project is judged to be justifiable and necessary to be implemented under the Grant Aid program by the Government of Japan.

3. 2. 2 Implementation and O/M Plan

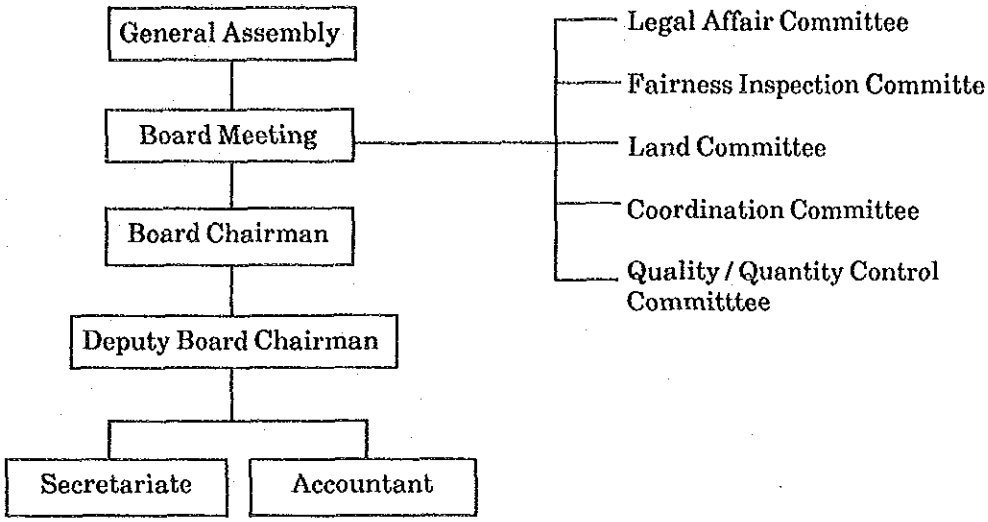
The Provincial Government of Marinduque is the Executing Agency of the project, though the subject project involves various fields of development such as irrigation, road, rural water supply and agricultural promotion.

The Provincial Government has no function under the organization to implement the construction works as well as administrate the operation and maintenance of the irrigation project implemented, as the irrigation works are implemented and administrated solely by the NIA.

The irrigation facilities for Tagum-Angas area covers less than 1,000 ha beneficiary area and classified as a small scale category. The dam height is planned to be about 22 m, however, then O/M of dam facility would be undertaken by the NIA, while that for the irrigation canal by the water Users' Association. Usually the Provincial Office will be in charge of the O/M work for this scale of dam under the supervision and technical guidance given by the NIA Central Office. The Water users' Association for the Tagum-Angas area is to be organized in the year 1991.

As for Laon-Mataas irrigation facilities, all the O/M works will be handled by the Irrigators' Association, as there is no dam (including diversion dam) with the height higher than 5 m. The said Association has been organized to date as shown in the following Figure.

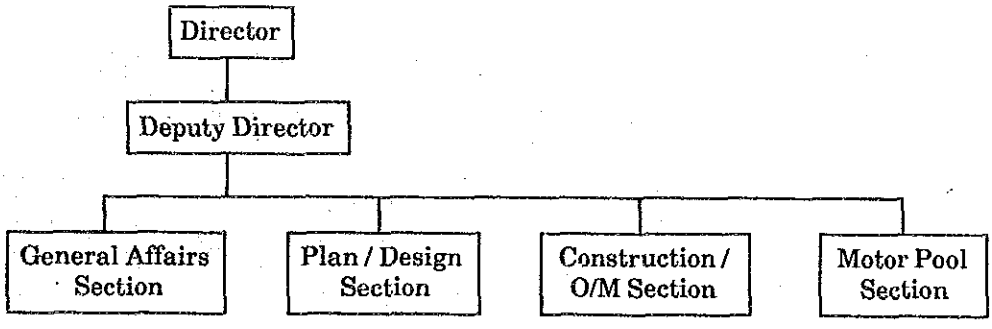
FIGURE 3-1 ORGANIZATION CHART OF LAON-MATAAS WATER USERS' ASSOCIATION



O/M works for 27 small scale irrigation systems presently existing in the province of Marinduque are carried out by relevant Irrigators' Association with having guidances and technical assistance from the NIA Provincial Office. The NIA, since its establishment, has been in charge of O/M works for the irrigation facilities with having the Central Office, Regional Offices, Provincial Offices, Project Implementation Offices and O/M Offices.

Organization chart of the Provincial Engineering Office of Marinduque is as shown in Figure 3-2, and its activities cover construction of provincial roads, O/M of roads, technical assistance for construction of rural water supply facilities as well as construction of school buildings and others. The O/M works for road facilities provided under the subject project would be performed by the Provincial Engineering Office.

FIGURE 3-2 ORGANIZATION CHART OF MARINDUQUE PROVINCIAL ENGINEERING OFFICE



The Construction / O/M Section has 13 staff in charge of construction and 56 staff for O/M works and is carrying out construction planning, construction supervision as well as O/M works for constructed facilities. Such O/M work machineries / equipment as bulldozer, grader, loader, roller, dump truck and etc. are managed by the Motorpool Section and operated for road surface cleaning, re-grading, pavement and repair for structures as required. As for O/M of sub-grade roads than provincial roads which exist for 450 km length in Marinduque Province, the Provincial Engineering Office directly involves in the O/M or indirectly through either municipal offices or Barangay Offices. Under the subject project, only rehabilitation works would be implemented and there will be no difficulty in O/M works for the rehabilitated roads.

The O/M services of the existing water supply are carried out by the due executing agency, Municipality Office. In details, the O/M services for the Sta. cruz water supply facilities are given by Sta. Cruz Municipal Water Supply Department, while those of Torrijos by Torrijos Municipal Water Supply Section.

The water supply plan worked out in the Project mainly aims to improve in increase the volume of water available, and the Project executing agency will be the agency for O/M of the facilities after completion of the Project.

The outline of rural water supply plans requested for Tagum-Angas, Sta. Cruz and Torrijos areas is as described below.

* Tagum-Angas and Sta. Cruz

The Sta. Cruz Plan will provide a pipe line between the Tambangan dam and receiving tank at Sta. Cruz and the Level 2 Water Supply in the Barangays around Tagum-Angas Area located along the above mentioned pipe line.

* Torrijos

The Torrijos Plan will provide a pipeline between the spring of water source and a receiving tank and the Level 2 Water Supply to the Barangays located on its way. The O/M organizations and annual costs and balance of accounts of Sta. Cruz Plan and Torrijos Plan are given in the paragraph of Present Water Supply, Chapter 2.

With Project, increase in domestic water supply volume is expected to raise the collection rate of water charges as follows. The water charges shall be collected by accountants or proper collectors of the Provincial government in the municipalities with provincial offices, and for Barangays, the charges shall be collected in each Barangay to deliver to the related water supply department offices, respectively.

Estimation of the future water charges to be collected with Project can be made as follows in presuming that the tariff of water charges remains unchanged. The said estimation reveals that even 80 percent of the collection rate of the water charges at maximum, will enable to keep surplus to some extent so that the water supply authorities concerned will be able to render more effective and efficient services of O/M.

Tagum-Angas area and sta. Cruz Area

Income; P30/M/H. H × 2,865 H.h × 12 × 0.8 = P825,120

Designed H.hold	:	2,865 households
Water Charge	:	P30/H.H
Effective Collection Rate	:	80 percent

Expenditure Increased Salary 3 × P1,500/Month × 12 M	=	P 54,000
Electric Charge (22+11)kw× 24 hrs÷ 2.5 × P4 × 365 days	=	P462,528
Treatment Chemicals : 1.112 kg/day × 365 × P138/kg	=	P 56,011
Present O/M Cost (Actual Cost in 1990)	=	P187,310
	Total :	P 759,849

* The staff will be stationed by one each for a filter basin and two pumping stations. Total : Three (3)

* Estimation of Amount of Necessary Treatment Chemicals

Designed daily supply amount of water	= 1,112 cu.m
Effective Chlorine Contents	= 70 percent
Application Rate	= 0.7 ppm
1,112 × 0.7 ÷ 1,000 ÷ 0.70	= 1.112 kg/day

Torrijos Area

Income : P15/month H. hold × 1,415 H. holds × 12 × 0.8 = P203,760

Designed No. of H. holds	= 1,415 H.holds
Water Charges	= P15/H.hold/mont.
Effective collection rate	= 80 percent

Expenditure:

Direct Salary 2 persons × P1,500/month × 12	= P36,000
Chlorination Chemicals 0.498 kg/day × 365 Days × P138/kg	= P25,084
Present O/M Cost (Actual Cost in 1990)	= P65,000
Total :	P126,084

* One for intake and the other for chlorination plant, total two(2) shall be assigned, respectively.
* Estimation of Chlorination Chemicals required:

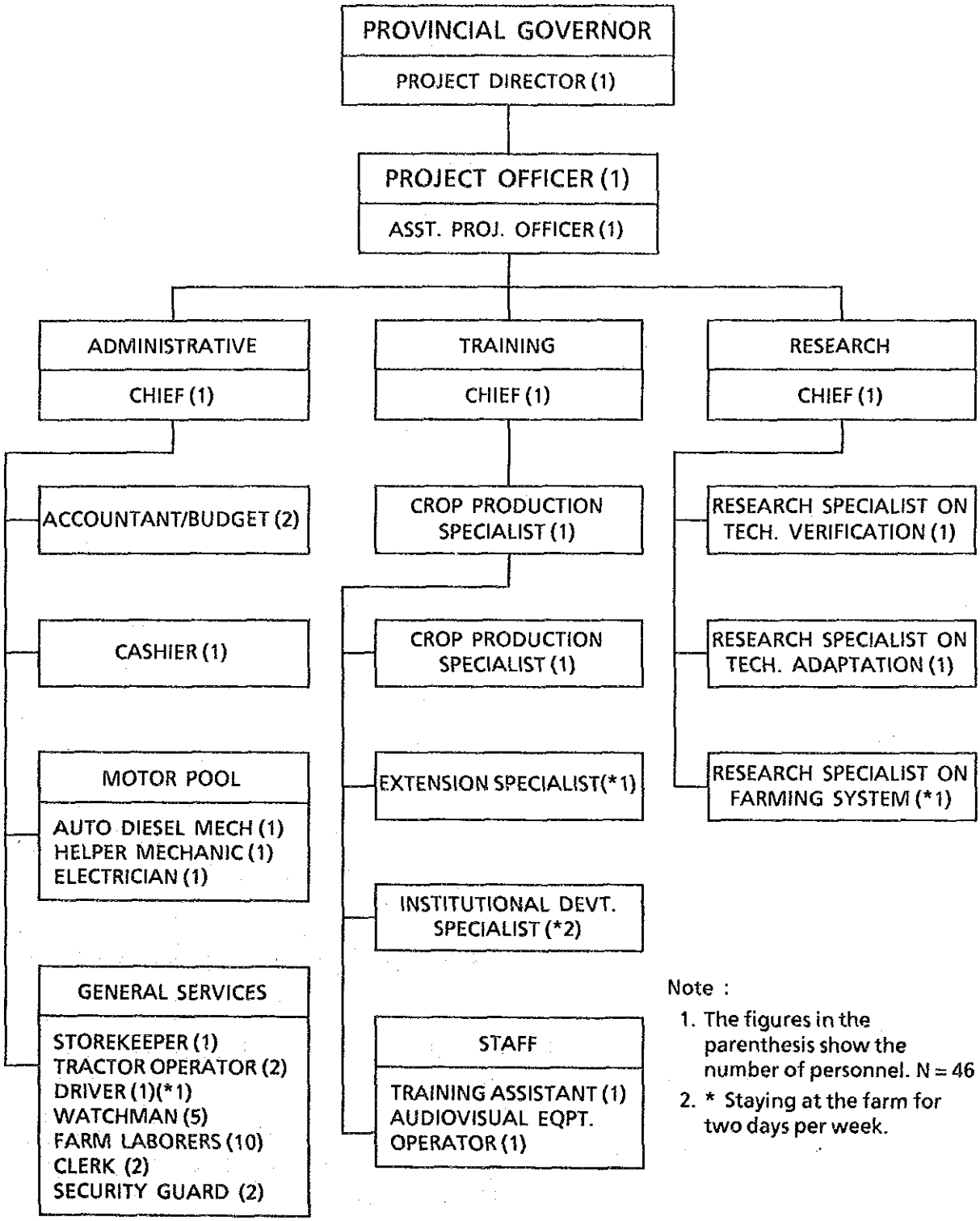
Designed Daily Supply Amount	:	498 cu.m
Effective Chlorine Contents	:	70 percent
Application Rate	:	0.7 ppm

498 × 0.7 ÷ 1,000 ÷ 0.7 = 0.498 kg/day

The Operation of the Marinduque Agricultural development Promotion Farm will be undertaken by a new organization with three divisions as shown in Figure 3-3. The organization has 46 of total personnel, including a director of the farm, six staff for training division, four staff for research division. The personnel requirements will be provided under the reorganization of the office of the provincial Training Center according to the national policy on decentralization of provincial government for the existing agricultural sector organizations, the Office of Provincial Agriculturist and the Marinduque Office for the Department of Agriculture (DA).

FIGURE 3 - 3 ORGANIZATIONAL CHART

MARINDUQUE AGRICULTURAL DEVELOPMENT AND PROMOTION FARM



Note :

1. The figures in the parenthesis show the number of personnel. N = 46
2. * Staying at the farm for two days per week.

The reorganization of the provincial Training Center to the Marinduque Agricultural Development Promotion Center is planned as follow;

TABLE 3-4 TRANSFER THE PERSONNELS TO THE MARINDUQUE AGRICULTURAL DEVELOPMENT PROMOTION FARM

Section	Present			Plan		
	Office&Others	Farm	Total	Office&Others	Farm	Total
DA Office, Marinduque						
Prcl Officer/Agriculturist	1	0	1	1	1	2
Planning	3	0	3	2	1	3
PAIMS	2	0	2	1	1	2
Administration	13	0	13	9	4	13
Operation	8	0	8	6	2	8
Agricultural Technology	6	0	6	6	0	6
Research	4	0	4	2	2	4
Municipal Agr'l Office	32	0	32	32	0	32
Brackishwater Demonstration Fish Farm Livestock Breeding Station and so on	18	0	18	18	0	18
Sub-total	87	0	87	77	11	87
Office of Prov' Agriculturist						
Administration	5	0	5	0	5	5
Nursery	9	0	9	0	9	9
Operation Extension	17	4	18	18	0	18
Prov'l Training Center	0	3	3	2	1	3
Sub-total	28	7	35	20	15	35
Total	115	7	122	99	27	123

Note: 1) The number of personnels for the office and others means the personnels who move outside the farm

2) As the Provincial Governor will be currently the project Director, there is no additional staff for both offices.

The organization of the Marinduque Agriucltural development Promotion farm is shown in the following;

- Project Director: The provincial Governor will concurrently assume this position.

- Project Officer : Undecided, (the Provincial Agricultural Officer will be concurrently the Project Officer)

- Training Section : Including three specialists as trainers, one assistant of trainer, one assistant of trainer and one audio-visual equipment operator. It may be possible to transfer the staff of DA provincial office for these position. Aside-from these staff, other three staff of DA provincial office will be assigned two or three days a week, who will take in charge of the training on extension method / technology, organization of farmers' organizations and development of cooperatives.

- Research Section : Comprised of four staff; a section chief and three research specialists, respectively for technology verification, technology adaptation and farming systems. In the existing organization of DA provincial office for research and that of the Office of Provincial Agriculturist, there are three or four competentes for tasks exclusive of a researcher of farming system. A DA provincial office staff is planned to be assigned for the researcher of farming system.

- Administrative Section : Including a section chief, two office staff, two clerks, three workshop staff, two tractor operators, two drivers, one storekeeper and five watchmen. It is considered that all staff could be transferred from the existing organizations of both offices after reorganization of the Office of Provincial Agriculturist.

It is considered that about fifteen million pesos of the current provincial government budget in 1991 will be increased by two to three times of the amount after decentralization. The 1991 budget of the DA provincial office amounts to 5,972,000 pesos including those for the budgets of crop production, animal husbandry, soils investigation and so on. On the other hand the budget of the Office of Provincial Agriculturists is 2,474,000 pesos. The total amount of both budgets is 8,446,000 pesos. The total expenditure of the proposed farm estimated at 3,150,000 pesos about 37 percent of the total amount of both budgets. Taking into account the necessity of agricultural development project, and the expected increase in the provincial budget, it may have little problem for the provincial government to bear the expenditure. Furthermore, if it is considered that the new staffing of the Marinduque Agricultural Development Promotion Farm will be formed by transferring the required number of staff from the existing two agricultural offices, the net increase of expenditure is accounted for the expenditure exclusive of the personnel expenses, being 583,000 pesos (about 6.9 percent of the total budget of both offices).

(Unit : peso)

Items of Expenditure	DA Provincial Office	Office of Provincial Agriculturist	Proposed Farm
Salary & Wages	4,918,000	1,781,000	2,567,000
Administrative	28,000	217,000	25,000
Operation	534,000	203,000	90,000
Facilities	152,000	83,000	60,000
Training	-	10,000	22,000
Project	112,000	-	-
Regulatory	103,000	-	-
Research	125,000	-	103,000
Others	-	180,000	240,000
Total	5,972,000	2,474,000	3,107,000

3. 2. 3 Examination / Review on Similar Natured Projects and Relations with the Other Projects Assisted by International Aid Institutions

In the Island of marinduque, there are irrigation development projects of SWIM and Communal Irrigation Project categories, but there is none of project which is directly concerned with the subject project. In the field of agricultural extension, there is a similar project in Gasan as assisted by the

United Nations. This project aims at agricultural technology extension for a program to increase the farmers' income. The project can be outlined as the followings.

Gasan Agricultural Extension Project

① Organization and Expert
Consultant dispatched by UN
(Livestock Expert from Bangladesh)

② Project Components
- Poultry raising
Technical guidance for 100 - 200 each chicken production at 3 villages in Gasan District (US$4,000 .... project cost)

- Handicraft production (Bamboos and rattan) and vegetable production
Guidance for 4 farmers' group (5 - 10 members for 1 group) in the other 3 villages in Gasan

The project involves the limited scope in poultry raising, handicraft production and vegetable production in a limited area and not including any research and testing. For the concern with the present project, agricultural development promotion especially for vegetables would be important aspect.

3. 2. 4 Examination on Project Components

In terms of the fields of development, the subject project consists of ①reinforcement of agricultural development promotion farm, ②consolidation of rural agri-infrastructures, ③rehabilitation of roads and ④rural water supply. Area-wise, the project involves in Sta. Cruz and Tagum-Augas areas in Sta. Cruz Municiplity, Laon-Mataas area in Mogpog Munipality and Torrijos area in Torrijos Munipality. Development plans included in the Project can be summarized as follows.

Sta. Cruz and Tagum-Angas Areas

- Irrigation development for 630ha area by means of dam and irrigation canal
- Rural water supply for Sta.Cruz area
- Rural water supply facilities (Level 2) along the pipe line
- Road rehabilitation
- Construction of multipurpose road pavement
- Reinforcement of agricultural development and promotion farm

Laon-Mataas Area

- Irrigation development for 175ha area with a diversion work and irrigation canal

Tarrijos Area

- Rural water supply for Torrijos area
- Rural water supply facilities (Level 2) along the pipe line

As for Sta. Cruz and Tagum-Angas areas, the Project aims at construction of main and lateral irrigation canals for conveyance of irrigation water as developed by the storage dam, introducing of irrigated agriculture through applying improved farming techniques as experimented by the Agricultural Development and Promotion Farm, rehabilitation of road facilities which would be needed for activated farming practices and construction of multipurpose road pavement which can be used for products transportation as well as drying of farm products especially rice. The water developed by the dam would be used as supplemental water source for rural water supply for Sta. Cruz area where people are suffering from the shortage of rural water supply. The water pipeline from the dam to Sta. Cruz will pass through Tagum-Angas area and public faucet are planned to be installed for the supply of water to Barangays on the way. In view of the above, the development plans for Sta. Cruz and Tagum-Angus areas are considered as an integrated regional development centering on dam construction.

Under the subject project, development for Laon - Mataas area involves only the construction of irrigation facilities. As Laon - Mataas area extends around Mogpog where national road and provincial road cross each

other at the center, the development plan is considered as an supplemental plan to the regional development plan.

While for Torrijos area, the development plan aims at improved rural water supply to Tarrijos area and Barangays located on the way, where the supply is in shortage at present.

As examined in the foregoings, the overall development plan under the subject project and the components are considered adequately justifiable.

3. 2. 5 Examination on Requested Facilities and Equipment

1) Requested Facilities

a) Agricultural Development and Promotion Farm

- Rehabilitation of the 7.5 ha agricultural development farm operated by the Provincial Government of Marinduque and expansion of related facilities

b) Agri-infrastructures consolidation

- Construction of Tagum - Angas irrigation facilities
- Construction of Laon - Mataas Communal Irrigation Project
- Construction of Tawilan Communal Irrigation Project

c) Road facilities rehabilitation

d) Rural water supply

- Sta. Cruz rural water supply system
- Torrijos rural water supply system

In view of the project targets as stated below, construction of all these facilities as above is judged to be quite necessary.

- Increased farmers' income through increased farm production as caused by introducing of irrigated agriculture

- Rationalization of post-harvest handling (especially drying) and product marketing
- Improved rural water supply
- Raising-up of people's standard of living
- Stabilization of people's livelihood

Among the facilities requested to be constructed under the subject Grant Aid Project, however, the construction for Tawilan irrigation facilities has been already commenced by the NIA, leaving at present some remaining works of rip-rap protection and gate installation for the diversion dam. For this sake, the NIA secured a budget (789 thousand pesos) under the 1991 budget and the Governor of Marinduque Province officially informed to the JICA Team of excluding the construction of Tawilan Communal Irrigation Project from the subject project. Further, concerning with the road facilities, there are some routes which can be substituted by O/M road for irrigation canal and traffic volume is rather limited, and detailed study/review would be discussed in the following chapter for Basic Design.

3. 2. 6 Basic Policy Line for Cooperation

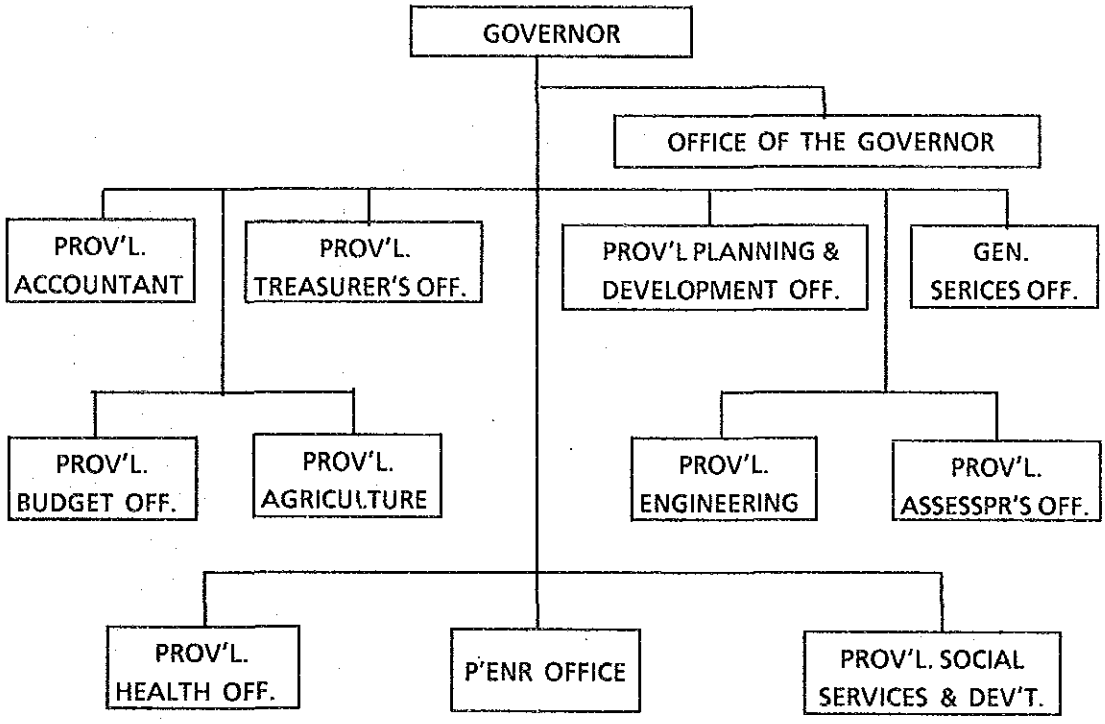
Through the examinations / reviews on various aspects of the subject project plan as detailed above, the project effects and benefits and possibility of realization as well as capability of Executing Agency and other Agencies concerned of the Government of the Philippines has been affirmatively confirmed. Further, as the project effects and benefits as planned are considered adequately meeting with the system of the Grant Aid Program by the Government of Japan, it is appropriate to proceed to Basic Design, assuming that the subject project would be implemented under the Grant Aid Program by the Government of Japan as requested. Components of the project requested would, however, be modified partly as described in the foregoings.

3.3 PROJECT DESCRIPTION

3.3.1 Executing Agency and Operational Structure

The executing agency for the Project is the provincial Government of Marinduque, whose organization chart is given in Figure 3-4 below.

FIGURE 3-4 ORGANIZATION CHART OF MARINDUQUE PROVINCIAL GOVERNMENT



The Provincial Governor has a responsibility for execution of the Project, although the Project consists of the construction of irrigation facilities, rehabilitation of road, construction of water supply facilities and reinforcement of agricultural development & promotion farm. However, operation and maintenance bodies for those works are as tabulated below:

- Tagum-Angas Irrigation Facilities ..... NIA (Dam)
  Irrigator's Association
- Laon-Mataas Irrigation Facilities ..... Irrigator's Association
- Road ..... Provincial Engineering Office
- Sta. Cruz Water Works ..... Sta. Cruz Water Supply

- Torrijos Water Works ..... Torrijos Water Supply

3. 3. 2 Plan of Operation

1) Irrigation Plan

a) Tagum-Angas Irrigation Facilities

The target yield of the paddy is expected at 4.0 ton/ha, from the present yield at 1.2ton/ha. Target crop production are estimated as shown in Table 3-5.

TABLE 3 - 5 CROP PRODUCTION (TAGUM-ANGAS)

Crops	Area (ha)	Yield (ton/ha)	Production
Paddy (Rainy Season)	480	4.0	1,920
Paddy (Dry Season)	408	4.0	1,632
Sub-Total	888		3,552
Mung-Bean	45	1.1	50
Peanut	45	1.7	77
Corn	30	1.5	45
Vegetable	90	18.0	1,620
Root Crops	30	10.0	300

b) Laon-Mataas Irrigation Facilities

Net irrigable area of Laon-Mataas irrigation Facilities is planned as 175ha. Cropping area at rainy season is 175 ha and 70 ha for dry season. This irrigation facilities is planned as mono crop of paddy. The production plan for this project is given in Table 3-6.

TABLE 3 - 6 CROP PRODUCTION (LAON-MATAAS)

Crops	Area (ha)	Yield (ton/ha)	Production
Paddy (Rainy Season)	175	4.0	700
Paddy (Dry Season)	70	4.0	280
Sub-Total	245		980

2) Water Supply Plan

a) Sta. Cruz Water Supply Facilities

Sta. Cruz Water Supply Plan is to supply the supplemental water for Sta. Cruz poblacion which water supply system troubled as shortage of water to supply the drinking water as level 2 to the barangays on the way to Sta. Cruz.

Projected population and water supply demand is tabulated in Table 3-7 below:

TABLE 3-7 WATER SUPPLY PLAN (STA. CRUZ)

Name of Barangay	Present Population (Person)	Water Supply Population (Person)	Projected Population, (Person)	Water Consumption Rate (LPCD)	Average Day Demand (m^3/day)
Sta. Cruz	8,111	8,111	7,638	100	764
Buyabod	2,011	1,608	1,849	60	111
Matalaba	1,028	925	1,064	60	64
Tawiran	1,070	856	984	60	59
Farm	-	-	100	300	30
Napo	1,478	(1,223)	(1,406)	60	(84)
Tay tay	1,292	(838)	(964)	60	(58)
Total	14,990	(12,723)	(13,041)		(1,112)

Note : LPCD ····· liters per capita per day
( ) ..... For future supply plan but included in demand projection.

b) Torrijos Water Supply Facilities

Torrijos Water Supply Plan is to supply the supplemental water for Torrijos poblacion and supply the drinking water as level 2 to the barangays on the way to Torrijos. Projected population and water demand is calculated as shown in Table 3-8 below:

TABLE 3-8 WATER SUPPLY PLAN (TORRIJOS)

Barangay	Present Population (Person)	Water Supply Population (Person)	Projected Population, (Person)	Water Consumption Rate (LPCD)	Average Day Demand (m^3/day)
Poctoy	(727)	(548)	(630)	(60)	(38)
Marlanga	1,157	975	918	60	55
Torrijos	2,074	2,074	1,953	100	195
Buangan	1,314	864	994	60	60
Cubuyo	1,458	981	1,128	60	68
Tigwi	1,987	1,739	2,000	60	120
Total	8,717	7,181	7,623		536

Note : LPCD ····· liters per capita per day
( ) ..... For future supply plan but included in demand projection.

3) Development of Agricultural Technology

It is planned that two kinds of activities on development of agricultural technology, namely field trials and training, will be undertaken at the Marinduque Agricultural Development and Promotion Farm (MADPF) . The details of the activities are as follows:

a) Field Trials

Following eight kinds of major filed trials will be conducted at MADPF;

- Field trials on irrigated paddy production
- Field trials on corn production
- Field trials on groundnut and beans production
- Field trials on industrial crops production
- Field trials on irrigated vegetables
- Field trials on coconut multi-storey cropping
- Field trials on soils/soil profile improvement and irrigation of upland crops
- Field trials on crop rotation, mixed cropping and packaging of production technology

The activities of the above field trials will be conducted at the field trial farm and research room. The cropping pattern, which will be applied in the filed trial farm is as shown in Figure 4-1.

b) Training

The training activities will be conducted for all Agricultural Technologists and farmers' leaders in Marinduque. The training for Agricultural Technologists will be held every five days during from January to April, based on the four year training program. For 109 leaders of farmers' groups in the proposed irrigation project area, three training classes are organized to conduct the training, following the training program in Table 3-9.

3. 3. 3 Location and Condition of Project Site

1) Tambangan Dam & Reservoir

Proposed dam site is located at down stream of the meandering of the Tambangan river. The undercut slope side is steep slope more than 40°and there is cliff having exposed rock, partly. The slip-off slope side of the river has gentle slope except slope base.

Plants in the reservoir area is coconuts mainly, and they plant the cassava partly. Under the 35 meters in elevation, ruins or natural monuments are not be found and no special birds or animal be found. Area of proposed reservoir area is measured as 34 ha, and the reservoir area is private land except river.

2) Tagum-Angas Irrigation Canal

One third of total canal length is planned to be constructed on the traces of old irrigation canal, and other part, proposed canal alignment soil pass the gentle slope of hilly side.

3) Laon-Mataas Irrigation Communal Irrigation Project Area

Proposed diversion dam site is located at the connection point with National Road between Mogpog and Sta. Cruz. Irrigation canal alignment is located at the boundary between paddy field and non.cultivable land mainly which is selected by the NIA.

TABLE 3 - 9 COURSE AND SCHEDULE OF TRAINING

Course \ Year / Month	First Year												Second Year												Third Year												Forth Year												Total
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
A. Training by ADPP																																																	
1. Training of Agri' l Technologists																																																
(1) Extension methodology	5																																															
(2) Improved POT on irrigated rice		5																																														
(3) Soil Amendment and fertilizing			5																																													
(4) POT on vegetables				5																																												
(5) POT on corn													5																																			
(6) POT on rootcrops														5																																		
(7) POT on fruit trees															5																																	
(8) Swine and goat production *																5			x																													
(9) On-farm water management *																									5																							
10) POT on mungbeans and other legumes																										5																						
11) Sloping agricultural land technology																											5																					
12) Carabao and cattle production *																												5																				
13) Irrigation of field crops																																					5											
14) Coffee and other industrial crops																																						5										
15) Poultry production *																																							5									
(16) Farming system including crop rotation and farm mechanization																																								5								
Sub-total	5	5	5	5									5	5	5	5									5	5	5	5									5	5	5	5								80
2. Training of Farmers Leaders in teh IADP area																																															
(1) POT on Irrigated rice FAP	3																																														
CL		3	3	3																																										
(2) Seed production All members					3																																										
(3) POT on vegetable production FAP									3																																						
CL										3	3	3																																		
(4) POT on corn production FAP													2																																		
CL														2	2																															
(5) POT on rootcrop production FAP																																					2										
CL																																						2	2								
(6) POT on fruit production FAP																									3																						
CL																										3	3																			
(7) Coconut multiple cropping FAP																	3																													
CL																		3	3																											
(8) Ducks and chicken production * FAP																				2																										
CL																					2	2																							
(9) Swine production * FAP																																	2														
CL																																		2	2											
(10) Carabao and cattle production * FAP																																									2						
CL																																									2	2	2				
(11) On-farm water management * FAP	2												1													1												1										
CL		2	2	2										1													1												1									
Sub-total	5	5	5	5	3				3	3	3	3	3	3	2			3	3	3	2	2	2		3	4	4								2	2	2	3	3	2					2	2	2	2	91
3. Training of Farmers Leaders Outside IADP Area																																															
(1) POT on Irrigated rice														3	3											3	3												3	3								
(2) Seed production																3												3												3							
(3) POT on corn production																			2	2												2	2										2	2			
(4) POT on vegetable production																																3	3										3	3			
(5) POT on rootcrop production																																		2	2										2	2	
(6) POT on fruit production																																		3	3										3	3	
(7) Coconut multiple cropping																																						2	2								
(8) Swine production *																																						2	2								
(9) Carabao and cattle production *																																									2	2					
10) Ornamental plant production																																											3				
Sub-total														3	3	3				2	2					3	3	5	2	5	4	7	5	5	6	6		3	6	5	2	5	4	7	5	5	5	101
Total	10	10	10	10	3				3	3	3	3	5	11	10	8		3	3	5	4	2	2		8	12	12	10	2	5	4	7	5	7	7	2	8	11	10	10	2	5	4	7	7	7	2	272
B. Assembling of Farmers' Organization																																															
(1) IAs in the IADP area		1	1										1	1											1	1											1	1									
(2) RIC in the IADP area			1											1												1											1									
(3) 4-H Club in the IADP area			1											1												1											1									
(4) PAFC monthly meeting	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(5) PAFC consultation/congress		2												2												2												2									
(6) RIC Federation conference			2												2												2												2								
(7) 4-H Club Federation conference				2												2												2												2						
(8) Seed growers conference	1			1			1			1			1			1			1			1			1			1			1			1			1			1			1			1	
(9) MAFC monthly meeting	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(10) IRF Provincial Implementing Team conference	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
(11) Program planning (Provin'l Office)																																															
(12) Personnel conference (Provin'l Office)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sub-total	5	7	9	7	4	7	5	4	4	5	4	4	5	7	9	7	4	7	5	4	4	5	4	4	5	7	9	7	4	7	5	4	4	5	4	4	5	7	9	7	4	7	5	4	4	5	4	4	260
Grand Total	15	17	19	17	7	7	5	4	7	8	7	7	13	18	19	15	4	10	8	9	8	7	6	4	13	19	21	17	6	12	9	11	9	12	11	6	13	18	19	17	6	12	9	11	11	12	11	6	532

Note: * ... by other agencies, POT ... package of technology, PAFC/MAFC ... Provincial/Municipal Agriuculture and Fishery Council, FAP ... Farmers' Association President, CL ... Contract Leader, IRF ... Integrated Rural Financing, RIC ... Rural Improvement Club

4) Road and Water Supply Facilities

Proposed site for water treatment plant is located at present paddy field. Construction of water supply pipe line is planned to locate along the road. Some part of pipe line alignment in the Napo and Sta. Cruz is under concrete pavement road, and other part, pipe laying works will be carried out at the gravel pavement or no pavement (shoulder of road).

3. 3. 4 Outline of Facilities and Equipment

1) Facilities

a) Reinforcement of Agricultural Development and Promotion Farm

- Construction of Farming Land ..... 3.7 ha
- Construction of Road ..... 1.6 km
- Construction of Irrigation Canal ..... 300 m
- Construction of Administration Building 1
- Procurement of Equipment for Laboratory Training and Cultivation ..... 1 lot
- Rehabilitation of Existing Building(W.C) 1

b) Tagum-Angas Irrigation Facilities

- Construction of Tambangan Dam 1
- Construction of Feeder Canal ..... 1.8 km
- Construction of Irrigation Canals ..... 16.4 km
- Construction of Turn-Out 30
- Other Related Facilities ..... L.S.

c) Laon-Mataas Irrigation Facilities

- Construction of Diversion Dam 1
- Construction of Irrigation Canal ..... 5,944 m
- Other Related Facilities ..... L.S

d) Road Works

- Rehabilitation of Road ..... L.S.
- Multipurpose Road Pavement ..... 800 m

e) Sta. Cruz Water Supply Works

- Construction of Treatment Plant 1
- Construction of Pumping Station 2
- Construction of Pipe Line ..... 11,640 m
- Construction of Public Faucet 83

f) Torrijos Water Supply Works

- Construction of Pipe Line ..... 12,800 m
- Construction of Sterilization facility 1
- Construction of Public Faucet 33

CHAPTER 4. BASIC DESIGN

4.1 DESIGN POLICY

The design policies of the Project facilities such as Tambangan dam, diversion dam and irrigation canal, road, water supply system and agricultural development and promotion farm, as well as to consider the equipment required for the farm are as follows:

① Natural factors on the design of the facilities, especially the dam design (Design Flood, Seismic Force etc.), should be applied taking into consideration the locality of site.

② In selecting the types of structures, building, etc. the natural and social conditions of the project area will be fully considered. Especially the water intake and conveyance from the dam to the beneficial area will be applied in a suitable level of facilities for operation and maintenance.

③ For the design of structures, local construction methods shall be applied taking into consideration the participation of local contractor.

④ In the event that other construction equipment and/or materials cannot be procured from domestic procurement, foreign products will also be studied as an alternative on those possibilities, accessibility and qualities and then the design will be performed.

⑤ The level of the project facilities and/or degree of development shall be along those conditions mentioned above and locality.

⑥ The project should be implemented taking into consideration the framework of Japanese grant-aid programme, such as construction period, etc. Therefore, the dimension and scheduling of the river diversion works essential for the dam construction shall be examined carefully by analyzing the climatological and hydrological conditions of the area in detail.

4.2 STUDY AND EXAMINATION OF DESIGN CRITERIA

Conditions and criteria for the basic design and cost estimate of the Project are examined as follows:

4.2.1 Topographical Conditions (Materials)

Topographic map	S = 1/50000	(1988, NAMRIA)	: catchment area
do	S = 1/4000	(1991, JICA)	: reservoir capacity, dam layout, canal location
do	S = 1/10000	(1988, JICA)	: general layout
Profile, dam axis	S = 1/500	(1991, JICA)	: dam layout
Cross sections, dam	S = 1/500	(1991, JICA)	: basic design, dam
Profile, Tagum-Angas Canal	S = 1/4000	(1991, JICA)	: layout of profile, canal
Profile, Laon-Mataas Canal	S = 1/4000	(1991, JICA; NIA)	: layout of profile, canal
Profile, Sta. Cruz Water Supply	S = 1/4000	(1991, JICA)	: layout of profile
Profile, Torrijos Water Supply	S = 1/1000	(1991, PEO)	: layout of profile
Profile, Alakan-Angas Road	S = 1/1000	(1991, PEO)	: Consideration of road

4.2.2 Geological and Soil Conditions (Materials)

Master Plan study on the Integrated Agricultural Development Project in Marinduque (1990)

Result of investigations on the Basic Design Study of the Project (1991)

4.2.3 Building

Design will be, in principle, governed by the local codes of the Philippines:

- The National Building Code (Code),
- National Structural Code of the Philippines (NSCP),
- Philippine Electrical Code,
- Philippine Society of Mechanical Engineers Code,
- The Fire Code,
- Philippine National Standards for Construction Materials, and
- Other relevant Codes and Standards.

4. 2. 4 River Facilities (Dam)

1) Drainage Area

Based on 1/50,000 topo-maps, the drainage area at the Tambangan Dam site is estimated at 32.5 sq.km.

2) Storage Capacity/Intake Quantity

The Tambangan dam is for supplying irrigation water for 630 ha of beneficiary area in Tagum - Angus and for supplying domestic water for 14,000 people in Sta. Cruz and Tagum - Angus areas.

The required storage capacity of the Tambangan Dam is planned as follows.

Effective storage capacity	1,400,000 cu.m
Design sediment volume	1,000,000 cu.m
Total	2,400,000 cu.m

Allocation of storage capacity is as planned and shown in Figure E-1 of Appendix.

In determining the effective storage capacity, the third ranked drought year as obtained through a consecutive water balance computation on 25 years records was adopted, where the discharge data availed in the Master Plan study and the effective rainfall (80% of 1/5 years frequency) applied for C.I.P by PEO of Marinduque were used.

1st rank	Required storage	3,599,000 cu.m
2nd rank	Required storage	1,431,000 cu.m
3rd rank	Required storage	1,365,000 ≒ 1,400,000 cu.m

While, assumptions made for the above computation are as explained below.

Irrigation area

Rainy season	480 ha (Paddy field)	150 ha (Upland field)
Dry season	408 ha (Paddy field)	150 ha (Upland Field)

Domestic water ..... Throughout the year 1,490 cu.m/day
Ratio of repeating use of irrigation water 20%
Irrigation efficiency 64%
Evaporation (Reservoir surface) ..... 60% of evaporation at Boac

The maximum water intake from the dam is calculated as follows.

Irrigation water	:	Q = 0.858 cu.m/s
Domestic use	:	Q = 0.021 cu.m/s
Total	:	0.879 cu.m/s

3) Design Sediment Volume

Concerning the discharge of sand/sediment within the subject drainage area, there is no data/info. available. Based on the field investigation, however, vegetation in the area is rather excellent mainly of coconut trees.

Geologically, the drainage basin is of Tertiary period where andesite is the base rock, and there is no chance for land sliding. The Tambangan River flowing down the drainage area has about 12 km river length at the dam site and the slope is observed as follows.

Upper stream section	1/30
Middle reach section	1/50
Lower stream section	1/160
Average (as a whole)	1/40

Based on the above, the unit sediment volume of the dam was assumed to be 300 cu.m/sq.km/year, and the total volume of 1,000,000 cu.m for 100 years period is taken into account.

4) Design Seismic Force

As the Island of Marinduque is located on the Pacific Ocean Earthquake Zone, attention should be paid to possible effect of seismic force on

structures. Earthquakes occurred in and around Marinduque seem to be caused mostly by structural movement being active along Visayan and Mindanao landmass, and therefore, the effect is not negligible in dam design.

Under the present survey, data on earthquake (1989 - May 1991) have been availed in addition to the NIA data (1907 - 1988) and analysis was made as follows.

Analysis results are as shown in Table E-1, Figure E-2 and Figure E-3 of Appendix.

- Additional data collection (1907 - 1991)
- Selection of 95 earthquakes occurred within 350 km radius from the dam site at Tambangan (East Longitude 122.07° and North Latitude 13.39°) and compute the Gal.
- The Gal values be put in order of higher value and co-relations between the rank / year and Gal value be plotted on Logarithmic Table to gain Gal values corresponding to the frequencies as examined.

The results are as shown below.

10	Year frequency	Gal	60	Equivalent Design Seismic Force	0.061≒0.07
20	〃		85	〃	0.087≒0.09
50	〃		116	〃	0.118≒0.12
100	〃		141	〃	0.144≒0.15

In the Philippines, design criteria on seismic force is yet to be arranged and through due consultation with NIA, 100 years frequency is to be adopted, and design seismic force of K = 0.15 is applied for design of Tambangan Dam.

5) Dam Design Flood Discharge

The drainage area of Tambangan Dam is 32.5 sq.km. There is a design criteria concerning the design flood discharge as arranged by the Department of Public Works. The criteria classifies the rainfall runoff to be 4 patterns as ① Frequent, ② Occasional ③ Rare and ④ Seldom and specifies a formula to estimate flood runoff with drainage area as a function. There is also Creager's

formula widely applied in the world, where non-graded ranking can be made up depending on the Coefficient C involved in the formula.

The design flood discharge for the subject Tambangan Dam has been fixed at 724 cu.m/s based on the Creager's formula (C = 75) through the analysis made on probable daily rainfall and flood traces in addition to the estimate made based on the said 2 formulas.

Further in detail, the estimation manner of design flood discharge is discussed as follows.

① Taking into account the scale of dam, when employing the pattern Rare case of the criteria by the Department of Public Works, the maximum design flood discharge is computed to be 723 cu.m/s.

② Climates in the Philippines are classified into four (4) types. When the coefficient of Creager's formula C = 75, which has been adopted for a dam in Bohol Island being presently under construction and the climate there is similar to the subject Tambangan site, be applied, the maximum design flood discharge is computed as 724 cu.m/s.

③ There is no rainfall data covering a long term in Marinduque. When 1/1,000 year frequency flood discharge is estimated based on the rainfall data at Tayabas (About 85 km N-W from Tambangan) where comparatively long term data are available, the result comes out as 688 cu.m/s.

④ Typhoon Herming attacked the Island of Marinduque on August 13, 1987 and brought about considerable damages. By investigating the then flood traces and interviewing the aged people in related localities, estimation was made to come out 252 cu.m/s of flood discharge.

⑤ In view of the above, the maximum flood discharge of 724 cu.m/s as derived from the Creager's formula was taken as the design flood discharge under the subject Tambangan Dam.

The maximum discharge through the spillway (design flood discharge for spillway) was estimated to be 590 cu.m/s. This specific flood discharge was compared in Figure E-4 in Appendix with the other specific flood discharges of other dams planned and constructed by NIA. As can be seen from the figure, the flood discharge for the subject Tambangan Dam is generally higher than the others.

6) Irrigation Canal

① Location of irrigation canal will be selected along the existing canal taking into consideration the getting the right of way.

② Designed water elevation of canal should be considered as the required water level from farming area.

7) Rural Water Supply

Design of rural water supply facility shall be carried out by the Rural Water Supply Design Manual which is provided by National Water Resources Council, and important figures for the design be described as follows:

① Design Population for water supply
= 1.15 × present population

② Water Consumption Rate:
Public Fancet System (Level II) = 60 LPCD
Household Connection (Level III) = 100 LPCD
* LPCD = liters per capita per day

③ Average Day Demand
= Design Population × Water Consumption Rate

④ Maximum Day Demand
= 1.30 × Average Day Demand

⑤ Maximum Hour Demand (cu.m/hour)

$$= \frac{2.5 \times \text{Average Day Demand}}{24}$$

4.3 BASIC PLAN

4.3.1 Agricultural Development and Promotion Farm

1) Land Use Plan

Proposed site for the agricultural development and promotion farm is existing Tamayo training farm which is located at Barangay Tamayo having 6.5 ha. Following manner is applied for the allocation of building zone, farm, road and irrigation canal.

① Standard farm' is planned at long toward west-east due to farm having slope toward north.

② Building zone is to be located at higher elevation part.

③ Existing coconut area will be used as it is.

④ Paddy farm is located at lower elevation part.

Layout of the Farm is shown in DWG No. 20, and area of each zone is described as follows.

①	Building zone	1.0 ha
②	Farm Paddy	1.3 ha
	* Upland crop	0.6 ha
	* Coconut	1.8 ha
③	Road and Canal	1.4 ha
④	Unused Area	0.4 ha
	(For future expansion)	
	Total	6.5 ha

2) Field Trial Plan

The object of field trials is to generate the following items through the use of production technology in order to verify the technology, these

investigation are generally developed by regional and central organizations of agricultural experimentation;

* Package production technology of irrigated paddy (varieties, nursery, planting distance, fertilizer application, soil improvement, pest control and other forms of cultivation technology)

* Package production technology of corn (varieties, nursery planting distance, fertilizer application, soil improvement, pest control and other forms of cultivation technology)

* Package production technology of groundnut and beans (varieties, planting distance, fertilizer application, soil improvement, pest control and other forms of cultivation technology)

* Package production technology of industrial crops like arrowroot and ubi (varieties, nursery, planting distance, fertilizer application, soil improvement, pest control and other forms of cultivation technology)

* Package production technology of irrigated vegetables (varieties, nursery planting distance, drafting, pinching / training, fertilizer application, soil improvement, pest control and other forms of cultivation technology)

* Coconut multi story cropping

* Soil and soil profile improvement and irrigation of diversified crops/upland crops

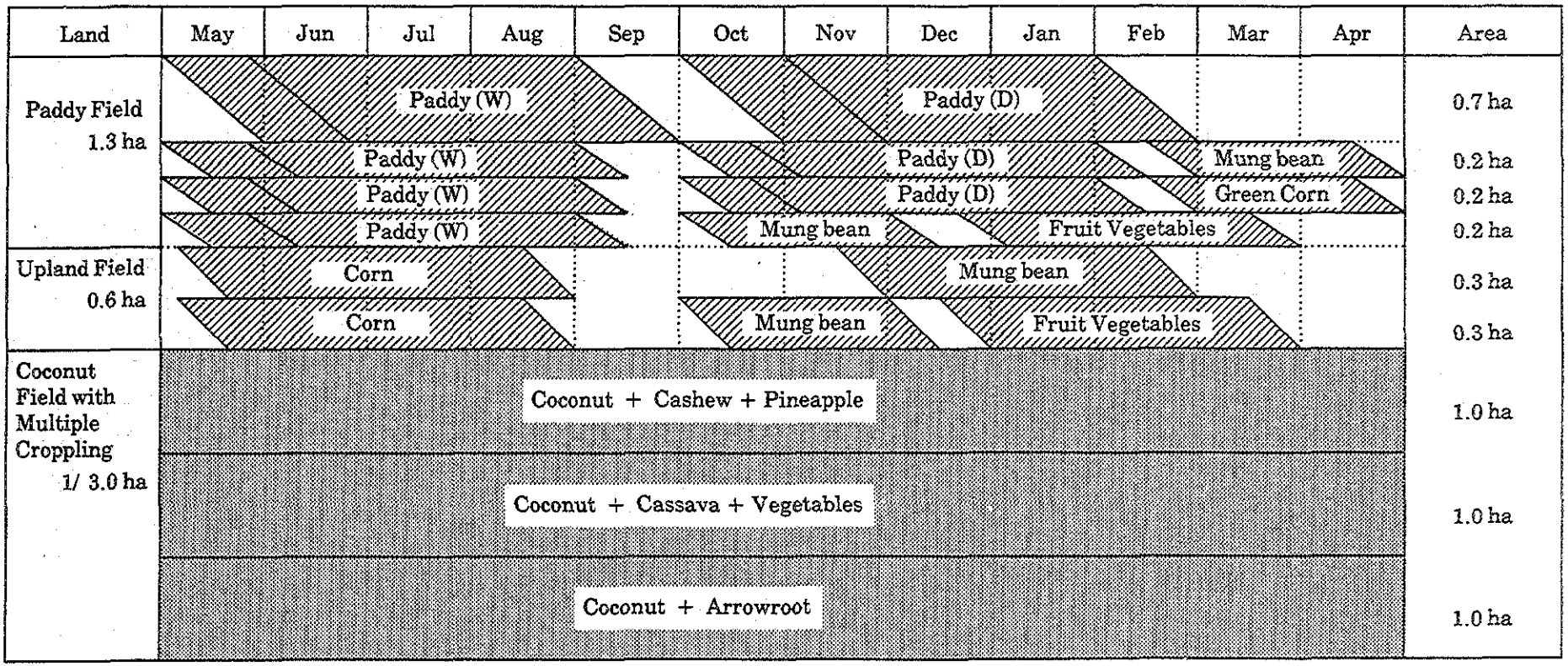
* Crop rotation, mixed cropping and packaging technology

6.5 ha of land has been acquired to establish a farm by the provincial government. Aside from the land, the government got a few hectares of coconut land for the field trials of coconut multistory cropping in the adjacent area of the farm. The scale of field trial is the available cultivation area in the

farm and the rented land. Such cropping patterns as shown in Figure 4-1 will be applied in these land.

The total area of trial farms in farms of net cultivation area accounts for 4.9 ha, comprising of 1.3 ha of irrigated paddy field, 0.6 ha of upland field, 3.0 ha of coconut area. In the irrigated paddy field, the field trials will be conducted to verify the applicability of cultivation technology on irrigated crops of paddy, beans, fruit vegetables (varieties, nursery, planting spacing, fertilizer application, soil improvement, pest control and other forms of cultivation technology) and to generate a package of production technology on the basis of a verification test. The research on farming system improvement with an introduction of the recommended package technology also includes the activities of a farm. Along with the above mentioned research activities, the other field trials on cultivation of irrigated diversified crops, upland crops and on the cultivation of multistory coconut cropping (irrigated and unirrigated) is required. For this purpose, farming technique is essential. The field trials will not only serve for research but also for exposing the respective and package technology amongst farmers and extension staff through training on practical technology in the field. It is required to have following items of survey and experiment to carry out the research.

FIGURE 4-1 CROPPING PATTERN IN MADPF



Note : 1/ Including 1.2 ha of land out of the proposed farm.

ITEMS OF SURVEY AND EXPERIMENT

Item of Survey/Experiment	Description
A. Basic data collection and analysis	
* Agroclimatological survey	collection and analysis of agroclimatic data at farm
* Water and soil survey	collection and analysis of water and soils for farm
* Pest survey	collection and analysis of major insects and diseases damage
B. Technology verification trials	
* Variety and yield trial	test on varieties and productivity
* Fertilizer trial	test on improvement fertilizer application
* Irrigation trial	test on irrigation method and water amount
* Spacing and ridging trial	test on spacing and ridging height and so on
* Pest control trial	test on pest control method including ecological control soil acidity, phosphoric deficiency and so on
* Trial on soil profile improvement	test on soil profile improvement (improvement of soil air and water permeability, rapid composting and so on)
* Trial on farm mechanization	test on deep plowing and use of small machineries and so on)
C. Technology adaptation trial	
* Trial on package technology	packaging of technology with yield test
* Survey on quality	quality test of farm products
* Survey on cost and return	test on cost and return
* Survey on adaptation of package technology	test on adaptation of package technology by farmers
D. Survey on farming system development	
* Trials on multiple cropping and crop rotation	survey on cropping intensity and sustainability of soil fertility and so on
* Survey on farm management improvement	survey on improvement of farm management

The above survey and experiment for water and soils and basic irrigation test need physical and chemical analysis of water and soils, which require high level of technology with a variety of experimental equipments. Therefore, these analysis are done in the concerned research organization where only sampling of materials are taken by the staff of farm under the instruction of staff of the organization. Therefore only simple equipments relating to the following observation and analysis are required to install at the farm;

* Observation of agro-climatological data
  Rainfall, wind direction/velocity, evaporation, temperature, humidity.

* Soil sample analysis
  Soil colour, soil particle, three phase of soils, soil acidity, electric conductivity, total nitrogen amount, other simple analysis by soil test kits.

* Observation on soil moisture
  Soil moisture test in the fields

* Population of major insects and fungus
  Observation on insect population and identification of fungus by microscope

* Observation on crop growth
  Number of tillers, plant height, number of leaves, number of panicles, number of root product

* Survey on yield
  Measurement of yield by experimental plot, yield component (number of panicle, number of grains per panicle, rate of ripening grains, weight of one thousand grains)

* Seed test
  Content of seed moisture, purity of seeds, rate of germination, weight of grains

* Production of fungus for rapid composting and root nodule bacteria Production of fungus activator and root nodule bacteria for distribution to farmers

3) Training Plan

To transfer the developed package of technology and other knowledge and skills to the farms leaders, a training program is prepared to train agricultural extension staff and farmers in Marinduque. There are forty extension staff, namely 26 staff in the DA local Office and 14 staff in the Office of Provincial Agriculturist. About the farmers' leaders, there are about 95 farmers leaders for 1,900 farm households in the proposed irrigation project area of the Tagum - Angas area and the Laon - Mataas area including the adjacent Tawiran irrigation project area as shown below;

TABLE 4-1 ESTIMATED NUMBER OF FARMERS' LEADERS

Area	Extension Area		Nos. of Group Leaders	
	Nos. of Barangay	Nos. of Farm Household	Nos. of Farmers' Association	Nos. of Irrigators Group
Tagum-Angus Area	8	1,086	8	54
Laon-Mataas Area	5	663	5	35
Tawiran Area	1	111	1	6
Total	14	1,890	14	95

Source : DA, NIA Marinduque

One of the most basic farmers' association is Irrigators' Group which consists of about 20 beneficiaries on the average in each unit body of operation and maintenance organization of irrigation system at terminal level. Therefore, each leader of Irrigators' Groups are regarded as the above said farmers' leader. It is considered that the trained farmers' leaders have the obligation to hand down the technology and skills among the member farmers. There are 95 of farmers' leaders in the project area. Aside from the Irrigators' Group, a Farmers' Association are organized in each Barangay, which has a elected president. There are 14 of the presidents of total Farmers' Association, who are added to the number of the farmers' leaders because it is considered that mobilization of Barangay into the agricultural extension activities is essential. Then 109 of farmers' leaders amounts for the total number of trainee.

One class has forty trainee, the same number of agricultural extension staff to be trained at the farm. Referring to the number of seating capacity per class is forty pupils for the primary school in Japan and also 35 to 40 pupils and 40 to 45 pupils per class respectively for elementary school in rural and urban areas in the Philippines. So the said 40 trainee per class is reasonable. 109 of the trainee for farmers' leaders are divided into three groups and each class has 32 of trainees.

The agricultural extension staff will be trained according the four years training program as shown in Table 3-10. The training are held annually for four months during January to April with twenty of training days, avoiding the busiest season of extension activities from May to December. Adding to the subject of the developed package technology and the practical knowledge, the training of other subjects related to the technology is included in the program. The major items of subjects and their training purpose are as shown in the below;

TRAINING SUBJECTS AND PURPOSE OF TRAINING

Subject	Purpose of Training
* Extension method and technology	to improve the extension method and technology,
* Package technology of irrigated paddy cultivation	to develop production technology on irrigation paddy cultivation
* Seed production	- do -
* Irrigation method	- do -
* Package technology of irrigated vegetables cultivation	to develop production technology on irrigated vegetables cultivation,
* Coconut multi storey cropping and sloping land cultivation	to develop production technology of multi store cropping and sloping land cultivation,
* Improvement of soils and subsoil	to improve soils and subsoil for cropping of irrigated diversified crops, coconut multi story cropping, and slopeing land cultivation,
* Animal husbandry	to promote diverse farming with animals,

Aside from the trainers of the farm staff and the staff of the Office of Provincial Agriculturist, other trainers will be mobilized from the Marinduque State College, the national training organization of Agricultural Training

Institute (ATI), Bureau of Plant Industry (BPI), Bureau of Soils and Water Management (BSWM) and so on. The trainers in the following list is available in Marinduque. Principally the trainers from other organization than the farm and the Office of Provincial Agriculturist are assigned for the training of special subject.

TRAINER IN MARINDUQUE PROVINCE

Trainer	Subject
A. Training Division (6 staff)	
1) Chief	cropping rotation, cropping system,
2) Crop Production Specialist	package technology on rice and other crops,
3) Crop Protection Specialist	crop protection on the production of rice and other crops,
4) Extension Specialist	extension method and technology,
5) Institutional Building Specialist	leadership training for multi prupose
6) Agri-cooperative Specialist	leadership training for cooperative development,
B. Research Division (4 staff)	
1) Chief	technology on irrigation, and improvement of soils and subsoils,
2) Technology Verification Researcher	package technology on irrigated vegetables cultivation and rapid composing,
3) Technology Adaptation Researcher	package technology on crop in field trial,
4) Farming System Specialist	development of farming system and integrated pest management
C. Livestock Specialists in Main Office of Provincial Agriculturist and Livestock Breeding Station (3 staff)	production technology of livestock and poultry, lviestock protection, and artificial insemination
D. Other Specialists in Main Office of Provincial Agriculturist (8 staff)	seed production and citification, management of coperatives, animal husbandry, artificial insemination agribusiness, multipul cropping, and extension
E. Livestock Specialists in Main Office of Provincial Agriculturist and Livestock Breeding Station (3 staff)	production technology of livestock and poultry, livestock protection, and artificial insemination
F. NIA (several staff)	institutional development of Irrigators' Association, O & M and water management at farmers' level
G. Marinduque State College (6 Professor or Assistant Professor)	horticulture, animal science, principal agriculture, biology, social science, and home economics

Though the training program for farmers' leaders similar subject to that for agricultural extension staff, it focus on the training of practical skills.

The Training Division is responsible for preparation and development of training designs / modules besides training works. However for the special subjects like water management the specific trainers have to be invited from NIA and others. For the farmers' leaders in the Tagum - Angus project area, two to three classes are organized for each, where each class has two or three training days with 32 trainee per class. The training program of the farmers' leaders starts in the latter half period of the four years program because the priority is given to the training for the farmers' leaders in the Tagum - Angus project area (See Table 4-2).

Presently there is no facilities to generate the adaptable technology in Marinduque, then it is not possible to train the agricultural extension staff and farmers' leader for the generated technology. Moreover there was a policy that every extension staff covers a wide range of agricultural technology, and most of the staff are hardly facilitated with the adequate training on crop production technology. Under this circumstance it is essential to train the staff with the actually generated technology in Marinduque.

4) Building Plan

a) Location Plan

The site slants to the north and northwest directions. There are a rock and three big trees around planned building site. This project does not intend to remove them and only digs pits and trenches for foundations without arranging the site land.

Sometimes strong typhoon attacks the site from the northwest. The buildings therefore will be located running the longitudinal direction in parallel with a east-west axis.

b) Rooming Plan

The Farm has the building for Training and Management Center and having following personnels and equipment (ref. to Table 4-2).

TABLE 4 - 2 FACILITIES OF THE FARM

Building/Room	Person to be Allocated		Equipment
Chief Room	Chief		
Administration Room	Management Div.	10	
	Training Div.	8	Training equipment
Lecture Room	(Trainee 40)		Audio-vidial
Research Room	Researcher	4	Laboratory equipment

c) Plan

Floor plan will be designed according to the location of furnitures and equipment installed in a room under the Code. In addition, such this island even in minimum shows over 114 of temperature-humidity index that all persons feel discomfortable if that indicates more than 80, cubic space per person will be made large, and moreover, wide open-air corridors and long caves will be also designed to obtain natural ventilation and keep rooms from rain. Furthermore double walls will be intended to prevent from typhoons from the west-northwest and from the strong rays of the sun from the west. Specific lavatories and slopes will be taken in the plan for disabled persons in accordance with the law, instructions, rules and regulations implementing the law to enhance mobility of disabled personas as well.

i) Lecture Room

This room will be used as both conference room for 100 members of the agricultural staff and lecture room for agricultural technologists and leaders. The room will be therefore designed under the idea that desks will be installed in it in the case of a lecture room and that only chairs will be used in the case of a conference room. When the room is used as a conference room, such desks will be moved to the outside so as to carry required chairs into the room, every desk will be designed as a personal desk.

The desks will be planned for 40 trainees and 3.0 m between a blackboard and the front row of desks will be spaced to utilize a overhead projector. Moreover a preparation room will be attached to the room so as to store chairs, and instruments and equipment for lecture.

ii) Administration Room

This room will be used by an administrative officers, full-time and part-time trainers and their staff. A personal room will be planned for a representative of the farm and a large room for the others. For this, a small meeting room, printing room, storage room and hot-water service room will be also planned attached to the room.

iii) Research Room

This room has two functions; research and experiment. Summary tests will be done for cereal, vegetable and fruit seeds, and for soil and culturing bacteria by 4 researchers and trainers. For this, furniture and equipment will have room for installation.

iv) Floor Area

As a result of the above investigation, every floor area will be determined as follow under the condition that the area of open-air corridors is not included in the floor area.

Room Name	Floor Area (sq.m)	Remarks
Lecture room	129.6	40 trainees or 100 attendants
Preparation room	32.4	
Representive room	23.1	
Office room	109.8	11 persons
Printing room	13.3	
Meeting room	21.4	max. 8 persons
Storage room	14.8	
Hot-Water service room	12.0	
Laboratory room	129.6	
Lavatory	48.6	
Hall	48.6	
Sub Total	583.2	

d) Elevation Plan

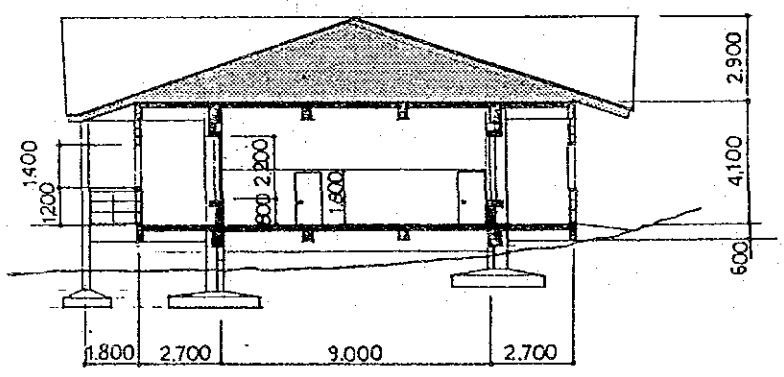
The buildings will be designed without arranging the land which slopes to the fish ponds. Planned buildings will be intended to harmonize with the existing buildings and surrounding environment, and to take sliding windows

caught sight of aged house in Marinduque. Openings of the buildings will be as large as possible to utilize natural draft. To do so, high ceiling height, movable windows and louver blocks will be adopted.

e) Section Plan

Basic story height of planned buildings will be 4.10 meter. These shall be determined by the span of columns. The roofs of main buildings will be constructed with concrete slab mounted wood truss to prevent from the heat of the sun.

FIGURE 4-2 TYPICAL CROSS SECTION OF BUILDING



f) Structural Design

* Substructures

By the soil information of the site as a result of boring a well, brown clay lays from ground to 3.0 m deep and tuff succeeds to it sandwiching about 1.5 thick basalt layer in the strata at the 13.5 m deep. Ground water appears at approximately 16.5 m deep and the ground level of the well is about 14.0 above average sea level.

The building foundations will be constructed on the brown layer. Although tuff layer is desirable as the building support layer, brown layer will be in principle employed as the building support layer because of one story buildings, and the existing building is also

constructed on the layer. The foundations will be designed by 5.0 tons/sq.m of the soil bearing capacity and this capacity will be reconfirmed before the beginning of the works.

* Superstructures

The superstructures will be reinforced concrete and rigid frame structures popularized in the local reinforced concrete walls resisting lateral force will be placed at the suitable parts between the columns.

Structure will be designed in accordance with the live load, wind load and seismic load stipulated in the Code and NSCP.

5) Power supply

A 10 KVA transformer is mounted on a electrical pole in front of the site but even now occurs shortage of capacity. The Province is expected to provide the other or capacity upped transformer according to the demand by this project.

6) Building Material Plan

Materials of the buildings will be in principle used in the obtainables in the Philippines to easy maintenance and repair but aluminium sash for windows and doors might be procured in Japan. Consideration will be taken to the quality and durability to save maintenance and repair cost at the same time.

The structure of the main buildings will be constructed with reinforced concrete, and reinforced concrete slab will be used to ground floor and roof, and moreover hollow concrete blocks will be used to partial walls. Furthermore, wood-truss roof will be mounted on the concrete slabs. Other buildings, workshop and warehouse, will be constructed with reinforced concrete frames, wood-truss roofs and concrete block walls. Aribricks and louver blocks will be also used to pass through natural draft.

The finish of the main buildings will be as follows;

* Exterior finish

Roof : Long sheet color iron batten seam roofing on asphalt roofing over wood-cement particle boards (t=20mm)

Wall : Polyurethane resin enamel paint on epoxy resin paint as undercoat and brown coat over mortar (t=30mm)

Sashes : Anodized color aluminium windows and steel door, and moreover steel rolling shutters for storage rooms

Floor : Pebbled concrete

* Interior finish

Ceiling : Two liquid mixed type epoxy resin enamel paint on epoxy resin paint as undercoat and brown coat over mortar (t=20mm) on exposure of structure.

Wall : Two liquid mixed type epoxy resin enamel paint on epoxy resin paint as undercoat and brown coat over mortar (t=20mm), and porcelain tiles (H=2.1m) over mortar (t=25mm) for only lavatories.

Floor : Two liquid mixed type epoxy resin paint for the lecture, office, research and laboratory, and dining rooms, and water resistance for kitchen, and porcelain tiles for lavatories on mortar (t=30mm).

7) Equipment to be Procured

For supporting the Farm's activities, the equipment shown in Table 4-3 will be procured.

TABLE 4-3 GRADE AND USAGE OF EQUIPMENTS

Equipments	Grade	Amount	Usage
1 Equipments for Experiment			
(1) Common Equipments			
1) Distilling Apparatus	3kw, 3~5ℓ/hr	1	Chemical analysis/Measurement of soil retentivity by tensiometer
2) Balance			
- Less than 600g	Two pans chemical balance (200g)/electronic scale (600g)	each one	Weighing of soils, seeds and reagents
- 2kg,15kg and 900kg	multi-function platform scale	each one	Weighing of plant materials and inputs
			Drying of soils and plant materials
3) Convection Oven	25~50°C, 150ℓ	1	Observation of compost fungus, disease
4) Microscope	Binocular microscope standard/Stereo microscope set	each one	germ and pathogenic
5) Thermostatic Germinator	Room temp., to 60°C with 14 PC. of trays	1	Seed test
6) Equipment of yield component analysis and seed testing	Standard equipment of seed testing for pady and corn	1 set	Grain yield analysis and seed testing
7) Quadrant sampling thresher	1HP	1	Grain yield analysis
8) Test Huller	20g/sec	1	Grain yield analysis
9) Refrigerator	270ℓ	1	Storing of seeds and plant materials
(2) Soil Analysis and Rapid Compost Making			
1) Soil PH meter	Analogue table type, mini. grad 0.05PH	1	Simple soil analysis
2) Conductivity meter	1μs~10ms/cm	1	-do-
3) Three phase meter	100mℓ soil sample Boyle's law type	1	-do-
4) Particle size analyses	Soil shaker (300mℓ×12)/pipete analyzer (500mℓ)	1 set	-do-
5) Tensiometer	PF0~2.9		Measurement of soil retentivity
6) Standard soil color chart	Standard color	1	Simple soil analysis
7) Kjeldahl analyzer	Distillation apparatus (100mℓ)/Digest 0.15 (50mℓ×6)	1 set	Measurement of nitrogen content
8) soil sampling equipments	Standard soil sampling equipments	1 set	Soil sampling for soil analysis
9) Autoclave	20ℓ,1.2kw	1	
2 Audio-Visula Equipments			
1) Color TV Monitor/Recorder	29inch color	1	Training
2) Video tape player/Recorder	Four heads	1	-do-
3) Video Camera	Beta type	1	-do-
4) Video Monitor	Beta type 11 inch color	1	-do-
5) Slide Projector	70~120mm, 250w lump	1	-do-
6) OHP	250w lump	1	-do-
7) Portable Amplifier	20w	1	-do-
8) Microphone	Cordless	2	-do-
9) Stereo radio cassette recorder	16w, 8cm speaker×2	1	-do-
10) Megaphone		2	-do-
3 Farm Equipment			
1) 4 wheel Tractor	30HP Diesel	1	Field trial and Training
2) Tractor attachments	Attachments for paddy and upland fields	1 set	-do-
3) Sprayer	Portable power type (21kg/cm²)/17.5ℓhandsprayer	2	-do-
4) Thresher	With engine (5.0HP), 1.2~2.0ton/hr	1	-do-
5) Rice dryer	1.6ton capacity	1	-do-
6) Hand Tractor	8 - 10 ps	2	-do-
7) Shredder	1~2ton/hr PTO use	1	-do-
8) Grass cutter	0.5HP	7	-do-
9) Pipe Master	ø 28~50mm	1	-do-
10) Sprinkler	No.30 head sprinkler×8	2sets	-do-
4 Weather Observation Equipments			
1) Rain Gauge	Manual	1	Weather observation
2) Hand Anemometer	Manual	1	-do-
3) Evaporimeter	ø1,200mm	1	-do-
4) Instrument shelter	Wooden leg	1	-do-
5) Thermometer	Wall type -20~50°C	2	-do-
6) Hygrometer	Rutherford type	2	-do-
5 Support Transport Equipments			-do-
1) Service pick-up	Double cabin. 4wd diesel	1	Transportation for research/training activities
2) Pick-up truck	2 ton diesel	1	-do-
3) Minibus	30 person	1	-do-
4) Motorcycle	125 cc	5	-do-
6 Office Equipments			
1) Computer system	40MB, with 2MB memory module	1	Preparation of training materials
2) Laser printer	HP laserjet	1	-do-
3) Copy machine	A3, B4, A3, B5 keys	1	-do-
4) Electronic typewriter	Full automatic keys	4	-do-
5) Calculator	12 digits	8	-do-
6) Drafting table and chair	1,200 mm×900mm	1 set	-do-
7) UPS	220 V	1	-do-

4.3.2 Tagum-Angas Irrigation Plan

1) Land Use Plan

700 ha of arable land in Tagum - Angas area can be irrigated by graving water from Tambangan dam.

These area is flat or sleepy land, is used rainfed paddy land mainly.

The soils in the upstream area of the project belongs to the soil series of Maranlig clay loam, while these in the downstream area belongs to the that of Tagum clay loam. the soils of Maranlig clay loam are derived from basalt and andesite, being suited for growing paddy. The soils of Tagum clay loam are also derived from such igneous rocks as andesite, of which drainagebility is poor because of low soil permeability. Both soils are acidic in soil reaction and are deficient in phosphate and potassium content to some extent. Then drainage condition of soils need some amendment or improvement to grow upland crops. Since similar soils to the soils in the project are prevailing in the province, the crop production technology which are applicable to the soils are indispensable to the agricultural development. For this purpose, there is a need to generate the related crop production technology and to train farmers' leaders and agricultural extension staff.

The land use plan in the project is formulated as follows;

- Generally the irrigation service area are limited to the existing paddy land to minimized project cost.

- The irrigation service area are expanded in the upland field, so far the irrigation water is available.

- The coconut land adjacent to the service area of the paddy fields or upland fields are also included into the irrigation project area, where the land is irrigated with the crops of the multistory cropping.

In the land use plan, the total of net irrigation service area amounts to 630 ha, which are comprised of 480 ha of paddy field, 60 ha of upland fields, and 90 ha of coconut land as shown in the following table;

TABLE 4-4 LAND USE PLAN

(Unit: ha)

Kind of Land	Present Without Project	With Project	
		Total	Irrigation Service Area
Paddy Fields			
- Irrigated	-	480	480
- Rainfed	400	-	-
Upland Fields	60	60	60
Coconut Land	120	120	90
Grass Land	80	-	-
Sub-Total	660	630	630
Road and Residence Area	40	40	0
Total	700	700	630

Note : The cropped area of multistory crops are estimated at 90 ha (120 ha × 75%)

2) Agricultural Development Plan

a) General

In the irrigation service area of Tambangan reservoir, paddy is selected as one of most suitable crops. The wet season paddy is cropped with area coverage of 100% in the total paddy fields, while the dry season paddy is cropped with area coverage of 85% in the total paddy fields. In upland field, vegetables and corn are planned to be grown under irrigation. The multistory cropping with corn, groundnut, mungbean and other beans, root crops like arrowroot and Ubi will be introduced fully in the coconut land under irrigation.

b) Farm Management

The most typical farm management is based on the paddy cultivation in the area where rainfed paddy fields are prevailing. The farm management is unstable with low income because the crop production is changeable year by year with low level of yield. In the area where the coconut land is prevailing, the farm management is based on coconut cultivation, where there are small

scaled farmer who grow mungbean and groundnut in the hilly upland area. Most of all these farm managements have very limited amount of marketable surplus and the farm income is very low. It is planned to improve the farm management by introducing irrigated agriculture, namely double cropping of irrigated paddy and coconut multistory cropping under irrigation, and double cropping of irrigated paddy plus upland crops inclusive of vegetables in upland fields under irrigation. Furthermore, it may be possible to expand the duck farming in the area of all year round irrigation. The trials of duck farming has been touched to introduce duck farming in the project area. As crop production is increased with implementation of the project, the by products of rice, corn and so on including rice straw is also increased. It makes possible to increase the number of swine, chicken and cattle in their farming, contributing to increase farm income as well as soil fertility of crop land through applying the increased amount of manure to soils.

c) Crop Selection

The main crop in the Project Area will be rice due to the followings;

- The soil in the Project Area are of texture and acidic in soil reaction, which is suited to grow paddy,

- Rice in Marinduque is considerably short in supply to compare with demand, so farmers desire to grow rice for home consumption as well as for markets,

- Paddy is presently cultivated in the Project Area and farmers are acquainted with its cultivation practices.

Corn is also selected as staple food as well as feed for livestock. Other kinds of upland are selected to grow in upland fields as well as in coconut land as multistory crops. The following four kinds of upland crops are selected;

Mungbean and other Legumes

Because legumes are in short supply and highly marketable in the province, and the cultivation of leguminous crops make the soils fertile.

Groundnut

Presently, groundnut production does not meet demand in the province and has high marketability. Crop rotation with maize, vegetables, and so on will show same effect to legumes.

Vegetables

The supply of vegetables in the Province is insufficient. Under the irrigation, the cultivation with vegetables is profitable, which may contribute to increase farm income various upland crops like string bean, bitter gourd squash, eggplant, tomato, water melon, carrot and cabbage are recommended for cultivation by DA. However, there is a need of field trials for selection of crops and varieties under Marinduque condition and for establishment production technology. Also, training of farmers' leaders and extension staff is necessary to develop vegetable production.

Root Crops

The soils in the Project Area is suited to grow root crops. For arrow root, some marketing has been established in the Province, where a considerable number of farmers grow it as industrial crops through forming grower association of arrowroot. The trials to introduce Ubi are started by DA in the Province.

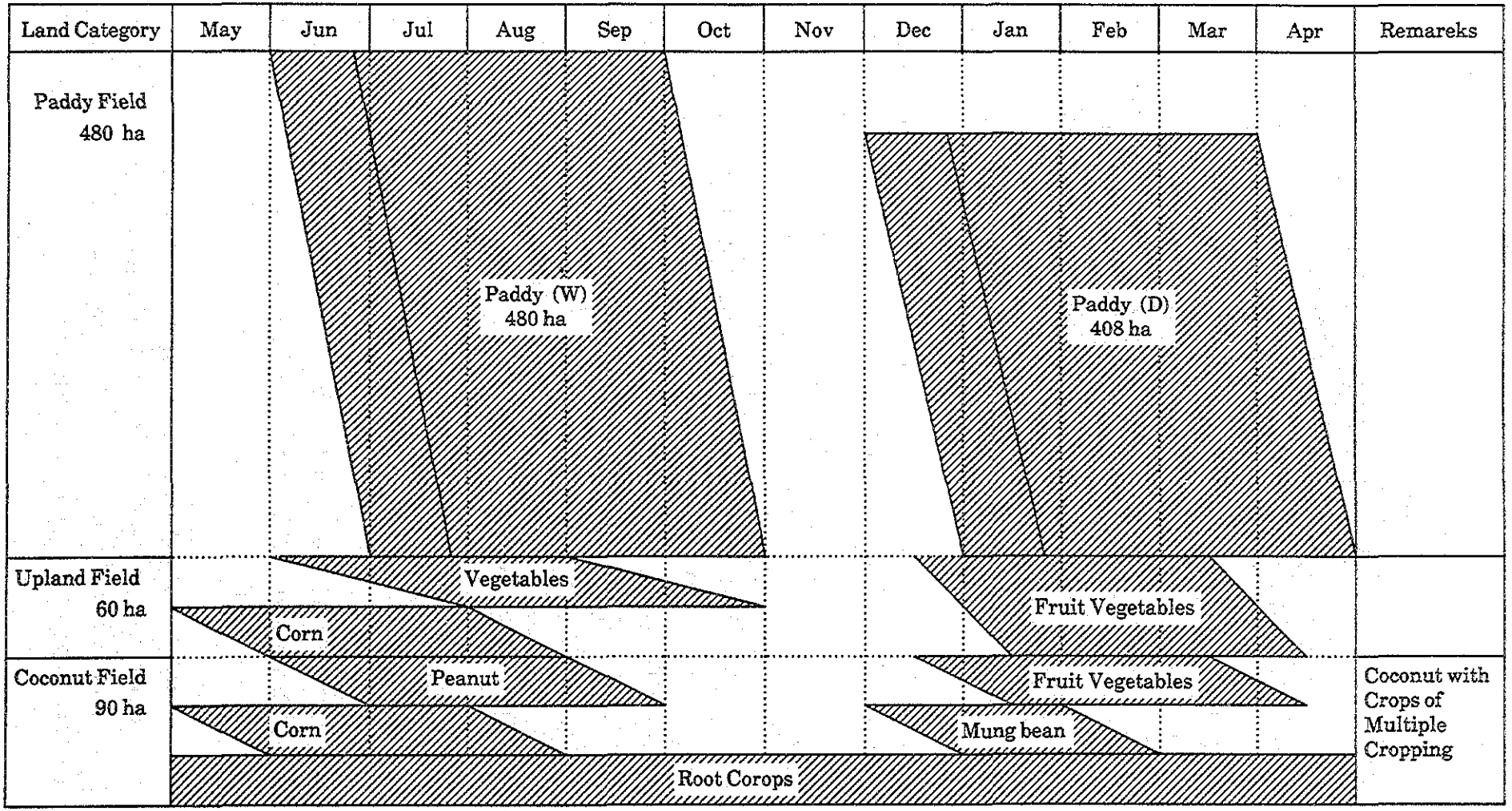
d) Proposed Cropping Pattern

The proposed cropping pattern by kind of land is shown in Figure 4-3.

For the "rice - rice" cropping, seedlings are transplanted during from late - June to early - July and the crop is harvested in October. As dry season cropping, seedlings are grown during from late - December to January, and the is harvested in April.

In the upland fields, such vegetables as eggplant, string bean, okra and squash are grown in wet season, while such vegetables as tomato, water melon, bitter gourd and so on will be cropped in dry season, employing two, kinds of crop rotation namely, vegetables (wet season) - vegetables (dry season)

FIGURE 4-3 PROPOSED CROPPING PATTERN (TAGUM ANGAS CIS AREA)



and corn - vegetables for the maintenance of healthy soils. As for coconut multistory cropping, three kinds of cropping pattern, namely groundnut - fruity vegetables, corn - mungbean, and year round root crops will be employed, depending upon the soil suitability in each area.

e) Cultivation Practice

It is expected that the cultivation technology to be generated by Agricultural Development and Promotion Farm (ADPF) will be widely applied in the Project Area.

Because the soils in the Project Area are acidic and phosphate fertilizers will be effective for yield increase, therefore, the field trials on application of lime and other soil amendment matter should be included in the ADPF research program. Furthermore, it is considered that the technology on soil profile improvement and drainage at on-farm level will be required to develop the production of upland crops in the Project Area. So the field trials on this matter also should be conducted at ADPF.

f) Target Yield

The target yield of paddy is expected to be 4.0 ton/ha in both season, based on the attained yield in the neighboring provinces. For upland crops, the target yields are estimated as follows;

Corn	1.5 ton/ha
Mungbean	1.1 ton/ha
Fruity Vegetables (Water melon)	18.0 ton/ha
Root Crops (Arrowroot)	10.0 ton/ha

To achieve the target yield, a period of five years is planned for the annual crop production in the Project Area as shown in Table 3 - 6.

3) Irrigation Plan

a) Irrigation Method

As shown in the previous section, the cropping pattern in the Project Area mainly consists of irrigated paddy, and irrigated upland crops, as shown in Table 4-5.

TABLE 4-5 CROPPING AREA

	Dry Season	Wet Season
Irrigation Paddy	480 ha (76.2%)	408 ha (64.8%)
Irrigated Upland Crop	60 ha (9.5%)	60 ha (9.5%)
Inter Cropping Area	90 ha (14.3%)	90 ha (14.3%)
Total	630 ha (100.0%)	558 ha (88.6%)

The irrigation plan was prepared based on the following criteria, taking into consideration the available water amount, cropping pattern and crop water requirement, etc.

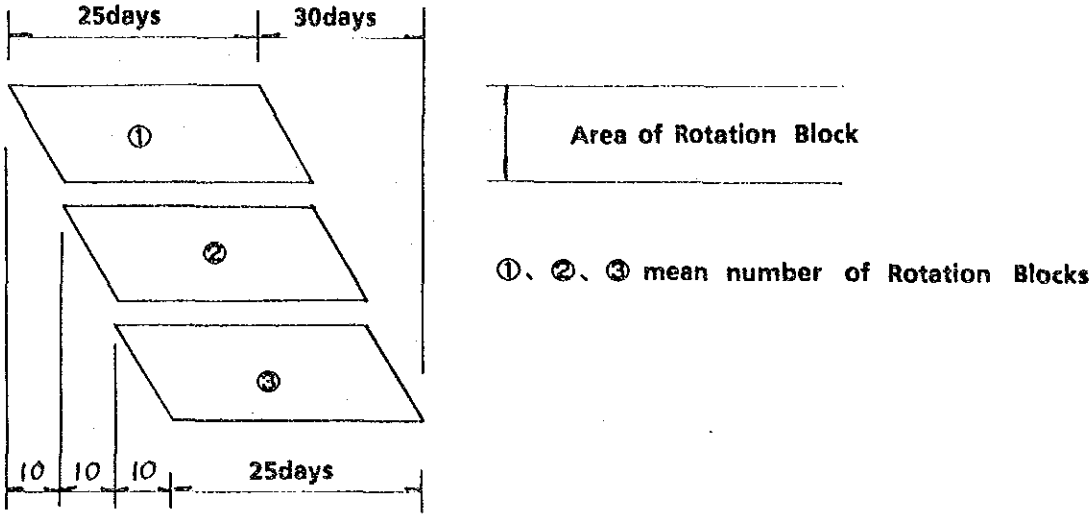
① rotational application will be conducted during the paddling stage within the rotation block,

② simultaneous application will be carried out during the growing stage for all crops within the irrigation block. When the available water reduces, the irrigation method will be changed to the rotational application.

③ irrigation for upland crops will be done by the same method as that for the paddy rice.

In the rotation block (18.6~37.7ha), the duration of the puddling stage(plowing and puddling period before planting) is 25 days and 10 days-rotation. Number of days to complete the puddling works in whole Project Area is 55 days as shown below:

FIGURE 4-4 PUDDLING SCHEDULE



b) Water Requirement

The crop consumptive-use(ETPc) is obtained by multiplying the evapotranspiration and crop coefficient(Kc). As for crop coefficient of rice, the consumptive use of rice is considered to be equal to evaporation rate(ET) in the NIA. In this Basic Design, this assumption was applied. Since there was no evaporation data in Marinduque province, ETPc will be calculated by the Penman method which is applied for the Master Plan Study on the Integrated Agricultural Development Project in Marinduque. (refer to Appendix Table E-4 and E-5)

Water requirement for rice was calculated 10-day periods based on the cropping pattern taking into consideration the following.

- Field percolation rate was 1mm/day during the entire growth period.
- Water requirement of puddling was 210mm for the wet season and 190mm for the dry season.

FIGURE 4-5 IRRIGATION DIAGRAM OF TAGUM-ANGAS SYSTEM

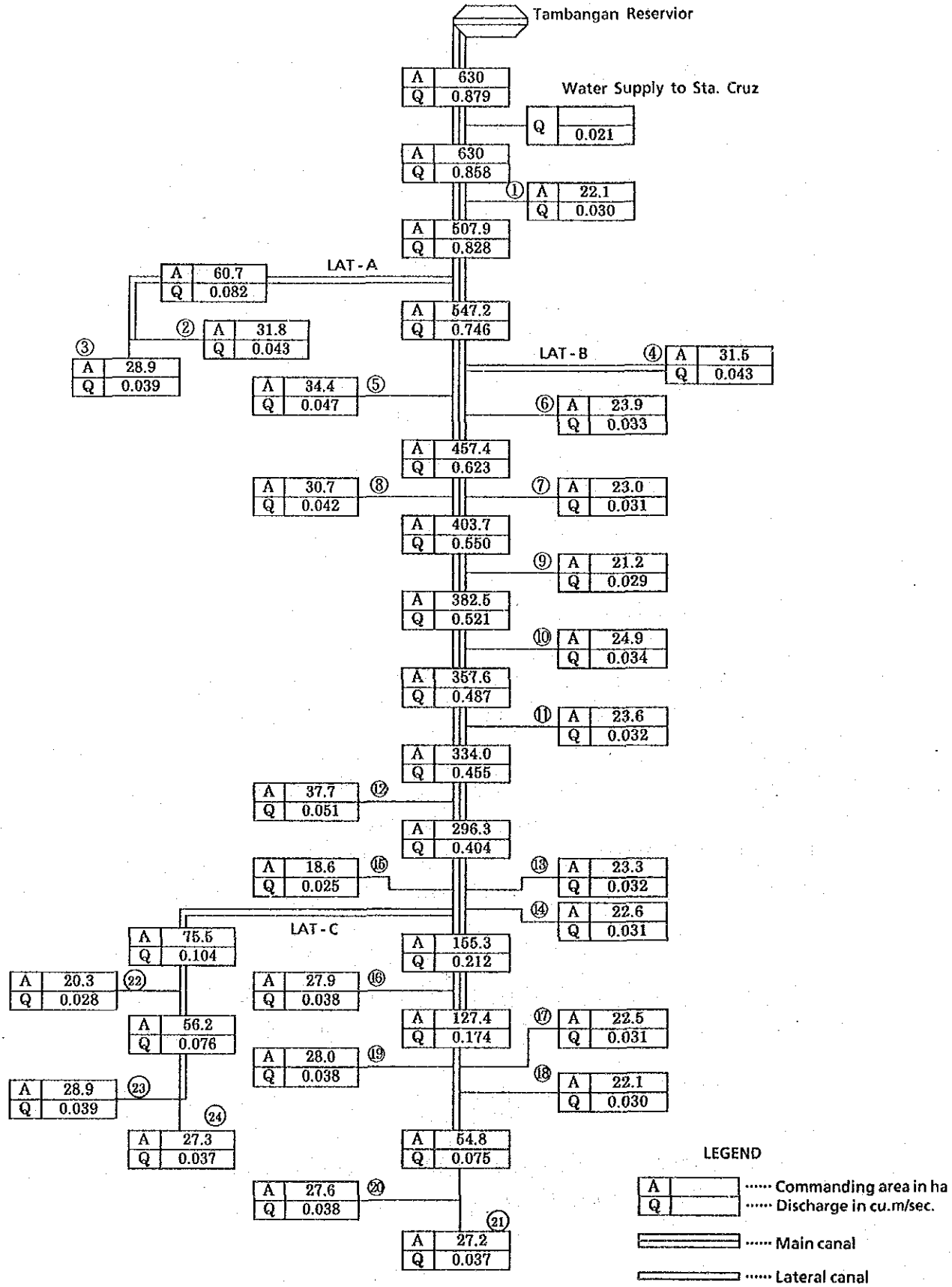


TABLE 4-6 WATER REQUIREMENT FOR PUDDLING

	Dry Season	Wet Season
First	80	70
Second	80	70
Third	50	50
Total	210	190

Similar to rice, the consumptive use of upland crops can be calculated by multiplying the evapotranspiration rate(ETo) and the crop coefficient(Kc). No data on the crop coefficient in the Project Area or neighboring areas were available; accordingly, the consumptive use of upland crops were calculated for 10-day periods in accordance with FAO Irrigation and Drainage Paper No. 24 (refer to Appendix Tables E-6 and E-7 in the Appendix).

The results of calculation of water requirement are as follows (refer to Appendix Table E-8 in Appendix) :

TABLE 4-7 CONSUMPTIVE-USE OF CROPS

Crop	ETPc
	mm
Rice (Wet Season)	669.7
Rice (Dry Season)	685.6
Vegetable (Wet Season)	296.5
Corn	338.6
Peanut	305.3
Fruit Vegetable	311.6
Mung Bean	289.5
Root Crops	782.9

c) Water Distribution Plan

i) Irrigation Efficiency

Considering the on-farm application losses (20%), conveyance losses (20%) and management losses (20%) the total irrigation efficiency is assumed as 0.512 (51.2%).

$0.512 = (1 - 0.20) \times (1 - 0.20) \times (1 - 0.20)$

In this Project Area, the irrigation water will be reused, therefore overall irrigation efficiency is 64%(=0.512/(1-0.2)) for canal design.

ii) Proposed Irrigation System

The proposed irrigable area is 630 ha in Tagum - Angus Irrigation System. The irrigation diagram of Tagum - Augas Irrigation System in shown in figure 4-5.

iii) Design Discharge of Irrigation Canals

The design discharge of main and lateral irrigation canals were calculated taking into consideration the irrigation of rice and upland crops.

The unit design discharge for rice of main and lateral irrigation canals were calculated for 10-day periods based on the cropping pattern, growth period, irrigation method, water requirement of rice by stages etc. Maximum water requirement is estimated as 1.36 ℓ/s/ha as shown in the Table E-8 in the Appendix.

4) Geology of Proposed Site

a) General

The proposed site is correlative with a Central Mountain Chain, and so the San Antonio volcanic covers site extensively. Although the outcrops consisting of platonic to hypabyssal rock and accidental xenolith are observed, the most part of basement rock is built up by the basaltic andesite lava. The minor jointed plain also recognizable on exposures along river floor, however, the fundamental rock characteristics infers to a hard and compacted rock mass.

Upon the basement rock, the terrace deposits can be distinguishable as different two types of upper and lower members. The upper terrace covers the exterior of hill top to form flat terrain which is scattered a lot of siliceous cobbles to boulders. Contrarily, the lower layer lie on the hill slope below the elevation of

45m and is mainly made up of silty gravel to clayey gravel. Furthermore, its upper boundary bounded to the river bed is not clear.

In view of the relation between positions of both terraces and dam sites, the upper terrace deposit not spreads out beyond both sills of dam and only lower terrace covers a part of left abutment of A site.

The weathering is suffered intensity to the surface facies in places, therefore, the lateritic clay covers with about 3m thick on the rock facies. In the river floor, the gravely materials with lesser fine particles piles with fairly thickness. these materials is supposed to be supplied after last glacial stage, hereby, the similar thickness of gravely facies can be guessed beneath both sills of A and B dam.

Between A and B site, the cliff formed by basaltic andesite has been traceable so that some effect by tectonic movement to the surrounding area. However, any fault or fracture zone wherever it run through the dam axis has not been noticeable clearly. Only at the 200m downstream of B site, the fault outcrop is found out, however, the tread of fault does not appear to be passing the proposed dam sites.

Figure E-5, E-6 & E-7 in the Appendix show the geological map in proposed site and geological cross section respectively.

b) Geological Survey

i) Drilling Investigation

Drilling had been planned 2 points in A site, and 8 points in B site.

The depth of drilling is also planned 15m except BB6 of 23 m. Their location, selection reasoning and result are as follows.

The detail of drilling inclusive of condition of drilling and drilling facies is shown in drilling log of Figure E-8 in Appendix and its location is shown in Figure E-5 in Appendix. From result of drilling, the similar geological sequence and structure can be led. Though the basement composed of andesite is partly observed as blocky body

which has an open crack due to weathering, to the deeper, the facies become to fresh and massive that is expressed by 20~80cm of RQD. In consideration of this features of drilling core, the basement rock especially to the deeper is correlative with CM class. Contrary to this, the weathering part of basement is indicated about less than 50 of RQD and the drilling core is also taken as a detritus, seeing that the facies of weathered zone has to compare with CL class. Moreover, the highly weathered layer is detected at the upper slope of abutment, and the layer, in general, is marked as consolidated silt facies which alters to clayey layer. Nevertheless, the distribution of this layer is confined to the upper slope of abutment and it shows 5 m thick on that.

Lower Terrace deposit, it covers the A dam site partly, is composed of mainly gravely facies with some intercalation of sand and clay. And the layer has been also confirmed by drilling works, as fairly consolidated facies resulting in 50 blows of SPT.

The river bed is maily gravely facies too, and maximum thickness is about 18 m. Due to drilling result, the loose facies is observed at upper horizon exclusively, and the lower horizon seems to be a rather dense facies accompanied with cobble to boulder gravels.

When a dam height of about 20 m in maximum is imagined, the basement, involving the weathered to fresh andesite and lower horizon of river bed and terrace deposit is expected to be an adequate bearing capacity to the dam body.

ii) Standard Penetration Test

Standard Penetration Test (SPT) had been carried out to the target of upper horizon of all drilling holes. the objective layers for testing are highly weathered andesite, terrace and river bed, bad especially at the upper unconsolidated sandy and silty facies of them. Excepting that of BB8, the results regularly can be summarized that a hard layer, more than 50 blows, is reached up to 2 to 3 m. At BB8 where is located at the edge of river floor of downstream, the value more than 20 blows can not be taken till the deeper horizon of 6m. The

excavation depth for dam foundation is required 3m in average and 6m in maximum. The detail results of testing are shown in the drilling log of Figure 4-8 .

TABLE 4-8 DRILLING RESULT

Drill Hole	Location	Selection Reasoning	Result
AB1	A axis, river floor	Confirmation of thickness of gravel	of Drilling gravel more than 15 m
AB2	A axis, r. Abutment	confirmation of thickness and facies of w.an.	weathered an. up to 3 m.
BB1	B axis, 1. abutment, spillway	confirmation of thickness and facies of w.an.	weathered an. up to 4 m.
BB2	A axis, 1.abutoment, spill way axis	confirmation of thickness and facies of w.an.	weathered an. up to 6 m.
BB3	A axis, 1. abutment, spill way u/s	confirmation of thickness and facies of w.gravel.	weathered an. thin.
BB4	spill way d/s.	confirmation of thickness and facies of w.w.an.	weathered an. thin.
BB5	B axis, 1. abutment, lower slope	confirmation of thickness and facies of w.an.	weathered an. thin.
BB6	B axis, river floor	confirmation of thickness and facies of gravel	gravel up to than 18 m
BB7	B axis, river floor	confirmation of thickness and facies of gravel	gravel up to than 15 m
BB8	B axis, river floor u/s.	confirmation of thickness and facies of grave.	gravel up to than 15 m
BB9	B axis, river floor d/s	confirmation of thickness and facies of gravel	gravel up to than 15 m
BB10	B axis, r. abutment,	confirmation of thickness and facies of w.an.	weathered an. up to 3 m

Note 1 : l.abutment is left abutment.
2 : r.abutment is right abutment.
3 : w.an.is weathered andesite.
4 : d/s is downstream
5 : u/s is upstream

iii) Permeability Test

The permeability test had been conducted to the whole drilling section. Their results are shown in the lugeon/permeability result of and Table E-9 of Appendix. As the maximum value the order of 10^{-2} cm/sec obtaining from the river bed,and the rather impervious value of 10^{-4} cm/sec (several to 30 Lu) had been taken for terrace and andesitic facies. As ordinary value for the foundation except for river floor, the value ranging 10^{-5} cm/sec to $5\text{-}10^{-4}$ cm/sec had been led through drilling works. On the other hand, the river bed consisting of loose sand and gravel is indicated as a high permeability of 10^{-2} cm/sec, and even 9×10^{-2} at the upper of this layer.

As stated above, these previous condition is required some treatment for foundation. Although this, the objective layer for treatment consist of either gravel or excessive high permeability, so that the potency for improving the water tight property is not seems to be desired by a normal cement grouting. For obtaining the water tight property definitely, the cut off wall to gravely layer and with the supplemental cement grouting for rocky layer are needed for these foundation.

iv) Test Pit Investigation

Test Pits had been dug at 3 localities involving both sides of dam site and its downstream. TP1 to 5 are in the left side of site and TP6 to 10 are in the right side, and TP11 to 18 had been carried out in the downstream area. And other pits of TP19-28 had carried out in the downstream area. And other pits of TP19-28 had been planned along the construction road. These results show in the log drawn in Figure E-9 of Appendix. As a general aspect of test pit investigation, the thickness of embankment materials, it mainly consisting of gravely clay, can be detected a depth of 3m in average to 5m in maximum at an area extending the left side ridge to construction road site. At the deeper horizon than clayey layer, the weather zone derived from andesite layer continues till the fresh rock zone. While satisfied condition for borrow area of left side area, the right ridge area appears to be deficient for borrow area since the clay layer is thin less

than 0.5m and is laid upon the andesitic layer directly. The gravely materials at the river floor can be traced out till the bottom of pit which is about 5m deep at least.

c) Embankment Material Investigation

The proposed sites for borrow area shown in Figure E-9 in the Appendix detail location of respective pit. And, the list for embankment material is also referred in Table E-10 in the Appendix.

i) Impermeable Material

The impermeable material can be taken from A and C borrow area where rang left ridge of dam site to planned construction road. the soil type for material is of mainly GC to CH and SC. Even if the deeper horizon may change to the weathered rock, the upper clayey horizon of 2.0 to 2.5 m can be founded as available material. Depending on these, about 90,000 cu.m from A borrow area and 160,000 cu.m from B area can be estimated as impermeable material.

ii) Semi-permeable Material

The capable area for semi-permeable materials is similar to that of impervious area of A and C borrow areas, in addition, D area in the river floor downstream of dam site is available. The soil types are ML or SM originated from andesite layer, and the sufficient quantity of these can be estimated since the weathered zone and river bed is observable with a enough thickness in places.

iii) Filter Material, Aggregate

The materials can be taken the river floor area, downstream of dam site, and along Mogpog river site. In practical use, the filter material and coarse aggregate are planned to be taken from the downstream of dam site, while fine aggregate is from Mogpog river. The quantity from both sites is also expected sufficiently.

iv) Riprap Material

The sufficient riprap material, even its quantity as well as its gravel size, can be collected from surrounding area of proposed dam site. The doable site for this type of material is planned to be downstream of dam site.

d) Laboratory Test

The locations of sampling for laboratory test and their results are shown in Figure E-9 and Table E-11 of the Appendix.

4) Dam Design

The basic dimensions and conditions for the design Tambangan Dam are described in section 4-2. Accordingly the basic design of the dam and appurtenant structures is as follow:

a) Location of Dam

Tambangan dam is located at about 1.5km upstream from junction of Tambangan river and Devilla river in Barangays Burug paran Sta. Cruz the dam has has its own catchment area of 32.5sq.km.

b) Layout of Dam

As shown in the Basic Design Drawings, salients features on the layout of Tambangan Dam are as follows:

* Two alternative lines were studied for dam axis, as shown in Figure E-5 of Appendix. Geological investigation works were carried on (as shown in figure E-6 of the Appendix or A dam axis and Figure E-7 for E-7 of this Appendix for B dam axis). The terrace deposits on the left side abutment of plan A dam axis is deep as 15m and is distributed widely, accordingly dam body will be loner and bigger than the plan B. Moreover, feeder canal after intake of dam will be 50 meter longer than the plan B and construction of feeder canal will be slightly difficult due to cliff. Therefore, the plan B dam axis is selected.

* The andesite which is base rock of dam body is fresh and is expected to have adequate bearing capacity. The weatherings are developing at left and right side abutment and permeability of them is 10 to 30 lugeon. The river bed is deposited by sand and gravel by 18 meter in maximum.

* Two types of foundation treatment are considered because the geological conditions of river bed and about are not same. The continuance cut-off wall method is employed for river bed, because this method has more advantage in easy construction and high water stop efficiency than open-cut method, blanket method and grouting method. For both side foundation treatment grouting is planned to be constructed due to slightly high seepage.

* Dam Type is inclined core type dam and the continuance cut-off is located at bottom of inclined core. The core materials will be the impermeable materials from the borrow area located at left bank.

* The width of dam crest is 6 m and free board is 2.0 meter above the high water level (El. 33.20m).

* The spillway will be located from the left bank of the damsite to the downstream area. The type of the inflow section is a side overflow type, and the downstream section is a ski-jump type.

  At the inflow section there will be no gate in order to establish a free over-flow so that flood water will be released.

* The intake feasibility, functions as divers on conduit, will be located just crossing the dam axis at right side of the river. Intake type is drop-inlet and control of intake amount will be carried out by the value at end of intake facility.

* Although the river diversion is a temporary work, it may become an important factor in the schedule of the dam construction because the construction must be competed within very short periods and work can be expected only during the dry season. The location of the

diversion works (conduit) is described above and, utilized as the intake conduit later.

The diversion works (conduit) is designed as 2 lines of ø 3,000 mm pipe based on diversion flow. The one line of the conduit will be utilized as intake conduit later.

c) Stability Analysis of the Dam

For the maximum standard section of the dam, the slope stability analysis has been performed. the standard section is shown in Drawing 3. The soil mechanical data applied in the stability analysis of the dam is shown in Table E-12 of Appendix, and the result is shown in Table E-13 in the Appendix.

This analysis has been performed according to the computer program, which is based on the revised Japanese standard on design of dams for irrigation and drainage projects, and is registered and used in the Project Development Department of NIA.

d) Hydromechnical Condition of the Spillway

The spillway is a free overflow type (geteless) on which flood water begins to flow on the full water level of the reservoir.

The synchronous amounts of the inflow and overflow have been analysed (Flood routing) and the results is shown in Figure E-11 in the Appendix.

The flood routing proves that, in case of a crest length of 60 m, the maximum amount of overflow will be 590 cu.m/sec with a flood of maximum inflow of 724 cu.m/sec and corresponding maximum overflow head reaches to 2.9 m. Although other alternatives of crest length of 60 m is the most appropriate from the viewpoint of the size of the dam and the spillway.

e) Hydromechanical Condition of the Intake (Diversion Works)

Intake water from the dam will flow in through the drop-inlet opening at the Low Water Level of El. 25.10 m in the reservoir, through the Conduit under the dam body and the national road, lift up to El. 24.00 through the Vertical Chamber,.

5) Irrigation Canal Design

a) Canal Alignment

The irrigation canals are provided to supply irrigation water to beneficiaries from Tambangan Dam. The beneficiaries of this Project are the irrigated farming lands which are divided into 24 irrigation blocks, and driving water supply for Sta. Cruz and others. the drinking water will be treated after intake of water from canal, then sent to Sta. Cruz. Feeder canal is called from intake at dam to the intake point of drinking water. the irrigation canal after that will be divided into main canal and lateral canal.

Canal alignment study was carried out by the topographic map which was prepared by JICA and during the site survey. Tambangan dam is planned to be constructed near the old pumping station which was constructed about 30 years before. There is traces of irrigation canal from the pumping station to existing Tamayo training center. Proposed canal will follow the trace of existing canal.

Irrigation canal will be designed by the earth canal. Irrigation canal networks has one (1) main canal and five (5) lateral canals. Main canal has five turn outs to lateral canals and 27 turn out to farms.

Following structure will be provided on the canal :

① Check : for keeping the water level to farming land

② Cross Drain : for smooth releasing the runoff from higher position

The structures on the canal are as shown in the Table 4-9 as follows :

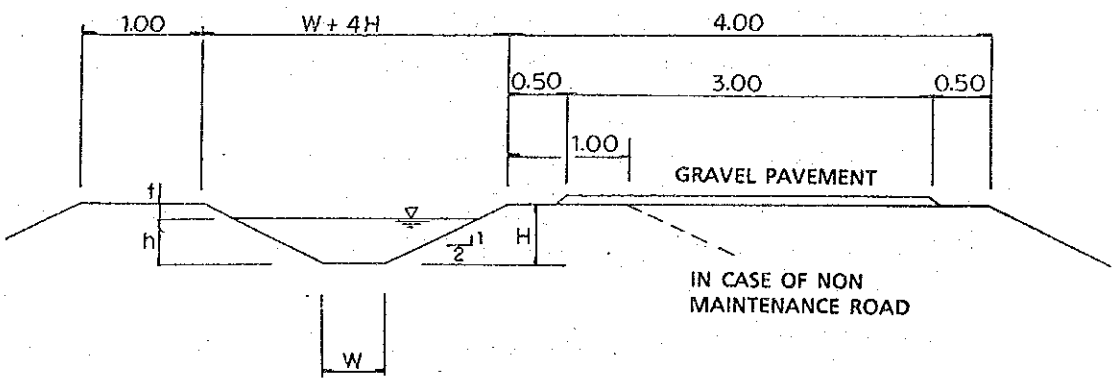
TABLE 4 - 9 STRUCTURES ON CANAL (Tagum-Angas)

Name of Canal	Canal Length (m)	Open Length (m)	Cut & Cover (m)	Siphon (m)	Check	Drop	Turn Out
Feeder Canal	1,800	0	300	1,500	1	1	2
Main Canal	8,800	8,700	0	100	6	2	18
Lateral A	700	700	0	0	0	0	1
Lateral B	600	600	0	0	0	0	2
Lateral C	2,000	2,000	0	0	1	0	3
Lateral D	1,600	1,600	0	0	0	0	1
Lateral E	2,700	2,700	0	0	1	0	3
Total	18,200	16,300	300	1,600	9	3	30

b) Maintenance Road

Maintenance road will be provided along the irrigation canal which is not run along the existing road nearly. According to NIA standard for national project maintenance road along the main canal is six (6) meters maintenance in width and road along the lateral canal is four (4) meters. This project is lateral canal class in terms of designed discharge of canal, therefore width of maintenance is four(4) meters, however, this maintenance road will be utilized not only maintenance purpose but also public purpose, then width should be five (5) meters and paving with by gravel is three(3) meters. Standard cross section of irrigation canal is shown in Figure 4-6 below.

FIGURE 4 - 6 STANDARD CROSS SECTION OF IRRIGATION CANAL



4. 3. 3 Laon-Mataas Irrigation System (Laon Mataas CIP)

1) Land Use Plan & Farm Management Plan

Laon Mataas CIP was decided to be constructed by the NIA, but completed only the concrete structure due to shortage of budget for construction.

NIA planed Laon Mataas CIP with irrigable area of 175ha and its planed cropping pattern is given below (detail is referred as Table E-14 in Appendix).

	Dry Season	Rainy Season
Irrigated Paddy	70 ha	175 ha

2) Irrigation Plan & Water Quality

Monthly water demand of irrigation and water requirement to water resources is given in Table E-15 of Appendix.

Marcopper Mining Corporation (MMC) planed to develop new pit because of mine out of Tapian pit. New mining pit at San Antonio is located at up-stream of Mogpog river which is the river to be constructed the diversion dam for Laon-Mataas UP. MMC made coffer dam and siltation dam on the Maguila-guila stream which is the branch stream of the Mogpog, and made plan to dispose the tailing disposal to the Tapian pit disposed, on the Mogpog river water, qualities of river water are good for irrigation use. The monitoring team composed DENR - Region IV, EMB, local government, MMC and so on was formed at January 1991 to for compliance monitoring / environmental surveillance of San Antonio Cooper Mining Project including water quality. Then it expected to control and maintain the water quality of Mogpog river.

3) Diversion Dam Plan

Laon Mataas Diversion Dam was planned by NIA. According to the geological survey at the proposed dam axis, its river bed is silty sand or gravel and N-Valuve of SPT (standard penetration test) is 20 and permeability is 2×14^{-4} cm/s. Fixed type diversion dam can be constructed. No structure such as gate hoist, bridge, etc will be constructed at the higher elevation part from dam crest to keep the smooth run-off of flood.

4) Irrigation Canal Plan

Structures of irrigation canal such as, culvert (cut & cover), syphone, turn-out, check, etc. at the downstream of intake at diverison dam, have been completed by NIA PIO. Following table gives the struetures of Canal System(* means the structures which are completed).

TABLE 4 - 10 STRUCTURES ON CANAL (Laon-Mataas)

Name of Canal	Length	Open Canal	Cut & Cover	Siphon	Check	Drop	Turn Out
Main Canal	3,170	2,345	825 *	65 *	2 *	0	5 *
Lateral A	2,229	2,109	0	120 *	2 *	0	4 *
Total	5,399	4,454	825	185	4	0	9

4. 3. 4 Road Plan

1) Road Improvement

a) Alakan - Tamayo - Angas Road

Following section of the road will be improved among the total length of 6.78 km.

Distance form National Road	Scope of Improvement
300 m	Due to the low elevation of road surface, embankment of road, shoulder reinforcement and gravel pavement (length about 300m) will be provided.
1,200 m	Cross drain will be provided because of no cross drain for smooth releasing of run-off from hilly site.
1,600 m	Inlet of existing cross drain will be improved because of eroded.
2,000 m	Cross drain will be provided because of no cross drain for smooth releasing the run-off at rainy time.
3,800 m	Road surface will be improved because of muddy surface at rainy time.

b) Napo - Prong Road

This road will be used as construction road and after completion this road will be important for maintenance, Therefore, smoothing of surface and gravel paving will be provided. Moreover, Napo-Villa bridge will be reconstructed by reinforcing concrete pipe and concrete pavement.

2) Multipurpose Road Pavement

Concrete pavement will be provided as the multipurpose road pavement with 4 m width at the following road section.

Name of Road	Name of Barangay	Length
Alakan-Angas	Tamayo	100 m
〃	〃	100 m
〃	Tagum	200 m
〃	Angas	100 m
〃	Angas	100 m
Napo-Angas	Napo	100 m
Taitai-Hegimit	Taitai	100 m

4. 3. 5 Rural Water Supply Plan

1) Tagum Angas Area, Sta. Cruz Area,

a) Alignment Plan and Design Discharge.

The proposed objective areas of water supply are those of the areas along the delivery pipeline between intake site and Sta. Cruz storage tank, and Agriculture Development and Promotion Farms along the lateral lines in Napo, Tawiran, Matelaba, Buyabad, Sta. Cruz and Tamayo. The designed total beneficial population is 13,041 persons and the designed average daily supply amount of water is 1,112 cu.m/day. The proposed water supply system is worked out as the Level-3 for Sta. Cruz area and Level-2 for the others. The total length of the proposed delivery lines is 11,640 m.

b) Intake Facilities

The water intake facilities will be provided at the Tanbangan dam serving as water sources for the Tagum-Angas Area Irrigation Project, and the intake amount will be 1,446 cu.m/day, the daily max, supply volume.(1,112 cu.m/day×1.3=1,446 cu.m/day).

The water quality survey at intake point has revealed that the water taken therefrom meets the water quality standards, except turbidity and color. And there will be the filtering facilities provided to reduce turbidity and color density.

c) Delivery Pipelines and Storage Tank

In principle, PVC pipes will be used and to be used for exposed portions. A comparative study was made for GI pipes and PVC pipes, which were selected as advantageous in popularity in the Philippine market and strength/durability out of a variety of pipes of GI, PVC, PE, PB currently available in the country. The study results that PVC pipes are economical in the ones smaller than 150 mm in dia., and PVC pipes have been taken as the ones to be used for the Project. GI pipes with superiority in solar ray resistibility will be used for those portions over rivers or streams while PVC pipes will be buried with earth coverage with thickness of 60 cm.

Two pumping facilities will be provided at the site filtering plant and at Buyabodo on the delivery route in taking into consideration inability of gravity delivery due to topographical conditions. For the pumping facilities with the filtering plant, the intake suction of pump will be designed on the basis of four-hours volume of the average daily supply.

The existing storage tank of Sta.Cruz has capacity of 523 cu.m (116,235 gallon). The water amount necessary for storage is 127 cu.m, equivalent to the amount of four hour supply of the Sta.Cruz on the daily average and the existing tank has a sufficient in volume. The tank will receive the mortar treatment for preventing water leakage, and float valve will be placed at the flow entrance so as to control the inflow.

The existing storage located at Tamayo has capacity of about 50 cu.m which is sufficient to meet the demand of 3,000 inhabitants, and the tank has the enough capacity. Then, the leakage preventive mortar repair and float valve will be designed as for future water supply available to those neighboring communities.

d) Filtering Plant

The proposed filtering plant is a sand filtering system, the design speed of water is 8 m/day with three filter basins in considering the easiness of O/M and economy. The chlorination facilities will be provided after filtering plant, and although there are four kinds of disinfectants available in the Philippines as Chlorine gas, hypochlorous acid calcium, breaching powder, and hypochlorous acid atrium. The first one, the most popular in the local market, will be used for the Project.

2) Torrijos Area

a) Design Alignment

The total length of the water supply pipe line will be 12,800 m. The proposed beneficial area is that extending between the water intake point and the existing Torrijos storage tank, and the main pipeline runs through the area with such communities as Tigwi, Kabyo, Bangan, Torrijos, Markanga, and

Pokyo. The designed total beneficial population is 6,993 persons, average daily supply amount is 498 cu.m/day.

The water supply system is at Level-3 for Torrijos and Level-2 for others.

b) Intake Facilities

The water source for Torrijos water supply system is spring in the mountain of Tigwi. Capacity of the spring is measured at 560 cu.m/day, and, the water quality at intake point has been found good to satisfy all the water quality standards of the country. In this view, no particular filtering plants will be provided for the plan but disinfection plant.

c) Pipelines and storage tanks

PVC pipes lines will be buried for the purpose as in the case of Sta.Cruz in principle, but Gl pipe will be used for the exposed portions like bridges and mountain areas between the water source and Tigwi. Gravity delivery is made available because water head between water source and terminal points can be sufficiently secured owing to the fact that the water source lies effectively high in elevation.

A distribution basin will be provided around the middle point between the spring and Tigwi village together with disinfecting plant.

Storage capacity of the existing Torrijos storage tank is 122 cu.m which can meet the demand based on the necessary amount of water for four (4) hours supply of the average supply.

Since, however, the water tank at Torrijos are already considerably time-worned, the leakage preventive mortar works will be executed together with providing float value at entrance of the flow so as to control the inflow water.

d) Filtering Plant

No particular filtering facilities are required in considering the excellent water quality, and there will be a disinfecting facilities provided in the middle of the water source and Tigwi village together with storage tank facilities. Disinfectant to be applied will the same as the case of Sta. Cruz hypochlorous calcium.

4. 3. 6 Basic Design Drawings

List of Basic Design Drawings is given as follow :

No of Drawing	Title
DWG No.1	General Map
DWG No.2	General Plan of Tagum-Angas Area
DWG No.3	Plan of Tambangan Dam
DWG No.4	Cross Section of Tambangan Dam
DWG No.5	Spill Way of Tambangan Dam
DWG No.6	Canal Profile of Tagum-Angas Irrigation Canal
DWG No.7	Canal Cross Section of Tagum-Angas Irrigation Canal
DWG No.8	Check & Drop of Tagum-Angas Irrigation Canal
DWG No.9	Turn-Out of Tagum-Angas Irrigation Canal
DWG No.10	Road Crossing & Cross Drain of Tagum Irrigation Canal
DWG No.11	Plan of Diversion Dam Laon-Mataas
DWG No.12	Section of Diversion Dam Laon-Mataas
DWG No.13	Canal Profile of Laon-Mataas CIP
DWG No.14	Standard Drawings of Road Improvement & Multipurpose Road Pavement
DWG No.15	Pipe Profile of Sta. Cruz Water Works
DWG No.16	Filtration Plant of Sta. Cruz Water Works
DWG No.17	Pump Station of Sta. Cruz Water Works
DWG No.18	Pipe profile of Torrijos Water Works
DWG No.19	Intake & Disinfection Facility of Water Works
DWG No.20	Plan of Agriculture Development & Promotion Farm
DWG No.21	Training & Administration Building (1)
DWG No.22	Training & Administration Building (2)

Note: Drawings are given in the end of this Report.

4.4 IMPLEMENTATION PLAN

4.4.1 Implementation Method

The implementation works include construction works and procurement works. The Construction works is composed of construction of irrigation facilities, road, water works and buildings, however, since the construction site of these construction are at same area mostly, these construction works are proposed to be carried out under one package contract works.

Meteorological condition of Marinduque Province is classified as Zone IV in the Philippines where the rainy season is not fixed, therefore construction schedule planning and its application for these climatic condition is very important. In case these construction works will be implemented under the Japanese Grant-aid, Japanese construction company is requested to complete the construction works with local contractor under the Japanese Grant-aid System.

Procurement of equipment is also planned to be carried out under one package contract with purchasing and setting up because equipment such as laboratory equipment, training equipment, agricultural machineries will be set up in the same farm.

4.4.2 Construction Condition

1) Material

The local construction materials for this construction works are planned to be used, however, the construction period is short, therefore, very careful attention is to be paid for procurement of construction materials such as cements, reinforcing bars, pipes, etc.

2) Flood diversion on the Dam Construction

a) Material Condition

The construction period of the dam is limited and then might not have enough days of the dry season even in which there happen sometimes sudden flooding by shower so that it requires an attention beforehand.

Mean meteorological condition such as rainfall, and temperature is given in the Figure E-12 in the Appendix according to the observed data at Sta. Cruz from March, 1983 to August, 1991.

b) Selection of Diversion Flood

In selecting the flood to be used in the design of diversion, 2-year flood, the largest and the second largest annual floods which may occur during the seasons mentioned below are estimated based on frequency analysis of daily rainfall data.

Case 1	Each Month	
Case 2	Most dry season	(Feb. to Apr.)
Case 3	Dry season	(Dec. to May)
Case 4	Yearly	(Jan. to Dec.)

The computation of probable floods is shown in Table E-16 in Appendix and the monthly probable floods obtained from the computation for Case 1 is given in Figure E-13 in Appendix.

c) Diversion Method and Diversion Flow

Since, the construction period is requested to be short due to Japanese Grant-aid System, diversion tunnel can't be constructed, therefore conduit and diversion channel through the dam will be provided. Conduit will be constructed on the left riverside then right side dam embankment is to be carried out. Therefore, diversion flow during the construction is estimated as follows :

i) Diversion Flow at Left Side Works

Diversion flow is designed at 204 cu.m/sec which is estimated at one time probability for two years for foundation treatment works, dam embankment and spillway construction.

ii) Diversion Flow at Right Side Works

Diversion flow at one time probability per two years for most dry season is 36 cu.m/sec, however, diversion flow by the maximum rainfall at February during eight (8) years is estimated at 58 cu.m/sec.

Flood during the right side construction works (only conduit can work for flood) is very important for whole construction.

Moreover, period of construction works might be changed from the most dry season due to climatic condition. Therefore, diversion flow is designed at 60 cu.m/s. This designed diversion flow is over the 56 cu.m/sec which is the flow estimated at once a year for dry season at Marinduque (from December to May). And, in case the embanking dam elevation will be higher than the coffer dam's, diversion capacity will be more.

For the above designed diversion flow, following diversion works is planned;

Conduit : two of ø 3,000 mm pipe
Open Canal : bottom width 5.0 m
river slope 1 : 50

Flow capacity curve is given in Figure E-14 in the Appendix.

d) Treatment of the embankment materials

As for the impervious soil materials, the major embankment materials of dam could be taken from the proposed reservoir area. While its imperviousness and structural strength are present, it may be necessary to

take care of the workability because the natural moisture content is rather high.

Therefore some countermeasures such as trenches at the borrow area for drainage would recommendable. And to scrape and pile up soil materials together with gravelly materials or weathered rock sufficiently existing in the lower layers of the proposed borrow area might be effective for the improvement of workability of the materials.

On the other hand, the site is in rather high temperature and usually has a strong sunshine so that the moisture content of material shall drop down immediately after borrowing. It may occur even in a few days of fine weather in the wet season, therefore, watering care shall be necessary at the site of embankment.

4. 4. 3 Construction Supervision Plan

1) Government of Marinduque

Government of Marinduque, which is the executing agency for this works, is requested to employ Japanese consultant for the detail design, construction supervision, and related activities, and approval of detail design, bid document, etc. is to be taken by the Government of Marinduque, However, it is necessary for the detail design of dam to take the NIA's approval because NIA will be the body for maintenance of dam after completion.

2) Consultant

When this works will be implemented under the Japanese Grant-aid Assistance, Japanese Consultant recommended by the JICA will be employed for the detail design, tendering and construction supervision under the Japanese Grant-aid System.

a) Detail Design and Tendering

- Detail Design and Preparation of Bid Document for construction works and procurement.
- Assistance of Tendering and evaluation of offers.
- Advice and presence to the contract negotiation
- Other necessary services

b) Construction Supervision

- Approval of Construction Drawings
- Supervision of construction schedule and quality control
- Control and approval of recording documents during the construction
- Assistance of final inspection and advice of issuing the acceptance document

4. 4. 4 Procurement Plan of Construction Materials

Procurement of construction materials will be managed by the Japanese contractor, however, purchasing plan of major materials is planned as follows :

1) Procurement in Philippines

- Construction Machine
- Cement
- Sand & Gravel
- Reinforcing bar
- Pipes
- Gate

2) Procurement from Japan

- Concrete Plant, Generator, Grouting Machine, Construction machine for continuance cut-off wall
- Aluminum Sash, Corrugated Steel Pipe, Bentonite, Rockbolt.

4. 4. 5 Implementation Plan

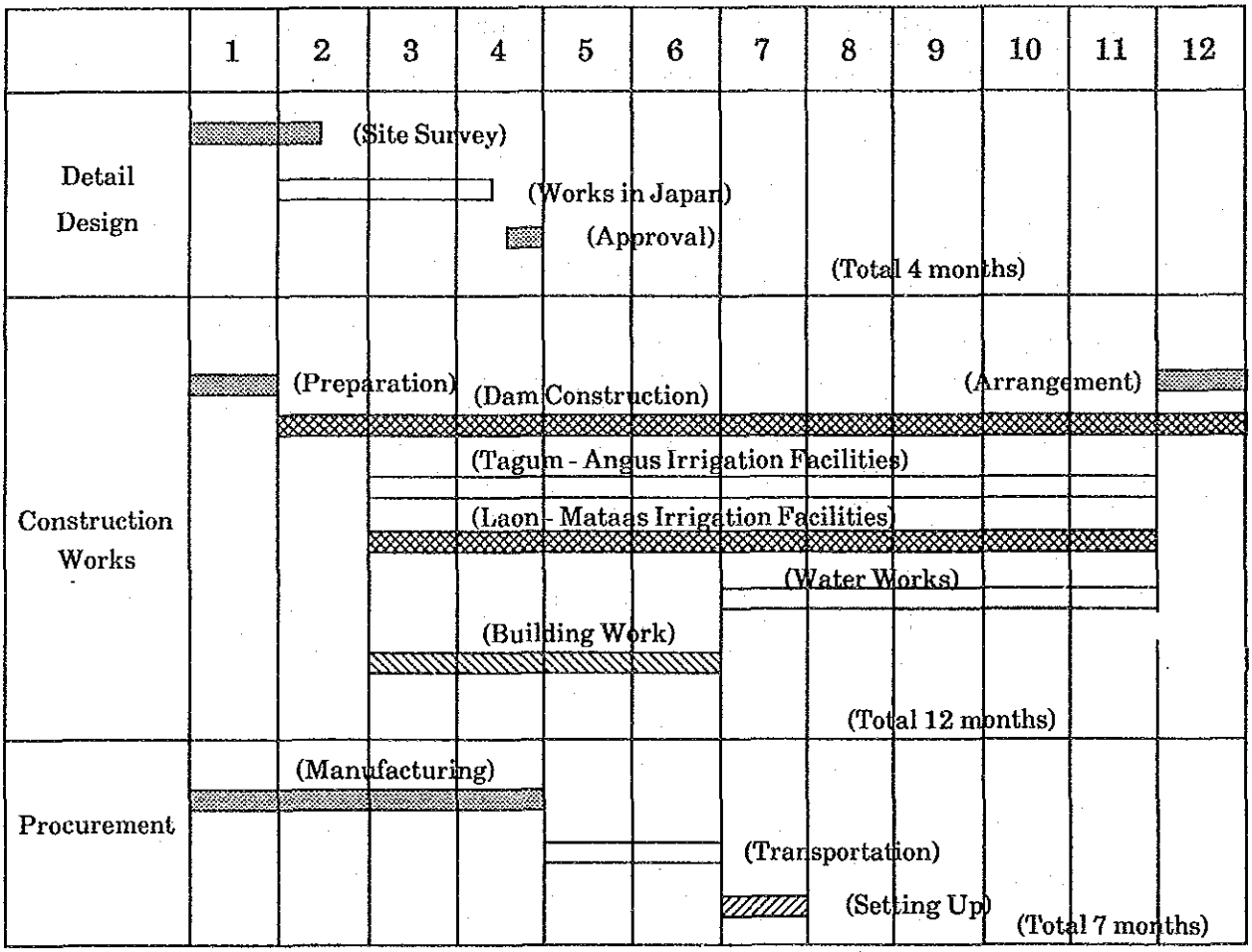
When this works will be implemented under the Japanese Grant-aid Assistance, it takes four month for detail design after verification of consultant contract with Government of Marinduque and Japanese Consultant which will be concluded after Exchange of Notes between Government of the Philippines and Government of Japan, and the construction period may be required for 12 months. Tentative Detail Schedule is given in Figure 4-7.

4. 4. 6 Cost Estimation

The Philippine Government will bear an amount of 1,368,000 pesos excluding taxes are as follows:

Land purchasing cost ..... 1,892,380 Peso for 32.5 ha

FIGURE 4-7 TENTATIVE CONSTRUCTION SCHEDULE



CHAPTER 5. PROJECT EFFECTS AND CONCLUSION

The subject Project aims at, through rural development especially introduction of irrigated agriculture and improvement of rural water supply raising-up of farmers' income and stabilization of rural peoples' daily lives in line with the policies involved in the Mid-Term National Development Plan, where development targets are focused on four(4) major points of poverty alleviation, generation of employment opportunities, promotion of equality and social justice and achieving of sustainable economic development.

Under the consolidation plan for agricultural infrastructures (Irrigation facilities and others), annual production of rice would be increased from the present 532 tons to 3,552 tons (3,020 tons increase). The increased production is to be derived not only from the consolidated irrigation facilities but also the improved farming technologies experimented and applied for extension services by the Agricultural Development Promotion Farm. The Promotion Farm will take up research and experimental activities on irrigated agriculture and also farming technologies for rainfed agriculture so that the Farm may serve to all the farmers in the Province in their quest to increase the agricultural products and resultant leveling up of the standard of living of rural people.

While the rural water supply plan for Sta. Cruz and Torrijos areas, where people suffer from inadequate supply and have to buy water for their daily lives, would directly contribute to leveling up of the peoples' standard of living. The number of people who may be benefited from these developments will amount to as much as 200,000 people, as in detail shown in Table 3-4.

APPENDIX

A. MEMBER LIST OF SURVEY TEAM

B. SURVEY SCHEDULE

C. LIST OF ATTENDANCE OF MEETING

D. MINUTES OF DISCUSSION

E. TABLES & FIGURES

APPENDIX A. MEMBER LIST OF SURVEY TEAM

A-1 BASIC DESIGN STUDY STAGE

NAME	SPECIALITY
Yukiharu KOSO	Team Leader Deputy Director Design Division Agricultural Structure Improvement Bureau Ministry of Agriculture, Forestry & Fisheries
Eiji INUI	Project Coordinator First Basic Design Study Division Grant Aid Study & Design department JICA
Hiroshi KONDO	Rural Development Planner SANYU Consultants Inc.
Yasunori HASEGAWA	Farm Management Planner SANYU Consultants Inc.
Hiroaki KAWACHI	Dam Designer SANYU Consultants Inc.
Masatoshi SOGAWA	Rural water Supply Facilities Designer SANYU Consultants Inc.
Tuneyoshi OGISO	Architectural Designer SANYU Consultants Inc.

A-2 DRAFT REPORT EXPLANATION

NAME	SPECIALITY
Yukiharu KOSO	Team Leader Deputy Director Design Division Agricultural Structure Improvement Bureau Ministry of Agriculture, Forestry & Fisheries
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Hiroshi KONDO	Rural Development Planner SANYU Consultants Inc.
Masatoshi SOGAWA	Dam Designer SANYU Consultants Inc.
Tuneyoshi OGISO	Architectural Designer SANYU Consultants Inc.

APPENDIX B. SURVEY SCHEDULE

B - 1 BASIC DESIGN STUDY STAGE

DATE	WORKS UNDERTAKEN
Sep. 2 (M)	All member of B/D Study Team arrived at Manila. Courtesy call to JICA Manila Office EOJ.
3 (T)	Courtesy call to DPWH, NIA & DA
4 (W)	Courtesy call to NEDA central, NEDA Regional IV & PMS
5 (T)	Leaving for Marinduque, Meeting with Provincial Officials
6 (F)	Site survey (Dam Site & Irrigable area)
7 (S)	Site survey (water resources for Torrijos water work & irrigable area)
8 (S)	Meeting in Team, Site survey (Project Area)
9 (M)	Meeting with Provincial Officials
10 (T)	T/L, Mr. Inui & Mr. Kondo leaving for Manila, Joint Meeting Signing of Minutes of Meeting
11 (W)	Reporting to JICA & EOJ Site survey (Present Water Supply, Dam site, agriculture)
12 (T)	T/L leaving for Tokyo Receiving answers to questionnaire and meeting site survey (dam site)
13 (F)	Mr. Inui leaving for Tokyo Arrangement of collected data (Marinduque Lay)
14 (S)	OFF
15 (S)	Mr. Kondo return back to Marinduque Meeting in Team. Site survey (Barankan)
16 (M)	Site survey (Laon-Mataas Irrigation area, dam site, Sta. Cruz)
17 (T)	Meeting in PIO for irrigation plan. Site survey (dam site, Torrijos) Data collection (PPDO, DA, DPWH)
18 (W)	Site survey (Tagum - Angas, reservoir area) Discharge measurement at Tigwi.
19 (T)	Site survey (canal alignment of Tagum - Angas Irrigation canal, multi purpose road pavement, port.)
20 (F)	Mr. Hasegawa & Sogawa leaving to Manila
21 (S)	Arrangement of collected data

DATE	WORKS UNDERTAKEN
Sep. 22 (S)	OFF
23 (M)	Data collection (NEDA, NSCP & DA - IV) Site survey (Material transportation way) Meeting with PEO (multi - purpose road pavement)
24 (T)	Data collection (NIA, DPWH, CIAP & DA) Site survey (multi - purpose road pavement, pipe line route between Tigwi - Torrijos)
25 (W)	Data collection (BPI, NIA - DCIEC) Site survey (water source of Tigwi, aggregate)
26 (T)	Mr. Hasegawa & Mr. Sogawa leaving for Tokyo Site survey (Road of Sta.Cruz & Napo)
27 (F)	Site check (Topo - survey, boring etc.)
28 (S)	Site check (test - pits)
29 (S)	Mr. Kondo, Mr. Kawachi & Mr. Ogiso leaving for Manila
30 (M)	Data collection
1 (T)	Data collection
2 (W)	Data collection
3 (T)	Data collection
4 (F)	Data collection
5 (S)	Arrangement of collected data
6 (M)	Arrangement of collected data
7 (T)	Data collection Mr. Kawachi leaving for Marinduque
8 (W)	Data collection Site check
9 (T)	Arrangement of collected data. Reporting to JICA office Mr. Kawachi leaving for Manila
10 (F)	Arrangement of collected data. Preparation of leaving
11 (S)	Mr. Kondo, Mr. Kawachi & Mr. Ogiso leaving for Tokyo

B - 2 DRAFT REPORT EXPLANATION

DATE	WORKS UNDERTAKEN
Mar. 5 (T)	Arriving at Manila Coutesy call to JICA Philippine office & EOJ
6 (F)	Explanation of Report to NEDA-Regional IV & NIA
7 (S)	Leaving for Marinduque, Explanation of Report to Provincial Government of Marinduque
8 (S)	Supplemental Site Survey
9 (M)	Discussion wiht PGM
10 (T)	Discussion with PGM & Signing of Minutes of Meeting
11 (W)	Leaving for Manila, Report toJICA, EOJ, PWH, NIA & NEDA - Regional IV
12 (T)	Leaving for Tokyo