F-2 Drainage and Flood Protection

F-2-1 Present Condition

1) Drainage Conditions and Facilities

The drainage damages in Marinduque are:

(1) Submergence of paddy field/coconut lands and lowly elevated agricultural areas at downstream of the rivers,

(2) Erosion of some portions of river embankments, loose/rough roads and temporary wooden bridges.

The 10 places that have habitual submerged damages are shown in Table F-2-1. The total area is 520 ha.

2) Flood Protection Facilities

The existing flood protection dikes are limited and not enough against floods.

In order to protect the river side areas from flood damages, two methods are applicable: construction of dikes and reservoirs. Since reservoir for flood control needs high dam at big capacity and much cost, protection dike system is recommended. (refer to Table F-2-2)

F-2-2 Drainage Planning and Flood Protection

1) Drainage Planning

For the design of proposed field drainage facilities, the drainage module of 6 lit/sec/ha would be applied by using a design rainfall of 66.5 mm/day on a probability of one to two years and the run-off coefficiency of 0.8.

$$q = 0.2778 \times \frac{66.5}{24} \times 0.8 \times 10 = 6 \text{ lit/sec/ha}$$

Standard drainage canal density is 30 m per ha with an earth-dike type canal. These field drainage canals are instituted to all proposed irrigation areas, namely: rehabilitation of existing systems and new irrigation projects. (refer to Table F-1-7)

b) Flood Protection

The proposed run-off discharge would be calculated by using the Discharge-Frequency-Drainage Area-Relationship by NIA. The probability of the proposed run-off is applied using a return period of one to ten years. Proposed specific discharge would be varied according to the drainage area of each river basin. (refer to Table F-2-3)

The total length of the proposed protection dike is 44 km. The dike type will be accepted one of three types which are reinforced concrete type, rubble concrete type and earth-fill type, depending on the geographical and hydrological river conditions. (refer to Table F-2-4)

Table F-2-1 Flood Damages and Drainage Conditions

Municipality	No.	Location	Cause of Damage	Flood Condition		
				Submerged Time (hr)	Max. Depth (m)	Area (ha)
Mogpog	1.	Danao-Subucao & Bato	Overflow from Mogpog River & Creek	12-24	0.5-2.0	100
	2.	Ino Capayang	Overflow from CMI dump pit	5	0.5	50
	3.	Butansapa	Overflow from Butansapa Creek & Runoff	6-24	0.3-1.0	10
Boac	4.	Mansabang	Overflow from Cabuyao Creek & Runoff	16-24	1.0-1.5	100
	5.	Tabigui	Overflow from Boac River	6	0.3-0.5	150
	6.	Ihatub	Overflow from Igatalo Creek	4-6	0.3	10
	7.	Bunganay	Overflow from Creek	6	0.3	15
Buenavista	8.	Bet. Caigangan & Poblacion	Runoff	4	0.3-0.5	15
Sta. Cruz	9.	Hupi	Runoff Water	3-6	0.3-0.5	30
	10.	Landy	Overflow from Creek & Runoff	3-4	0.3-0.5	40
Total						520

Source: Provincial Engineering Office and JICA Study Team (as of Aug., 1989)

Table F-2-2 Existing Flood Control Facilities

Municipality	Name of River	Location	Purpose	Open Channel	Facilities (m)	
					Earth Dike	Revetment
BOAC	Boac River	Poblacion	Town area protection	-	-	1,150 *
		Balimbing	Road & farm land	-	-	205
	Bantay River	Bantay	Village area	-	-	260
	Amoingon	Amoingon	Village area	-	-	270
Sub-Total						1,885
MOGPOG	Mogpog River	Nangka	Road	-	-	45 *
		Laon	Village area	-	-	120
		Sumangga	Road & farm land	-	-	260 *
		Butansapa	Road	-	-	20 **
	Ulan River	Capayang	Farm land	700	150	300
	Balanacan River	Balanacan	Village area	-	170	160
Sub-Total				700	320	905
STA. CRUZ	Buyabod Creek	Buyabod	Farm land, houses & school	950	-	340
	Bitik Creek	Bitik	Village area	500	-	375 *
	Lady Creek	Landy	Village area	-	-	45
Sub-Total				1,400	-	760
TORRIJOS	Matuya-tuya Creek	Matuyatuya	Farm land & houses	400	740	320
	Poctoy Creek	Poctoy	Farm land	200	200	15
	Cabuyo River	Cabuyo	Village area	-	-	75
Sub-Total				600	940	410
GASAN	Libtangin River	Libtangin	Farm land	-	-	240
	Tiguion River	Dili	Market area	-	-	200 **
		Tiguion	Road & houses	-	-	110 ***
	Dawis River	Dawis	Village area	-	-	100 ***
Sub-Total				-	-	650
Total				2,750	1,260	4,610

Source: DWPH Provincial Office and JICA Study Team
Notes : *---Damaged by typhoon, **---Totally washed out, ***---Need extension

Table F-2-3 Proposed Specific Discharge

River Basin (sq.km)	10	20	50	100	200
Return Period (year)					
1/2	5.0	4.2	3.3	2.7	2.2
1/5	11	9.0	7.0	5.8	4.7
1/10	16	13	10	8.5	7.0
1/20	22	18	14	11.5	9.5
1/50	28	24	19	16	13
1/100	37	30	24	20	16

Source: Based on Flood Frequency Curve by NIA

Table F-2-4 Proposed Flood Protection Dike

Development Stage	Dike Type and Length (Km)			
	A	B	C	Total
Short Term Development	(0.3)	(1.3)	(10.8)	(12.4)
Mogpog River	0.2	0.7	2.2	3.1
Boac River	0.1	0.6	5.0	5.7
Potat (Bagtingon)	-	-	1.6	1.6
Cabuyao (Mansabang)	-	-	2.0	2.0
Medium Term Development	(0.5)	(1.8)	(8.8)	(11.1)
Mogpog River	0.3	1.1	2.2	3.6
Boac River	0.2	0.7	6.6	7.5
Long Term Development	(0.9)	(3.1)	(16.1)	(20.1)
Mogpog River	0.5	1.8	4.5	6.8
Boac River	0.4	1.3	11.6	13.3
Total	(1.7)	(6.2)	(35.7)	(43.6)

Notes : Type A ------ Reinforced Concrete Dike
Type B ------ Rubble Concrete Dike
Type C ------ Earth Dike

F-3 Village Water Supply

F-3-1 Present Condition

1) Bagtingon (Buenavista) Area

In Marinduque, only Municipality of Buenavista have no water works. So village water for Buenavista is generally taken from deep and shallow wells with manual pump. There exist only 17 public wells in the urban areas, and 36 public wells in the rural area. The village water supply system is not adequate and quantity of water to be supplied are not enough. The total number of people served by public wells are approximately 7,040 persons, which is only 45 percent of the population in the Municipality of Buenavista. Therefore about 55 percent of the people in the Municipality of Buenavista get their village water from other sources like privately-owned wells or other means. The development of the village water is the strong inhabitants desire.

2) Tagum-Angas (Sta. Cruz) Area

The village water for Tagum-Angas area is generally taken from deep and shallow well with manual pump. The village water supply system is not adequate and quantity of water to be supplied are not enough. According to the geological survey, this area is the difficult area of drawing the ground water, so the development of the village water is the strong inhabitants desire.

F-3-2 Development Plan

1) General

The village water supply plan is studied on the two components of estimation of the water requirement and preliminary design of village water system.

The project is composed of the farming water and rural water supply. The farming water is including the water for livestock, and for wash of farm product and farming machine.

2) Estimation of Water Requirement

a) Design Water Requirement

Water requirement is different from the mode of living to the form of livestock's raising. Considering to water demand of domestic and livestock use, following criteria is applied for the design water requirement.

Livestock use:	Cattle ----------	50 lit/head/day
	Carabao ----------	50 lit/head/day
	Horse ----------	45 lit/head/day
	Hogs ----------	35 lit/head/day
	Goat ----------	8 lit/head/day
	Chicken ----------	0.6 lit/head/day
Washing use:	Truck, Tractor ---	100 lit/head/day
	Plow, Hoe --------	5 lit/head/day
Domestic use:	Level II ---------	60 lit/person/day

b) Water Demand

Considering to trend of population and livestock, the water demand for village water at implementation period of the year 2010 are as follows:

		Bagtingon area		Tagum-Angas area	
		Head	cu.m/day	Head	cu.m/day
Livestock use:	Cattle	1,590	80	1,340	67
	Carabao	4,980	249	2,680	134
	Horse	1,180	53	130	6
	Hogs	13,710	480	2,680	94
	Goat	2,900	23	4,020	32
	Chicken	91,510	55	8,040	5
	A total		940		338
Irrigation :			300		---
Domestic use :	Level II	15,650	939	5,600	336
Others :			10		10
Average day demand	(q)		2,190		684
Maximum day demand	(1.3 q)		2,850		890
Maximum hour demand	(2.5 q)		5,460		1,710

3) Preliminary Design of Village Water System

Considering an economical system, the possibility of using a gravity system should be considered first. In Bagtingon area, there exist a good spring which gushing out about 40 to 50 lit/sec even dry season. Therefore this spring being applied as a water sources for village water. The facilities of this system is composed of the diversion dam, the main pipe, the reservoir, the distribution pipe and communal faucets. On the other hand, the Tagum-Angas area would be supplied the water from the proposed Tagum-Angas dam. The preliminary improvement plan of village water supply are summarized as follows: (refer to Figures F-3-1 and F-3-2)

	Bagtingon area	Tagum-Angas area
Intake discharge:	2,850 cu.m/day	890 cu.m/day
Water sources:	Spring (Foot of Mr. Marindig)	Tagum-Angas dam
Facilities:	Diversion dam Ground reservoir (V = 950 cu.m) Main pipe (G.I pipe 6"L=7.5km) Distribution pipe (G.I pipe 4"L=9 km) (G.I pipe 2"L=7 km) Communal faucets (84 sets)	Main pipe (G.I pipe 8"L=6.0km) Distribution pipe (G.I pipe 6"L=5 km) (G.I pipe 4"L=6 km) (G.I pipe 2"L=8 km) Communal faucets (70 sets) Ground reservoir (V = 300 cu.m)
O & M body:	Village water supply association	Village water supply association

Figure F-3-1 Bagtingon Village Water Supply System

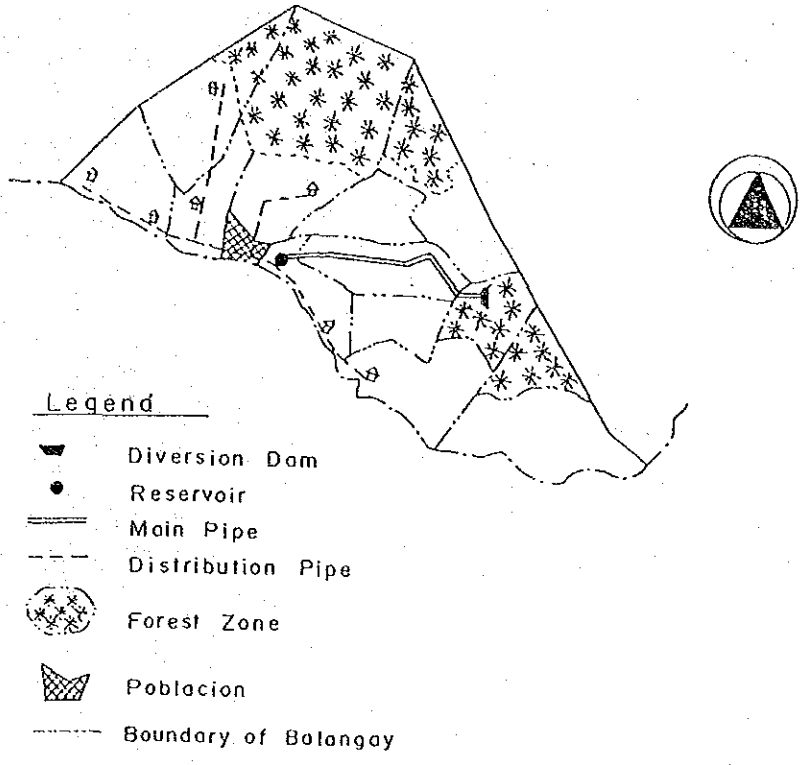
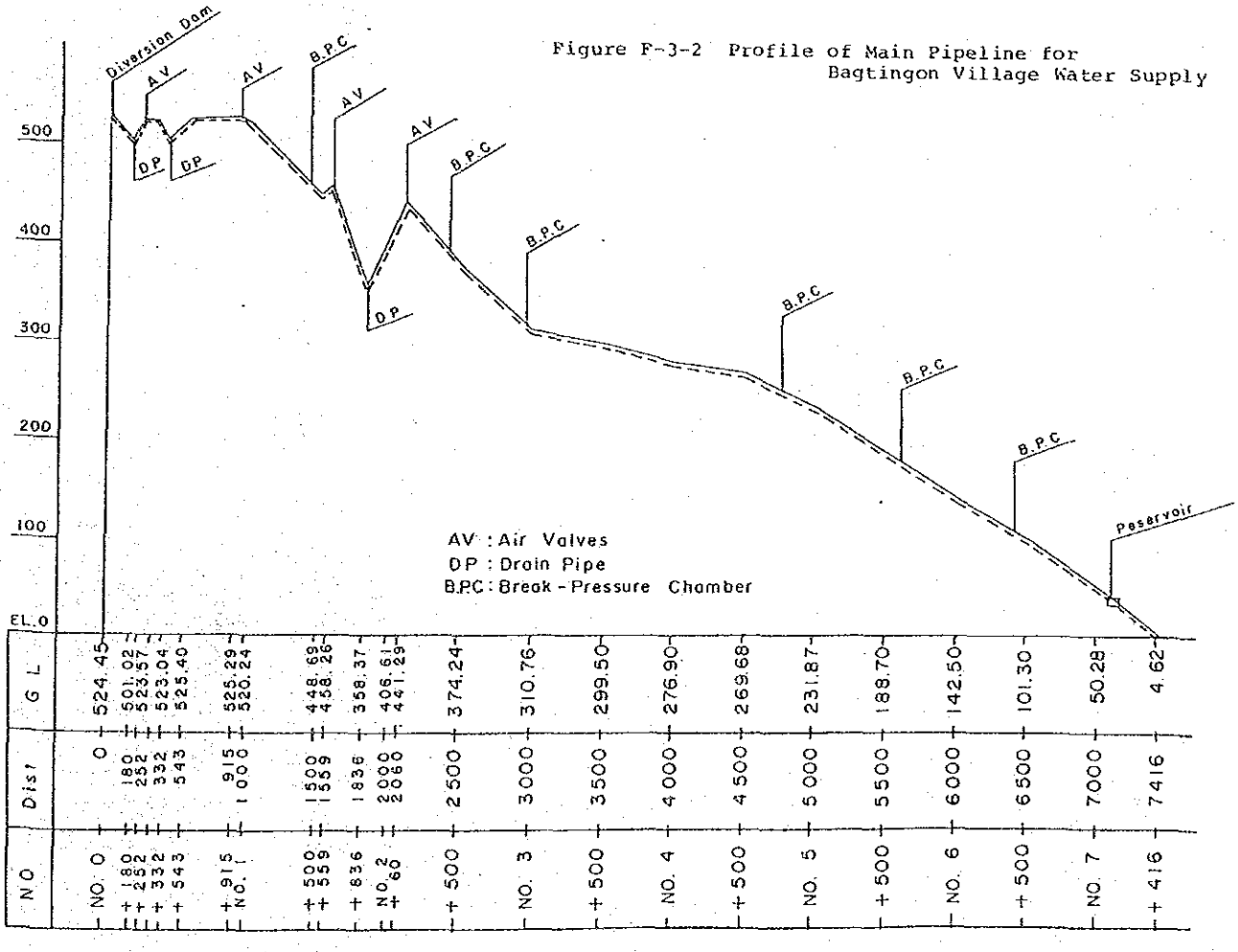


Figure F-3-2 Profile of Main Pipeline for Bagtingon Village Water Supply



APPENDIX G ROADS AND TRANSPORTATION

APPENDIX G ROADS AND TRANSPORTATION

APPENDIX G ROADS AND TRANSPORTATION

G-1 Roads

G-1-1 Present Condition

1) Present Condition

Rural roads are mainly composed of provincial and Barangay roads. Approximately 90% of provincial and Barangay roads are either gravel or earth surface, while bridges are mostly temporary structures such as timber and bailey bridges. (refer to Figure G-1-1 and Tables G-1-1 and G-1-2)

There are several on-going and existing road projects funded by IBRD, ADB and national/local government. IBRD has assisted in the restoration projects and replacement of the temporary bridges along the circumferential road (national road). On the other hand, ADB will finance the improvement projects to upgrade from gravel surface to asphalt pavement along the circumferential road as well. The road projects funded by the national/local governments are mostly rehabilitation of provincial and Barangay roads which have been damaged by typhoons and floods. (refer to Table G-1-4)

2) Typhoon and Flood Damage

In November 1987, Typhoon Sisang with maximum wind strength of 233 kph brought heavy damage to the Marinduque Province. About 65 km of road were damaged according to the survey mission dispatched by ADB. Thereafter, in late 1988, almost 20% of the provincial and Barangay roads (77 km) were heavily damaged by two super typhoons, Typhoon Unsang and Typhoon Yoning. (refer to Table G-1-3)

3) Operation and Maintenance

Maintenance works for roads and bridges are composed of regular maintenance and periodic maintenance. Approximately 60% of the annual maintenance cost are used for regular maintenance and 40% for periodic maintenance. Such maintenance of roads seems to be rather important in the Marinduque province than in other provinces in the Philippines, as this province is frequently hit by typhoons. Nearly 30% of the annual budget of the provincial government are spent for public works mainly maintenance of local roads and bridges. (refer to Tables G-1-5 and G-1-6)

G-1-2 Development Plan

1) Targets and Plans

Since the Master Plan is divided into three stages as described in the Main Report, targets for each development stage are also set up and presented below.

a) Targets for Short-Term Development

First attention shall be paid to improvement/upgrading of the existing roads which could get quick benefits with less investment costs.

Improvement/Upgrading and construction of rural roads (farm-to-market roads) shall be concentrated on the roads between Barangay centers or major productive areas and municipal centers. Construction of trunk farm roads shall be to connect farming areas and Barangays according to the irrigation and agriculture development scheme. Replacement of temporary bridges, asphalt pavement of national roads, and construction of multi-purpose pavement shall be undertaken steadily.

b) Targets for Medium-Term Development

Improvement/Upgrading and construction of rural roads shall be for roads between small villages, adjacent to the Barangay centers and main rural roads or municipal centers. Construction of trunk farm roads shall also be pursued based on the irrigation and agriculture development.

c) Targets for Long-Term Development

Many development plans will be implemented to attain overall target by the end of the final development stage. Targets in this stage are; construction of rural roads in the remote Barangays/villages to existing road as major targets, improvement/upgrading of existing minor rural roads, construction of farm roads, replacement of all remaining existing temporary bridges, and asphalt pavement of all national roads.

Based on the targets described above, rural road development plans are formulated by development stages. (refer to Figures G-1-1 and G-1-2, and Tables G-1-7 and G-1-8)

2) Operation and Maintenance

The maintenance operations are broken down into regular (routine) and periodic maintenance. The regular maintenance includes all of the normal operations that are performed one or more times a year such as filling the potholes, cleaning drainage ditches, vegetation control, bridge channel clearing, etc. Periodic maintenance includes the operations that are scheduled ahead of time with intervals of several years, such as pavement resurfacing, regravelling, painting of steel bridges, etc. Since the maintenance operations have not been properly executed due to lack of equipment, supply of some maintenance equipment including workshop tools and facilities to Motor Pool of PEO should be important program to be implemented in the short-term development stage. (refer to Table G-1-9)

Table G-1-1 Existing Road Length in Marinduque (as of March 1989)

Road Type	Pavement					Bridges							
	Length (km)	Concrete (km)	Asphalt (km)	Gravel (km)	Earth (km)	Timber		Bailey		Concrete		Steel	
						No.	L.M.	No.	L.M.	No.	L.M.	No.	L.M.
National	219.18	2.86	53.11	142.81	20.40	9	90.4	4	60.9	17	742.5	6	340.5
Provincial	173.38	4.90	23.29	145.19	-	8	76.6	1	20.0	3	18.0	-	-
Municipal	135.09	15.68	6.70	65.19	47.52	-	-	-	-	-	-	-	-
Barangay	138.82	-	-	116.90	21.92	-	-	-	-	-	-	-	-
Total	666.47	23.44	83.10	470.09	89.84	17	167.0	5	80.9	20	760.5	6	340.5
(%)	(100)	(3.5)	(12.5)	(70.5)	(13.5)								

Source: Department of Public Works and Highways (DPWH), District Office, Marinduque
Provincial Engineering Office, Marinduque

Table G-1-2 Road Density in 1987

Category	Total Road Length (a) (km)	Total Land Area (b) (km^2)	Population (c) (1,000)	Road Density (a)/(b)	Road Density (a)/(c)
Philippines	157,810	300,000	57,356	0.53	2.75
Marinduque	665.2	959.2	198.2	0.69	3.36

Source: Department of Public Works and Highways (DPWH)

Note : Population is estimated as 2.4% increase rate for over all Philippines and 1.9% for Marinduque Province based on the population census in 1980.

Table G-1-3 Inventory of Road Damage by Recent Typhoon

Municipality	No. of Section Damaged	Road Length Damaged (km)	Estimated Damage Cost (1,000 ₱)
Boac	5	23.3	2,170
Mogpog	3	16.4	1,070
Gasan	3	7.6	1,600
Sta. Cruz	4	11.1	2,140
Torrijos	5	16.3	1,650
Buenavista	1	2.0	350
Total	21	76.7	8,980

Source: Department of Public Works and Highways (DPWH), District Office, Marinduque

Note : Inventory was conducted on December 1988 after being hit by typhoon Unsang (November) and Yoning (December).

Table G-1-4 On-going/Existing Road Project in Marinduque

Name of Project	Road Type	Executing Agency	Status of Project	Length	Remarks
1. IBRD Assisted Project					
1) Construction of 11 structures	National	DPWH	On-going	180 lm	5th IBRD Loan, 5RCDG & 6RCBC, Replacement
2) Restoration Project	-do-	-do-	-do-	6.8 km	2 Projects, Asphalting, 5th IBRD Loan
3) Matalaba-Devilla Road (New)	Provincial	PEO	Programed in 1990	5.0 km	Under SRRIP, Preparation of bid documents
4) Mogpog-Balanacan Road	National	DPWH	Programed in 1990	3.0 km	5th IBRD Loan, Asphalting
2. ADB Assisted Project					
1) Taytay-Torrijos-Gasan	National	DPWH	Programed in 1989	14.4 km	Asphalting/Gravel, Under package 1b
2) Infra-reconstruction program	-do-	-do-	Programed in 1990	-	4 Projects, Damaged by typhoon Sisang
3. JUNBO Loan Project					
1) Construction of 2 Bridges	National	DPWH	On-going	41.7 lm	Yamog & Balanacan bridges, Replacement
4. U.S. Assisted Project					
1) Boac Interior Road	National	DPWH	Programed in 1990	23.0 km	
5. National Funding Project					
1) Improvement/Rehabilitation Project	National	DPWH	On-going	6.5 km	4 Projects, 1988 & 89 Infra Project
2) Improvement/Rehabilitation Project	Barangay	DPWH/PEO	-do-	28.0 km	12 Projects, 1987, 88 Project
3) Improvement/Rehabilitation Project	Provincial	PEO	-do-	25.3 km	13 Projects, 1988 & 89 Infra Project
4) New Road Proejct	Barangay	DPWH	-do-	1.5 km	3 Projects, 1988 Project
5) New Road Project	Provincial	-do-	-do-	9.86 km	5 Projects, 1988 & 89 Infra Project
6) Calamity Project	Barangay/ Provincial	-do-	Not-started	22.3 km	19 Projects, 1988 Calamity Fund
7) Multi-purpose Pavement	Barangay	-do-	On-going	37 places	150 lm each, 1989 Infra Project

Source: DPWH, PEO

Table G-1-5 Equipment List in PEO
(As of March 1989)

Name of Equipment	No. of Unit	Year Acquired	Rental Rate Peso/Day	Condition
Bulldozer	2	1980	2,255	Fair
Road Grader	2	1980	3,000	Fair
Front End Loader	2	1980	1,440	Fair
Road Roller	1	1980	1,260	Fair
Dumptruck	3	1980	1,725	Fair
Pick-up	1	1980	465	Fair
Jeep, land Cruiser	1	1973	-	Poor

Source: Provincial Engineering Office, marinduque

Table G-1-6 List of Equipment in the Area Shop of DPWH
(As of March 1989)

Name of Equipment	No. of Unit	Year Acquired	Rental Rate Peso/Day	Condition
Pick-up	10	1975-1988	110-465	Fair(8), Good(2)
Dump Truck	5	1976-1983	970-1725	Fair
Payloader	3	1974-1984	1,165-2255	Poor(1), Fair(2)
Road Grader	5	1978-1983	2,100-3000	Poor(2), Fair(3)
Road Roller	3	1978-1984	1,260-1700	Poor(1), Fair(2)
Bulldozer	3	-	2255	Fair
Truck Crane (25t)	1	1969	4425	Fair
Road Maintainer	2	1977-1979	870	Poor(1), Fair (1)
Rock Crusher Portable	1	1984	840	Fair
Asphalt Distributor	1	1988	2880	Fair
Asphalt Mixer	1	1988	1400	Good
Asphalt Kettle	1	-	200	Fair
Drilling Machine	1	1988	-	Fair
Lane Marker	1	1984	130	Good
Pavement Breaker	1	1985	80	Fair
Grass Cutter	3	1987	20	Poor
Welding Machine	1	1978	250	Poor
Water Pump Robin	2	1984	20	Fair
Pile Hammer	1	1980	-	Fair
Clamshell	1	-	85	Fair
Generator	1	-	230	Fair

Source: Marinduque Area Shop, Region IV-B Equipment Service, DPWH

Table G-1-7 Rural Road Development Plan

Item	Improvement/Upgrading				Construction			
	S.T.	M.T.	L.T.	Total	S.T.	M.T.	L.T.	Total
1. Farm-to-market Road								
Type A (km)	40	40	80	160	20	-	-	20
Type B (km)	40	30	-	70	20	30	70	120
Type C (km)	50	20	-	70	40	50	100	190
Total (km)	130	90	80	300	80	80	170	330
2. Farm Road								
Type D (km)	0	0	0	0	80	70	150	300
3. Multi-Purpose Pavement (Place)	0	0	0	0	200	100	100	400
4. Bridge (L.M)	200	100	70	370	120	120	260	500

Note 1: Side ditches and culvert crossing shall be sufficiently considered in engineering aspect.
2: Bridge types shall be either RCDG or non-composite beam girder.
3: Length of multi-purpose pavement shall be 150 l.m per place.

Source: JICA Study Team

Table G-1-8 Proposed Road Density

Stage (Year)	Total Road Length (a) (km)	Total Land Area (b) (km^2)	Population (c) (1,000)	Road Density (a)/(b)	Road Density (a)/(c)
1987	665	959.2	198.2	0.69	3.36
1989	678 1/	-do-	205.8	0.71	3.29
S.T. (1995)	758	-do-	230.4	0.79	3.29
M.T. (2000)	838	-do-	253.1	0.87	3.30
L.T. (2010)	1008	-do-	305.5	1.05	3.30

Note: 1/ On-going projects for 1989 are included

Source: JICA Study Team

Table G-1-9 Equipment List for Reinforcement of PEO Motor Pool

Name of Equipment	Description	No. of Unit	Remarks
1. Maintenance Equipment			
Bulldozer	70 PS	2	
Motor Grader	125 PS	1	
Wheel Loader	0.4 m^3	1	
Backhoe	0.3 m^3	2	
Road Roller	3.3 t	2	
Vibrating Roller	2.5 t, 700 mm	1	
Dumptruck	11 t	2	
Water Truck	6500 l	2	
Concrete Mixer	0.5 m^3, Engine type	2	
Compresser	5 m^3/min	1	
Water Pump	ϕ 100, 5.2 kw	1	
Aggregate Crusher	760 x 180	1	
Jack Hammer	590 mm, 2.3 m^3/min	2	
Grass Cutter	Handy type	10	
2. Workshop Equipment & Tools			
Oil Storage Tank	1.0 m^3 w/pump	1	
Welding Machine	5 kw, Engine type	2	
Chain Block	10 t	1	
Others		LS	
3. Facility			
Equipment Pool		800 m^2	
Workshop		200 m^3	

Source: JICA Study Team

Figure G-1-1 Proposed Road Network in Marinduque

Legend

——————: National Road

——————: Provincial/Barangay Road

++++++++++++++++: Marcopper Mining Road (Private)

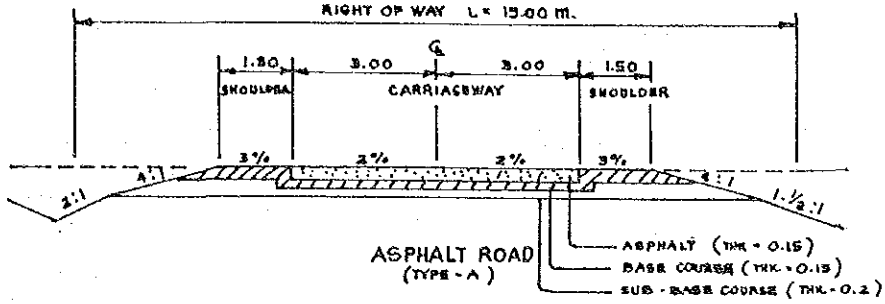
– – – – – – – – – –: Proposed Road

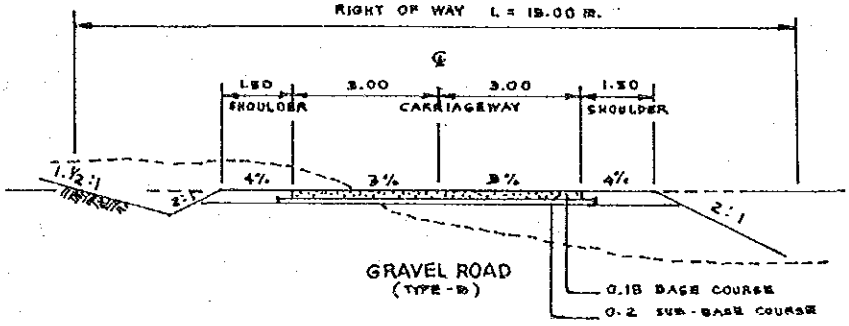
0 5 10km

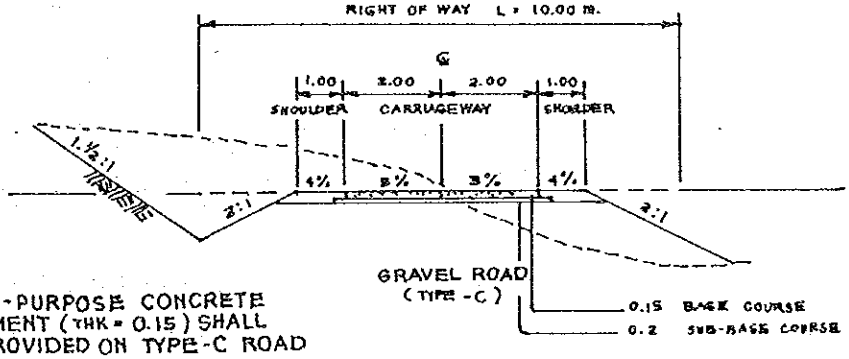
Note: Minor roads are not indicated in the map

Source: JICA Study Team

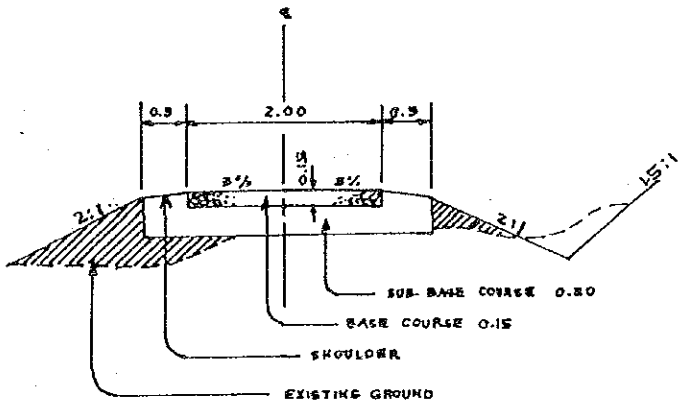
Figure G-1-2 Standard Road Section







NOTE :
MULTI-PURPOSE CONCRETE PAVEMENT (THK = 0.15) SHALL BE PROVIDED ON TYPE-C ROAD



GRAVEL ROAD
(TYPE - D)

G-2 Transportation

G-2-1 Present Condition

1) Internal Transportation

Internal traffic system in Marinduque consists of trucks, jeepneys, or tricycles. A Total of 1,128 motor vehicles are registered int he Province, which gives a very low rate of ownership of 5.4 vehicles per 1,000 population. These are mainly of cars, 3.7%; trucks, 7.2%; motorcycles, 15.8%; jeeps, 49.3%; and tricycles, 24%. (refer to Table G-2-1)

Jeepneys are commonly used means of transport serving inter-municipal routes with over passenger capacity, because of the few frequency of traffic. But after six o'clock in the evening, the traffic volume become quite few and the jeepneys hardly move round. (refer to Table G-2-2)

Since there exist very few waiting shed, inhabitants find it difficult to ride jeepney, especially during rainy season. On the other hand, the tricycle generally operate for travels within the municipality, usually within the urban area. The heaviest traffic flows are observed on the roads of Boac, the Boac-Mogpog. (refer to Tables G-2-3 and G-2-4)

The main commodities being transported on the road are groceries, bottled soft drinks, copra, rice and general cargoes. However some areas are not served by motor vehicles because of the absence of road. The people who live in the interior part has either to hike or go on horseback riding.

2) External Transportation

External traffic between Marinduque island and other island is done by sea routes and airplanes. There are six ports in the province, the most important of which are the two national ports located in Balanacan,

Mogpog and in Buyabod, Santa Cruz. The other ports are two municipal ports and two private ports (refer to Table G-2-5)

A ferry boat services per day between Balanacan and Lucena. The national port of Buyabod has an average ship call of 70 vessels per month. The average monthly cargo is estimated at 2,138 tons while passenger traffic is recorded at 148,359. (refer to Table G-2-6)

The existing port facilities are not adequate to meet the increasing demand of cargo and passenger traffic. So improvement of the port facilities is a strong desire of inhabitants.

In addition, there are two airports in Marinduque, a public airport at Gasan and private airport at Santa Cruz. The province is served by the Gasan airport, where the Philippine Airlines land to Manila once a day.

G-2-2 Development Plan

1) Basic Concept

With consideration to increase of the number of passenger and quantities of cargos handled by the ports and forecast of the traffic volume for the on-going and the proposed development plan, it would be necessary to improve the existing Balanacan, Buyabod and Cawit port and to construction of waiting shed. However it is impossible to provide a perfect facilities covering the whole area in a short time, as well as the cost of the construction of facilities must be considered. Therefore, considering the existing condition of these ports and roads, the improvement of the port which facing serious problems at present should be projected first. (refer to Table G-2-7)

2) Development Strategy

The development of the traffic system was projected, based on the following consideration.

- The support of the trading, commercial activities of the province was contemplated.

- The improvement of the present transport system of the province was contemplated.

3) Selection of Project

Based on the development strategy, the improvement of the traffic system projects were selected as follows:

- Cawit port improvement project : Construction of passenger shed
  A = 8 m x 50 m ---- 1 unit
  Construction of cargo shed
  A = 20 m x 50 m ---- 1 unit
  Set up fork lift
  V = 5 ton ---- 2 units

- Balanacan port improvement project: Construction of passenger shed
  A = 8 m x 50 m ---- 2 units
  Construction of cargo shed
  A = 20 m x 50 m ---- 2 units
  Set up fork lift
  V = 5 ton ---- 2 units

- Buyabod port improvement project : Construction of passenger shed
  A = 8 m X 50 m ---- 2 units
  Construction of cargo shed
  A = 20 m x 50 m ---- 2 units
  Set up fork lift
  V = 5 ton ---- 2 units

- Waiting shed project : Construction of waiting shed along the national, Provincial and Barangay road at interval of one kilometer.
  A = 3 m x 3 m

Table G.2.1 Number of Motor Vehicles Registered

	1985	1986	1987	1988
1. Private				
Cars/Trucks	111	106	118	106
Jeepneys	319	256	281	319
Motor Cycle	412	115	126	171
Motor Tricycles	2	47	-	1
Others	1	2	-	-
Sub-Total	845	526	525	597
2. Hire				
Cars/Trucks	4	5	2	3
Jeepneys	148	192	203	196
Motor Cycles	-	-	-	-
Motor Tricycles	1	299	297	270
Others	4	2	1	1
Sub-Total	157	498	503	470
3. Government				
Cars/Trucks	18	15	21	14
Jeepneys/UV	32	31	32	41
Motor Cycles	7	12	13	6
Motor Tricycles	-	-	-	-
Others	-	-	-	-
Sub-Total	57	58	66	61
Total	1,059	1,082	1,094	1,128

Source: Land Transportation Commission, Boac District Office, Marinduque.

Table G-2-2 Existing Service Level for Road Transportation

Service Route	Kind of Vehicles	Number of Unit	Frequency of Trip	Passenger Capacity (Person/Unit)	Service Hour
Boac to Mogpog	Jeepney	33	66	22	5:00 to 20:00
Boac to Balanacan	-do-	12-15	24-30	22	3:00 to 10:00
Boac to Sta. Cruz	-do-	19	19	22	5:30 to 16:00
Boac to Marcopper	-do-	2	4	20	4:00 to 16:30
Boac to Buenavista	-do-	12	12	18	5:00 to 17:00
Boac to Gasan	-do-	12	24	18	-do-
Mogpog to Balanacan	-do-	3-4	6-12	22	3:00 to 18:00
Mogpog to Bocboc	-do-	5	10	22	6:00 to 17:00
Mogpog to Sta. Cruz	-do-	2	2	18	6:00 to 12:00
Sta. Cruz to Torrijos	-do-	18	18	18	5:30 to 17:00
Sta. Cruz to Matuya-tuya-Bonliw	-do-	3	3	18	6:00 to 17:00
Sta. Cruz to Napo-Pulong Parang	-do-	3	3-6	18	-do-
Sta. Cruz to Tamayo-Alobo	-do-	4	4-6	18	-do-
Torrijos to Buyabod	-do-	3-4	3-4	20	2:00 to 18:00
Torrijos to Malibago	-do-	2	2	18	6:00 to 17:00
Torrijos to Buenavista	-do-	3	3	18	5:00 to 9:00 (Sundy only)
Buenavista to Gasan	-do-	3	3	18	-
Buenavista to Balanacan	-do-	4	8	18	1:00 to 17:00
Buenavista to Malibago	-do-	3	3	18	6:00 to 17:00
Gasan to Balanacan	-do-	4	8	18	2:00 to 17.00

Source: Drivers Associations in Marinduque

Table G-2-3 Traffic Volume by DPWH

Road Section	Station	1983	1984	1985	1986	1987	1988
Boac - Mogpog	Sumawga, Boac	213	244	255	206	218	-
Mogpog - Balanacan	Loan, Mogpog	127	151	127	129		
Sta. Cruz - Torrijos	Buyabod, Sta. Cruz	318	312	265	311	336	
Mogpog - Sta. Cruz	Dolores, Sta. Cruz	245	265	133	108		
Boac - Gasan	Balaring, Boac	360	351	340	326	238	
Gasan - Buenavista	Bognoyan, Gasan	150	145	147	140	132	132
Buenavista - Torrijos	Buangan, Torrijos	119	96	61	52		

Source: Annual Average Daily Traffic (AADT) by DPWH.
Note : Motor tricycles and motor cycles are not included in the list.
Each figure shows the number of vehicles during the time 9:00-15:00 hours daily average.

Table G-2-4 Traffic Volume based on Traffic Survey

Survey Station	Road Section	Car/Truck/Jeepney/Others			Motor Tricycle/Motor Cycle			Total Ave.
		Feb. 21	Feb. 22	Ave.	Feb. 21	Feb. 22	Ave.	
Bantad, Boac	Boac - Mogpog	1,068	1,236	1,152	2,082	2,245	2,164	3,316
Butansapa, Mogpog	Mogpog - Sta. Cruz	224	286	255	22	22	22	277
Tawiran, Sta. Cruz	Sta. Cruz - Torrijos	362	362	362	80	79	80	442
Malibago, Torrijos	Torrijos, Buenavista	68	72	70	5	2	4	74
Bognoyan, Gasan	Buenavista - Gasan	432	344	388	558	505	532	920
Cawit, Boac	Gasan - Boac	598	574	586	170	149	160	746

Source: JICA Study Team, 1989
Note : Actual traffic survey was conducted for 12 hours, then the daily traffic volume is shown as 1.2 times of traffic volumes per 12 hours.

Table G-2-5 Number of Ports by Classification and Location

Classification	Number	Location
National	2	Balanacan, Mogpog Buyabad, Santa Cruz
Municipality	2	Laylay, Boac Gasan
Private	2	Bolog, Santa Cruz Sayao, Mogpog
Total	6	

Source: Philippine Ports Authority, Marinduque

Table G-2-6 Number of Vessels, Passenger Traffic and Volume of Cargoes by Each Port in Marinduque

Name of Call	Number of Vessels	Volume of Cargo (ton/year)	No. of Passenger of Traffic Embarked	Disembarked
Balanacan	890	12,640	102,380	99,190
Santa Cruz	840	25,660	76,860	71,500
Laylay	-	-	-	-
Gasan	-	6,600	-	-
Sayao	-	-	-	-
Balogo	130	65,530	-	-

Source: Philippine Ports Authority, Marinduque

Table G-2-7 Forecast of Traffic Volume

Road Section	1988	1989	1995	2000	2010
Boac - Mogpog	206	1,152	3,044	4,621	6,197
Sta. Cruz - Torrijos	311	362	464	549	634
Mogpog - Sta. Cruz	108	255	549	794	1,039
Boac - Gasan	326	586	1,106	1,539	1,973
Gasan - Buenavista	140	388	884	1,297	1,711
Buenavista - Torrijos	52	70	106	136	213

Source: 1. Annual Average Daily Traffic by DPWH.
2. Actual Traffic Survey by the Study Team.
3. Estimated of the Study Team.

Notes : 1. Moter tricycles and motor cycles are not included in the list.
2. Estimated by the methods of arithmetical progression.

APPENDIX H AQUACULTURE DEVELOPMENT

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H-1 Introduction

H-1-1 Background

1) Role of Fish as Diet in the Philippines

Fisheries product is the major part of the Filipino diet for people of all income classes and geographic regions. Fish products provide over 50% of the animal protein food for people in the lower income group. Even in the higher income group, fish is by far the largest single source of animal protein. The consumption of fish, meat and dairy products as well as fruit and vegetables increases steadily with income. Per capita consumption of fish and other food in the Filipino diet ranges between 26% and 41% of the total diet. The national average was recorded at 31% in 1982. Fresh fish is generally preferred in the Philippines, though salted, dried and smoked fish are widely consumed particularly in the inland rural areas. (refer to Table H-1-1)

Per capital fish supply increased during the first half of the 1970's and then declined to its earlier level in 1980. However, in 1981, the total domestic production of edible products increased significantly and as a result, per capita supply increased by almost 15%. Until 1977, the Philippines was a net importer of fish, primarily canned mackerel and sardines from Japan. Import augmented local production and helped increase domestic per capita supply in the first half of the 1970's.

During the period of 1975 to 1985, the total domestic production of fish for human consumption grew at an average annual rate of 3.3%. The food supply from the fisheries sector was at its peak in 1983 with a total production of 2.1 million MT. The increase in the supply is partly due to the significant increase in production from the aquaculture sector. The supply of fish for consumption has grown at a slower rate than the other fishery products. (refer to Table H-1-2)

The share of aquaculture production in fish supply grew from 6.8% in 1975 to 21% in 1985. A post harvest loss of fish products from the sea is estimated to be about 20% due to lack of ice and cold storage facilities and inadequate handling. Therefore, the share of aquatic production may be high and is estimated to be 8.5% in 1975 to 26% in 1985. (refer to Table H-1-3)

2) Aquaculture in the Philippines

Recently, fishing of marine products in the Philippines has declined considerably due primarily to the rising costs of fishing paraphernalia and the over-exploitation of traditional fishing grounds. As a consequence, catch from the sea are unlikely to meet the future demands for fish. On account of under-supply of fish resources, the extent of increasing catch through the introduction of more efficient fishing technology is restricted.

On the other had, the Philippines has a long tradition of brackish water aquaculture. Only in recent years emphasis has been given to the development of brackish water aquaculture together with the introduction of high intensive technology.

The importance of aquaculture has to be seen from the following point of view of:

- source of animal protein - food for the population
- foreign exchange earnings by exportation of fish, shrimp and related products.
- increasing employment opportunities and retaining the population immigrant outside the major urban area, etc.

3) Aquaculture Technology in the Philippines

a) Shrimp Culture

Until recently, shrimp culture yields in the Philippines has been too low to induce farmers to concentrate on shrimps as a primary crop. The country has some 210,320 ha under fish and shrimp culture, of which the greater part are brackish water fish ponds. Also there are at least 240,000 ha of undeveloped swamp land being suitable for brackishwater fish and/or shrimp culture and 115,000 ha for fresh water swamp lands. (refer to Table H-1-4)

The technology used in the Philippines is chiefly the extensive method. However, since the beginning of the 1980's, black tiger shrimp (penaeus monodon) intensive culture technology, developed in Taiwan province of P.R.China, has been introduced to several large enterprises in the Philippines. Since the mid 1980's, the shrimp pond has been harvested an average of two to four ton per crop per hectare for a total of six to 12 ton annually, with a cropping intensity of three crops per year. This is much higher than the 370 to 700 kg achieved through the traditional methods.

These highly intensive technologies were provided by institutional organizations, such as the College of Fisheries, University of the Philippines, the Fisheries Institution of BFAR and SEAFDEC, etc. together with highly educated and well experienced local biologists. The technology developed by these institutions has reached the high level of international standard.

b) Bangus Culture (Milk-Fish)

In the Asian/Pacific region, the leading Bangus producers are the Philippines and Indonesia. In the Philippines, production rose sharply from 107,924 MT in 1975 to 173,302 MT in 1980.

Bangus production is usually producing 700 to 1,000 kg per hectare with the traditional methods. A 2,000 kg/ha yield using improved technology is a good harvest for fish ponds. Moreover, applying fish pen (Cage Culture) more intensive aquaculture method with feeding, a harvest of from 5,000 to 10,000 kg/ha can produce.

Table H-1-1 Fish and Other Food in the Filipino Diet per Capita Consumption, 1982

(unit: kg/year)

Type of Food	National	Luzon	Visayas	Mindanao
Animal Protein				
1) Fish Products	40 (56%)	36 (47%)	49 (70%)	46 (70%)
2) Dairy, Poultry, Egg, Pork, Beef	31 (44%)	40 (53%)	21 (30%)	19+N*(30%)
Total	71 (100%)	76 (100%)	70 (100%)	65 (100%)

Source: *N negligible
Note : Prepared by the JICA Study Team based information from Food and Nutrition Research Institute, Manila

Table H-1-2 Fish Production by Sector

(unit: 1,000 MT)

Year	Grand Total Fishery Product (A) B+C+D	Fish Production From Sea B	Aquaculture C	Sea Weed D
1975	1,336.8	1,230.6	83.9 (6.8%)	22.6
1976	1,393.5	1,234.2	139.5	19.8
1977	1,508.9	1,345.3	131.9	31.7
1978	1,580.4	1,364.0	130.9	85.5
1979	1,581.3	1,364.9	135.1	106.1
1980	1,672.3	1,383.1	173.5	115.7
1981	1,772.9	1,433.4	253.2	86.3
1982	1,897.0	1,504.7	283.1	109.2
1983	2,110.2	1,665.1	312.5	132.6
1984	2,080.4	1,602.5	332.9	145.0
1985	2,052.0	1,557.3	327.3 (21%)	167.4
Rate of Growth	7.15%	3.3%	24.3%	14.5%

Source: Prepared by the Jica Study Team based Statistics of BFAR

Table H-1-3 Fish Supply Available for Consumption in the Philippines

Selected years between 1970 to 1985

(unit: 1,000 MT)

		1970	1972	1974	1976	1978	1980	1981
a)	Total domestic production (excluding non-edible products)	989	1,122	1,268	1,357	1,410	1,405	1,660
b)	20% post-harvest loss	198	234	254	271	282	281	332
c)	Export of edible fish	-2	-9	-15	-15	-28	-56	-62
d)	Import of edible fish	53	53	47	45	30	29	30
e)	Total domestic supply	842	942	1,046	1,116	1,130	1,097	1,296
f)	Mid year population (million)	36.7	38.7	40.8	43.1	45.4	47.9	49.2
g)	Annual per capital fish supply	22.9	24.3	25.6	25.9	24.9	22.9	26.3

Source: FAO Info Fish Marketing Digest

Table H-1-4 Average Productivity of Shrimps in Asian Countries (1985)

Country	Average Yield (kg/ha)
Bangladesh	108
Burma	173
China, PR of	714
India	395
Indonesia	162
Malaysia	553
Philippines	149
Singapore	1,476
Thailand	450
Vietname	260
Average of "extensive" and "semi-intensive" countries	240
Japan	6,145
Taiwan PC	7,750
Average of "intensive" countries	7,620
Asian average	284

Source: INFOFISH

H-2 Aquaculture in Marinduque

H-2-1 Present Condition

The aquaculture in Marinduque is mainly the Bangus (Chanos Chanos) culture which is the traditionally operating in the Philippines since many years. The Bangus culture ponds are generally located among the swamp and mangrove bushes areas distributed in North-West and North-East areas and extending to the East coast of Torrijos of Marinduque with total estimated about 4,500 to 5,000 ha. Of these areas, about 1,500 to 2,000 ha of mangrove and swamp areas in total could be developed as fish and/or shrimp culture ponds by preserving the natural environment where there play an important role in the reproduction of various aquatic animals like Bangus, Shrimp, Crab and Lapu-Lapu (Grouper - Epinephelus SPP) and other species.

The development of brackishwater fishponds (incl. shrimp) in Marinduque has rapidly increased for the last five years covering about 700 ha of mangrove areas. This figure includes illegally constructed fishponds which contributed much to the destruction of the natural habitat of marine life (e.g. shrimp, crab, oyster and other fishes etc.).

At the end of 1988, about 84% of brackishwater fishponds were used for a Bangus culture with average production ranging from 800 to 1,000 kg/ha, and the estimated total production reached at 507 MT per year.

When the recent technology developed and used in the Philippines apply in Marinduque, at least 3,000 MT of Bangus can be produced, and per capital consumption will be increased by 18 kg/year.

The remaining areas, about 16% (112 ha), were used for Black Tiger Shrimp culture with an average production of 1.1 MT/ha per year which is about 440 kg/ha/crop under 2 or 2.5 times harvest a year.

This figure is remarkably low than the figures of other provinces in the Region IV. Existing Bangus and shrimp culture ponds were appropriated to 55 operators with six to 15 ha each. There is no shrimp hatchery facilities in Marinduque and shortage of supply from wild sources due to the lack of technology for catching wild fry. (refer to Figure H-2-1 and Tables H-2-1 to H-2-3)

H-2-2 Aquaculture Technology

1) Bangus Culture

The technology of Bangus culture used in Marinduque is, in general, the extensive method traditionally used for many years without any feeding. Production under this method ranged between 800 and 1,100 kg/ha only. The ponds are constructed without consider of engineering technology. It is rough and carelessly constructed without provision against heavy rainfall and typhoons, and also without any protection for digging banks, for mud crabs which results in the escape of fry and fishes.

2) Shrimp Culture

The technology used for shrimp culture in Marinduque is also the extensive method. The Brackishwater Demonstration Fish Farm under DA Region-IV exist in Tamayo, Sta. Cruz is operating as a core of shrimp culture in Marinduque for development shrimp culture technology.

The farm has 4.7 ha culture ponds with office, dormitory and seminar hall for training local technicians in the future.

However, due to lack of budget for the operation and improvement of the facilities including laboratory equipments and facilities, the expansion doesn't achieving its purpose. Three biologists are working as staff of the farm. The laboratory, however, has only a thermometer, PH meter and saline meter. The training course for local technicians has not started yet.

The banks of the ponds are not constructed properly, therefore, it is difficult to transport materials for fish and shrimp culture along the ponds. Also many parts of the bank are collapsed due to the recent typhoon that hit the Marinduque island.

The last experimental shrimp culture carried out by the farm was resulted in the increase of production of shrimp which reached 1.2 MT/ha/crop for 120 days of breeding. This production level is still lower than the production compared with other provinces used the semi-intensive method.

However, a mortality rate of this experiment was improved and shown only ten percents. The fry was bought from the commercial shrimp hatchery plant in the other province at price ranged from 450 to 500 pesos per 1,000 post larvas, because of the shortage of post larva stage (PLS) of shrimps and lack of the technology for collecting PLS. This price is extremely expensive for shrimp farming for commercial purposes. The price should be less than 150 poses per 1,000 PLS. The wild mother shrimp can be caught at the coastal mangrove areas.

Table H-2-1 Bangus Fry Fishing Ground (Concessioned)

Area	Name of Concessionaire	Period	Production	No. of Catcher
Boac, Torrijos	Adela Ituralde	Feb.-Oct.	1,585,000 Frys	95
Mogpog	Rodolfo Marquez	-do-	2,750,000	109

Source: DA Region-iV Marinduque

Table H-2-2 Bangus Fry Reservation Areas

Area	Production	No. of Gatherer
Bahi Hasiga, Gasan	450,000	30
Ulong, Mogpog	126,000	12
Marlangga, Torrijos	156,000	18
Laylay, Boac	100,000	10
Total	832,000	70

Source: DA Region-IV Marinduque

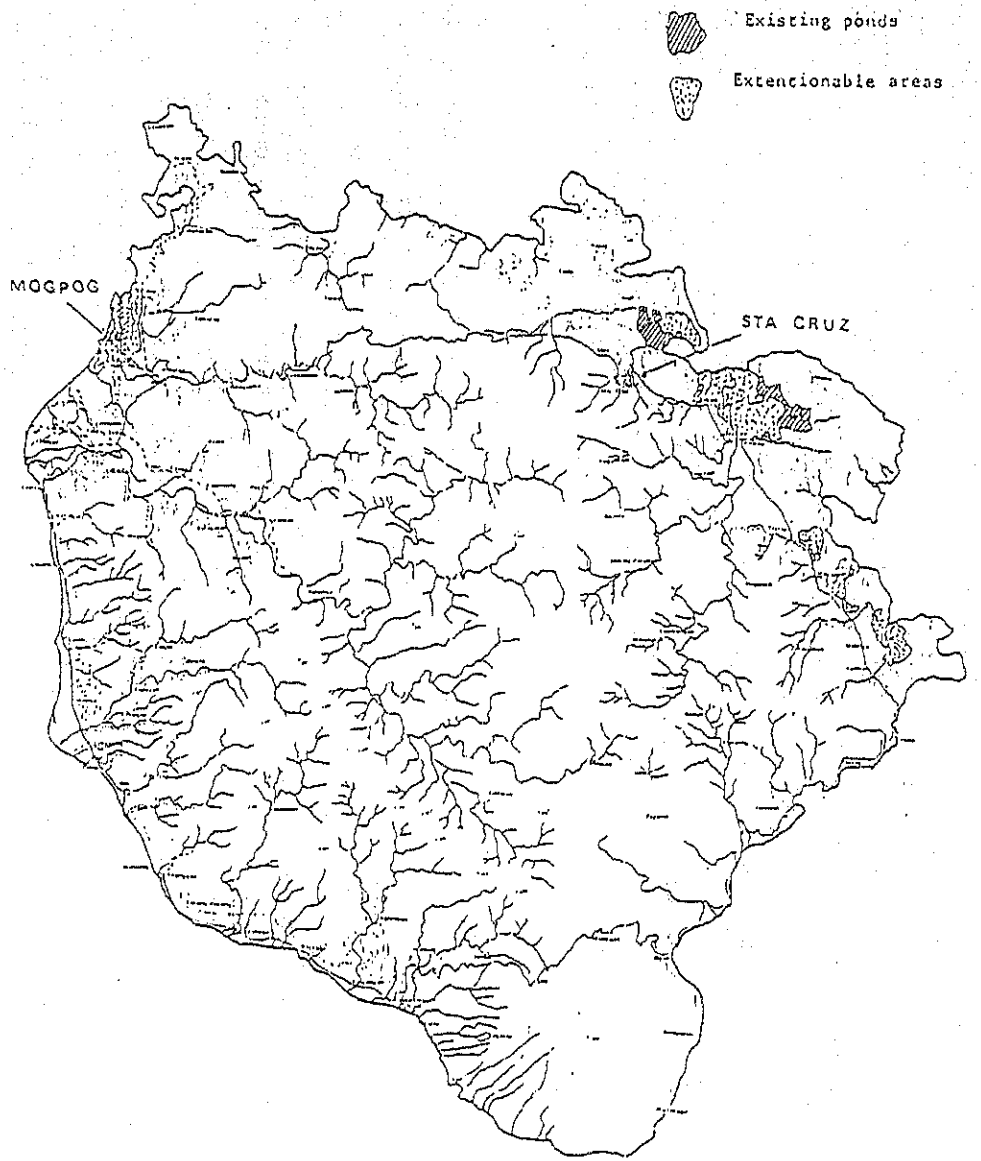
Table H-2-3 Brackish Water Pond Information (1984)

Municipality	Developed Area (ha)	Developing Area (ha)	Total Area (ha)	No. of Operators
1. Mogpog	73.14	18	91.14	16
2. Sta. Cruz	252.0	98.5	350.5	30
3. Torrijos	71.89	25.5	97.39	9
Total	397.03	142.0	539.03	55

Source: DA Region-IV Marinduque

Figure H-2-1

Location Map of Existing and Potential Fish Ponds



H-3 Aquaculture Development

H-3-1 Development Plan

The improvement of inland fisheries including brackishwater pond culture has the possibility to increase employment and earning income and hence improve the socioeconomic condition of the island.

The development of 1,500 ha of swamp area including existing brackishwater ponds which can produce 3,500 to 4,000 MT of Black Tiger Shrimp (under the condition of 2.5 crops per year with a productivity of 1.25 MT per crop) would have a value of about 740 million pesos even with a decrease of the market price in the consumer markets.

On the other hand, supply of fish protein is essential for the nutritional needs of the people in the island. However, production of fishery products is only about 1,400 MT from both the sea and fish ponds and per capita consumption is only 5.6 kg/year which is 15% of the national average.

Recent technology developed and used in the Philippines can produce 3,000 MT of Bangus and increase per capita consumption by at least 18 kg/year. Improvement of fish farming practices in the broadest sense is seen as the singly most important element of production growth of ponds already developed in Marinduque.

The aquaculture industry in the province, however, is still in its infant stage. It has lagged behind as compared with other province in terms of productivity and technology being applied. It is in this premise that we deemed it necessary to establish experimental and demonstration farms to address the problems besetting the aquaculture industry.

In this circumstances, it is urgently required for design of development schemes and policy for the aquaculture industry in Marinduque and to prevent destroying of the mangrove areas by illegal

fish ponds construction and others should be required arranging persuasive reasons to the members of aquaculture farmers based on study carried out by the laboratory.

And also to secure economical respect of the province and expectation of better earning by the farmers, introduction and development of new technology and new type of fish species to the industry is essential.

In general, the development of the aquaculture industry can be attained easily within a short period of time and information on farming technology studies carried out at the laboratory and also based on experiences gathered from other farmers in the region can be utilized to accelerate the rapid growth of the industry.

Since the development of the aquaculture business in Marinduque lags behind compared with other provinces, the preparation of technical support system to be aquaculture farmers would be a most important matter to be considered in the development of the aquaculture industry.

Therefore, it is essential to take into consideration of establishing laboratory of brackishwater fish culture demonstration farm for take lead and guide as an instructor of the aquaculture industry.

H-3-2 Basic Measure for Development

As an immediate objective for the development of the aquaculture industry in Marinduque, it is necessary that the following measures be taken by the Provincial Government before installing laboratory for brackishwater fish culture demonstration farms; namely:

1) Provide regulatory measures for the aquaculture industry

Provide previsional guide lines on the utilization of swamp and mangrove areas.

2) Identify existing and potential areas for fishpond development

Delineate mangrove salvage zone areas available for fish pond taking into consideration of about 40-50 meters from coast line and main stream in the mangrove areas.

3) Monitor environmental condition of swamp and mangrove areas

Study annual fluctuation of the following

- Salinity of selected points in the mangrove areas, main stream river mouth and middle point
- Sea water tidal level at selected point
- Volume of fresh water stream at selected area
- Condition of soil at selected fishponds.

H-3-3 Improvement of Brackishwater Fish Culture Demonstration Farm

1) General

On the culture of agro-fisheries products, it has been observed that the condition of the natural environments such as weather, soils, quality of water, etc. determined the kind of technology needed for the culture of these fishery products.

It is, therefore, necessary that demonstration farm be established to determine the appropriate technology required for the production of agricultural and fishery products. Such demonstration farms can also be utilized to study the possibility of introducing new agro-based products in the province.

The technology to be used for aquaculture should be based on the technology developed by the institutional organization and on studies to be made on production, developing suitable feeds for every stage of growth, feeding and measure taken on possible diseases of the shrimp and fish based on local conditions.

2) Improvement Plan

The existing demonstration farm for fish and shrimp in Tamayo has a total area of 4.7 ha with eight ponds varying in sizes from 0.25 to 1.4 ha (three nursing ponds and five grow-out ponds). For the year round shrimp culture experimental operation, at lease 12 ponds with an area of about 0.5 ha is required.

For fish culture operation (monoculture or poly-culture) an additional four ponds in size of 0.5 ha except for nursing ponds shall be required.

The existing bank of the culture ponds is narrow and weak against heavy rainfall and also insufficient transport for various materials by small trucks. The depth of the ponds are shallow hence it is difficult to maintain a suitable temperature for appetizing feed by the animal and poly-culture. The temperature records of the farm is shown often more than 30°C. The pond soil shows 3.6 to 3.7 PH which is extremely high acidity and not suitable for culturing fish and crustaceans.

The farming ponds should, therefore, be reconstructed and the area extended to about ten ha with reinforce banks and proper depth ponds suitable for culturing and testing various marine animals.

The proposal of reconstruction and expansion for the Brackishwater Fish Culture Demonstration Farm is designed based on environmental condition in the site of the farm.

- Salinity of the water between swamp (mangrove) areas and back yard land is fructuated largely during dry and rainy seasons and it is difficult to obtain proper salinity water and also adjusting salinity suitable for hatching fish and shrimp eggs.
- For convenience sake on studying various problems in the mangrove areas and transporting fish fingerling through canal, it will be most suitable to build facilities of the laboratory, hatchery, etc. on the artificial plateau in the center of the aquaculture ponds (farm). (refer to Figure H-3-1)

H-3-4 Objectives of the Proposed Laboratory at Brackishwater Fish Culture Demonstration Farm

It is fundamental and essential to study various condition of water temperature, quality of the water, water salinity, condition of culture ponds and bottom soil, system of culture, environmental condition and quality of feeds together with compound of ingredients by species for each stages of growing for fish and crustaceans. And proceeding publication of the result of the study for popularizing to the member of aquaculture farmers in Marinduque.

Especially, Marinduque is located in the center of Philippines archipelagos but often isolated from other large provinces (islands) due to lack of adequate infrastructures (e.g. transportation, telecommunication, etc.) which were resulted difficulty in obtaining fish and shrimp larva and also necessary information particularly on fish and shrimp culture. Consequently, establishment of the experimental agro-fisheries farms with the laboratory for demonstration of practice is becoming a pressing needs.

The objectives to be undertaken in the laboratory are as follows;

- To study the prevention of diseases for the animals often fish contract a disease due to the changes in environmental conditions and other factor;
- To develop new technology in aquaculture;
- To develop a low cost but high animal feeds;
- To experiment culture of new species of fish;
- To collect data on culture of new species of fish; and
- To publish studies being carried out in the laboratory.

All these studies will aim to improve aquaculture technology and will benefit the aquaculture industry of Marinduque. For the purpose of the above mentioned objectives of studies and demonstration of aquaculture technology at the Tamayo laboratory, the following equipment and facilities are required.

- Shrimp Hatchery Plant (For short-term development)
- Small Scale Fish-Meal and Feed Processing Plant (For medium-term development)
- Pilot Processing Plant, Ice Making Plant with Cold Store (For short-term development)

H-3-5 Shrimp Hatchery Plant

There is no problem in gathering the certain number of post larva of the shrimp and fishes from the coastal mangrove areas in Marinduque. It is, however, essential to establish a shrimp hatchery plant in Tamayo, Sta. Cruz, Marinduque to ensure the availability of the fry in all year round.

Tamayo, Sta. Cruz is the center of brackishwater aquaculture and about 65% of brackishwater fishponds in the province is located in this municipality.

For supply of post larva (PL) to the member of Marinduque aquaculture industry (or cooperative union) with reasonable price and continuous supply should be required self-financing operation of the hatchery plant. Namely, to secure obtaining mother shrimp, replenishment of various materials, charge and fee of energies (fuel, electricity, etc.) and personal expenses.

Usually, public organization are operating within annual budget without profits, however, this project is designed and considered taken minimized profitability on operation caused often delay of budgetary procedure and/or insufficiency of the budget has been proved in many similar organization in developing countries.

The hatchery plant will have a capacity of supplying PL to cover a minimum 500 ha of shrimp ponds with density of about 60 to 70 thousand PLs/ha with two crops per year (culture period is 120 to 140 days/crop with size of under 16/20 per lb.).

This measure takes into account the recent price decrease in the major markets by size of 30/40 (headless shrimp in account 30 to 40 pieces per pound of 460 gr). Decrease in price is a result of over production by shrimp culture industry in the world. The world supply has reached nearly 600 thousand MT in 1988 which is more than 28% of the total world production. (refer to Figure H-3-2 and Tables H-3-1 and H-3-2)

Remarks:

The size of 30/40 is the most economical sizes relevant to the growth rate of shrimp and volume of feeds on intensive method. However, size larger than 16/20 such as under 8, 9/12, 13/15 sizes are in shortage in the markets and commands a higher price in major markets.

H-3-6 Small Scale Fish-Meal and Feed Processing Equipments

The plant will make use of locally available raw materials in the production of feeds and fish meal so as to produce a high quality but cheaper than the commercial feeds. The fish meal and feeds processing plant will ensure a steady supply of feeds to the aquaculture demonstration farms. (refer to Figure H-3-3)

It is essential to study proper feed ingredient combinations for shrimp nursing stage and stage of grow out ponds. For semi-intensive and/or intensive shrimp culturing method, the cost of feed plays an important role in the production costs together with the cost of PLS. The common commercial shrimp feeds are usually has unnecessary ingredients and/or material to increase its weight. And often decomposed with oxidation of the fat and oil caused long period of storage.

Fresh and properly composed ratio of combination with the right ingredient would be very appetizing to the shrimps and with this, rapid growth with low mortality rate and perhaps feeding ratio of one to 1.5 kg for one kilogram of production would be enough.

- Automatic Fish Meal Processing Line (refer to Figure H-3-4)
  Cooker, Bucket Conveyer, Screw Press, Rotary Kiln, etc.
- Shrimp and Fish Pelletized Feed Processing Line (refer to Figure H-3-5)
  Hummer Mill, Mixer, Pellet Feed Processing Machine, Colloid Mill, Dryer, etc.

A study of composition and materials available from local sources to be used as raw material for shrimp and fish feed like rice bran, meals of shrimp head and trash fish would reduce cost of feeds.

H-3-7 Pilot Processing Plant, Ice Making Plant and Cold Storage

The establishment of an ice plant and cold storage facilities as well as a processing plant is vital to the study area.

Generally, about 70% of the fish catch are sold immediately, and the remained fish are dried and less frequently salted or smoked in the Philippines. Processing of fish by these methods has very limited investment and little hired labor.

Marinduque has also similar condition with other provinces, namely, the non-availability of facilities like ice plants and cold storage, etc. Lack of such facilities would affect the increase of production from fish and shrimp culture and it will be great extent affect to the economic aspect of the province.

The processing of agro-fisheries products will conform with the standard set for the processing of exportable products. It will not only maintain the freshness of the products but also increase its commercial value. Demonstration on the proper handling of agro-fishery products will be conducted in the training center, specifically, for farmers and other interested groups as well as fish processing industry.

Basic facilities of the processing plant (refer to Figure H-3-3 and H-3-6)

- One-line of shrimp of fish processing (in capacity equivalent 2,000 lbs/hr shrimp processing)
- Horizontal plate freezer (3 ton/day)
- Cold store, -30°C (115 cu.m)
- Automatic plate ice making machine (10 MT/day) with 15 MT ice store.

H-3-8 Other Fishery Industrial Facilities

The site of the ice plant should be closed to the center of the fish culture ponds, in two places at Mogpog and Torrijos areas with a recommended capacity of seven and five MT, respectively.

Table H-3-1 List of Proposed Prawn Hatchery w/10 Million Capacity

	Description	Quantity
1)	Water Tank	
a)	Polycarbonate Tank 2 ton	4 pcs.
b)	" " 1 "	6 "
c)	" " 0.5 "	10 "
d)	" " 0.1 "	10 "
e)	Hatching brine shrimp eggs 1 "	6 "
f)	Inside Tank for Breeding 4m x 3m x 1.5m	12 Nos.
g)	Outside Tank for Breeding 4m x 6m x 1.5m	14 Nos.
2)	Water Supply Facilities (Sea Water)	
a)	Sea-water Pump 7.5 kw	2 pcs.
b)	" " 5.0 kw	2 "
c)	" " 1.5 kw	1 "
d)	Portable under water pump 0.75 kw	4 "
e)	High Level Tank 7 m high	1 "
f)	Piping (construction arrange at spot)	
g)	Machine for Electric works	
h)	Sterilizer	2 "
3)	Water Supply Facilities (Fresh Water)	
a)	Well and High Level Tank	
b)	Water Pump 0.75 kw (200 L/Min.)	2 pcs.
c)	Sanitation facilities	
d)	Piping	
4)	Air Reaction System	
a)	Root Blower 3.7 kw	2 pcs.
b)	Air Pipe (with Cock)	1 set
c)	Air Stone	400 pcs.
5)	Generator and Transmission	
a)	Generator, Diesel Engine 35 KVA	1 unit
b)	" " " 15 KVA	1 "
c)	Portable Gasoline Generator 5 KVA	1 "
d)	Transformer 2 kw	2 "
e)	Automatic Voltage Regulator 1 kw	1 "
f)	Trans-Distributor	1 set
g)	Distributing Board and Wiring	

	Description	Quantity
6)	Domestic Electrificator	
a)	Juice Mixer	2 units
b)	Refrigerator	1 "
c)	Freezer	1 "
d)	Coffee Mill	1 "
7)	Laboratory Materials and Equipments	
a)	Microscope	2 units
b)	" , Three Lenses	1 "
c)	Thermometer, 0 - 100 °C	10 pcs.
d)	Hydrometer	5 sets
e)	DO Meter	1 "
f)	PH Meter	2 "
g)	Ammonia Meter	1 "
h)	Salinity Refractometer, S-100	2 "
i)	Dissecting Instrument Set	1 "
j)	Electric Balances, 100 gr.	2 "
k)	Chemical Balance	1 "
l)	Heater Set	10 "
8)	Articles of Consumption	
a)	Glass Instrument for test	1 set
b)	Hose Cock	1 "
c)	Net (Polyethylene, Nylon)	1 "
d)	Stainless Wire Net, 30 m	1 "
e)	Assorted Feed for Shrimp	1 "
f)	Medicines	1 "
g)	Materials for Tank Repairing	
h)	Articles of Consumption	
9)	Hatchery Building	360 sq.m

Table H-3-2 List of Shrimp Farm and Equipments

	Item	Quantity
1.	Main Gate	3 units
2.	Secondary Gate	18 "
3.	Civil Engineering Works	10 ha
4.	Road	450 m
5.	Axial Flow Pump	3 units
6.	Service Vehicle	1 unit
7.	Paddle Wheel	24 units
8.	Generator (Standby) 50 KVA	1 unit

Figure H-3-1 Proposed Aquaculture Demonstration Farm

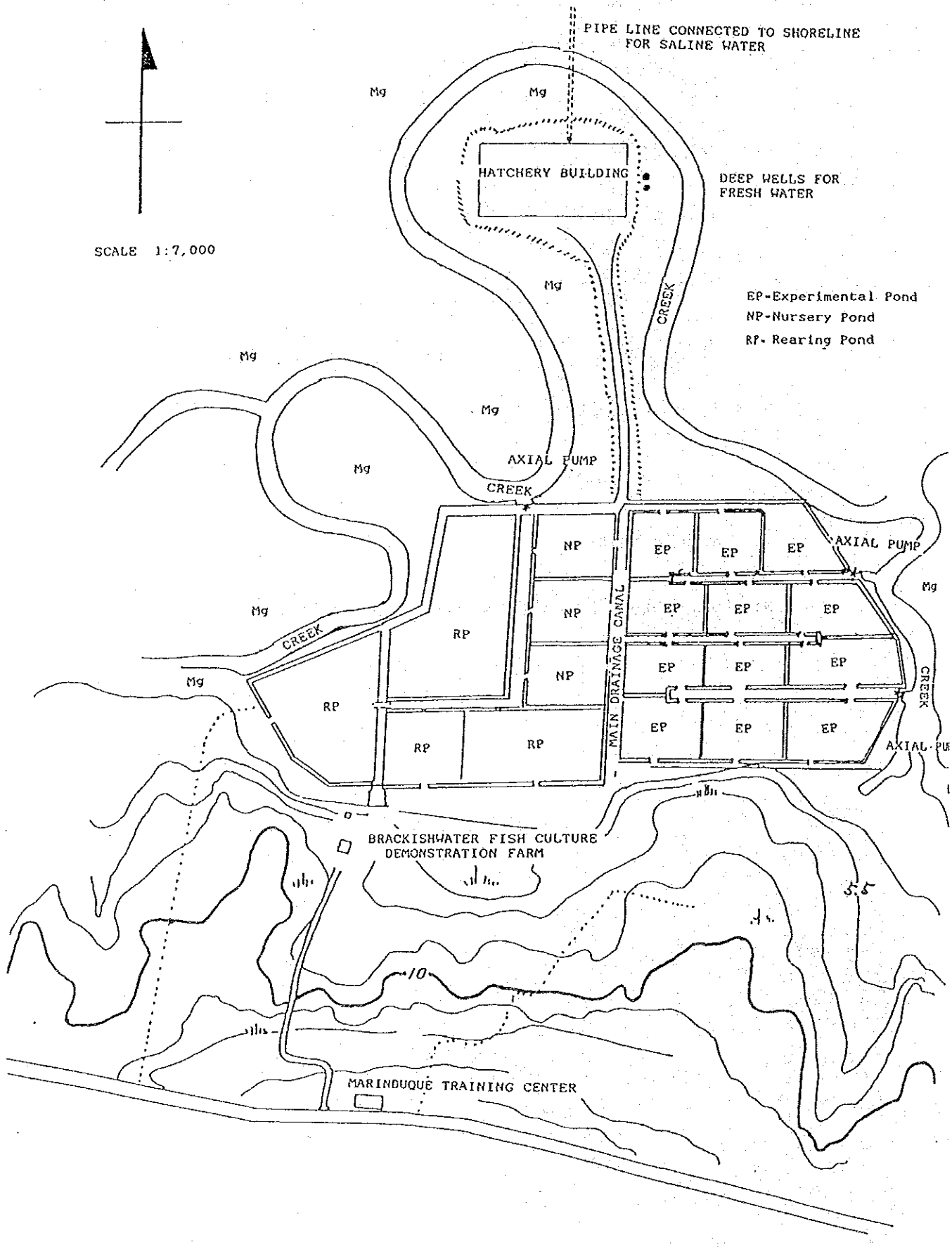


Figure H-3-2 Shrimp Hatchery Plant

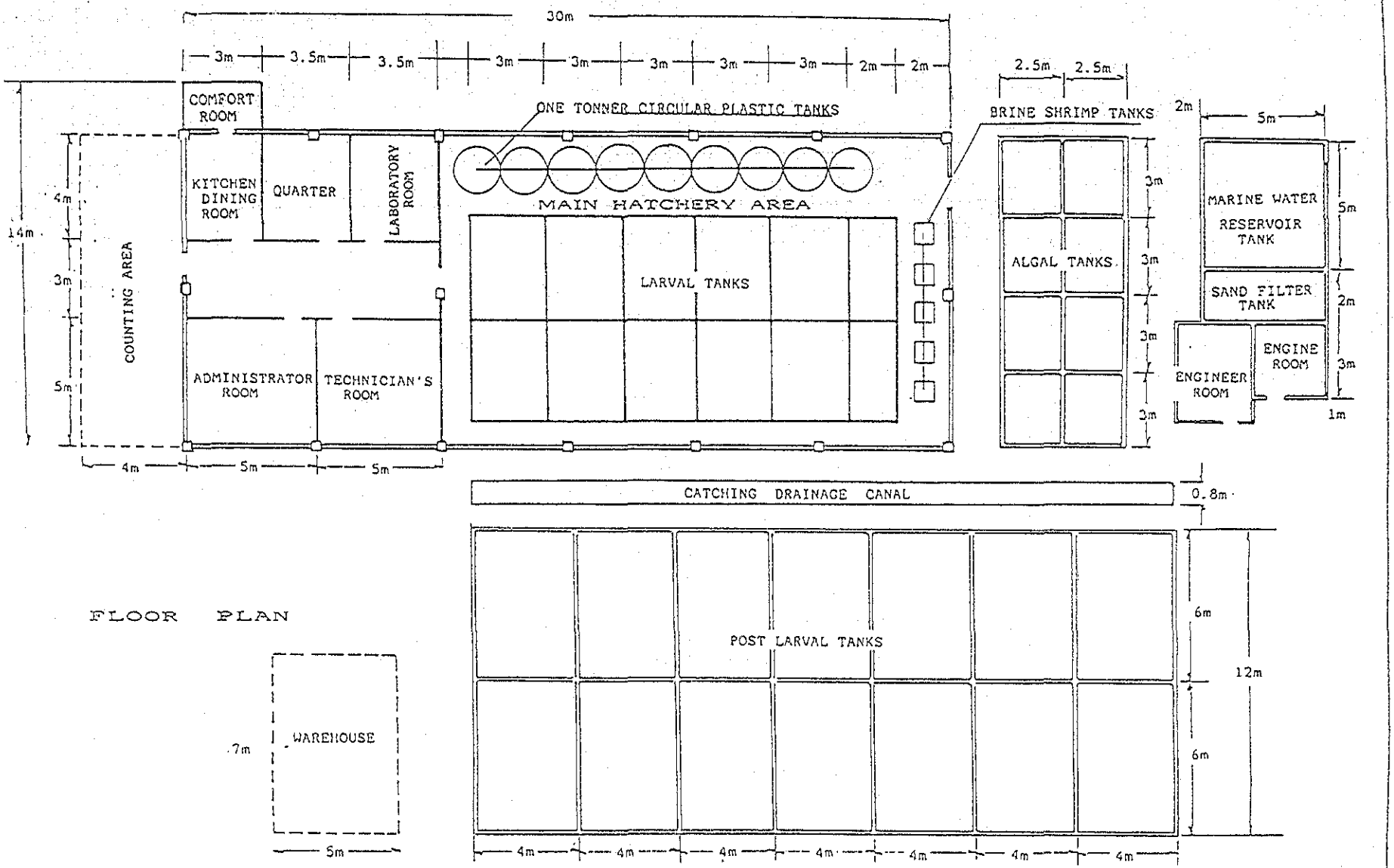


Figure H-3-3 Fish & Shrimp Processing and Feed Plant

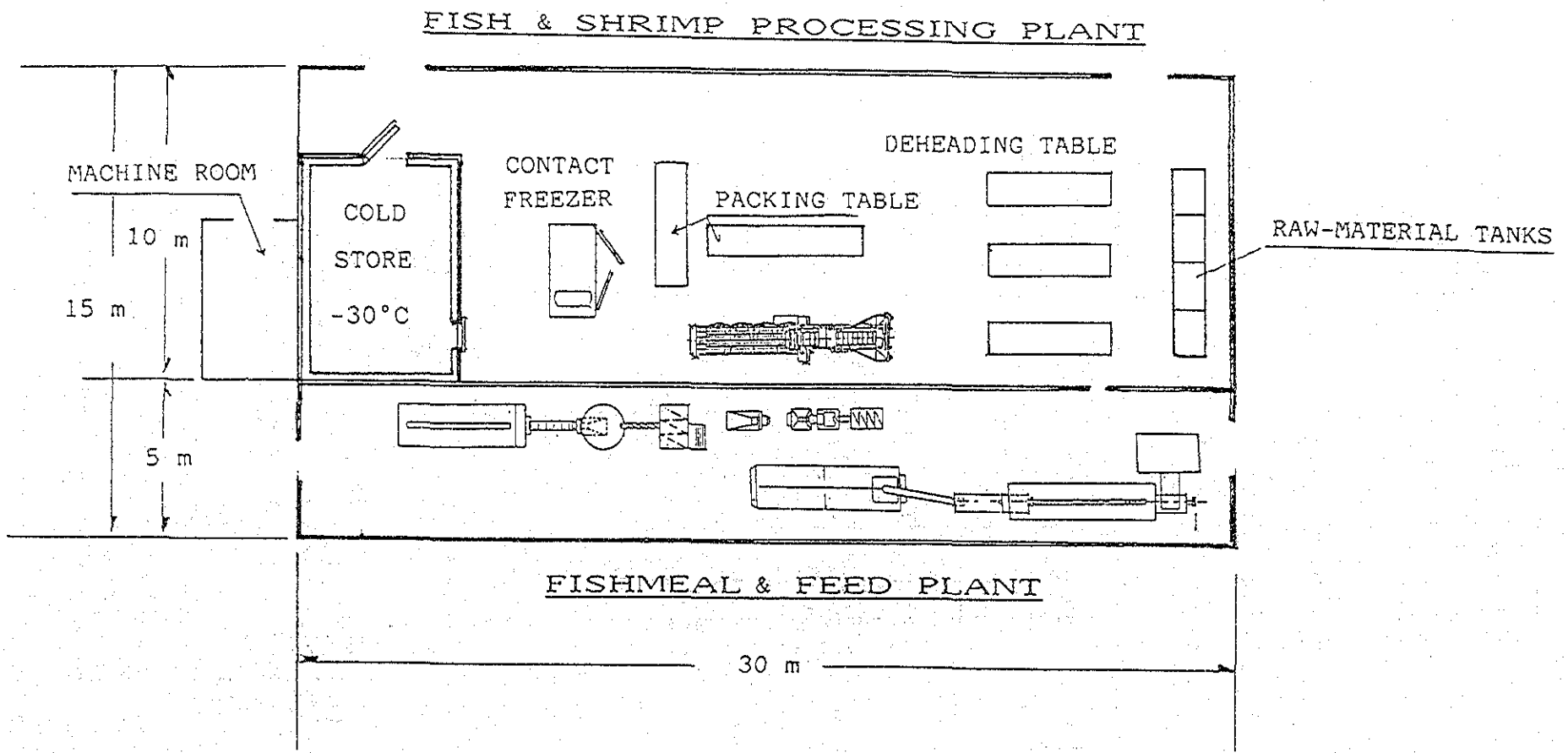


Figure H-3-4 Automatic Fish Meal Processing Line

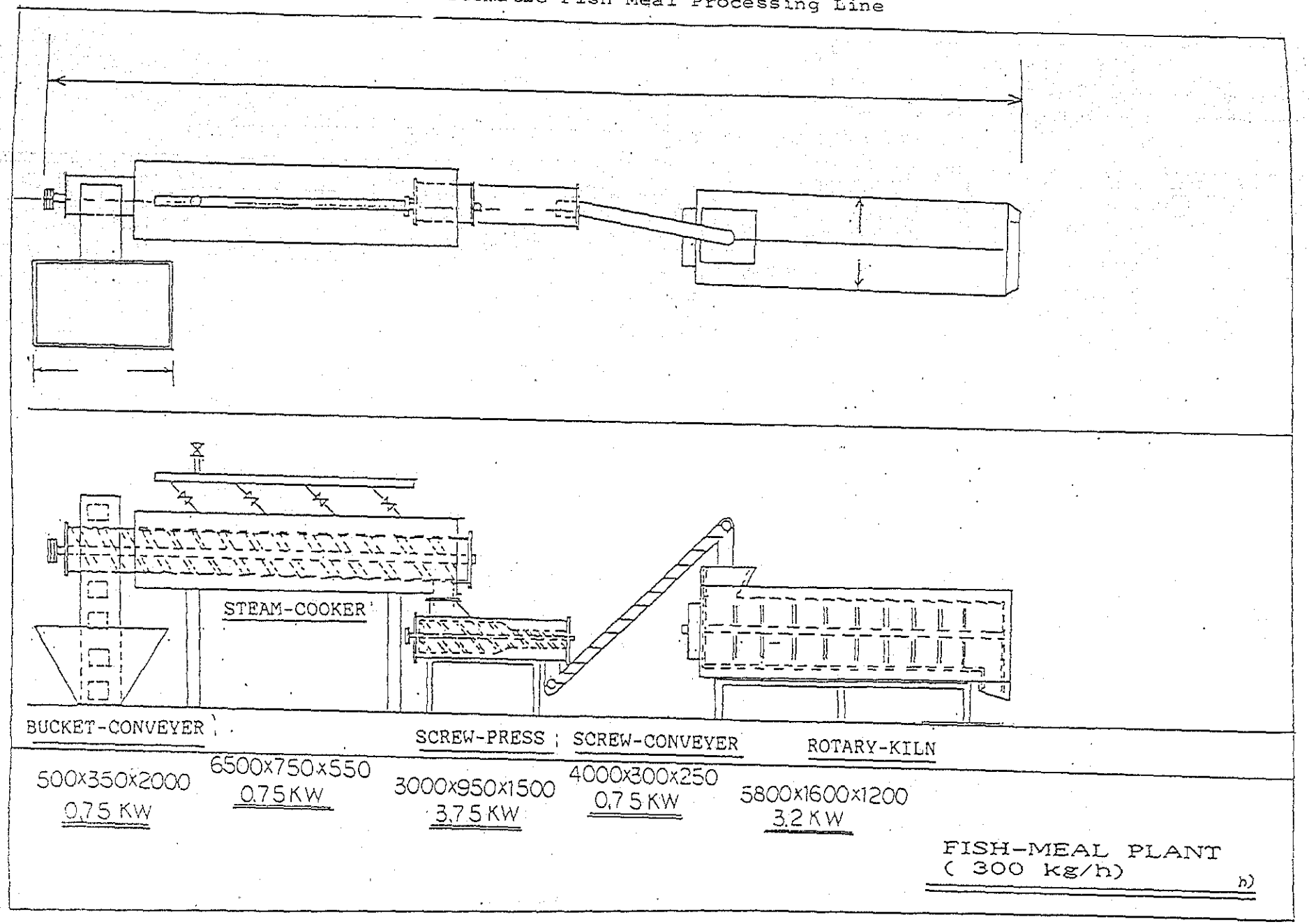


Figure H-3-5 Shrimp and Fish Feed Processing Line

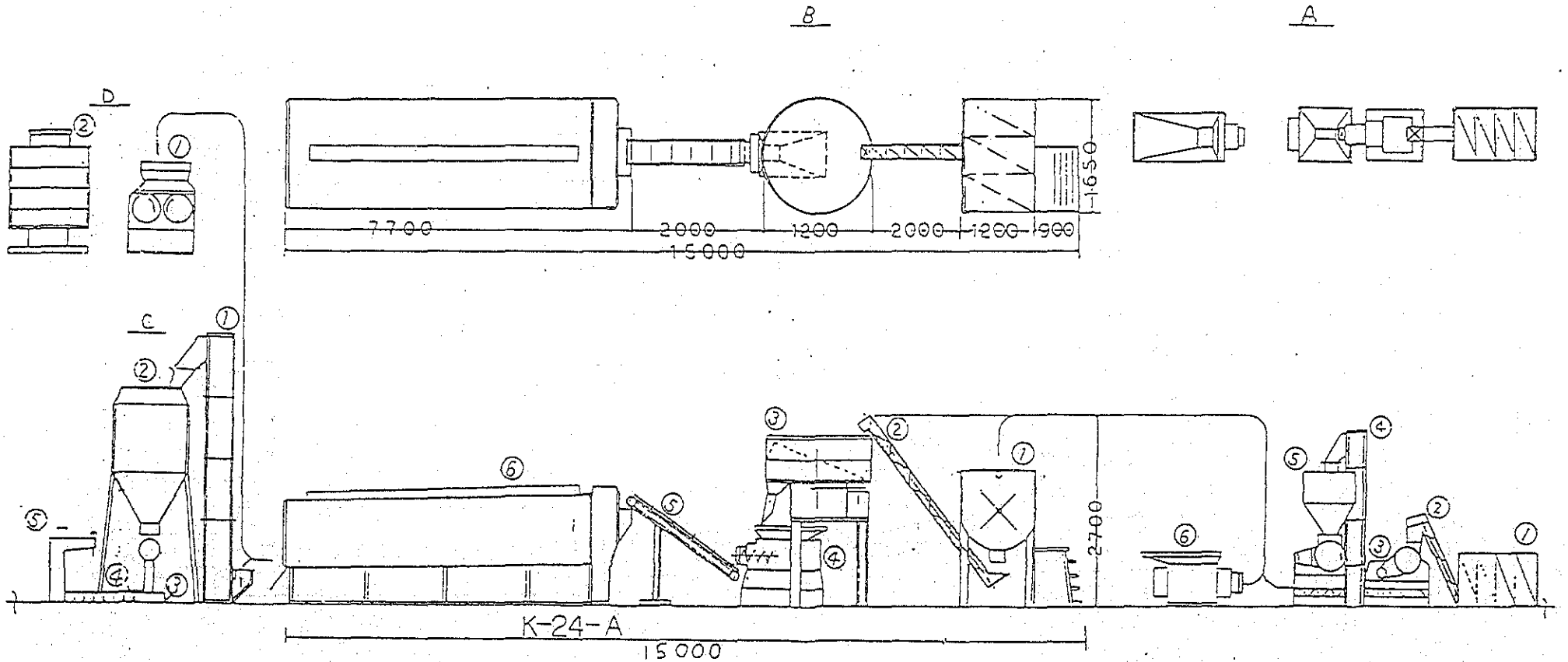
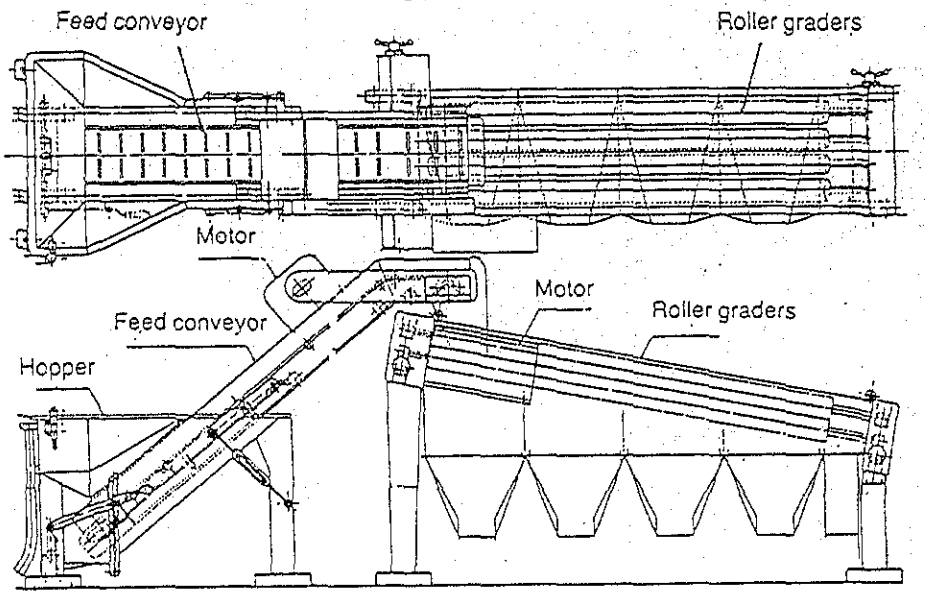
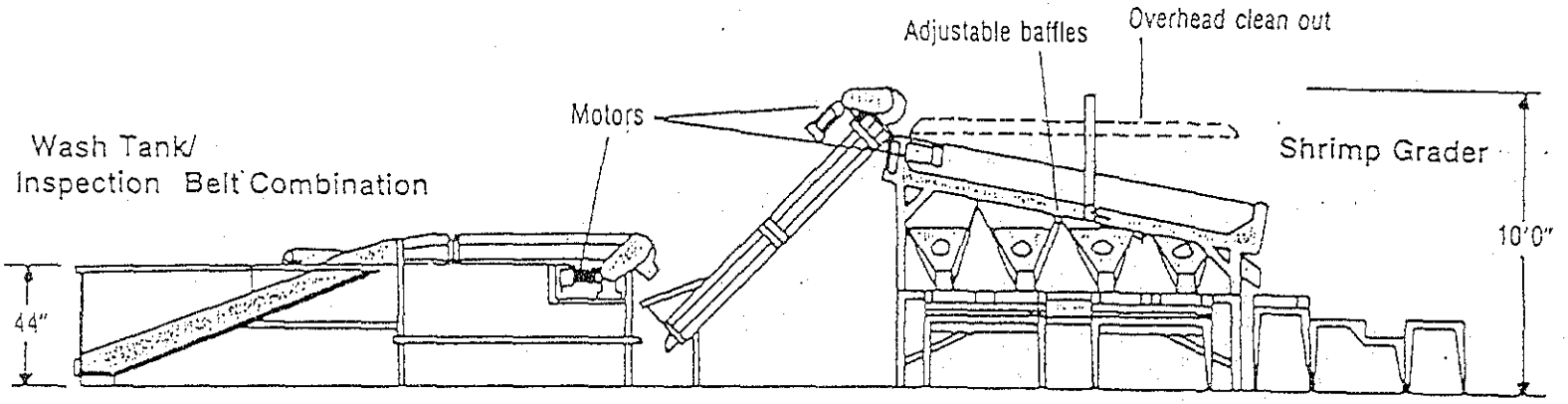


Figure H-3-6

Double-type shrimp grader





Grading capacity 2000 lbs/hr — 5 sizes

H-4 Development of Fresh Water Fish Culture

It is rather difficult to expect increase of catch from the surrounding seas of the island than fish culture. Attention must, therefore, be focused on the poly-culture of carp in the paddy field and/or the reservoir for irrigation. The species recommended to be cultured are carps, grass carps and other fresh water fish species.

Marinduque have many river water resources. These rivers can be converted into dams with embankment and used as artificial small ponds for fresh water fish culture and can also be used as water reservoir.

Following reservoirs and/or dams are considered as ponds of fish culture, namely:

Name of site	Volume (1,000 cu.m)
Tagum-Angas	2,800
Bachao	740
Cabugao	334
Antipolo	420
Balagasan	350
Bagtingon	1,400
Bangbang	600
Masaguisi	180
Binunga	5,700
Other 7 reservoirs	3,000
Total	15,524

15,524,000 x 60% = 9,314,000 = 9,300,000 cu.m

Bio-mass 50 g/cu.m; 9,300,000 x 50 = 465,000 kg

It is estimated that about 465 MT of fish can be supplied per year without feeding.

H-5 Culture Program for Coconut Crabs

The information particularly inhabit of the coconut crabs were gathered from various parts of Marinduque until 1987, but according to the recent information, it has been died out recently in the Marinduque. There is no ecological information for the coconut crabs especially data for breeding of coconut crabs and therefore, it is rather difficult discussing the matter of the culturing technology.

In general, however, it can be estimated that this type of species shall be taken long period for growing large size as well as spiny lobster. Therefore, it is recommendable that make preservation area of about one or two ha in coconut plantation close to the laboratory and studying possibility of artificial hatchery methods and feeding for breeding based on observation of ecology of coconut crabs as a part of the activities of the proposed Tamayo fish culture laboratory.

APPENDIX I RURAL INFRASTRUCTURE DEVELOPMENT

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I-1 General

The improvement of rural infrastructure is one of the important subjects for the agricultural integrated development in the province of Marinduque. For the purpose of the development of Marinduque, the rural infrastructure should be more improved. However, there is a financial restriction and it is impossible to construct all required facilities at one time. Therefore, considering the most effective impact for the development of Marinduque, required infrastructures and priority project should be studied.

I-2 Rural Water Supply

I-2-1 Present Condition

1) Summary

The major existing water supply system in the study area is the water works system that is managed by the Municipal government. The system serves five poblacion, Boac, Mogpog, Gasan, Sta. Cruz and Torrijos. In addition, there are Level II system in some Barangays which are located far way from the poblacions. Further, there are a number of Level I system, scattered in the three poblacion and Barangays. The present water supply conditions are not satisfactory, due to deterioration of the water supply facilities and damages of water sources and transmission systems. (refer to Figure I-2-1)

2) Water Sources

The water sources currently used by Level III, II, and I systems in the study area are spring, deep wells, and shallow wells. Major characteristics of the water quality of the existing water sources are summarized below.

a) Spring Water

- Water of most springs has good water quality, not requiring any water treatment.
- Generally the water is soft and not corrosive.

b) Deep and Shallow Well Water

- Generally the water is soft and not corrosive, but some wells dug on the seaside district has high chlorinity.
- The water is free from contamination by domestic waste water.

c) River Water

- The surface water of the rivers has high values of turbidity.
- Value of dissolved matters is high, which is undesirable for domestic use.

3) Distribution System

The existing distribution system of Level III is composed of mainly five systems of Boac, Mogpog, Sta. Cruz, Torrijos and Gasan. The system does not, in a precise meaning, have a transmission system, but the pipeline between the intake and entrance at the poblacion will be termed transmission line, and the networks covering the poblacions will be called distribution system, for specific description.

a) Boac Waterworks System

The Boac water system provides water to five Barangays and the poblacion of Boac municipality. The municipality of Boac depends heavily on the two deep wells water pumps system, seven spring catchbasin and Bugawas/Bahay Igat dam located on the hillside of Bugawas/Igat mountain which provides water to Daig reservoir. This two deep wells water pump system can produce 1,850 cu.m/day. The seven springs has an elevation of 158 m above sea level. It has a capacity of 820 cu.m/day during dry season. Bugawas/Buhay Igat dam has an elevation of 124 m above sea level. It has a discharge capacity of

820 cu.m/day during dry season. Daig settling basin/reservoir has a capacity of 1,300 cu.m. This volume of water comes from seven springs and Bugawas/Igat creek. From Bugawas/Bahay Igat dam, water is channeled through 8 inches diameter CCI pipes. It is 6 km to Daig settling basin/reservoir. From Daig settling basin/reservoir, water is channeled through 6 inches diameter CCI pipes distributed to the consumers. It is 3 km away from the poblacion of Boac. The waterwork system of Boac has been in operation since 1955. Ever since no major rehabilitation was done to improve the waterworks system.

b) Mogpog Waterworks System

The Mogpog water system provides water to four Barangays and the poblacion of Mogpog municipality. The municipality of Mogpog depends heavily on the fur deep wells water pump system and two springs located in Amontay and Danao. This four deep wells water pump system can produce 2,700 cu.m/day. The two springs have a capacity of 110 cu.m/day during dry season. The present distribution is constructed in 1927. The lines are clogged and leaky. The machines and pumps are old and designed for less number of consumers. The present system is very costly to maintain and has no room for expansion if the present distribution will be used.

c) Torrijos Waterworks System

The Torrijos water system provides water to three Barangays and the poblacion of Torrijos municipality. The municipality of Torrijos depends heavily on the spring located in Naampiyas, a site of Barangay Nanka more than 11 km from the poblacion. The spring has a capacity of 3,500 cu.m/day during dry season.

The waterworks network has been in existence since 1922 with five inches GI pipes on its main lines from its reservoir at Marlangga. Since then it has not been rehabilitated. Old pipeline connections from its source were replaced in 1955 with asbestos pipes but at present has been found defective.

d) Sta. Cruz Waterworks System

The Sta. Cruz water system provides water to the poblacion of Sta. Cruz. The municipality of Sta. Cruz depends heavily on the two springs located in Barangay Libjo and Bangcuangan more than one km from the poblacion. These springs have a total capacity of 200 cu.m/day during dry season. The present water system is constructed in 1917. The lines are clogged and leaky, so most of houses are served only three to five hours per day.

e) Gasan Waterworks System

The Gasan water system provides water to the poblacion of Gasan municipality with water meter. The poblacion depends heavily on the two deep wells water pump system. The waterwork system of Gasan has been in operation since 1921. The present water supply conditions are far from satisfactory, due to deterioration of the water supply facilities and damages to transmission systems.

4) Present Water Use

Present sources of water supplies for the urban area are springs and wells. There are 44 public water supply facilities in the urban area. The total number of the service population under the present water works is about 18,000, which is 74% of population in the urban area. (refer to Table I-2-1)

On the other hand, sources of water in the rural areas are ground water from deep and shallow wells with manual pump. The total population served by public wells is approximately 101,200, which is 55% of the population in the rural area. (refer to Table I-2-2)

I-2-2 Development Plan

1) Basic Concept

With consideration to improvement of rural living environment, it would be necessary to improve the rural water supply system. However it is impossible to provide a perfect supply system covering the whole area of the Marinduque in a short time, as the cost of the construction of facilities must be considered. Therefore, considering the existing condition of the rural water supply in Marinduque, the improvement of the rural water supply system covering those areas which are facing serious problems at present should be projected first.

2) Development Strategy

The development of the rural water supply system was projected, based on the following consideration:

- The improvement of the rural water supply system covering the area suffering a water shortage will be contemplated.
- The improvement of the rural water supply system covering the area suffering a poor water quality will be contemplated.
- Depending on the volume of total water demand, water source system facilities will be selected from among diversion system, spring system, pumping-up system, or well system.

3) Selection of Project

Based on the development strategy, the improvement of the rural water supply project was selected as follows: (refer to Table I-2-3)

a) Short-Term Development

- Sta. Cruz water supply project (refer to Figure I-2-2)

  Objective: To solve water shortage and provide stable water supply

  Target Population: 56,400 persons

Major Facilities:	Diversion dam	
	Reservoir	(V = 1,500 cu.m)
	Main pipe	(ϕ8") L = 18 km
		(ϕ6") L = 2 km
	Distribution pipe	(ϕ4") L = 24 km
		(ϕ2") L = 17 km
	Cummunual faucet	154 sets
Design Criteria:	Average water supply	3,380 cu.m/day
	Peak water supply	4,400 cu.m/day
O & M Body:	Water District	

b) Medium-Term Development

- Rehabilitation of Boac water supply

Objective:	To provide stable and good quality water supply
Target Population:	5,400 persons
Description:	Replacement of old pipes G.I. pipe ϕ8"L = 5.5 km, ϕ6"L = 7.0 km ϕ4"L = 3.0 km, ϕ3"L = 1.5 km
O & M Body:	Water District

- Rehabilitation of Mogpog water supply

Objective:	To provide stable and good quality water supply
Target Population:	4,000 persons
Description:	Replacement of old pipes G.I. pipe ϕ6"L = 1.0 km, ϕ4"L = 2.5 km ϕ3"L = 1.0 km, ϕ2"L = 2.0 km ϕ1.5"L = 1.0 km, ϕ1"L = 1.0 km Rehabilitation of deep well Q = 1,600 cu.m/day
O & M Body:	Water District

- Rehabilitation of Sta. Cruz water supply

Objective:	To provide stable and good quality water supply
Target Population:	10,000 persons
Description:	Replacement of old pipes G.I. pipe ϕ4"L = 6.5 km
O & M Body:	Water District

- Rehabilitation of Torrijos water supply

Objective:	To provide stable and good quality water supply
Target Population:	2,200 persons
Description:	Replacement of old pipes G.I. pipe ϕ6"L = 10 km
O & M Body:	Water District

c) Long-Term Development

- Gasan water supply development project (refer to Figure I-2-3)

Objective:	To solve shortage of water and provide stable water supply	
Target Population:	29,700 persons	
Major Facilities:	Spring box	
	Reservoir	(V = 880 cu.m)
	Main pipe	(ϕ6") L = 8.0 km
	Distribution pipe	(ϕ4") L = 16.0 km
		(ϕ2") L = 13.0 km
	Communal faucet	133 sets
Design Criteria:	Average water supply	1,780 cu.m/day
	Peak water supply	2,200 cu.m/day
O & M Body:	Water District	

- Boac water supply development project

Objective:	To solve shortage of water and provide stable water supply
Target Population:	25,600 persons

Major Facilities:	Ground reservoir	V = 670 cu.m
	Major pipe (ϕ8")	L = 1 km
	Distribution pipe (ϕ4")	L = 12 km
O & M Body:	Water District	

4) Water Demand

Water demand projection in this section is undertaken to obtain a basis for a long range water supply plan until the Master Plan target year 2010. The water demand projection years are 1995, 2000 and 2010 conforming to the design year of this study. Summary of the served population, average day water demand, maximum day water demand and peak hour water demand are calculated. (refer to Table I-2-4)

5) Water Source

Major characteristics of the water quality of the existing water sources are as follows:

a) Spring Water

- Water of most springs has good water quality, not requiring any water treatment.
- Generally the water is soft and not corrosive.

b) Deep and Shallow Well Water

- Generally the water is soft and not corrosive, but some wells dug on the seaside district has high chlorinity.
- The water is free from contamination by domestic waste water.

c) River Water

- The surface water of the rivers has high values of turbidity.
- Value of dissolved matters is high, which is undesirable for domestic use.

The potential water sources in the Study Area was estimated about their suitability. (refer to Table I-2-5)

6) Design Criteria for Planning

To prepare the master plan on a standardized basis, the following design criteria are worked out. In preparing these design criteria, due consideration has been given to the design criteria that were made by RWDC and complied in the Technical Standard Manual. And to make the present criteria more realistic and workable, the local conditions including that of existing water supply facilities, in particular are taken into account.

a) Per Capita Water Consumption

For planning of the district water supply system, average daily per capita consumptions for each study area are applied as follows.

Level II	:	60 lit/person/day
Level III	:	100 lit/person/day

b) Water Demand

Since no data on maximum day and peak hour demands in each study area are available the following demand factor shall be used.

Average day demand	:	Design population x Per capita consumption
Maximum day demand	:	1.30 x Average day demand
Peak hour demand	:	2.50 x Average day demand

c) Capacity of the Facilities

The capacity of the water source and transmission facilities shall be determined based on Maximum day demand. The distribution facilities shall be designed based on peak hour demand.

d) Water Pressure

Maximum static pressure on a pipeline shall not exceed 7 kg/sq.cm. A special device shall be installed to keep the water pressure within

the said limit. Minimum water pressure at pipe ends of the distribution system shall not be less than 7 m in head, as far as practicable.

e) Pipe Material

Pipe material shall be galvanized iron pipe. In selection of pipe materials, the following shall be taken into consideration.

- Maximum static pressure and water hammer impact which the pipeline is to be subjected to.
- Condition of the road under which the pipeline is to be lied.
- The convenience of the maintenance of the pipeline.
- In deference to the existing method.

f) Valves, Air Valves, and Drain Pipe

Valves should be installed at the following points.

Transmission pipelines	:	Strategic operating points at about 2 km intervals.
Distribution mains	:	All main crosses and branches and at about 300 m intervals.

Air valves should be installed at the top of vertical curves of pipelines. Drain pipes should be installed at the bottom of vertical curves of pipelines, where draining from the pipeline is possible.

g) Storage Capacity

The capacity of a distribution reservoir shall be equivalent to eight hours quantity of maximum day demand. The said capacity can be split into plural numbers of reservoir in accordance with the needs of the locality.

h) Water Meters

All production of the water source facilities and distribution shall be metered. For this purpose, bulk meters shall be provided at appropriate and convenient places to measure.

i) Communal Faucets

The public shall be provided with seven communal faucets at every Balangay covered by water supply system. In poblacion, the communal faucets shall be arranged at about 50 meter intervals.

j) Operation and Maintenance

Rural water supply facilities would be turned over to DPWH after implementation of the project. Afterward the facilities, the right of using and duty of operation and maintenance would be transfered to Rural Water Supply and Sanitation Association (RWSA). DPWH would assume the leadership of RWSA and beneficial Barangays for smooth operation and maintenance of facilities. The operation and maintenance fee would be charged to beneficiaries in principle. (refer to Figure I-2-4)

Table I-2-1 Number of Houses and Population Served by Public Water Supply System in Urban Areas of 1988

	Boac	Buenavista	Gasan	Mogpog	Sta. Cruz	Torrijos	Total
Urban Area							
House	1,080	380	520	640	2,000	440	5,060
Head	5,400	1,900	2,600	3,200	10,000	2,200	25,300
Level-I							
House	-	262	26	-	570	-	858
Head	-	1,310	130	-	2,820	-	4,260
Level-II							
House	-	-	-	70		-	70
Head	-	-	-	350		-	350
Level-III							
House	1,080	-	220	570	1,430	440	3,740
Head	5,400	-	1,090	2,850	7,180	2,200	18,720
Total Served							
House	1,080	262	246	640	2,000	440	4,668
Head	5,400	1.310	1,220	3,200	10,000	2,200	23,330
Kind of Water Source							
Wells	2	17	4	7	-	4	34
Spring	7	-	-	1	1	1	10
River	-	-	-	-	-	-	-
Facilities of Water District							
Pump	2	17	4	7	-	4	34
Reservoir	2	-	2	2	1	1	8
Filtration	1	-	-	1	-	-	2

Source: Department of Public Works and Highways & Municipal Office

Table I-2-2 Number and Population Served by Existing Domestic Public Facilities in Rural Areas as of 1988

Municipality	Rural Area		Deep Well with Pump			Shallow Well w/Pump			Level-II		Total No. Served	
	House	Head	House	Head	Unit	House	Head	Unit	House	Head	House	Head
Boac	7,720	38,600	2,780	13,880	105	1,830	9,130	32	2,260	11,300	6,870	34,310
Buenavista	2,740	13,700	70	320	17	1,080	5,410	19	-	-	1,150	5,730
Gasan	5,000	25,000	1,390	6,940	55	1,810	9,040	22	-	-	3,200	15,980
Mogpog	5,280	28,300	1,370	6,840	37	280	1,390	21	160	800	1,810	9,030
Sta. Cruz	10,360	51,800	1,860	9,290	41	2,100	10,530	19	-	-	3,970	19,820
Torrijos	4,860	24,300	1,030	5,140	37	1,190	5,930	19	1,060	5,300	3,280	16,370
Total	25,960	181,700	8,500	42,410	292	8,300	41,430	132	3,480	17,400	20,280	101,240

Source: Department of Public Works and Highways & Municipal Office

Table I-2-3 Preliminary Improvement Plan of Rural Water Supply

Project Area	Sta,Cruz	Boac	Mogpog	Gasan	Torrijos
Intake discharge (cu m/day)	4,840	2,000	-	2,320	-
Water source	Spring	Dam	Spring Well	Spring	Spring
Construction Facilities					
Diversion Dam	2 sets	-	-	-	-
Spring Box	-	-	-	1 set	-
Reservoir (cu.m)	1,600	700	-	800	-
GI Pipe (km)	φ8"L=18 φ6"L= 2 φ4"L=24 φ2"L=17	φ8"L= 1 φ4"L=12	-	φ6"L= 8 φ4"L=16 φ2"L=13	-
Communal Faucet (set)	154	84	-	133	-
Replacement Facilities					
GI Pipe (km)	-	φ8"L=5.5 φ6"L=7.0 φ4"L=3.0 φ3"L=1.5	φ6"L=0.8 φ4"L=2.2 φ3"L=1.0 φ2"L=1.5 φ1.5"L=0.5 φ1"L=0.5	-	φ6"L=10

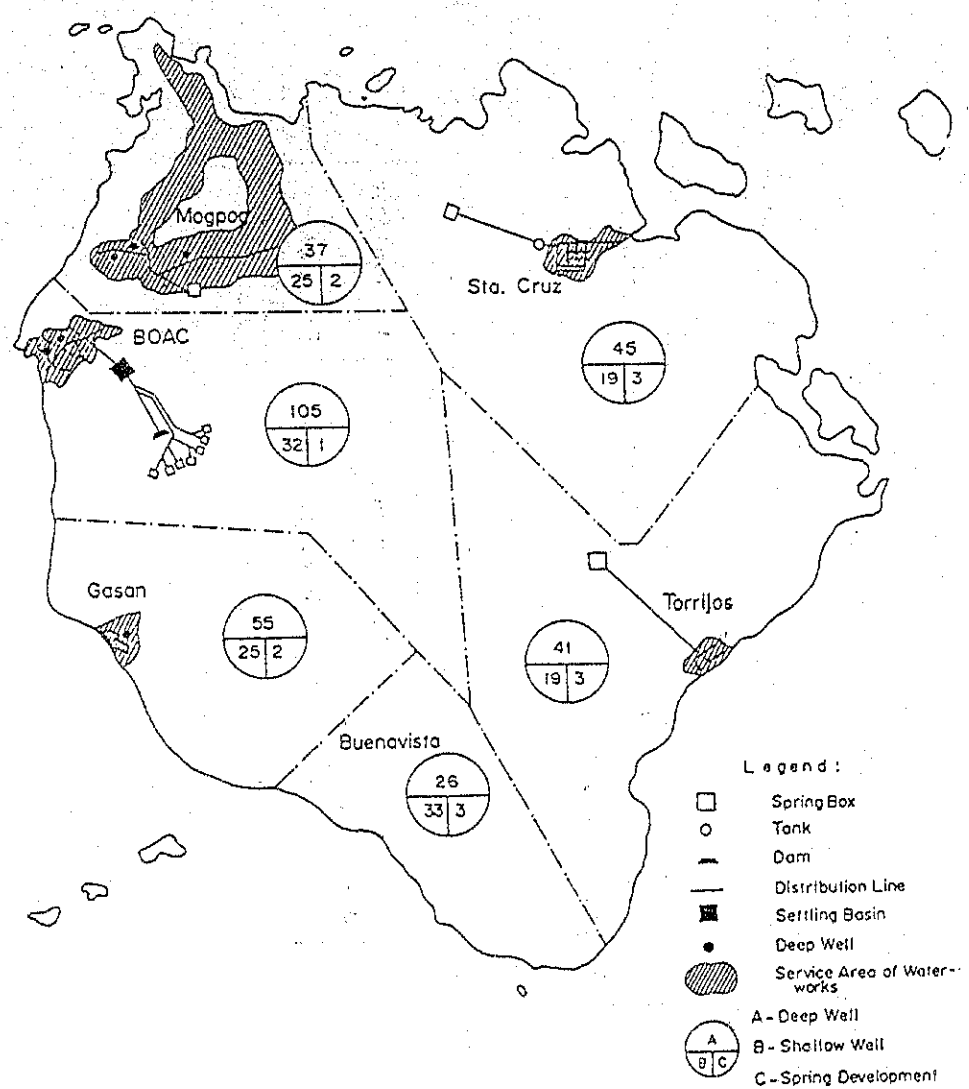
Table I-2-4 Fluctuations in the Water Demand

Year	Municipality	Served Population Urban	Served Population Rural	Average Day Demand q (cu.m/day)	Maximum Day Demand 1.3q (cu.m/day)	Peak Hour Demand 2.5q (cu.m/day)
1995	Boac	6,097	28,217 Σ34,314	2,059	2,677	5,148
	Gasan	2,916	19,482 Σ22,398	1,344	1,747	3,360
	Mogpog	3,532	22,035 Σ25,567	1,534	1,994	3,835
	Sta. Cruz	11,088	31,434 Σ42,522	2,551	3,316	6,378
	Torrijos	2,459	15,807 Σ18,266	1,096	1,425	2,740
2000	Boac	6,699	31,002 Σ37,701	2,262	2,941	5,655
	Gasan	3,204	21,405 Σ24,609	1,477	1,920	3,693
	Mogpog	3,881	24,210 Σ28,091	1,685	2,191	4,213
	Sta. Cruz	12,182	34,536 Σ46,718	2,803	3,644	7,008
	Torrijos	2,701	17,367 Σ20,068	1,204	1,565	3,010
2010	Boac	8,086	37,421 Σ45,507	2,730	3,549	6,825
	Gasan	3,868	25,838 Σ29,706	1,782	2,317	4,455
	Mogpog	4,684	29,223 Σ33,907	2,034	2,644	5,085
	Sta. Cruz	14,705	41,688 Σ56,393	3,384	4,399	8,460
	Torrijos	3,261	20,964 Σ24,225	1,454	1,890	3,635

Table I-2-5 Conditions of Potential Sources

Municipality	Water Source	Capacity (cu.m/day)	Distance from Poblacion (km)	Water Quality
Boac	Bugawas/Igat Spring	800	11	Good
	Bahay/Igat Creak	800	9	Good
	Boac River Binunga Dam	2,000		Good
	Σ	3,600		
Buenavista	Siniluan Spring	3,000	8	Good
Gasan	Katapusang Tubic Spring	3,400	8	Good
Mogpog	Amontay/Danao Spring	110	1 to 2	Good
	Deep Well in the City	2,700	0 to 1	Good
	Σ	2,810		
Sta. Cruz	Tayapos Creak Spring	2,500	18	Good
	Tawang River Spring	2,500	18	Good
	Σ	5,000		
Torrijos	Naampiyas River Spring	3,500	11	Good

Figure I-2-1 Geographical Situation of Water Supply Facilities



Gigure I-2-2 Sta.Cruz Rural Water Supply System

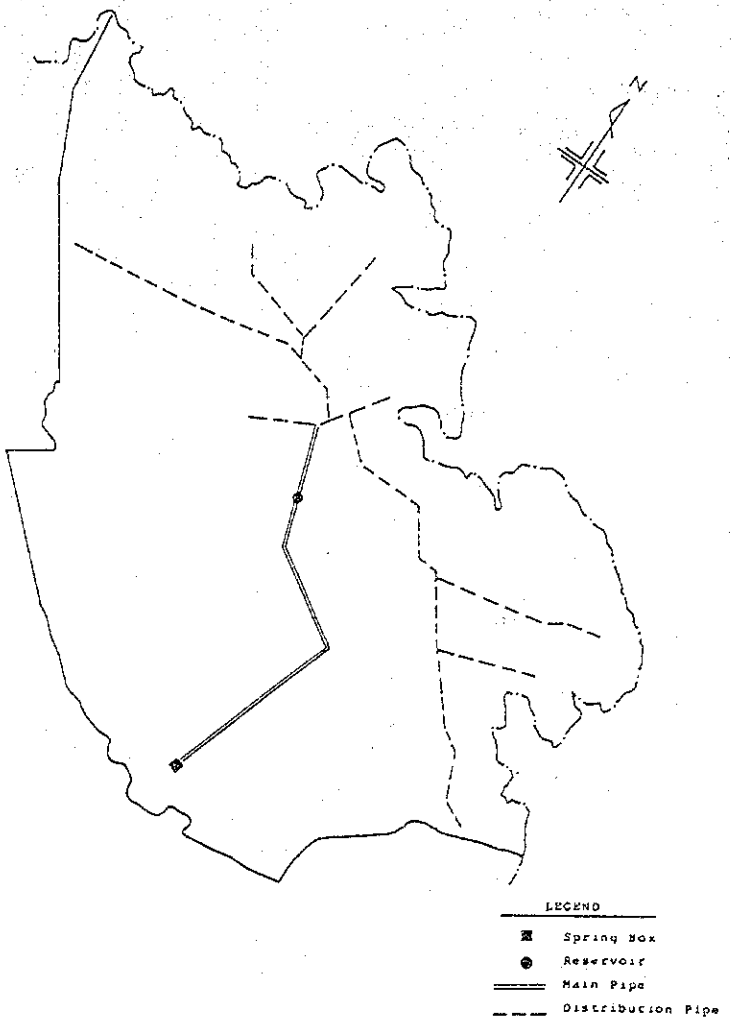


Figure I-2-3 Gasan Rural Water Supply System

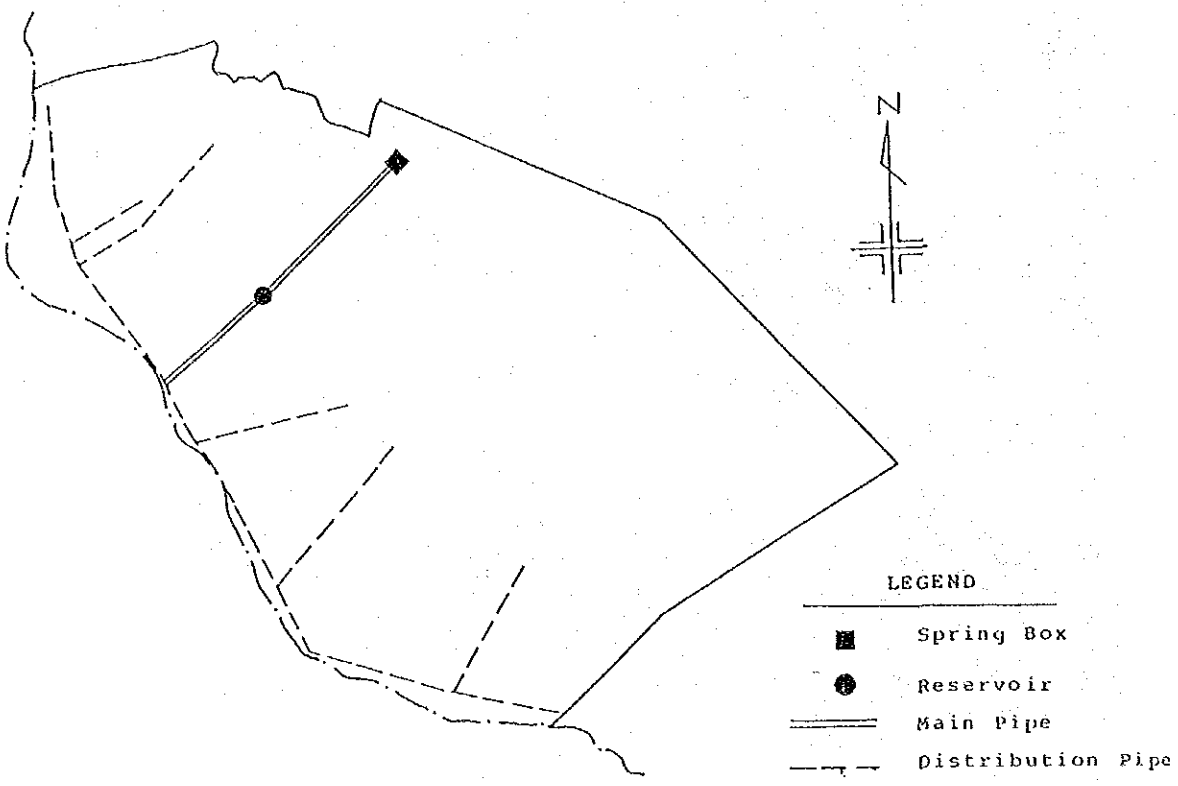
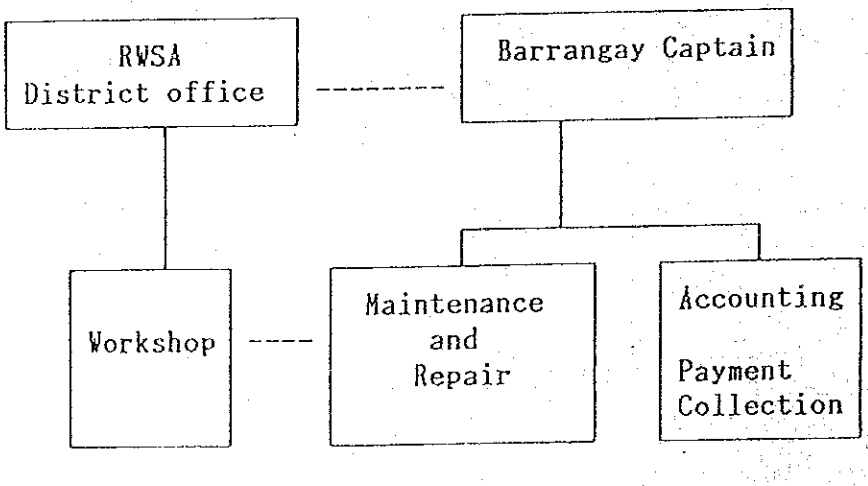


Figure I-2-4 Proposed Organization for Rural Water Supply



I-3 Rural Electrification

I-3-1 Present Condition

1) Summary

The electric power consumed in the province is supplied by the Marinduque Electric Cooperative, Inc. (MARELCO) through the Marcopper Mining Corporation. The six municipalities are all energized while abut 64% of the Barangays are connected by power. As of 1988, MARELCO has a total of about 8,350 house connections mostly located near the power line, but the average diffusion rate is only 25%. (refer to Table I-3-1)

The transmission line, power distribution station and other related facilities are provided and electric powers is supplied 24 hr. a day. The average load is 334 kw. The maximum demand is 1,300 kw, and the load factor is nearly 26%. The total length of existing transmission line is about 416 km. But the transmission line are often closed by strong typhoon and heavy rain. In 1987, the length of the transmission line damaged by two strong typhoons reached about 17.5 km. (refer to Figure I-3-1)

2) Average Consumption

The total amount of consumption in the province reached about 2.9 million kwh per annum. The average consumption of the present consumer level is as follows:

- Residential	-------	24 kwh/consumer/month
- Small commercial	-------	15 kwh/consumer/month
- Large commercial	-------	250 kwh/consumer/month
- Public institutional	-------	134 kwh/consumer/month
- Street light	-------	19 kwh/consumer/month
- Minimum consumers	-------	7 kwh/consumer/month

3) Electric Charges

According to the study at Marinduque Electric Cooperative, Inc. (MARELCO), the unit price of electric power in the Study Area is as follows:

Minimum charge	(1 kwh - 10 kwh)	-----	25 peso
Excess charge		-----	2.5 peso/kwh

I-3-2 Development Plan

1) Basic Concept

With consideration to improvement of rural living environment, it would be necessary to improve the rural electrification system.

However it is impossible to provide a perfect electrification system covering the whole area of Marinduque in a short time, as well as the cost of the construction of facilities should be considered.

Therefore, considering the existing condition of the rural electrification in Marinduque, the most effective development of rural electrification plan should be projected.

2) Development Strategy

The development of the rural electrification was projected, based on the following consideration.:

- The improvement of the generator owned by the corporation will be contemplated.
- The extension of the transmission line will be contemplated.

3) Selection of Project

Based on the development strategy, the generator would be operated by NPC and transmission line should be extended to the rural area.

The average diffusion rate became 52% and more than 95% of Balangays will be electrified for the short-term development. During long-term development plan, the diffusion rate will be extended to 75%. (refer to Table I-3-1)

a) Short-Term Development

Objective:	To promote rural electrification and expand the energized area
Program:	Set up new generators 2.25 MW x 4 units Transmission line (69 kv) L = 57 km (4.16 to 13.2 kv) L = 475 km
Target house:	8,700 houses
Diffusion rate:	52%
O & M body:	NPC, MARELCO

b) Medium-Term Development

Objective:	To expand energized area
Program:	Transmission line 1ϕ -- 30 km, Secondary -- 120 km
Target house:	7,600 houses
Diffusion rate:	65%

c) Long-Term Development

Objective:	To expand energized area
Program:	Transmission line 1ϕ -- 40 km, Secondary -- 170 km
Target house:	17,200 houses
Diffusion rate:	75%

4) Electric Power Demand

Electric power demand projection in this section is undertaken to obtain a basis for a long range electric power supply plan until the Master Plan target year 2010. The electric power demand projection year are 1995, 2000 and 2010 conforming to the design years of this study. Electric power demand have been made separately for residential, small commercial, large commercial, industrial, public building, and for street light demands.

Total energy requirement will be increased to 12.0 GWH in 1995, 17.3 GWH in 2000, and 29.5 GWH in 2010. (refer to Table I-3-2)

Figure I-3-1 Existing Electric Transmission Line System

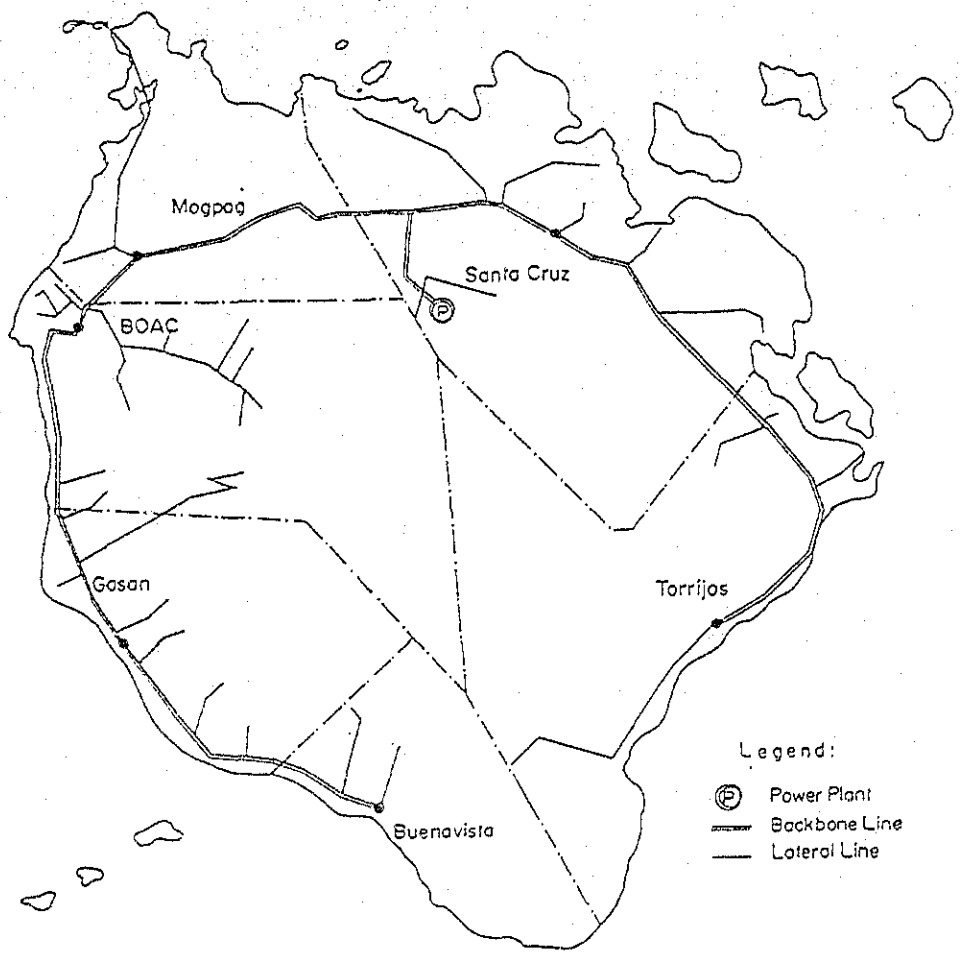


Table I.3.1 Number of Barangays and House Connected by Power

Municipality	Total Number		Barangay Connect		House Connected	
	Barangay	House	Number	%	Number	%
Boac	61	7,733	42	68.8	2,750	35.5
Buenavista	165	2,643	10	62.5	491	18.5
Gasan	25	4,664	24	96.0	1,380	29.5
Mogpog	37	5,419	24	64.8	1,422	26.2
Sta. Cruz	55	10,381	26	47.2	2,210	21.2
Torrijos	25	4,500	14	56.0	673	14.9
Total	219	35,340	140	63.9	8,926	25.2

Source: Marinduque Electric Cooperation, Inc.

Table I-3-2 Fluctuations in the Electric Power Demand

ITEM	YEAR 1990	1995	2000	2010
POTENCIAL CONSUMERS (Household)	32,000	34,600	39,400	57,100
RESIDENTIAL CONSUMERS	10,930	18,000	25,600	42,800
Diffusion rate (%)	34	52	65	75
KWH/consumers/month	25	25	25	30
Demand (MWH/year)	3,279	5,400	7,680	15,408
SMALL COMMERCIAL CONSUMERS	600	1,500	2,400	3,200
KWH/consumers/month	15	15	15	15
Demand (MWH/year)	108	270	432	576
LARGE COMMERCIAL CONSUMERS	260	560	990	1,550
KWH/consumers/month	250	250	250	250
Demand (MWH/year)	780	1,689	2,970	4,650
INDUSTRIAL CONSUMERS	-	1	1	1
MWH/consumers/month	-	200	250	350
Demand (MWH/year)	-	2,400	3,000	4,200
PUBLIC BUILDING CONSUMERS	150	190	250	390
KWH/consumers/month	145	145	145	145
Demand (MWH/year)	261	331	435	679
STREET LIGHT UNITS	255	330	450	580
KWH/consumers/month	22	22	22	22
Demand (MWH/year)	67	87	119	153
TOTAL DEMAND (MWH/year)	4,495	10,177	14,636	25,660
Energy losses (MWH/year)	899	1,832	2,634	3,850
Energy losses (%)	20	18	18	15
Energy requirement (MWH/year)	5,394	12,009	17,270	29,510
Average load (KW)	622	1,390	1,999	3,416
Load facter (%)	28	32	33	35
Peak demand (MW)	2.22	4.34	6.06	9.76

Source: Marinduque Electric Cooperation, Inc.
Estimate of Study Team.

Notes : SMALL COMMERCIAL - Commercial establishments & Industrial establishment with demand up to 25 KW demand.
LARGE COMMERCIAL - Commercial establishments with more than 25 KW demand.

I-4 Health and Medical Facilities

I-4-1 Present Condition

1) Health Manpower and Facilities

Health services delivery in the province are carried out by the Provincial Health Office through two government hospitals, namely the Sta. Cruz District Hospital and the Marinduque Provincial Hospital; eight Rural Health Units of Main Health Centers, two each in Boac and Sta. Cruz and one each for the remaining four municipalities, and forty-three Barangay Health Station located in strategic barangays throughout the province. Laboratory and radiological support are provided by the two government hospitals, however simple laboratory examinations are available in the Main Health Center of Sta. Cruz and Buenavista. Sputum microscope for the diagnoc of pulmonary tuberculosis is available in all main health centers. Examination of malaria smears are done in Sta. Cruz, Boac, Buenavista Rural Health Units and also the provincial hospital. (refer to Figure I-4-1)

The health manpower of Marinduque consisted of twelve resident physician and anesthesiologist are serving in two government hospitals, eight rural health physicians, thirteen public health nurses and eleven rural sanitations inspectors stationed at the main health centers. There are forty-three health midwives, thirty-four of whom are in the Balangay health stations and the rest are in the main health centers. There are three hospital dentists and six public health dentists under the supervision of a senior dentist. Two hospital pharmacists, two medical technologists, two x-ray technicians and thirty-two nurses are serving in the two government hospitals of the province. Thirteen nutritionists are responsible for the nutrition program of the province. Leadership and management are provided by one provincial health officer, one assistant provincial health officer, one district health officer, three administrative officers and fourteen technical services staff of the Provincial Health Office. Various support personnel consisting of 110 employees completes the total health manpower of 258 for the Department of Health in Marinduque. (refer to Tables I-4-1 and I-4-2)

2) Birth

The total births registered in the province for the year 1988 were 4,744 with a Crude Birth Rate of 23.4 per one thousand population. The three municipalities with the highest birth rates are Buenavista with a crude birth rate of 26.6, followed by Gasan with a rate of 25.8, and Boac with 24.4. The lowest three crude birth rates were registered in Torrijos (23.7), Sta. Cruz (23.5) and in Mogpog (17.6).

The significant of these figures is an overall reduction of considerable degree of the crude birth rate of Marinduque from an average of 26.1 per one thousand population for past five years (1983-1987) to 23.4 in the year under review.

3) Death

In the year 1988, Marinduque registered a total deaths of 1,570 with a crude death rate of 7.7 per one thousand population. The municipality of Sta. Cruz had highest number of deaths 501 or a crude death rate of 8.3 per one thousand population. Next is Boac with a recorded deaths of 318, a rate of 7.4, Mogpog is third with 251 deaths and a crude death rate of 8.2. The three municipalities with the lowest number of deaths are those of Torrijos with 199 or a rate of 7.6, Gasan with 167 deaths, a rate of 6.2 and last is Buenavista with 134 recorded deaths and a rate of 8.6 per one thousand population.

Compared to the figures of the averaged past five years with 1,273 reported deaths or a rate of 6.7 per one thousand population, the number of recorded deaths increased by 297 with a corresponding increase of 1.1 in the crude death rate for the year 1988. A greater number of these deaths were reported during the first and second quarters of the past year mainly from pneumonia and diarrhea, two diseases which resulted from typhoons and floods.

4) Infant Death

The most sensitive indicator for the health level in a particular community is the infant mortality rate per one thousand livebirths. In 1988, Marinduque registered a total of 184 deaths in the age group of below one year with a rate of 38.8 per one thousand livebirths. Torrijos registered the highest rate of 54.7, followed by Mogpog with 50.4, Buenavista with 45.7 and Sta. Cruz with 44.2 deaths below one year of age per one thousand livebirths. The two municipalities of Boac and Gasan registered a significantly low infant mortality rate of 26.6 and 18.8, respectively.

Taken against the average figures of the past five years of 231 infant deaths with a rate of 46.4 per one thousand livebirths, the current figures account for 47 less in the number of infant deaths and 7.6 less in the infant mortality rate. This is a 16.4% reduction of the infant mortality rate for the averaged past five years, signifying an improved child care and infant survival programs carried out mainly through the activities of six clinics, breast feeding advocacy, expanded program on immunization and rehabilitation of malnutrition cases.

5) Maternal Death

The past year 1988 registered a total of six maternal deaths with a rate of 1.3 per one thousand livebirths. For Marinduque, the municipalities of Torrijos and Sta. Cruz accounted for two maternal deaths each with a rate of 3.2 and 1.4 maternal mortality per one thousand livebirths. Mogpog had one maternal death with a rate of 1.9 and Boac also had one death with a rate of 1.0. Gasan and Buenavista had no reported maternal deaths.

These figures have doubled the average figures of the past five years which were three maternal deaths and a rate of 0.6 per one thousand livebirths for the whole province.

6) Leading Causes of Infant Mortality

It is noteworthy to point out that only four are due to communicable diseases: pneumonia, diarrhea, septicesima and meningitis; the remaining six are due to non-communicable diseases: congenital anomalies, immaturity, malnutrition, respiratory distress syndrome, congenital heart disease and accidents. (refer to Table I-4-3)

Comparing the figures for 1987 with that of the past five years shows basically only minimal changes. All these disease conditions except congenital anomalies are preventable diseases which can be greatly minimized with the application of proper technology.

7) Leading Causes of Maternal Mortality

The saddest thing to happen is to lose the life of someone who has brought forth a new life into the world and this is what commonly happen with maternal deaths. Maternal mortality rate is the most variable among the health indicators exhibiting great fluctuations from year to year although the pattern of the cause of deaths virtually remains the same. (refer to Table I-4-4)

Again, most of these deaths are highly preventable if only vigilance and timely judgement to apply knowledge and skills appropriate to the situation.

8) Leading Causes of Morbidity

Analysis and comparison of the ten leading causes of morbidity between those of 1987 and those of the average past five years yield two general conclusions; one, the top five leading causes of illnesses are still communicable diseases both for the past five years and year under review; two, the numbers and rates of the ten leading causes of morbidity for the year 1987 are approximately one and a half times the average figures of the past five years. (refer to Table I-4-5)

9) Leading Causes of Mortality

Analysis of 1987 leading causes of mortality and comparing their figures with those of the average past five year discloses the following observations. (refer to Table I-4-6)

- The leading causes of mortality are essentially the same disease conditions found as the leading causes of illness except for cancer and meningitis.
- Six of causes of deaths are communicable diseases namely: Pneumonia (1st), Pulomonary Tuberculosis, Measles (5th and 6th respectively), Diarrhea, Meningitis and Hepatitis (8th, 9th and 10th respectively), while only four causes of mortality are non-communicable disease conditions, Diseases of the Heart, Diseases of the Vascular System, accidents (2nd, 3rd and 4th in rank) and Cancer, the seventh causes of deaths.
- The figures for death in 1987 are approximately same those for average past five years.

I-4-2 Development Plan

1) Basic Concept

With consideration to improvement of healthful environment in the study area, it would be necessary to carry out a plan for the consideration of the health facilities and medical manpower, However it is impossible to provide perfect facilities in a short time, as well as the cost of the construction of facilities should be considered. Therefore, considering the existing condition of the health organization in Marinduque, the improvement program of Department of Health should be given first priority.

2) Development Strategy

The development of the health and medical system plan was projected, based on following consideration:

- Carry out a plan for the consolidation of the existing health facilities.
- The delivery of basic health and nutrition services will be contemplated.
- The increase of the health manpower will be contemplated.

3) Selection of Project

Based on the development strategy, the improvement of the health and medical development project was selected as follows:

a) Short-Term Development

Objective:	To rehabilitate and/or construct health centers and/or facilities		
Program:	Construction of BHS	---	8 units
	Construction of Health center	---	1 unit
	Rehabilitation of BHS	---	2 units
	Rehabilitation of RHU	---	2 units
	Renovation/Expansion of hospital-		2 units
	Sep up clinic car	---	2 units

b) Medium-Term Development

Objective:	To conduct additional health and/or medical facilities		
Program:	Construction of RHU	--------	3 units
	Construction of BHU	--------	7 units

c) Long-Term Development

Objective:	To build up the health manpower capabilities of the health facilities		
Program:	Increase number of physicians	---	4 persons
	Increase number of dentists	---	3 persons

Table I-4-1 Number of Government Health Staff Assigned to Public Facilities as of 1988

Name of Facility	Municipality	Physician	Nurse	Midwife	Rural Sanitary Inspector	Dentist	Medical Technologist	Nutritionist	Educator
1. Boac RHU I	Boac	1	2	6	1	-	1	1	-
2. Boac RHU II	Bantay, Boac	1	1	3	1	-	-	-	-
3. Buenavista RHU	Buenavista	1	1	4	1	1	-	1	-
4. Gasan RHU	Gasan	1	2	5	2	1	-	1	-
5. Mogpog RHU	Mogpog	1	2	6	2	1	-	1	-
6. Sta. Cruz RHU I	Sta. Cruz	1	2	7	2	1	1	1	-
7. Sta. Cruz RHU II	Napo, Sta. Cruz	1	1	6	1	1	-	-	-
8. Torrijos RHU	Torrijos	1	2	6	1	1	-	-	-
Total		8	13	43	11	6	2	5	-

Source: Provincial Health Office, 1988

Table I-4-2 Name of Hospitals and Number of Health Staff as of 1988

Name of Hospital	Municipality	Kind of Medical Care	Physician	Nurse	Dentist	Medical Technologist	Other Staff	Bed Capacity
Santa Cruz Hospital (District)	Sta. Cruz	Secondary	4	7	1	1	29	25
Marinduque Provincial Hospital	Boac	Tertiary Provincial	19	25	2	1	81	100
Total			23	32	3	2	110	125

Source: Provincial Health Office, 1988

Table I-4-3 Ten (10) Leading Causes of Infant Mortality in Number and Rate per 1,000 Live Births, Five-Year Average and 1987

	Causes	Average (1981-1986)		1987	
		Number	Rate	Number	Rate
1.	Broncho Pneumonia	66	13.26	109	19.60
2.	Diarrhea	28	5.62	22	3.95
3.	Immaturity	21	4.22	19	3.41
4.	Congenital Heart Disease	-	-	15	2.69
5.	Sepsis Neonatorum	14	2.81	11	1.97
6.	Congenital Anomaly	-	-	9	1.61
7.	Malnutrition	14	2.81	8	1.43
8.	Respiratory Disease Syndrome	-	-	8	1.43
9.	Accident	-	-	4	0.71
10.	Meningitis	6	1.20	4	0.71

Source: Provincial Health Office

Table I-4-4 Ten (10) Leading Main Causes of Maternal Mortality in Number and Rate per 1,000 Live Births, Five-Year Average and 1987

	Causes	Average (1981-1986)		1987	
		Number	Rate	Number	Rate
1.	Placental Retention	1	0.2	1	0.17
2.	Hemorrhage of Pregnancy	1	0.2	-	-
3.	Abortion	1	0.2	-	-
4.	Eclampsis	1	0.2	-	-
5.	--	-	-	-	-
6.	--	-	-	-	-
7.	--	-	-	-	-
8.	--	-	-	-	-
9.	--	-	-	-	-
10.	--	-	-	-	-

Source: Provincial Health Office, 1988

Table I-4-5 Ten (10) Leading Causes of Morbidity in Number and Rate per 100,000 Population, Five-Year Average (1981-1986) and 1987

	Causes	Average (1981-1986)		1987	
		Number	Rate	Number	Rate
1.	Diarrhea	637	340.70	920	462.00
2.	Pneumonia	353	198.16	727	365.08
3.	Measles	137	73.31	627	314.86
4.	Tuberculosis, all forms	393	210.08	553	277.70
5.	Bronchitis	547	311.43	354	177.77
6.	Diseases of the Heart	122	65.02	310	155.67
7.	Influenza	328	174.81	287	144.12
8.	Dis. of the vascular system	-	-	207	103.95
9.	Accident	53	28.24	127	63.77
10.	Hepatitis	88	47.50	84	42.18

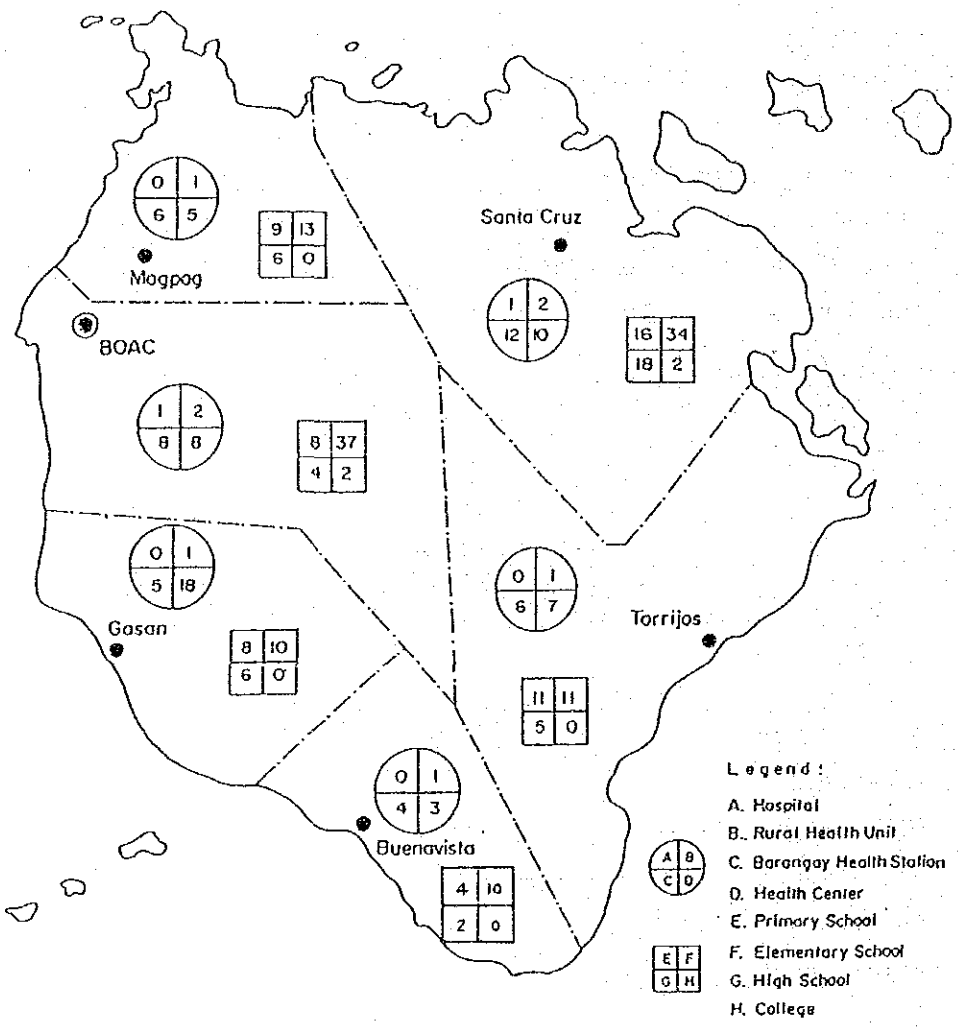
Source: Provincial Health Office, 1988

Table I-4-6 Ten (10) Leading Causes of Mortality in Number and Rate per 100,000 Population, Five-Year Average (1981-1986) and 1987

	Causes	Average (1981-1986)		1987	
		Number	Rate	Number	Rate
1.	Pneumonia	160	85.48	305	153.16
2.	Diseases of the Heart	125	52.70	105	52.70
3.	Dis. of the Vascular System	87	47.01	72	36.15
4.	Accident	21	14.82	43	21.59
5.	Pulomonary Tuberculosis	150	80.87	35	17.57
6.	Measless	-	-	21	10.54
7.	Cancer, All Forms	63	34.14	17	8.53
8.	Diarrhea	51	27.66	17	8.53
9.	Meningitis	-	-	15	7.53
10.	Hepatitis	-	5.22	12	6.02

Source: Provincial Health Office, 1988

Figure I-4-1 Geographic Situation of Health and Education Institution



I-5 Education

I-5-1 Present Condition

Formal education in Marinduque is classified into elementary, secondary, and tertiary levels. (refer to Figure I-4-1)

1) Elementary Education

Elementary education is being provided in 19 school districts constituting 110 complete elementary, 41 complete primary and 15 incomplete primary schools. The total number of classrooms, enrollment and teaching personnel are recorded at 958, 34, 161 and 1,211 respectively, with classroom-pupil ratio and a teacher-pupil ratio of 1:36 and 1:28 respectively. (refer to Tables I-5-1, I-5-2 and I-5-3)

Most of the formal education services are provided by the Marinduque Division of the Department of Education, Culture and Sports (DECS). The education facilities are inadequate and are concentrated in centers making it inaccessible to pupils who are coming from remote Barangays particularly during rainy season. The majority of the school buildings are damaged by typhoon. So the part of the administration are making effort to rehabilitate, replace schoolhouses and buildings. But the progress is slow because of the insufficiency of the funds and uncertainty of budget allocation.

2) Secondary Education

There are a total of 41 secondary schools of which 30 are public schools and 11 are privately owned. Total enrollment in the high school level is recorded at 13,226, with about 454 teachers, consequently the teacher-pupil ratio is 1:29. (refer to Tables I-5-4 and I-5-5)

Majority of the school furniture, tools and equipment and school supplies are insufficient. And significant percentage of students are dropping out the school, which associated with poverty, the need for family labor and the poor condition of school facilities.

3) Tertiary Education

As for higher educational institution, there are two public colleges and two private colleges. The two public colleges are Marinduque Institute of Science and Technology and the Marinduque Community College, which offer four courses. The two private colleges are Santa Cruz Institute and Immaculate Conception College. (refer to Tables I-5-6 and I-5-7)

I-5-2 Development Plan

1) Basic Concept

With consideration to improvement of education in the study area, it would be necessary to carry out a plan for the consolidation of the educational facilities. Therefore, considering the existing condition of the educational organization in Marinduque, DPWH school building program will be given first priority.

2) Development Strategy

The development of the educational plan was projected, based on following consideration:

- Carry out a plan for the consolidation of the existing educational facilities.
- Basic training of sanitation.

3) Selection of Project

Based on the development strategy, the improvement of the educational facilities project was selected as follows:

a) Short-Term Development

Objective:	To improve educational facilities		
Program:	Rehabilitation of E/S	---	245 schools
	Replacement of E/S	---	40 "
	Construction of E/S	---	20 "
	Construction of school toilet	---	9 "

b) Medium-Term Development

Objective:	Practice of basic training on sanitation		
	Bring up the successor of agriculture		
Program:	Construction of primary school toilet	---	56 units
	Strengthen of agriculture section in MIST		

c) Long-Term Development

Objective:	Practice of basic training on sanitation		
Program:	Construction of elementary school toilet	---	110 units

Table I-5-1 Status on Complete Primary School as of 1988

School District	Municipality Included	No. of Schools	No. of Class	No. of Enrollment	No. of Teacher
I	Boac North	3	6	155	6
II	Boac South	3	6	189	6
III	Buenavista	4	10	285	10
IV	Gasan	5	17	492	17
V	Mogpog	5	10	270	10
VI	Sta. Cruz East	7	15	482	16
VII	Sta. Cruz North	5	16	461	14
VIII	Sta. Cruz South	1	2	73	2
IX	Torrijos	8	21	624	17
Total		41	103	3,030	98

Source: Department of Education, Culture and Sports

Table I-5-2 Status on Incomplete Primary School as of 1988

School District	Municipality Included	No. of Schools	No. of Class	No. of Enrollment	No. of Teacher
I	Boac North	0	0	0	0
II	Boac South	2	1	48	2
III	Buenavista	0	0	0	0
IV	Gasan	3	5	125	5
V	Mogpog	4	4	68	4
VI	Sta. Cruz East	0	0	0	0
VII	Sta. Cruz North	2	3	79	3
VIII	Sta. Cruz South	1	1	29	1
IX	Torrijos	3	3	100	3
Total		15	17	449	18

Source: Department of Education, Culture and Sports

Table I-5-3 Status on Complete Elementary School as of 1988

District Number	Municipality Included	No. of Schools	No. of Class	No. of Enrollment	No. of Teachers
I	Boac North	18	119	3,572	139
II	Boac South	14	96	2,934	118
III	Buenavista	10	73	2,543	88
IV	Gasan	10	89	3,830	134
V	Mogpog	13	116	4,368	158
VI	Sta. Cruz East	11	82	2,917	101
VII	Sta. Cruz North	10	72	2,854	93
VIII	Sta. Cruz South	13	113	3,733	138
IX	Torrijos	11	78	3,930	126
Total		110	838	30,681	1,095

Source: Department of Education, Culture and Sports

Table I-5-4 Status on Public High School as of 1988

Municipality	No. of Schools	No. of Class	No. of Enrollment	No. of Treachers
Boac	3	58	2,570	95
Buenavista	1	13	565	15
Mogpog	4	21	873	23
Gasan	4	29	996	43
Sta. Cruz	14	39	3,205	103
Torrijos	4	31	1,170	39
Total	30	191	9,379	318

Source: Department of Education, Culture and Sports

Table I-5-5 Status on Private High School as of 1988

Municipality	Number of School	Number of Class	Number of Enrollment	Number of Teachers
Boac	1	4	190	9
Buenavista	1	4	177	4
Mogpog	2	20	810	27
Gasan	2	16	543	17
Sta. Cruz	4	38	1,728	67
Torrijos	1	8	399	12
Total	11	90	3,847	136

Source: Department of Education, Culture and Sports

Table I-5-6 Status on Public College as of 1988

Name of School	Kind of Course	No. of Class	No. of Enrollment	No. of Teachers
Marinduque Institute Science & Technology	BSIE	4	204	
	BSIT	4	237	
	BSCE	1	72	90
	2TTEC	2	352	
Marinduque Community College	AB		112	
	BSE		23	
	BSEE		273	30
	BSC		22	

Source: Marinduque Institute of Science and Technology.
Marinduque Community College

Note : BSIE - Bachelor of Science in Industrial Education
BSIT - Bachelor of Science in Industrial Technology
BSCE - Bachelor of Science in Civil Engineering
2TTEC- 2 year Trade Technical Education Curriculum
AB - Bachelor of Arts
BSE - Bachelor of Science in Education
BSEE - Bachelor of Science in Elementary Education
BSC - Bachelor of Science in Commerce

Table I-5-7 Status on Private College as of 1988

Name of School	Kind of Course	No. of Class	No. of Enrollment	No. of Teachers
Santa Cruz Institute	BSE		54	
	BSC		22	
	1YGCC		13	
	2YJSC		10	20
	5MVC		9	
	STENO		3	
Immaculate Conception College	BSE		17	
	BSEE		97	
	BSC		167	25
	2YJSC		95	

Source: Santa Cruz Institute, Immaculate Conception College.
Note : BSE - Bachelor of Science in Education
BSC - Bachelor of Science in Commerce
1YGCC- 1 year General Clerical Course
1YJSC- 2 year Jr. Secretarial Course
5MVC - 5 month Vocational Course
STENO- Stenography
BSEE - Bachelor of Science in Elementary Education

I-6 Housing

I-6-1 Present Condition

The region registered a total of 1,132,217 of dwelling units with an occupancy rate of 96.9%. Relative to other provinces, Marinduque ranked second with the lowest number of dwelling units. There are 33,184 dwelling units in Marinduque of which 32,168 are occupied. The occupancy rate is 96.9%. (refer to Table I-6-1)

Most houses are built with wood and bamboo. They are frequently damaged by typhoons.

I-6-2 Development Plan

The traditional house built in the rural area could be improved by seeking advice from the Health and Sanitary Officer and housing authority as well. There are many points to improve for comfortable life. The priority would be given to improve its kitchen and toilet. There exists no treatment system, so sewage water is drained to the river directly. Garbage is thrown outside of the house and toilet is very simple and poor. In order to solve the sanitation and health problems which peoples confront with a difficulty, improvement of the house is very important.

Table I-6-1 Number of Dwelling Unit, Occupied and Vacant by Province, Region IV

Province	Total No. of Dwelling Units	Occupied Units		Unoccupied Units	
		Number	%	Number	%
Batangas	210,694	206,256	18.8	4,438	12.8
Cavite	142,242	138,179	12.6	4,063	11.7
Laguna	179,511	174,558	15.9	4,953	14.3
Marinduque	33,184	32,168	2.9	1,016	2.9
Occidental Mindoro	41,775	40,111	3.6	1,664	4.9
Oriental Mindoro	83,150	80,145	7.3	3,005	8.7
Palawan	70,910	67,364	6.1	3,546	10.2
Quezon	213,541	206,195	18.8	6,436	18.6
Aurora	19,848	18,704	1.7	1,144	3.3
Rizal	101,262	98,427	9.0	2,835	8.2
Romblon	37,100	35,528	3.2	1,572	4.5
Total	1,132,217	1,097,545	100.0	34,672	10.0

Source: 1980 Statistics, National Census and statistics Office

I-7 Communication

I-7-1 Present Condition

The province has postal, telephone and telegraph services and radio communication. The most ordinary communication system is the postal services. Each municipality is provided with a postal station. There is no public telephone services in Marinduque, but there exist commercial telephone services in Boac and Mogpog. Long distance calls outside the province are available in Boac through PILTEL, a private entity, but no telephone line between each municipality. On the other hand, telegraph is being served by the Bureau of Telecommunication (BUTEL), a governmental agency and a private company in Boac and Santa Cruz, respectively. The radio communication is transmitted by BUTEL, through its network in Boac to Buenavista, Torrijos, Santa Cruz and Lucena city.

I-7-2 Development Plan

1) Basic Concept

With consideration to improvement of the economic condition in Marinduque, it would be necessary to develop the communication system. However it is impossible to provide a perfect communication system covering the whole area of the Marinduque in a short time, as well as the cost of the construction facilities must be considered. Therefore, considering the existing condition of the communication system, the most effective development of the communication plan should be projected.

2) Development Strategy

The development of the communication system was projected, based on the following consideration.

- The future program of BUTEL and PILTEL will be given first priority.

- The telephone system would be proposed to be improved by installing telephone system not only in private houses but in all public buildings.

3) Selection of Project

Based on the development strategy, the improvement of communication system project was selected as follows:

a) Short-Term Development

Program:	Set up 60 telephones in public buildings (Boac, Buenavista, Mogpog, Gasan, Sta. Cruz) Wiring distance of about 40 km

b) Medium-Term Development

Program:	Install a telephone exchange system at Torrijos Set up 50 telephones in public buildings

c) Long-Term Development

Program:	Fill up the telephone network gap in Marinduque Wiring distance of about 100 km

I-8 Welfare

I-8-1 Present Condition

1) Summary

Welfare in Marinduque is classified into Family and community welfare, Child and youth welfare, Women's welfare, and Disabled person's welfare.

The Family and community welfare is summarized as follows:

a) Livelihood assistance for family heads and other needy adult
b) Practical skills development
c) Family planning motivation
d) Self-employment assistance

The programs on child and youth welfare is as follows:

a) Practical skills development, non-formal education
b) Supplemental feeding
c) Pre-marital counselling
d) Population awareness and sex education

The women's welfare programs are:

a) Livelihood development
b) Leadership training for women
c) Day care services

The disabled person's welfare programs are presented as follows:

a) Rehabilitation of their physical and mental well being
b) Job placement situated for them

Based on these programs, Provincial social welfare officers are working on a plan to remedy programs of poverty, especially child nutrition, but can not be worked out because of the insufficient funds.

2) Highlights of Accomplishments

For the year 1988, Marinduque branch had reached out 178 depressed and non-depressed Barangays in the province providing assistance to 10,888 new and 15,503 old clients against annual target of 21,026 thus having 125.5% accomplishment. Service headcounts for the year 1988 totaled to 27,078 new and 10,262 old accomplishments against 42,896 target service headcount thereby having 87.1% branch performance in various services per clientele category. The breakdown of service connections by clientele is shown in Tables I-8-1 and I-8-2.

I-8-2 Development Plan

1) Basic Conception

With consideration to improvement of welfare in the study area, it would be necessary to carry out a plan for the consolidation of the welfare activity. Considering the existing conditions of the welfare organization in Marinduque, program of Department of Social Services and Department should be given first priority.

2) Selection of Project

Based on the development concept, the improvement of the welfare project was selected as follows:

a)	Assistance to socially disadvantaged family	:	Self Employment Assistance Marriage Counselling Service Social service for solo parent
b)	Women's Welfare	:	Social Community Skills Development Maternal and child Care
c)	Disability Prevention and Rehabilitation of disabled person	:	Disability Prevention Vocational Skills Development Self Employment Assistance

d)	Emergency Assistance	:	Integrated Disaster prepareness
e)	Child and Youth Welfare	:	Day Care Service Supplemental Feeding Skills for livelihood development

Table I-8-1 Accomplishment by Headcount

Clientele Category	Target Headcount	Accomplishment	Served %
FHONA	4,676	3,709	79.3
CHILDREN	8,578	10,656	124.2
YOUTH	1,600	1,359	85.0
DISABLED	354	340	96.0
DISTRESSED	5,818	9,132	157.0
WID	592	1,200	202.7
TOTAL	21,028	26,396	125.5

Table I-8-2 Accomplishment by Service Headcount

Clientele Category	Target Service Headcount	Accomplishment	Served %
SEA	918	1,182	128.8
P	1,012	507	50.1
JP	100	151	151.0
DCS	4,548	7,513	165.2
SF	4,030	4,877	121.0
EA	9,500	12,908	135.9
FPM	6,050	3,523	58.2
PMC	245	9	3.7
PASE	1,146	399	34.8
SSS	15,592	6,271	40.2
TOTAL	42,896	37,340	87.1

Notes: FHONA = Family Head and other Needy Adult
WID = Women in Development
SEA = Self Employment Assistance
P = Practical Skills Development
JP = Job Placement
DCS = Day care Service
SF = Supplemental Feeding
EA = Emergency Assistance
FPM = Family Planning Motivation
PMC = Pre-Marriage Counselling
PASE = Population Awareness and Sex Education
SSS = Special Social Services

APPENDIX J COST ESTIMATE

APPENDIX J COST ESTIMATE

APPENDIX J COST ESTIMATE

J-1 Development Cost

The development cost is composed of 11 item costs according to the sectoral development plans as follows:

1. Agricultural development
2. Agricultural infrastructure development
   1) Irrigation development
   2) Drainage development
   3) Rural road development
   4) Village water supply development
3. Rural infrastructure development
   1) Rural water supply development
   2) Hydro-power and rural electrification development
   3) Traffic system development
   4) Social services development
4. Aquaculture development
5. Marinduque Agricultural Development and Promotion Project (MADPP)

The total development cost is estimated at 3,800 million pesos. (refer to Tables J-1-1, J-1-2 and J-1-3)