normal high water level of reservoir
	NIA	National Irrigation Administration
	NIS	National Irrigation System
	NPC	National Power Corporation
	NSCB	National Statistics Coordinating Board
	NWRB	Natural Water Resources Board
(O)	OECF	Overseas Economic Cooperation Fund
	OLT	Operation Land Transfer
(P)	PAFC	Provincial Agriculture and Fisheries Council
	PAGASA	Philippine Atmospheric Geophysical and Astronomical Service
	PAL	Philippine Airlines
	PAO	Provincial Agricultural Officer
	PAS	Provincial Agricultural Services
	PCA	Philippine Coconut Authority
	PCFC	People's Credit and Finance Corporation

PD	Project Description
PEO	Provincial Engineer Office
PENRO	Provincial Environment and Natural Resources Office
PES	Provincial Environment Services
PIO	Provincial Irrigation Office
PIS	Pump-lift Irrigation System
PNR	Philippine National Railways
PPDO	Provincial Planning and Development Office
PRA	Participatory Rural Appraisal
(R) RA	Republic Act
RFU	Regional Field Unit
RIS	River Irrigation System
RRA	Rapid Rural Appraisal
RSI	Rural Sanitary Inspector
RWSA	Rural Waterworks and Sanitation Association
RWSPMO	Rural Water Supply Project Management Office
(S) SADOPE	Santo Domingo Peoples Cooperative
SALT	Sloping Agricultural Land Technology
SEC	Securities and Exchange Commission
SIDA	Swedish International Development Agency
SOP	Standard Operating Procedure
SWIM	Small Impounding Management Projects
(T) TEV	Training-Extension cum Visit
TSKI	Taytay Sa Kauswagan, Inc.
(U) USDA	United States Department of Agriculture
(V) VICTO	Visayas Cooperative Development Center, Inc.
VOS	Voluntary Offer to Sell
(W) WB	World Bank
WD	Water District
WESVIA	Western Visayas Integrated Agricultural Research Center
WIT	Western Institute of Technology
WRDP	Water Resources Development Project
WRF	Water Resources Facilities

Measurement

Length

mm	=	millimeter	
cm	=	centimeter	
	=	0.39 in.	
m	=	meter	= 1.09 yd
	=	3.28 ft.	
km	=	kilometer	= 0.62 ml

Area

cm ²	=	square centimeter	
m ²	=	square meter	
km ²	=	square kilometer	
	=	100 ha	
ha	=	hectare	= 0.01 km ²
	=	2.5 ac	

Electrical Measures

kW	=	kilowatt	= 1,000 watt
MW	=	megawatt	= 1,000 kW
GW	=	gigawatt	= 1,000 MW
kV	=	kilovolt	= 1,000 Volt

Other Measures

%	=	percent
°	=	degree
'	=	minute
"	=	second
°C	=	degree in Celsius
Hp, PS	=	horse power

Volume

lit.	=	litter
cm ³	=	cubic centimeter
m ³	=	cubic meter
	=	1,000 lit.
MCM	=	million m ³
	=	1x10 ³ m ³

Weight

g	=	gram	
kg	=	kilogram	
t	=	metric ton	= 1,000 kg
ppm	=	part per million	
µg	=	micro gram	
cavan	=	50 kg	

Time

sec	=	second	
min	=	minute	= 60 seconds
hr	=	hour	= 60 minutes
	=	3,600 seconds	
day	=	24 hrs	= 1,440 minutes
	=	86,400 seconds	
yr	=	year	

Derived Measures

m ³ /sec	=	cubic meter per second (Cumec)
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Monetary

US\$	=	US dollar
	=	Japanese yen
P	=	Philippine peso