REPUBLIC OF THE PHILIPPINES

THE FEASIBILITY STUDY ON THE IMPROVEMENT OF OPERATION AND MAINTENANCE IN PUMPING IRRIGATION SYSTEMS

ANNEXES

VOLUME I

JANUARY, 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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SELECTION OF THE HIGH PRIORITY PROJECTS

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1. GENERAL

The main objectives of the feasibility study on the improvement of operation and maintenance in the pump irrigation systems (hereinafter called the Study) are summarized below:

- to formulate a development plan for the improvement of operation and maintenance of the National Pump Irrigation Systems, and
- to examine the technical and economic feasibility of the selected high priority projects including their financial justifiability.

The Study covers the national pump irrigation systems throughout the country. The pump irrigation systems with water sources of groundwater, however, were excluded from the Study as NIA and JICA Study Team agreed mutually in "the Minutes of Meeting" dated 4th August 1987.

In conclusion there are twelve pump irrigation systems for the Study in the whole country as follows:

(1) Bonga Pump #1 Irrigation System
(2) Bonga Pump #2 Irrigation System
(3) Bonga Pump #3 Irrigation System
(4) Iguig, Alcala-Amulung Pump Irrigation System
(5) Solana Pump Irrigation System
(6) MARIIS (Pump #1, Pump #2 and Pump #2 Irrigation Systems)
(7) UPRIIS Penaranda Pump Irrigation System
(8) AMRIS (Bustos-Pandi, Buenavista and Tibagan Pumps Irrigation Systems)
(9) Cabuyao East Pump Irrigation System
(10) Santa Cruz River Irrigation System
(11) Santa Maria River Irrigation System
(12) Libmanan-Cabusao Pump Irrigation System

With respect to the mini-hydropower development, there are 110 prospective potential sites for the Study.

This ANNEX presents (i) constraints on operation and maintenance of these pump irrigation systems, (ii) sets forth basic development concept and criteria for screening the high priority projects for the feasibility study and (iii) selects the priority projects.

The Study of the Annex was carried out based on data and information collected during the Stage 1 from July 1987 to March 1988.

2. PRESENT CONDITIONS AND CONSTRAINTS OF THE PUMPING IRRIGATION SYSTEMS

2.1 General

In order to identify the present, specific constraints of each of the systems, the field surveys and preliminary study were carried out with special emphasis being put on the following five major constraints:

(1) Constraints on planning of irrigation and drainage

- land/water resources
- development plan
- design

(2) Constraints on physical properties of the systems

- irrigation and drainage canal
- pump facilities
- structures/road
- monitoring facilities
- O&M equipment

(3) Constraints on management

- organization (structure/work load)
- communication system
- monitoring system
- procedure of operation and maintenance
- irrigation fee/collection efficiency of fee
- O&M cost
- financial status

(4) Constraints on irrigators' association

- Organization
- communication system
- operation and maintenance
- financial status

(5) Constraints on beneficiary farmers

- farming practices
- farm size/tenure status
- crop yields/market
- profitability of crops
- capacity to pay

The data and information used in this report were collected mainly from the following government authorities concerned:

(1) National Irrigation Administration (NIA)

(2) NIA Regional Office (II, III, IV and V)

(3) System Offices; Ilocos Norte Irrigation Service, Solana-Tuguegarao-Pinacanauan, MARIIS, Alcala-Amulung-Iguig, AMRIS, UPRIIS, Laguna FLIS, Sta. Cruz-Mabacan, Sta. Maria-Mayor, Libmanan-Cabusao

(4) Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)

(5) International Rice Research Institute (IRRI)

(6) Bureau of Agricultural Statistics

(7) National Census and Statistics Office

(8) Department of Agrarian Reform (DAR)

(9) National Food Authority (NFA)

(10) Bureau of Lands

(11) Bureau of Soils and Management

(12) Agriculture and Training Institute

(13) Bureau of Plant Industry (BPI)

(14) Philippine Council for Agriculture and Resources Research

(15) University of the Philippines at Los Baños

(16) National Economic and Development Authority (NEDA)

In addition, the following field surveys were carried out in order to supplement and confirm the data and information collected.

(1) Farm economic survey on 200 beneficiary farmers in all the systems.

(2) Evaluation survey of water management by 16 water masters/water management technologists and 32 ditchtenders/gatekeepers in all the systems.

(3) Measurement of the actual discharge capacity of the existing 38 pump units in all the systems.

(4) Farmer's intention survey on 200 beneficiary farmers in the present irrigation service area and 192 non-beneficiary farmers in the generated area.

(5) Inventory survey on all gated structures in all the systems.

Based on these surveys, the principal features and necessity of improvement of each of the systems were clarified as summarized in Tables 2.1 and 2.2. Location of the systems is illustrated in Figs. 2.1 to 2.16.

2.2 Bonga Pump #1 Irrigation System

The Bonga Pump #1 Irrigation System is located at the lower reaches of the Bonga river. Administratively this system is under the jurisdiction of Sarrat and San Nicolas municipalities, Ilocos Norte province.

Operation of this project commenced in 1977. Its service area during 1978 and 1979 was said to be 426 ha. However, the present service area has been reduced to 298 ha in 1986 because the lateral A area has not been irrigated due to physical defects of the canal resulting in insufficient canal capacity. 162 ha (54%) of the land were irrigated in

the wet season and 187 ha (63%) in the dry season in 1986. The remaining area is mostly rainfed.

Irrigation facilities comprise 3.4 km of main canal, 6.1 km of lateral canals, and 110 related structures. These function fairly well though improvement of the lower embankment of canal (lateral B) and reinforcement of turnouts are needed. The pump station has 2 units with a total rated capacity of 75.7 m^3/min. However, the efficiency of the pumps has decreased to 44% of the rated capacity because of severe abrasion of the impellers. This fact represents one of the most serious factors that raise the operation cost. In addition, improper wiring installation/connection and no fuse at primary circuit breaker are found.

This system was fully turned over by NIA to the Sarrat-San Nicolas IA in December 1985 in turn-over stage 2. The membership of IA is 272. The participation ratio of farmers to IA in the service area is estimated to be about 20%. Operation and maintenance (O&M) of the irrigation system and collection of irrigation service fee (ISF) are conducted by IA except for O&M of the pumps. NIA provides technical assistance to IA through assignment of one water master and one pump operator without charge. Water delivery is made relatively well by three-block rotation system. Maintenance of the irrigation canals is also good as a whole.

Under such situation the farmers in the area practice three kinds of cropping patterns; (i) paddy-paddy, (ii) paddy-diversified crops, mainly garlic, and (iii) paddy-fallow. The unit yield of crops is estimated to be about 3.3 to 3.5 tons/ha for paddy and about 0.9 tons/ha for garlic. The varieties used predominantly are IR series for rice and local varieties for garlic. The cropping intensity is estimated to be 117% in the service area and 187% in the irrigation area. In the service area the total number of farm households is estimated to be about 520. The average farm size is very small, being estimated at about 0.2 ha. The economic condition of farmers still remains at the subsistence level due to small farm size and low yield of crops.

With respect to crop diversification, a processing plant for tomato paste established in Sarrat has been operated since 1985. This plant has a total processing capacity of 480 tons/day. At present the plant is running at only about 30% of its capacity. A private firm manages the plant and provides technical services to the farmers under contract. Judging from the present market condition, it is considered that tomato would become one of the promising crops in the system from the standpoint of soil condition and good drainage of the lands.

The rate of irrigation service fee (ISF) is 8 cavans of paddy/ha in the wet season, 12 cavans of paddy/ha in the dry season and 7.2 cavans of paddy equivalent/ha for diversified crops. The amount of ISF collected in 1986 was 179×10^3 pesos, showing a collection efficiency of 42%. On the other hand, the total O&M cost in 1986 was estimated to be 458×10^3 pesos or 1,312 pesos/ha equivalent for the benefited area. About 80% of this cost is for pump energy charge. Electric power needed for pump operation is supplied by Ilocos Norte Electric Cooperative, Inc. (INECO) at an average price of 2.17 pesos/kWh which is about two times the power rate of the National Power Corporation (NAPOCOR). This fact is also one of the serious factors contributing to raising the operation cost. The balance of income and O&M cost showed a deficit of 279×10^3 pesos.

2.3 Bonga Pump #2 Irrigation System

The Bonga Pump #2 Irrigation System is located at the lower reaches of the Bonga river. The system covers the area of San Nicolas and Laoag municipalities in Ilocos Norte province.

The system was operated in 1977. The design area seems to be 1,200 ha. The irrigation service area was 674 ha in 1986. The area commanded by the lower half of the main canal has been excluded from the service area due to (i) farmers' intention, (ii) higher operation cost for irrigation of such area, according to the information from the System Office. In 1986, 450 ha (67%) and 275 ha (41%) were irrigated in the wet and dry seasons, respectively. The annual irrigation ratio in the service area is only 108%. Most of the remaining area is under rainfed condition.

The irrigation system consists of 14.2 km of main canal, 20 km of lateral canals, 382 related structures and 21.8 km of service roads. All the canals are concrete lined. This irrigation system functions well. The pump station has 3 units but one unit is not operated due to defect of the bearings. The present efficiency of the operational pumps is estimated at 77%. No fuse at primary circuit breaker and improper wiring installation and connection are also found. Abrasion of impellers accrued by sand sucking up is also one of the problems.

All of the Bonga Pump #2 system was turned over to the San Nicolas-Laoag IA in December, 1985 in turn-over stage 2. At present, 503 farmers are members of this IA. The participation ratio of farmers in this system is roughly estimated to be about 20%. This IA is very active. Operation and maintenance of the system and collection of ISF are carried out by IA. NIA provides technical services to IA. O&M are strictly controlled by IA. Rotational irrigation with 16 blocks is carried out applying intermittent irrigation method with a 9-day interval.

Under such situation the farmers apply three cropping patterns; (i) paddy-paddy, (ii) paddy-diversified crops and (iii) paddy-fallow. Most of the farmers utilize IR varieties for paddy and local varieties for garlic. The diversified crops, mainly garlic, are grown in the land having medium soil texture and good drainage. As same as in the case of the Bonga Pump #1, tomato is expected to become one of the prospective diversified crops in the future. The unit yields of crops are estimated to be 3.5 to 4.0 tons/ha of paddy, 1.7 tons/ha of garlic. The cropping intensity is estimated to be 108% for the service area and 161% for the irrigated area. In the service area there are about 2,500 farmers. The average farm size is estimated to be 0.3 ha. The economic condition of most of the farmers also remains at the subsistence level because of small scale of farm size and low productivity of crops.

The ISF rate is 8 cavans of paddy/ha in the wet season, and 12 cavans of paddy/ha in the dry season paddy and 7.2 cavans of paddy equivalent/ha for diversified crops. The ISF amount collected in 1986 was 336×10^3 pesos corresponding to a collection efficiency of around 39%. The total O&M cost in 1986 amounted to 654×10^3 pesos or 902 pesos/ha for the benefited area. The pump energy cost occupied 85% of the total cost. Electric power needed for pump operation is provided by INECO at an average rate of 2.14 pesos/kWh. This rate is about two times the NAPOCOR's rate. As a result, the financial status of the system showed as deficit of 318×10^3 pesos.

2.4 Bonga Pump #3 Irrigation System

The Bonga Pump #3 Irrigation System is located at the lower reaches of the Bonga river. Administratively the system belongs to Laoag municipality of Ilocos Norte province.

The service area of the system was 202 ha in 1986. The irrigated area in 1986 was 144 ha (71%) in the wet season and 67 ha (47%) in the dry season. Most of he remaining area is under rainfed condition. One of the causes of lower rate of irrigated area is mainly the disruption of function of the canal and siphon in the Lateral A/B areas which were damaged by earthquake in 1983.

The irrigation system is composed of a 4.8 km main canal, 3.3 km of lateral canals and 85 related structures. All the canals are of concrete lining type. The condition of these irrigation facilities is fairly good in general. However, it is necessary to improve part of the lateral canals because of their low embankment. Most of the turnouts are installed without control gates, and this fact impedes proper water delivery. There are 2 units of pumps at present but one is out of order because of a burned motor coil. The efficiency of the remaining operational pump is only at 46% of its rated capacity due to abrasion of the impellers. Furthermore, no fuse at primary circuit breaker and improper wiring installation are identified. It is prerequisite to prevent river bank from scouring on the upstream side of the pumping station.

The entire system was turned over to the Western IA in April 1986 in turn-over stage 2. This IA has a membership of 252 or about 60% of the total number of farmers in the system. The cash statement indicates that this IA is very active. Operation and maintenance of the system as well as collection of ISF are conducted by the IA. NIA provides technical services through assignment of one pump operator and one water master without charge. Two-block rotation system is applied along with one-week interval intermittent irrigation method. The main problem of water delivery is the lack of turnouts with gated structures. Maintenance of irrigation canals is carried out relatively well by IA.

Under such situation, the farmers apply the following cropping pattern; (i) paddy-paddy, (ii) paddy-fallow and (iii) paddy-diversified crops. The soils in the service area are medium and fine in texture. It appears that the diversified crops are grown in the medium textured soils. The farmers use most of IR varieties for rice and local varieties for garlic. As same as in the case of the Bonga Pump #1, tomato is expected to be one of the prospective diversified crops in the future. The yield of crops is estimated to be 3.8 to 4.1 tons/ha of paddy and 2.2 tons/ha of garlic. The cropping intensity is estimated to be 101% for the service area and 142% for irrigated area. About 420 farmers are settling in the service area. The average farm size is estimated at 0.5 ha. The economy of most of the farmers is considered to remain at the subsistence level.

The applied ISF rate in this system is 8 cavans of paddy/ha in the wet season, 12 cavans of paddy/ha in the dry season and 7.2 cavans of paddy equivalent/ha for diversified crops. The total amount of ISF collected in 1986 was 140×10^3 pesos, representing an estimated collection efficiency of 47%. The total O&M cost is estimated to be 277×10^3 pesos or 1,351 pesos/ha for the benefited area. Energy cost for pump operation occupies 70% of the total O&M cost. Electric power for pump operation is provided by INECO at a rate of 2.17 pesos/kWh on an average in 1986. This power rate is about two times that of NAPOCOR. Balance of income and O&M cost in the system showed a deficit of 137×10^3 pesos.

2.5 Iguig, Alcala-Amulung Pump Irrigation System

The Iguig, Alcala-Amulung Pump Irrigation system is located at the lower reaches of the Cagayan river. Administratively, the system is under the jurisdiction of Iguig, Alcala and Amulung municipalities, in Cagayan province.

This system consists of two independent irrigation systems; (i) Iguig pump irrigation system and (ii) Alcala-Amulung pump irrigation system. Water sources depend on the Cagayan river.

Operation of the Iguig and the Alcala-Amulung started in November 1983 and November 1982 respectively under the Cagayan Integrated Agricultural Development Project - Irrigation Component (CIADP-IC). This system was handed over by CIADP-IC to the Region II office in January 1987.

The service area is 2,443 ha comprising 603 ha in the Iguig and 1,840 ha in the Alcala-Amulung. In the Iguig, 218 ha (36%) and 362 ha (60%) of lands were irrigated in the wet and dry seasons in 1986, respectively. The irrigated areas in the Alcala-Amulung were 746 ha (41%) in the wet season and 1,015 ha (55%) in the dry season in 1986. The remaining area is under rainfed condition or fallow land. Such low irrigation ratio is considered to result from (i) restriction of irrigation area due to physical defects of canals (insufficient canal capacity), (ii) the fact that farmers do not want irrigation water due to high ISF, (iii) improper water delivery and (iv) inundation problems.

The irrigation facilities in the Iguig consist of a 6.1 km main canal, 8.2 km of lateral canals, 70 related structures and 11.6 km of service roads. The Alcala-Amulung has a 9.9 km main canal, 22.0 km of lateral canals, 141 related structures and 18.2 km of service roads. Most of the canals are of earth type. Related structures are in good condition. The problems are (i) silt deposits in the Alcala main canal as a cause of sheet erosion on the hillside along the canal, (ii) low embankment in some portions of the canals. The total length of drainage canals in both systems amounts to 45.9 km. These canals do not function due to insufficient canal capacity resulting from the lack of maintenance. The pumps in both systems have no specific problems. The operation efficiency of the existing pumps is over 90% of the rated capacity.

The both systems are managed by the Iguig, Alcala-Amulung Pump Irrigation System office. Staffing of the office and their work load are conforming to the NIA criteria. Water distribution is conducted by intermittent irrigation method, applying 3-block rotation system in the Iguig and 6-block rotation system in the Alcala-Amulung. Irrigation water supplied by the pumping system was as large as 2,100-2,500 mm/ha/year in 1986, according to estimation based on pump operation records. In spite of such condition, illegal water intake and complains of insufficient water distribution from the farmers occur in the system. The major reasons for improper distribution of irrigation water may be (i) physical defect of canals (silting problems), (ii) much water intake in the upper stream of canals and (iii) the fact that the farmers do not follow the irrigation schedule prepared by the system office.

Irrigators' associations (IAs) have not yet been instituted in the system. In order to promote the establishment of IAs, 2 irrigation community organizers were assigned to the system in August 1987. It is urgently required to set up active IAs in the system for efficient water and system management.

The total number of farmers in both service areas is estimated to be 3,170. The average farm size is estimated at about 0.8 ha. The cropping pattern prevailing in the area is (i) paddy-paddy and (ii) paddy-fallow. Although about 90% of the lands in the service area are classified into 1st class rice land, diversified crops are not cultivated in the service area due to such constraints as poor drainage, market and supporting systems at present. IR varieties are predominant in the service area. The unit yield of paddy is estimated to be 3.3 to 3.5 tons/ha. Because of small farm size and low yield of paddy, most of the farmers are considered to still remain at the subsistence level. In view of the conditions of soils, drainage, market and supporting systems, the introduction of diversified crops to the entire service area in the system would require huge investment. It is therefore to be difficult at present and even in the future.

Irrigation service fee levied on farmers is 7.5 cavans of paddy/ha in both wet and dry seasons. Total ISF collected in 1986 amounted to $1,419 \times 10^3$ pesos, corresponding to a collection efficiency of 51%. The total O&M cost in 1986 was estimated to be $1,913 \times 10^3$ pesos or 817 pesos/ha for the benefited area. The energy cost for pumps occupied about 30% of this total cost. The balance of income and O&M cost showed a deficit of 494×10^3 pesos in 1986.

2.6 Solana Pump Irrigation System

The Solana Pump Irrigation System is located 5 km west of Tuguegarao. It extends over the left bank in the lower reaches of the Cagayan river. Administratively, the system covers Solana municipality, Cagayan province.

The system has been operated since May 1980. The design area is said to be 3,600 ha. However, the irrigation service area in 1986 was 1,320 ha. Such a large reduction of irrigation service area mainly results from the following facts; (i) two out of the 4 pump units have not been operated and (ii) although the pumps are planned to be operated 24 hrs/day, the actual operation duration was limited to 10-14 hrs/day due to the bad condition of the pump motors. In 1986 the pumps were operated only in the dry season and 780 ha were irrigated. This represents a yearly irrigation ratio of only 60%.

The system's irrigation facilities consist of a 18.4 km main canal, 25.6 km of lateral canals, 191 related structures and 32.9 km of service roads. It has also 19.1 km of drainage canals. All the canals are of earth type. The main problems of the canals are (i) deterioration of the lower portion of the main canal, (ii) siltation in the upper portion of the main canal and (iii) embankment of the main canal. Especially sedimentation causes the drainage function to be worst.

Two pump units are not in operational condition due to defect of the control panel board, excessive vibration of pump/motors and water leakage. At present, only 2 pump units are operated. As a result, the actual discharge capacity of 2 pumps corresponds to only 40% of their total rated capacity. Loss of energy through power transmission to the pump station is another constraint. Besides, sand sedimentation at the intake site of the pumps causes submersion in every flood season. That is also one of the factors resulting in high maintenance cost.

The Solana irrigation system is managed by NIA and Solana Cagayan River IA. The system was turned over to IA in May 1987 in turn-over stage 2. IA has a membership of about 810 or equivalent to about 65% of

the total number of farmers in the service area. IA is responsible for O&M of the canals, preparation of list of irrigated and planted areas (LIPA), distribution of ISF bills and collection of ISF. NIA is responsible for management of pump operation, preparation of ISF bills and technical assistance to IA. Water delivery is done by intermittent irrigation method (one week interval). Three-block rotation system is practiced. Operation and control of irrigation water are not carried out properly. The main problems are mainly physical defects of control structures, insufficient canal capacity, some illegal water intakes, etc. Maintenance of the canal seems not to be conducted properly. According to the data on performance of training for IA farmers, the training programmes have scarcely been executed. Therefore, realization of training programmes for IA farmers is essential for effective O&M.

At present 1,250 farmers are engaged in paddy cultivation in the service area. The average farm size is estimated at about 1.1 ha. The farmers apply the paddy-paddy or paddy-fallow cropping pattern. The unit yield of paddy is 3.1 to 3.3 tons/ha. Diversified crops are not cultivated at present. It is considered that most of the farmers still remain at the subsistence level.

Demands for diversified crops are expected because Tuguegarao city, a big market place, is very near to the service area. However, for introduction of diversified crops in the area, careful study on their adaptability to the area is needed, considering the poor drainage condition, heavy clay soils, etc.

The ISF rate applied in the system is the highest among all the pumping systems: 14 cavans of paddy/ha for both wet and dry seasons. The total ISF amount collected in 1986 was 501×10^3 pesos, that means a collection efficiency of 44%. The total O&M cost was calculated at $2,083 \times 10^3$ pesos or 3,472 pesos/ha for the benefited area. Energy cost for the pumps occupied about 80% of the total O&M cost. Electric power needed for pump operation is provided by the Cagayan Electric Cooperative, inc. at an average rate of 1.9 pesos/kWh. Income and expenditures showed a deficit balance of $1,582 \times 10^3$ pesos in 1986.

2.7 Magat River Integrated Irrigation System (MARIIS)

2.7.1 MARIIS Pump #1 Irrigation System

The MARIIS Pump #1 System is a part of the MARIIS. It extends over the service area of the district IV in MARIIS. Administratively, it is under the jurisdiction of Angadanan and Alicia municipalities in Isabela province.

The system has been operated since 1985. Its service area is 1,200 ha out of which 422 ha (35%) were irrigated in the wet season and 389 ha (32%) in the dry season in 1986. The remaining area is rainfed or fallow land because levelling development of the lands is not yet completed. It is a rule that land levelling should be carried out at the farmers' own expenses. Then progress of development of these land was rather slow because the farmers encounter financial constraints.

The irrigation facilities in the system comprise a 7.8 km main canal, 9.1 km of lateral canals, 109 related structures and 16.9 km of service roads. All canals are of earth type. The condition of both the main and lateral canals is fairly good although the some portions of the canals are lower than the designed embankment level. The related structures on canals function physically well.

The pump station has 3 units, out of which one unit is not operational because of mixture of lubricating oil and water due to a defect of the oil seals. The remaining 2 pumps run quite well at an efficiency ratio of over 90% of their rated capacity.

The MARIIS Pump #1 System is managed by NIA and 3 irrigators' associations; BRD IA, Ramon Bagsak IA and Viga Region IA. The entire system was turned over to the IAs during the period of May to August 1984 in turn-over stage 1. The total membership of all IAs amounts to about 350 or about 25% of the total number of farmers in the service area. IAs are responsible for cleaning and maintenance of irrigation canals and assistance to activities of NIA field O&M staff. NIA is responsible for O&M work with the exception of maintenance of the canal facilities.

Water distribution is carried out by 4-block rotation system with weekly interval. Preliminary study indicates that irrigation water provided by the pumps was very abundant, reaching 3,400 mm/ha/year in 1986. In spite of such situation, there are phenomena of water shortage in the downstream part of the service area and illegal water intake. The facts suggest that (i) much irrigation water intake occurs in the upper stream of canals, (ii) there is discrepancy between the actual cropping pattern and the irrigation schedule, and (iii) farmland levelling is inadequate. The results of field interview with farmers and the field O&M staff of NIA indicated that non-member farmers in IAs do not follow the irrigation schedule and water distribution rule. This is one of the most serious constraints on equal distribution of irrigation water. Accordingly, it is essential to promote the motivation of these non-member farmers through training and organization.

Approximately 70% of the lands in the service area have undulating topography with a gradient of 3 to 8%. Up to the present, about 40% of the lands have been developed.

The farmers cultivate paddy in both seasons in the irrigated land. The rest of the area remains rainfed or fallow land. Diversified crops are not planted in the irrigated area. The unit yield of paddy is 3.5 to 4.0 tons/ha. At present, the total number of farmers in the service area is estimated to be 1,460. The farm size averages 0.8 ha per farm household. Early implementation of land development is the most urgent work to realize the fullest profit from the system as well as the better living standard of the farmers in the service area.

In 1986, the applied ISF rate is 6 cavans of paddy/ha in the wet season and 8 cavans of paddy/ha in the dry season. The total ISF amount collected was 467×10^3 pesos, representing a collection efficiency of 51%. The total O&M cost was estimated to be $1,598 \times 10^3$ pesos or 1,980 pesos/ha for the benefited area. Power energy cost for pump occupies about 70% of the total O&M cost. The cash balance of the system showed a deficit of $1,131 \times 10^3$ pesos in 1986.

2.7.2 MARIIS Pump #2 and #3 Irrigation System

The MARIIS Pump #2 and #3 System is a part of the MARIIS. It extends over the service area of the district III in MARIIS. The system covers the municipalities of Gamu and Burgos in Isabela province.

The system has been operated since November 1984. The service area of the system is 6,185 ha consisting of 3,098 ha in the Pump #2 area and 3,087 ha in the Pump #3 area. The Pump #3 station functions as a booster pump station. Water source depends on the North Diversion Canal No. 7 in

MARIIS. Out of the total service area, 2,286 ha (37%) and 2,176 ha (35%) were irrigated in wet and dry seasons in 1986, respectively. The rest still remains rainfed land or fallow land. As same as in the case of the MARIIS Pump #1 System, slow progress of land development seriously affects the expansion of irrigated land in this system.

The irrigation facilities comprise 25 km of main canals, 64.1 km of lateral canals, 423 related structures and 82.9 km of service roads. Earth canal type is applied in the system. The irrigation canals and related structures function fairly well although there are some constraints on minor repair and desilting.

The MARIIS Pump #2 station has 5 pump units, out of which one unit are out of order due to damage of the bowl, suction cover, oil seals and strainer as well as motor trip-off. The present actual capacity of the pumps is estimated to be 552 m^3/min in total or 55% of their total rated capacity. The operational pumps function well at an efficiency ratio of over 90%. All the pump units (5) in the MARIIS Pump #3 station are operated at a pump efficiency of about 80%.

At present 16 IAs were registered in the system. The total membership of IAs is estimated at 1,170 or 23% of the total number of farmers in the service area. NIA made contracts for turning over the system to 13 IAs out of the 16 IAs. The area covered by these contracts is estimated to be about 50% of the service area. The contracts were made in May 1985 in turn-over stage 1. As same as in the case of the MARIIS Pump #1, IAs contracted with NIA are responsible for cleaning and maintenance of canals and assistance to the work of field O&M staff of NIA. NIA is responsible for all the O&M work except for these of IA.

Delivery and control of irrigation water are not carried out properly at present. The area commanded by the Pump #3 has encountered severe water shortage. In 1986, the total irrigation water supplied by the Pump #2 was estimated at about 3,100 mm/year for the entire service area of 6,185 ha, indicating abundant supply of irrigation water. However, excessive water amount (about 3,500 mm/ha/year) was used in the area commanded by the Pump #2 which is located at the upper portion of the Pump #3. The main problems of improper delivery and control of water are accrued from (i) no establishment of proper operation rule, (ii) no application of rotational irrigation system, and (iii) low degree of farmers' understanding on irrigation, especially the non-member farmers of IAs. Training programme on irrigation management and organization of non-member farmers is pre-requisite.

Like the MARIIS Pump #1 area, about 40% of the land in the service area has undulating topography with a gradient of 3 to 5%. At present, land development for about 40% of the service area has already been implemented. The remaining areas are still under rainfed condition or fallow lands. At present about 5,000 farmers cultivate in the service area. The estimated average farm size is 1.1 ha. The cropping pattern comprises (i) paddy-paddy and (ii) paddy-fallow. No diversified crops are found in the irrigated land. The predominant rice varieties are IR series. In spite of the topographic constraints, the farmers apply direct seeding method in both seasons due to lack of labor force. The rate of direct seeding method application is 20% in the wet season and 40% in the dry season. The unit yield of paddy is estimated to be 3.5 to 4.0 tons/ha. The economy of most of the farmers is considered to still remain at subsistence level. Early implementation of land development is also urgently required here as same as in the MARIIS Pump #1 System.

The applied ISF rate is 6 cavans/ha of wet season paddy and 8 cavans/ha for dry season paddy. The total ISF amount collected in 1986

reached $2,051 \times 10^3$ pesos, i.e. a collection efficiency of around at 49%. The O&M cost was estimated to be $6,623 \times 10^3$ pesos for the entire service area or 1,484 pesos/ha for the benefited area. 76% of this cost was paid for energy consumed for the pumps. The balance of income from ISF and O&M cost showed a deficit of $4,572 \times 10^3$ pesos. The district III office has incomes other than ISF, mainly from rental charge of equipment. Such incomes estimated to be $2,711 \times 10^3$ pesos were allocated to the Pump #2/#3 system. Then the actual deficit was $1,861 \times 10^3$ pesos.

2.8 UPRIIS - Penaranda Pump Irrigation System

The UPRIIS - Penaranda Pump Irrigation System is located 15 km southeast of Cabanatuan city. It extends over the area of the District IV in the Upper Pampanga Integrated Irrigation System (UPRIIS). Administratively, it is under the jurisdiction of Penaranda municipality in Nueva Ecija province.

The system has been operated since 1981 under UPRIIS. The system was fully turned over to the Penaranda IA in June 1986 in turn-over stage 3. Management of the system is fully conducted by the Penaranda IA.

The service area is 400 ha. In 1986, 331 ha (83%) were irrigated in both wet and dry seasons. Water source is dependent on the main canal of the Penaranda River Irrigation System in the District IV, UPRIIS.

The irrigation facilities comprise a 4.5 km lateral canal, 27 related structures and 4.4 km of service roads. All the canals are of earth type and function properly, except for some minor problems of sand sedimentation due to lack of maintenance. The related structures are also working properly.

Two pump units are installed for the system. These are running at an efficiency ratio of about 80% of the rated capacity. Physically, no specific problems are identified.

A 3-block rotational irrigation system is established. However irrigation water distribution is not always strictly controlled, resulting in water shortage in the lower reaches of canals. Furthermore, irregularity of electric supply to the pumps constitutes one of the most serious constraints on operation. Electric power is provided by the Nueva Ecija 3 Electric Cooperatives, Inc. (NE3 Elect. Coop.) at an average rate of 2.31 pesos/kWh. However, power supply is often cut by NAPOCOR because of delay in payment of electricity bill by NE3 Elect. Coop.

There are 230 farmers in the service area. About 90% of the farmers are members of the Penaranda IA. The estimated average farm size is 1.7 ha. The farmers cultivate paddy in both wet and dry seasons. Diversified crops are not grown. The unit yield of paddy is 3.8 to 4.3 tons/ha. From the stand-point of relatively high unit yield of paddy and large farm size, the economy of the farmers in the system is considered to be fairly good.

The applied ISF rate was 7 cavans and 10 cavans per ha of paddy in wet and dry seasons, respectively. In 1986 an ISF amount of 594×10^3 pesos was collected, representing a collection efficiency of 76%. On the other hand, the total O&M cost amounted to 661×10^3 pesos or 1,009 pesos/ha for the benefited area. 91% of this cost was spent for power consumption by the pumps. The balance of ISF and the O&M cost showed a deficit of 61×10^3 pesos. The total amount to be paid to NIA was 55% of 833×10^3 pesos which consist of electric bill, amortization cost and service fee.

2.9 Angat-Maasim River Irrigation System (AMRIS)

2.9.1 AMRIS Bustos-Pandi Pump Irrigation System

The AMRIS Bustos-Pandi Pump Irrigation System is situated 6 km southeast of San Rafael. It extends over the Zone 1 area in AMRIS. Administratively, the system lies in the municipalities of Bustos and Pandi in Bulacan province.

This system was operated in 1968 under AMRIS. The system was fully turned over to the Buspan IA in June 1984 in turn-over stage 3. Management of the system is conducted by IA with technical assistance from NIA.

The service area is 731 ha. In 1986, 651 ha (89%) were irrigated in the wet season and 661 ha (90%) in the dry season. Water source is dependent on the Lateral B of South Main Canal of AMRIS. The irrigation facilities consist of a 13.8 km main canal, 17.2 km of lateral canals, 93 related structures and 15.8 km of service roads. All the canals are of earth type. These facilities function fairly well with minor repair.

There are two pump units in the pump station. The efficiency of these pumps is over 90% of their rated capacity (121.1 m^3/min). No specific constraints with regard to the pumps are identified. However, proper maintenance of the transmission line connecting the pump station with the sub-station of NAPOCOR is required.

Irrigation water delivery is carried out by 3-block rotation system with weekly interval. At present, strict control of irrigation water is done by IA under the technical assistance of NIA for pump operation. This system is one of the most successful irrigation systems among the turn-over programme in the country. The main reason of the success in water management is considered to be the effect of training of the IA farmers which has been done by eager and capable staffs of the AMRIS office during the turn-over period. During the turn-over period, the IA farmers understood the system and financial management and gained technological knowledge through the training.

At present, the Buspan IA has an active membership of about 500 or about 85% of the total number of farmers in the service area. The prevailing cropping pattern is 1.2 ha. The estimated average farm size is double cropping of paddy per year. No diversified crops are planted. The unit yield of paddy, 4.3 to 4.6 tons/ha, is the highest among all the systems. The economic condition of the farmers is considered to be good.

The ISF rate applied in the system is 5 cavans of paddy/ha in the wet season and 5.5 cavans of paddy/ha in the dry season. In 1986, the total ISF amount collected was 902×10^3 pesos, showing a collection efficiency of 89%. The O&M cost was estimated to be 506×10^3 pesos in total or 386 pesos/ha for the benefited area. Power energy cost occupies 96% of the total O&M cost. In conclusion, the financial status of IA showed a surplus of 396×10^3 pesos.

2.9.2 AMRIS Buenavista Pump Irrigation System

The AMRIS Buenavista Pump Irrigation System is located at 5 km northwest of San Rafael. It extends over the Zone 2 area in AMRIS and covers San Rafael municipality in Bulacan province.

This system has been operated since 1976 under AMRIS. In June 1985 NIA fully turned over the system to the Kapatiran IA at turn-over stage 3. All management of the system has been undertaken by this IA since then.

The service area is 351 ha. In 1986, 340 ha (97%) were irrigated in the wet season and 341 ha (97%) in the dry season. Water source is dependent on the North Main Canal of AMRIS.

The irrigation facilities include 5.1 km of lateral canals, 62 related structures and 3.1 km of service roads. The function of the irrigation canals and related structures is fairly good like the condition in the Bustos-Pandi Pump system. Minor repair of the facilities is needed.

There are 2 pump units in the System. No specific constraints of the pumps exist, except for improper wiring installation and connection in the control panel. The present pump operation efficiency is over 90% of their rated capacity. As same as in the case of the Bustos-Pandi system, proper maintenance of the transmission line is required.

Delivery and control of irrigation water are strictly conducted by IA. Three-block rotation system with weekly interval irrigation is practiced. This system is also one of the successful irrigation systems among the turn-over programs in the country. The main reason of the success is as same as in the Bustos-Pandi System.

The membership of Kapatiran IA amounts to 199. The estimated average farm size is 1.7 ha. The farmers practice double cropping of paddy per year. Diversified crops are not planted in the irrigated land. The unit yield of paddy is 3.7 to 4.2 tons/ha. Owing to the high yield of paddy and large farm size, the economy of the farmers in the system is considered to be good.

The ISF rate applied in the system is 4 cavans of paddy/ha in wet season paddy and 6 cavan/ha in dry season paddy. Total ISF amount collected in 1986 reached 472×10^3 pesos, representing a collection efficiency of 86%. The O&M cost was 256×10^3 pesos in total or 376 pesos/ha, 90% of this cost was spent for energy consumed for pump operation. The financial status of IA showed a surplus of 216×10^3 pesos.

2.9.3 AMRIS Tibagan Pump Irrigation System

The AMRIS Tibagan Pump Irrigation System is located at 6 km north of San Rafael. It extends over the Zone 1 area in AMRIS. The system is within the three municipalities of Angat, Bustos and Pandi in Bulacan province.

Operation of this system was commenced in 1976 under AMRIS. According to the turn-over programme, NIA fully turned over the system to the Anbuspa IA in June 1985 (turn-over stage 3). The service area is 1,295 ha. In 1986, 1,251 ha (97%) were irrigated in the wet season and 1,187 ha (92%) in the dry season. Water source is the Angat river.

The irrigation facilities comprise 26.7 km of main canals, 7.7 km of lateral canal, 227 related structures and 31.8 km of service roads. The irrigation canals and related structures function well in general. With respect to the 4-unit pumping station, there are no specific problems. The pump efficiency is over 90% of their rated capacity.

The area commanded by the system is irrigated through two main canals: i.e. the high line canal and the low line canal. Delivery and distribution of irrigation water are carried out at weekly intermittent irrigation interval by 5-block rotation system for the high line area and 3-block rotation system for the low line area. At present strict control and distribution of water are carried out by IA. Maintenance of canals is carried out well through farmers' mutual cooperation system. This system is also one of the most successful turn-over projects in the country. The main reason is as same as mentioned in the AMRIS Bustos-Pandi System and the AMRIS Buenavista system.

The total membership of the Anbuspa IA is about 1,160 or 96% of the farmers in the service area. The average farm size is about 1.1 ha. The cropping pattern prevailing in the system is double cropping of paddy per year. Diversified crops are not planted in the irrigated land. The unit yield of paddy is estimated to be 3.7 to 4.2 tons/ha. The economic condition of the farmers is considered to be good because of high yield of paddy and relatively large farm size.

The ISF rate applied in the system is 5 cavans of paddy/ha in the wet season and 7 cavans of paddy/ha in the dry season. IA collected an ISF amount of $1,564 \times 10^3$ pesos in 1986 with a collection efficiency of 62%. In 1987 the collection efficiency rose up to 76%. The O&M cost in 1986 was estimated to be $1,749 \times 10^3$ pesos in total or 731 pesos/ha for the benefited area. The cash balance of income of ISF and O&M cost showed a deficit of 185×10^3 pesos. However the financial status of IA has improved steadily year by year.

2.10 Cabuyao East Pump Irrigation System

The Cabuyao East Pump Irrigation System is located about 35 km south of Metro Manila. It extends over the lands along the Laguna de Bay near Cabuyao. Administratively, the system is under Cabuyao municipality in Laguna province.

The system was constructed during the period from 1977 to 1983 to irrigate an area of about 1,500 ha. At the same time a small diversion weir at the San Juan river has been constructed to supply supplemental irrigation water. The land was initially planned to be irrigated through four laterals; A, B, C and D branched from the main canal. However, the farmers in the area commanded by the laterals C and D have cultivated paddy in the wet season and diversified crops in the dry season using only irrigation water from the diversion weir at the Niugan river. And the farmers do not want to use irrigation water released from the pumps, therefore the said areas were excluded from the service area of the Cabuyao East System. The service area of the system is reduced to 575 ha at present. In 1986, 570 ha (99%) were irrigated in the wet season and 504 ha (88%) in the dry season. Water source depends on the San Cristobal river.

The irrigation facilities consist of nine main canals of 6.9 km in total length, 11.2 km of lateral canals, 111 related structures and 16.5 km of service roads. About 50% of the canals are lined. In general the canals and related structures are well maintained except for some minor portions to be repaired.

The pump station consists of 3 pump units, all of which are operational. There are no specific constraints with regard to the pumps except for the minor problem of 3-phase current unbalance in all the pump motors. The present pump efficiency is 83%.

Management of the system is conducted by the Laguna Friar Land Irrigation System office. The system is not yet turned over to IA although two IAs-Kagitingan IA and Anak Bukid IA-have been organized already. The field O&M staffs comprise 1 water master, 1 gatekeeper, 6 ditchtenders and 2 pump operators. The work load of these staffs generally conforms to the NIA standard. Distribution of irrigation water is made properly in general. Two-block irrigation rotation system is applied in the system.

In the service area, 490 farmers are engaged in paddy cultivation. They practice double cropping of paddy per year or paddy-fallow pattern. Diversified crops are not cultivated in the irrigated land. The most recent IR varieties are dominant. Most of the farmers in the service area practice dapog seedling method and straight transplanting method. It is said that the area under the system is one of the most advanced areas of rice cultivation in the Philippines. The unit yield of paddy is 4.3 to 4.6 tons/ha. The estimated average farm size is 1.2 ha. The economic condition of the farmers is considered to be good.

The ISF rate applied in the system was 3 cavans of paddy/ha in the wet season and 4 cavans of paddy/ha in the dry season. The total ISF amount collected was $1,012 \times 10^3$ pesos, showing a collection efficiency of 82% in 1986. On the other hand, the O&M cost was 596×10^3 pesos in total or 594 pesos/ha for the benefited area. The energy cost for the pumps occupies about 60% of the total O&M cost. The financial status of the system showed an estimated surplus of 416×10^3 pesos.

2.11 Santa Cruz River Irrigation System

The Santa Cruz River Irrigation System is located about 50 km southeast of Metro Manila. It extends over the land along the Laguna de Bay near Pila. Administratively, the service area covers six municipalities in Laguna province; Pila, Calauan, Nagcarlan, Liliw, Santa Cruz and Victoria.

Historically, this system was implemented in 1958 as a gravity irrigation system. After that, establishment of two pumping systems and rehabilitation/extension of the existing system were planned to increase dependability of irrigation water under the Laguna de Bay Development Project-1. The service area in this plan was delineated to be 6,340 ha. The construction was conducted during the period from 1977 to 1985. In this service area there were considerable plantation areas of sugarcane, coconut and lanzones. Incidentally, the farmers in the plantation area did not want to diversify the crop to include paddy cultivation and also had no intention to receive irrigation water. NIA, therefore, excluded such lands from the service area. Then the service area is reduced to 3,362 ha at present. On the other hand the pumping stations were constructed in 1983. Operation of the pumps, however, has not yet been done up to date since an agreement on irrigation service fee between NIA and the farmers has not yet been reached.

At present irrigation is carried out by gravity system. Irrigation water is fed by the Santa Cruz river through the Santa Cruz diversion dam. In 1986, 2,313 ha (69%) were irrigated in the wet season and 2,176 ha (65%) in the dry season. Most of the remaining area is rainfed or fallow land.

The irrigation facilities consist of 24.1 km of main canals, 63.7 km of lateral canals, 475 related structures and 70.8 km of service roads. About 45% of the canals are lined. The canals and related structures are

good in condition in general. However, the system office encounteres the following problems with respect to the newly constructed pump system: (i) need of rehabilitation about 100 m of pipeline (1-B) connecting the No. 1 pump station with the No. 2 pump station (booster pumps) damaged by uplift, (ii) insufficient flow capacity at the lower reaches of the Buluscan river (3 km) to be used as an inlet channel leading water from the Laguna to the intake site of the pump No. 1 and (iii) need for minor repair of irrigation facilities. As for the pumps, their operation has not yet been started since their installation.

The system are fully managed by the Santa Cruz, Mabacan, Malaunod, Balanac and Lumban River Irrigation Systems. The turn-over programme is not yet realized. The field O&M staffs assigned to the system comprise 2 water masters, 1 gatekeeper and 23 ditchtenders. The work load of these staffs mostly accords with the NIA criteria.

In the service area there are about 2,400 farmers having an average farm size of 1.4 ha. It is also well known that the service area is one of the most advanced areas of rice cultivation. The most recent IR varieties are applied. Dapog seedling method and straight transplanting method are practiced. The cropping pattern prevailing in the service area comprises (i) double cropping of paddy per year and (ii) paddy-fallow. The unit yield of paddy is 3.6 to 4.2 tons/ha.

Two irrigators' associations have been established: (i) Walang Tangihan IA and (ii) Isang Diwa IA. The membership of both IAs totals 255 or about 10% of the total number of farmers in the service area.

Since the service area is irrigated by only the gravity system at present, ISF rate is set at 2 cavans of paddy/ha for the wet season and 3 cavans of paddy/ha for the dry season. In 1986, an ISF amount of $1,271 \times 10^3$ pesos was collected, corresponding to a 76% in collection efficiency. The O&M cost was $1,091 \times 10^3$ pesos in total or 293 pesos/ha for the benefited area. In conclusion, the financial status of the system showed a surplus of 180×10^6 pesos.

2.12 Santa Maria River Irrigation System

The Santa Maria River Irrigation System is located about 40 km southeast of Metro Manila. It extends over the flat alluvial plain along the Laguna de Bay near Santa Maria. Administratively, the service area of the system is under the jurisdiction of three municipalities in Laguna province; Santa Maria, Mabitac and Pangil.

The service area of the system as delineated in 1986 was 1,653 ha. Irrigation water is supplied by (i) the Mata diversion dam (Mata river), (ii) the Santa Maria diversion dam (Santa Maria river), and (iii) the Laguna de Bay. There are two pump stations: Pump Station No. 1 and Pump Station No. 2. The pump station No. 2 has a function as a booster station. The service area is broadly divided into two areas. One is the area of 639 ha irrigated by the pump station No. 1. The other is the area of 1,014 ha served by the two dams and the pump station No. 2. However, the pump station No. 2 has not yet been operated since its installation.

In 1986, 841 ha (51%) were irrigated in the wet season and 1,129 ha (68%) in the dry season. The pump station No. 1 is operated only in the dry season and irrigates 289 ha.

The system's irrigation facilities consist of 35.2 km of main canals, 17 km of lateral canals, 269 related structures and 47.6 km of

service roads. In general, the canals and related structures are functioning properly.

Each of the pump stations has 3 pump units. Although the efficiency of these pumps cannot be identified because of interruption of electric supply from First Laguna Electric Cooperative, Inc. (FLELCO) at present, there seems to be no specific problems for these pumps except check bulb was damaged.

The system is fully managed by the Santa Maria-Mayor River Irrigation System office. The field O&M staff assigned to the system comprises 1 water management technologist, 1 gatekeeper, 1 pump operator and 7 ditchtenders. The work load of these staff is reasonable in comparison with the NIA standard. Rotational irrigation system is not practiced in the system. Distribution and control of irrigation water are not always carried out properly because of lack of on-farm facilities and improper operation of gates.

There are three irrigators' associations; Supply Main Canal #1 IA, Lateral G IA and Lateral A Extension IA. However, they are not yet registered by the Exchange Commission and also appear not active. In the service area there are about 1,580 farmers having an area of 1.1 ha in farm size. All the farmers are engaged in paddy cultivation. The farmers use IR varieties of rice and practice straight transplanting method. No diversified crops are planted. The prevailing cropping pattern in the service area comprises (i) double cropping of paddy and (ii) paddy-fallow. The cropping intensity is estimated to be 130% in the irrigated area. The unit yield of paddy is estimated to be 3.0 to 3.6 tons/ha.

Three different ISF rates are applied in the system as follows:

(cavans of paddy/ha)

Area	Wet Season Paddy	Dry Season Paddy
Area served by pumps only	7	10
Area served by the dams	2	3
Area served by pumps & dams	5	7

The total ISF amount collected in 1986 was 355×10^3 pesos, that means a collection efficiency of 55%. On the other hand, the O&M cost was estimated to be $1,183 \times 10^3$ pesos in total or 814 pesos/ha for the benefited area. Electric power for pump operation is supplied by FLELCO at an average rate of 2.16 pesos/kWh. The energy cost for pump occupies 50% of the total O&M cost. The financial status in 1986 showed a deficit of 828×10^3 pesos.

2.13 Libmanan-Cabusao Pump Irrigation System

The Libmanan-Cabusao Pump Irrigation System is located about 15 km northwest of Naga city. It extends over the flat alluvial plains near the estuary of the Bicol river. It is under the jurisdiction of the municipalities of Libmanan and Cabusao in Camarines Sur province.

Construction of the system was started in 1976 and completed in 1981. During the construction period, formation of irrigators' organization was implemented and the Libmanan-Cabusao Irrigators Service

Cooperative (LCISC) was registered in 1981. A memorandum of agreement was signed between LCISC and NIA in April 1982 for joint management of the system. A management committee was created, being composed of 4 LCISC directors and 3 NIA representatives assisted by the chief of the system. The joint management was performed for four cropping seasons. LCISC, however, backed out of the contract in May 1985.

The service area has been originally designed to be about 4,523 ha, but was reduced to 2,195 ha in 1986. Such a reduction in area results from the fact that: (i) there are higher elevated lands which could not be irrigated by the existing system in the design area, (ii) the area at the end portion of the canal cannot be irrigated due to defect of irrigation canal facilities, and (iii) insufficient irrigation water supply from the pumps (2 out of the 4 pump units are out of order).

The system's irrigation facilities comprise 9 main canals of 11.2 km long in total, 53 km of lateral canals, 297 related structures, 40.5 km of service roads and 11 flap gates. There are 56.8 km of drainage canals. Most of these facilities are rather poor in condition. The following physical defects are the most severe constraints for operation; (i) decrease of canal capacity due to siltation in the closed conduit in the upper reaches of the main canal, (ii) actual flow capacity being smaller than the designed capacity due to outcrop of hard rocks in the downstream portion of the said conduit, (iii) low embankment of the canals, (iv) decrease of flow capacity at considerable portions of the lateral canals due to silting and land slipping of canal slopes, (v) total deterioration of a catch drain, (vi) siltation in all the drainage canals, and (vii) deterioration of all the flap gates.

There are 4 pump units in the pump station. Out of these, 2 units are not operational due to defect of their motors and fuse. Another operational pumps have no specific problems, and run at over 90% of their rated capacity.

The system is managed by the Libmanan-Cabusao Pump Irrigation System office at present. The field O&M staff consists of 2 water masters and 2 pump operators. No ditchtenders are assigned to the system. Judging from the NIA standard on work load, reinforcement of staff with emphasis on ditchtenders and administrative staff for ISF collection is essential.

Delivery and control of irrigation water are not conducted properly due to physical defects of irrigation/drainage facilities as well as shortage of O&M staff.

In order to reorganize of the irrigators' associations, NIA assigned one irrigation community organizer to the system. Up to the present, 2 irrigators' associations have been registered; Handong IA and CUISA IA. The total membership of both IAs is 232 or 13% of the total number of farmers in the service area. The total irrigation area commanded by IAs is 235 ha or about 20% of the total service area of the system. The Handong IA and the CUISA IA were turned over in June 1987 and January 1986, respectively. Both IAs are under turn-over stage 3. At present these IAs are very active.

There exist about 1,050 farmers in the service area and their average farm size is 2.1 ha. About 60% of the lands in the service area are low lying lands classified as second- and third-class rice land. At present, these lands are very poorly drained due to non function of the drainage canals. Such situation seriously affects the rice yield. The farmers cultivate only paddy. The prevailing cropping pattern is (i) double cropping of paddy per year and (ii) paddy-fallow. The unit

of 2.8 to 3.3 tons/ha is the lowest in all the systems. The cropping intensity is about 120% in the irrigated area.

The ISF rate in the system was set at 6 cavans of paddy/ha for both seasons. The total ISF amount collected in 1986 was 296×10^3 pesos. This represents a collection efficiency of 24% which is the lowest in the pumping systems. The O&M cost was $1,501 \times 10^3$ pesos in total or 1,136 pesos/ha for the benefited area. Electric power cost for the pumps was calculated to be 74% of the total O&M cost. Electric power for the pumps is supplied by the Camarines Sur Electric Cooperative, Inc. at an average rate of 2.1 pesos/kWh. The financial status of the system showed a deficit of $1,205 \times 10^3$ pesos.

3. IMPROVEMENT PLAN ON OPERATION AND MAINTENANCE OF THE NATIONAL PUMP IRRIGATION SYSTEMS

3.1 Basic Development Concept

The chapter 2 clarifies present problems and constraints on management on the existing national pump irrigation systems. These may be summarized as follows; (i) the financial status of the systems is marginal or is becoming worse and (ii) the farmer's economy of most of the beneficiary farmers in the systems remains at the subsistence level.

The financial status of the systems has been seriously affected by rising operation and maintenance costs and a low collection rate of irrigation service fee. The rising O&M costs result from (i) rising unit costs of electricity for operation of the pumps, (ii) falling efficiency of pump facilities and (iii) falling overall irrigation efficiency due to deterioration of irrigation/drainage facilities and improper management of operation and maintenance. The low rate and amount of irrigation service fee collection result from a complicated combination of (i) negative farmer's perception of NIA services caused by shortage of irrigation water supply, (ii) low payment capacity of farmers, and (iii) constraints on the fee collection method.

The subsistence farmer's poor economy is considered to be the result of low farm income due to (i) low unit yields of paddy, (ii) the low cropping intensity and (iii) small farm size.

The basic development concept for this study is to be set therefore, (i) to improve the financial status of the systems and (ii) to increase farmers' income in the systems. Accordingly the approach to the study has been formulated as follows:

(i) Cheaper electricity for pump operation will be obtained by direct purchase of electric power from the National Power Corporation where the present power sources depend on the local cooperative inc. Further study on mini-hydropower development project will be carried out to locate cheaper electricity,

(ii) Raising the present efficiency of the pumps will be realized through improvement and/or replacement of pump facilities including electric equipment,

(iii) Irrigation efficiency will be improved through rehabilitation and/or improvement of the existing irrigation and drainage facilities in the Systems,

(iv) Land development will be carried out in areas where land levelling has not yet been done,

(v) Management of operation and maintenance, especially for raising irrigation efficiency, will be improved by strengthening O&M and monitoring equipment, reinforcement of O&M staff in the system and guidance/advice to the farmers, systematization/ simplification of the recording system, improvement of communications and application of proper regulation/work schedules for O&M of the facilities,

(vi) Increase of crop production will be realized by increasing cropping intensity and unit yields of crops through

application of proper irrigation farming under adequate distribution of irrigation water, and

(vii) Crop diversification with higher profitability crops will be introduced into the Systems to the extent that conditions of climate, soils and marketability of the crops permit.

This basic approach to the improvement of operation and maintenance of the national pump irrigation systems is illustrated in Fig. 3.1.

3.2 Delineation of the Study Area

The irrigation service area for each of the pump irrigation systems has declined since construction for various reasons. Taking account of such circumstances, the study for the objective area for each of the pump irrigation systems has been carried out for both "the generated area" and "the present irrigation service area" as alternative plans.

(Unit: ha)

Pump Irrigation System	Generated Area	Present Service Area
Bonga pump #1	426	298
Bonga pump #2	1,200	674
Bonga pump #3	218	202
Iguig	770	603
Alcala-Amulung	2,279	1,840
Solana	2,865	1,210
MARIIS pump #1	1,667	1,200
MARIIS pump #2/#3	6,753	6,185
Penaranda	535	400
Bustos-Pandi	900	731
Buenavista	541	351
Tibagan	1,839	1,295
Cabuyao East	1,013	575
Santa Cruz	4,896	3,362
Santa Maria	2,800	1,653
Libmanan-Cabusao	4,102	2,195

Water sources of irrigation water supply to each of the pump irrigation systems were analized for both the generated area and the present irrigation service area. The result of the analyses indicates that present water sources can fully provide perennial irrigation water with each of the systems.

3.3 Improvement Plan of Physical Facilities

3.3.1 Pump and Power Supply

The basic concept of the improvement plan on the pumping and electrical equipment is to maintain an appropriate pump efficiency of the pumps and to reduce electrical charge for operation.

The improvement plan for the pumping and electrical equipment in each of the systems has been formulated for replacement or rehabilitation

of the equipment as appropriate taking into account the present condition of the equipment and its economic life.

Economic life of these equipment is applied to 15 years for pump, motor, switchgear and transformer, 20 years for valve and 25 years for piping fitting.

In replacement of the pumps, vertical shaft mixed flow type will be adopted.

Power supply for pump operation is planned to be obtained by direct purchase of electric power from NAPOCOR where the present power sources depend on the local cooperative inc. Transmission line connecting the pump stations and the existing power grid of NAPOCOR will be installed for seven pump systems, namely as Bonga pump #1, Bonga pump #2, Bonga pump #3, Solana, Penaranda, Santa Maria and Libmanan-Cabusao. Substation will be also installed at Libmanan-Cabusao. The existing transmission line is planned to be replaced taking into its' economic life (15 years).

The proposed works of pump and power supply facilities for each of the systems are shown in Table 3.1.

3.3.2 Irrigation and Drainage

The irrigation and drainage plan has been carried out to restore the existing facilities to the original design in principle.

In addition, to facilitate water management, special attention has been paid to installation of steel gates at all the point of turnouts, head and check structures. Also installation of on-farm canals is planned at the density of 70 m/ha for farm ditches and 60 m/ha for farm drains.

Farm road is planned to be installed alongside the main canals and the lateral canals by rehabilitation and new construction.

The proposed works of these facilities are shown in Table 3.2.

3.3.3 Land Development

Land development work has been completed for all systems except MARIIS pump #1 and MARIIS pump #2/#3. Land development plans, therefore, have only been formulated for MARIIS pump #1 and #2/#3 systems.

The objective areas for land development will be shown as follows:

(Unit: ha)

System	Present Service Area	The Generated Area
MARIIS pump #1	720	1,190
MARIIS pump #2/#3	3,710	4,280

3.4 Improvement Plan on System Management

3.4.1 System Office

As described in chapter 2, the pump irrigation systems are managed by the NIA system office or irrigator's associations. Bonga pump #1, Bonga pump #2, Bonga pump #3, Iguig, Alcala-Amulung, Solana, MARIIS pump #1, MARIIS pump #2/#3, Cabuyao East, Santa Cruz, Santa Maria and Libmanan-Cabusao are fully managed by the NIA system offices. Other irrigation systems are under turn-over stage 3 and managed by the respective irrigator's association.

Organizational structure of the present NIA system offices is simple in general. A superintendent is fully responsible for an overall O&M management on the irrigation system. Under him there are two sections; administration and operation & management, in general. The system offices function well in general from the standpoint of structure. The present simple organizational structure will remain in the future.

The work load of O&M staff is different among the system offices. The institutional plan for the system offices, therefore, has been formulated to reinforce O&M staff, especially ditch tender and watermaster, on the basis of an assessment of present work load of staff. The result are shown as follows:

(Unit: No. of staff)

System	Present Condition		With Project Condition			
			Service Area		Generated Area	
	WM	DT	WM	DT	WM	DT
Bonga pump #1	1	0	1	0	1	0
Bonga pump #2	1	0	1	0	1	0
Bonga pump #3	1	0	1	0	1	0
Iguig	1	3	1	3	1	3
Alcala-Amulung	2	7	2	7	2	7
Solana	2	5	2	5	4	6
MARIIS pump #1	2	0	2	0	2	0
MARIIS pump #2/#3	3	7	8	7	9	7
Cabuyao East	1	6	1	6	1	6
Santa Cruz	2	23	4	23	7	23
Santa Maria	1	7	2	7	4	12
Libmanan-Cabusao	2	0	2	8	5	9

WM: Water Master, DT: Ditch Tender

The farmer's associations in the systems have been instituted under assistance of the NIA. The irrigation systems namely Penaranda, Bustos-Pandi, Buenavista, Tibagan and some part of Libmanan-Cabusao are fully managed by the irrigator's associations. The farmer's associations are functioned well with respect to management of O&M works and will perform O&M works in the future.

3.4.2 Water Distribution

Irrigation water distribution at the right time and in proper volume is essential for increasing agricultural production. For this purpose the water distribution will be planned taking account of the followings:

(i) Irrigation schedule will be made systematically and practically,

(ii) Present rotational irrigation systems will be modified taking into consideration the existing canal systems and their canal capacities,

(iii) Irrigation water delivery will be controlled by the head gates at laterals and sub-laterals,

(iv) Operation of turnout in irrigation water distribution will be carried out under fully opened or fully closed gate condition, and

(v) Present suspension schedule on irrigation water supply will be modified taking account of local condition.

3.4.3 Communication and Monitoring System

There exist several internal communication methods within each of the irrigation systems; i) meeting/conference, ii) official written memorandum circulars, iii) bulletin board, iv) public address and v) radio/walkie-talkie communication systems.

The organization of the each of the system offices is simple and small, so that communication within the system office functions well except non-functional communication of radio. The improvement plan on communication system, therefore, has been formulated to rehabilitate the existing communication equipment of radio and walkie-talkie. Further reinforcement of transportation equipment is planned on the basis of the size of area and length of roads.

Monitoring on meteo-hydrological measurement, progress of irrigated area and identification of agronomic characteristics is one of the most important key factors for operation. At present equipment of meteo-hydrological measurement are considerably deteriorated and insufficient for smooth operation. The improvement plan on monitoring system, therefore, has been formulated to rehabilitate the existing equipments and reinforce number of equipment. The installation of equipment is planned as follows:

(i) rain gage : One set of rain gage will be installed at each of the pump station.

(ii) staff gage : One set of staff gage will be installed at outlet of each of the pump station as well as canals up to laterals.

The proposed works of communication and monitoring system is shown in Table 3.3.

3.4.4 Maintenance and Repairing

Maintenance and repairing works for irrigation/drainage facilities comprise (i) rehabilitation work and daily routing work to keep facilities in good operating conditions. At present maintenance and repairing of these facilities are not carried out sufficiently due to lack of fund. Problems are deficiency of the daily maintenance and minor repair. Considerable number of the operationable gates have no lubricating oil. Vegetation control is not satisfactorily practiced for lower reach of

laterals and sub-lateral. Also sand sedimentation control is not satisfactorily practice in the irrigation system to large extent.

The improvement plan on maintenance and repairing is formulated to reinforce budget for O&M and repairing and to strengthen the O&M staff (especially ditch tender). Further number of maintenance equipment is planned to be strengthened.

These proposed number of equipment is shown in Table 3.3.

3.5 Farm Management Plan

3.5.1 Land Use and Cropping Pattern

The irrigation project will provide base to increase unit yield of crops and crop production through completion of pump, irrigation, drainage and related facilities. After implementation of the project, present land use conditions will change considerably as follows:

(Unit: ha)

System	Present Condition						With Project Condition			
	Service Area			Generated Area			Service Area		Generated Area	
	RF	IL		RF	IL		RF	IL	RF	IL
		Wet	Dry		Wet	Dry				
Bonga pump #1	161	137	132	289	137	132	0	298	0	426
Bonga pump #2	183	491	264	709	491	264	0	674	0	1,200
Bonga pump #3	56	146	84	72	146	84	0	202	0	218
Iguig	329	274	397	382	274	397	0	603	0	770
Alcala-Amulung	1,094	746	1,009	1,102	746	1,009	0	1,840	0	2,279
Solana	446	874	798	1,787	874	798	0	1,320	0	2,865
MARIIS #1	117	355	301	122	355	301	0	1,200	0	1,667
MARIIS #2/#3	202	2,604	2,340	242	2,604	2,340	0	6,185	0	6,753
Penaranda	73	327	341	208	327	341	0	400	0	535
Bustos-Pandi	48	660	659	191	660	659	0	731	0	900
Buenavista	18	328	333	193	328	333	0	351	0	541
Tibagan	48	1,237	1,205	540	1,237	1,205	0	1,295	0	1,839
Cabuyao East	6	569	526	444	569	526	0	575	0	1,013
Santa Cruz	969	2,250	1,940	2,503	2,250	1,940	0	3,362	0	4,896
Santa Maria	723	730	858	1,870	730	858	0	1,653	0	2,800
Libmanan-Cabusao	779	1,416	1,563	2,686	1,416	1,563	0	2,195	0	4,102

RF: rainfed, IL: irrigated land

The cropping pattern for each irrigation system has been examined from the standpoint of climatic conditions, agricultural characteristics of soils, marketability of crops, farmer's experience and intentions, etc. Introduction of double cropping of paddy has been planned for the systems other than Bonga pump #1, Bonga pump #2 and Bonga pump #3. In the Bonga pump systems a cropping pattern consisting of wet season paddy and dry season diversified crops (tomato and garlic) are proposed with special emphasis being given to the marketability of processed tomatos.

Proposed cropping pattern is illustrated in Fig. 3.2.

3.5.2 Farming Practice and Anticipated Yield

Proper farming practice is the most essential factor for realizing full exploitation of the agricultural potential in the systems. For this purpose high-yielding and/or improved varieties will be introduced. Proper amount of fertilizer and chemicals will be applied through proper farming practices with project condition.

The recommended farm inputs per ha are shown below:

(Unit: kg/ha)

Item		Paddy		Tomato	Garlic
		Wet	Dry		
Seed		50	50	0.3	500
Fertilizer:	N	75	80	100	120
	P	35	35	85	100
	K	35	35	85	100
Chemicals		13	13	8	5
Labor	(man-day)	105	110	209	206
Animal	(animal-day)	2	2	0	0
Machine	(machinery-day)	0.5	0.5	0.5	0.5

Unit yields of crops are estimated both in future without and with project conditions.

Unit yields of crops in future without project condition are estimated as same as present unit yields. However the unit yield of crops under present irrigated condition is estimated to become unit yield under rainfed condition after when economic life of the existing pump equipment expires.

Unit yields of crops, in future with project condition are estimated on the basis of the results of interview survey on well irrigated land and data obtained from the authority concerned.

The anticipated unit yield of crops is estimated as follows:

(Unit: ton/ha)

System	Without Project Condition			With Project Condition			
	Wet Season Paddy		Dry Season Paddy	Wet Season Paddy	Dry Season		
					Paddy	Garlic	Tomato
	RF	IL	IL	IL	IL	IL	IL
Bonga pump #1	2.3	-	-	4.5	5.0	4.5	10.0
Bonga pump #2	2.4	-	-	4.5	5.0	4.5	10.0
Bonga pump #3	2.3	-	-	4.5	5.0	4.5	10.0
Iguig	1.8	3.3	3.5	4.5	5.0	-	-
Alcala-Amulung	1.8	3.3	3.5	4.5	5.0	-	-
Solana	2.0	-	-	4.5	5.0	-	-
MARIIS #1	1.8	3.5	4.0	4.5	5.0	-	-
MARIIS #2/#3	1.8	3.5	4.0	4.5	5.0	-	-
Penaranda	3.4	-	-	4.5	5.0	-	-
Bustos-Pandi	3.5	-	-	4.5	5.0	-	-
Buenavista	3.3	-	-	4.5	5.0	-	-
Tibagan	3.4	-	-	4.5	5.0	-	-
Cabuyao East	1.7	-	-	4.5	5.0	-	-
Santa Cruz	1.7	-	-	4.5	5.0	-	-
Santa Maria	1.7	-	-	4.5	5.0	-	-
Libmanan-Cabusao	2.0	-	-	4.5	5.0	-	-

RF: rainfed, IL: irrigated land

For the achievement of the anticipated yield, optimum application of farm input will be required together with effective water management.

Total production of crops with project condition in each of the systems is estimated as follows:

(Unit: ton)

System	Paddy		Garlic		Tomato	
	SA	GA	SA	GA	SA	GA
Bonga pump #1	2,380	3,400	50	50	800	1,200
Bonga pump #2	5,800	10,300	160	160	850	1,850
Bonga pump #3	1,570	1,670	90	90	500	600
Iguig	5,730	7,320	-	-	-	-
Alcala-Amulung	17,480	21,650	-	-	-	-
Solana	12,540	27,220	-	-	-	-
MARIIS #1	11,400	15,840	-	-	-	-
MARIIS #2/#3	58,760	64,150	-	-	-	-
Penaranda	3,800	5,080	-	-	-	-
Bustos-Pandi	6,940	8,550	-	-	-	-
Buenavista	3,330	5,140	-	-	-	-
Tibagan	12,300	17,470	-	-	-	-
Cabuyao East	5,460	9,620	-	-	-	-
Santa Cruz	31,940	46,510	-	-	-	-
Santa Maria	15,700	26,600	-	-	-	-
Libmanan-Cabusao	20,850	38,970	-	-	-	-

SA: Present Service Area, GA: Generated Area

3.5.3 Farm Income

In order to assess the irrigation project from farmer's economy viewpoint, preliminary analysis of farm budget for typical farmer is examined under present condition and future with project condition.

After completion of the project, perennial irrigation will become available for farmers. As a result, increase of unit yield of crops and cropping intensity will be much expected in the future with project condition. Under such situations, drastic increase of farm income can be expected for the farmers in the systems. The farm income for typical farmers in present condition and with project condition is presented below:

(Unit: Peso)

System	Farm Size (ha)	Present Condition		With Project Condition		Increment	
		SA	GA	SA	GA	SA	GA
Bonga pump #1	0.21	2,107	1,803	5,218	5,218	3,111	3,415
Bonga pump #2	0.27	3,654	-	6,799	-	3,145	-
Bonga pump #3	0.48	7,043	7,043	11,974	11,974	4,931	4,931
Iguig	0.61	7,351	6,325	12,846	12,846	5,495	6,521
Alcala-Amulung	0.77	7,560	6,494	14,188	14,188	6,628	7,694
Solana	1.06	13,698	9,213	17,914	17,914	4,216	8,701
MARIIS #1	0.82	3,320	2,390	11,832	11,832	8,512	9,442
MARIIS #2/#3	1.08	5,735	5,253	15,130	15,130	9,395	9,877
Penaranda	1.74	23,853	20,614	24,879	24,879	1,025	4,264
Bustos-Pandi	1.21	14,945	13,454	15,492	15,492	546	2,038
Buenavista	1.65	20,121	16,223	20,927	20,927	806	4,704
Tibagan	1.08	13,037	10,932	13,698	13,698	660	2,766
Cabuyao East	1.18	211,077	13,227	21,358	21,358	281	8,131
Santa Cruz	1.41	16,349	12,572	25,373	25,373	9,024	12,801
Santa Maria	1.05	8,732	6,463	18,711	18,711	9,979	12,248
Libmanan-Cabusao	2.09	9,331	8,424	32,056	32,056	22,725	23,632

SA: Present Service Area, GA: Generated Area

3.6 Training Programme

3.6.1 O&M Staff

It is essential for effective and smooth performance of O&M works to reinforce the ability of O&M staff with the skills of O&M works in terms of expansion of knowledge and understanding of O&M works. It is therefore proposed that the emphasis of training should be on the practical skills necessary for performance of O&M through on-the-job training and seminar/lecture.

Training programmes are planned for ditchtenders, water masters and pump operators.

Training will be aimed at bringing about specific improvements such as:

(i) correct and accurate collection of discharge, rainfall, crop area and other data required for system operation.

(ii) processing, analysis and recording data in a systematic, logical and uniform manner.

(iii) planning, allocating and controlling water distribution so that prescribed discharges are maintained at control points.

(iv) promoting a real understanding of interdependence of water supply and crop production.

(v) implementing routine preventive maintenance for irrigation facilities, pump equipment, monitoring equipment, etc. on a regular and timely basis.

It is considered that training for the O&M staff will be performed by the professional members of NIA central office in principle.

The number of trainee (the O&M staff) and trainer (professionals) to be required for O&M staff training are estimated as follows:

(Unit: number)

System	Service Area				Generated Area			
	Trainee			Trainer	Trainee			Trainer
	WM	DP	PO		WM	DT	PO	
Bonga pump #1	1	0	1	2	1	0	1	2
Bonga pump #2	1	0	1	2	1	0	1	2
Bonga pump #3	1	0	1	2	1	0	1	2
Iguig	1	3	4	3	1	3	4	3
Alcala-Amulung	2	7	2	3	2	7	2	3
Solana	2	5	2	3	4	6	2	3
MARIIS #1	2	0	3	2	2	0	3	2
MARIIS #2/#3	8	7	3	3	9	7	3	3
Penaranda	0	0	2	1	0	0	2	1
Bustos-Pandi	0	0	1	1	0	0	1	1
Buenavista	0	0	1	1	0	0	1	1
Tibagan	0	0	1	1	0	0	1	1
Cabuyao East	1	6	2	3	1	6	2	3
Santa Cruz	4	23	2	3	7	23	2	3
Santa Maria	2	7	2	3	4	12	2	3
Libmanan-Cabusao	2	8	2	3	5	9	2	3

WM: water master, DT: ditchtender, PO: pump operator

3.6.2 Farmers

It is also prerequisite for effective and smooth performance of water management to reinforce the ability of farmers in the irrigation systems.

At present the Bustos-Pandi, the Buenavista and the Tibagan pump irrigation systems are one of the most successful pump irrigation systems among the turnover programme in the country. The main reason of the success in water management is considered to be the effect of training of farmers in the irrigator's association which has been done by staff of the AMRIS office. Three different training programmes, namely (i) leadership, (ii) system management and (iii) financial management were performed for about 25% of total farmers in these systems.

Taking account of above fact, it has been planned that 25% of the farmers in each of the systems should receive such programmes as leadership, system management and financial management.

It is considered that training for farmers will be performed by staff of the system office and professional members of NIA central office.

The number of farmers and trainer staff to be required for this training are estimated as follows:

(Unit: number)

System	Service Area		Generated Area	
	Trainee	Trainer	Trainee	Trainer
Bonga pump #1	73	3	129	5
Bonga pump #2	245	9	511	17
Bonga pump #3	12	1	20	1
Iguig	245	9	313	11
Alcala-Amulung	740	25	917	31
Solana	691	23	1,529	51
MARIIS #1	296	10	437	15
MARIIS #2/#3	942	32	1,057	36
Penaranda	0	0	20	1
Bustos-Pandi	0	0	20	1
Buenavista	0	0	7	1
Tibagan	10	1	136	5
Cabuyao East	5	1	60	2
Santa Cruz	455	16	821	28
Santa Maria	395	14	669	23
Libmanan-Cabusao	460	15	861	29

3.7 Cost Estimate

3.7.1 Project Cost

The project cost of each of the irrigation systems is estimated on the basis of preliminary study of the project facilities. The project cost comprises direct construction cost, procurement cost of pump, electrical, O&M and monitoring equipments, training cost, engineering/administration cost and physical contingency. The direct

construction cost consists of rehabilitation/construction of irrigation/drainage works, farm service road, on farm facilities and land development.

The project cost is estimated with the following assumption:

(i) The exchange rate used in the estimate is: US$1.00 = Peso 21 = ¥135,

(ii) Construction works will be executed on the contract basis,

(iii) Engineering and administration cost is estimated at 15% of total cost of direct construction cost and procurement cost, and

(iv) Physical contingency is estimated at 20% of total cost of direct construction cost, procurement cost and engineering/administration cost.

The project cost of each of the project is shown in Table 3.4.

3.7.2 Cost of Operation, Maintenance and Replacement

The annual operation and maintenance cost consists of salaries/wages of staff and labours, office expenses, pump energy cost, running and repairing costs of O&M, monitoring, electrical equipment, and maintenance cost of facilities.

Pump and electrical equipment, gates/attachments, and O&M equipments are to be replaced at a certain time within 50 years of the project life. The economic useful life is assumed as 15 years for pump and electrical equipment, 8 to 10 years for O&M equipment, 20 to 25 years for valve/pipe fitting of pump equipment and 25 years for gates.

The cost of operation, maintenance and replacement for each of the system is shown in Table 3.5.

4. SELECTION OF HIGH PRIORITY PUMP IRRIGATION SYSTEMS

In order to select high priority national pump irrigation systems from the 12 systems for the feasibility study, the following screening criteria were used;

(i) Management of O&M for the pump irrigation system should be undertaken by NIA.

(ii) The economic internal rate of return should be over 15%.

(iii) The beneficiary farmers in the system should have higher intention to pay the irrigation service fee necessary for operation of the pump system.

(iv) The financial status of the system office should be showing a deficit at present.

(v) The potential financial soundness on both the system office and the beneficiary farmers is expected to be high.

(vi) The system will be located in the economically depressed area. The gross domestic product per capita in the system will be less than an average gross domestic product per capita (Peso 9,130) of the whole Philippines with the exception of National Capital Region.

An assessment of the screening criteria for each of the system is shown in Table 4.1.

Based on this assessment, the following national pump irrigation systems have been selected.

(i) Bonga Pump #1 Irrigation System

(ii) Bonga Pump #2 Irrigation System

(iii) Bonga Pump #3 Irrigation System

(iv) Alcala-Amulung Pump Irrigation System

(v) Solana Pump Irrigation System

(vi) Libmanan-Cabusao Pump Irrigation System

5. MINI-HYDROPOWER DEVELOPMENT

5.1 Identified Prospective Sites

In the first place, 110 potential sites for mini-hydropower development contemplated by NIA were preliminarily studied from the standpoint of (i) accessibility to the site, (ii) canal discharge throughout the year, (iii) head of drop, (iv) distance of the distribution grid to NAPOCOR or local electric cooperative inc., and (v) condition of sedimentation in canals. 65 potential sites were selected from 110 potential sites and surveyed in the field.

After the field survey, the selection of prospective sites for mini-hydropower development has been carried out for 65 potential sites, on the basis of the following conditions:

(i) Drop height : 3 m in minimum

(ii) Canal discharge : perennial flow

(iii) Accessibility to sites

(iv) Distance between a substation and a potential site : less than 20 km

(v) Location of the existing pump station

Based on the above conditions, 17 prospective mini-hydropower development sites have been identified. The location of these sites is illustrated in Fig. 5.1 and their principal features are summarized in Table 5.1.

5.2 Benefit and Cost

The power benefit of each of the prospective power development project is estimated as the saving cost by supplying electric power from mini-hydropower plant instead of supply from alternative diesel power plant which has equivalent power output. The benefit is calculated by the following formula

$$B = Q \times Cq \times 24 \times 365 \times K$$

where:
- B = Benefit ($/year)
- Q = Fuel consumption rate (lit/hr)
- Cq = Fuel cost ($/lit)
- K = Operation factor: 0.6

The power benefit of each of the mini-hydropower development project is shown in Table 5.1.

The construction cost comprises installation cost of water turbine, generator, transformer, switch-gears, transmission line facilities and civil works of their installation. The estimated cost is shown in Table 5.1.

Operation and maintenance cost is estimated at 1.5% of the total construction cost.

5.3 Selection of High Priority Mini-Hydropower Development Project

In order to examine the economic viability of these prospective mini-hydropower development projects, the economic internal rate of return for each of the projects has been calculated as follows:

Prospective Sites	Name of Irrigation System	Economic Internal Rate of Return (%)
No. 1	CHICO-RIS	14.2
No. 2	- DO -	14.3
No. 1 and No. 2	- DO -	15.7
No. 3	- DO -	3.7
No. 4	- DO -	3.7
No. 5	- DO -	10.5
No. 6	AGNO-RIS	9.7
No. 7	- DO -	7.9
No. 8	DIPALO-RIS	3.5
No. 9	- DO -	3.5
No. 10	TARLAC-RIS	9.3
No. 11	MAGAT-RIIS	7.1
No. 12	ANGAT-RIS	4.7
No. 13	- DO -	7.5
No. 14	- DO -	5.5
No. 15	T-RIS	6.1
No. 16	P-RIS	10.5
No. 17	UPRIIS	9.9

Based on the result of the economic internal rate of return, the prospective site No. 1, No. 2 and the combined of the sites 1 and 2, within the Chico river irrigation system, which has the highest value of internal rate of return, has been selected for the feasibility study.

Table 2.1 PRESENT CONDITION OF THE PUMP SYSTEMS (1/2)

Name of Systems	Generated Area (ha)	Service Area (ha)	No. of Lots in Service Area	No. of Farmers in Service Area	No. of Farmers in Generated Area	Farm Size (1) (ha)	Irrigation Facilities: Length of Canal (km) Main	Lateral	No. of Structure	Length of Service Road (km)	Pump Facilities: Date of Install	No. of Units	Presently Operated Units	Design Capacity (m3/m)	Actual Capacity (m3/m)	Source of Power	Power Rate (peso/kWh)	Length of Drainage Canal (km)	Irrigated Area 1986 (ha) Wet	Dry	Benefited Area 1986 (ha) Wet	Dry	Annual Irri. Waer Supplied by Pumps in '86 (MW/year)
Bonga Pump #1	426	298	3,630	1,420	2,030	0.21	3.38	6.08	110	-	1975	2	2	75.7	32.7	INECO(2)	2.17	0	162	187	162	187	1,720
Bonga Pump #2	1,200	674	5,900	2,500	4,400	0.27	14.18	21.80	382	21.82	1975	3	2	208.2	107.7	INECO	2.14	0	450	275	450	275	1,613
Bonga Pump #3	218	202	1,660	420	450	0.48	4.75	3.32	65	-	1975	2	1	68.1	31.0	INECO	2.17	0	114	67	138	67	2,274
Iguig	770	603	-	980	1,251	0.61	6.08	8.17	70	11.61	1983	3	3	112.8	106.0	NAPOCOR(4)	1.98	13.96	218	362			2,525
											1983	3	2	16.2	10.4	NAPOCOR	1.98	31.90					
Alcala/Amulung	2,350	1,840	3,610	2,190	2,800	0.84	9.87	21.96	141	18.15	1982	4	4	291.5	(8)	NAPOCOR	1.40	45.86	746	1,015			2,071
Iguig/Alcala/Amulung	3,120	2,443	-	3,170		0.77	15.95	30.13		29.76									964	1,377	964	1,377	
Solana	2,865	1,320	1,890	1,250	2,700	1.06	18.36	25.62	181	32.86	1975	4	2	408.8	163.7	CAGELCO(3)	1.90	19.10	0	780	0	600	1,519(9)
MARIIS Pump #1	1,667	1,200	140	1,455	2,021	0.82	7.78	9.09	109	16.87	1984	3	2	207.0	129.0	NAPOCOR	1.36	0	422	389	422	385	3,391
MARIIS Pump #2	3,518	3,098		2,143		0.82					1983	5	3	996.0	551.7	NAPOCOR	1.26		1,609	1,777			3,522
MARIIS Pump #3	3,235	3,087		2,858		1.45					1983	5	5	444.0	365.9	NAPOCOR	1.26		677	399			2,018
MARIIS Pump #2 & #3	6,753	6,185	1,112	5,001	5,460	1.08	24.96	64.11	423	82.92								10.28	2,286	2,176	2,286	2,176	3,126
UPRIIS Penaranda	535	400	262	230	308	1.74	-	4.45	27	4.44	1980	2	2	54.0	42.9	NES.ELEC. COOP(5)	2.31	0	331	331	324	331	1,859
AMRIS Bustos Pandi	900	731	794	588	724	1.21	13.76	17.24	93	15.84	1972	2	2	121.1	108.6	NAPOCOR	1.27	0	651	661	651	661	
AMRIS Buenavista	541	351	265	213	328	1.65	-	5.13	62	3.12	1976	2	2	56.0	52.4	NAPOCOR	1.33	0	340	341	340	341	1,300
AMRIS Tibagan	1,839	1,295	1,402	1,202	1,707	1.08	26.66	7.69	227	31.78	1976	2	2	70.4	61.0	NAPOCOR	1.13	0	1,251	1,187	1,206	1,187	1,900
											1976	2	2	140.8	135.6	NAPOCOR	1.13						
Cabuyao East	1,013	575	361	489	588	1.18	6.88	11.17	111	16.52	1978	3	3	117.0	97.0	NAPOCOR	1.14	0	570	504	499	504	1,707
Sta. Cruz	4,896	3,362	2,835	2,388	3,931	1.41	24.12	63.72	475	70.77	1984	7	0	431.0	(8)	-	-	2.28	2,313	2,176	2,030	2,176	0
											1984	2	0	141.0	(8)	-	-						
Sta. Maria, Pump	881	639									1984	3	0	204.0	(8)	ELELCO(6)	2.16						
											1984	3	0	87.0	(8)	ELELCO	2.16		0	289	0	289	
Sta. Maria, Whole Area	2,800	1,653	2,219	1,579	7,675	1.05	35.19	16.97	269	47.63								0	841	1,129	792	661	
Libmanan Cabusao	4,102	2,195	1,680	1,050	1,960	2.09	11.17	52.99	297	40.50	1979	4	2	366.4	172.3	CA.SUR 1 ELEC.COOP(7)	2.10	56.75	341	1,127	273	1,048	1,371

Remarks: (1): Service area/No. of farmers in the service area
(2): Ilocos Norte Electric Cooperative Inc.
(3): Cagayan Electric Cooperative Inc.
(4): National Power Corporation
(5): Nueva Ecija 3 Electric Cooperative Inc.
(6): First Laguna Electric Cooperative Inc.
(7): Camarines Sur 1 Electric Cooperative Inc.
(8): Actual discharge capacity was not measured
(9): Dry crop season only

Table 2.1 PRESENT CONDITION OF THE PUMP SYSTEMS (2/2)

Name of Systems	Irrigation Fee Rate per Ha: Wet (Cavan)	Irrigation Fee Rate per Ha: Dry (Cavan)	Collected Irrigation Fee Amount in '86 (1,000 peso)	Efficiency of Irrigation Fee Collection in '86	Total O&M Cost in '86 (1,000 peso)	% of Pump Energy Cost to Total O&M Cost	Balance Irrigation Fee Minus O&M Cost (1,000 peso)	Unit O&M Cost per Ha (peso/ha): Service Area	Unit O&M Cost per Ha (peso/ha): Benefited Area	Work Load of O&M Staff: WM (3) (ha/staff)	Work Load of O&M Staff: DT (4) (km/staff)	No. of Registered Irrigators Association	Turnover to IA: No. of IA	Turnover to IA: Date	Turnover to IA: Stage	No. of IA Farmers Trained in the Past (5)	Cropping Pattern: Wet	Cropping Pattern: Dry	Cropping Intensity (%): Service Area	Cropping Intensity (%): Irrigated Area (6)	Unit Yield of Paddy (ton/ha): Wet Season	Unit Yield of Paddy (ton/ha): Dry Season	Unit Yield of Paddy (ton/ha): Rain-fed	Farm Income in Service Area (peso/household)	Gross Domestic Product per Capita (peso)
Bonga Pump #1	8.0	12.0	179	42	458	84	-279	1,537	1,312	298	-	1	1	Dec.'85	2	57	Paddy	Paddyo or Div. Crop or Fallow	117	187	3.3	3.5	2.3	4,900	6,970
Bogna Pump #2	8.0	12.0	336	39	654	85	-318	970	902	674	-	1	1	Dec.'85	2	95	Paddy	Paddyo or Div. Crop or Fallow	108	161	3.5	4.0	2.4	4,900	6,970
Bonga Pump #3	8.0	12.0	140	47	277	69	-137	1,371	1,351	202	-	1	1	Apr.'86	2	83	Paddy	Paddyo or Div. Crop or Fallow	101	142	3.8	4.1	2.3	6,100	6,970
Iguig										814	4.6													7,400	7,055
Alcala/Amulung										814	4.6													6,700	7,055
Iguig/Alcala/Amulung	7.5	7.5	1,419	51	1,913	26	-494	783	617			Not Yet	0	-	-	0	Paddy	Paddy or Fallow	96	170	3.3	3.5	1.8		7,055
Solana	14.0	14.0	501	44	2,083	77	-1,582	1,578	3,472	920	8.8	1	1	May '87	2	25	Paddy	Paddy or Fallow	45	60	3.1	3.3	2.8	5,900	7,055
MARIIS Pump #1	6.0	8.0	467	51	1,598	73	-1,131	1,332	1,980	600	-	3	3	May-Aug.'84	1	68	Paddy	Paddy or Fallow	67	191	3.5	4.0	1.8	3,300	7,055
MARIIS Pump #2												11	9	May '85	1										7,055
MARIIS Pump #3												5	4	May '85	1									5,700	7,055
MARIIS Pump #2 & #3	6.0	8.0	2,051	49	6,623	76	-4,572	1,071	1,484	440	-	16	13		1	308	Paddy	Paddy or Fallow	72	195	3.5	4.0	1.8		7,055
UPRIIS Panaranda	7.0	10.0	594	76	661	91	-61	1,653	1,009	-	-	1	1	Jun.'86	3	-	Paddy	Paddy or Fallow	164	195	3.8	4.3	3.4	23,900	11,088
AMRIS Bustos Pandi	5.0	5.5	902	89	506	96	396	592	386	-	-	1	1	Jun.'84	3	161	Paddy	Paddy or Fallow	179	198	4.3	4.6	3.5	14,900	11,088
AMRIS Buenavista	4.0	6.0	472	86	256	90	216	729	376	-	-	1	1	Jun.'85	3	75	Paddy	Paddy or Fallow	194	200	3.7	4.2	3.3	20,100	11,088
AMRIS Tibagan	5.0	7.0	1,564	62	1,749	98	-185	1,351	731	-	-	1	1	Jun.'86	3	291	Paddy	Paddy or Fallow	185	191	3.7	4.2	3.4	13,000	11,088
Cabuyao East	3.0	4.0	1,012	82	596	62	416	1,037	594	575	3.0	2	0	-	-	79	Paddy	Paddy or Fallow	174	176	4.3	4.6	1.7	21,100	12,847
Sta. Cruz	2.0	3.0	1,271	76	1,091	0	180	293	259	1,060	3.9	2	2	Feb.'82 Oct.'84	1	142	Paddy	Paddy or Fallow	113	182	3.6	4.2	1.7	16,300	12,847
Sta. Maria, Whole Area	7.0(1) 5.0(2)	10.0(1) 7.0(2)	355	55	1,183	50	-828	716	814	1,653	5.4	Not Yet	0	-	-	0	Paddy	Paddy or Fallow	88	129	3.0	3.6	1.7	8,700	12,847
Libmanan Cabusao	6.0	6.0	296	24	1,301	74	-1,205	684	1,136	1,100	-	2(7)	2	Jan.'86 Jun.'87	3	0	Paddy	Paddy or Fallow	60	117	2.8	3.3	2.0	10,400	5,292

Remarks: (1): Irrigation service fee for the area irrigated by pump system
(2): Irrigation service fee for the area irrigated by both pump and gravity systems
(3): Water master
(4): Ditch tender
(5): Number of IA farmers who received training programmes (leadership, financial management or system management) in the past
(6): Annual benefited area/higher value of the irrigated area within wet and dry seasons in 1986
(7): Irrigator associations cover about 10% of the irrigation service area

Table 2.2 NECESSITY OF O&M IMPROVEMENT IN PUMP IRRIGATION SYSEMS

Name of Pumping System	Rehabilitation of Irrigation/Drainage Facilities			Rehabilitation of Pumping Station		Direct Power Supply from NPC		Supply of O&M Equip-ment	Increase of Nos. of OM Staff	Reinforce-ment and Improvement of Monitoring System	Reinforce-ment of Communi-cation System	Special Train-ing of Farmers	Special Training of OM Staff
	Canal System	On-farm Facility	Land Develop-ment	Pump Equip-ment	Electric Equip-ment	Trans-mission Line	Sub-station						
Bonga Pump #1	O	O	X	O	O	O	O	O	X	O	X	O	O
Bonga Pump #2	O	O	X	O	O	O	O	O	X	O	X	O	O
Bonga Pump #3	O	O	X	O	O	O	O	O	X	O	X	O	O
Iguig	O	O	X	X	X	X	X	O	X	X	X	O	O
Alcala-Amulung	O	O	X	X	X	X	O	O	X	O	X	O	O
Solana	O	O	X	O	O	O	X	O	O	O	X	O	O
MARIIS Pump #1	O	O	O	X	X	X	X	O	X	X	O	O	O
MARIIS Pump #2 & #3	O	O	O	X	X	X	X	O	O	X	O	O	O
UPRIIS Penaranda	O	O	X	X	X	O	X	O	X	X	X	O	O
AMRIS Bustos-Pandi	O	O	X	O	O	O	X	O	X	X	X	O	O
AMRIS Buenavista	O	O	X	O	O	O	X	O	X	X	X	O	O
AMRIS Tibagan	O	O	X	O	O	O	X	O	X	X	X	O	O
Cabuyao East	O	O	X	O	O	O	X	O	X	O	X	O	O
Sta. Cruz	O	O	X	x	X	X	X	O	O	O	X	O	O
Sta. Maria	O	O	X	O	X	O	X	O	O	O	X	O	O
Libmanan-Cabusao	O	O	X	O	O	X	O	O	O	O	O	O	O

Remarks: O: Improvement or reinforcement is needed.
X: No improvement is needed

Table 3.1 PROPOSED REHABILITATION & IMPROVEMENT WORKS FOR PUMPING FACILITIES

Name of ISA	Pump Equipment (Unit)	Electric Equipment (Unit)	Transmission Line (km)	Sub Station (Unit)	Transmission Line (1,000 P)
Bonga Pump #1 ISA					
Generated Area	2	1	23	-	2,797
Present Service Area	1	1	23	-	2,797
Bonga Pump #2 ISA					
Generated Area	2	1	28	-	3,498
Present Service Area	1	1	28	-	3,498
Bonga Pump #3 ISA					
Generated Area	1	1	7	-	925
Present Service Area	1	1	7	-	925
Iguig Pump ISA					
Generated Area	-	-	-	-	-
Present Service Area	-	-	-	-	-
Alcala-Amulung Pump ISA					
Generated Area	-	-	-	-	-
Present Service Area	-	-	-	-	-
Solana Pump ISA					
Generated Area	3	1	12	-	1,498
Present Service Area	2	1	12	-	1,498
Mariis Pump #1 ISA					
Generated Area	-	-	-	-	-
Present Service Area	-	-	-	-	-
Mariis Pump #2 & #3 ISA					
Generated Area	-	-	-	-	-
Present Service Area	-	-	-	-	-
Penaranda Pump ISA					
Generated Area	-	-	19	-	2,340
Present Service Area	-	-	19	-	2,340
Bustos-Pandi Pump ISA					
Generated Area	2	1	33	-	4,095
Present Service Area	2	1	33	-	4,095
Buenavista Pump ISA					
Generated Area	2	1	19	-	2,340
Present Service Area	2	1	19	-	2,340
Tibagan Pump ISA					
Generated Area	4	1	19	-	2,340
Present Service Area	4	1	19	-	2,340
Cabuyao East Pump ISA					
Generated Area	3	1	14	-	1,755
Present Service Area	3	1	14	-	1,755
Santa Cruz River ISA					
Generated Area	-	-	-	-	-
Present Service Area	-	-	-	-	-
Santa Maria River ISA					
Generated Area	1(valve only)	-	12	-	1,428
Present Service Area	1(valve only)	-	12	-	1,428
Libmanan-Cabusao Pump ISA					
Generated Area	1	1	14	1	1,755
Present Service Area	-	-	14	1	1,755

Table 3.2 PROPOSED MAJOR REHABILITATION & IMPROVEMENT WORKS FOR IRRIGATION AND DRAINAGE FACILITIES

Name of ISA	Irrigation Facilities									Drainage Facilities		O & M Road		On farm Facilities		
	Upgrading of Embankment (km)	Canal Desiltation (km)	Repair of Canal Lining (km)	Enlargement of Canal Section (km)	Improvement of Canal Structure: Turnout (no.)	Headgate (no.)	Checkgate (no.)	Pipeline (km)	Siphon (no.)	Desiltation of Drainage Canal (km)	Replacement of Flapgate (no.)	Construction of New Road (km)	Resurfacing of Existing Road (km)	Construction of Farm Ditches (km)	Construction of Farm Drains (km)	Land Reclamation (ha)
1. Generated Area																
Bonga Pump #1 ISA	1.16	-	-	-	35	-	-	-	-	-	-	3	-	13	26	-
Bonga Pump #2 ISA	0.24	-	-	-	67	-	-	-	-	-	-	-	-	46	72	-
Bonga Pump #3 ISA	0.45	-	0.20	-	35	1	-	-	1	-	-	5	-	0	13	-
Iguig Pump ISA	0.85	2.72	-	-	-	-	-	-	-	14	-	-	-	5	37	-
Alcala-Amulung Pump ISA	0.30	3.75	-	-	7	-	-	-	-	32	-	-	5	22	96	-
Solana Pump ISA	9.02	22.67	-	-	46	4	1	-	-	19	-	5	17	100	172	-
Mariis Pump #1 ISA	1.57	-	-	-	4	-	-	-	-	-	-	-	1	62	92	1,187
Mariis Pump #2 & #3 ISA	9.21	7.52	-	-	33	-	4	-	-	-	-	-	6	223	403	4,279
Penaranda Pump ISA	0.07	2.39	-	-	6	1	-	-	-	-	-	-	-	28	32	-
Bustos-Pandi Pump ISA	-	-	-	-	4	-	-	-	-	-	-	-	-	48	54	-
Buenavista Pump ISA	-	-	-	-	17	1	-	-	-	-	-	-	-	31	32	-
Tibagan Pump ISA	-	-	-	-	18	1	-	-	-	-	-	-	-	96	110	-
Cabuyao East Pump ISA	-	-	-	-	33	6	-	-	-	-	-	-	8	10	42	-
Santa Cruz River ISA	-	13.90	-	-	21	5	4	0.01	-	-	-	-	-	230	237	-
Santa Maria River ISA	-	-	-	-	3	-	-	-	2	-	-	-	-	179	168	-
Libmanan-Cabusao Pump ISA	16.98	3.52	-	1.46	24	5	-	-	-	57	16	19	7	131	212	-
2. Present Srvice Area																
Bonga Pump #1 ISA	1.03	-	-	-	11	-	-	-	-	-	-	2	-	10	18	-
Bonga Pump #2 ISA	0.24	-	-	-	35	-	-	-	-	-	-	-	-	26	40	-
Bonga Pump #3 ISA	0.45	-	-	-	31	1	-	-	-	-	-	5	-	-	12	-
Iguig Pump ISA	0.51	2.29	-	-	-	-	-	-	-	14	-	-	-	4	29	-
Alcala-Amulung Pump ISA	0.30	0.96	-	-	7	-	-	-	-	32	-	-	2	17	78	-
Solana Pump ISA	9.02	6.77	-	-	23	-	-	-	-	19	-	-	4	46	79	-
Mariis Pump #1 ISA	1.57	-	-	-	3	-	-	-	-	-	-	-	1	44	66	720
Mariis Pump #2 & #3 ISA	9.21	7.52	-	-	26	-	3	-	-	-	-	-	6	204	369	3,711
Penaranda Pump ISA	0.07	2.39	-	-	6	1	-	-	-	-	-	-	-	21	24	-
Bustos-Pandi Pump ISA	-	-	-	-	4	-	-	-	-	-	-	-	-	39	44	-
Buenavista Pump ISA	-	-	-	-	17	1	-	-	-	-	-	-	-	20	21	-
Tibagan Pump ISA	-	-	-	-	15	1	-	-	-	-	-	-	-	67	78	-
Cabuyao East Pump ISA	-	-	-	-	13	3	-	-	-	-	-	-	4	2	24	-
Santa Cruz River ISA	-	-	-	-	21	5	4	-	-	-	-	-	-	158	202	-
Santa Maria River ISA	-	-	-	-	1	-	-	-	1	-	-	-	-	106	99	-
Libmanan-Cabusao Pump ISA	12.70	3.52	-	1.46	15	5	-	-	-	57	16	15	7	55	110	-

Table 3.3 PROPOSED SYSTEM MANAGEMENT FACILITIES

Item	Unit	Bonga #1 Bonga #3		Iguig Alcala-Amulung		Solana		Marlis #1		Marlis #2&#3		Penaranda		Bustos-Pandi Buenavista Tibagan		Cabuyao-East		Santa Cruz		Santa Maria		Libmanan-Cabusao	
		G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.	G.A.	P.S.A.
O & M Equipment																							
1.Heavy Equipment																							
1.Crane-Crawler,25 ton	Unit	1	1	1	-	-	-	2	2	2	2	2	2	2	2	-	-	1	-	-	-	-	-
2.Crane-Truck,20 ton	Unit	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.Backhoe-Crawler,0.35 m3	Unit	1	1	-	-	1	-	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1
4.Backhoe-Crawler,0.7 m3	Unit	-	-	-	-	-	-	2	2	2	2	2	2	2	2	-	-	-	-	-	-	-	-
5.Tractor-Crawler,140 Hp	Unit	-	-	-	-	1	-	2	2	2	2	2	2	3	3	-	-	1	-	-	-	-	-
6.Tractor-Crawler,75-90 Hp	Unit	1	1	1	1	1	1	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1	1
7.Front-end Loader Wheeled,1.7 m3	Unit	-	-	1	1	1	-	2	2	2	2	2	2	3	3	1	1	1	1	1	-	1	1
8.Loader/w Backhoe, Wheeled,0.2 m3	Unit	1	1	1	1	1	-	3	3	3	3	3	3	3	3	1	1	1	1	1	1	-	-
9.Motor Grader,125 Hp	Unit	1	1	-	-	1	1	2	2	2	2	2	2	3	3	1	1	1	1	1	1	1	1
10.Roller,Vibration,4 ton	Unit	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1
11.Farm Tractor,45 Hp	Unit	1	1	-	-	-	-	3	3	3	3	3	3	5	5	-	-	-	-	-	-	-	-
12.Folklift,3 ton	Unit	1	1	-	-	-	-	1	1	1	1	1	1	1	1	-	-	-	-	-	-	-	-
13.Dump Truck,6 ton	Unit	-	-	-	-	1	1	4	4	4	4	4	4	4	4	1	1	2	1	1	1	-	-
2.Light Equipment																							
1.Jeep-4 wheel	Unit	2	2	2	1	-	-	3	3	3	3	3	3	3	3	1	1	2	1	1	-	1	1
2.Pick-up,3/4 ton	Unit	2	2	2	1	1	1	4	4	4	4	4	4	5	5	1	1	2	1	1	-	1	1
3.Cargo Truck 6 ton	Unit	1	1	2	1	1	-	2	2	2	2	2	2	1	1	1	1	1	1	1	1	-	-
4.Motorcycle	Unit	27	27	27	12	12	1	81	81	81	81	81	81	##	109	12	12	30	12	12	12	12	12
3.Miscellaneous Equipment																							
1.Concrete Mixer,0.5 m3	Unit	1	1	1	1	1	1	3	3	3	3	3	3	4	4	1	1	1	1	1	1	1	1
2.Compressor,Air,3.7 m3	Set	1	1	1	1	1	1	3	3	3	3	3	3	1	1	1	1	1	1	1	1	1	1
3.Pump,Centrifugal,80 mm	Set	1	1	1	1	1	1	3	3	3	3	3	3	4	4	1	1	2	1	1	1	1	1
4. -do- 100 mm	Set	1	1	1	1	1	1	3	3	3	3	3	3	4	4	1	1	1	1	1	1	1	1
5. -do- 150 mm	Set	1	1	1	1	1	1	3	3	3	3	3	3	4	4	-	-	-	-	-	-	-	-
6.Sand Pump	Set	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1
7.Welding Machine,50 KVA	Set	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8.Chain Block,5 ton	Unit	1	1	2	2	2	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2
Monitering Facilities																							
1.Rain Gage(Standard Type)	Set	-	-	-	-	-	-	1	1	1	1	1	1	2	2	-	-	-	-	-	-	-	-
2.Staff Gage	Pc.	13	11	13	12	8	4	5	5	28	23	2	2	15	15	4	3	2	2	2	2	10	10
Communication Facilities																							
Radio Set	Set	-	-	-	-	-	-	1	1	5	5	-	-	1	1	1	1	-	-	-	-	1	1

Remarks G.A.: Generated Area
P.S.A.: Present Service Area

Table 3.4 SUMMARY OF PROJECT COST

(Unit:1,000 Pesos)

Name of ISA	Improvement of Pumping Facilities	Improvement of Irrigation & Drainage Facilities	Reinforcement of O & M Equipment	Improvement of Monitering & Communication Facilities	Training Programme	Sub Total	Engineering & Administration	Sub Total	Physical Contingency	Grand Total	Cost per Ha
1. Generated Area											
Bonga Pump #1 ISA	13,774	1,220	1,148	38	145	16,325	2,449	18,774	3,755	22,529	53
Bonga Pump #2 ISA	19,182	2,037	3,254	152	551	25,176	3,776	28,952	5,790	34,743	29
Bonga Pump #3 ISA	8,269	1,230	765	57	28	10,349	1,552	11,901	2,380	14,282	66
Iguig Pump ISA	-	1,205	5,254	76	347	6,882	1,032	7,914	1,583	9,497	12
Alcala-Amulung Pump ISA	-	7,072	15,761	171	994	23,998	3,600	27,598	5,520	33,117	15
Solana Pump ISA	31,008	8,336	17,137	152	1,647	58,280	8,742	67,022	13,404	80,426	28
Mariis Pump #1 ISA	-	125,924	4,343	147	475	130,889	19,633	150,522	30,104	180,627	108
Mariis Pump #2 & #3 ISA	-	456,353	12,407	784	1,150	470,694	70,604	541,298	108,260	649,558	96
Penaranda Pump ISA	2,340	891	1,241	40	26	4,538	681	5,219	1,044	6,262	12
Bustos-Pandi Pump ISA	16,018	1,447	2,100	230	25	19,820	2,973	22,792	4,558	27,351	30
Buenavista Pump ISA	10,595	1,000	1,399	21	12	13,027	1,954	14,981	2,996	17,977	33
Tibagan Pump ISA	26,976	2,907	3,496	88	149	33,616	5,042	38,659	7,732	46,391	25
Cabuyao East Pump ISA	16,027	1,300	3,530	126	77	21,060	3,159	24,218	4,844	29,062	29
Santa Cruz River ISA	-	7,296	22,974	19	909	31,198	4,680	35,878	7,176	43,053	9
Santa Maria River ISA	1,845	4,919	12,208	19	735	19,726	2,959	22,685	4,537	27,223	10
Libmanan-Cabusao Pump ISA	37,523	20,982	10,564	240	938	70,247	10,537	80,784	16,157	96,941	24
2. Present Service Area											
Bonga Pump #1 ISA	10,400	731	957	19	85	12,192	1,829	14,021	2,804	16,825	56
Bonga Pump #2 ISA	15,236	1,139	2,266	133	269	19,043	2,856	21,899	4,380	26,279	39
Bonga Pump #3 ISA	8,269	1,105	765	57	20	10,216	1,532	11,748	2,350	14,098	70
Iguig Pump ISA	-	1,040	2,314	76	275	3,705	556	4,261	852	5,113	8
Alcala-Amulung Pump ISA	-	6,608	6,941	152	805	14,506	2,176	16,682	3,336	20,018	11
Solana Pump ISA	24,486	4,886	7,917	76	750	38,115	5,717	43,833	8,767	52,599	40
Mariis Pump #1 ISA	-	76,709	3,102	147	324	80,282	12,042	92,324	18,465	110,789	92
Mariis Pump #2 & #3 ISA	-	396,431	12,407	689	1,026	410,553	61,583	472,136	94,427	566,563	92
Penaranda Pump ISA	2,340	679	1,241	40	4	4,304	646	4,950	990	5,940	15
Bustos-Pandi Pump ISA	16,018	1,180	1,399	230	3	18,830	2,824	21,654	4,331	25,985	36
Buenavista Pump ISA	10,595	689	701	21	3	12,009	1,801	13,810	2,762	16,572	47
Tibagan Pump ISA	26,976	2,059	2,800	88	15	31,938	4,791	36,729	7,346	44,075	34
Cabuyao East Pump ISA	16,027	626	2,205	107	20	18,985	2,848	21,832	4,366	26,199	46
Santa Cruz River ISA	-	5,207	12,598	19	516	18,340	2,751	21,091	4,218	25,309	8
Santa Maria River ISA	1,845	2,899	8,964	19	438	14,165	2,125	16,290	3,258	19,548	12
Libmanan-Cabusao Pump ISA	23,630	17,192	10,564	240	506	52,132	7,820	59,952	11,990	71,942	33

Table 3.5 COST OF OPERATION, MAINTENANCE AND REPLACEMENT (1/2)
(FOR SERVICE AREA)

(Unit: 1,000 peso)

Project	Bonga #1		Bonga #2		Bonga #3		Iguig		Alcala-Amlung		Solana		MARIIS #1		MARIIS #2/3	
Year	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
4	414	0	917	0	265	0	1,073	1,759	3,075	8,333	2,440	0	2,430	0	7,628	0
5	414	348	917	827	265	276	1,073	0	3,075	0	2,440	408	2,430	0	7,628	0
6	414	0	917	0	265	0	1,073	61,340	3,075	111,752	2,440	0	2,430	0	7,628	0
7	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
8	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	26,962	7,628	88,496
9	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
10	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
11	414	957	917	2,266	265	765	1,073	2,314	3,075	6,941	2,440	7,917	2,430	3,102	7,628	12,407
12	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
13	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
14	414	0	917	0	265	0	1,073	1,759	3,075	8,333	2,440	0	2,430	0	7,628	0
15	414	348	917	827	265	276	1,073	0	3,075	0	2,440	408	2,430	0	7,628	0
16	414	10,400	917	15,236	265	8,269	1,073	11,892	3,075	9,648	2,440	24,486	2,430	0	7,628	0
17	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
18	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
19	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
20	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
21	414	957	917	2,266	265	765	1,073	63,654	3,075	118,693	2,440	7,917	2,430	3,102	7,628	12,407
22	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
23	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	26,962	7,628	88,496
24	414	0	917	0	265	0	1,073	1,759	3,075	8,333	2,440	0	2,430	0	7,628	0
25	414	348	917	827	265	276	1,073	0	3,075	0	2,440	408	2,430	0	7,628	0
26	414	194	917	1,779	265	299	1,073	176	3,075	635	2,440	381	2,430	631	7,628	2,539
27	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
28	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
29	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
30	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
31	414	11,357	917	17,502	265	9,034	1,073	2,314	3,075	6,941	2,440	32,403	2,430	3,102	7,628	12,407
32	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
33	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
34	414	0	917	0	265	0	1,073	1,759	3,075	8,333	2,440	0	2,430	0	7,628	0
35	414	348	917	827	265	276	1,073	0	3,075	0	2,440	408	2,430	0	7,628	0
36	414	0	917	0	265	0	1,073	61,340	3,075	111,752	2,440	0	2,430	0	7,628	0
37	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
38	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	26,962	7,628	88,496
39	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
40	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
41	414	957	917	2,266	265	765	1,073	14,206	3,075	16,589	2,440	7,917	2,430	3,102	7,628	12,407
42	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
43	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
44	414	0	917	0	265	0	1,073	1,759	3,075	8,333	2,440	0	2,430	0	7,628	0
45	414	348	917	827	265	276	1,073	0	3,075	0	2,440	408	2,430	0	7,628	0
46	414	10,400	917	15,236	265	8,269	1,073	0	3,075	0	2,440	24,486	2,430	0	7,628	0
47	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
48	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
49	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0
50	414	0	917	0	265	0	1,073	0	3,075	0	2,440	0	2,430	0	7,628	0

Project	Penaranda		Bustos-Pandi		Buenavista		Tibayan		Cabuyao East		Sta. Cruz		Sta. Maria		Liban-Cabusao	
Year	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
4	495	12,052	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	27,716
5	495	0	626	205	361	103	2,470	410	830	0	3,386	0	2,394	1,542	2,126	3,787
6	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
7	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
8	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	41,798	2,126	0
9	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
10	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
11	495	1,241	626	1,400	361	700	2,470	2,800	830	2,206	3,386	12,598	2,394	8,963	2,126	10,564
12	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
13	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
14	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
15	495	0	626	205	361	103	2,470	410	830	0	3,386	0	2,394	1,542	2,126	3,787
16	495	2,340	626	16,018	361	10,595	2,470	26,976	830	16,027	3,386	83,893	2,394	1,428	2,126	1,755
17	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
18	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
19	495	12,052	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	27,716
20	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
21	495	1,241	626	1,400	361	700	2,470	2,800	830	2,206	3,386	12,598	2,394	8,963	2,126	10,564
22	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
23	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	41,798	2,126	0
24	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
25	495	0	626	205	361	103	2,470	410	830	0	3,386	0	2,394	1,542	2,126	3,787
26	495	116	626	545	361	462	2,470	1,301	830	216	3,386	1,652	2,394	424	2,126	24,009
27	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
28	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
29	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
30	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
31	495	3,581	626	17,418	361	11,295	2,470	29,776	830	18,233	3,386	96,491	2,394	10,391	2,126	12,319
32	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
33	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
34	495	12,052	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	27,716
35	495	0	626	205	361	103	2,470	410	830	0	3,386	0	2,394	1,542	2,126	3,787
36	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
37	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
38	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	41,798	2,126	0
39	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
40	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
41	495	1,241	626	1,400	361	700	2,470	2,800	830	2,206	3,386	12,598	2,394	8,963	2,126	10,564
42	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
43	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
44	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
45	495	0	626	205	361	103	2,470	410	830	0	3,386	0	2,394	1,542	2,126	3,787
46	495	2,340	626	16,018	361	10,595	2,470	26,976	830	16,027	3,386	83,893	2,394	1,428	2,126	1,755
47	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
48	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0
49	495	12,052	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	27,716
50	495	0	626	0	361	0	2,470	0	830	0	3,386	0	2,394	0	2,126	0

Table 3.5 COST OF OPERATION, MAINTENANCE AND REPLACEMENT (2/2)
(FOR GENERATED AREA)

(Unit: 1,000 peso)

Project	Bonga #1		Bonga #2		Bonga #3		Iquig		Alcala-Amlung		Solana		MARIIS #1		MARIIS #2/3	
Year	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
4	558	0	1,548	0	279	0	1,318	2,778	3,687	8,333	4,835	0	3,274	0	8,215	0
5	558	413	1,548	1,172	279	276	1,318	0	3,687	0	4,835	408	3,274	0	8,215	0
6	558	0	1,548	0	279	0	1,318	61,340	3,687	111,752	4,835	0	3,274	0	8,215	0
7	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
8	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	26,962	8,215	88,496
9	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
10	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
11	558	1,148	1,548	3,254	279	765	1,318	5,254	3,687	15,761	4,835	17,137	3,274	4,343	8,215	12,407
12	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
13	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
14	558	0	1,548	0	279	0	1,318	2,778	3,687	8,333	4,835	0	3,274	0	8,215	0
15	558	413	1,548	1,172	279	276	1,318	0	3,687	0	4,835	408	3,274	0	8,215	0
16	558	13,774	1,548	19,182	279	8,269	1,318	12,565	3,687	9,873	4,835	31,008	3,274	0	8,215	0
17	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
18	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
19	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
20	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
21	558	1,148	1,548	3,254	279	765	1,318	66,594	3,687	127,513	4,835	17,137	3,274	4,343	8,215	12,407
22	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
23	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	26,962	8,215	88,496
24	558	0	1,548	0	279	0	1,318	2,778	3,687	8,333	4,835	0	3,274	0	8,215	0
25	558	413	1,548	1,172	279	276	1,318	0	3,687	0	4,835	408	3,274	0	8,215	0
26	558	377	1,548	2,172	279	328	1,318	198	3,687	666	4,835	615	3,274	653	8,215	2,948
27	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
28	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
29	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
30	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
31	558	14,922	1,548	22,436	279	8,269	1,318	5,254	3,687	15,761	4,835	48,145	3,274	4,343	8,215	12,407
32	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
33	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
34	558	0	1,548	0	279	0	1,318	2,778	3,687	8,333	4,835	0	3,274	0	8,215	0
35	558	413	1,548	1,172	279	276	1,318	0	3,687	0	4,835	408	3,274	0	8,215	0
36	558	0	1,548	0	279	0	1,318	61,340	3,687	111,752	4,835	0	3,274	0	8,215	0
37	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
38	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	26,962	8,215	88,496
39	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
40	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
41	558	1,148	1,548	3,254	279	765	1,318	17,819	3,687	25,634	4,835	17,137	3,274	4,343	8,215	12,407
42	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
43	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
44	558	0	1,548	0	279	0	1,318	2,778	3,687	8,333	4,835	0	3,274	0	8,215	0
45	558	413	1,548	1,172	279	276	1,318	0	3,687	0	4,835	408	3,274	0	8,215	0
46	558	13,774	1,548	19,182	279	8,269	1,318	0	3,687	0	4,835	31,008	3,274	0	8,215	0
47	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
48	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
49	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0
50	558	0	1,548	0	279	0	1,318	0	3,687	0	4,835	0	3,274	0	8,215	0

Project	Penaranda		Bustos-Pandi		Buenavista		Tibayan		Cabuyao East		Sta. Cruz		Sta. Maria		Liban-Cabusao	
Year	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R	O&M	R
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
4	649	12,052	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	21,321
5	649	0	770	308	549	205	3,492	513	1,313	0	5,913	0	4,667	1,778	3,244	5,055
6	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
7	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
8	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	41,798	3,244	0
9	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
10	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
11	649	1,241	770	2,100	549	1,400	3,492	3,496	1,313	3,530	5,913	22,974	4,667	12,207	3,244	10,564
12	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
13	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
14	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
15	649	0	770	308	549	205	3,492	513	1,313	0	5,913	0	4,667	1,778	3,244	5,055
16	649	2,340	770	16,018	549	10,595	3,492	26,976	1,313	16,027	5,913	83,893	4,667	1,428	3,244	15,648
17	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
18	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
19	649	12,502	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	21,321
20	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
21	649	1,241	770	2,100	549	1,400	3,492	3,496	1,313	3,530	5,913	22,974	4,667	12,207	3,244	10,564
22	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
23	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	41,798	3,244	0
24	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
25	649	0	770	308	549	205	3,492	513	1,313	0	5,913	0	4,667	1,778	3,244	5,055
26	649	123	770	545	549	462	3,492	1,301	1,313	381	5,913	1,652	4,667	820	3,244	24,211
27	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
28	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
29	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
30	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
31	649	3,581	770	18,118	549	11,995	3,492	30,472	1,313	19,557	5,913	106,867	4,667	13,635	3,244	26,212
32	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
33	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
34	649	12,052	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	21,321
35	649	0	770	308	549	205	3,492	513	1,313	0	5,913	0	4,667	1,778	3,244	5,055
36	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
37	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
38	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	41,798	3,244	0
39	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
40	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
41	649	1,241	770	2,100	549	1,400	3,492	3,496	1,313	3,530	5,913	22,974	4,667	12,207	3,244	10,564
42	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
43	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
44	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
45	649	0	770	308	549	205	3,492	513	1,313	0	5,913	0	4,667	1,778	3,244	5,055
46	649	2,340	770	16,018	549	10,595	3,492	26,976	1,313	16,027	5,913	83,893	4,667	1,428	3,244	15,648
47	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
48	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0
49	649	12,052	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	21,321
50	649	0	770	0	549	0	3,492	0	1,313	0	5,913	0	4,667	0	3,244	0

Table 4.1 ASSESSMENT OF SCREENING CRITERIA FOR THE PUMP IRRIGATION SYSTEMS

Assessment Factor / Name of System	Management by NIA		Internal Rate of Return				Farmers' Willingness to Pay for ISF*		Financial Status of System		Economically Depressed Area**		Potential Financial Soundness***						Overall Assessment
			GA		SA		GA	SA			Regional Economic Condition		GA			SA			
	Turn-over Stage	Assess-ment	EIRR (%)	Assess-ment	EIRR (%)	Assess-ment	Assess-ment	Assess-ment	Balance (1,000 pesos)	Assess-ment	per Capita GDP (pesos)	Assess-ment	Increased Ratio of Farm Income (%)	Rank	Assess-ment	Increased Ratio of Farm Income (%)	Rank	Assess-ment	
Bonga Pump #1	1	Yes	19.7	Yes	18.4	Yes	Yes	Yes	-279	Yes	6,970	Yes	308	2	Yes	263	3	Yes	Yes
Bonga Pump #2	1	Yes	27.2	Yes	21.4	Yes	No	Yes	-318	Yes	6,970	Yes	269	5	Yes	201	5	Yes	Yes
Bonga Pump #3	1	Yes	16.5	Yes	15.2	Yes	Yes	Yes	-137	Yes	6,970	Yes	214	9	Yes	199	6	Yes	Yes
Iguig	-	Yes	13.8	No	10.4	No	Yes	Yes	-494	Yes	7,055	Yes	203	10	Yes	175	8	Yes	No
Alcala-Amulung	-	Yes	20.2	Yes	18.4	Yes	Yes	Yes	-494	Yes	7,055	Yes	221	8	Yes	195	7	Yes	Yes
Solana	2	Yes	25.2	Yes	19.2	Yes	Yes	Yes	-1,582	Yes	7,055	Yes	240	6	Yes	163	10	Yes	Yes
MARIIS Pump #1	1	Yes	6.3	No	6.8	No	Yes	Yes	-1,131	Yes	7,055	Yes	495	1	Yes	356	1	Yes	No
MARIIS Pump #2/3	1	Yes	7.3	No	7.5	No	Yes	Yes	-4,572	Yes	7,055	Yes	288	4	Yes	264	2	Yes	No
Penaranda	3	No	25.2	Yes	19.6	Yes	Yes	Yes	-61	Yes	11,088	No	121	15	No	104	13	No	No
Bustos-Pandi	3	No	20.8	Yes	18.5	Yes	Yes	Yes	396	No	11,088	No	115	16	No	104	13	No	No
Buenavista	3	No	19.3	Yes	14.5	Yes	Yes	Yes	216	No	11,088	No	129	13	No	104	13	No	No
Tibagan	3	No	21.5	Yes	17.2	Yes	Yes	Yes	-185	Yes	11,088	No	125	14	No	105	12	No	No
Cabuyao East	-	Yes	28.4	Yes	20.2	Yes	No	Yes	416	No	12,847	No	161	12	Yes	101	16	No	No
Sta. Cruz	1	Yes	38.5	Yes	32.3	Yes	No	No	180	No	12,847	No	202	11	Yes	155	11	Yes	No
Sta. Maria	-	Yes	38.3	Yes	25.8	Yes	No	No	-828	Yes	12,847	No	290	3	Yes	214	4	Yes	No
Libmanam-Cabusao	-	Yes	26.8	Yes	19.0	Yes	Yes	Yes	-1,205	Yes	5,292	Yes	233	7	Yes	166	9	Yes	Yes

Remarks:
- GA: Generated area
- SA: Present irrigation service area
- IRR: Economic internal rate of return (Economic cost and benefit are shown in Table 4.2)
- *: Farmer's willing to pay irrigation service fee for pump operation
- **: The gross domestic product per capita will be less than an average gross domestic product per capita (peso 9,130) of the whole Philippines with Unexception of National Capital Region
- ***: It is considered sound in assessment that increased ratio of farm income between present condition and with project condition become over 150% in terms of households.

Table 4.2 IRRIGATION BENEFIT AND ECONOMIC COST (1/2)
(FOR SERVICE AREA)

(Unit : thousands Pesos)

	Bonga #1			Bonga #2			Bonga #3			Iquig			Alcala-Amulung			Solana			MARIIS #1			MARIIS #2 & #3		
	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I
A. IRRIGATION BENEFIT																								
1 Area (ha)																								
Wet Season																								
Paddy																								
Irrigated	298	0	298	674	0	674	202	0	202	603	0	603	1,840	0	1,840	1,320	0	1,320	1,200	0	1,200	6,185	0	6,185
Rainfed	0	298	-298	0	674	-674	0	202	-202	0	603	-603	0	1,840	-1,840	0	1,320	-1,320	0	472	-472	0	2,806	-2,806
Dry Season																								
Paddy	208	0	208	554	0	554	132	0	132	603	0	603	1,840	0	1,840	1,320	0	1,320	1,200	0	1,200	6,185	0	6,185
Diversified Crops																								
Garlic	10	0	10	35	0	35	20	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	80	0	80	85	0	85	50	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Unit Net Production Value (Peso/ha)																								
Wet Season																								
Paddy																								
Irrigated	8,313	0	8,313	8,313	0	8,313	8,313	0	8,313	9,665	0	9,665	9,665	0	9,665	9,665	0	9,665	8,910	0	8,910	8,910	0	8,910
Rainfed	0	4,456	-4,456	0	4,582	-4,582	0	4,339	-4,339	0	4,117	-4,117	0	4,035	-4,035	0	5,096	-5,096	0	3,055	-3,055	0	3,120	-3,120
Dry Season																								
Paddy	9,789	0	9,789	9,789	0	9,789	9,789	0	9,789	11,222	0	11,222	11,222	0	11,222	11,222	0	11,222	10,437	0	10,437	10,437	0	10,437
Diversified Crops																								
Garlic	15,718	0	15,718	15,718	0	15,718	15,718	0	15,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	29,677	0	29,677	29,677	0	29,677	29,677	0	29,677	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Irrigation Benefit																								
Wet Season																								
Paddy																								
Irrigated	2,477	0	2,477	5,603	0	5,603	1,679	0	1,679	5,828	0	5,828	17,784	0	17,784	12,758	0	12,758	10,692	0	10,692	55,108	0	55,108
Rainfed	0	1,328	-1,328	0	3,088	-3,088	0	876	-876	0	2,483	-2,483	0	7,424	-7,424	0	6,727	-6,727	0	1,442	-1,442	0	8,755	-8,755
Dry Season																								
Paddy	2,036	0	2,036	5,423	0	5,423	1,292	0	1,292	6,767	0	6,767	20,648	0	20,648	14,813	0	14,813	12,524	0	12,524	64,553	0	64,553
Diversified Crops																								
Garlic	157	0	157	550	0	550	314	0	314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	2,374	0	2,374	2,523	0	2,523	1,484	0	1,484	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	7,045	1,328	5,717	14,099	3,088	11,010	4,770	876	3,893	12,595	2,483	10,112	38,432	7,424	31,008	27,571	6,727	20,844	23,216	1,442	21,774	119,661	8,755	110,906
B. ECONOMIC COST		17,466			27,222			15,086			5,977			25,813			56,855			180,546			927,230	

	Penaranda			Bustos-Pandi			Buenavista			Tibagan			Cabuyao East			Sta. Cruz			Sta. Maria			Libmanan-Cabusao		
	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I
A. IRRIGATION BENEFIT																								
1 Area (ha)																								
Wet Season																								
Paddy																								
Irrigated	400	0	400	731	0	731	351	0	351	1,295	0	1,295	575	0	575	3,362	2,250	1,112	1,653	730	923	2,195	0	2,195
Rainfed	0	400	-400	0	708	-708	0	346	-346	0	1,285	-1,285	0	575	-575	0	969	-969	0	723	-723	0	2,195	-2,195
Dry Season																								
Paddy	400	0	400	731	0	731	351	0	351	1,295	0	1,295	575	0	575	3,362	1,940	1,422	1,653	858	795	2,195	0	2,195
Diversified Crops																								
Garlic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Unit Net Production Value (Peso/ha)																								
Wet Season																								
Paddy																								
Irrigated	9,726	0	9,726	9,067	0	9,067	9,067	0	9,067	9,067	0	9,067	8,957	0	8,957	8,957	8,208	749	8,957	6,668	2,289	8,871	0	8,871
Rainfed	0	8,472	-8,472	0	7,930	-7,930	0	7,543	-7,543	0	7,509	-7,509	0	2,148	-2,148	0	2,813	-2,813	0	2,915	-2,915	0	3,950	-3,950
Dry Season																								
Paddy	11,314	0	11,314	10,626	0	10,626	10,626	0	10,626	10,626	0	10,626	10,500	0	10,500	10,500	10,107	393	10,500	8,588	1,912	10,372	0	10,372
Diversified Crops																								
Garlic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Irrigation Benefit																								
Wet Season																								
Paddy																								
Irrigated	3,890	0	3,890	6,628	0	6,628	3,183	0	3,183	11,742	0	11,742	5,150	0	5,150	30,113	18,468	11,645	14,806	4,868	9,938	19,472	0	19,472
Rainfed	0	3,389	-3,389	0	5,614	-5,614	0	2,610	-2,610	0	9,649	-9,649	0	1,235	-1,235	0	2,726	-2,726	0	2,108	-2,108	0	8,670	-8,670
Dry Season																								
Paddy	4,526	0	4,526	7,768	0	7,768	3,730	0	3,730	13,761	0	13,761	6,038	0	6,038	35,301	19,608	15,693	17,357	7,369	9,988	22,767	0	22,767
Diversified Crops																								
Garlic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	8,416	3,389	5,027	14,396	5,614	8,781	6,912	2,610	4,302	25,502	9,649	15,853	11,188	1,235	9,953	69,414	40,801	24,613	32,162	14,344	17,819	42,238	8,670	33,568
B. ECONOMIC COST		6,549			27,004			17,193			45,926			26,739			29,926			22,081			87,427	

Remarks : W : With project condition
W/O : Without project condition
I : Increment

Table 4.2 IRRIGATION BENEFIT AND ECONOMIC COST (2/2)
(FOR GENERATED AREA)

(Unit : thousands Pesos)

	Banga #1			Banga #2			Banga #3			Iguig			Alcala-Amulung			Solano			MARIIS #1			MARIIS #2 & #3**		
	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I
A. IRRIGATION BENEFIT																								
1 Area (ha)																								
Wet Season																								
Paddy																								
Irrigated	426	0	426	1,200	0	1,200	218	0	218	770	0	770	2,279	0	2,279	2,865	0	2,865	1,667	0	1,667	6,753	0	6,753
Rainfed	0	426	-426	0	1,200	-1,200	0	218	-218	0	770	-770	0	2,279	-2,279	0	2,865	-2,865	0	472	-472	0	2,806	-2,806
Dry Season																								
Paddy	296	0	296	980	0	980	138	0	138	770	0	770	2,279	0	2,279	2,865	0	2,865	1,667	0	1,667	6,753	0	6,753
Diversified Crops																								
Garlic	10	46	-36	35	88	-53	20	47	-27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	120	0	120	185	0	185	60	0	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Unit Net Production Value (Peso/ha)																								
Wet Season																								
Paddy																								
Irrigated	8,313	0	8,313	8,313	0	8,313	8,313	0	8,313	9,665	0	9,665	9,665	0	9,665	9,665	0	9,665	8,910	0	8,910	8,910	0	8,910
Rainfed	0	4,456	-4,456	0	4,582	-4,582	0	4,339	-4,339	0	4,117	-4,117	0	4,035	-4,035	0	5,096	-5,096	0	3,055	-3,055	0	3,120	-3,120
Dry Season																								
Paddy	9,789	0	9,789	9,789	0	9,789	9,789	0	9,789	11,222	0	11,222	11,222	0	11,222	11,222	0	11,222	10,437	0	10,437	10,437	0	10,437
Diversified Crops																								
Garlic	15,718	0	15,718	15,718	0	15,718	15,718	0	15,718	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	29,677	0	29,677	29,677	0	29,677	29,677	0	29,677	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Irrigation Benefit																								
Wet Season																								
Paddy																								
Irrigated	3,541	0	3,541	9,976	0	9,976	1,812	0	1,812	7,442	0	7,442	22,027	0	22,027	27,690	0	27,690	14,853	0	14,853	60,169	0	60,169
Rainfed	0	1,898	-1,898	0	5,498	-5,498	0	946	-946	0	3,170	-3,170	0	9,196	-9,196	0	14,600	-14,600	0	1,442	-1,442	0	8,755	-8,755
Dry Season																								
Paddy	2,898	0	2,898	9,593	0	9,593	1,351	0	1,351	8,641	0	8,641	25,575	0	25,575	32,151	0	32,151	17,398	0	17,398	70,481	0	70,481
Diversified Crops																								
Garlic	157	0	157	550	0	550	314	0	314	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	3,561	0	3,561	5,490	0	5,490	1,781	0	1,781	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10,157	1,898	8,259	25,609	5,498	20,111	5,258	946	4,312	16,083	3,170	12,913	47,601	9,196	38,406	59,841	14,600	45,241	32,251	1,442	30,809	130,650	8,755	121,896
B. ECONOMIC COST	23,596			36,434			15,382			10,496			39,285			87,596			295,172			1,064,751		

	Penaranda			Bustos-Pandi			Buenavista			Tibagan			Cabuyao East			Sta. Cruz			Sta. Maria			Libmanan-Cabusao		
	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I	W	W/O	I
A. IRRIGATION BENEFIT																								
1 Area (ha)																								
Wet Season																								
Paddy																								
Irrigated	535	0	535	900	0	900	541	0	541	1,839	0	1,839	1,013	0	1,013	4,896	2,250	2,646	2,800	730	2,070	4,102	0	4,102
Rainfed	0	535	-535	0	877	-877	0	536	-536	0	1,829	-1,829	0	1,013	-1,013	0	2,503	-2,503	0	1,870	-1,870	0	4,102	-4,102
Dry Season																								
Paddy	535	0	535	900	0	900	541	0	541	1,839	0	1,839	1,013	0	1,013	4,896	1,940	2,956	2,800	858	1,942	4,102	0	4,102
Diversified Crops																								
Garlic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Unit Net Production Value (Peso/ha)																								
Wet Season																								
Paddy																								
Irrigated	9,726	0	9,726	9,067	0	9,067	9,067	0	9,067	9,067	0	9,067	8,957	0	8,957	8,957	8,208	749	8,957	6,668	2,289	8,871	0	8,871
Rainfed	0	8,472	-8,472	0	7,930	-7,930	0	7,543	-7,543	0	7,509	-7,509	0	2,148	-2,148	0	2,813	-2,813	0	2,915	-2,915	0	3,954	-3,954
Dry Season																								
Paddy	11,314	0	11,314	10,626	0	10,626	10,626	0	10,626	10,626	0	10,626	10,500	0	10,500	10,500	10,107	393	10,500	8,588	1,912	10,372	0	10,372
Diversified Crops																								
Garlic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3 Irrigation Benefit																								
Wet Season																								
Paddy																								
Irrigated	5,203	0	5,203	8,160	0	8,160	4,905	0	4,905	16,674	0	16,674	9,073	0	9,073	43,853	18,468	25,385	25,080	4,868	20,212	36,389	0	36,389
Rainfed	0	4,533	-4,533	0	6,955	-6,955	0	4,043	-4,043	0	13,734	-13,734	0	2,176	-2,176	0	7,041	-7,041	0	5,451	-5,451	0	16,203	-16,203
Dry Season																								
Paddy	6,053	0	6,053	9,563	0	9,563	5,749	0	5,749	19,541	0	19,541	10,637	0	10,637	51,408	19,608	31,800	29,400	7,369	22,031	42,546	0	42,546
Diversified Crops																								
Garlic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tomato	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11,256	4,533	6,724	17,724	6,955	10,769	10,654	4,043	6,611	36,215	13,734	22,481	19,710	2,176	17,534	95,261	45,117	50,145	54,480	17,687	36,792	78,935	16,203	62,732
B. ECONOMIC COST	7,058			28,610			18,881			48,982			30,200			49,481			31,525			115,774		

Remarks : W ; With project condition
W/O ; Without project condition
I ; Increment

Table 5.1 SALIENT FEATURES OF THE MINI-HYDROPOWER DEVELOPMENT PROJECT

Case No.	Site No.	System	Province	Canal	Station	Head (m)	Discharge Qw/Qdr /1 (m³/s)	Out-put (kW)	Annual Energy (1,000MWH)	Installation Cost (10^3 US$) /2 WT	/3 GEN	/4 TR	/5 SW-Gear	Sub-Total	T/L&A FC	T/L&A LC	Civil (LC)	Total FC	Total LC	Grand Total	O&M Cost (10^3US$)	Economic Cost (10^3US$)	Benefit (10^3US$)	Internal Rate of Return (%)
1	1	CHICO-RIS	APAYAO	TUBUK SUPPLY CANAL No.1	STA8+615	21.1	4/2	700	4.517	496.15	333.07	29.23	453.46	1,301.91	433.88	13.97	600.2	1,735.79	614.17	2,349.96	27	2,246	378	14.2
2	2	-do-	-do-	CHICO MAIN CANAL	STA22+317	8.55	12/10	770	5.062	646.15	295.92	32.3	453.46	1,428.07	493.2	89.44	652.08	1,921.35	741.52	2,662.87	29	2,537	431	14.3
3	3	-do-	-do-	CHICO GORGOB MAIN CANAL	STA0+940 1+160	9.12	1.8/1.5	120	0.631	312	132	10.8	104	558.8	63.68	11.18	205.5	622.48	216.68	839.16	13	802	55	3.7
4	4	-do-	-do-	-do-	STA0+940 1+160	9.12	1.8/1.5	120	0.631	312	132	10.8	104	558.8	63.68	11.18	205.5	622.48	216.68	839.16	13	802	55	3.7
5	5	-do-	-do-	QUEZON MAIN CANAL	STA0+80 0+240, 0+460	8.25	12/10	760	4.912	673.08	377.7	31.0	453.46	1,535.24	452.8	67.08	1,603.48	1,988.04	1,670.56	3,658.6	32	3,375	363	10.5
6	6	AGNO RIS	PANGA-SINAN	AGNO MAIN CANAL	STA5+000	4.27	17/8	547	2.875	673	429	20	360	1,482	99.69	27.95	545.1	1,581.69	573.05	2,154.74	32	2,057	252	9.7
7	7	-do-	-do-	-do-	STA8+096 8+270	6.26	9.2	438	2.755	484.62	307.7	31.0	453.46	1,276.78	422	27.95	706.66	1,698.78	734.61	2,433.39	26	2,308	233	7.9
8	8	DIPALO RIS	-do-	DIPALO MAIN CANAL	STA0+800 0+963	8.17	5/2.5	296	1.555	497	721	13.6	200	1,431.6	86.48	33.54	526.5	1,518.08	560.04	2,078.12	31	1,983	132	3.5
9	9	-do-	-do-	-do-	STA1+252 STA1+420	8.17	5/2.5	296	1.555	497	721	13.6	200	1,431.6	86.48	33.54	526.5	1,518.08	560.04	2,078.12	31	1,983	132	3.5
10	10	TARLACRIS	TARLAC	CAMLING MAIN CANAL	STA2+283 2+404	9.6	6/1.3	418	2.197	480.76	282	32.8	240.38	1,035.94	161.49	92.23	381.22	1,197.43	473.45	1,670.88	25	1,590	189	9.9
11	11	MAGAT RIIS	ISABELA	SOUTH HIGH CANAL	STA10+372	3.8	19/14	474	2.491	801	520	18.4	344	1,683.4	57.28	0	619.0	1,750.68	619.0	2,369.68	36	2,265	221	7.1
12	12	ANGAT RIS	BULACAN	SAN RAFAEL MAIN CANAL	NORTH CONSTANT GATE	3.8	16	500	2.260	676.82	431	24.62	453.46	1,585.77	452.8	67.08	660.07	2,038.57	727.15	2,765.72	33	2,642.1	194	4.7
13	13	-do-	-do-	BUSTOS MAIN CANAL	SOUTH CONSTANT GATE	4.75	12/3.6	441	2.318	564	641	17.6	296	1,518.6	48.08	0	558.5	1,566.68	558.5	2,125.18	32	2,030	205	7.5
14	14	-do-	-do-	-do-	TALANFAS CHECK GATE	3.8	10/3	294	1.545	593	336	13.6	240	1,182.6	59.08	14.0	435	1,241.68	449.0	1,690.68	25	1,615	134	5.5
15	15	T-RIS	PAMPANGA	T-RIS MAIN CANAL	STA5+30	14.79	2.2/0.53	252	1,324	320.5	173.07	13.6	160.26	667.43	148.89	100.62	409.67	816.32	510.29	1,326.61	20	1,239	110	6.1
16	16	P-RIS	-do-	P-RIS MAIN CANAL	STA1+300	5.7	25	1,175	5.787	1,030.77	692.31	42.31	453.46	2,218.85	538.2	156.52	908.27	2,757.05	1,064.79	3,821.84	46	3,641	467	10.5
17	17	UPRIIS	N. ECIJA	PENARANDA MAIN CANAL	STA5+226	6.43	10	507	3.258	538.46	323.1	25	453.46	1,340.02	430.8	99.13	559.99	1,770.82	599.12	2,369.94	27	2,268.09	275	9.9
	1 & 2*	CHICO-RIS	APAYAO											2,729.98	504.28	103.41	1,252.28	3,234.26	1,355.69	4,589.95	56	4,359	809	15.7

Remarks: /1 : Qw : Discharge in wet season, Qdr : Discharge in dry season
/2 : Water turbine /3 : Generator /4 : Transmision line facilities
/5 : Switchgear /6 : Transmission line facilities

* Combined site No. 1 with site No.2

FIG. 2.1 GENERAL LAYOUT OF BONGA PUMP #1 IRRIGATION SYSTEM

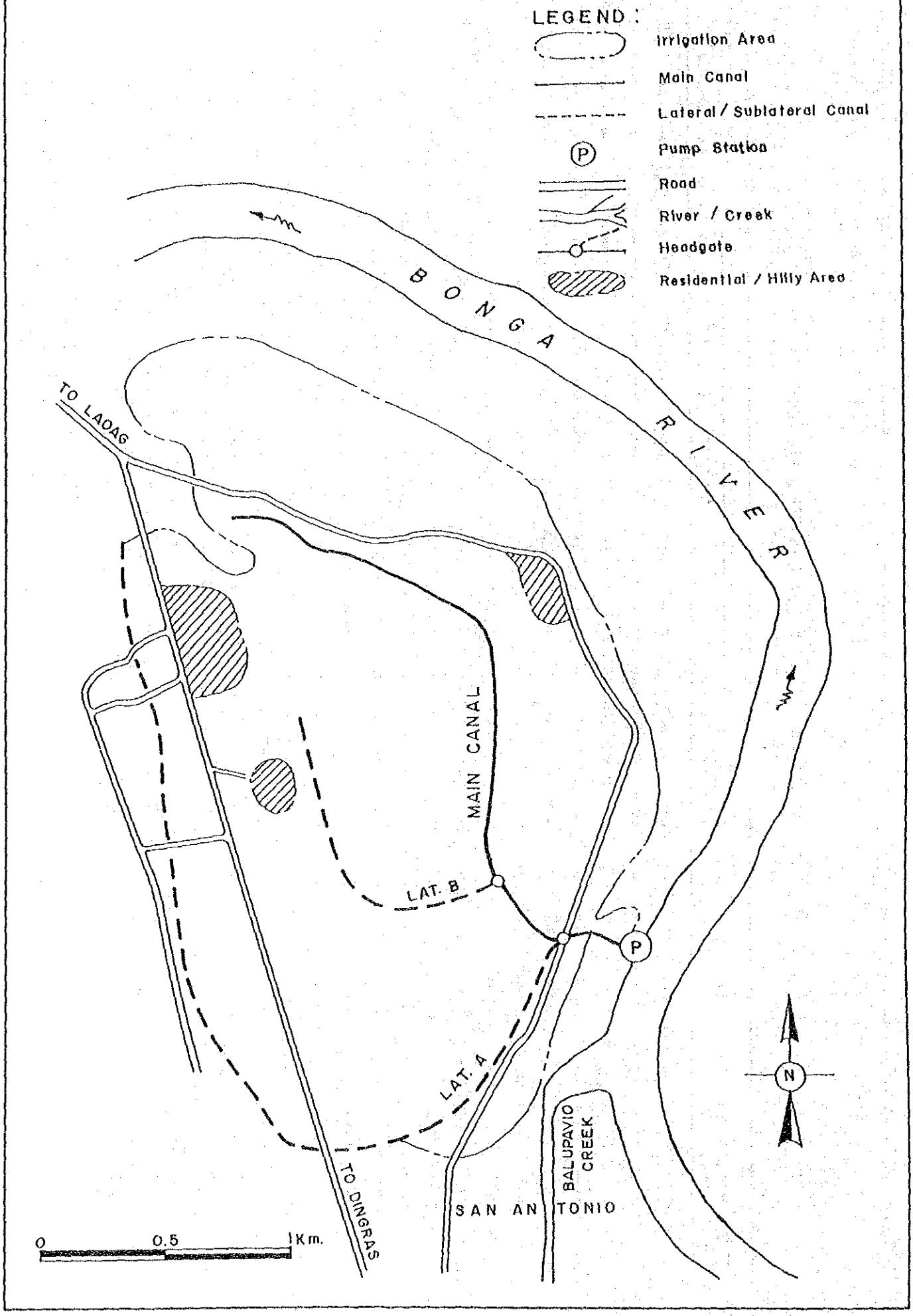

FIG. 2.2 GENERAL LAYOUT OF BONGA PUMP #2 IRRIGATION SYSTEM

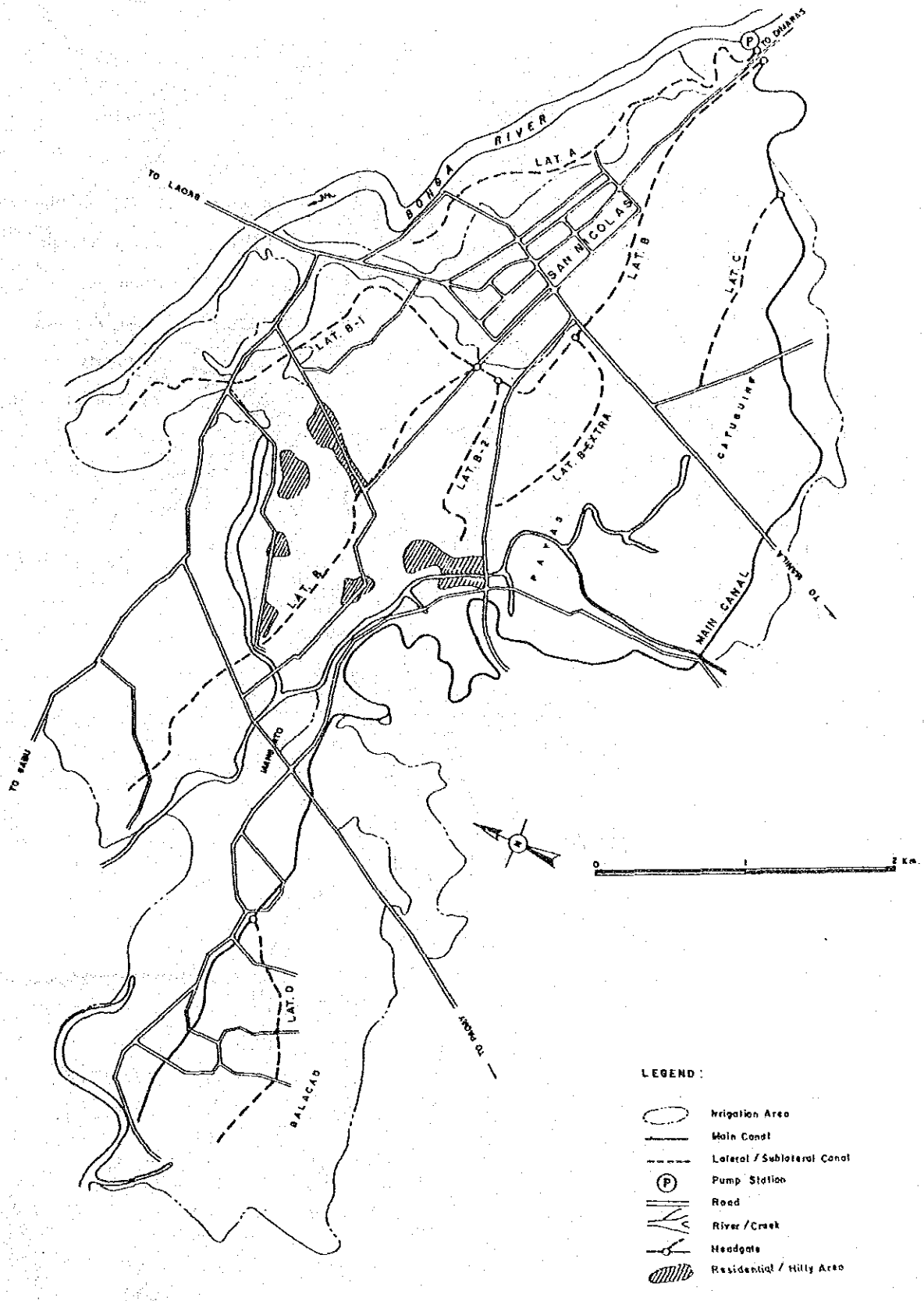

FIG. 2.3 GENERAL LAYOUT OF BONGA PUMP #3 IRRIGATION SYSTEM