5) Vertic Tropoquepts and Udorthentic Pellusterts: 1,340 ha

They are from the volcanic tuff and/or tuffaceous rocks and are formed of very fine textured cum sticky soils. These soils lie on the lower terraces and have mostly been reclaimed for agricultural production. These soils generally have low inherent fertility but could be expected to be used for productive paddy cultivation if modern farming technology is applied.

(5) Hydrology

There are numerous small drainage channels in the Project area. All of these channels are characterized by small catchment areas, steep and short river courses. Run-off durations of flood flows for all the drainage channels are very short. Only 4 drainage channels have perennial flows. These discharge flows are from springs, and thus, the discharges depend on the extent and geological constitution of the catchment area of the drainage channels. Generally, these discharges are reduced to as little as 3 to 5 lit./sec during the dry season.

2.3.3 Present Agricultural Setting

(1) Land use

Agricultural land covers 1,440 ha or 30% of the Project area of 4,930 ha. The remaining 70% of land is grass land, bush/shrub, forest and buildings or residence. The land use of the Project area is as shown below.

Present Land Use (ha)

Land Categories	Total
Agricultural Land:	1,440
- Irrigated Paddy Field	450
- Rainfed Paddy Field	320
- Upland Field	160
- Orchard Garden	350
- Coconut Plantation	100
- Others	60
Non-Agricultural Land	3,160
- Forest	280
- Bush/Shrub	1,520
- Grass land	1,360
Residence Yard/Others	330
Total	4,930

(2) Land ownership and tenure systems

Before implementation of the agrarian reform, the land of the Project area belonged to nine land owners. The farmers who are the beneficiaries of the current agrarian reform were peasants employed on those rice plantations. DAR as of the end of October, 1991 has already distributed the land covering 2,736 ha to 1,753 farmer beneficiaries.

(3) Farm production

Agriculture is the mainstay of the rural economy in the Project area. The main crops are paddy, corn, root crops, vegetables, coffee, cacao, and fruit trees.

The present paddy production in the Project area is estimated as shown below on the basis of the data of the Jala-Jala municipality agriculture office in 1991.

Description		Cultivation Area (ha)	Unit Yield (ton/ha)	Production (ton)
Irrigation area	Rainy season	350	3.5	1.225
	Dry season	70	4.0	280
Rainfed area	Rainy season	420	3.0	1.260
Total		840	-	2,765

The above data shows the increasing tendency on paddy production in the Project area from 2.7 ton/ha to 3.3 ton/ha, which is conceived as the results of the enhancement of the owner farmers' incentive on paddy production after agrarian reform, effects on the agricultural extension services on seeds, fertilizers, agro-chemicals.

(4) Post harvest and marketing

Harvest activities such as reaping, threshing and winnowing, are usually done manually. These harvesting works are usually scheduled on both contract based work and/or mutual assistance of the farmers each others.

Threshing is usually done by a beating method using the traditional implement, purchase to threshing table or bamboo frame threshing stand. Usage of a power thresher (IRRI model) or pedal thresher is only used by rich farmers. The majority of

farmers rely on conventional sun drying using public road pavement, concrete floors such as basketball courts, village halls, etc.

About 15 small capacity rice mills equipment "called Kiskisan" having a working capacity of 0.3 ton/hr are available in the Project area. Other than the above, 5 rice mill complexes "called Cono" which has a working capacity of about 0.5 to 1.0 ton/ha are operating. These 20 mills are mainly used for milling paddy for local consumption.

Marketing of farm products from the Project area to outside market is made by individual farmers. Farmers' cooperatives in the area have not yet organized joint marketing of farm products. Thus, the performance of the marketing system is inefficient in terms of movement of product and marketing costs.

(5) Farmers' organizations

In the Project area, there are 18 farmers cooperatives societies - 6 farmers associations, 7 multi-purpose cooperatives and 5 irrigators' associations. The membership of the above cooperative societies overlapped with each others. Thus, a farmer has two to three memberships in most case. Under the guidance of Bureau of Cooperative in DA, the farmers association and multi-purpose cooperative had been organized aiming to maintain joint liability on farmers credit as well as mutual assistance on agricultural production. Irrigation association has a function to maintain the irrigation facilities under the technical supervision of NIA. In general, most of these cooperatives societies are not so active due to the lack of funds, and insufficient guidance and facilities.

(6) Agricultural institutions and support activities

In the Project area, the DA has three regular agricultural production technologists and four casuals. Their main function is to assist farmers in improving institutional and farm management practices through disseminating agricultural information and transfer of farm technologies. They also organize credit and multipurpose cooperatives, farmers associations and other related organizations. The municipal agrarian reform office (MARO) assists the farmers in tenure development through a process of registration and documentation follow-ups of prospective farmer beneficiaries included in the land transfer operations. At present, the municipal

manpower of DAR consists of three agrarian reform technologists, one statistician, a clerk and the municipal agrarian reform officer as head.

Recently, Meralco Foundation Inc. (MFI) has established in Bayugo area, the Agricultural and Aquacultural Extension Center (AAEC) including the function of agricultural extension, home economy extension, demonstration farm and operation and management of fish nursery pond.

(7) Financial and insurance services

As for the financial service structures, there was a rural bank at Jala-Jala previously but it has closed due to less profitable business. The present source of credit for farmers in the area includes the cooperatives and private individuals (relatives and friends). Of four cooperatives established, three cooperatives are active in granting loans to a limited extent. The multipurpose cooperative averaged about Peso 18,750.00 per month. The operation of the cooperative appears well managed with the guidance of the Municipal Agricultural Office. Besides credit extended to members, the cooperatives started a consumer goods store for the patronage of both members and non-members.

2.3.4 Irrigation and Drainage Works

(1) Irrigation

In the Project area, fifteen communal irrigation systems (CIS) have been constructed by use of river or creek flows. The general features of the existing CIS are as shown in Table.4 and Fig.1. Rainfalls and river discharges in the Project area fluctuate in magnitude and time of occurrence. Irrigation area in the wet season has 350 ha or 72% of the service area. Further, the river discharges in the dry season are scarce or dried up, then the irrigation service in the dry season is limited to 70 ha in total or 14% of the service area.

All existing CIS are provided with diversion dams which are mostly constructed on the middle reaches of steep rivers or creeks. There exist fifteen diversion dams - for example diversion weir, barrage with wooden stoplogs, and simple check structures - depending on sizes of rivers and topography. No provision or less functioning of scouring sluices occurs heavy sedimentation in the upstream river sections and serious

scouring in the downstream river sections. Further, absence of the intake gates accelerates siltation in their canal systems.

A total of 25.5 km of main and lateral irrigation canals serves for operational CIS. About 74% of the canals are lined with concrete blocks or wet stone masonry of U-shape flume type, to save losses of the limited water sources. In general, canal slopes are steep, running on the surfaces of steep slope land. Most of canal linings are superannuated.

No diversion structure such as turnout, division box is provided in the CIS. Some conveyance structures to cross roads and streams are constructed. Diversion of water to lateral canals or to fields is controlled only by means of stones or turfs through breakage of canal embankments or canal linings.

There is no inspection road of both main and lateral canals. Water supply to fields is carried out by plot to plot supply. The downstream fields confront excess water in flood seasons and water shortage in the dry seasons. Equitable water supply is not assured.

(2) Drainage

There are no distinct drainage canals to evacuate excess rainfall or to convey excess irrigation water to the natural streams or creeks. In the lowlying area, some irrigation canals have the dual purpose of irrigation and drainage. However, since those canals are small in capacity, it is brought inundation problems in the downstream areas when heavy rainfalls occur. The major streams or creeks have sufficient capacities to flow down surface runoffs in the upper and middle reaches. However, in the lower reaches toward Laguna lake, their capacities get smaller. At crossing points with the lake coastal roads, the flow capacities are reduced significantly due to heavy sedimentation in river courses. In the CIS area, runoff of the small creeks is collected for irrigation, consequently, the stream courses disappear into paddy fields. Thus, during heavy precipitation, serious inundation sometimes appears in the low-lying paddy fields.

(3) Operation and maintenance

Operation and maintenance of CIS are carried out by the Irrigators Associations (IA) under the technical and administrative guidance of the NIA provincial office. The IA holds regular meetings to discuss the cropping and water supply schedules and any important matters related to their association. Generally, canal cleaning is done by members of IA. The water tender of IA monitors farm operation and water distribution according to the schedules.

The water charges are paid to the irrigation association. Generally, the water charges are paid in paddy at the rate of 125 to 175 kg/ha/crop season. The charges are collected by a fee collector employed or designated by IA with a monetary incentive of 5% of the collected fees. The rate of water charges fluctuates, year by year, depending upon the progress of irrigation services.

2.3.5 Power Supply Services

Electric power in the Project area is supplied by the Manila Electric Company (MERALCO) which receives electric power in bulk from he National Power Corporation (NPC) and distributes the power to consumers. Electric power for Jala-Jala is supplied from the Malaya Thermal Plant which has a generating capacity of 300 MW and is located 5 km north of Jala-Jala poblacion. Construction of distribution lines and connection to users as well as maintenance of these facilities are undertaken by MERALCO. The general features of the power supply systems in Project area are:

- Malaya Thermal Plant	300 MW
- Sub-station adjacent to Malaya Thermal Plant (stepdown)	20 kV/3.6 kV
- Distribution line	
Secondary distribution line (single phase, high voltage)	3.60 kV
Tertiary distribution line (single phase, low voltage)	220 V

2.3.6 Rural Water Supply

In the Project area, groundwater is the main source for drinking water and domestic use. Shallow wells (713) and deep wells (63) which are graded into level-I are installed under the current rural water supply program. Shallow wells have a depth of 20 to 30 m, while deep wells are around 60 m. One well can possibly supply domestic

water for 22 to 69 persons. Other than the above, in Jala-Jala Poblacion, the water supply system at level-III was established in 1981 by the Jala-Jala Waterwork Association. This system includes a 150 m deep well with a 5 litre/sec capacity turbine pump, pump house, 38 cubic m of distribution steel tank, and more than 2 km of distribution pipelines.

To assess the quality of groundwater, during the investigation period of the Feasibility Study, some 37 wells and 5 springs were selected at random, and water sampling tests were conducted in the field. And detailed chemical analysis and biological test were conducted on 10 of the water samples selected at random as shown in Table.5.

The pH value and iron content of water for some wells in the Sipsipin area exceeded the permissible limits of 6.5 to 8.5. The well water of such areas in Sipsipin are not acceptable for potable water according to the standard ranges specified in the Philippines. Biological tests showed that eight (8) of 10 sampled wells were contaminated with the bacillus. This is due to the absence of or weak protection measures against seepage of drained water and proximity to septic and sewage tanks. Some samples showed contamination with abnormal values of turbidity and color.

The interview survey on the water supply conditions has been conducted with respect to well function, water quantity in the dry season and water quality. The result did not coincide well with the results of the laboratory test but they provide an efficient tool for interpretation of the area characteristics. The results are summarized below.

Well Nos.		Less Function		Less Quantity		Less Quality		Trouble Well	
(nos)	(%)	(nos)	(%)	(nos)	(%)	(nos)	(%)	(nos)	(%)
665	(100)	69	(11)	81	(12)	104	(16)	198	(30)

2.3.7 Road and Transportation

Access to Jala-Jala, capital of Jala-Jala municipality, is by national road route 301, which leads to Metro Manila about 75 km distance. This route is being paved with concrete by the provincial DPWH. To village Bagumbong, the branch from national road route 349 is available up to the adjacent Matikiw village of Laguna province. This road is also being paved by the provincial DPWH.

In the Project area, there are about 44 km of village roads and about 3 km of municipal roads. The municipal roads in Jala-Jala town or villages are mostly paved with concrete. Village roads are still unpaved, and more or less affected by erosion hazard. In fact, most village roads are hard to pass during the rainy season.

The link road of Jala-Jala peninsula from Jala-Jala to Bagumbong through Punta, 18.0 km long, was preliminarily implemented by the municipal office with construction equipment leased from DPWH in 1975, and clearing and excavation were executed up to Bagumbong without any structural works. At present, however, only the route between Jala-Jala and Palay-Palay, about 8.5 km, can be passed during the dry season and the remaining 10 km is not passable. Recently the Rizal Provincial Engineering Office commenced clearing and gravel metalling for a part of the above route with a completion schedule by September 1992 according to villagers' urgent demand. However, since the present works provide only sub-base course, concrete pavement for the whole route is strongly desired. The route of the link road is as shown in Fig.2.

The transportation system in the Project area consists of land and water systems. The road system includes simple pathways, feeder roads, village, municipal, provincial, and national roads. To travel across Laguna lake from Jala-Jala area to other towns of Laguna and Rizal provinces, a water transportation system is available.

Private light buses and public bus service are available to transport goods or passengers from Jala-Jala area to Tanay city, while public bus service is available thereafter from Tanay to Metro Manila. To transport large quantities of goods to or from a market place, the shippers usually contract out vehicles.

CHAPTER 3
OUTLINE OF THE PROJECT

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3.1 Objective

In line with the Medium Term National Development Plan, CARP has been operative since 1987. The Government intends to support the beneficiaries of agrarian reform by stabilizing both crop productivity and livelihood through implementing the integrated rural development conceived in CARP. The Government selected Jala-Jala area as a model area for CARP since agrarian reform in the area had progressed well, but the area was confronted with insufficient agricultural and rural infrastructures. The Government decided to implement the integrated Jala-Jala rural development project. with the following primary goals:

1) Early development of self-reliant farmers,
2) Increased regional gross domestic product (RGDP) by improving the socio-economic structure and basis of production, and
3) Attainment of self-sufficiency in staple food production (rice) within the municipality.

DAR, as of the end of October 1991, has already distributed land to 1,757 beneficiary farmers covering 2,736 ha or 96% of the target of the agrarian reform. However, since most of the beneficiary farmers have insufficient farming capital and agricultural support services are functioning sufficiently in the area, the crop productivity and farm income levels still remain at a minimal level.

The Project, to realize the effect of agrarian reform, aims at 1) improvement/ construction of four communal irrigation systems with high development priority; 2) improvement of road network, which will have a large development effect; 3) construction of rural water supply systems; and 4) construction of rice mill center, which will be effective for increasing marketability of farm produce.

3.2 Study and Examination of the Request

3.2.1 Justification of the Project

An assessment of the Request from the Government of the Philippines, the content of which as explained in Section 2.2, was made as to the suitability of the implementation of the Project under Japan's grant aid from the viewpoints of the national development plan, CARP implementation progress, and infrastructure development conditions of the Project area. The results of the assessment are summarized below:

(1) Significance of the project in view of the national development plan and CARP implementation

The Government of the Philippines is executing the Medium Term Development Plan for national economic development with the following targets:

1) To alleviate rural poverty,
2) To reinforce existing employment and to create further employment opportunities through development of the rural economy,
3) To realize social justice as well as to regulate fairly, and
4) To achieve sustainable economic growth.

In line with the Medium Term Development Plan, CAPR has been on-schedule since 1987. The essential objectives of CARP are:

1) To promote social justice,
2) To move the nation towards sound rural development and industrialization, and
3) To establish owner cultivationship of economic farm size.

The Government intends to support the beneficiaries of agrarian reform by stabilizing both crop productivity and livelihood through implementing integrated rural development conceived in CARP.

The proposed Project intends to bring up self-reliant farmers early for agrarian reform beneficiaries, increase regional domestic production by improving the socio-economic structures and foundations, and increase self-sufficiency of food production

within the municipal area. The Project consists of irrigation and drainage development, road network improvement, rural water supply facilities improvement, and construction of past-harvest processing facilities for paddy. The Government has designated the integrated Jala-Jala rural development Project as a model project of CARP, and put emphasis on the early realization of the Project. Thus the implementation of the Project exactly meets the intent and scope of the national plan and contributes largely to the promotion of the CARP implementation

(2) Early bringing up of self-reliance farmers

In the agrarian reform law, it has been set forth that the beneficiaries of agrarian reform shall amortize the allocated land and pay the land charges within 25 years. In the case of the Project area, the land charge due is estimated to be about Peso 3,500 to 4,500 per ha or equivalent to an annual charge of Peso 140 to Peso 180 per ha. The unit farm size under the present agrarian reform is a little smaller than 1.5 ha/household. Therefore, to achieve land amortization and financial self-reliance of the beneficiary farmers, increase of farm production and up-grading of farm productivity shall be realized through promotion of intensification of farming and diversification of crops. The farm households in Jala-Jala area can be grouped into four farming categories - namely: paddy cultivation, paddy/upland crop, upland crop, and plantation. Of these, the most beneficial farm household is the paddy cultivation farm which covers about 43% of the total farm households in Jala-Jala area

Under the Project, the gross income of the paddy farm is expected to increase from Peso 29,100 per ha to Peso 62,300 per ha, and the capacity to pay is also expected to increase significantly from Peso 8,200 per ha to Peso 33,900 per ha as shown in the table below..

Unit : Peso

Item	Without Project	With Project
Gross Income	29,060	62,260
On-farm	12,960	57,400
Non-farm	16,100	4,860
Gross Outgo	20,900	28,400
Net Revenue	8,160	33,860

This will contribute much to the improvement of farm budget and living standard of farmers. Four (4) irrigation systems will be improved under the Project, which will allow double cropping of paddy in the irrigation areas to be introduced. This will lead

to increasing the crop production, to improvement of the farm budget, and to the financial self-reliance of the farmers, and thus it will contribute to extension to the other CARP implementing area as a demonstration model project.

(3) Significance of the Project in self-sufficiency of staple food

The Jala-Jala area is presently short of the paddy production (2,800 tons) for self-consumption (4,600 tons as of 2000 year) within the area. To meet the demand of rice, double cropping of paddy a year as well as securing a unit yield of paddy is necessary. Under the Project, the existing irrigation system will be improved, and irrigation service to the dry season cropping will be secured through development of new irrigation systems by use of pumped water from Laguna lake. The Project will help a lot to attaining self-sufficiency in staple food at the municipality level.

(4) Activation of farming and socio-economic activities through improvement of road network

Most village roads in the Jala-Jala area are hard to pass during the rainy season due to muddy conditions and serious erosion. This restricts farm production and socio-economic activities to a large extent. Through the improvement of the trunk road and feeder roads to link the Jala-Jala Peninsula as well as to connect villages/farms with the trunk roads, the farm-to-market road network will be established. It will contribute to activation of farming and socio-economic activities

(5) Improvement of domestic water supply and sanitary conditions

The domestic water in the Jala-Jala area is taken from a shallow aquifer through shallow tubewells. The villagers confront a low quality of water which does not meet the national standard for drinking water and a decreasing quantity of water in the dry season. Most well water is contaminated with the bacillus due mainly to the absence of or weak protection measures against seepage of drained water. To those areas, rural water supply facilities will be provided to assure safe and stable water supply. Improvement of rural water supply will help enhance socio-economic activities in the rural area, and improve the sanitary condition of the villages.

(6) Activation of farmers association

In Jala-Jala area, there are 18 farmers cooperative societies which have been organized at the village level for such purposes as farm production, irrigation,

distribution of the farm input, and farm credit. In general, most of those cooperative societies are not active due to the lack of funds and insufficient guidance and facilities. The membership of the above cooperative societies overlapped with each other.

The proposed irrigation and drainage facilities, rural water supply facilities, and rice mill center will be transferred to an association to be organized by the beneficiaries after completion of the construction works. They will own, operate and maintain the constructed facilities. The actual participation of the beneficiaries to the project implementation will contribute to activation of the farmers association and to sustainable socio-economic development of the rural area.

3.2.2 Examination of Project Implementation and Operation and Maintenance Plan

The Department of Agrarian Reform will be responsible for implementation of the Project. To smoothly manage and operate the Project works, the Policy Coordinating Committee will be organized, being composed of representatives of DAR, and line agencies of CARP such as DPWH, NIA, DA, and MERALCO Foundation Inc. The technical assistance in the implementation of the Project will also be rendered from the line agencies of CARP.

After completion of the Project works, the Project facilities will be transferred to the respective operation and maintenance bodies as described below.

(1) Road network

The trunk road will be transferred to the Provincial Government of Rizal and it will be maintained as a provincial road. The feeder roads will also be transferred to the Provincial Government and maintained as village roads. The maintenance works of the roads will consist of routine maintenance and periodical maintenance. The routine maintenance will be carried out once or twice a year for repair of holes to road surface and removal of sediments in the side drains. Periodical maintenance will be carried out, in general, once a year for repair of pavement.

The maintenance and repair of the roads after transferred to the Provincial Government will be executed with the budgetary arrangement of the Province commonly by use of contractors. The annual operation and maintenance of the roads is estimated to be Peso 528,000 and Peso 146,000 for the trunk road and feeder roads, respectively as shown in Table.8. It is recommended that the above amount be arranged in the annual budget of the Province so as to sufficiently maintain the

functions of the constructed roads. It is confirmed that a memorandum of agreement will be entered into by the DAR (Project Office) and Rizal Provincial Government (Provincial Engineering Office), to ensure that necessary maintenance of the roads is undertaken.

(2) Irrigation and drainage facilities

After completion of the construction works, the irrigation and drainage facilities will be transferred to irrigation associations to be organized in the respective concerned villages, and the associations will own, operate, and maintain the constructed irrigation and drainage facilities as their communal irrigation systems .

NIA Provincial Office will provide guidance in the organizational development of the association and system management. Irrigation associations of Sipsipin and Llano irrigation systems, for which NIA Provincial Office has constructed some of the irrigation canals, have been organized in 1989, and NIA Provincial Office has provided the guidance and training of the financial management of the association and system management in 1991. Further, the associations of Palay-Palay and Pagkalinawan are scheduled to be established prior to the construction works of facilities under the guidance of NIA and be given training by NIA.

The officers of the association who will be elected by the members of the association consist of a president, vice president, secretary, treasurer, and an auditor. Irrigation water charges are collected in paddy by a water charge collector hired or designated by each association. To operate and maintain irrigation pumps and canal systems, a pump operator and a ditch tender are assigned by the association. Electric charge for the pump operation are covered by the collected irrigation charges. The annual electric charge of the respective irrigation systems are estimated as shown in Table.6 and summarized as below in terms of the unit cost per ha, together with the rate of the farmer's gross income of Peso 62,260.

Irrigation System	Electric Charge	Rate to Gross Income
Sipsipin	2,450 Peso/ha	4%
Llano	3,010 Peso/ha	5%
Palay-Palay	4,095 Peso/ha	7%
Pagkalinawan	3,900Peso/ha	6%

The members of the association will be able to pay the electric charge from the farmer's net revenue accrued from the Project implementation.

Further, the irrigation associations will be assisted in securing loans for its initial operation capital requirement. The said loans are expected to be extended thru the existing lending windows of the CARP e.g., Development Bank of the Philippines (DBP) and Land Bank of the Philippines (LBP).

(3) Rural water supply system

After completion of the construction works, the rural water supply facilities will be transferred to a village waterworks and sanitation association to be organized in the concerned village, and the association will own, operate, and maintain the constructed water supply facility. DPWH will provide the guidance in the association development, financial management of the association and facilities management.

The officers of the association consist of a president, vice president, secretary, treasurer, and a board member. The officers also make up the board of directors. The general assembly meeting is conducted annually, presided by the president, and the meetings of the board of directors are held quarterly, supported with special meetings called by the president as may be required. The board will assign a bookkeeper and a caretaker for the facility, who are responsible for keeping of financial record, collection of water charges, and supervising of operation and maintenance of facility. The operation and maintenance costs of the rural water supply facilities will be covered by the water charges collected from the members of the association. The annual operation and maintenance costs are estimated as shown in Table.9 and summarized below.

Level-I	:	48 Peso/household
Level-II	:	250 Peso/household

The DPWH has confirmed that the estimated O&M cost of rural water supply facilities is affordable on the part of the water users associations according to the experience in the present operation systems.

The members of the association will be able to pay the water charge from the farmer's net revenue accrued from the Project implementation.

(4) Rice Mill Center

At the onset, DAR will be owned and controlled the operation of the Rice Mill Center, and set up a transition period whereby ownership and control will be turned

over to a farmers association whose present farmers' groups will be federated into an umbrella organization.

During the transition period, DAR will be made a contract arrangement with a Non-government Organization (NGO) deemed to have the required entrepreneurial expertise in performing the day-to-day operation of the Rice Mill Center and necessary skills to undertake an on-the-job training for the farmer counterpart organization. The financial disbursement system, accounting, auditing rules and regulations of the Philippines government is not appropriately suited for a private oriented business operation as envisioned for the Rice Mill Center. While the task of undertaking the operational activities of the Rice Mill Center is passed on to an NGO, the ultimate responsibility of ensuring the success of business operations still rests with DAR who will closely monitored and set implementing policies and operating measures for the Rice Mill Center.

For the financial arrangements on the initial operation stage, the cost of hiring the services of an NGO shall be shouldered by the DAR with the funding to be also sourced from the local counterpart fund. The following direct operating expenses of the rice mill operations shall be shouldered by the farmer federation:

- Paddy procurement costs;
- Milling cost; and
- Marketing expenses.

In this regard, the farmer federation shall be assisted in sourcing out loans for its initial operating capital requirements. The DAR envisions that the loan requirements shall come from its existing lending windows, e.g. Development Bank of the Philippines (DBP), Quedan Guarantee Fund, and the Land Bank of the Philippines (LBP). Above organizational and financial arrangements by the DAR will be carried out before completion of the rice mill facilities.

3.2.3 Examination of the Project Components

(1) Irrigation and drainage facilities

Thirteen (13) irrigation plans consisting of improvement of the existing 15 irrigation systems and development of rainfed paddy fields and upland fields were

formulated in the Integrated Jala-Jala rural development project on the basis of the following water resources utilization plan.

1) Irrigation plan by use of river flow supplemented by pumped water from Laguna lake

This irrigation plan was applied for the improvement of the existing communal irrigation systems. The existing irrigation systems depend on the river flows - irrigation is affected by the rainfall so the rainy season cropping is not stable and dry season cropping is limited due to the decreased river flow. To cope with these constraints, a pumping station is needed along with improved intake, canals and their related structures. With this development concept, the development of eight (8) communal irrigation systems commanding 650 ha is planned.

2) Irrigation plan only by pumped water from Laguna lake

This irrigation plan was applied for the development of the rainfed paddy fields. There are no reliable river flows in the rainfed area so the only irrigation water source is Laguna lake which will require a pump station to be constructed. With this irrigation plan, development of 5 irrigation systems commanding 370 ha is formulated.

3) Irrigation plan by impound

The pump irrigation system has a higher operation and maintenance cost compared with the gravity irrigation system. In the Jala-Jala area, the river slope is steep, so the impound site is limited. However, Palay-Palay river remains unutilized for irrigation. An impounding plan to utilize the Palay-Palay river flow is proposed for the Palay-Palay area of 140 ha after comparison with the pumping plan .

Of the irrigation component, the Government request to a grant aid was made to the following four (4) irrigation development schemes: Some part of irrigation canals of Sipsipin and Llano have been constructed by NIA. To complete the irrigation systems, the early implementation is strongly desired by villagers. Palay-Palay and Pagkalinawan areas remain under the rainfed condition, and then agricultural activities are restricted only in the rainy season. Large benefits of the Project implementation to cope with such situations will be expected.

1) Sipsipin irrigation system
Irrigation area 170 ha (pump station , intake canalization system)

2) Llano irrigation system
Irrigation area 65 ha (pump station intake, canalization system)

3) Palay-Palay irrigation system
Irrigation area 140 ha (impound, pump station, canalization system)

4) Pagkalinawan irrigation system
Irrigation area 55 ha (pump station, canalization system)

From the facts of the urgency and high expected projects benefit as mentioned above, it is judged viable that the improvement of those four (4) irrigation systems is executed under a grant aid. The basic plan of the irrigation and drainage facilities for the above areas was determined as shown below:

1) Sipsipin irrigation system

The Sipsipin irrigation system is located in Sipsipin village in the northern part of Jala-Jala area. The irrigation area consists of the existing Puan-Linis and Butingge communal irrigation systems commanding the paddy fields of 170 ha. The irrigation service is largely affected by the fluctuation of rainfall in the rainy season cropping and is available to only 20% of the service area in the dry season due mainly to the scarce river flow of the Puan river. In order to introduce double cropping of paddy into the area, the following irrigation and drainage facilities shall be provided:

Irrigation water is diverted from the Puan river in the dry season and supplemented by water of Laguna lake with construction of a pump station.

NIA has constructed some of irrigation canals on the basis of the irrigation plan prepared in the Feasibility Study. Examination of the present conditions and flow capacities of the canals showed most to be utilized. Thus, the existing canals can be incorporated into the Project irrigation system with improvement and a systematic irrigation system will be established. These canal shall be of U-shaped concrete lining in order to prevent the canal from eroding and to reduce seepage loss.

The irrigation area extends from the skirts of the hills, and the runoff from the hilly areas passes through the irrigation area in its lower parts and discharges to Laguna lake. The runoff is used for irrigation due to lack of irrigation water, but there are no definite drainage canals, so the area has poor drainage in the rainy season. A drainage canal system shall be established by improving of the existing drainage streams and providing collector drains. An inspection road will be provided along with main irrigation canals with a width of 1 m. Farm roads are not included in the Project because of the feeder road works.

2) Llano irrigation system

The Llano irrigation system is located in Llano village on the southern part of Bayugo, commanding rainfed paddy fields of 65 ha. In order to introduce double cropping of paddy, the following irrigation and drainage facilities shall be required. Irrigation water will be taken from the pumping from Laguna lake since there is no other reliable source.

NIA constructed some of the irrigation canals in 1990-1991 on the basis of the irrigation plan prepared in the Feasibility Study and according to the examination of the present conditions and flow capacities of the canals, most of them are judged to be utilized. By incorporating the constructed canals by NIA, the systematic irrigation canal system is established. The canals are of U-shaped concrete lining, to prevent erosion to the canal and to reduce the seepage losses because the canals run on the steep slopes.

The irrigation area extends from the skirts of the hills and the runoff from the hills passes through the Project area in its lower parts without definite drainage streams and as a result the area has poor drainage. With the Project, the drainage network will be constructed by providing drainage canals in the lower parts and collector drains alongside the main irrigation canal.

3) Palay-Palay irrigation system

The Palay-Palay irrigation system was formulated with an impounding system by use of the Palay-Palay river flow to serve an area of about

140 ha of rainfed paddy fields in Village Palay-Palay in the Feasibility Study.

The Palay-Palay river remains unutilized for irrigation due mainly to its deep valley, even though it is one of the major rivers in Jala-Jala area. In formulating an irrigation plan of Palay-Palay area in the Feasibility Study, an impounding plan was studied in view of its advantage of operation and maintenance.

The Palay-Palay dam site was selected at a narrow cross section about 1.5 km upstream of the river mouth on the basis of topographical and geological investigations.

Geology of the dam site was preliminarily investigated by test pitting and surface geological investigation as well as geo-electrical prospecting of the whole Jala-Jala area in the Feasibility Study. According to the geological investigation, the geological conditions of the dam site are:

i) The dam site is underlain by an interbedded sequence of tuff and tuffaceous sandstone,
ii) Those are moderately consolidated and slightly undulated making the rock friable and permeable, and
iii) Fresh tuff is generally hard but friable.

The low water level of the reservoir was set at 20 m, whereas the irrigation area extends from El. 30 m immediately downstream of the dam. As a results high elevated area of about 30 ha is not served directly by a canal system from the dam. To serve such area, an additional pumping station to use reservoir water is planned.

The dam was designed on the basis of the above investigation results and further analysis. The impounding plan was compared to the pumping from Laguna lake plan and was found to be more economical in terms of the annual cost. As a result, the Palay-Palay irrigation system was formulated with an impounding plan.

The detailed geological investigation of the dam site was carried out by the Basic Design Team in the field survey period from October to November

1991 by a contract with a Philippine geological investigation firm. The geological investigation consisted of the following:

i) Core drilling of 70 m in total length for 3 boreholes with field permeability test and standard penetration test.
ii) Laboratory test of embankment materials and core samples taken from drilling.

The following is the summary of the geological conditions of the dam site:

The proposed dam site is underlain by an intercalated sequence of sedimentary rocks and is in turn overlain by pyroclatic rock which appears to be water-laid. The sedimentary sequence consists of sandstone, siltstone, mud stone and diatomite while the pyroclatic rock is composed mainly of lapilli tuff.

The sand stone is fine to medium grained, poorly to moderately consolidated and is generally friable. The silt stone/mudstone sequence is thinly bedded, moderately hard and brittle when dry but can be easily split along its laminations. They exhibit several slump fractures which are generally tight. The diatomite is off-white in color, soft, light in weight, porous and friable. It grades laterally into diatomaceous siltstone or the interbedded sequence of siltstone and diatomite.

The characteristics of the foundation materials are as follows:

The foundation rocks at the dam site are permeable and remedial measures are therefore necessary to prevent uplift under the dam.

The foundation rocks at the right abutment as well as at the river bed section possesses low bearing capacity and compressive strength. Further, the foundation on the left abutment includes a weak layer at a depth of about 14 m below the ground surface. This weak material consists of diatomite which varies in composition from the purer variety to the diatomaceous siltstone or the interbedded sequence of diatomite and siltstone. The high grade diatomite is very light in weight, friable and extremely porous and is therefore highly compressible.

Under these conditions, the following foundation treatment is required:

- Excavation of surface rock down to 5 m in depth
- Curtain grouting to lengthen the seepage path. The bottom of the curtain grouting line is determined on the basis of the water pressure test. The maximum depth of curtain grouting is estimated to be 20 m from the bedrock excavation.

The dam design was carried out on the basis of the abovementioned condition in the Basic Design Study. The general features are as summarized below:

a) Storage capacity		
Total storage	:	1,060 x 10^3m^3
Effective storage	:	722 x 10^3m^3
Sediment storage	:	338 x 10^3m^3
b) Dam crest El.	:	El.30.0 m
c) Design water level		
Design flood water level	:	HWL. 28.0 m
Design high water level	:	FWL. 26.5 m
Design low water level	:	LWL. 20.5 m

The dam cost which is estimated on the basis of those geological conditions increases to a large extent from the estimate in the Feasibility Study due to additional foundation treatment. The increased cost of the dam necessitates the re-examination of economic viability of the dam plan.

As a result of an economic comparison, the impounding irrigation system of Palay-Palay area is economically less advantageous, compared with the pumping-up system, which is attributed to the revealed weak foundation of the dam site.

Despite the advantage of the impounding system in terms of the low O&M cost then less burden to irrigation users, the impounding system has low economic viability due to a large initial cost.

Taking into account the construction sequence of foundation treatment and embankment under the climate conditions of the Project area, the construction of impound cannot be completed within one year. Since, as s rule, a Japan's grant aid project must be implemented under the single-year budget system, the construction of Palay-Palay impound requiring more than 1 year of time span can not be executed under the Project.

Taking into account the urgency of the implementation of this area, irrigation and drainage works of this area shall be given priority in Jala-Jala area, then the Palay-Palay irrigation plan is formulated with an economically justifiable pumping plan in the Basic Design Study.

4) Pagkalinawan irrigation system

The Pagkalinawan irrigation system is located in Pagkalinawan village with a command area of 55 ha - paddy fields (45 ha) and citrus orchard (10 ha). The irrigation area is a narrow strip with comparatively steep slopes. Due to lack of the reliable irrigation water, paddy fields are not effectively utilized. In order to introduce the double cropping of paddy for the paddy fields and upland irrigation, the following irrigation facilities will be constructed under the Project.

A pumping station will be constructed for pumping Laguna lake water. The pump station will be located on the shore of the lake in the central part of the irrigation area, and a discharge pipeline will be provided to transport pumped water to the beginning of the canals. The main irrigation canals will start from the outlet of the discharge pipeline and extend towards the left and right sides of the area.

The canals shall be of U-shaped concrete lining type to prevent erosion to the canals and to reduce seepage losses from canals since the canals run on steep slopes. The drainage canals will be provided alongside irrigation canals for collecting and discharging the runoff from hilly areas.

(2) Road networks

1) Trunk road

The link road starting from Jala-Jala to Bagumbong through Punta along the lake shore is required to link all Villages and to join the national road. The link road will function as a trunk road which will greatly improve the inhabitant economic life and save transportation time for them. The trunk road will be paved with concrete and related structures will be improved/replaced

a. General Plan

The route of trunk road to be improved is from Jala-Jala up to Bagumbong, 18.1 km long.

b. Cross section

The crss section is determined in accordance with Design Guidelines Criteria and Standards prepared by DPWH.

- Width of road : Total width of 9.1 m
  Pavement width of 6.1 m

- Type of pavement:
  Concrete pavement taking into account the present practice of the national roads approaching to Jala-Jala area. The thickness of pavement will be sufficient for the traffic after completion of the integrated Jala-Jala rural development project

- Drainage facilities:
  Side drain ditch and drainage crossing to maintain the sufficient function of the road

2) Feeder road

In Jala-Jala area, there exist a number of villages roads. Those roads are not paved and are more or less affected by erosion hazard. In fact, most Village roads are hard to pass in the rainy season due to muddy or serious erosion because of lack of drainage and maintenance works. These road conditions largely restrict daily transportation and agricultural production. The feeder road will be improved to connect farm land/villages with the trunk road in line with the trunk road improvement plan.

The feeder road will be paved to ensure all weather transportation. The type of the pavement shall be of gravel metaling in consideration of economized construction and prevailing practice of feeder road improvement in the Philippines.

a. General plan

The existing village roads vary in their volume of traffic and conditions of roads surfaces. The village roads are grouped in to the following categories according to the effect and urgency of their improvement:

i) High priority of road improvement
   - Village roads to be used for operation and maintenance roads for irrigation pump station, intake, and rural water supply pump station
   - Village road to connect the hilly areas with the trunk road
   - Village roads to connect village/farm land with the trunk road

ii) Low priority of road improvement
   - Village road with less beneficiary households
   - Village road affected with inundation due to raising water of Laguna lake

Improvement of those roads in group (a) will be executed under the grant aid. Improvement of the other roads is recommended to be executed in accordance with the progress of the other rural development in the Jala-Jala area.

b. Cross section

The cross section of the feeder road is:

- Width of road : Total width of 6.0 m
  Pavement width of 4.0 m
- Type of pavement : Gravel metalling taking into account the present practice of the village roads. The thickness of gravel metalling will be determined to be 20 cm.
- Drainage facilities : Side drain ditch and drainage crossing to maintain the sufficient function of the road

The following roads will be improved as the feeder road under the Project.

Village	Number	Length
	(nos)	(m)
Sipsipin	3	2,190
Jala-Jala	1	1,300
Bayugo	3	1,398
Punta	2	360
Palay-Palay	2	3,600
Pagkalinawan	4	1,020
Lubo	3	1,000
Bagumbong	3	3,100
Total	21	13,968

(3) Rural water supply system

Domestic water in Jala-Jala area is obtained from shallow aquifers by use of the hand-operated pumps. Most of the villages in the Project area face with water shortage, low water quality, and a long distance from water source or well. In order to improve the water supply conditions for such areas, rural water supply facilities to obtain the water from deep aquifers will be provided. The Government of the Philippines requested 18 level-I and 4 Level-II rural water supply facilities as mentioned in Section 2.2. The requirement and required level of the facilities were examined as follows:

1) Assessment of the required site

The requirement for facilities depends on the hydro-geology, topography, and socio-economic conditions. The rural water supply facilities shall be provided to the following areas:

a. where well is not available or not functioning
b. where the water does not meet the Philippines standard of the drinking water
c. where well is dried-up or the water volume is reduced in the dry season
d. where the water is contaminated with bacteria
e. where the number of existing wells is no enough.

The willingness of the expected beneficiaries shall be confirmed.

2) System capacity

a. The water supply facilities to be provided under the Project shall be Level-I and Level-II on the basis of the prevailing practice adapted by DPWH:

- Level-I:
  This system is the same as the water supply system prevailing in the Project area and it is equipped with a cylinder-type manual pump. Beneficiary households shall number 25 to 50 and be located within 250 m from a well. The water use shall be determined on the basis of the daily unit water consumption of 40 liter per person.

- Level-II:
  This facility consists of a deep well, pumping equipment, water tank, main pipe line, distribution pipeline, and communal faucets. This system shall be provided to the area where numbers of beneficiaries are more than 100 households for the water confronted area. One faucet will be provided so as to serve 4-6 households. The capacity of water supply system is determined on the basis of the daily unit water consumption of 80 liter per person.

b. Selection of each level is made in the following order:
- In principle, Level-I shall be provided first
- Where stable and safe water can not be obtained from a Level-I system, the anticipated beneficiaries are more than 100 households, and can afford the water charge, Level-II is applied

3) Locations of the facilities to be provided

a. Sipsipin
Three (3) hamlets on the southern part of Village Sipsipin have low water quality with respect to iron content and pH value and the number of well in two hamlets lying on the skirt of the hills is not sufficient, then five (5) numbers of Level-I will be provided for the these areas.

b. Bayugo

Several Level-I facilities were constructed in this village in 1991 by DPWH. No additional water supply facility will be needed under the Project.

c. Punta

According to the result of biological tests, the well water is contaminated with bacillus due mainly to the absence of or weak protection measures against seepage of drain water which is in close proximity to septic tank and sewage tanks. The number of wells is not sufficient for the domestic water requirement. The anticipated beneficiaries in the village are more than the requirement for application of Level-II. For this area, one Level-II facility will be provided. Further, a hamlet located on the eastern part of this village is not sufficient in the number of wells. For this area, one Level-I facility will be provided.

d. Palay-Palay

Most of the villages have hot well water with bitter taste, odor, and the water is not suitable for drinking. The wells of hamlets located along the shore of Laguna lake are shallow and the well water is contaminated with bacillus due mainly to the absence of or weak protection measures against seepage of drain water and a proximity to septic and sewage tanks. Further, the village located on the skirt of the hill has no well, and their drinking water is taken from the river bed of the Palay-Palay river or from wells 1.5 km from their homes. Two (2) Level-I facilities will locate along the lake shore and one (1) Level-I at the skirt of the hill.

e. Pagkalinawan

Most of the villages have hot well water with bitter taste, odor, and the water is not suitable for drinking. The wells located along the shore of Laguna lake are shallow and the well water is contaminated with bacillus. due mainly to the absence of or weak protection measures against seepage of drain water and a proximity to septic and sewage tanks. Two Level-I facilities will be provided.

f. Lubo

Water of most of wells is lowered in quantity in the dry season and contaminated with bacillus for the same reason as the other areas. To improve the water supply condition in this village, one (1) Level-II facility using spring water was implemented by DPWH in 1990. The works completed so far were a water tank and part of the distribution pipelines, although the works were suspended in the survey period of the Basic Design Study in November 1991 due to lack of budget. The water supply of a major part of the village will be improved with completion of this system. However, the southern part of this village is not covered with the above system, so, one (1) Level- I facility will be provided there.

g. Bagumbong

The water is lowered in the dry season. Well water is not used due to low quality of water (bad odor). To obtain water suitable for the drinking, the well shall be constructed far from the village. The anticipated beneficiaries meet the requirement of Level-II. One (1) Level-II facility will be constructed to serve the central part of this village, three (3) Level-I will be provided - two (2) for two (2) hamlets along with the shore of Laguna lake on the western part of this village and one (1) for a hamlet on the foot of the hill.

h. Paalaman

A level-II facility using a spring was completed by DPWH in 1991. Therefore, the rural water supply facility in this area is satisfied at the present time.

The location and system level of the rural water supply facilities in each Village are summarized as follows:

Village	Request of Government of the Philippines Level-I	Level-II	Basic Design Study Level-I	Level-II
	(nos)	(nos)	(nos)	(nos)
Sipsipin	5	0	5	0
Jala-Jala	0	0	0	0
Bayugo	0	1	0	0
Punta	1	1	1	1
Palay-Palay	3	0	3	0
Pagkalinawan	3	1	3	0
Lubo	3	0	1	0
Bagumbong	3	1	3	1
Paalaman	0	0	0	0
Total	18	4	16	2

(4) Rice mill center

The rice mill center will be effective for enhancement of profitability of paddy farming in the Project area, accrued from solving the shortage of milling capacity of existing rice mill facilities, improving the quality, reducing losses of post-harvest activities, and systematic marketing. The rice mill center will be managed by farmers corporations. Farmer's active participation to operation and management of the constructed facilities will contribute to sustainable development.

Jala-Jala area has 20 rice mills owned by individual farmers or independent entrepreneurs at present. These rice mills having a working capacity of 0.2 ton/hr to 0.5 ton/hr are mostly superannuated and mainly used for custom milling for local consumption. Those are not renewed or purchased because of small operation capital, or lack of funds. Therefore, the proposed rice mill center will not be competetive to the existing rice mill owners in the Project area.

According to the rice mill survey, these rice mill owners managed by farmers or farmers' groups are not arranged to renew or purchase of the facility because of small operating costs or lack of funds. The propose rice mill center will not compete with wholesalers and rice mill owners in the Project area.

DAR carried out the observation trip to the rice mill center successfully, managed by the Tarlac Integrated Livelihood Center (TILC) with representative farmers' group leaders in November 1991. According to the field visit to the existing rice mill center, the farmers have taken actions to a preliminary arrangement of

organizing a united farmers, cooperative in Jala-Jala, which would become an operational body of the rice mill center.

In this regard, there is a need to establish a rice mill center under the Project.

(5) Power supply system

The Project will provide irrigation pumps, deep well pumps for rural water supply, and a rice mill center. With implementation of the Project, the power demand will be increased largely. The existing power distribution line of 3.6 kV with a single phase is not sufficient to satisfy that power demand. The power distribution line of 34.5 kV with three phase current will be constructed by extension of the existing power line started from Malaya thermal plant to supply the power. The construction works and operation and maintenance of electrical power supply facilities in the Project area are executed solely by MERALCO, then the power supply facilities of the Project will also be executed and operated/maintained by MERALCO. According to the nature of the Japan grant aid program, such facilities to be owned by the private entity are not suitable.

Under such situation, discussions were held between the officials of DAR and the Basic Design Study Team. Through the discussions, it was confirmed that the Government of the Philippines had the responsibility of the implementation of the power supply facilities of the Project.

3.2.4 Examination of Equipment and Facilities

(1) Pump equipment

The irrigation water of four (4) irrigation systems will be pumped from Laguna lake. The pumping equipment plan of the irrigation systems are examined as follows:

1) The pumping station consists of an inlet channel, suction pond, pump house, distribution pipeline, and outlet. The inlet channel will be an open channel to be constructed inward the lake so as to ensure smooth introduction of water in the dry season in the low water level of the lake. Since the inlet channel will inundate in the rainy season with the raised lake water level, shorter length is better to reduce the operation and maintenance

works such as removal of sediments in the channel. Therefore, the pump house will be located near to the shore of the lake. Pump heads will be determined on the basis of the highest water level and lowest water level of the lake in the past 10 years, i.e., +2.84 m and -0.40 m, respectively.

2) According to the pattern of the seasonal diversion requirements, the peak requirement will occur in one month and in the other periods the requirements are less than 50%. In consideration of these seasonal patterns of the requirements, two sets of pumps without a spare set are installed. The pumping equipment will be designed on the basis of 24-hour continuous operation at the design peak demand period. The pump of horizontal shaft volute type with respect of the easier operation and repair and low initial cost.

3) The irrigation area of the Project has gradual dipping slopes toward Laguna lake with different required pumping heads and irrigation areas. Sipsipin and Palay-Palay areas are comparatively large and command high elevated areas, then the high head pumps are required. To save the operation cost, two groups of pump will be provided separately for the high elevated area and low elevated area. The other two systems will be provided with a direct pumping system to the whole command area.

(2) Rice mill equipment

The rice mill will consist of a) receiving and drying, b) milling, c) paddy and rice warehouse, d) custom mill and e) others. The facilities and equipment plan of the rice mill facilities is examined as follows:

1) Receiving and drying facilities

Total paddy production in the proposed four (4) irrigation systems of 420 ha is estimated at 2,100 tons in wet and dry season. Total harvested paddy in 30 days is estimated at 70 tons per day. About 20 tons (30%) of paddy are dried on the roads or farmers' yards and stored in the farmers warehouse for home consumption, seeds, and stock. The remaining 50 tons paddy will be brought into the proposed rice mill center without drying. As a result, the shortage of drying facilities in the Project area is a

serious problem and it is necessary to improve both drying and milling facilities for marketable rice.

At present, the paddy is transported from the field to farmers' yard or rice mills manually or by animal carts due to shortage of transport equipment and insufficient farm road networks. The road networks will be improved under the Project. To effectively collect paddy from farmers, transportation equipment shall be provided to the rice mill center.

Drying facilities, consisting of dryer and sun drying floor, as well as transportation equipment are necessary.

2) Milling facilities

In the Philippines, rice mill facilities can be classified into 4 types according to the type and capacity installed:

i) Kiskisan type of small mill (0.25 ton/hr, light duty type):
ii) Cono type of medium mill (0.5 - 0.75 ton/hr, light duty type):
iii) Medium capacity complex type (1.0 ton/hr, heavy duty type):
iv) Large capacity complex type (2.5 ton/hr, heavy duty type):

The operational conditions and technical specifications of each are as follows:

Descriptions	Kiskisan Type	Cono Type	Complex Type (Medium)	Industrial Type (Large)
Technical Specification	Light Duty For Individual Use	Light Duty For individual Use	Heavy Duty For Industrial Use	Heavy Duty For Industrial Use
Milling Quality	Fair	Fair	Excellent	Excellent
- Broken (%)	>20	>15	<5-7	<5-7
- Milling Efficiency.(%)	<60	<60	>62	>62
Operation/Maintenance	Easy/Free Operation	Easy /Free Operation	Need Operation System	Need Operation System
Beneficiary Farmers	5	10 - 15	200 - 250	850 - 950

Source : Feasibility Study Report, 1990

The i) Kiskisan and ii) Cono type of rice mills are, at present, assembled in the Philippines and prevail in rice producing area extensively. This

equipment is cheap in price and have a simple mechanism for easy operation. However, milling quality and operation losses (broken hazard) are not acceptable as profitable operation.

Rice mill equipment of iii) and iv) are the heavy duty type capable for industrial use. Rice mill of iii) type is considered to be most suitable compact unit for doing rice milling enterprise at the farmers cooperative bases. However, to meet the total rice milling requirement, iii) type rice mill equipment requires 3 units for the Project area. Consequently, this installation requires rather heavy capital investment due to requirement of related facilities and structures for each unit. Amortization of the facilities is also large and heavy for the farmer beneficiaries. Rice mill equipment of iv) type is a suitable unit for rice production program of the Project. Requirement of large capital investment at one time is a demerit of this unit, although annual O/M costs would be payable by themselves.

In consideration of both the technical and financial merits and demerits, iv) type of rice mill has been selected for this plan.

3) Paddy and rice warehouse

The storing of paddy for home consumption, seeds, and stocks in the Project area is by small storage of each farmers' house yard after winnowing, drying and bagging. This capacity of storing will be not change in future, drastically. It is anticipated that the shortage of warehouse will become seriously increased with increased paddy production. Consequently, it is considered necessary to improve warehouse capacity for paddy storage.

The required warehouse capacity in the proposed rice mill center is estimated 500 tons (10 days receiving amount) for paddy and 100 tons (10 days milling capacity) for rice.

4) Custom milling facilities for the individual farmers

Most paddy fields are developed on low lying land and some on gently sloped terrace. According to the balance study for home consumption rice, some villagers in sloped terrace and steeply sloped mountains areas are short of rice, and supplied from villagers in low land area. The existing 20

rice mills are located in 10 villages, however, there are only 4 rice mills in Bayugo, Llano, Punta and Palay-Palay villages surrounding the proposed site of the rice mill center. Total production of paddy in Llano and Palay-Palay irrigation areas is estimated 1,000 tons per season. As compared with these paddy production, present milling capacity will be insufficient not only milling of commercial rice but also custom milling for home consumption. Therefore, the introduction of small rice mills in the Project area is needed to be used in custom milling for farmers' home consumption. For the propose, a small rice mill facility (0.3 to 0.5 t/hr, one-pass type) is recommended.

5) Other facilities

The required number of technical and administrative staff for O&M and management of the proposed rice mill center is estimated at 22 staff and about 30 workers. Operation and administration of the facilities will require not only rice milling staff, such as for buying, marketing, drying and milling, but also staff for personnel management, documentation, general affairs and accounting. Therefore, the operation and administration office is necessary as well as a garage, water supply facilities, and other facilities for smooth operation. To effectively collect paddy from the farmers, wireless communication system will be required. To systematically manage marketing of rice and office administration, a set of computer and copying machine is also required.

3.2.5 Necessity of Technical Assistance

(1) Irrigation and drainage facilities

NIA is executing the institutional development program to enhance the organization of irrigation associations, consisting of development training of irrigation association members on basic leadership, financial management and system management. Further, through collaborative efforts with the different government agencies as well as private institutions, the external assistance programs are undertaken, such as marketing, production credit, crop insurance, etc.

The guidance and training to be provided by NIA to the irrigation associations in the Project area includes the following:

1) Organization development of association to be made prior to commencement of the construction works
2) financial arrangement and system management to be made prior to transferring facilities to the irrigation association
3) Actual operation and management of water supply to be made after transferring facilities, consisting of scheduling, mid-term evaluation and post evaluation of the water supply to be made together with irrigation association.

The irrigation associations of Sipsipin and Llano areas have been organized with guidance of NIA, and the above-mentioned pre-transferring guidance was carried out in 1991. Further, the associations of Palay-Palay and Pagkalinawan are scheduled to be established prior to the constructio works of facilities under the guidance of NIA and be given training by NIA.

As mentioned above, the program on the guidance and training of operation and management of the communal irrigation systems has been taken by NIA, and the program has been applied to the Project area. Therefore, the Japan's technical assistance to the operation and maintenance, and management of irrigation facilities of the Project will not be needed.

(2) Rural water supply facilities

Referring to Law R.A.6716 entitled "An Act providing for the Construction of Water Wells and Rainwater Collectors, Development of Springs and Rehabilitation of Existing Water Wells in All Villages in the Philippines", DPWH has a program of guidance and training on the organization development, and financial management and system management of rural water supply facilities. Prior to the implementation of the rural water supply facilities, the Village Waterworks and Sanitation Association (BWSA) will be organized for a given village where the rural water supply system is constructed. The BWSA is an organization of water consumers in the village which shall own, operate and maintain the constructed rural water supply system. After the association is organized, the guidance in financial management of the association and technical guidance on the system operation and maintenance are provided.

As mentioned above, the program on the guidance and training of operation and management of the rural water supply system has been taken by DPWH, and the

program is ready for the Project area. Therefore, the Japan's technical assistance to the operation and maintenance, and management of rural water supply system of the Project will not be needed.

(3) Rice mill center

With respect to technical assistance on administration, operation and maintenance of the facilities before and/ or after implementation of the rice mill center, it is expected that these will be provided from the following government agencies and non-government organization.

a. NAPHIRE (National Postharvest Institute for Research and Extension)

This institute was established in 1978 to spearhead the development of the country's post-harvest industry. The objective of the training program is to promote the development of the post-harvest industry by upgrading the knowledge and skills of the various workers. The following training courses for rice mill operation in post-harvest technologies are provided.

i) General Training Course on Grain Post-harvest Technology; 1 - 4 weeks

ii) Specialized Training Course on Paddy Drying and Milling; 2 weeks

iii) Specialized Training Course on Storage Pest Management; 2 weeks

The above training courses are open to both public and private entities involving in actual post-harvest operations.

b. NFA (National Food Authority)

NFA provides technical assistance to the farmers' organization through provision of post-harvest facilities such as portable and stationary rice mills, dryers, warehouses and threshers supplied under Japan's grant aid. NFA prepares training programs in compliance with the request of farmers' organization. These training programs include the institutional development, grain post-harvest technology, grains drying principles and system, and entrepreneurial development.

c. NGO (Non-government Organization)

DAR identified the following NGOs having satisfactory capacity of staff and facilities for the management and on-the-job training for operation and maintenance of the rice mill facilities.

i) Meralco Foundation (MFI)
ii) Tarlac Integrated Livelihood Foundation (TILF)
iii) National Confederation of Cooperatives (NATCCO)
iv) National Agribusiness Corporation (NABCOR)

For technical assistance, DAR will contract with the selected NGO for management and on-the-job training of the staff for the proposed rice mill center. During the construction period, the manufacturer of rice mill equipment will also provide the technical training to the staff through assembling and test operation. Therefore, the Japan's technical assistance to operation and management of the rice mill center will not be needed.

3.3 Project Description

3.3.1 Executing Agency and Operational Structure

The Department of Agrarian Reform will be the executing agency of the Project. An office called "Jala-Jala Project Office" will be established under DAR and will take part in day to day operations relating to the implementation of the Project. In implementing the Project works and operation and maintenance of the completed facilities, technical assistance will be rendered from the line agencies of CARP, such as NIA for irrigation and drainage facilities, DPWH for road networks and rural water supply systems, DA for rice mill center. To smoothly manage and operate the Project work, the following are organized:

(1) Policy Cordinating Committee (PCC)

An undersecretary of DAR will act as the chairman of PCC. It will be composed of representatives of DAR and line agencies and will control implementation of the Project as follows:

1) Composition

- Chairman : Undersecretary of DAR
- Vice chairman : Assistant Secretary of DAR
- Member : Regional Direction of DAR
  Provincial Director of DAR
  Project Managers for CARP, NIA, DPWH, DA
  Mayor of Jala-Jala

2) Functions

- Decision on matters/policies relating to overall project implementation, monitoring and evaluation
- Action on recommendations relating to project management
- Approval of the project's annual operating budget

The Jala-Jala Project Office will be established in the Project site and be headed by a full time project manager. It will consist of a physical infrastructure division and economic and social infrastructure division with the following functions:

1) Office of the Project Manager (including Planning, Finance and Administrative Services)

- Undertake socio-economic studies;
- Formulate operating and management systems;
- Undertake over-all project planning and scheduling;
- Initiate and coordinate all project execution activities;
- Review project performance;
- Recommend policies and strategies related to over-all project implementation to the PCC;
- Spearhead all coordination activities with the various line agencies involved; and
- Implement all policies and directions set by PCC.

2) Physical Infrastructure Division

- Provide necessary counterpart assistance in the implementation of various infrastructure facilities;
- Ensure timely provision of project inputs;
- Coordinate with contractors regarding work schedule;
- Undertake inspection and quality control of constructed facilities; and
- Prepare all required reports.

3) Economic and Social Infrastructure Division
   - Undertake institutional development works;
   - Facilitate community and cooperatives and development;
   - Administer the center's economic and training facilities;
   - Undertake market development; and
   - Assume all functions related to agricultural and technology extension.

The Project implementation organization chart is as shown in Fig.3. The Project Office will be composed mainly of personnel detailed from the various participating line agencies. The Project, however, shall also hire personnel as seemed necessary.

3.3.2 Plan of Operation

The implementation of the Project will be carried out in two stages, i.e., Stage-I and Stage-II. Immediately after the Exchange of Notes (E/N) to be made between the Government of Japan and the Government of the Philippines, Stage-I works will be commenced from the design works which consist of the detailed investigation, design and tender works. The construction works will be executed by the contractor to be selected through the competitive bidding from the Japanese construction firms. The construction period of Stage-I will be required for 12 months. Stage-II works will also be commenced after conclusion of the E/N of Stage-II. The construction time required for Stage-II is 12 months.

Stage-I works cover the following:

- Irrigation and drainage works of Sipsipin and Llano irrigation systems (235 ha in total)
- Trunk road from Jala-Jala up to Llano (6.5 km), and feeder roads in village Sipsipin, Jala-Jala and Bayugo (4.89 km in total)
- Rice mill center
- Rural water supply systems for village Sipsipin (5 Level-I systems)

Stage-II covers the following:

- Irrigation and drainage works of Palay-Palay and Pagkalinawan irrigation systems (195 ha)
- Trunk road from Punta up to Bagumbong (11.6 Km) and feeder roads in village Punta, Palay-Palay, Pagkalinawan, Lubo and Bagumbong (9.08 km)

- Rural waters supply system for village Punta, Palay-Palay, Pagkalinawan, Lubo and Bagumbong (11 Level-I systems and 2 Level-II systems)

3.3.3 Location and Condition of the Rice Mill Center

The proposed rice mill center will be constructed within the 2 ha land area located at Llano of Bayugo village being owned by Meralco Foundation Inc. (MFI). The land required by the rice mill center will be leased or donated by MFI. This site is approximately 5.5 km away from the Jala-Jala town.

The present condition of the site in regards to power, water, and telephone communication is as below:

1) Power supply
   Electric power supply by MERALCO will be taken from the 34.5 kV transmission line beside the main road. The power supply for the rice mill facilities will be three (3) phase, 380 V and single phase, 220 V, and 60 Hz.

2) Water supply
   No public facilities for water supply are available in and around the construction site. Water supply facilities, such as deep well, water reserved tank and piping system will be needed for the office and rice mill facilities.

3) Telephone communication and others
   Telephone line and public gas supply facilities are not available in and around the site.

3.3.4 Outline of the Facilities and Equipment

The principal features of the facilities and equipment to be provided under the grant aid are as follows:

(1) Irrigation and drainage facilities

Irrigation System		Sipsipin (High head)	Sipsipin (Low head)	Llano	Palay-Palay (High head)	Palay-Palay (Low head)	Pagkalinawan
Pump Station							
Pump type		---- horizontal shaft volute type----					
Rated capacity	(m^3/min/set)	5.19	6.57	4.50	2.55	7.11	3.06
Pump dia.	(mm)	200	200	125	125	250	100
Numbers	(set)	2	2	2	2	2	2
Rated head	(m)	48	19	22	40	26	32
Out of motor	(kW/nos)	75	37	30	30	55	37
Discharge pipeline							
Dia	(mm)	400	450	400	300	450	300
Length	(km)	1.56	0/63	0.24	1.62	0.94	0.15
Irrigation canal							
Canal type		---- U-shaped concrete lining --					
Length	(km)	9.93		0.94	9.56		3.94
Related structures	(nos)	218		72	170		72
Drainage canal							
Canal type		---- Earth canal --					
Length	(km)	5.25		4.18	1.18		2.83
Related structures	(nos)	11		3	2		7

(2) Road network

Description		Trunk Road	Feeder Road
Total length	(km)	18.1	14.0
Numbers	(nos)	1	21
Pavement			
Type		Concrete	Gravel metaling
Thickness	(cm)	20	20
Width			
Total width	(m)	9.1	6.0
Pavement width	(m)	6.1	4.0
Related Structures	(nos)	87	14

(3) Rural water supply system

Description		Level-I	Level-II
Numbers of System	(nos)	16	2
Well			
Depth	(m)	40-80	80-100
Casing dia.	(mm)	100	150
Borehole dia.	(mm)	200	350
Pump			
Pump type		--Manual operated--	--Submersible--
Discharge	(m^3/min)	0.02	0.22-0.26
Output of motor	(kW)	-	5.5
Water tank	(m^3)	-	32-38
Distribution pipeline	(km)	-	3.7
Faucet	(nos)	-	103

(4) Rice mill center

1)	Procurement, receiving, weighing and classifying facilities		
	a. Max. receiving quantity	:	50 tons/day
	b. Equipment	:	Trucks (4tons) x 2, Jeep x 1, Movable slat conveyor x 1, Table scale (1,000kg) x 2, Moisture meter x 2, Grain trier for bag x 3
2)	Drying facilities		
	a. Drying method	:	Both sun-drying on concrete floor and mechanical drying by ventilated / batch type dryer with supplementary heat of rice husk furnace are introduced.
	b. Equipment for mechanical dryer	:	Receiving hopper (600kg), Paddy cleaner, Dryer (5tons) x 4, Rice husk furnace, Packet elevators and conveyors
	c. Equipment for sun-drying	:	Carrier (500kg) x 6, Water proof sheets, paddy sacks
3)	Rice Milling Facilities		
	a. Milling method	:	One line of machinery (2.5t/hr) for marketable rice milling and two (2) set of one-pass type (0.3t/hr) for custom milling will be introduced.
	b. Marketable rice milling equipment	:	Receiving hopper, paddy cleaner, Paddy husker (2.5t/hr), Stoner, Rice whitener, Rotary shifter, Packet elevators and conveyors, Table scale (250kg) x 2, Bag sewing machine
	c. Custom milling equipment	:	One-pass rice mill (0.3t/hr) x 2, Table scale (250kg)
4)	Paddy and Rice warehouse and others		
	a. Warehouse	:	for paddy (500tons), milled rice (100tons), rice husk, rice bran and ash
	b. Others	:	Administrative and control office, garage, water supply facility and toilet (outside) Jeep, Radio communication equipment, Computer, Copy machine

3.3.5 Operation and Maintenance Plan

(1) Irrigation and drainage facilities

The irrigation and drainage facilities will be transferred to irrigation associations after completion of the construction works. The association will be organized in the respective concerned villages before implementation of the construction works with the guidance of NIA. The associations will own, operate, and maintain the constructed irrigation and drainage facilities as their communal irrigation systems.

NIA will also provide guidance in financial management of the association and system management. Irrigation associations of Sipsipin and Llano irrigation systems, for which NIA has constructed some of the irrigation canals, have been organized in

1989, and NIA has provided the guidance and training of the financial management of the association and system management in 1991. After transferring of the constructed facilities and entering into operation, NIA will give the guidance in the scheduling, mid-term evaluation and post evaluation of water management.

The officers of the association who will be elected by the members of the association consist of the following:

- a president
- a vice president
- a secretary
- a treasurer
- an auditor

The association will assign a pump operation and maintenance staff, and a ditch tender for canal system management. As for the irrigation charge collection, an irrigation charge collector is assigned by the association. The annual electric charge adn operation and maintenance costs of the respective irrigation systems are estimated as shown in Tables.6 and 7 and summarized below. Operation and maintenance costs are collected from the members of the irrigation association according to the irrigated area.

Unit: Peso

Description	Sipsipin	Llano	Palay-Palay	Pagkalinawan
1. Salaries				
Officers	50,000	50,000	50,000	50,000
O&M staff	10,000	10,000	10,000	10,000
2. Pump O&M Cost	416,400	195,700	573,300	214,500
3. O&M Cost of Facilities	34,000	13,000	28,000	11,000
4. Materials and others	20,600	10,300	20,700	10,500
Total	531,000	279,000	682,000	296,000
(Peso/ha)	(3,120)	(4,290)	(4,870)	(5,380)

(2) Road network

After completion of the construction works, the trunk road and feeder roads will be transferred to the Provincial Government of Rizal, and under the present provincial organization, operation and maintenance of those roads will be executed.

The annual operation and maintenance costs are estimated according to the procedure of the DPWH, Bureau of Maintenance as shown in Table.8. The estimated costs are Peso 528,000 and Peso 146,000, respectively.

(3) Rural water supply system

After completion of the construction works, the rural water supply facilities will be transferred to a village waterworks and sanitation association (BWSA) to be organized in the concerned village, in accordance with Law R.A.6716 titled "An Act providing for the Construction of Water Wells and Rainwater Collectors, Development of Springs and Rehabilitation of Existing Water Wells in All Villages in the Philippines". The BWSA will own, operate, maintain the constructed water supply facility. DPWH will provide the guidance in the development of BWSA, financial management of the BWSA and facilities management.

The responsibility of a BWSA are:

- To properly operate and maintain the constructed water supply facilities
- To attend training to be conducted by DPWH and other government agencies that are relevant to the upkeep of their facility
- To collect fees from its members
- To observe sanitary practice

The officers of the BWSA to be organized in each village consist of the following:

- a president
- a vice president
- a secretary
- a treasurer
- a board member

All officers compose the board of directors. The board will assign a bookkeeper and a caretaker for the facility, who are responsible for keeping of financial record, collection of water charges, supervising of operation and maintenance of facility, etc.

The annual operation and maintenance costs of the rural water supply facilities are estimated as shown in Table.9, and summarized below:

Unit: Peso

Description	Level-I	Level-II
1) Salaries		
1) Officers	16,000	2,000
2) Laborers	9,600	2,000
2) O&M Cost of Pump	0	83,950
3) O&M Cost of Facilities	8,000	2,000
4) Material and Others	4,800	10,100
Total	38,400	100,050
(Unit Cost/household)	(48)	(250)

(4) Rice mill center

1) Organization of Operation and Maintenance

Organizational structure for the rice mill center is shown Fig.4. A Board of Director to be composed of representative of the DAR, NGO, NAMAJA and the local government unit will be created. The Board will make operating policies and approve action plans for the rice mill operation, and link with the highest policy making body of the Project.

The assigned NGO will organize its working team that will be responsible for the day-to-day operation of the rice mill. This team will undertake collection and transport of harvested paddy, quality control, rice milling activities and marketing of milled rice. On the other hand, the farmers' cooperatives will also organize its counterpart working team that will work hand-in-hand and undertaken on-the-job training by the NGO working group.

The proposed organization of the operation and maintenance of rice mill center will be divided into the following three (3) sections under a manager of the rice mill center ; administration/finance section, procurement/ marketing section, and processing/maintenance section. The main functions of these sections are shown below:

a. Administration and Finance Section
for planning, administering, bookkeeping, personnel control, accounting, financing and auditing

b. Procurement and Marketing Section
for procuring, classifying, weighing, transporting, selling and promoting

c. Processing and Maintenance Section
for drying, storing, milling, packing, maintenance and repairing

2) Required Number of Staffing

The operation of the rice mill center will require the following personnel at the full development stage:

Items	Engineers / Clerks	Permanent Workers
1) General Project Manager	1	
- Secretary	1	
2) Administration / Finance Section ;		
- Administration Office	1	1
- Accountant, Cashier	3	2
- Bookkeeper	2	2
- Security, Helper		5
3) Procurement / Marketing Section ;		
- Procurement Officer	1	
- Marketing Officer	1	
- Classifier, Weigher	2	2
- Warehouseman	1	3
- Truck Driver	2	2
4) Processing / Maintenance Section ;		
- Processing Officer	1	
- Dryer Operator	2	4
- Rice Mill Operator	2	4
- Weigher, Sewer	1	3
- Mechanic	1	2
Total	22	30

3) Additional Equipment and Materials

The following equipment and materials for management and operation of the rice mill facilities, which are not covered under a Japan's grant aid, will be procured by the DAR.

a. for rice mill facilities: tables and chairs, cabinets, hand tools, etc.
b. for drying facilities and warehouse: pallet, sacks, scopes, brooms, etc.
c. for office facilities: tables and chairs, bookshelves, cabinets, calculators, etc.

4) Operation and Maintenance Costs

Annual operation and maintenance costs consist of salary and wages, power charge, fuel and lubrication, repairing and maintenance costs,

consumable supplies, and labor. Total amount of O/M cost is estimated in Table.10, and summarized as follows:

Unit: Peso

1)	Salary and wage	:	22 staff, 30 assistants	1,920,000
2)	Power charge	:	358,000 kwh	823,500
3)	Fuel and lubrication	:	light oil, gasoline	183,000
4)	Repairing and maintenance	:	with spareparts	246,000
5)	Sacks	:	for rice, by-products	135,000
6)	Consumable supplies	:	for rice milling, office	156,000
7)	Labor cost	:	2,200 mm/day per year	176,000
	Total			3,639,500

In addition to the above, the purchasing cost for paddy will be needed, however, after getting into the full development stage, such cost will be covered by the benefit accrued from the rice mill operation.

3.4 Technical Cooperation

Through the assessment made in the preceding Sections, it was clarified that the aims and expected effects of the Project meet the intents of the Japan's grant aid program. The basic design of the Project facilities will be made in line with the concept that the Project will be implemented under the program of Japan's grant aid.

CHAPTER 4
BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Irrigation and Drainage Facilities

4.1.1 Design Policy

The irrigation and drainage works consist of construction of pumping stations, construction/improvement of intake, irrigation and drainage canals and their related structures to set up communal irrigation systems in Sipsipin, Llano, Palay-Palay, and Pagkalinawan areas. These facilities are, in principle, planned so as 1) to have appropriate scale for their specific purposes from technical and economical viewpoints, 2) to function to facilitate efficient and economical operation and maintenance by water users

In preparing the basic design of the facilities, due consideration was given to the simplification of the design and maximum use of locally available materials for construction so that the facilities will be easily operated, maintained, and repaired by water users. The basic design policies for respective facilities are as explained below.

(1) Irrigation facilities

1) The irrigation area to be covered under the Project shall be 430 ha consisting of Sipsipin of 170 ha, Llano of 65 ha, Palay-Palay of 140 ha and Pagkalinawan of 55 ha,

2) A high irrigation efficiency shall be attained,

3) The types of irrigation facilities shall be determined in view of the efficient water management and operation and maintenance of irrigation facilities, taking into account the existing irrigation practices prevailing in the areas, and

4) Design of the facilities shall take into account the site working conditions, availability of local materials and easier construction works in and around the Project site.

(2) Drainage facilities

1) The maximum use of the existing drainage channels and natural streams and their incorporation into the drainage system shall be considered.

2) The layout of the drainage canals shall be selected in consideration of safe guarding the irrigation canal system and roads which will be constructed on the gently sloped areas.

4.1.2 Study and Examination of Design Criteria

(1) Irrigation water requirement

The crops proposed for the Project are paddy rice, upland crops such as soybeans, corn, beans, eggplant, and citrus. The irrigation water requirements are separately estimated for each crop according to the proposed cropping patterns on a monthly basis.

Paddy rice	:	(ET + PE + PU - ER +NR)/IE
Upland field	:	(IN + ET - ER) / IE
Citrus	:	(ET - ER) / IE

where,	ET	Evapotranspiration
	PE	Percolation
	PU	Puddling water requirement
	ER	Effective rainfall
	NR	Nursery water requirement
	IN	Pre-irrigation
	IE	Irrigation efficiency

In the above calculation, the following basis is applied:

1) ET is estimated by product of potential evapotranspiration by crop coefficient relating to the crop growth stages. Data of potential evaporation estimated in IRRI at Los Banos by a modified Penman method on a monthly basis are used.

2) PE is determined to be 2 mm/day based on the field investigation result in the study area.

3) PU is estimated to be 180 mm for filling a root zone, losses due to evaporation and percolation, and standing water on a field surface.

4) NR is calculated for land preparation, evaporation, percolation loss for nursing period of 25 days and 5% of the paddy fields.

5) ER for paddy fields is estimated on the basis of the result of water balance in paddy fields, and ER for upland fields is based on the relationship of consumptive use of water by crops and effective rainfall proposed by USDA.

6) IE of paddy field and upland field are determined, taking into account the irrigation method to be applied, small extent of irrigation system area, lining canals in major parts. The overall irrigation efficiencies for respective paddy and upland fields used in the estimate are as follows:

Irrigation efficiency	Paddy field	Upland field
Application efficiency	75%	65%
Conveyance efficiency	85%	85%
Overall efficiency	64%	55%

Based on the result of the estimate of water requirement, the design unit water requirements for paddy field and upland field are determined as follows:

Cropping System	Unit Water Requirement
	(l/sec/ha)
Paddy field	2.30
Paddy field and upland field	1.85

(2) Headwork plan

The existing irrigation systems have been dependent only on the river flows, so irrigation services are largely affected by the fluctuation of rainfall in the rainy season cropping and limited to the rainfall extent in the dry season cropping due to scarce or dried up river flows. The following two intake measures are taken in the basic design of the irrigation system of the Project.

1) Irrigation system by use of river flow supplemented with pumping of lake water

The Sipsipin irrigation system will be improved with this plan. Discharge of the Puan river, which is a water source of the existing Sipsipin communal irrigation system, decrease remarkably in the dry season. Then, irrigation service remains in 5% to 10% of the command area. In order to introduce stable irrigation farming into the scheme area, improvement of intake and canal system, and construction of a pumping station will be made with the Project.

2) Irrigation system by pumping of lake water

There is no rivers or available river flows in Llano and Pagkalinawan areas. Irrigation water for those areas will be diverted by a pump station. Also, as mentioned in the preceding section, irrigation water for Palay-Palay area will be diverted with a pumping station. Therefore, those three irrigation systems will be designed with a pumping plan.

(3) Drainage water requirement

The unit drainage water requirements are estimated for respective areas on the basis of drainage characteristics of vegetation, soil, and ground surface slope. The drainage water requirements of paddy fields and hilly areas are separately estimated as shown below.

1) Paddy field drainage water requirement

The drainage water requirement within the Project area is estimated by the following formula:

$$Q = C \times I \times A$$

where, Q : Unit drainage water requirement (l/sec/ha)
C : Peak runoff coefficient of the paddy field, 0.4
I : Design rainfall intensity; five (5) year 24-hour rainfall storm, 182 mm/day calculated from the data for 20 years in Jala-Jala area which is estimated from the Santa Cruz climatological station
A : Drainage area (ha)

$$Q = 0.4 \times 182 \times 10^{-3} / (24 \times 3,600 \times 10^{-7}) = 8.4 \text{ l/sec/ha}$$

2) Drainage water requirement of upland field and hilly area

Drainage water requirements for upland fields and hilly areas are estimated by using McMath formula, U.S. Bureau of Reclamation as shown below.

$$Q = 2.3 \times C \times i \times S^{1/5} \times A^{4/5}$$

where, Q : Drainage discharge (l/sec)
C : Coefficient representing the drainage area characteristics for upland : 0.40 for hilly area : 0.42
i : Rainfall intensity for the time of concentration and frequency (mm/hr)
S : Fall of drainage channel between the farthest contribution point and the point of concentration
A : Drainage area (ha)

(4) Proposed cropping pattern

The proposed cropping patterns for respective irrigation areas are determined, taking into account i) suitability for soil and climatic characteristics, ii) self-sufficiency of staple food in the municipality, iii) profitability to farm economy by introducing crop diversification, iv) acceptability to the present farming practice, and v) agriculture policy of the Government. The proposed cropping patters thus determined are as shown in Figure 3 and summarized below:

Sipsipin	:	2 paddy cropping a year
Llano	:	2 paddy cropping a year
Palay-Palay	:	2 paddy cropping a year
Pagkalinawan	:	2 paddy cropping a year with vegetables and fruits

4.1.3 Basic Plan

(1) Irrigation system

1) Sipsipin Irrigation System

Headwork plan

The existing intake for this irrigation system which is located about 1 km upstream of the crossing point of the Puan river with the national road has been repaired by NIA. To prevent sand and debris from flowing into a canal system, and to effectively divert river discharges, sluice gates at intake are provided. The river bank protections are also provided.

Pump station

The irrigation area extends on alluvial fans along the Puan river with gentle slopes towards Laguna lake. To save operation and maintenance cost, the pumping equipment will be provided in two groups, high head pump and low head pump for the high elevated and low lying areas, respectively. The proposed pumping station will be located on the shore of Laguna lake west of Sipsipin village. Pumped water will be transported to the beginnings of both high elevated and low lying areas through separate discharge pipelines. The pipelines will be located along the feeder road to be improved with the Project, to secure access for efficient operation and maintenance.

Irrigation canal

The main irrigation canals of the high elevated and low lying areas will start from the outlets of the respective discharge pipelines, run along the counter lines and branch off main farm ditches. Special attention will be paid to avoid loss of farm land in making selection of the canal routes on the existing canals. The canals are of U-shaped precast concrete lining type to prevent erosion to the canals due to high velocity which will occur on steep slopes and to reduce seepage loss from canals. The canals which have been constructed by NIA agree well with the Project requirements in routes and capacities. Thus, they can be incorporated into the Project canal system with such improvement as i) canal embankment on both sides, ii) replacement of the canals with less flow capacities, and iii) provision of additional canal related structures.

Drainage canal

Rainfall runoff from the hilly areas passes presently across the Project area in the low depressed portions and discharges to Laguna lake. Runoff is presently used for irrigation due to lack of irrigation water. These conditions occurs poor drainage in the rainy season. Since the Project irrigation canals will be aligned along the counter lines, rainfall runoff and irrigation excess will be intercepted by the irrigation canals. To smoothly introduce such drainage water to Laguna lake, drainage canals will be provided along with such irrigation canals in addition to improvement of the existing drainage streams.

2) Llano Irrigation System

Pumping station

Pumping Station of the Llano irrigation system will be located on the shore of Laguna lake in the southern edge of Llano village. Pumped water will be transported through a discharge pipeline of 240 m in length to the beginning of the main canal.

Irrigation canal

A main canal will start from an outlet of the discharge pipe line, run along the skirt of the hill, then branch off main farm ditches which will run towards Laguna lake. The canals are of U-shaped precast concrete lining type to prevent erosion to canals due to high velocity on steep slopes and to reduce seepage loss from canals. The canals which have been constructed by NIA agree well with the Project requirements in routes and capacities. Thus, they can be incorporated into the Project canal system with such improvement as i) canal embankment on both sides, ii) replacement of the canals with less flowing capacities, and iii) provision of additional canal related structures.

Drainage canal

The Project area extends on gentle slopes from the skirt of the hill towards Laguna lake. Rainfall runoff from the hilly areas discharges to Laguna lake across the Project area. Runoff is presently used for irrigation but there is no definite drainage canal in the area so it has poor drainage in the rainy season. Since the Project irrigation canals will be aligned along the skirts of the hills, rainfall runoff and irrigation excess will be intercepted by the irrigation canals. To smoothly introduce such drainage water to Laguna lake, drainage canals will be provided along with such irrigation canals in addition to improvement of the existing drainage streams.

3) Palay-Palay Irrigation System

Pumping station

The pump station will be located on the eastern part of Palay-Palay village. The irrigation area extends on the existing paddy fields gently sloping towards Laguna lake, then pumping equipment will be provided with two

groups of high and low head pumps, to reduce the operation and maintenance cost of the pumps. The pumped water will be transported to the outlets at the beginnings of the irrigation canals through discharge pipelines which are separately provided to the high elevated and low lying areas. The pipelines will be located alongside a feeder road to be improved with the Project.

Irrigation canal

Irrigation main canal will run along the skirts of the hills and on the higher part of the irrigation area, branching main farm ditches. Since the canals are running on moderately steep slopes, the canals are of U-shaped concrete lining type to prevent erosion to the canals and to reduce seepage losses.

Drainage canal

There is no definite drainage canal and drainage water gathers on the low depressed parts. During the rainy season, the water stagnates on the low area because of the poor drainage condition.

Since main irrigation canal run along the contour lines, the runoff from the hilly areas and irrigation excess will be intercepted with them. The drainage canals system will be networked with improvement of the existing drainage streams and collector drains along the irrigation canals.

4) Pagkalinawan Irrigation System

A pump station will be located on shore of Laguna lake in the central part of the irrigation area. The pumped water will be transported to the beginning of the irrigation canal through a discharge pipeline. Two main canals will start from outlet of the discharge pipeline on right and left sides, diverting main farm ditches. The canal are of U-shaped concrete lining type since the canals run on steep slope and erosion control and seepage reduction are necessary. The drainage canals are provided to collect the runoff from the hilly areas and to discharge it to Laguna lake.

(2) Pump station

The pump station consists of an inlet channel with suction pond, pump house, discharge pipeline, and outlet. The pump house is selected on the shore of Laguna lake adjacent to the irrigation area so that the pump station will be safe for high water of the lake and an inlet channel will be shortened. The design water levels of the pump station are determined on the basis of Laguna lake water level record. After converted to the RI bench mark system based on which the topographic maps of the Project have been prepared, the recorded minimum and maximum water levels were taken to be the design low and high water levels:

Design high water level	:	El.+2.84 m
Design low water level	:	El.- 0.40 m

The pumping equipment is designed on the basis of 24 hour continuous operation at the peak demand period. According to the estimate of the diversion requirements of each system, the peak requirement occurs in one month and in the other periods the requirements are less than 50%. In consideration of these patterns of seasonal water requirements, two sets of pump without a spare set are proposed. The design discharge per set are 1 to 5 m^3/min and total heads range from 20 to 50 m. In addition to the above hydraulic condition, taking into account easier operation, maintenance and repair, a horizontal shaft volute pump is selected. The pipelines are of buried polyethylene vinyl pipe.

Durability of pump equipment depends on timely maintenance and repair of the pump. To prolong the durability, an appropriate number of spare parts and consumables and genuine tools for repairing will be supplied under the Project.

Design discharges of pumps are determined by the following formula:

$$Qt = q \times A \times 1/1{,}000 \times 60$$

$$Qu = Qt \times 1/2$$

where, Qt : Total pump discharge (m^3/min.)
Qu: Pump discharge per set (m^3/min/set)
q : Unit water requirement (l/sec/ha)
for paddy irrigation area, 2.30 l/sec/ha
for paddy with upland crops, 1.80 l/sec/ha.
A : Command area (ha)

The principal features of the pump stations thus designed are summarized below:

Irrigation system		Sipsipin		Llano	Palay Play		Pagkalinawan
		high head	low head		high head	Low head	
Pump type		---- Horizontal shaft volute --					
Pump							
Discharge	(m^3/min/set)	5.19	6.57	4.50	2.55	7.11	3.06
Dia.	(mm)	200	200	125	125	250	100
Number	(set)	2	2	2	2	2	2
Rated head	(m)	48	19	22	40	26	32
Output of motor	(kW/set)	75	37	30	30	55	37
Discharge pipeline							
Type		---- Polyethylene vinyl --					
Dia.	(mm)	400	450	400	300	450	300
Total length	(m)	1.56	0.63	0.24	1.62	0.94	0.15

The Project canals consist of a main canal and main farm ditch. These canals run on slightly steep slopes. In order to prevent erosion to the canal, to reduce seepage loss, and to minimize the occupied area, a canals are designed with U-shaped concrete flume which is prevailing in the Project area. In selecting the concrete lining method, the in-situ concrete lining method and precast concrete lining method are conceivable. The advantages and disadvantages of both methods were examined:

The in-situ concrete lining method, in general, requires precise techniques in placing, finishing, and curing concrete and even if well implemented, much losses of concrete inevitably occur. On the other hand, precast concrete lining has several advantages - i) quality control of precast units is easy because they are manufactured in a central plant, ii) precast concrete unit can be manufactured even during the rainy season, in which major works are suspended, and iii) damaged lining parts can be easily repaired by simply replacing the damaged precast unit with new ones.

As a result, the U-shaped precast concrete flume is selected for the Project. Hydraulic designs of these canals were carried out on the following conditions:

Design discharge is determined by the following formula:

$$Q = q \times A \times 1/1,000$$

where, Q : Design discharge (m^3/sec)
q : Unit water requirement (l/sec/ha)
for paddy irrigation area, 2.30 l/sec/ha
for paddy with upland crops, 1.80 l/sec/ha
A : Command area (ha)

Design discharges of the canals in the respective irrigation systems are as shown in Figure 4.

Allowable velocity	:	Max. 1.5 m/sec Min. 0.30 m/sec
Roughness coefficient(for Manning formula)	:	0.015
Freeboard(up to top of lining)	:	0.20 m

(4) Related canal structures

In conjunction to the irrigation canals, the various canal related structures are provided to divert the water, to regulate the water level, and to cross the road and/or streams. Kinds and numbers of the structures to be provide under the Project are as follows:

Description		Sipsipin	Llano	Play Play	Pagkalinawan
Length of canal	(km)	9.93	0.94	9.56	3.94
Number of canal	(no.)	25	6	18	9
Related structure	(no.)				
Turnout		16	5	10	5
Culvert		7	0	7	7
Field outlet		170	65	140	55
Drop		19	0	10	0
Siphon		1	0	0	2
Drainage crossing		2	1	0	2
Aqueduct		2	0	1	0

(5) Drainage canal

The proposed drainage canal works consist of improvement of natural streams and farm drain to be newly provided. All these drainage canals are designed to be trapezoidal open canals of unlined type. Designs of these drainage canals are carried out in the following manner:

Design discharge is determined by the following formula on the basis of the unit drainage water requirement mentioned in the previous section:

For paddy field : $Qi = qi \times A$

For out side area : $Qo = qo \times A$

Design discharges thus calculated for the canals in the respective irrigation systems are as shown in Figure 5.

	Max.	Min.
Allowable velocity (m/sec)		
Drainage canal	0.6	0.3
Related structure	2.5	0.3
Roughness coefficient		
Drainage canal	: 0.030	
Related structure	: 0.015	
Design water level	: 10 cm below the ground surface	
Canal side slope	: 1 : 1.0	

The canal structures to be provided to the drainage canals are culverts to cross roads. The numbers of the related structures to be provide under the Project are as shown below:

Description	Sipsipin	Llano	Palay-Palay	Pagkalinawan
Number of canal (nos.)	9	11	3	9
Length of canal (km)	5.3	4.2	1.2	2.8
Drainage culvert (nos.)	11	3	2	7

4.2 Road Network

4.2.1 Design Policy

The road network plan consists of improvement of a trunk road and a number of feeder roads to improve the traffic conditions of villages in the Jala-Jala area, to promote the rural development, and to improve living conditions of rural inhabitants.

The link road of Jala-Jala Peninsula from Jala-Jala to Bagumbong through Punta for about 18.5 km was implemented by the Jala-Jala municipality office in 1975, and clearing and stripping were executed up to Bagumbong without structural works. At present, however, only the route between Jala-Jala and Palay-Palay for about 8 km can be passed and the remaining route of 10 km is not passable. Recently, the Rizal

Provincial Engineering Office commenced clearing and gravel metalling for a part of the above routes with a completion schedule by September 1992 according to villagers urgent demand. Village roads are unpaved and affected by erosion hazard. In fact, in the rainy season, most village roads are hard to pass due to muddy conditions. These poor road conditions hinder social and agricultural production activities in the Jala-Jala area. The design policy of the road network improvement is as follows:

1) To improve the Jala-Jala Peninsula link road as a trunk road, in order to connect all villages, and introduce traffic of the area to the existing national roads leading to Manila and adjacent market towns.

2) To improve the existing village roads, in order to connect the trunk road with villages and connect village with farm land.

4.2.2 Study and Examination of Design Criteria

The link road from Jala-Jala to Bagumbong of 18.1 km will be improved under the Project of which the route of about 14.3 km was gravel-metalled by DPWH (inclusive of under construction). The road base condition is well consolidated. Whereas, since the remaining route is newly constructed, sufficient base treatment is required and drainage crossing structures and embankment to cross the low-elevated area shall be provided.

The feeder roads to be improved under the Project are 21 village roads of 14.0 km total in length. The village roads presently suffer from muddy conditions due mainly to lack of drainage facilities, insufficient embankment height, and lack of maintenance works. Therefore, road surfacing is necessary together with additional earthfilling. Besides, to maintain the function of the feeder roads, adequate drainage facilities shall be provided.

4.2.3 Basic Plan

(1) Trunk road

1) Cross section

a. Total width shall be 9.1 m and pavement width shall be 6.1 m on the base the design criteria of DPWH
b. The pavement shall be of concrete, taking into account that i) this road is a trunk road in the area, ii) extension of the national roads to approach to Jala-Jala area which is under the concrete pavement, iii) operation and maintenance of the trunk road will be made jointly by DPWH
c. Thickness of the pavement shall be of 20 cm on the basis of soil condition of the road base and anticipated traffic
d. Design condition of base course of the road shall be as follows:

Gravel surfaced route	Design CBR 4-6	13 cm
Newly constructing route	Design CBR 2-4	18 cm

Material of the base course is crushed stones for mechanical stabilization.

Transverse slope of road shall be 1.5% for pavement portion and 3% for shoulders.

2) Drainage facilities

The drainage facilities to be provided for the trunk roads consist of the crossing of the natural streams and existing irrigation canals. The side drain ditch is of earthen canal with a side slope of 1:1.5. The drainage crossings are of concrete box culvert and concrete pipe culvert depending on the flow capacities, of which flow capacities are determined on the basis of the unit drainage requirement as described in the succeeding section.

(2) Feeder road

1) Cross section

- Total width shall be 6.0 m and pavement width shall be 4.0 m on the base of the criteria of DPWH.

- The pavement type shall be of gravel metalling, taking into account economized construction and common practice used in the Philippines for feeder roads.
- Thickness of the gravel metalling shall be of 20 cm on the basis of soil condition of the road base and anticipated traffic.
- Design condition of base course of the road shall be as follows. Transverse slope of road shall be 2.5% for pavement portion and 4% for shoulders.

2) Drainage facilities

The drainage facilities to be provided for the trunk roads consist of crossings of the natural streams and existing irrigation canals, and side drain ditches. The side drain ditch is of earthen canal with a side slope of 1:1.0. The drainage crossings are of concrete box culvert and concrete pipe culvert depending on the flow capacities, of which flow capacities are determined on the basis of the unit drainage requirement as described in the succeeding section.

The principal features of the road network to be improved are as described below:

Description		Trunk road	Feeder road
Length	(km)	18.1	14.0
Number	(nos.)	1	21
Pavement			
Type		concrete	gravel
Thickness	(cm)	20	20
Road width			
Total width	(m)	9.1	6.0
Pavement width	(m)	6.1	4.0
Related structures	(nos.)	87	32

4.3 Rural Water Supply System

4.3.1 Design Policy

Domestic water in Jala-Jala area is obtained from shallow aquifers by use of hand-operated pumps. The present water supply in the Project area is confronted with

water shortage, low water quality, and long distance from water source or well. In order to establish and improve the water supply system to the above areas, rural water supply facilities to obtain the water from deep aquifers will be provided. The design criteria of the rural water supply system is set as shown below.

4.3.2 Study and Examination of Design Criteria

The rural water supply facilities will be provided to the areas which are confronted with low water quality and quantity as described in the previous section. The water supply facilities under the Project shall be of the following Level-I and Level-II on the basis of the prevailing practice adapted by DPWH:

Level-I : About 25 to 50 beneficiaries should be located within 250 m from a well. This facilities is of a well equipped with a hand-operating pump same as the existing facilities. The water use shall be determined on the basis of the daily unit water consumption of 40 lit/person.

Level-II : This system shall be provided to the area where numbers of beneficiaries are more than 100 households for the water confronted area. Level-II facilities consist of a deep well, pumping equipment, water tank, main pipeline, distribution pipeline, and communal faucets. One faucet will be provided so as to serve about 4-6 households. The capacity of water supply system is determined on the basis of the daily unit water consumption of 80 lit/person.

4.3.3 Basic Plan

The water supply facilities are designed to accommodate the water requirement for increase population after 5 years according to the present practice in the Philippines. The system capacities of the respective Levels are determined on the following basis:

Level-I

Daily average water supply,q	:	40 lit/day/person
Average daily water supply, Q1	:	q x design population
Maximum daily water supply, Q2	:	1.3 x Q1
Maximum hourly water supply, Q3	:	2.5 x Q1
Well		
Borehole dia.	:	200 mm
Casing dia.	:	100 mm
Screen dia	:	100 mm

Level-II

1) Daily water supply

Daily average water supply,q	:	80 lit/day/person
Average daily water supply, Q1	:	q x design population
Maximum daily water supply, Q2	:	1.3 x Q1
Maximum hourly water supply, Q3	:	2.5 x Q1

2) Communal faucet

Water head at the end	:	3.5 m
Minimum diameter	:	13 mm

3) Storage tank

Structure:overhead tank, reinforced concrete structure

Storage volume	:	0.20 to 0.25 x Q2

4) Distribution pipeline : PVC pipe

5) Pump

Pump operation hour	:	12 hr per day
Pump discharge	:	Max. daily water demand/12 hr
Pump type	:	submersible type

6) Well

Borehole dia.	:	350 mm
Casing	:	FRP, dia 150 mm
Screen	:	FRP, dia 150 mm

The principal features of the rural water supply systems thus determined are as shown below:

Level-I

Village	Beneficiary	Number	Well		
			Borehole Dia	Well depth	Casing dia
	(household/no)	(nos.)	(mm)	(m)	(mm)
Sipsipin	50	5	200	50~70	100
Punta	50	1	200	40	100
Palay-Palay	50	3	200	40~70	100
Pagkalinawan	50	3	200	50~60	100
Lubo	50	1	200	50	100
Bagumbong	50	3	200	50~80	100

Level-II

Description	Unit	Punta	Bagumbong
Beneficiary			
Present household	(household)	271	227
Present population	(person)	1,626	1,362
Design population	(person)	1,829	1,532
Water demand			
Daily average water supply	(m^3/day)	146	123
Max.daily water supply	(m^3/day)	190	159
Max.hourly water supply	(lit/sec)	4.2	4.6
Well			
Well depth	(m)	100	100
Casing dia	(mm)	150	150
Pump			
Type		---- submersible type ----	
Discharge	(m^3/min)	0.26	0.22
Output of motor	(kW)	5.5	5.5
Rated head	(m)	50	50
Tank capacity	(m^3)	38	32
Distribution pipeline			
Pipe dia.	(mm)	25-50	25-100
Total length	(m)	1.42	2.31
Faucet	(nos.)	56	47

4.4 Rice Mill Center

4.4.1 Design Policy

(1) Basic concepts

The design of facilities and equipment for the rice mill center was based on the following basic concepts, in addition to considering the local conditions:

1) Installation and operation of facilities introduced for the rice mill center should maximize the current marketing system, organizations, and channels.

2) Facilities and equipment should be designed so as to improve paddy quality, minimizing quantity of post-harvest losses, but highly developed machinery, such as wet type rice polishing machine, color sorter and blender, should not be introduced.

3) Transporting, storing and sun-drying works should mainly use manpower. Facilities and equipment should be designed taking into consideration labor saving devices, high efficiency, reduction of heavy labor and cost saving.

4) Facilities should be designed for safe operation with flexibility under current labor practices and technical level.

5) Special types of equipment should be avoided as far as possible in order to reduce costs and to simplify procurement of spare parts.

(2) Design criteria

The basic design criteria was determined as follows:

1) Command area for the collection of paddy

The command area of the proposed rice mill center is 770 ha of which 420 ha is paddy field under the 4 Project irrigation areas (Sipsipin, Palay-Palay, Llano and Pagkalinawan) and 350 ha is existing paddy fields. These fields are scattered in 10 villages.

2) Target paddy yield and production

The proposed paddy cropping pattern in the irrigated field generalizes double cropping of paddy a year. Anticipated paddy production is estimated based on the Feasibility Study report and the yield record at Jala-Jala municipal agricultural office. The unit yield will gradually increase after the construction of irrigation facilities and it will achieve target yield of 5 ton/ha by 1998. Annual paddy production in the command area of the rice milling facility is estimated as follows:

Land Category	Cropping Area	Unit Yield	Production
Irrigated Paddy Field			
Wet season	457 ha*	5.0 t/ha	2,285 tons
Dry season	457 ha	5.0 t/ha	2,285 tons
Non-irrigated Paddy Field			
Wet season	313 ha	3.5 t/ha	1,096 tons
Total	1,227 ha		5,666 tons

* : including existing paddy field of 37 ha

3) Harvesting period and quantity of paddy to be collected

Based on the proposed cropping pattern, the harvest period of paddy in the Project area is:

Irrigated Paddy Field
Wet season : September - October (60 days)
Dry season : February - March (30 days)

Non-irrigated Paddy Field
Wet season : September - November (90 days)

Total quantity of paddy to be collected for the proposed rice mill center is estimated to reach 4,000 tons a year after reduction for stock paddy (seeds, animal feed, etc.) and total capacity of the existing rice mills, as follows:

Items	Wet Season Paddy	Dry Season Paddy	Total
Total Production (tons)	3,381	2,285	5,666
Seeds			
Planted area (ha)	770	457	1,227
Unit amount (kg/ha)	50	50	
Total amount (tons)	39	22	61
Stock of paddy 6.7%* (tons)	227	154	381
Total capacity of rice mills (tons)	790	442	1,232
Total quantity to be collected (tons)	2,325	1,667	3,992

*) : Agricultural Statistics, 1990, Ref. Fig. 4.41.

4) Determining operation condition

Operating conditions of the rice mill facilities were determined on the basis of the capacity of collecting paddy, processing and storing as follows:

- Operating period for collection/ receiving	:	5 months a year		
- Operating days for collecting / receiving	:	140 days a year	wet season dry season	100 days 40 days
- Operating period for rice mill facilities	:	Rice milling ;	wet season dry season	5 months 4 months
		Custom milling ;		12 months
- Operating days for rice mill facilities	:	Rice milling ;	wet season dry season	120 days 100 days
		Custom milling ;		250 days
- Daily operating hours	:	Total working hours ; Net operating hours ; (5 hrs/day for custom milling)		8 hrs/day 6 hrs/day

The drying facilities in the wet season would be operated for 24 hrs/day as necessary.

4.4.2 Study and Examination of Design Criteria

Work flow related to the rice mill facilities is illustrated in Figure 4.4.2, covering from transport of paddy to the receiving, processing, and shipping of rice. These required facilities and equipment, and their optimum capacities are described below:

(1) Transporting vehicles for paddy and rice

Transporting vehicles will be used to convey bagged paddy from collecting depots to the receiving facility of the rice mill center. The collecting depots will be established and operated by farmers' group, and will be placed beside the main road in each village or paddy field.

(2) Receiving facility

The main function of the receiving facility will be weighing and classifying paddy transported from the collecting depots by truck, jeep and cart, and preparing receiving slips. The receiving paddy will be classified by moisture content, and sampled and checked whenever necessary. The very wet paddy (20-24% of moisture content) will be sent to a mechanical drying process. The semi-dry paddy will be sent

to a sun-drying floor and dried paddy will be put into the milling process or stored. The conveyance of these paddy in the rice mill yard will be by belt conveyer and hand carts.

The maximum quantity of receiving paddy is 50 tons/day or 10 tons/hr in the wet season, as estimated below:

Items	Wet Season		Dry Season
	Irrigated field	Non-irrig.field	Irrigated field
Quantity of collected paddy (tons)	1,667	658	1,667
Net operation days (days)	40	100	40
Daily receiving paddy (tons/day)	42	7	42
Net operation hours (hrs/day)	7	7	7
Operation efficiency (%)	70	70	70
Max. receiving quantity (tons/hr)	8.5	1.5	8.5

(3) Drying facilities

Sun-drying is a common practice for drying of paddy because sunshine hours are long enough and annual rainfall days are minimal in the Project area. However, after double cropping is introduced by the irrigation facilities, the wet paddy having high moisture content in wet season will be transported into the facilities. Accordingly, mechanical drying will have to be introduced in order to avoid deterioration of the wet paddy.

For this, two (2) drying facilities will have to be provided in the rice mill facilities; a mechanical dryer and a concrete floor for sun-drying. Proposed capacity of drying facilities is estimated 20 tons or 40% of total receiving paddy for mechanical dryer, and 30 tons (or 60%) for sun-drying.

Work on the sun-drying floor would consist of opening sacks, tipping paddy on the floor, spreading out to 5 cm deep, and repeated stirring up so that it may be dried uniformly without cracking. After drying, paddy will be bagged and then brought to the the warehouse or the processing facilities. The very wet paddy will be directly brought to the receiving hopper and paddy cleaner for removal of immature paddy and foreign matter, and then sent to the dryer. The dried paddy will be conveyed to the milling process or bagged for the warehouse.

(4) Rice milling facilities

The required capacity for milling is estimated at 2.5 tons/hr as follows:

Items		Wet Season	Dry Season	Total
Total quantity of receiving paddy	(tons)	2,325	1,667	3,992
Net operation days	(days)	120	100	220
Processing capacity per day	(tons/day)	20	17	18
Quantity of marketable milling*	(tons)	17	14	15
Operating hours	(hrs)	7	7	7
Operating efficiency	(%)	70	70	70
Milling capacity per hour	(tons/hr)	2.8	2.3	2.5

*) : The capacity of milling is estimated at 84% of total receiving paddy for marketing rice, and remaining of 16% or 3tons/hr for the custom milling.

The work flow of the rice milling process will be as follow:

1) Receiving and cleaning of paddy
Dried paddy in the warehouse or dryers' tank will be sent to receiving hopper, and cleaned by paddy cleaner to remove foreign matter (gravel and iron fragments), immature paddy, and chaffs.

2) Husking and separating
Clean paddy will be husked by the husker and will be separated into brown rice, paddy (unhusked rice), and husk. Paddy will be husked again.

3) De-stoning
Pebbles or sands remaining in brown rice will be removed.

4) Whitening
Brown rice will be whitened by removing bran.

5) Rice polishing
Whitened rice will be polished.

6) Separating and storing
Whole rice, small broken rice, and brewers rice will be separated and stored in separate tank.

(5) Weighing and bagging facilities

Rice will be bagged according to the marketable weight for example 50 kg/bag. By-products such as the rice brewers, rice bran, and husk will be shipped as they are after bagging and weighing.

(6) Custom milling facilities

With the completion of the irrigation facilities, it is anticipated that paddy production in the Project area will increase largely. Present rice mill capacity will be insufficient not only for milling of commercial rice but also for custom milling for home consumption. The custom milling facilities will be required 3 ton/day of capacity by small mill (0.3-0.5 ton/hr, one-pass type).

(7) Warehouse for paddy, rice and others

The harvested paddy are temporarily stored at farmers' storage, and sent to the rice mill. After receiving and drying in the rice mill, paddy will be stored in the warehouse. Milled rice will be stored in the warehouse for several days.

(8) Management and operation office

An office for administrative and technical staff will be required in the rice mill facilities. This office will have sections for general affairs, accountants, collecting and shipping, and drying and milling under the control of a project manager.

(9) Other facilities

Some storage for the by-products will be needed to protect them from rain and wind. Additional facilities such as water supply facility, garage, and a toilet will be required.

4.4.3 Basic Plan

Basic plans for the rice mill facilities consist of 1) proposed equipment (Ref. Figure 4.4.3) and 2) buildings.

(1) Proposed equipment plan

1) Transport vehicles for paddy and rice

The loading capacity of transport vehicle (truck) for paddy and rice will be 4 tons since they will be operated along the main road which has a width of 6.1 m. The minimum number of trucks is estimated to be two (2), because many transportation vehicles (jeeps and carts) can be used by farmer or farmers' group in the Project area. These trucks will be common cargo type with a hood, which can put on and off easily, to keep off the rain when the paddy or rice is transported on rainy days.

2) Receiving and weighing equipment

a.	Table scale	:	1,000 kg x 2 nos., for weighing 10 to 15 sacks
b.	Grain moisture meter	:	electric resistance type, range 11 to 30% portable type x 2 sets, stationary type 1 set
c.	Grain trier for bag	:	21mm x 300mm, with leather case x 3 nos.
d.	Belt conveyer	:	movable slat conveyer, 5m length x 1 set
e.	Handcart	:	for carrier of bagged paddy, 500 kg x 2 nos.

3) Equipment for drying facilities

a. Equipment for mechanical dryer :

The type of machine will be of a recirculating batch type with heat source of a rice husk furnace, taking into account the difficulty in getting fuel and easy operation. The dryer will be the type to meet the following:

i) moisture content of paddy is over 20%
ii) drying is quick and uniform
iii) quick loading and unloading is possible
iv) high operation technique is not necessary

The number of dryer is estimated as follows:

- Quantity of drying paddy	20 t/day
- Reduction of moisture	0.8% per hour
- Operating hour	10 hrs/day
- Capacity of dryer	5 tons/ unit
- Required number	4 sets

During the rainy days, dryer will be required 2 cycles per day or 24 hrs. operation for 40 t/day of drying paddy.

A dryer will be equiped with a hopper, pre-cleaner, a husk furnace, bucket elevators, tanks dust collecting devices and a control panel.

b. Equipment for sun-drying : About 30 t/day of wet paddy (moisture content 16-20%) will be dried on the sun-drying concrete floor. Some of equipment will be necessary as follows:
- Handcart for carrier of bagged paddy, 500 kg x 4 nos.
- Waterproof sheet will be used for the paddy heaped on the sun-drying floor when it rain. Size of sheet is estimated as (5m x 10m = $50m^2$) x 4 sheets

4) Equipment for milling facilities

The machinery and equipment for milling will be furnished as a one line system for receiving, cleaning, husking, de-stoning, whitening, polishing and bagging. Machinery and equipment will be placed with enough space for safe operation and for easier maintenance and repair. The following equipment will be required.

a. Hopper and bucket elevator : One hopper and bucket elevators will be provided. Paddy will be directly conveyed from mechanical drying facilities or received the sacks from warehouse. The capacity will be determined as follows ;

- Operation hour	;	6 hrs/day
- Quantity of milling paddy	;	15 t/day
- Operation efficiency	;	80%
- Required capacity	;	3.5 ton/hr

b. Paddy cleaner : Paddy should be cleaned before milling process for protection of mechanical damages. One paddy cleaner with 2.5 ton/hr will be installed.

c. Husker : One husker of rubber roll type with 2.5 ton/hr of mill capacity will be proposed.

d. Separator : One separator with 2 ton/hr capacity will be proposed.

e. De-stoner : This is a device to exclude gravel mixed with brown rice by specific gravity. One machine with 2 ton/hr capacity will be provided.

f. Whitener and polisher : Almost all varieties of paddy to be handled will be of the Indica type and mainly of IR-line. Taking the variety of paddy condition, a whitener which has two (2) processes; an abrasive process as first stage and a friction process as second process, will be proposed. In addition, a rice polisher of a friction type will be installed as a third stage. These machinery with 1.6 ton/hr capacity will be proposed.

g. Separator : Whitened rice will be divided into three (3) groups ; whole rice, mixed rice and small broken rice, and rice bran will be removed. One (1) rotary sifter (2 ton/hr) will be proposed.

h. Whitened rice tank : Two (2) whitened rice tanks are required to store whole rice, large and small broken rice, separately. The capacity will be 3 tons each.

i. Table scale, sewing machine : Two (2) table scales (100 kg), and one (1) sewing machine (50 sacks/hr) will be installed.

j. Other equipment : Besides the above milling facilities, conveyance equipment such as bucket elevators and belt conveyors, a control panel for operation, power distribution line, and cyclones for bran and dust collecting are required.

5) Equipment for custom milling facility

Proposed capacity of the custom milling facility is as follows:

a. Total home consumption rice : 22,847 persons(1998) x 101 kg/person/year = 2,307 tons
b. Total quantity of paddy : 2,307 tons x 65 % = 3,550 tons per year
c. Total capacity of existing mills : (0.1 ton/hr x 3.5 hr/day x 20) x 190 days = 1,232 tons/year
d. Required quantity for milling : 3,550 tons - 1,232 tons = 2,318 tons per year

Required quantity for custom milling is estimated at about 640 tons per year, since the existing rice mill in the project area is not sufficient enough for the increase paddy production for home consumption (refer to Figure 5.4-1). Required number of machinery for custom milling is estimated as follows:

a. Annual operation hour : (365 days x 70%) x 5 hr/day = 1,275 hrs per year
b. Milling capacity per hour : 640 tons/year / (1,275 hrs x 85%) = 0.6 ton/hr
c. Number of machines : 0.6 ton/hr/0.3 ton/hr = 2 nos.

6) Other equipment for rice mill facility

The following equipment will be needed for efficient management and operation of the proposed rice mill facilities:

a. Testing, inspection equipment : For the inspection of paddy quality, grain classification, some of testing equipment such as a test winnower, a husker, a balance, etc. are needed.

b. O&M and office equipment : To ensure the successful operation of the rice mill facilities through the smooth collection of paddy, the close communication among farmers' group, the collection of marketing information, etc., one (1) jeep, radio communication equipment, computer with printer and copy machine are required.

(2) Proposed building plan

The proposed rice mill center is designed so as to accommodate the collectable amount of paddy conveyed in the Project area, and the buildings required for proper operation and maintenances.

As for the technical standards for designing the buildings, Philippines technical guidance for design loads will be applied, and for other areas, relevant Japanese standards will be applied. In design planning, local conditions such as climate, customs, traditional practices shall be taken into consideration as much as possible. Domestic materials and construction methods shall be taken into account.

The related buildings consist of: i) building for drying facilities, paddy warehouse and custom milling, ii) building for the rice mill facilities and rice warehouse facilities, iii) administrative and control office, iv) others such as the storage for rice husk, husks' ash and dust, a garage, a water supply facilities and a outdoor toilet, etc. Architectural planning for these buildings are as follows:

1) Buildings for drying facilities, custom milling facilities, and milling facility
The building will be constructed with steel structure, and the colored formed iron steel will be used for roof and reinforced concrete for wainscot and floor taking consideration the durability and economic aspect on the long spans and high eaves.

2) Storage for rice husk, husks' ash, dust, etc.
The building will be constructed with concrete block for wall, the colored formed iron steel for roof, and reinforced concrete for floor taking consideration the easy maintenance and economic aspect.

3) Office, toilet and others
The building will be constructed with concrete block for wall, the colored formed iron steel for roof, and reinforced concrete for floor taking consideration the comfort, cleanliness and economic aspect.

The floor area of each facility will depend on machinery size and arrangement, working and storing space, as well as number of staff. The proposed floor area of each facility is as follows:

a.	Building for drying, paddy warehouse and custom milling facilities	441 m^2
b.	Building for rice mill facilities and rice warehouse	1,080 m^2
c.	Sun-drying floor	1,300 m^2
d.	Rice husk storage	100 m^2
e.	Rice bran and dust storage	90 m^2
f.	Husks' ash storage	32 m^2
g.	Administrative and control office	198 m^2
h.	Out-door toilet	14 m^2
i	Garage	161 m^2

Detailed estimation of floor area is shown in the following Tables.

Facilities	Calculation Method		Remarks
A.	<u>Building for drying, paddy warehouse and custom milling : 441 m^2</u>		
(1)	Dryer (5 tons x 4 nos) (612 m^2)		Depend on drawing layout of machines
	Receiving and weighing/classifying area (10m x 5m = 50 m^2)		
(2)	Paddy warehouse (351 m^2)	a. max. storage capacity 500 tons	
		b. storage amount/ floor area 0.5 t/m^3	specific gravity
		c. average stacking height 5.0 m	20 stacks
		d. passage space 65 m^2	
		(a / b / c) + d = 13 m x 26m = 338 m^2	
(3)	Custom milling (117 m^2)		
	Milling machine 0.3 t/he x 2 sets	9m x 9m = 81 m^2	
	Husk, rice bran storage	4m x 9m = 36 m^2	
B.	<u>Building for rice mill facilities and rice warehouse : 1,080 m^2</u>		
(1)	Milling machinery (2.5 ton/hr x 1 nos) (267.9 m^2)	18.5m x 8m = 148 m^2	Depend on drawing layout of machines
		working and passage space 120 m^2	
(2)	Control room	6.3m x 4.5m = 28.3 m^2	control panel 2m x 0.6m
(3)	Inspection/ testing room	6.3m x 4.5m = 28.3 m^2	
(4)	Parts store	6.3m x 4.5m = 28.3 m^2	
(5)	Rice warehouse (88.2 m^2)	a. production of milled rice 15 t/day	milling rate ; 0.67
		b. storage amount/ floor area 0.55 t/m^3	specific gravity
		c. average stacking height 3.0 m	15 stacks
		d. passage space 27.6 m^2	
		(a / b / c) + d = 6.3m x 14m = 88.2 m^2	
C.	<u>Sun-drying concrete floor : 1,300 m^2</u>		
	Concrete floor	a. max. drying capacity 30 t/day	
		b. drying amount/ floor area 0,55 t/m^3	specific gravity
		c. average layer thickness 0.05 m	one (1) day for drying
		d. working and passage space 210 m^2	
		(a / b / c) + d = 42m x 31m = 1,300 m^2	