Fig. 12.3 HIGH IMPACT TOURISM PROJECTS RECOMMENDED AREAS

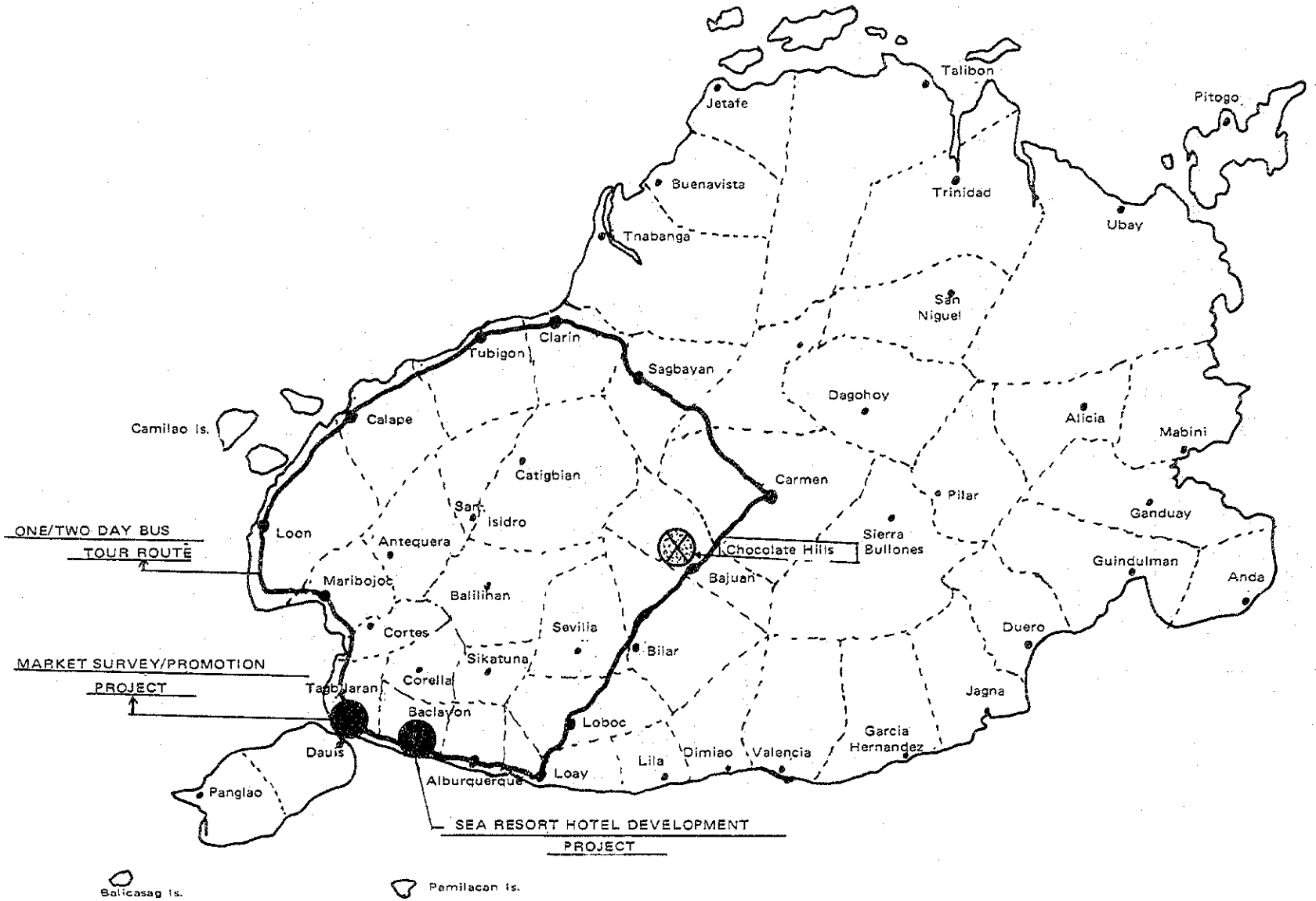


FIG. 12.4 HIGH IMPACT TOURISM PROJECTS: IMPLEMENTATION SCHEDULE

PROJECT TITLE/ PROJECT COMPONENT	1980 YEAR 1985					REMARKS	
	1st	2nd	3rd	4th	5th		
A. MARKET SURVEY/PROMOTION PROJECT							
Office Set-Up	■	----	----	----	----		
Data Generation/Information Service	----	■	■	■	■		
Promotion Leaflet Editing	■						
Printing Leaflets		■	■	■	■		50,000 Copies/Yr.
B. SEA RESORT HOTEL DEVELOPMENT PROJECT							
Inception and Site Selection	■						
Feasibility Study	■						
Land Acquisition	----	■					
Application for Incentives		■	■				P.D. 535 Incentive Plan
Detail Design/Documentation/-Bidding			■	■			
Construction				■	■		
Pre-opening Personnel Training/Promotion				■			

APPENDIX

Appendix 12-1

TOURIST VOLUME (INTERNATIONAL AND DOMESTIC TOURIST ARRIVALS)

Year	Bohol[1/]	Av. Growth Rate	Region VII[2/]	Av. Growth Rate
		1977/1973		1978/1973
1973	760 (4.7)[3/]		16,025	
1974	1,210 (3.3)		37,168	
1975	2,190 (3.8)	46.7%	56,985	39.3%
1976	3,870 (4.0)		96,316	
1977	5,180 (5.2)		99,275	
1978	-		116,976	

Notes: 1/ Source: Provincial Trade and Tourism Committee
2/ Source: Ministry of Tourism, Region VII Field Office
3/ Parenthesized figures indicate the percentage of tourist volume in Bohol to that in Region VII.

Appendix 12-2

TOURIST VOLUME TO BOHOL (TOURIST ARRIVALS)

Types / Year	International[1)]	%	Domestic	%	Total	%
1973	110	14.5	650	85.5	760	100
1974	230	19.0	980	81.0	1,210	100
1975	450	20.5	1,740	79.5	2,190	100
1976	760	19.6	3,110	80.4	3,870	100
1977	980	18.9	4,200	81.1	5,180	100
Total	2,530	19.2	10,680	80.8	13,210	100

Note: 1) International Tourists include Foreign Tourists and Balikbayan (Overseas Filipinos).

Source: Provincial Trade and Tourism Committee

Appendix 12-3

TOURIST ORIGINS (1973-77 PERIOD)

Origin	No. of Arrivals	%
Cebu	2,390	18.1
Cagayan de Oro (Mindanao)	4,470	33.8
Manila, etc.	3,820	28.9
Foreign and Balikbayan	2,530	19.2
Total	13,210	100

Source: Provincial Trade and Tourism Committee

EXISTING TOURIST SPOTS

Natural

Chocolate Hills	- nationally recognized priority area of tourism development located between Carmen and Sagbayan, noted for continuous strings of cone-shaped limestone hills.
Tontonan Falls	- located in Loboc.
Badiang Springs	- freshwater spring located in Valencia.
Hinagdanan Cave	- underground limestone cave with freshwater spring in Dauis.
White sand beaches	- Doljo and Alona in Panglao, Bikini in Dauis, Laya in Baclayon, Santa Fe in Alburquerque, and other remote islands as Pamilacan Island, Balicasag Island and Cabilao Island.
Banati Hill	- a vista overlooking the City of Tagbilaran.
Tarsius Monkey	- the smallest species of monkey inhabiting the Corella area.

Man-Made

Sikatuna/Legapi Blood Compact Site	- a nationally important historical site located in Barrio Bool, Tagbilaran.
Baclayon Church	- the oldest church in the Philippines, built in 1595, located in Baclayon.
Punta Cruz	- one of the well-kept watch towers used against piracy built in the 17th century, located in Maribojoc.
Magsaysay Camp	- a boyscout reservation located in Bilar.
Roxas Park	- located in Garcia-Hernandez.
K of C Promenade	- a viewing point located in Tagbilaran.

Appendix 12-5

HOTEL INDUSTRY INVESTMENT SCHEDULE (DETAILED)

Year	Tourist Volume[1]	Average length of stay[2]	Additional rooms required[3]	Investment (₱ Million)[4]
1980	8,070	2.10	-	-
1985	15,500	2.15	31	3.1
1990	31,900	2.85	219	21.9
2000	99,100	3.45	955	95.5

Notes:

1) Tourist Volume is the same as the Target Tourist Volume described in Section 12.1.4 Tourism Objectives and Target Variables.

2) Average length of stay is computed as follows:

$$\text{Av. length of Stay} = [(A \times B) + (C \times D)] / \text{Target tourist Volume}$$

where: A = number of International tourists
B = target length of stay for international tourists
C = number of Domestic tourists
D = target length of stay for domestic tourists

3) The additional number of the required hotel rooms is computed as follows:

$$\text{No. of Additional Rooms} = \left(\frac{A \times B}{C \times D \times E}\right) - F$$

where: A = tourist volume
B = average length of stay
C = total number of days per year = 365 days
D = occupancy rate = 60%
E = room utilization factor = 1.2
F = existing number of hotel rooms

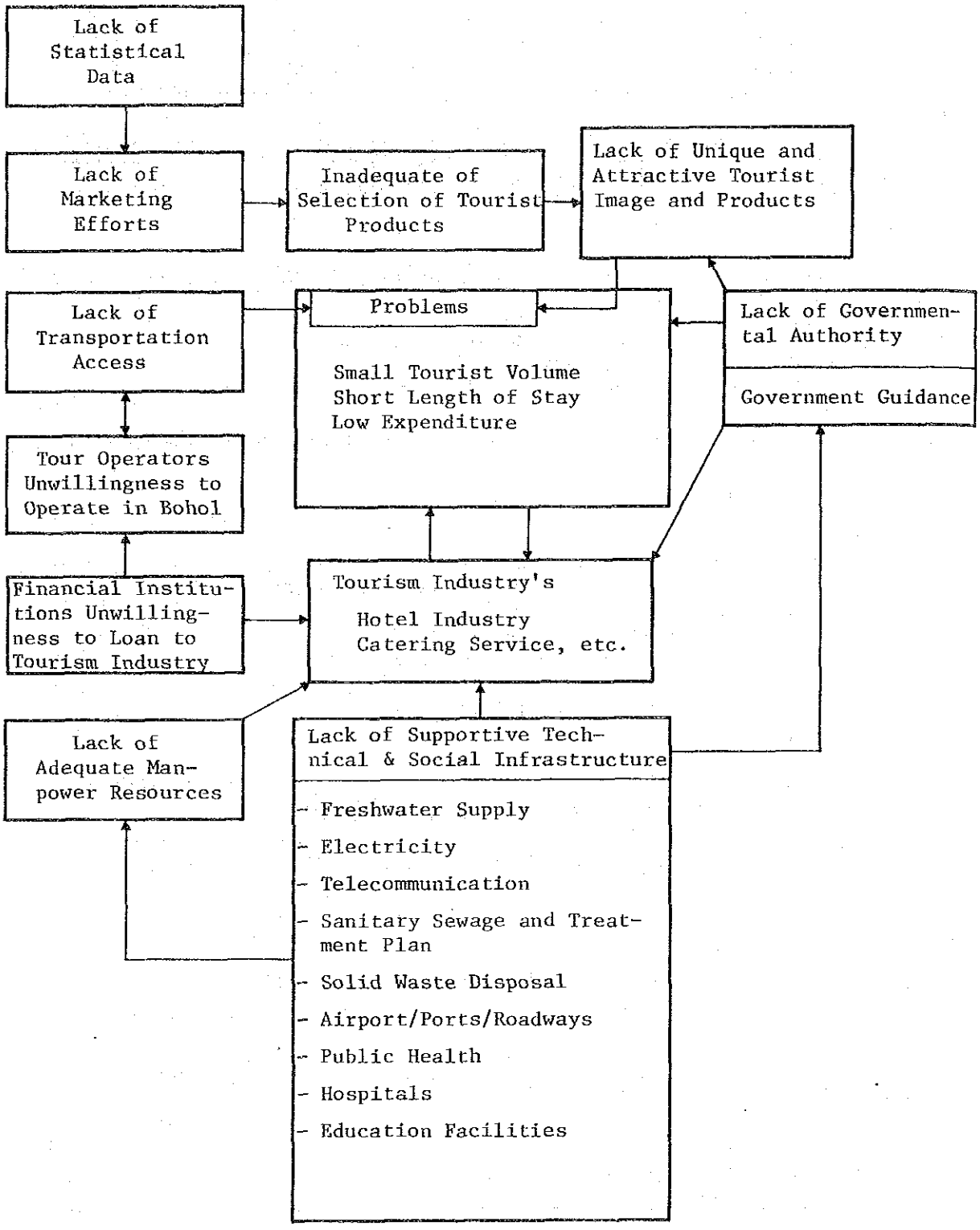
4) Cost per room is ₱100,000 as of 1980.

Appendix 12-6

TOURISM PROJECT/LOCATION MATRIX

	Short Term	Medium Term	Long Term
Institutional Reform	-	-	-
Market Survey/Promotion	Tagbilaran	-	-
Hotel	Baclayon	Tagbilaran/Carmen/Panglao	Tubigon/Jagna
Transportation	Tagbilaran/Tubigon	Tagbilaran/Tubigon/Jagna	Ubay/Talibon
Manpower Training	Tagbilaran	-	-
Historical Site/Bldg. Improvement	Blood Compact Site near Baclayon	Baclayon Church	Other Churches/ buildings
Park/recreational facilities	-	Carmen/Magsaysay Camp	Pamacsalan Lakeside Camp
Wildlife/Environmental Protection	Tarsus Monkey in Corella Area	Carmen/various Sea Resort Areas	Mountain/Sea Resort

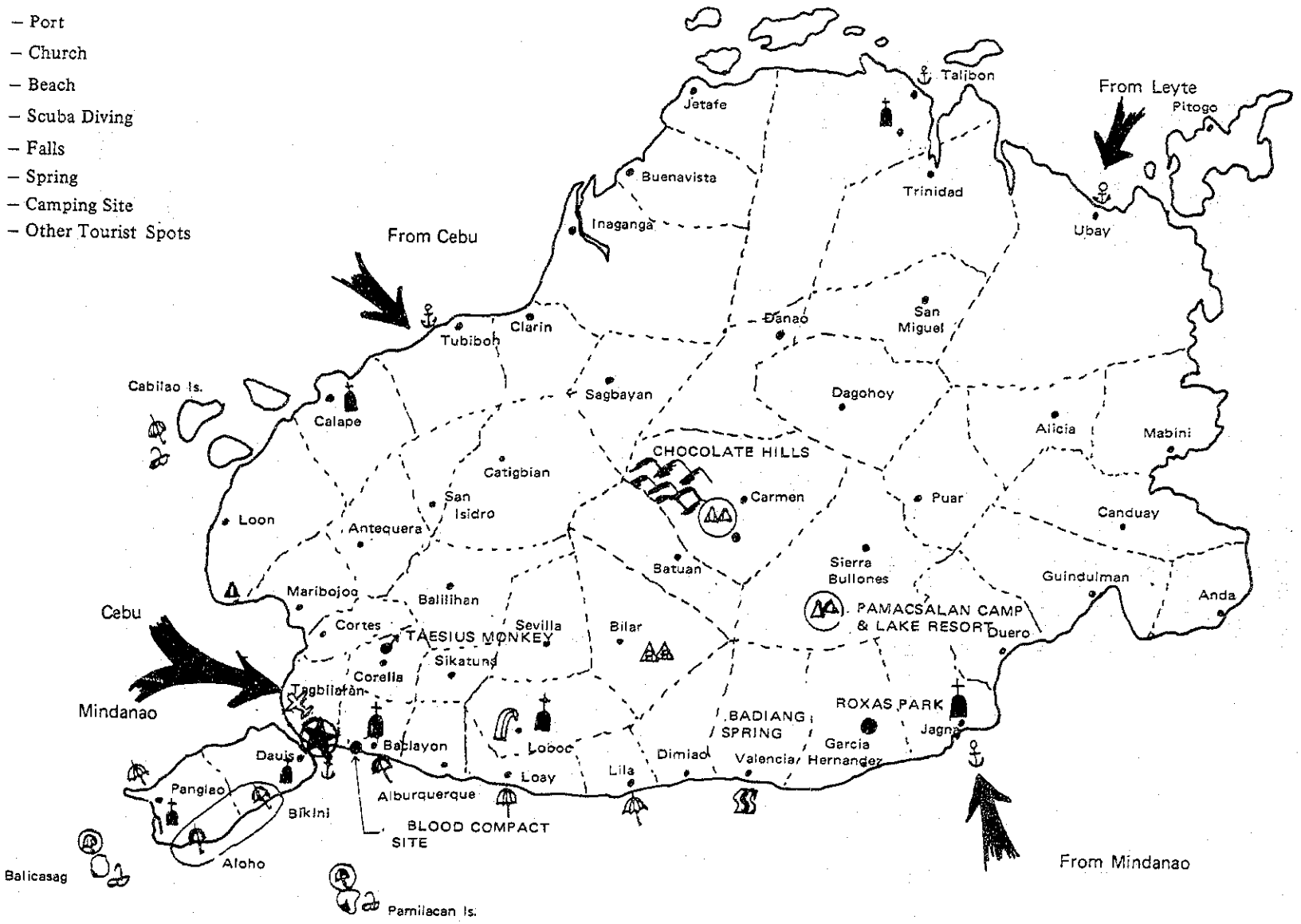
INTERRELATIONSHIP OF TOURISM PROBLEMS



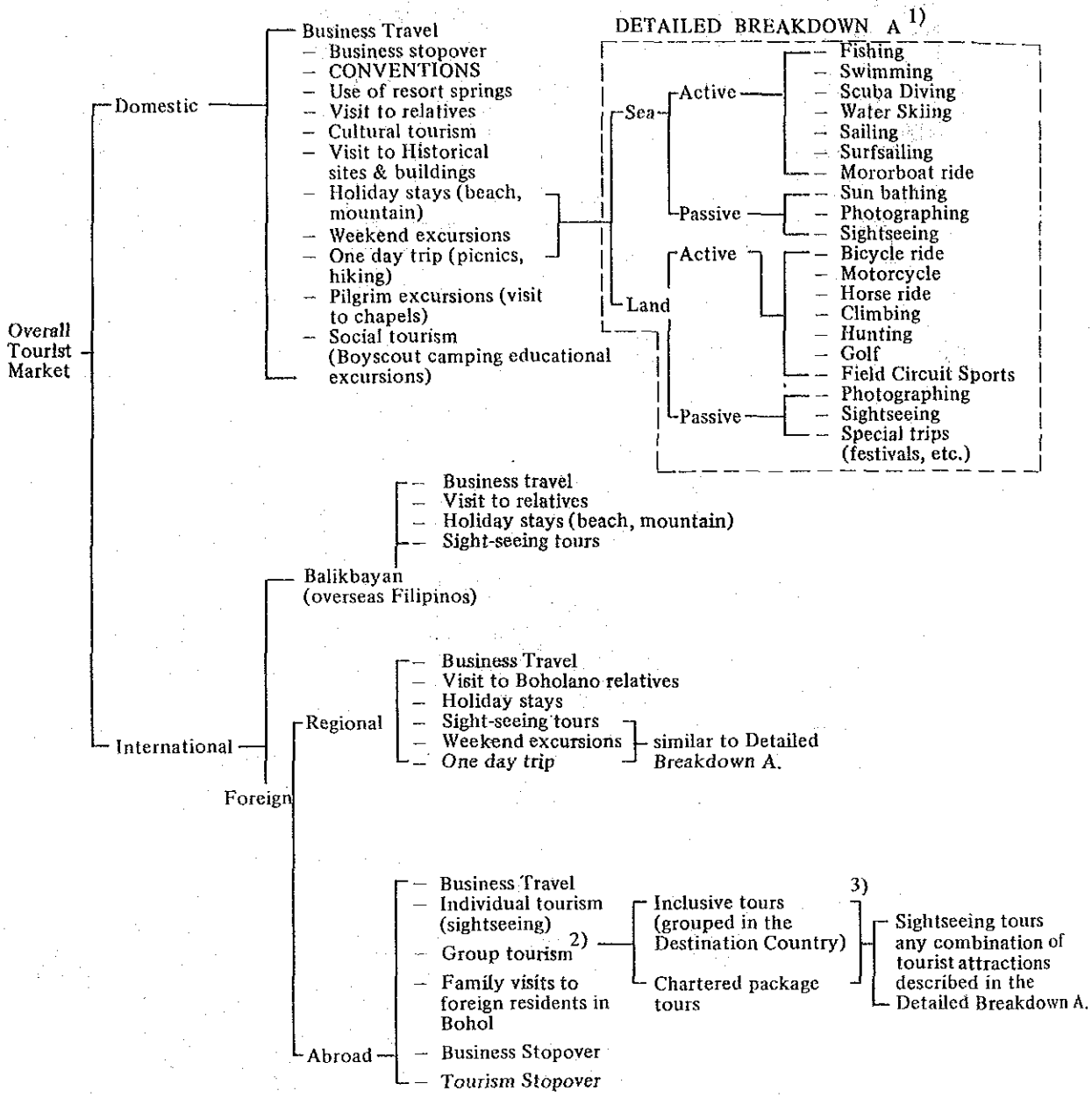
EXISTING AND POTENTIAL TOURISM RESOURCES MAP

LEGEND

- Potential Resources
- Port
- Church
- Beach
- Scuba Diving
- Falls
- Spring
- Camping Site
- Other Tourist Spots



OVERALL TOURIST MARKETS AND POSSIBLE TOURIST ATTRACTIONS IN BOHOL



NOTES:
1) Most of the items described in the Detailed Breakdown A are potential tourist attractions except for swimming, scuba-diving,sun-bathing and photographing.

2) Foreign group tourism in Bohol is presently limited to Scuba diving activities.

3) Inclusive tours and Charactered package tours are presently non-existent.

INFRASTRUCTURE SECTOR

CHAPTER 13
WATER RESOURCES MANAGEMENT DEVELOPMENT PROGRAMS AND PROJECTS

CHAPTER 13 WATER RESOURCES MANAGEMENT DEVELOPMENT PROGRAMS AND PROJECTS

13.1 General Background for Water Resource Management in Bohol

The annual rainfall in Bohol is rather low compared with the other areas in the Republic. Distribution of annual rainfall ranges from 1,300 to 2,200 mm/year. The most significant characteristic of rainfall is that the majority of occurances are sporadic torrential showers. The total discharge of rivers in the province is estimated at 3,140 million m^3/year. At present about 15% of it is consumed to irrigate farmland of about 11,000 ha. However, in order to attain the set target for the future development of irrigation, an additional 9,000 ha of palay irrigation is required. For this purpose the water consumption rate will have to be increased to 30% of the total discharge. Therefore, it is urgently required to undertake studies on water resource management. Groundwater has served an important role as a water source for domestic water supply. At present it is estimated that 30% of the total population is served by an improved system of water supply. It is proposed to bring a clean and sufficient water supply to 100% of the population by the end of the year 2000.

For this purpose, groundwater will have to be effectively and efficiently utilized. In order to attain the set target of irrigation development, an additional irrigation farm level equivalent to 10,000 ha of double cropping is required by the end of year 1990. Total investment cost for this purpose is estimated at 430 million pesos and the total increase in palay production is expected to be about 40,000 ton/year by the year 1990.

Since it is concluded that an available water resource is one of the ceiling factor to the extension of irrigation farm land, an increase in unit production rate (ton/ha) is definitely required in irrigation development especially in a later phase of development. Required unit production rate is expected at 4 ton/ha in the double cropped paddy field by the end of the year 1990.

13.2 Hydrometeorology

13.2.1 Climate

Generally, the meteorological features of Bohol Island such as mean monthly temperature, relative humidity and wind velocity show quite moderate fluctuation throughout the year. Mean monthly temperatures vary from 25.9°C to 28.2°C, relative humidity from 79% to 84% and wind velocity from 4 km/hour to 6 km/hour. As for the prevailing wind direction, Bohol Island is affected by the north-east monsoon from October to May and by the south-west monsoon from June to September.

Since temperature differentials in the Philippine archipelago are very slight, the classification of four climatic zones for the

Philippines is based on rainfall differences which are decidedly variant due to the combined influence of topography and air stream direction. The main air currents of the Philippines are roughly divided into three groups as follows:

a) The trade wind, reaching the islands from a generally easterly direction and coming from the tropical high pressure area of the Pacific.

b) Equatorial air (loosely called the southwest monsoon) pushing its way across the equator from the strong tropical high-pressure areas of the southern hemisphere; and

c) Others (loosely called the northeast monsoon) streaming along the easterly and south-easterly side of the Great Asiatic high pressure area.

The monthly distribution of rainfall in the Philippines is shown in Figure 13.1 and the features of each of the four climatic zones are explained below. The island of Bohol belongs to the fourth climatic type.

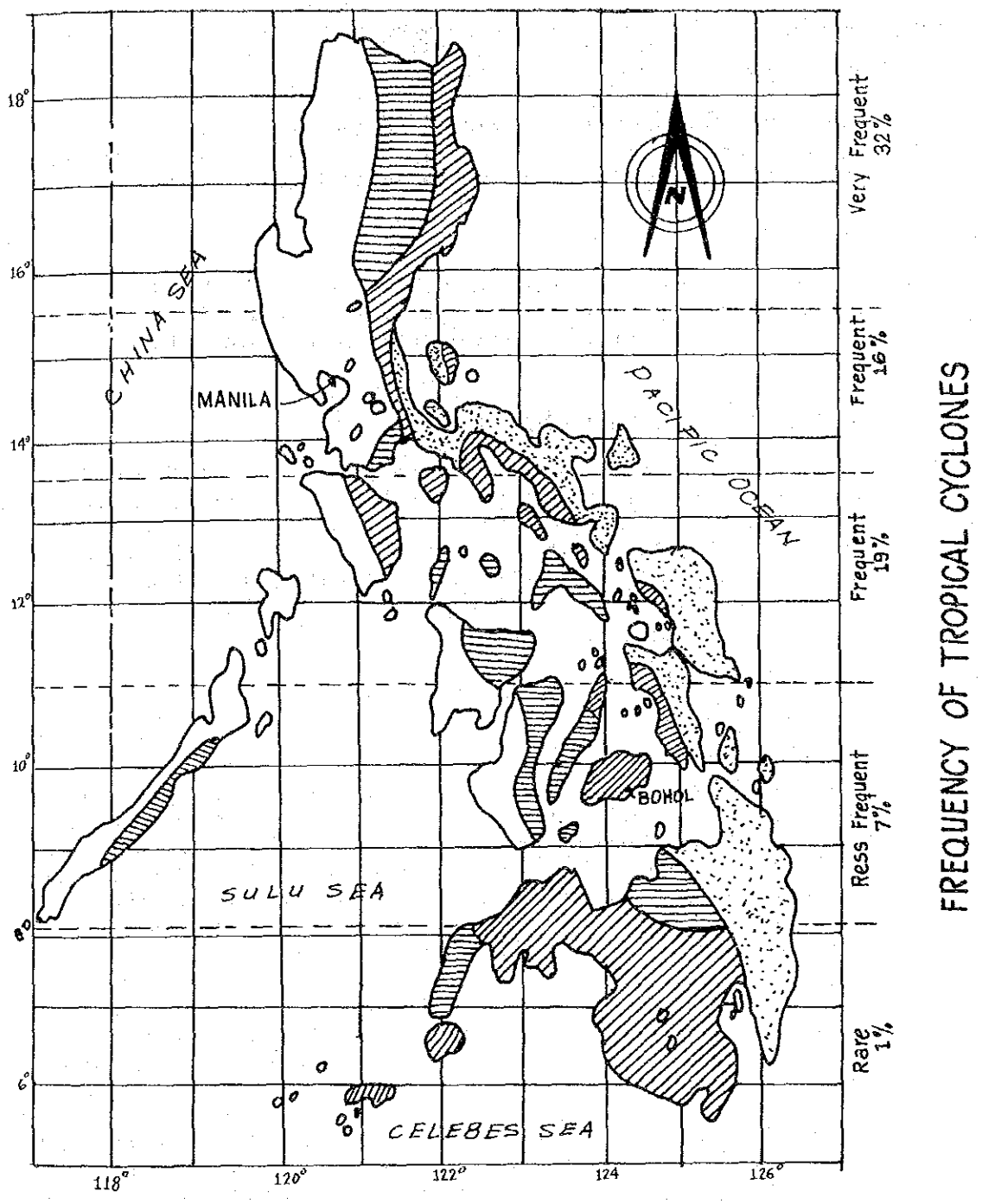
1st Type - Two pronounced seasons: one dry from November to April the other wet during the rest of the year. All the regions on the western part of the Islands of Luzon, Mindoro, Negros and Palawan are of this type.

2nd Type - No dry season, with a very pronounced maximum rain period from November to January. In this climate fall Catanduanes, Sorsogon, the eastern part of Albay, the eastern and northern parts of Camarines Norte and Camarines Sur, a great portion of the eastern part of Quezon, Samar, the eastern part of Leyte, and a large portion of eastern Mindanao.

3rd Type - Seasons not very pronounced: relatively dry from November to April wet during the rest of the year. Regions with this type of climate are the western part of Cagayan, Isabela, Nueva Vizcaya, the eastern portion of the Mountain Province, Southern Quezon, Masbate, Romblon, Northeast Panay, Eastern Negros, Central and Southern Cebu, part of Northern Mindanao and most of Eastern Palawan.

4th Type - Rainfall more or less evenly distributed throughout the year. Regions affected by this type are the Batanes Province, northeastern Luzon, the southwestern part of Camarines Norte, Western parts of Camarines Sur and Albay, Bondoo Peninsula, Eastern Mindoro, Marinduque, Western Leyte, Northern Cebu, Bohol and most of Central, Eastern and Southern Mindanao.

FIG. 13.1 CLIMATE MAP OF THE PHILIPPINES



SOURCE : NIA / 1978 MANILA

13.2.2 Observation Sites of Hydrometeorology

1. Meteorological Station

There is only one meteorological station at Tagbiralan and an almost complete set of data is available for 28 years starting from 1951 to-date taken under the supervision of PAGASA.

2. Raingauge Stations

There are fifteen rain gauge stations including the above meteorological station as shown in Appendices 13.1 and 13.3. Of these stations, automatic gauges have been installed at Tagbiralan and Dagohoy.

3. River Discharge Measurement Stations

As shown in Appendix 13.1, there are nine river discharge gauging stations in the province. Of these stations, 6 are installed for the special purpose of the Wahig Pamacsalan Irrigation Project. Data collection commenced in 1955 at Loboc and in 1967 at Pamacsalan. The rest of the stations were only established recently.

13.2.3 Rainfall Pattern

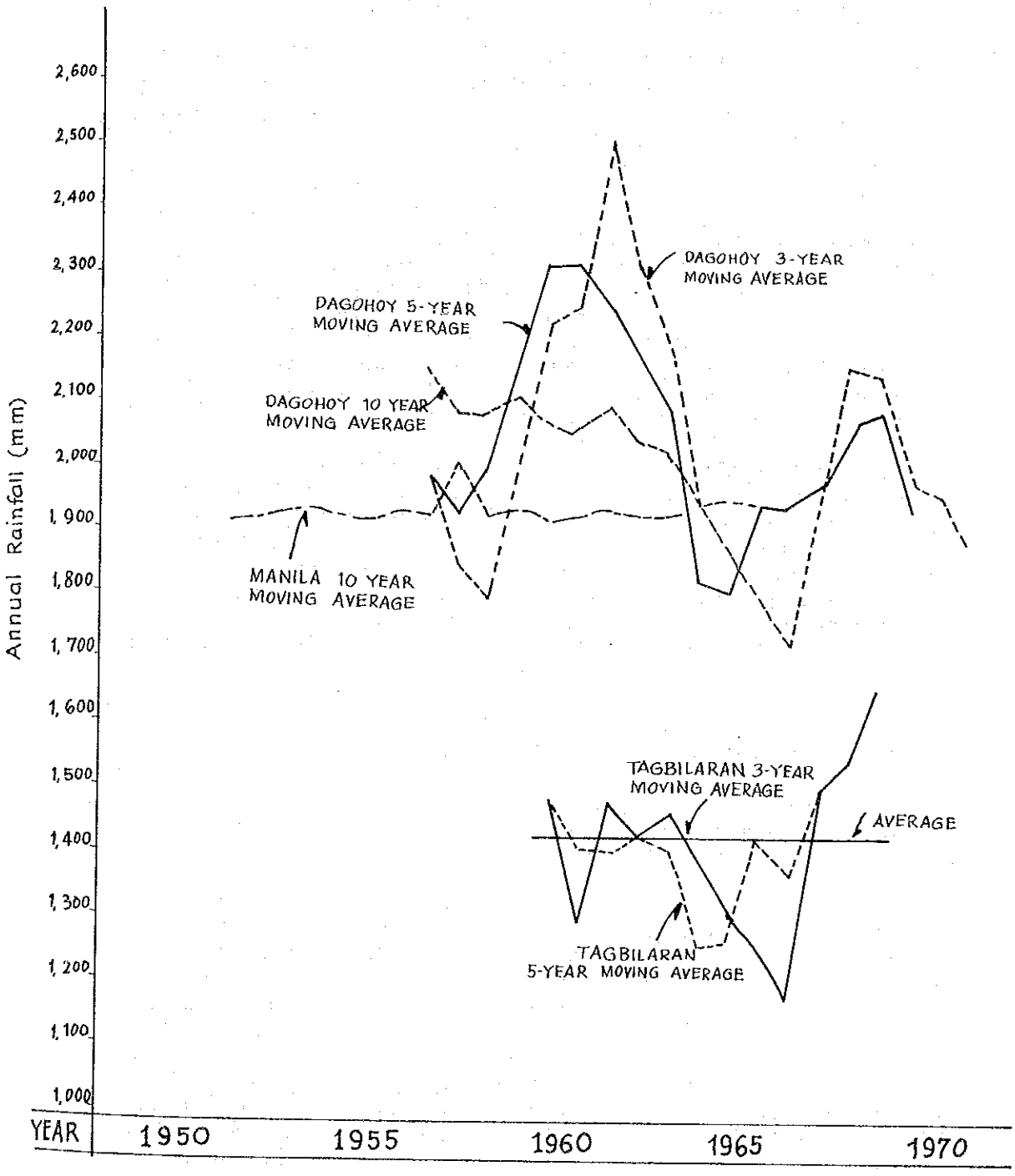
1. Annual Rainfall

The annual rainfall in Bohol is rather low compared with the other areas in the Republic. Similar to the southwestern half of Leyte, the province seems to be shaded by Leyte from typhoons coming from the east. Therefore, presumably the major source of rainfall in the province is brought by moisture in the southwestern wind; the effect of typhoons is only supplementary to the total amount of rainfall of the province.

Distribution of annual rainfall in the province ranges from 1,300 to 2,200 mm per year. The highest rainfall is recorded in the area around Mt. Sagungan ranging from 2,000 to 2,200 mm per year. To the north-north west from the mountain up to Ubay, there is also relatively high rainfall. The driest areas are in the western and the northern end of the province where it rains only about 1,500 mm per year. In the central part of the province, there is a relatively high rainfall; however its magnitude decreases towards northwest down to 1,500 mm per year in the coast.

The most significant characteristic of rainfall in the province is that the majority of rains occurs as sporadic torrential showers caused by tropical convections of air masses which result in a high intensity of rain over a narrow area. With this type of rainfall pattern, it is easy to predict that there will be occasional crop hazards caused by dry days from one rain to the next, even in wet seasons, and soil erosion and uneven discharge of rivers especially where catchment areas are small.

FIG. 13.2 MOVING AVERAGE TREND OF ANNUAL RAINFALL



The magnitude of an annual rainfall is one of the indicators to estimate the extent to which water is available. However, for the practical planning purpose of conservation and management of soil and water resources which are the initial tasks for the future development of the province, further analysis is necessary on the water balance or water inventory.

The isohyets map of annual rainfall is shown in Appendix 13.2 based on the rainfall data analysis at selected major raingauge stations as shown in Appendix 13.3.

2. Long Term Trend of Annual Rainfall

In order to determine the long term trend of rainfall pattern in Bohol, the annual rainfalls of Tagbilaran from 1960 to 1975 have been collected. Also the 10-year moving average of annual rainfall at Manila from 1950 to 1964 has been quoted from "A study of the water balance in the Philippines" by M.M.Obradovich.

3-year and 5-year moving averages of annual rainfall at Tagbilaran and Dagohoy stations are illustrated in Fig. 13.2 together with the 10-year moving average of the Manila station.

As seen from the Fig. 13.2 the general trend of rainfall at Manila and Tagbilaran are rather similar, although the magnitude of the rainfall is different. As for the Tagbilaran Station, the average annual rainfall from 1960 to 1975 is 1,485.5 mm/year, and the annual rainfall of recent years has decreased by about 15% from former years. The most severe drought condition was recorded at Manila station during the period 1870 to 1900 when the average annual rainfall was about 10% less than the recent 20-year average.

13.2.4 Evapotranspiration & Effective Rain

Normally crop water requirement and evaporation have a good correlation, especially the correlation of paddy rice water requirement and pan evaporation, which has been well researched in the Philippines. In Bohol to arrive at a more accurate estimation of the paddy rice water requirement, evaporation stations were installed in the Wahig-Pamacsalan Irrigation Project Area.
Available records from these evaporation stations show a daily mean evaporation of 3.24 mm with total evaporation during the year 1978 of 1183.3 mm. Appendix 13.4 shows daily evaporation data ranging from 0 to 8 mm/day for the year 1978 of Abahaman Hydromet Station.

An estimation of potential evapotranspiration is required for irrigation planning and in the Central Visayas it is roughly estimated that potential evapotranspiration ranges from 1,600 mm to 1,700 mm per year. It appears that western part of the province has slightly higher evapotranspiration than the eastern side.

For the purpose of water resource planning an analysis of the estimated actual evapotranspiration is required. There are

several methods for this estimation, however for this study with its very limited time schedule, a simple method was applied.

For this purpose an assumption is made that an average actual evapotranspiration rate is 5 mm per day. Daily rainfall data were recalculated with this assumption at some selected rain gauge stations in the province. An effective rainfall figure which subject to subsurface percolation as ground water recharge and surface run-off within a unit hydrological period was thus obtained.

The effective rainfall at an area around Mt. Sagungan, which is receiving the highest rainfall in the province, was estimated at 1,300 mm to 1,500 mm per year. In other words, almost 35% of annual rainfall is accounted for as actual evapotranspiration. In the same manner, the actual evapotranspiration is estimated at 50% of annual rainfall in the surrounding areas down below the mountain slopes which receive an average annual rainfall on the order of 1,500 mm per year. Therefore, the effective rainfall ranges from 700 mm per year in the dry area to 1,500 mm per year in the wettest area in the province.

13.2.5 River System and River Discharge

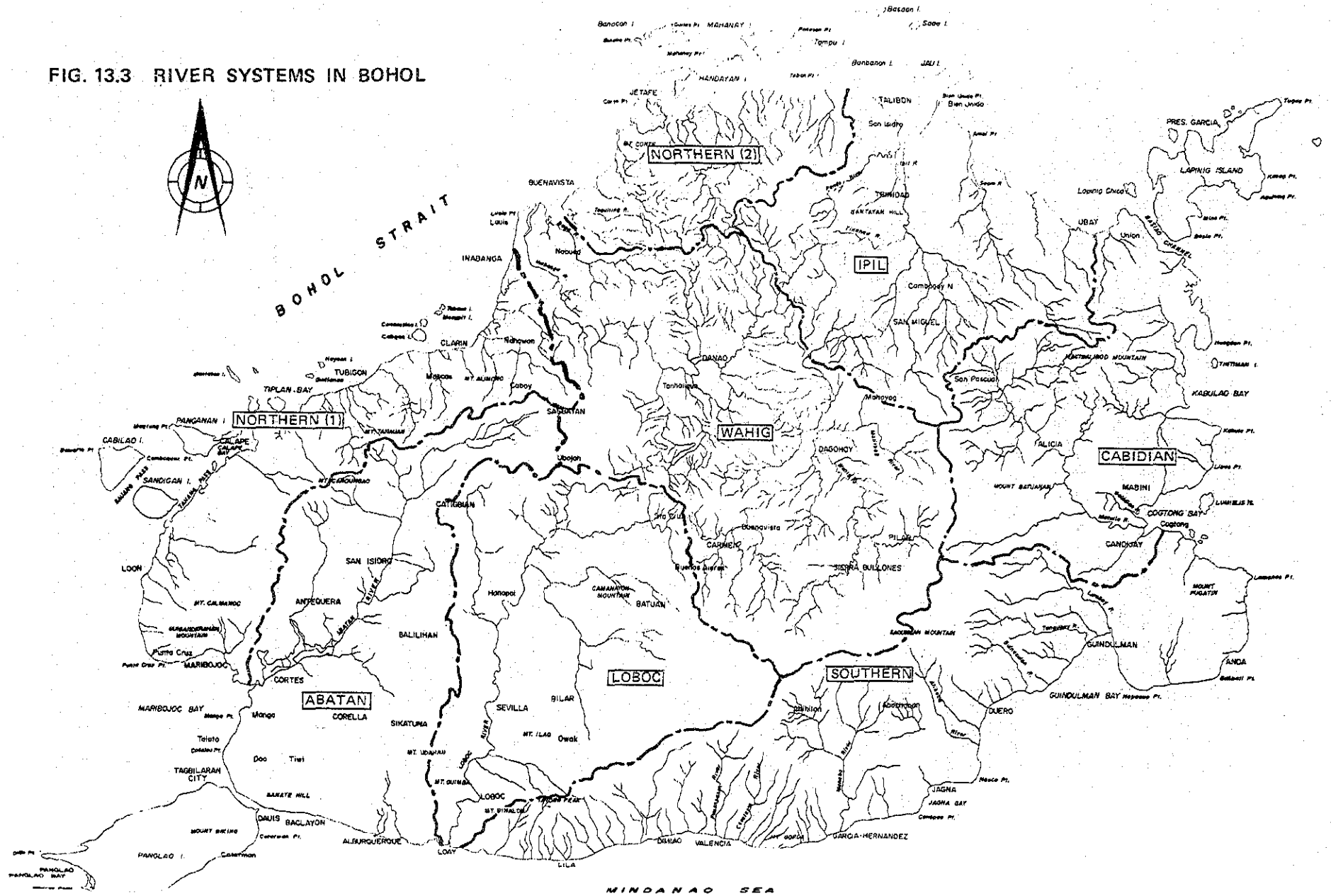
In general, the catchment areas in the province are classified into two groups. The greater part of the island from southwest to northeast is occupied by the large catchment areas of Loboc, Wahig, Ipil, Cabidian and Ahatan Rivers. The catchment area of each river ranges from 300 to 650 square kilometers. In the northern and southern fringe areas of the province, there are many small catchment areas. These catchment areas are on the steep slopes of Mt. Sagungan in the southern end and of Mt. Tanauan in the northwestern end. Each of these small rivers is less than 10 kilometers in length and most of them have only 10 to 50 square kilometers of catchment areas (See map, Fig. 13.3).

The river slope is rather flat in the catchment areas of Abatan, Loboc, upstream of Wahig and Ipil Rivers, and lie on limestone, shale and sandstone formations. And in some areas on limestone and shale formation, the density of rivers is very small especially in the Abatan and Loboc catchment areas. On the other hand, catchment areas are rather steep in areas of volcanic rock, metamorphic rock and crystalline limestone.

River discharge data are sometimes subject to involvement of errors depending on the accuracy in construction of rating curves. It is of very much importance to construct an accurate rating curve periodically. In the province there are four discharge measurement sites with almost complete data. These are Wahig, Pamacsalan, Loboc and Bilar Rivers.

Loboc River has the largest catchment area (650 km^2) in the province. The magnitude of annual discharge ranges from 450 million to 990 million cubic meters. The average annual discharge is estimated at 630 million cubic meters per year.

FIG. 13.3 RIVER SYSTEMS IN BOHOL



At Wahig and Pamacsalan, river discharges were measured at stations upstream of the confluences of the two. The amount of discharge recorded at these stations includes the head waters running from the catchment areas on the northwestern slope of Mt. Sagungan, which is the most wet area in the province. There is considerable fluctuation among the amounts of annual discharge from year to year, however an average annual discharge is estimated at 33 million cubic meters per year at Wahig. Although the magnitude of discharge is small because of the size of catchment area, the specific yield of these areas is the highest in the province.

Based on the hydrological data obtained, hydrological components of the studied catchment areas were estimated as shown below:

Hydrological Components of Studied Catchment Areas

Catchment Area (Name)	(km^2)	Annual Rainfall (mm/year)	Actual Evap. (mm/year)	Effective Rainfall (mm/year)	Annual Discharge (mm/year)	Runoff Coeff. (%)
Wahig	25	2,000	700	1,300	1,200	60
Pamacsalan	28	2,000	700	1,300	1,150	58
Loboc	618	1,900	800	1,100	970	54

Considering the above hydrological components, the annual discharge of other major catchment areas in the province was estimated as shown in Table 13.1. The total annual river discharge in Bohol is estimated at 3,140 million cubic meters.

Table 13.1 Estimated Total River Discharge in Bohol

Catchment Area (Name)	(km^2)	Annual Rainfall (mm/year)	Effective Rainfall (mm/year)	Annual Discharge (mm/year)	Runoff Coeff. (%)	Total Discharge (mil.m^3/year)
Loboc	650	1,900	1,100	970	54	630
Wahig	615	1,700	980	850	50	520
Ipil	417	1,500	750	675	45	280
Cabidian	288	1,800	1,080	940	52	270
Abatan	606	1,500	750	675	45	410
Southern Area	630	1,800	1,170	1,000	56	630
Northern Area	591	1,500	750	675	45	400
Total						3,140

13.3 Estimation of Groundwater Storage

Groundwater use as a source of domestic water is very common in the province. It is recorded that more than 600 artesian wells distributed in many Municipalities have a total yield of 10,000 m^3/day.

However, due to the predominating calcareous geologic conditions in the western half of the province, full exploitation of groundwater is hampered. Based on the previously assumed hydrological components total recharge of groundwater in the province is estimated as shown below:

Recharge of Groundwater

Catchment Area (Name)	(km^2)	Rate of Recharge (mm/year)	Total Amount of Recharge (million m^3/year)
Loboc	650	130	84.5
Wahig	615	130	80.0
Ipil	417	75	31.3
Cadibian	288	140	40.3
Abatan	606	75	45.5
Southern Area	630	170	107.1
Northern Area	591	75	44.3
Total	3,797	-	433.0

The total amount of groundwater stored in various kinds of aquifers is estimated to be on the order of 400 million m^3. Although, from a technical point of view, only a part of the total storage of groundwater is exploitable, the present consumption of groundwater (3 $\sim$ 4 million m^3/year) is only a few percent of the estimated total storage.

13.4 Analysis of Current Water Resource Management Problems and Trends

13.4.1 Background

Agriculture has been playing one of the most important roles in provincial economy of Bohol and the same condition will continue in future. However, due to the unreliability of a rainfall pattern (over a fixed area or at a regular time), productivity of agriculture is relatively low in the Republic. Accordingly, irrigation is very important for the economic upgrading of the province. At present about 15% of the total surface water is estimated as being consumed by irrigation. However, to attain the set target of product of irrigation it is necessary to utilize all available water resources at the most efficient rate.

13.4.2 Water Resource Management

A great deal of effort has been made by each relevant government agency in the various fields of water development. However, it

appears that data collection on river discharge and groundwater is still insufficient to formulate realistic future development projects. Although surface water is abundantly available at present, the required water resources for future development are estimated at 30% of the total surface water in the province which can only be maintained by prudent water source planning. Therefore, it is urgently required to undertake studies on the following:

- Assessment of available water sources based on seasonal and geographical analysis.
- The most efficient way of water utilization
- Analysis on the price of water

It is also required to identify the magnitude and locations of available groundwater in the province.

13.4.3 Irrigation

1. Classification of Irrigation Schemes

Irrigation is of vital importance to the economy of the province, especially for rice cultivation. At present almost ten thousand hectars of land is irrigated for paddy. The authority concerned with irrigation (National Irrigation Authority: NIA) has classified irrigation schemes into three categories as follows:

1) National Projects: The size of farmland supplied is more than 1,000 ha. Construction and operation are maintained by the NIA. In turn, the NIA collects irrigation fees from farmers. Irrigation fees are determined as shown below using a depreciation period of 40 years. (Note: 1 cavan = 75 liters.)

	Wet season crop fee	Dry season crop fee
Pump irrigation	3 cavans/ha	5 cavans/ha
Gravitational irrigation	2 cavans/ha	3 cavans/ha

Selection of crop is the option of the farmers.

2) Communal Projects: The size of farmland is between 50 and 1,000 ha. Upon completion of construction by the NIA, the project is handed over to Irrigator Service Association (ISA) for their operation and maintenance. Membership to the ISA is limited exclusively to the farmer beneficiaries of the project. The ISA has to repay the construction cost to the NIA within 50 years with one year grace period. Of the total cost, 10% covers the direct cost for NIA, 70% is to be paid by ISA without interest and the balance of 20% is to be paid with interest at the rate of the monetary value of 1.5 cavans per hectare of irrigated area.

3) Private Projects: This category consists of projects constructed and operated by private individuals with technical assistance from the NIA.
At present there are 209 private and 243 communal irrigation schemes in the province, and four reservoir type national projects have been identified for development as follows:

- Wahig-Pamacsalan Irrigation Scheme
- Cayacay Irrigation Scheme
- Bulilis Irrigation Scheme
- San Agustin Irrigation Scheme

However, only the feasibility study for Wahig-Pamacsalan Scheme has been completed. The total area of irrigated farmland in the province is estimated at 11,015 ha based on the agricultural census in 1971 and NIA drawings.

Since surface water plays an important role in the planning of irrigation schemes, distribution of existing irrigated farmland is classified by major catchment areas according to the river systems of the province as shown below in Table 13.2 (see Section 13.2.5).

Table 13.2 Estimated Total Irrigated Area in Bohol

Catchment Area (Name)	Catchment Area (km^2)	Communal Irrigation Areas: Beneficiary Area (ha)	Communal Irrigation Areas: No. of Schemes (No.)	Communal Irrigation Areas: Average Size (ha)	Private Irrigation Areas: Beneficiary Area (ha)	Private Irrigation Areas: No. of Schemes (No.)	Private Irrigation Areas: Average Size (ha)	Increased Area* (ha)	Total (ha)
Loboc	650	1,635.8	50	33	232	41	5.7	800	2,668
Wahig	615	988.6	45	22	402	69	5.8	450	1,846
Ipil	417	51.5	7	7	66	14	4.9	600	718
Cabidian	288	1,331.0	23	58	219	38	5.8	170	1,720
Abatan	606	234.8	17	14	72	15	4.8	330	637
Southern Area	630	1,565.8	72	22	14	3	4.7	606	2,180
Northern Area	591	685.3	27	25	11	4	2.7	550	1,246
Total									11,015

Note: * Increased irrigation after the NIA drawing were prepared; however, further details are not available.

Data Source: NIA Irrigation Maps.

2. Irrigated Land

Distribution of irrigation for farmland is determined by the two major fectors: availability of water and fertile land. Large extensions of irrigated areas are found at Bilar, Carmen and Batuan Municipalities in the Loboc Catchment Area and at Serra Bullones and Pilar Municipalities in the Wahig/Inabanga Catchment Area. In these areas, surface water is available at

rivers running from Mt. Sagungan. Another extensively irrigated area of farms is observed at the Southern Catchment Area occupying the southern mountain slopes of Mt. Sagungan, especially at Garcia Hernandes, Duero and Jagna Municipalities. As available land for irrigation in this catchment area is limited to only narrow strips of river terraces and also narrow strips of coastal plains, further extension of irrigation by reclamation is unlikely.

On the other hand, Ipil Catchment Area has only about 700 ha of irrigated land. This may be attributed to the fact that surface water is insufficient for the lands available.

A similar condition is observed in the Abatan Catchment Area where there is only 637 ha of irrigated farmland; although insufficient surface water, there is also lack of suitable land for irrigation because of the calcareous nature of the soil.

The average size of communal irrigation schemes ranges from 7 ha in the Ipil Catchment Area to 58 ha in the Cadibian Catchment Area. The majority of irrigation schemes have an average land size of 20 to 30 ha. Hectarage of privately irrigated farms falls between 2.7 and 6.0 ha.

3. Productivity of Irrigation

The details of rice cultivation is summarized in Table 13.3. Almost 74% of the total agricultural households (61,000) in the province cultivate palay (rice). Out of these, 42% of households are irrigating their rice fields. The total area of irrigated rice fields is estimated at 11,015 ha and the cumulative effective area of rice cultivation is about 51,000 ha. Accordingly it seems that almost all of rice cultivation was double cropped.

Total yield of rice cultivation with irrigation is estimated at 33,000 metric tons giving an average yield of 3.23 metric tons per ha in a year. This rate of yield has attained almost 67% of the target set by Masagana 99.

Lowland rain-fed rice cultivation is also practiced where land is available. However, the yield, in this case, is estimated at 2.66 metric tons per ha in a year. On the other hand, the rest of farmers cultivating rice without irrigation facilities (58% of the total number of rice cultivating households) have to rely on rain water for their upland and lowland rice. In this case an average yield is estimated at 1.98 metric ton per ha in a year. Therefore, the importance of irrigation for the agricultural development in the province is a demonstrable fact which cannot be over emphasized.

Table 13.3 Rice Cultivation Data

		Physical Crop Area (ha) ①	Effective Crop Area					②/① X 100 (%)	Production ③ (1,000t)	Productivity ③/① t/ha (index)
			Lowland			Upland	Total ②			
			1st Crop	2nd	3rd					
Farms with Irrigation Facilities (42%)	Irrigated	–	10,117	9,750	33	–	19,900	197	33.17	3.28 (138)
	Non-Irrig.	–	568	554	3	–	1,125	198	1.51	2.66 (112)
	Upland	–	–	–	–	263	263	100	0.22	0.85 (36)
	Total	11,594	10,685	10,304	36	263	21,288	184	34.90	3.01 (126)
Farms without Irrig. Facilities (58%)		17,965	16,029	12,771	240	978	30,018	167	35.56	1.98 (83)
Grand Total (45,044 Farms)		29,559	26,714 (52%)	23,075 (45%)	276 –	1,241 (2%)	51,306 (100%)	174	70.46	2.38 (100)

Data Source: Bohol 1971 Census of Agr. 1974
Note: 1 cavan of palay = 44 kg.

4. Water Consumption for Irrigation

The water requirement for irrigation used as design criteria by NIA is 1.5 ℓ/sec/ha in the wet season and 2.5 ℓ/sec/ha in the dry season, for 24-hour irrigation including conveyance and operation losses. Taking 120 days as one cropping period (including land preparation), the above rate is equivalent to 16,000 m^3/ha/crop in the wet season and 26,000 m^3/ha/crop in the dry season. Since almost all irrigated land is double cropped, the annual unit water consumption is estimated at 42,000 m^3/ha/year (16,000 + 26,000).
Accordingly total water consumption for irrigation by catchment area is summarized as shown in Table 13.4.

Table 13.4 Total Water Consumption for Irrigation

Catchment Area	Irrigated Area (ha)	Annual Water Consumption (million m^3/year)
Loboc	2,668	112.1
Wahig	1,846	77.5
Ipil	718	30.2
Cadibian	1,720	72.2
Abatan	637	26.8
Southern Area	2,180	91.6
Northern Area	1,246	52.3
Total	11,015	462.7

Data Source: Bohol 1971 Census of Agri. & NIA standard water duty.

Total water consumption for irrigation at present is estimated at 462.7 million m^3/year, which is equivalent to 15% of the total river discharge of the province in an average year (see Section 13.2.5). This is a relatively high rate of surface water consumption.

5. Use of Flood Waters

There is a relatively dry period in the rainfall pattern in the province during the months from March to May. Accordingly, there is an apparent decrease in river discharge during the same period.
For Loboc River, monthly discharge varies from 17 to 27 cubic meters per second from June to February, while during the month in the dry period it is recorded at only 10 cubic meters per second.
In addition, monthly river discharge in the province displays considerable fluctuation from year to year. This may be attributed to the fact that the major part of river discharge consists of abrupt floods caused by irregular torrential tropical showers. It is, therefore, of very great importance to take special measures to utilize flood waters for irrigation, not only for crops in dry season, but also for supplementary purposes during the wet season between rainfalls in order to prevent crop damage. For this purpose prudent water source planning is urgently required at an early phase in the Development Program.

13.4.4 Present State of Water Supply

1. Concept of Water Supply

Water supply systems are classified into two categories in the Republic: Systems serving more than 20,000 people are classified as urban water systems and the necessary assistance is given by Local Water Utility Authority (LWUA). Water supply systems serving less than 20,000 people are considered as rural water systems and the Ministry of Pubic Works (MPW) is the working body to provide necessary assistance.

2. Rural Water Supply

Since 1978 a task force for rural water supply has been organized in the National Water Resources Council (NWRC) to accerelate the improvement of rural water supply. The basic strategy of accelerating development of rural water supply is to organize Rural Water Works Association in each rural cluster area to operate a water supply system for the benefit of its own members (beneficiaries).
Coordinators work at various provinces to prepare reports on the rural water supply to the government. However, the report for Bohol Province is not yet completed.
According to the guideline of the NWRC, the service level of rural water supply is classified into three levels as follows:

Level of Service		Description of Water Supply Service
Level-1	:	A point source is located within distance of 500m from houses. A grant from the government of 1,000 pesos is paid to cover part of the construction material cost for a hand pump. Usually, the water source is a shallow well with a depth ranging from 15 to 30m. The water charge is 0.3 pesos per household per month.
Level-2	:	Public taps with small scale distribution pipes or a storage tank are provided within a distance of 25m from houses. The standard construction cost is estimated at 50,000 pesos for 100 households. A governmental loan is available for 90% of the total construction cost with 4% rate of interest and a 15 to 20 year repayment period. The balance of 10% of the total construction cost is paid by the local beneficiaries. The maximum revenue from water charge is estimated 7 pesos per household per month.
Level-3	:	Water supply with private service connections.

A detailed study on rural water supply has not yet been conducted in Bohol province. However, an inventory of existing artesian wells was worked out at provincial office of MPW. All of these wells are used to supply domestic water. There are between 600 and 700 artesian wells in the province and each has an estimated capacity of 27-36 liters per minute (6-8 gallons per minute).

Accordingly, the total capacity of existing water source of rural water supply is estimated at 1,300-1,600 m^3 per hour. Assuming an operation time of 8 hours per day, the estimated daily capacity of the rural water supply is approximately 10,400-12,800 m^3. Taking the consumption rate of 40 liters per day per person (ℓ/d/cap) as given by the design criteria of NWRC, this source of water has a supply capacity for a population of 260,000-320,000 persons.

At present, therefore, 30% to 40% of the total population (790,000) is served by artesian wells. Presumably the rest of population is taking domestic water from open wells and springs.

3. Urban Water Supply

As mentioned above, a water supply system serving more than 20,000 population is categorized as an urban water supply. According to the report of the census conducted in 1975, there are about 700 urban places in the republic. Since 1974, the government has been making a concerted effort to improve urban water supply systems by improving about 100 of the urban water supply systems.

There is only one urban center, Tagbilaran City, in Bohol. The Tagbilaran waterworks system provides services to the population of the city and portions of the districts of Mansasa, Bool, Dampas, Booy, Cogon, Taloto, Ubojan, Manga, Tiptip, Dao, Gaboc and Tiwi and to the Municipality of Dauis. The system consisting of eight (8) deepwell pumping units with two (2) storage tanks for the pumping units is described in detail in Appendix 13.5. The system services only 60% of the central 500 hectare area out of approximately 3,270 hectares. The present population of about 59,000 people is expected to soar as high as 231,000 by the year 2000.

As there is no rivers or streams within the territorial jurisdiction of Tagbilaran City, the only source of water supply at present is groundwater from drilled wells.

The system is currently administered and controlled by the provincial government under the direction of the waterworks superintendent. Although the rank and file employees are obviously capable, the adequacy of service is poor due to lack of proper maintenance tools and spare parts to replace worn-out parts for the entire system. The method of direct pumping of water to main distribution pipes causes several interruptions of service daily due to leakages in the piping systems. At present the two storage reservoirs are no longer in use. Since water treatment employed is by chlorination and the treatment is applied at the storage tank prior to distribution, water is being distributed for public consumption without being properly treated. Present service is sadly inefficient and is predicted to become worse in the years to come.

The population within the service area that are not served water from the Tagbilaran Waterworks system relies upon privately constructed deep wells and artesian wells constructed by the Ministry of Public Works. Per capita consumption of water is likely to increase from the present 29 to 52 gallon per day per capita (g/d/cap) by the year 2000 based on the rate of increase in population and the rate of urbanization of the area.

13.5 Development Potentials

13.5.1 Development Potential for Irrigation

The development potential of irrigation depends on availability of lands and water sources. According to the NIA report irrigable area in the province is estimated at 37,000 ha, but at present only 11,015 ha is irrigated. In this case, the availability of irrigable lands cannot be the deterring factor of the irrigation development in the province. However, if the balance of 26,000 ha is to be irrigated, the necessary amount of water is estimated at 1,092 million m^3/year based on a unit water consumption for double cropping of paddy of 42,000 m^3/ha/year. This amount of water is almost 35% of total surface water in the province of 3,140 million m^3/year (see Section 13.2.5). Water consumption rate of 35% of the total

annual river discharge is very difficult to attain and generally it is not economically justified without accurate water source planning. Therefore, the availability of water sources appears to be the first ceiling factor for future irrigation development.

Table 13.5 Available Water Sources for Additional Irrigation

Catchment Area	Annual Discharge (million m^3/year)	20% of Total discharge (million m^3/year)	30% of Total discharge (million m^3/year)	Present Water consumption (million m^3/year)	Additional Available Water 20% (million m^3/year)	30%
Loboc	630	126	189	112	14	77
Wahig	520	104	156	78	26	78
Ipil	280	56	84	30	26	54
Cadibian	270	54	81	72	-18	9
Abatan	410	82	123	26	56	97
Southern Area	630	126	189	92	34	97
Northern Area	400	80	120	52	28	68
Total	3,140	628	942	462	-	480
Total ha equivalent	-	15,000	22,000	-	- 11,000	

Based on the assumptions made in the previous sections, available water sources for the additional irrigation are summarized as shown in Table 13.5.

When 20% of total discharge of surface water is utilized, an additional 4,000 ha may be irrigated for double cropping or when 30% can be attained, an additional 11,000 ha can be irrigated. However, 30% of water use rate may be the maximum to be attained. In this case, detailed water source planning is definitely required.

13.5.2 Water Supply Potentials

At present about 30% of total population is served by rural water supply systems, mainly from artesian wells.

Projection of the water requirement for rural area is made based on the assumptions listed below:

- 100% of people will be supplied by water which is both safe and sufficient by the year 2000.
- The annual growth rate of the rural water supply is 3%.
- Annual daily consumption will increase at the rate of 2 to 3%.

As shown in Table 13.6, by the year 2000, 24.0 million m^3/year of water source will be required from a rural water supply system. This amount accounts for less than 10% of the total groundwater storage.

Table 13.6 Forecast of Rural Water Supply Requirements to the Year 2000

	1980	1985	1990	1995	2000
Total Population	792,000	867,000	938,000	1,034,000	1,131,000
Present Population Served	250,000	584,000	685,000	910,000	1,131,000
Population Increment to be Served	542,000	283,000	253,000	124,000	0
Supply Growth Rate	3%	3%	3%	3%	
Consumption (ℓ/c/d)	40	45	50	55	60
Total Consumption (m^3/day)	22,000	33,200	34,250	50,000	68,000
(million m^3/year)	7.9	12.1	12.5	18.3	24.8

Since it can be concluded that there are sufficient water sources for water supply, the next most important aspect for future development on water supply is where to locate the water sources to minimize the price of water.

13.6 Objectives and Targets

13.6.1 Irrigation

1. Objectives

Although the total area of irrigable land is estimated at 37,000 ha, the available water sources which the province can afford are equivalent to about 22,000 ha of double cropped paddy making use of 30% of total surface water.

Therefore, objectives of irrigation development are to extend irrigation during the short and medium terms of development and to increase the unit production rate during long term development to make optimum use of available water to attain the productivity target set for irrigation.

2. Objectives of Water Supply Development

Clean and adequate supply of water can help prevent water born epidemics, and contribute to raising the standard of living and enable the fruits of development to be realized by the other sectors of the economy.

13.6.2 Target

1. Target of Irrigation Development

According to the target for production of palay (rice), the growth rate and future production has been forecast as shown in Table 13.7 and as described below.

Table 13.7 Forecast of Palay (Rice) Production

	1980	1985	1990
1. Target Production (tons/year)	90,340	107,300	135,650
2. Growth Rate (%)		3.5%	4.8%
3. Irrigated Palay			
Total Area (ha)	11,000	15,000	20,000
Production(tons/year)	38,500	57,000	80,000
Unit Production (tons/ha)	3.5	3.8	4.0
4. Low Land Palay			
Total Area (ha)	10,000	10,000	12,000
Production(tons/year)	28,000	30,000	36,000
Unit Production (tons/ha)	2.8	3.0	3.0
5. Upland Palay			
Total Area (ha)	10,000	10,000	10,000
Production(tons/year)	20,000	20,000	20,000
Unit Production (tons/ha)	2	2	2
Total Production(tons/year)	86,500	107,000	136,000
Total Farmland (ha)	31,000	35,000	42,000
Effective Farmland (ha)	56,000	60,740	69,500

To achieve the crop production targets, the growth rate and total amount of irrigation required has been estimated and is also described below.

1) Short Term 1980-1985

During the short term, the required growth rate of palay production by irrigation is estimated at 3.5% and total production in 1985 is expected to reach at 57,000 tons/year. For this purpose required increase of irrigated farmlands is 4,000 ha with a unit production rate of 3.8 ton/ha.

2) Medium Term 1985-1990

During the medium term, the required growth rate of palay production by irrigation has to increase to 4.8%. Total

production of palay is estimated at 80,000 tons/year by the end of 1990.

For this purpose an additional increase of irrigated farmlands is required of 7,000 ha by the end of 1990. The unit production rate is expected to be 4.0 tons/ha.

3) Long Term 1990-2000

For the long term, the extension of physical irrigated land will be rather difficult due to the limited resources of land and water. Therefore, increase in production must be attained by increase in the unit production rate rather than by increasing physical land area. For this purpose detailed water source planning and improvement of irrigation management is definitely required.

2. Target of Water Supply Development

The proposed target of rural water supply is to supply everybody in the province with a clean and adequate amount of water by the year 2000.

As shown in Table 13.6, total amount of water source for this purpose is estimated at 12.1 million m^3/year in 1985 and 24.8 million m^3/year in the year 2000.

In addition, the water supply system at Tagbiralan has to be improved in order to meet the required service level of urban water supply by 2000.

13.7 Development Strategy

Through the provisions of safe water supply, water plays a significant developmental role in raising agricultural productivity, providing support to industry, generating electrical energy and in the building of strong human resources.

13.7.1 Irrigation

By the year 2000, agriculture will continue to be the major water using sector consuming about 942 million m^3/year out of the 3,100 million m^3/year of total discharge of rivers. While the aggregate water picture implies abundance, the location specific-nature of water can create certain problematic situations depending on the topographic conditions of the irrigable area. Cognizant of the economic efficiency implied by the impounding surface run-off water approach (Reservoir type water development), water resources projects have been largely conducted on a multi-purpose use concept: projects that provide for the multipurpose functions of irrigation, water supply for domestic and industrial purposes, flood control and mini/micro-hydroelectric power generation.

Supporting this strategy are 12 impounding projects (see Table 13.8 and 13.9 summary of projects): four (4) National projects and eleven communal projects, the largest of which are Wahig-Pamacsalan RIP (national project) and Cahayag CIP (communal project). To enhance their effectiveness, these water resources development programs will be complemented by watershed management and erosion control. The irrigation development framework may be divided into two general types: gravity and pump irrigation. The pump irrigation program (Communal and Individual recepient) is intended for areas where conveyance of water from source to irrigable areas would not be possible by gravity. Pump program (individual recepient) is intended to serve small scale farmers with irrigable areas ranging from 4 to 7 hectares of rice land. The implementation of these programs for fully developing the required irrigation area will entail a total investment cost of about 427 million (including price escalation up to year 2000). Cost recovery of the project should be made, based on existing NIA policies and guidelines in the development of irrigation projects, i.e.

(a) National irrigation systems are constructed and operated by NIA. In turn, the NIA collects irrigation fees from farmers benefiting from the system.

(b) Communal irrigation systems are those constructed by NIA and upon completion are turned over to the Irrigator Service Assn. (ISA) on condition that the ISA shall repay the NIA the construction cost of the project. To optimize the benefits from irrigation its program implementation should be coordinated with the agencies involved in food production like the BPI. BAEx. and the Bureau of Soils (B.S.).

For added strength, the water management training program, which involves the training of water technologist (irrigation technicians) and the gradual dissemination of knowledge to farmers through the ISA, will be accelerated.

13.7.2 Water Supply

With the planned economic growth and the consequent rise in the standard of living per capita consumption of water will also increase. The industrial transformation likewise implies increase in industry's water requirement.

The plan for domestic water system development for Bohol should be accomplished in phases. Each phase should be planned to meet the water demand of the intended service area projected for a period of five (5) to ten (10) years.

Phase I - Improvement of the Tagbilaran waterworks system to provide a safe and adequate water service to a population of about 65,000 people.

Phase II - Expansion of the Tagbilaran waterworks system to provide safe and adequate water service to all 15 districts within the

territorial jurisdiction of Tagbilaran City and to the Municipality of Dauis. Also during this period intensive investigation and surveys shall be conducted on the scheme of developing the domestic water supply in all five (5) BIAD centers.

Phase III - Improvement of all existing water supply systems in the rural areas and construction of new ones to provide safe and adequate water supply to about 70% of the total population of Bohol through communal springs and open wells. To effectively operate and maintain these systems, an extensive network of trained community associations shall be organized. Intensive training programs shall be a continuing process to preserve the investments in water supply and develop manpower capability.

13.7.3 Hydroelectric Power Generation

Of the five major rivers and a number of minor rivers which have potential for Mini and/or Micro hydroelectric power generation, only Loboc river has been harnessed by the NPC to generate about 1.2 megawatts which represents about 10% only of its hydropower generating potential.

Although studies are being undertaken to expand the generating capacity of the existing Loboc hydro-electric plant, plans have also been formulated to construct another power plant at Upper Loboc river (Calinga-an, Sevilla. Bohol) to generate a total of about 8 megawatts. A Wahig-Pamacsalan rivers, hydro-power development will be integrated with irrigation. The generating capacity of Wahig-Pamacsalan has been decided at 1.7 megawatts. Other rivers at Antequera and Garcia-Hernandez (Menaba river) are also good potentials for mini-hydroelectric power generation. The grid system of development of electric power on the island adopted by the NPC is designed to provide the populace access to a sufficient supply of electrical energy.

13.8 High Impact Project

To keep up with the over-all goal of establishing a much-improved Boholano community, much attention should be given to high impact projects to support the envisioned strategy of rapidly increasing productivity, particularly in agricultural crop productivity where the majority of the population is engaged. Projects considered to have high impact to transform a presently depressed area by immediate development of its water resources consist of the following:

13.8.1 High Impact Projects of Irrigation

1) National Projects:

(a) Introduction:

There are four projects identified as National irrigation projects in Bohol which are described in detail as shown in Table 13.8.

Table 13.8 National Irrigation Projects Summary

Name/Location of Project	Potential Irrigable Area (Ha)	Estimated Cost in ₱ 1,000	Proposed Implementation Schedule	Remarks
1. Wahig-Pamacsalan Sierra-Bullones, Pilar	6,000	327,000	1981-1986	Feasibility study jointly undertaken by NIA and JICA mission sometime in Aug. to Nov. 1977
2. Cayacay RIP Ubay	1,000	18,541	1982-1986	Proposed
3. Bulilis RIP Ubay	1,500	27,801	1985-1990	Proposed scheme of development shall be trans-basin from Wahig-Pamacsalan RIP
4. San Agustin RIP Talibon	1,200	21,820	1983-1988	Proposed

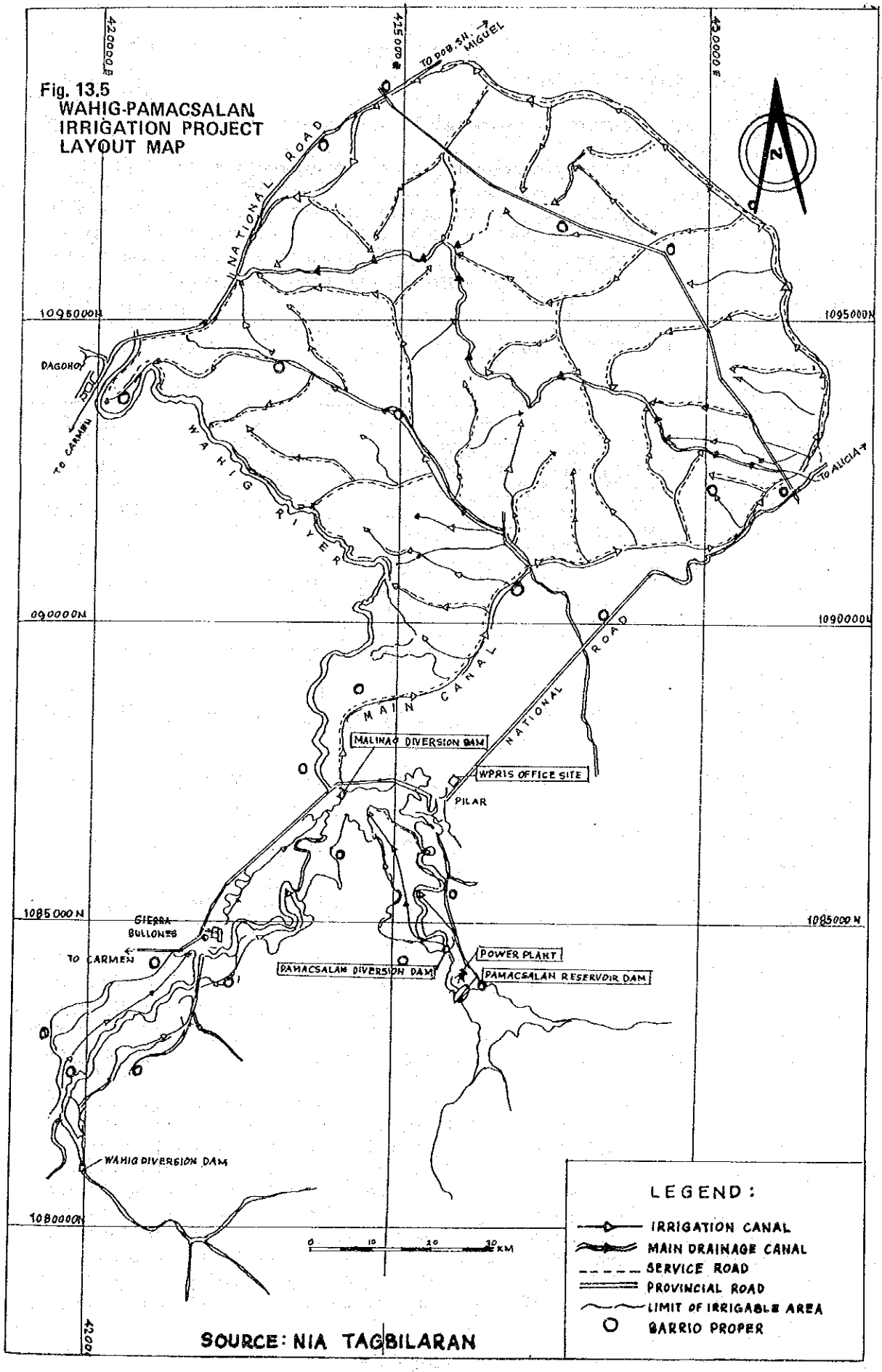
Source: NIA Tagbilaran

Of all four National Projects, the Wahig-Pamacsalan project will have extremely high impact for the development of Bohol.

(b) Project Description and Implementation:

The project area covering an acreage of about 6,000 hectares is located in the eastern central part of the province. The area of influence covers the municipalities of Pilar, Sierra-Bullones, Dagohoy, San Miguel, Alicia and Ubay. The main project works are the Pamascalan Reservoir Dam and the Malinao Diversion Dam with storage functions. The purposes of the project are for irrigation and hydroelectric-power generation. The project cost was estimated to be 328.5 million pesos. The tentative schedule of implementation from the final designing of all proposed works to be undertaken up to the full completion has been set from June 1981 to June 1986. Figure 13.5 shows the general layout of the project.

Fig. 13.5
WAHIG-PAMACSALAN
IRRIGATION PROJECT
LAYOUT MAP



SOURCE: NIA TAGBILARAN

2) Communal Projects

(a) Summary of Communal Irrigation Projects

The many communal projects proposed for development in the province (see Table 13.9) are in line with the policy of the government to give priority attention to projects that could be conducted with a multi-purpose concept. The Cahayag CIP project has high impact in this aspect considering its size and location.

Table 13.9 Communal Irrigation Project Summary

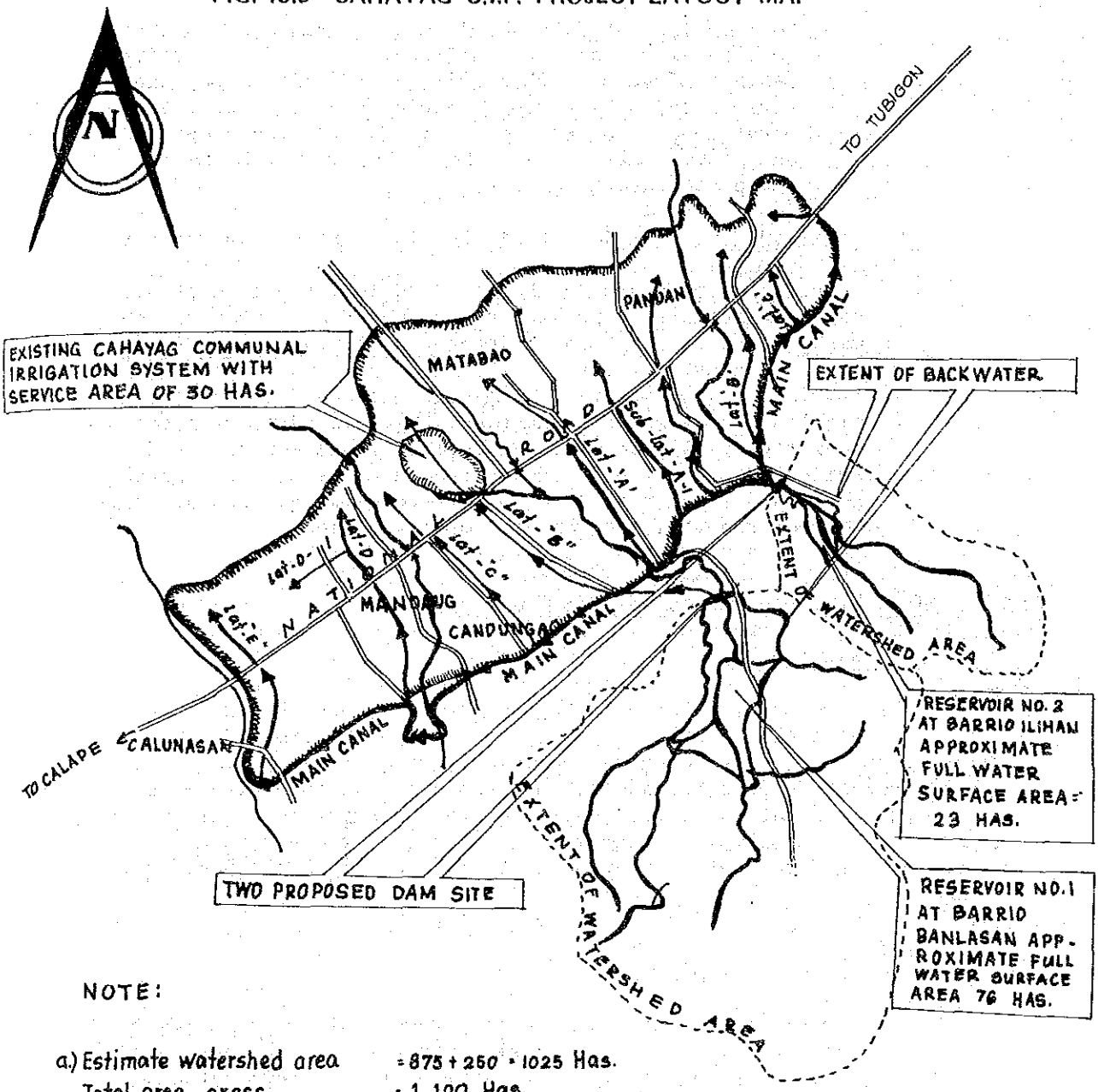
(Source: NIA Tagbilaran)

Name/Location of Project	Potential Irrigable Area (ha)	Estimated Cost ₱1,000	Name of Water Source	Proposed Implementation
1. Cahayag CIP Tubigon	600	11,000	Banlanan River, Hihan Creek	1983-1984
2. Tipolo-Union CIP Ubay	150	2,750	Tipole Creek	1985
3. Ubojan-Cabulihan Tubigon	200	3,570	Tubigon River	1982-1983
4. Iapaean CIP Inabanga	300	5,360	Lapacan Creek	1983-1984
5. Maubid CIP Inabanga	100	2,000	Maubid River	1983
6. Bay-ang CIP Ubay	100	2,200	Calangahan Creek	1984
7. Cagting CIP Ubay	200	2,920	Pasanan Creek (Cagting Creek)	1986
8. Ondol CIP Mabini	100	2,300	Ondol Creek	1987-1988

(b) Cahayag CIP Project Description and Implementation

Cahayag CIP is located in the northwestern part of the island capable of serving potential irrigable area of about 600 hectares within the territorial jurisdiction of the municipalities of Calape and Tubigon. The project is multi-purpose in the sense that impounding dams with heights of about 25 to 30 meters are ideal for micro hydro-power development and in the Reservoir area, fresh water fish culture can be introduced. There are two impounding dams proposed for construction at the Barangays of Banlasan and Ilihan in the

FIG. 13.6 CAHAYAG C.I.P. PROJECT LAYOUT MAP



NOTE:

a.) Estimate watershed area = 875 + 250 = 1025 Has.
Total area - gross = 1,100 Has.
Less area coconut & other crops = 450 Has
Existing Irrigated area = 30 Has
irrigable area - net = 550 - 650 Has.
b.) Delinated from military map
c.) Subject to actual survey

SOURCE: NIA TUBIGON

municipality of Tubigon. The estimated cost amounts to a total of about ₱11 million. The project is implementable anytime within 1981 to 1985 after thorough surface and subsurface geologic investigations, and after underlying the foundation of the two proposed dam sites. Figure 13.6 shows the general layout of the proposed Cahayag CIP.

3) Detailed Investigation of all Possible Irrigation Projects

Technical assistance on the detailed investigation of all possible irrigation project areas, water sources of which maybe surface water and/or impounded rainfall run-off and water studies to determine the technical and financial feasibility to construct simple diversions dams to service small areas should be conducted. These studies will require four technical experts for a period of six months, at an estimated cost of ₱700,000. These studies are very necessary to hasten implementation of these irrigations projects to meet the physical targets for irrigation.

13.8.3 High Impact Projects of Water Supply

1. Introduction

The condition of the existing water systems in the province (rural & urban) are very poor. As earlier mentioned people cannot be efficiently served potable water from public water systems despite the abundance of water. The perennial water problem that exists can be traced to the existing distribution system and thus the urgent need to improve these systems is of high priority to provide sufficient water to the populace.

2. Project Description and Implementation

1) Improvement of Tagbilaran Water Works

The project consist of the improvement of the existing 8 pumping units and distribution systems and the construction of a filtering tank, purifying tank and reservoir tank. Water shall be pump out from the well to filtering tank and purifying tank. In this tank water shall be treated by clorination before it is stored in the reservoir tank for distribution. Capacity of these tanks shall be so designed to meet the water needs of the populace in the CYs 1985 to 2000 allocated as follows:

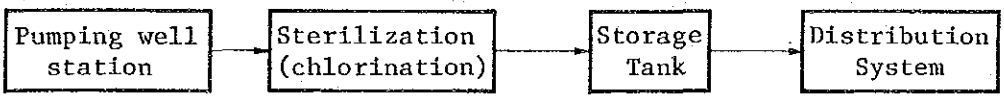
(a) CY 1985 Water Supply Demand

a. Household (population of about 51,000)	4,300 tons/day
b. Industrial	1,200 tons/day
Total for CY 1985	5,500 tons/day

(b) Future Demand of Tagbilaran Urban Water Supply

a. Household (population of about 86,400)	18,300 tons/day
b. Industrial + Public Purposes	2,000 tons/day
Total for CY 2000	19,300 tons/day

Cost of the project is estimated at about ₱12,000,000 and period of implementation shall be 1980 to 1985. The Figure shown below indicates the flow of the Tagbilaran Water Works:



The computed output of the 8 existing well pumping plants at Tagbilaran City of about 6,800 ton/day is good enough to supply its water supply demand of 5,500 ton/day in the year 1985, but construction of one (1) more well is necessary to provide a-lowance for distribution losses estimated at about 10 to 20% of the total output to meet the total demand in 1985. For the provision of sufficient water for Tagbilaran City after 1985, water source planning has to be formulated under the river basin water master plan. (see 13.9.3)

3. Improvement and Construction of Water Systems in the Rural Areas

The project will involve communal springs and open well development giving priority to five (5) BIAD centers. Implementation of the project shall be undertaken by the BPW in coordination with the local waterworks service units in the Rural Areas. The communal springs and open well development shall also be complemented with intensive studies on the possibility of tapping springs with abundant water supply in the municipalities of Pilar, Valencia and Sevilla to service nearby Barangays and adjoining municipalities with an adequate, safe water supply.

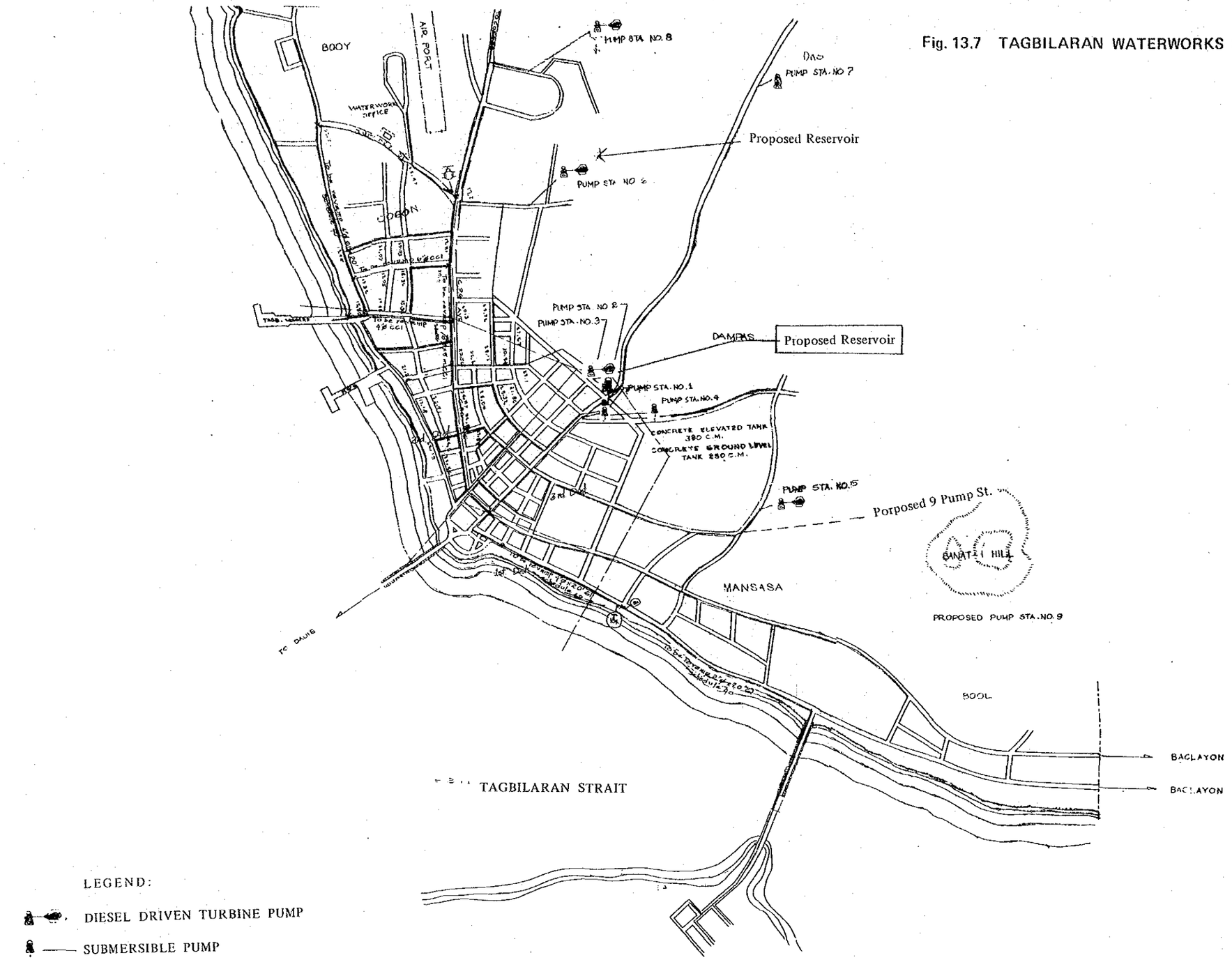
For this purpose the following rural water supply schemes are proposed for each municipality except Tagbilaran.

Service level - 1 water supply 30 places
Service level - 2 water supply 1 place

4. Groundwater Development

Intensive groundwater investigation shall be undertaken throughout the province. The project will involve acquisition of groundwater exploration equipment, drilling machines and the hiring of highly technical experts in groundwater development, primarily for purposes of domestic water supply and irrigation. The time frame of the study and development shall be five to ten years. (see section 13.9.3 below)

Fig. 13.7 TAGBILARAN WATERWORKS SYSTEM LAYOUT



LEGEND:

- DIESEL DRIVEN TURBINE PUMP
- SUBMERSIBLE PUMP
- INDUCTION MOTOR DRIVEN PUMP
- TEE JOINT
- CROSS TEE JOINT
- GATE VALVE
- ELBOW

13.9 Economic Aspect of the Projects

13.9.1 Economic Aspect of Irrigation

According to the NIA's proposal, the implementation schedule of irrigation schemes during short and medium terms is summarized as below in Table 13.10:

Table 13.10 Short/Medium Term Implementation Schedule
(Data Source: NIA Tagbilaran)

Project	1980	1985	1990	Investment cost (million Pesos)
National "Reservoir-type Irrigation Projects" (RIP)				
Wahig Pamacsalan RIP	6,000ha			328.5
Cayacay RIP		1,000ha		18.5
Bulilis RIP		1,500ha		27.8
San Augstin RIP		1,200ha		21.8
"Communal Irrigation Projects" (CIP)				
Cahayag CIP	600ha			11.0
Tipolo-Union CIP	150ha			2.8
Ubojan-Cabulihan CIP	200ha			3.6
Iapaean CIP	300ha			5.4
Maubid CIP	100ha			2.0
Bay-ang CIP	100ha			2.2
Cagting CIP	200ha			2.9
Ondol CIP	100ha			2.3
Total	7,450ha	4,000ha		428.8
Target	4,000ha	5,000ha		

In addition, 960ha of pump irrigation schemes are also proposed for the implementation from 1980 to 1990.

The total hectorage of the proposed irrigation schemes is estimated at about 12,000ha by 1990.

However, according to NIA drawings, many existing irrigation schemes are involved in the land area of proposed schemes for the improvement of the existing systems.

In the Wahig Pacsalan RIP area, projects involve the following existing irrigated farmlands:

Wahig Pacsalan RIP

Municipality	Pump Irrigation Schemes	Communal Irrigation Schemes	Total
Sierra Bullones	30 ha	297 ha	327 ha
Bagohoy	151 ha	0	151 ha
Alicia	4 ha	20 ha	24 ha
Pilar	113 ha	160 ha	273 ha
Total	298 ha	477 ha	775 ha

Data Source: NIA Tagbilaran

Therefore the net increase in irrigated farmlands under Wahig Pamacsalan RIP is estimated at about 5,000 ha. In the same way, the Cayacay CIP includes 122 ha of improvement of existing communal irrigation schemes in Calape Municipality. Therefore, the net increase in irrigated farmlands of this project is estimated at 500 ha. As a whole, the total net increase in irrigated lands is approximately 6,800 ha in the short term development projects from 1980 to 1985 shown above. This increase of irrigated land area will easily cover the targeted extension of irrigated land during the short term development. During the medium term development from 1985 to 1990, the net increase in irrigated land is estimated at 4,000 ha against 5,000 ha of targeted increase. However, during the short term development this difference between actual increase and targeted increase should be covered. This is strongly recommendable since during long term development increase in palay production largely depends on increase in the production rate from unit land area due to limited water and land resources.

Table 13.11 Summary of Project Targets and Costs

1980-1985	Irrigated Land Net Increase Expected (ha)	Irrigated Land Net Increase Targeted (ha)	Total Production Net Increase Expected (ton/year)	Total Production Net Increase Targeted (ton/year)	Investment Cost (million pesos)
High Impact Projects	5,700	-	19,950	-	328.5
Other Projects	1,150	4,000	4,025	-	32.2
Sub-total	6,850	4,000	23,975	18,500	360.7
1985-1990					
Medium Term	4,000	5,000	16,000	23,000	68.1
Sub-total	4,000	5,000	16,000	23,000	68.1
Grand Total 1980-1990	10,850	9,000	39,975	41,500	428.8

The net increase in total product by 1990 is expected to be 39,975 tons/year from increased irrigated area plus 7,700 tons/year by increased unit production rate of 4 ton/ha of existing irrigated lands, which almost achieves the targeted increase of total production (41,500 tons/year). The effect of the high impact projects to the total net increase in production is estimated at 35% and 55% in 1985 and 1900 respectively.

13.9.2 Effect of Water Supply High Impact Project

1. General

Prior to the formulation of water supply projects, it is necessary to undertake a detailed study on groundwater resources and the present state of the water supply in the rural areas.

In this section of the report, only the effect of the high impact project against set target will be evaluated.

2. Rural Water Supply

The proposed high impact projects consist of 30 units of service level-1 rural water supply schemes and one unit of level-2 rural water supply scheme in each municipality. The population to be served by these high impact projects are estimated as below:

Service level-1 scheme : 140 person per unit
Service level-2 scheme : 500 person per unit

Total Population to be served:

(140 x 30 + 500) x 46 municipalities = 216,200 persons

These schemes are to be implemented at the sites selected by the above studies. While the targeted number of additional population to be served by improved water supply is estimated at 584,000 by 1985, about 250,000 is served by improved water supply at present. Accordingly additional 334,000 person will have to be served from 1980 to 1985. Therefore the short-term high impact projects of rural water supply will serve about 58% of targeted population.

The total cost of high impact projects for rural water supply is estimated as below:

(unit: million₱)

Service level-1 schemes:	1,000 pesos x 30 x 46	= 1.38
Service level-2 schemes:	50,000 pesos x 46	= 2.30
Total		3.68

3. Urban Water Supply

The only real urban area in the province is Tagbilaran. This city is not only the administrative center, but also expected to be the center for public health diagnostic service and for small to medium scale industries. In future it will also be the terminal point for tourists to visit the province from outside. Therefore, it is proposed to complete 100% urban water supply at an early phase of the development plan.

For this purpose, the high impact project to improve the Tagbilaran water supply is proposed to be put into 88% complete service in the short term development project ending at 1985. Total cost required is estimated at 1,200,000 pesos.

13.9.3 Studies on Water Resource Management

To attain the set target of the integrated development project, rational water resource management plays one of the most important roles, both in planning and implementation stages of various water oriented projects. However, at present basic data are still insufficient on hydrology, hydrogeology, irrigation management and rural water supply. For this purpose, province wide detailed studies on these aspects are urgently recommended and necessary at an early stage of the BIADP. There must be a set of detailed river basin water master plan studies for accessment of available water resources in the province and determining the most efficient and economical techniques of water utilization for the development.

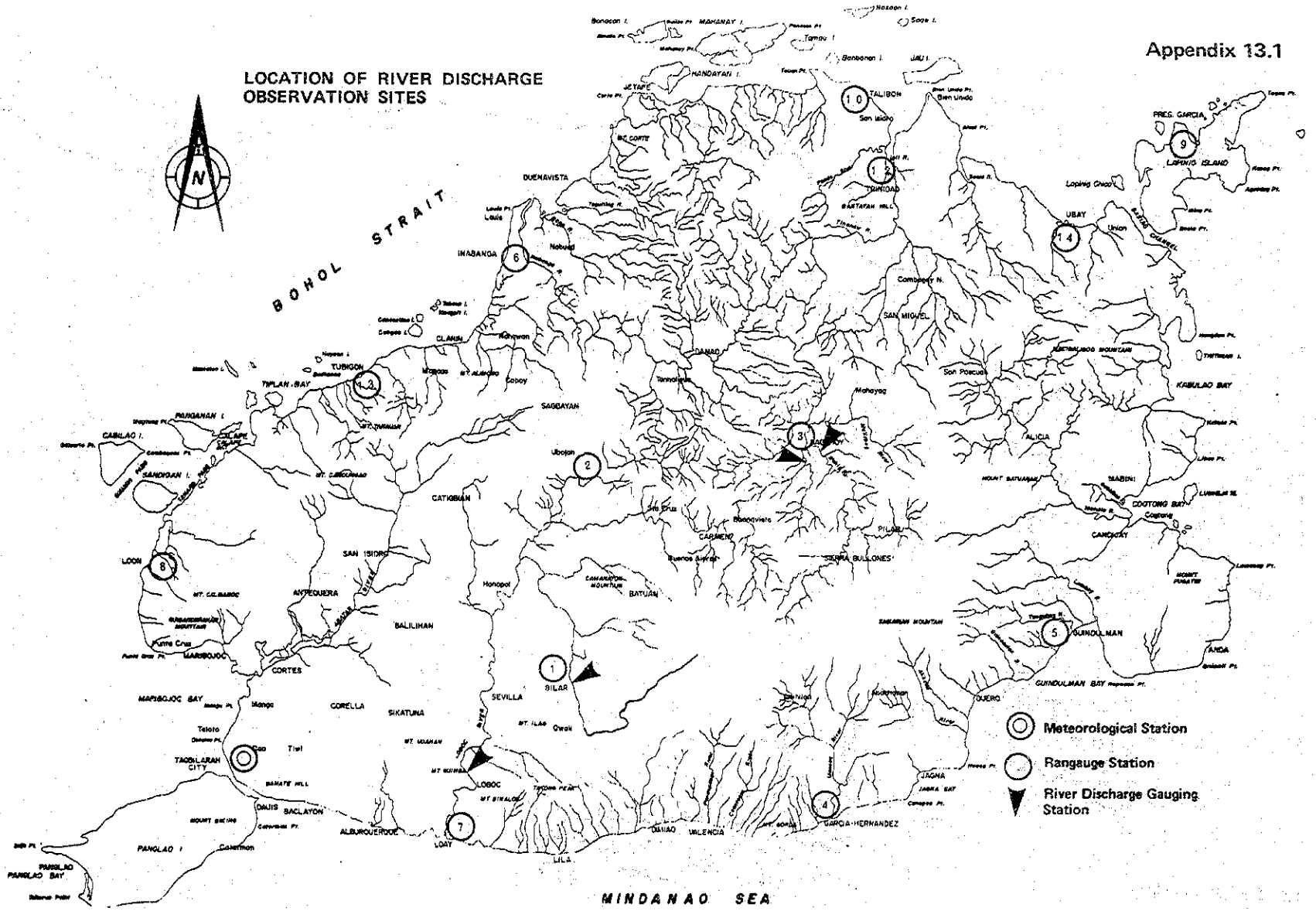
For this purpose it is proposed to organize a study team of highly experienced experts in the various field as shown below:

Hydrologist	1
Hydrogeologist	1
Economist	1
Irrigation Engineer	2
Sanitary Engineer	1
Civil Engineer	1

The study will require two to three years and its estimated cost is 6,700,000 pesos. This study includes the detailed investigation of irrigation schemes and groundwater development described in Section 13.8.

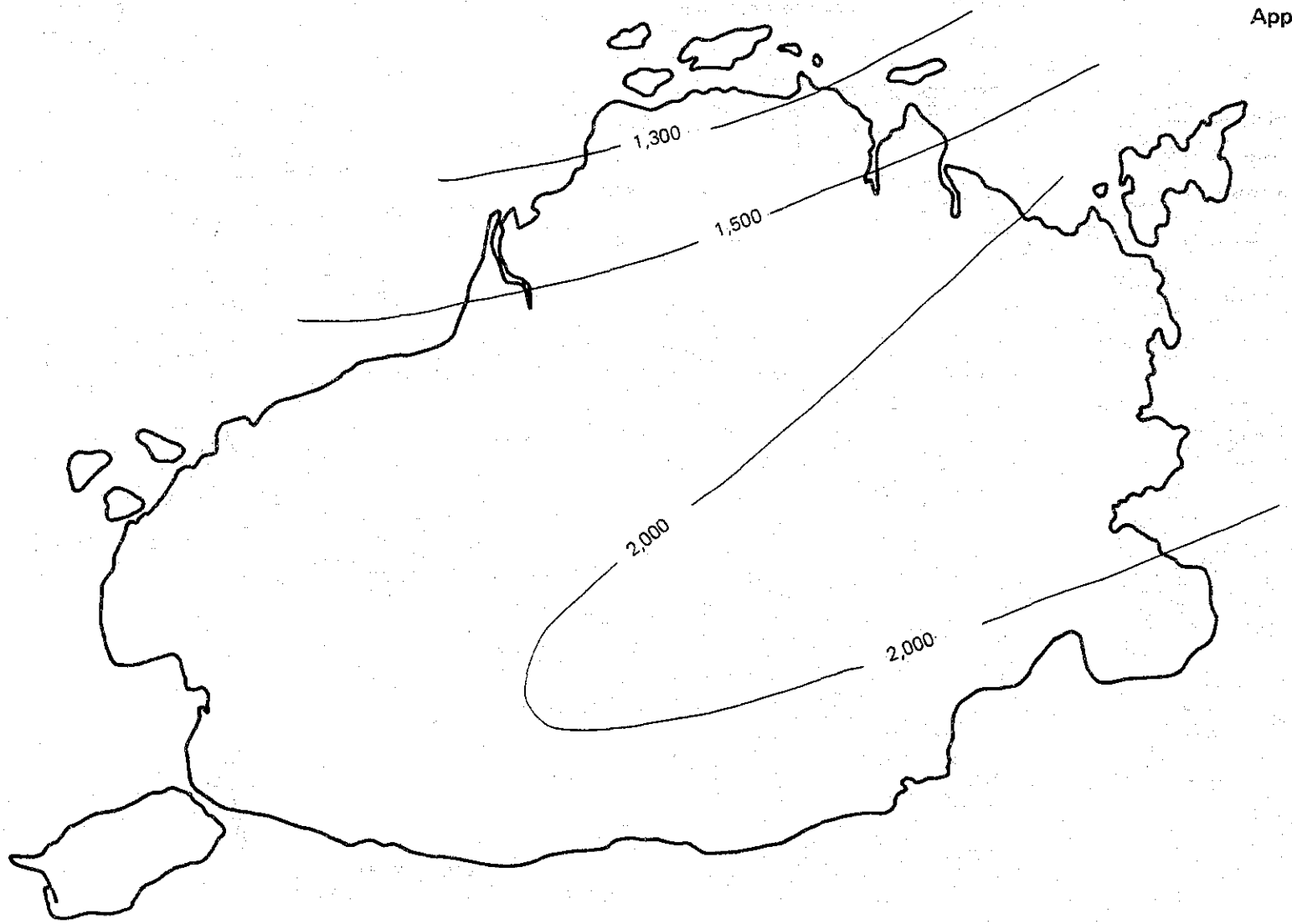
APPENDIX

Appendix 13.1



ISOHYET MAP OF ANNUAL RAINFALL mm/Year

Appendix 13.2



Appendix 13-3

RAINGAUGE STATIONS IN BOHOL

Name of Stations	Location Lat. N	Long. E	Type of Gauge
1. Bilar	9 43'	124 06'	Standard Raingauge
2. Carmen	9 50'	124 12'	Standard Raingauge
3. Dagohoy	9 54'	124 16'	Automatic Raingauge
4. Garcia - Hernandez	9 37'	124 18'	Standard Raingauge
5. Guindulman	9 45'	124 29'	Standard Raingauge
6. Inabanga	10 02'	124 04'	Standard Raingauge
7. Loay	9 36'	124 01'	Standard Raingauge
8. Loon	9 46'	123 48'	Standard Raingauge
9. Pitogo	10 07'	124 33'	Standard Raingauge
10. Talibon	10 09'	124 22'	Standard Raingauge
11. Tagbilaran	9 39'	123 51'	Automatic Raingauge
12. Trinidad	10 05'	124 21'	Standard Raingauge
13. Tubigon	9 57'	124 00'	Standard Raingauge
14. Ubay	10 03'	124 28'	Standard Raingauge
15. Calangaman, Ubay (Part)	9 50'	124 34'	Standard Raingauge

Source: Station of Bureau of Soils PAGASA Manila

Appendix 13-4

DAILY EVAPORATION 1978 (TAGBILARAN)

(UNIT: MM)

Date	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	2.0	3.0	5.0	4.5	6.0	0	4.0	5.5	3.0	6.0	3.0
2	0	3.0	4.0	6.0	3.0	6.0	2.0	5.0	3.0	1.0	4.0	2.0
3	5.8	1.5	2.0	6.0	3.5	4.0	2.0	3.0	3.0	4.0	3.0	1.0
4	1.0	1.0	3.0	6.0	3.5	3.0	3.0	1.0	2.0	2.0	6.0	2.0
5	6.0	3.0	3.0	6.5	5.0	6.0	3.0	1.5	3.0	5.0	2.5	2.5
6	3.3	5.0	3.0	2.0	5.0	6.0	1.0	2.5	2.0	2.5	6.0	0.5
7	1.3	5.0	4.0	2.0	5.0	5.0	2.0	5.0	1.0	1.5	4.0	0.5
8	2.0	6.0	4.0	3.0	3.0	5.0	3.0	5.0	4.0	1.5	1.0	1.0
9	1.0	5.0	4.0	3.0	2.0	5.0	2.0	4.0	2.0	5.0	2.0	0.5
10	1.0	1.0	5.0	3.0	3.0	3.0	1.5	4.5	5.5	6.0	2.5	1.0
11	1.5	3.0	4.0	1.8	6.0	1.0	4.0	0	3.0	6.5	5.4	1.0
12	1.0	2.0	4.0	4.0	4.0	2.0	1.0	5.0	2.0	3.5	3.5	1.5
13	2.0	0	5.0	2.0	3.0	4.0	1.0	7.0	1.0	3.0	2.0	1.0
14	1.0	4.0	3.0	6.0	3.0	1.0	4.0	5.0	3.0	5.0	1.5	0
15	8.0	6.0	1.5	4.0	4.0	4.0	3.9	4.5	5.0	3.0	2.0	3.0
16	3.0	2.0	1.5	3.0	4.0	0	2.3	4.0	2.3	0	0	1.0
17	5.5	4.0	3.0	6.0	4.0	3.0	2.5	1.5	1.0	4.0	3.5	6.0
18	5.0	3.0	1.0	7.0	3.0	1.0	4.5	2.5	2.8	2.5	3.5	6.0
19	7,5	1.5	5.0	5.0	7.0	1.0	3.5	3.4	4.0	3.0	1.5	4.0
20	5.0	3.0	4.0	2.0	4.0	0	2.0	1.0	3.0	3.5	3.0	3.0
21	3.2	3.0	4.0	1.0	2.0	2.0	2.5	6.3	3.0	3.5	2.0	4.5
22	3.0	4.0	5.0	2.0	4.0	4.0	5.0	5.0	3.0	5.0	2.0	1.0
23	2.0	2.0	5.0	4.5	5.0	3.0	2.0	2.0	3.0	5.0	3.5	2.5
24	4.8	3.0	8.0	6.0	4.0	3.0	5.0	6.0	3.0	4.0	4.0	2.0
25	2.0	4.0	4.0	6.0	5.0	5.0	4.0	4.0	1.0	3.0	1.0	3.0
26	5.0	1.0	5.0	2.0	4.0	2.0	3.0	3.5	1.0	5.5	2.5	2.0
27	2.0	3.0	3.5	2.0	4.0	0	4.5	3.5	3.0	4.0	1.0	2.5
28	3.0	5.0	4.5	4.0	5.0	1.0	3.5	4.0	4.0	2.0	2.0	4.5
29	1.0	-	6.0	3.0	6.0	3.0	3.5	2.5	4.0	5.0	1.5	2.5
30	1.5	-	4.0	5.0	6.0	3.0	4.0	2.0	5.0	3.0	3.5	1.5
31	1.7	-	4.0	-	1.0	-	1.0	5.0	-	4.0	-	0
Total	91.6	86.0	120.	118.8	125.5	92.0	86.2	113.2	88.1	109.5	85.9	66.5
Mean	3.0	3.1	3.9	2.0	2.0	3.1	2.8	3.6	2.9	3.5	2.9	2.0

Source: NIA TAGBILARAN

TAGBILARAN WATER WORKS PUMPING UNITS

Well Plant	Capacity (GPM)	Size (h.p.)	Type	Configuration	Remarks
1st Pumping Plant	100	10	Electric	Vertical	Ind. Motor
2nd Pumping Plant	180	21	Submersible Pump	-	20 H.P.
		15	Electric	Vertical	Not being used
3rd Pumping Plant	180	48	Diesel	Horizontal	With 48 H.P. Stand-by Engine
4th Pumping Plant	240	15	Electric	Vertical	Submersible
5th Pumping Plant	225	80	Diesel	Horizontal	With 80 H.P. Stand-by Engine
6th Pumping Plant	400	58	Diesel	Horizontal	With 80 H.P. Stand-by Engine
7th Pumping Plant	280	20	Electric	Vertical	Submersible
8th Pumping Plant	-	30	Diesel	Horizontal	60 H.P. 4 cyl. Diesel Engine

Source: Tagbilaran Waterworks

CHAPTER 14
TRANSPORTATION SYSTEM DEVELOPMENT PROGRAMS AND PROJECTS

CHAPTER 14 TRANSPORTATION SYSTEM DEVELOPMENT PROGRAMS AND PROJECTS

14.1 Summary of the Transportation Situation and Plan for Bohol

14.1.1 General Considerations for Transportation

Bohol Province is one of the economically depressed areas in the country. One of the major reasons of its state of underdevelopment is inadequate transportation infrastructure facilities. The improvement of the transportation system would contribute much to the province's economic development. An efficient transportation system can be one of the contributing factors to the proper distribution of agricultural and industrial products from production areas to markets or consumption areas. The implementation of the transportation projects must be coordinated so as to enhance total economic and social development.

14.1.2 Analysis of Current Transportation Problems and Trends

Brief descriptions of the present state of transportation in the province by mode of transport are as follows:

1. Roads and Bridges

The existing major road network in Bohol is fair but inconsistent. Most of the roads are surfaced with gravel and Telford, but without a uniform surface condition throughout the whole length of the road (i.e., a 10 km road has 3 km of good condition surface with intermittent unsatisfactory condition surface, etc.)

There are many dangerous Timber and Bailey bridges which are about 20 to 30 years old with narrow widths of 3.8 - 4.2 m. More than fifty percent (50%) of the Barangay Roads are impassable, especially during the rainy season, due to inadequate drainage system and the lack of permanent bridges. There is an urgent need for the improvement of the existing roads and related bridges as discussed in Section 14.2 below.

2. Port Facilities

Bohol Province has a total number of 24 ports. Out of these twenty four ports, only the Tagbilaran, Tubigon, Jagna, Ubay, Talibon, Garcia Hemandez and Loay ports are kept in good condition. The rest of the ports are deserted or unused.

The description of the different ports' condition are described in section 14.3 below.

The Tagbilaran port has a significant volume of cargo and passengers and the Jagna and Tubigon ports are catching up with the

Tagbilaran port's rate of increase in cargo and passengers. There is an urgent need for the improvement of sea traffic and port facilities to handle the increasing volume of cargo and passengers.

3. Airport Facilities

YS-11 single flights have been operating between the Mactan and Tagbilaran airports, at a frequency of four times a week. However, the greater number of commuters are being transported by ships sailing between Cabu and Bohol.

The Tagbilaran airport's concrete paved runway (1,050 m x 30 m) was constructed in 1966 and is still in good condition, but an extension of at least 1,200 m is needed to handle larger aircraft.

One of the facilities that would help to upgrade the airport's safety function would be a Non-Directional Radio Beacon (NDB) as discussed in Section 4.4 below.

14.1.3 Transport Study Objectives and Target Variables

The objectives of transportation study are the following:

- to study the transportation system which will best meet the present and future traffic demand.
- to determine the flow of passengers and commodities.
- to determine the type and capacity of conveyance needed for an effective flow of traffic.

The transportation projects have been categorized according to priority. High priority projects are those recommended for implementation during the years 1980 to 1985 because of their immediate importance to the transportation needs of Bohol; the second priority projects are those which need to be implemented during the five years after the first priority projects have been implemented, i.e., 1985 - 1990.

The transportation projects are described and categorized according to mode of transport.

14.1.4 Transportation Programs Recommended for Immediate Implementation

The Road, Port and Airport projects under this program are discussed in the respective Short Term Development Programs (1980 - 1985) parts of this chapter (Sections 7.2 - 7.4). Implementation of these projects within 2 to 3 years (1980 - 1982 or 1983) is deemed necessary for the overall development of Bohol. High impact transportation projects and the transportation network for 1985 are shown in App. 14-1 and App. 14-2 respectively.

1. Road Improvement Projects

Tagbilaran North Road (Tagbilaran - Tubigon)

Tagbilaran East Road (Tagbilaran - Jagna)

Loay Interior Road (Loay - Carmen)

Description

The projects involve the improvement and rehabilitation of the existing section of Tagbilaran North Road, Tagbilaran East Road and Loay Interior Road, which are the trunk roads in Bohol, and also involves the replacement of old and dangerous bridges of other national roads. The project covers a distance of 156 kms of roads and 581 m of bridges.

Justification

The proposed improvement will provide safer and more convenient travel for the motoring public, generate savings in transport costs, and help accelerate the economic growth of the area and will tap the tourism potential of Chocolate Hills.

Project Cost

The total cost is estimated at ₱32.3 M, (US$4.4M)

Implementation

The detailed engineering design work for the project is proposed to be undertaken in 1980, and the construction is scheduled to start within the period between 1981 and 1982. The feasibility study was finished by the IBRD in 1979.

Implementing Agency

The Ministry of Public Highways

2. SEA Port Improvement Projects: Tagbilaran, Jagna and Tubigon Ports

Description

Tagbilaran Port

Repairing of Fenders, Construction of Sheds and Warehouse.
Construction of Jetty and Passenger Terminal.

Jagna Port

Reparing of Jetty and Warehouse
Construction of Passenger Terminal

Tubigon Port

Dredging around the existing Jetty

Construction of Fenders and Warehouse
Construction of the Ferry Terminal

Cogtong Port

New construction of Fishery port. (see Chapter 10)

Justification

The construction and improvement of such facilities will relieve these ports of difficulties in handling cargo and passenger traffic demand. Ferry services between Cebu and Bohol will enhance the economic growth of Bohol through the faster movement of people and goods. New Cogtong port is need for fishery development in Bohol.

Project Cost

The total cost is estimated at ₱52.4 M (US$7.2M)

Implementation

The detailed feasibility study and engineering design work for the proejct are proposed to be undertaken in 1980, and the construction is scheduled to start within the period between 1981 and 1982. The feasibility study for Ferry was finished by the IBRD in 1979.

Implementing Agency

The Philippine Ports Authority will be the implementing agency through the Ministry of Public Works.

3. Airport Improvement Projects: Tagbilaran Airport

Description

The project involves upgrading and improvement of facilities of the secondary airport at Tagbilaran airport, acquisition of real estate, extension of paving runway (150 m), installation of navigational aid (Non-Directional Radio Beacon).

Justification

Improvements are essential for the attainment of air safety and landing/take off operation and are necessary to meet the minimum standards required by future air traffic.

Project Cost

The total cost is estimated at ₱4.0 M (US$0.6M)

Implementation

The detailed feasibility study and engineering design work for

the project are proposed to be undertaken in 1980, and the construction is scheduled to start within the period between 1981 and 1982.

Implementing Agency

The Ministry of Public Works, Ministry of Transportation and Communications through the Civil Aeronautics Administration.

14.2 Road and Bridge Development Plan

14.2.1 General Considerations for Roads in Bohol

Geographically, Bohol is relatively flat and it resembles a large plateau. The northern and central parts of the province consist of low rolling hills and broad valleys and only the southern portion is a bit mountainous (800 meters high) and then drops off steeply to the coast. Sedimentary rock formations are found along the coastline mostly consisting of limestone.

The trunk roads of Bohol are the north road, the east road and the interior road. The Tagbilaran North Road, which is 122 km long, starts from Tagbilaran and goes westward along the coast and goes towards Tubigon and terminates at Trinidad. The Tagbilaran East Road, which is 139 km long, starts from Tagbilaran and follows the coast to the east up to Trinidad. The Loay Interior Road, which is 79 km long, starts from Loay and goes northward to Trinidad.

The road network in Bohol is fairly adequate. There is no need to construct new major roads, although, there is a need for new Barangay and feeder roads. Some of the Barangay roads are not passable during the rainy season.

The roads have been adequately maintained by the Ministry of Public Highways (MPH) to meet present demand. However, there is a need to upgrade and improve the national roads to a better standard mainly through paving and widening and also to replace a reconstruct old and dangerous bridges of the national roads in order to service the future agricultural development in central area of Bohol, fishery development in eastern area and tourism development of Carmen.

Considering the actual condition of roads and the expected increase of vehicles due to the island's development, the plan to improve and rehabilitate existing roads should be given priority consideration and implemented for the future development of Bohol.

14.2.2 Analysis of Current Road Problems and Trends

1. Existing Roads

The road network in Bohol is classified into National Roads, Provincial Roads, the Municipal Road, City Roads and Barangay/ Feeder Roads National Roads are classified into two categores -

primary and secondary. The main National Roads are the Tagbilaran East Road, the Tagbilaran North Road and the Loay Interior Road. These roads are shown in the location map in APP. 14-3.

Road classification and road surface conditions in Bohol are shown in APP. 14-4

Pavement Ratio of National Roads is 31.9% and those of Provincial Roads and Municipal Roads is 2.1% and 19.3% respectively.

The Pavement Ratio of Cebu is 19.1% while that of Bohol is 8.4%, which is the lowest ratio in Region 7 (See App. 14-5). On the other hand, road density ratio of Cebu and Bohol are 0.73km/km^2 and 0.83km/km^2 respectively. There is no need to construct new major roads, however, there is a need for barangay and farm-to-market feeder roads.

Most of the roads are surfaced with Gravel and Telford, but without uniform levels of surface condition throughout the whole length of the road. Asphalt and Concrete Roads are in fair condition.

In as much as there is a scarcity of stone materials from the river, which would ideally be the best material, limestone has been used for surfacing.

. National Roads

A total length of 590 kilometers is classified as National Road. Thirty percent (30%) of these roads are in good condition, thirty eight percent (38%) are in fair condition and thirty two percent (32%) are in poor condition.

However, 359 kilometers of national raods are to be rehabilitated under the Fifth IBRD Packages by 1983.

. Provincial Roads

Sixty percent (60%) of the existing Provincial Roads need improvement and rehabilitation and upgrading of its quality to the usual standards. A total of 430 kilometers have been proposed to be improved and upgraded. Thirty two (32) kilometers of roads is being proposed for construction by MPH.

The province receives aid from the national government to cover one-half of the total maintenance costs and all of the total construction costs of new roads.

. Municipal Roads

Around fifty percent (50%) of the existing city and municipal roads are in fair condition.

Cities and municipalities receive maintenance counterpart funds from the national government, amounting to one-third of the total maintenance costs and all of the construction costs of new roads.

. Barangay Feeder Roads

Of the total raod network, 1,833 km are classified as barangay roads. Thirty percent (30%) of these roads are in good condition. The rest of the roads are impassable especially during the rainy season, due to the inadequate drainage system and the lack of permanent bridges. A total of 332 kilometers of barangay roads is being proposed for construction by the MPH.

2. Bridges

The present number of existing bridges is shown in App. 14-6. The total number of bridges is 192, with a total length of 3,600 m and an average span of 18.8 m. There are no long span bridges. Three very old steel bridges in the 1st Engineering District are being replaced with new Reinforced Concrete bridges. The load capacity of most of RC bridges is 20 metric tons but a few of the bridges have a lower load capacity of 15 metric tons. The load capacity of a Bailey bridge and a Timber bridge is 15 metric tons and 10 metric tons, respectively.

The existing Timber bridges and Bailey bridges are assumed to be 20 to 30 years old with narrow width of 3.8 - 4.2 m, which is one of the causes of the obstruction of traffic flow.

Reinforced concrete bridges which were constructed from the 1910's to the 1930's have one-lane width of 4.0 to 4.5 m, but those constructed from the 1940's to the 1970's have a two-lane width of 6.7 to 7.3 m. Some of the old R.C. bridges are one-lane concrete bridges.

The permissible vehicle weights in the Philippines are as follows:

Type of Vehicles	Maximum Gross Weight
Truck with 2 axles	15 tons
Truck with tandem rear axles	15 tons
Truck with semi-trailer	27 tons

Since the load capacity of the old timber and baile bridges is assumed to be less than 15 tons, there is the dangerous possibility that they will collapse.

3. Maintenance Cost

The maintenance cost estimate procedure recommended by the Highway Act is the use of a basic maintenance cost per kilometer and the adjustment of the function of the traffic and pavement width.

Government regulations determine the basic maintenance cost, the annual basis 1978 cost for National Roads has been fixed at ₱11,342/EMK (Equivalent Maintenance Kilometer). It is expected

that the maintenance cost will increase to ₱13,500/EMK in the year 1990. Maintenance costs for the national roads are shown in App. T. 14-7.

4. Registered Number of Vehicles

The total number of registered vehicles (excluding tricycles and motorcycles) in Bohol is 2,340 in 1977, which gives the very low rate of ownership of about 3.0 vehicles per 1,000 population as shown in App. 14-8.

5. Public Transport

Public transport services comprise scheduled bus operations, and informal jeepney and tricycle services.

The tricycles generally operate within the urban areas, but also serve short inter-urban routes. Large 60-passenger buses make express trip with limited stops from origin to destination and serve long routes. For Local services, small or medium-sized buses, 25-45 passenger capacity, are used. Public transportation service routes in Bohol are shown in App. 14-9.

6. Estimated Traffic Demand

Private and Public transportation demands are based on population growth, economic development and transport demand-income elasticities.

Traffic will be generated due to the development of agriculture, tourism, fishery and industry.

Existing traffic and factors which will affect traffic volume are discussed in the following paragraphs.

Existing Traffic

The heaviest traffic flows were observed on the roads of Tagbilaran City. Traffic composition is 55% motorcycles and motorized tricycles, 25% buses and jeepneys, 20% trucks, vans and cars.

The Circuit Roads (Tagbilaran East and North Road) have heavier traffic flow than the Loay-Trinidad roads and Jagna-Clarin Roads.

The traffic flow on the Circuit Road rapidly reduces as the distance increases from Tagbilaran City up to Jagna and Tubigon.

In the roads from Jagna to Trinidad, traffic remains constant, but from Tubigon to Talibon the traffic decreases and then increases again as it approaches Trinidad.

Most of the minor roads, barangay/feeder roads, have low traffic volumes and are used only by local vehicle owners.

The main commodities being transported on the major roads, (circuit

roads) are groceries, bottled drinks, copra, rice and construction materials.

Vehicles are operated within a speed limit of 10/km/hr within the Tagbilaran City proper, 20-40 km/hr on gravel roads (due to poor surface condition) and 40-60 km/hr on asphalt and concrete roads.

Population

The 1980 population in Bohol is forecast to be about 971,686 with an average growth rate of 1.4% for the period from 1975 to 1980.

The population growth in Bohol is below the average growth of the whole country and also below the average growth of Region 7, due to a considerable number of Boholanos migrating to other islands.

Agriculture

It is assumed that the surplus of rice in Bohol in 1980 will be 37,000 metric tons. After the Wahig Projects is completed, the project will roduce approximately 20,000 metric tons of rice. Therefore, there will be 47,000 metric tons to 50,000 metric tons of surplus rice per year assuming 7,000 metric tons to 10,000 metric tons are held as reserves.

This surplus rice will be exported to Cebu from the Tubigon port and to Mindanao from the Jagna port. This will require a significant increase in traffic flow from the project site to both Tubigon and Jagna.

Tourism

In the year 1978, an estimate of 3,000 tourists (domestic and foreign) visited Bohol.

Most of the tourists visited the Chocolate Hills, using the Loay Interior Road to get to the site. A number of them also visited the beach areas located in the southwest part of Tagbilaran or Panglao.

Ports

The Tagbilaran Port is the largest port in Bohol. This port handles inter-island passengers and freight traffic. In 1978, the port handled 436,000 passengers and 200,000 tons of freight.

The Jagna port handles 187,000 passengers and 26,000 tons of cargo annually.

The Tubigon port handles about 150,000 passengers and 8,000 tons of cargo, while the Talibon port handles about 11,000 tons of freight. The IBRD's proposed project of putting a ferry passenger services at the Tubigon port into operation could create a significant increase of traffic in the surrounding road network.

Estimated Annual Average Daily Traffic (AADT)

Annual Average Daily Traffic (AADT) in 1978 and estimated AADT in 1986 were taken from the IBRD Road Feasibility Study Report which forecasts the future traffic volume in terms of surveyed traffic volume and future development of Bohol. The study results are shown in App. 14-10, App. 14-11 and App. 14-12.

The Average Yearly traffic growth rate was assumed approximately 6.0 percent in that report.

14.2.3 Road Planning Objectives and Target Variables

The improvement of the existing roads will require a change from the present deteriorated condition to good asphalt-pavement.

The new road facilities should be adequate for the future development of the agriculture, fishing, mining and tourism industries.

Taking the current problems of the existing roads into consideration, the following objectives were established:

1. Objectives

   1) To pave all gravel roads of the existing national, provincial, municipal and city roads, and to overlay all worn out asphalt surfaces.

   2) To replace the Tumber and Bailey bridges, the one-lane reinforced concrete bridges and the steel bridges on all national roads with two-lane permanent bridges.

   3) To replace the Timber bridges and old Bailey bridges with new Bailey or permanent bridges on all the provincial and barangay roads.

   4) To widen the roads by adding shoulders in accordance with the set standard cross section: two-lane for national roads and one-lane for provincial roads.

   5) To improve the drainage system facilities and road protection.

   6) To provide adequate miscellaneous road facilities such as guardrails, road signs and road markings.

   7) To improve existing barangay and provincial raods and to construct some new ones.

   8) To upgrade maintenance road capability.

2. Targets

   In order to achieve the objectives mentioned, three ranges of targets have been set:

- Short Term (1980 - 85)

- Medium Term (1985 - 90)

- Long Term (1990 - 2000)

The project term for each main effective is listed as follows and shown in Fig. 14.1.

1) To improve all the national roads by the year 1990.

2) To improve all the provincial, municipal and barangay roads by the year 1990.

3) To construct some provincial and barangay roads by the year 1990.

4) To replace the old and narrow dangerous bridges of the national roads by 1985.

5) To improve by 1985, the provincial, municipal and barangay roads which are now in poor condition. The improvement of the rest of the roads will continue until 1990.

6) To improve the Tagbilaran-Tubigon roads by converting them into four-lane roads and to construct a by-pass of Tagbilaran City by the year 2000.

14.2.4 Road Development Strategies

In order to get satisfactory results with regards to road improvement in terms of the limited funds, the following strategies should be implemented, taking into consideration the development projects of the other industries:

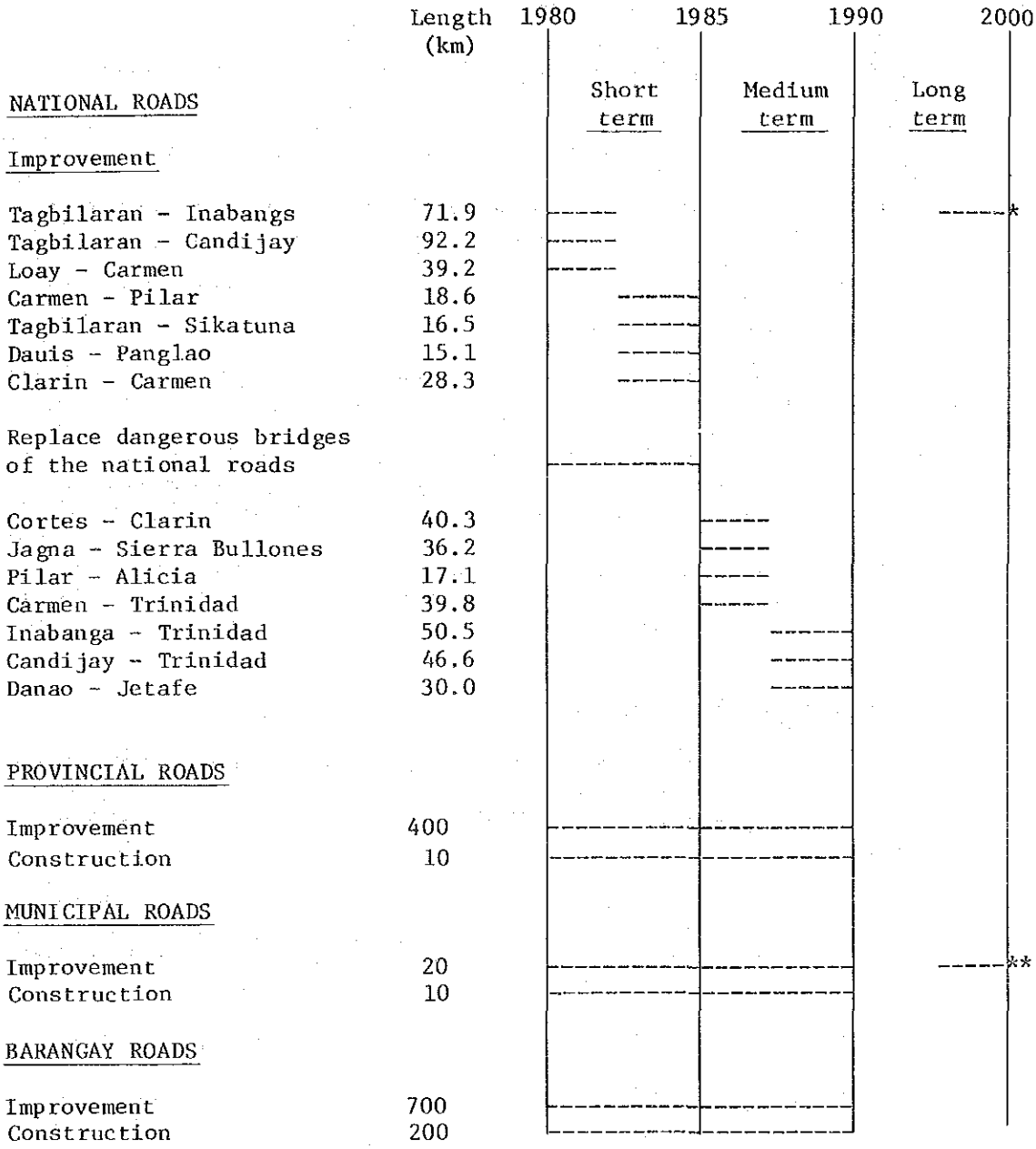
1) With regards to road improvement, national roads which have heavy traffic or which are connected with the major ports of Tagbilaran, Tubigon and Jagna, should be given first priority as follows:

Tagbilaran - Tubigon	(Tagbilaran North Road)
Tagbilaran - Jagna	(Tagbilaran East Road)
Loay - Carmen	(Loay Interior Road)
Tagbilaran - Sikatuna	

The rest of the roads which have low traffic volumes will be given second priority.

2) During the construction of the Wahig Dam (one of the major irrigation projects), the Jagna-Carmen or Tubigon-Carmen roads should be used as routes for transporting the hydro-power generator and construction materials. The old bridges on these

Fig. 14.1 ROAD PROJECT TARGETS (1980 - 2000)



* Four-lane road between Tagbilaran and Tubigon
** By-pass of Tagbilaran City

roads should therefore be replaced with permanent bridges. After the bridges are replaced, the improvement of these roads should come next.

3) The Dauis-Panglao and Loay-Carmen roads, which connect Tagbilaran to the Panglao and Chocolate Hills tourist spots should be improved first before any improvement is made on the Tubigon-Carmen Road.

4) The areas affected by the Wahig Irrigation Project are the municipalities of Alicia, Dagohoy, Pilar, San Miguel and Sierra Bullones. The road network of these municipalities will therefore need to be improved.

Priority should be given to the Carmen-Pilar national road; the national roads of Pilar-Alicia and Carmen-San Miguel will follow:

14.2.5 Road and Bridge Improvement Program

1. Road Improvement Program for Immediate Implementation (1980 - 1982 or 1983)

Under this program, the road sections connecting the major ports of Bohol and the road section leading to the main tourist spot of the province are being considered. They are the Tagbilaran-Tubigon, Tagbilaran-Jagna and Loay-Carmen roads, with a total length of 156.1 km. Most of the transport activities of the province are centered in these road sections. These roads are included in the short term program (1980 - 1985), but further study and investigation revealed the urgency of improvement and upgrading within a shorter period of 2 to 3 years. This program includes the replacement and widening of dangerous and narrow bridges respectively.

The following unit costs have been used for the cost estimate for the improvement and construction of roads and bridges:

Bitumunous Surface Treatment (BST)	210,000/km
Reinforced Concrete Bridge	22,000/m
Overlay of BST	65,000/km
Miscellaneous, Drainage, Embankment, Shoulder	50,000/km

Kinds of Roads	New Construction	Improvement
Provincial Road (Gravel)	250,000/km	52,000/km
Municiapl Road (BST)	690,000/km	140,000/km
Barangay Road	115,000/km	23,000/km

A summary of Immediate, Short-term and Medium Term projects and costs are shown in Table 14.1 to 14.3 which follow.

Table 14.1 Projects for Immediate Implementation (1980 - 82/3)

National Roads From-To	Total Length (km)	To be paved (km)	To be overlaid (km)	Bridge to be replaced (m)	Cost P(x1,000)	Cost US $(x1,000)
Tagbilaran - Tubigon	53.6	21.2	2.5	115.0	9,824.5	1,345,8
Tagbilaran - Jagna	63.3	12.1	7.5	122.0	8,877.5	1,216.1
Loay-Carmen	39.2	17.1	8.1	64.0	7,485.5	1,025.4
Replacement of Dangerous Bridges of Other National Roads				280.0	6,160.0	843.8
TOTAL	156.1	50.4	18.1	581.0	32,347.5	4,431.1

Table 14.2 Short Term Projects (1980 - 85)

National Road From - To	Total Length (km)	To be paved (km)	To be over-laid (km)	To be replaced bridge (m)	Cost P(x1,000)	Cost US$(x1,000)
Tagbilaran - Inabanga	71.9	30.5	11.5	116	14,399.5	1,972.5
Tagbilaran - Candijay	92.2	19.5	8.4	119	11,869.0	1,625.9
Loay - Carmen	39.2	17.1	8.1	69	7,595.5	1,040.5
Carmen - Pilar	18.6	13.0	1.5	92	5,781.5	792.0
Tagbilaran - Sikatuna	16.5	6.0	-	-	2,085.0	285.6
Dauis - Panglao	15.1	13.0	-	20	3,925.0	537.7
Clarin - Carmen	28.3	28.0	-	83	9,121.0	1,249.5
Replacement of Dangerous Bridges of Other Roads	-	-	-	376	8,272.0	1,133.2
SUB TOTAL	281.8	127.1	29.5	925	63,048.5	8,636.8
Design & Supervision Fee 15%					9,451.3	1,295.5
Provincial Roads (Gravel)	Construction - none		Improvement - 200 km		10,400.0	1,424.7
Municpal & City Roads (BST)	Construction - none		Improvement - 10 km		1,400.0	191.9
Barangay Roads (Gravel)	Construction - 100 km		Improvement - 350 km		19,550.0	2,678.0
TOTAL					103,849.8	14,226.9

Table 14.3 Medium Term Projects (1985 - 90)

National Road From - To	Total Length (km)	To be paved (km)	To be over-laid (km)	To be replaced bridge (m)	Cost P(x1,000)	Cost US$(x1,000)
National Roads						
Cortes - Clarin	40.3	37.3	1.5	7	10,099.5	1,983.5
Jagna - Sierra Bu-lones	36.2	36.0	-	66	10,822.0	1,482.5
Pilar - Alicia	17.1	15.0	0.5	152	7,381.5	1,001.2
Carmen - Trinidad	39.8	33.0	2.0	111	11,492.0	1,574.2
Inabanga - Trinidad	50.5	47.0	2.0	200	16,925.0	2,318.5
Candijay - Trinidad	46.6	36.0	2.0	112	12,484.0	1,710.1
Danao - Jetafe	30.0	28.5	-	164	11,093.0	1,519.6
SUB TOTAL	260.5	232.8	8.0	812	80,297.0	10,999.6
Design & Supervision Fee 15%					12,044.6	1,649.9
Privincial Roads (Gravel)	Construction - 10 km		Improvement - 200 km		12,900.0	1,767.0
Municipal and City Roads (BST)	Construction - 10 km		Improvement - 10 km		8,360.0	1,137.0
Barangay Roads (Gravel)	Construction - 100 km		Improvement - 350 km		9,200.0	1,260.2
TOTAL					122,741.6	16 813.7

14.3 Sea Port Development Plan

14.3.1 General Considerations for Sea Ports in Bohol

Bohol is an island province situated in the center of the scattered islands of the Central Visayas. Transportation of goods and materials from Bohol Island to other islands mainly rely on sea transportation.

There are twenty-four (24) ports registered in Bohol. Four ports are national, eighteen are municipal and two are private ports. However, most of the municipal ports are not used because of run-down facilities.

Most of the cargo transactions in Bohol are done at the three national ports of Tagbilaran, Tubigon and Jagna. Special cargoes such as silica and limestone are handled by the Jetafe port and Garcia-Hermandez ports, respectively. The Tagbilaran port serves as an entrance port of Bohol and plays an important role for sea transportation around the island. The Jagna and Ubay ports are secondary ports for Mindanao and Leyte islands, respectively. The Tubigon port is also a connecting point to the Cebu Island, and has a close relation with the Tagbilaran and Tahbon ports for the transportation of cargo and passengers.

Almost all of the ports of Bohol, except for the Tagbilaran, Tubigon and Jagna ports have become less frequently used and no efforts have been made to repair their facilities.

Because the water around the island is quite calm, surrounded by coral reefs and a number of islands, boats could be effectively and economically constructed. No breakwater is needed and a jetty can be easily installed having the required sea depth after the construction of a causeway. Maintenance dredging is not necessary for maintaining the required sea depth. The jetty can be prepared by a concrete pier type structure with fenders in a wooden cluster.

The Tagbilaran, Tubigon, Loay and Catagbacan ports are kept in good condition unlike the other ports which have deteriorated.

Considering the actual situation of the ports stated above and the expected increase of cargo handled by the ports due to the island's development, plans to develop and repair the facilities of the existing ports should be given priority consideration and implemented for the future expansion program of Bohol.

14.3.2 Analysis of Current Port Problems and Trends

1. Prevailing Conditions of the Ports of Bohol

Tagbilaran Port (National Port) - Tagbilaran port is situated at the southwest end of Bohol Island, facing the Panglao Island. It is the largest domestic port of the province and connects Bohol to Cebu and Mindanao. With the existence of coral reefs in the area, waves seldom disturb the port and a breakwater is therefore not necessary. Sea depth in front of the jetty and the causeway is -7.0 m and -3 m, respectively. The structure of the jetty is a pile foundation type and the causeway is a gravity type.

Jagna Port (National Port) - Jagna port is situated 63 km from the Tagbilaran port. The port serves as the major link with ports in Mindanao, especially those of Cagayan de Oro and Butuan provinces. Export of dry fish shipped from this port to Mindanao has been greater in volume than from Tagbilaran port due to its geographical proximity. Ships arriving at this port are mostly mixed cargo vessels. Main cargoes handled at this port are manure, cement, soft drinks and beer for import; dry fish, marine products and copra for export. There is no breakwater of this port. The pier is 84 m long and 11.5 m wide and is a concrete pile type. The fenders, the warehouse, as well as the passenger terminal at the base of the pier are already delapidated and should be repaired immediately. The P.P.A. has plans of repairing them, especially the fenders and the slab. However, these plans have not been carried out because of the lack of funds. During the monsoon season, the port is utilized as a refuge port. The sea depth alongside the port's jetty is 8.4 m (H.W.L.) and 7.8 m (L.W.L.).

Loay Port (Municipal Port) - The Loay Port is an estuary port situated at the south seashore of Bohol, 18.5 km from the port of Tagbilaran. A concrete landing facility (65 m long and 10 m wide) having a -3 m sea depth is constructed 500 m upstream from the Loay river. A 50 m long jetty is installed at the estuary of this river with a light beacon. Silica is exported from this port to Higan at the rate of 450 tons/month. Passenger boats commute between Loay and Butuan of the Mindanao archipelago. At present, no general cargo boat enters this port and the jetty us now used only for travellers and fishing boats.

Dimiao Port (Municipal Port) - The Dimiao port is situated at the south seashore of Bohol, 36.7 km east from the Tagbilaran port. A wooden pier (6 m x 5 m) is constructed at the end of the causeway (88 m long and 4.5 m wide). The pier is delapidated and floor planks are missing from the frame of the pier. It is reported that this port will be abolished by the P.P.A.

Garcia-Hernandez Port (Private Port) - The Garcia-Hernandez port is situated at the south seashore of Bohol 52.6 km from Tagbilaran port. It was constructed through a joint venture between the Kawasaki Steel Corporation and the Philippine Santa Co., for shipment of limestone to Cagayan de Oro, Mindanao. The annual production of limestone was estimated about 900,000 tons a year for the first period of construction. Export of limestone from Bohol consisted of 31,000 tons/month from November to December in 1976 and 32,000 tons/month from January to March, 1977. Limestone was transported to the pier from the mine, about 3 km away from the seashore and loaded on ships by belt conveyors and shiploaders. The capacity of the shiploader is 1000 t/hr. An outline of production facilities are as follows:

Capacity of mining	1,200,000 tons/year
Capacity of transportation	1,200,000 tons/year (By dump truck)
Crushing capacity	2,000,000 tons/year

Crusher	830 tons/year
Capacity of storage	50,000 tons
Number of workers	121 men (March 1977)

Guindulman Port (Municipal Port) - The port is situated at the southeast seashore of Bohol Island, 84.6 km from Tagbilaran port. A pier (40 m x 4.5 m) is constructed at the end of a 40 m long causeway and with wooden superstructure and concrete pile foundation. The port is now used, but limited only to trawlers which carry fish. The causeway has been destroyed by the waves and should be repaired immediately. There is another port in Guindulman which is managed by the national port authorities, which has already been abandoned. The port was previously used for the export of manganese.

Tapal Port (Municipal Port) - The Tapal port is located at the east seashore of Bohol, about 130 kms from the Tagbilaran port and faces Lapinig Island. A reinforced concrete pier with concrete piles is set on the top of the causeway (about 50 m long) and is used as a port of refuge from the wild sea condition by the shippers going and coming from the Leyte Island. The port is not in use now because of its long distance from the Ubay town.

Ubay Port (Municipal Port) - The port is situated northwast of the Bohol Island. A pier with 4 steps is set at the top of the causeway (235 m long and 3.5 m wide) and is used for departure and arrival of small boasts commuting to the Leyte and Cebu Islands. Connection between the pier and the ship is done by lighters. The port is used as a fishery port and a small-scale ice plant is installed at the base of the causeway.

Trinidad Port (Municipal Port) - This port is the only port installed along a river in Bohol; it is situated at about 5 kms up from the estuary of the North Ipil River. However, since the port is seldom used because of preference for the Ubay and Talibon ports. No port facilities (except for the wooden piles), remain at the port site. The port area is covered by silt.

Talibon Port (Municipal Port) - The port site is situated at the north part of Bohol and faces the Camotes Sea. Two wooden piers (4.0 m and 6.0 m) are set at the top of the causeway (393 m long and 3.5 m wide) and the sea depth in front of the pier is 3 m. Port facilities are all dilapidated, but the port is utilized by ferry boats commuting between Cebu and Tagbilaran and by trawlers.

Jetafe Port (Municipal Port) - The port is situated in the middle of the northern seashore of Bohol. A concrete pier (15 m long and 6 m wide) is constructed at the end of the causeway (130 m long and 4 m wide). The port is utilized only for the shipping of silica. The pier is partially destroyed and needs repair.

Buenavista Port (Municipal Port) - The port is situated at about 9 kms from Jetafe port, but is not being used except for temporary calls of fishing boats. The causeway (60 m long and 3.5 m wide) is the only constructed port facility.

Clarin Port (Municipal Port) - The port is situated at the northwest seashore of Bohol, about 8 kms north of the Tubigon port. The port's only remaining facility is an unusable causeway.

Tubigon Port (National Port) - The port is located at the west seashore of Bohol and Cebu Island can be reached from it within 2 hours. The port now handles a large volume of cargoes and also has ferry services. Waves seldom disturb and distract the port operations since abundant coral reefs existing around the area act as natural barrier and the Catangtangan Island which is situated in front of the port, also prevents waves coming from the Cebu Island direction from hitting the port. A reinforced concrete pier (115 m long x 8 m wide) with concrete piles is constructed at the top end of the causeway (810 m long and 6 m wide) as port facilities.

Catagbacan Port (Municipal Port) - The port is located 35 kms north from the Tagbilaran port. A reinforced concrete pier (123 m long and 8 m wide) with concrete piles is set at the top end of the causeway (810 m long and 6 m wide). The port is well kept but not used. The port was considered to be used as a ferry terminal, but the road leading to the pier is long and inadequate.

Maribojoc Port (National Port) - The port is situated at the west seashore of Bohol, 14.3 kms from the Tagbilaran port. The port was formerly utilized as a private port for export of galvanized steel plates. A wooden pier with concrete piles now remains at the top end of the causeway. The causeway was damaged by the waves and is now left unused.

Cortes Port (Municipal Port) - The port is located at 10 kms north of the Tagbilaran Port. The port was formerly used for unloading lumber from Mindanao. Now, it serves as a docking area for fishing boats.

Pitogo Port (Municipal Port) - The Pitogo port is located at the Lapinig Island, north of Bohol Island. The jetty of the port (100 m long and 4.5 m wide), is now used for receiving cargo and passengers.

2. The Present Sea Transport System and Facilities of Ports in Bohol

Sea transport network of Bohol Island is indicated in App. 14-13. Transportation of cargoes and passengers from Talibon to Cebu and vice-versa are now handled by small ships of 20 G.T. at frequencies of three times per week. However, the volume of cargo and passengers throughput is not so large. Sea transportation between the ports of Talibon and Ubay and the port of Leyte Island is also handled by small wooden ships and the volume is not big enough to justify the use of a larger vessel.

With the completion of national road network system circling Bohol Island, all the ports now connected with each other by the existing inadequate road network will play a more vital role as a component of the future transportation system in Bohol.

The Talibon and Ubay ports are not expected to experience a heavy volume of sea traffic for the time being, and the existing port facilities of these two ports will be able to handle traffic adequately. The expansion of facilities of these ports will, therefore, be considered only when the cargoes and number of passengers increase according to the Bohol Development Plan implementation.

The sea transportation between Cebu and Tabigon is not so developed at present, but will possibly expand in the future in proportion to the progress of the development plan of the Bohol Islands. The Tubigon and the Tagbilaran ports have very close working relation with each other regarding transport of the cargo they handle. The possibility of expansion of facilities of the Tubigon port should be evaluated by study of the volume of cargo handled.

The Tagbilaran port is an entrance port of Bohol Island and significant volume of cargo and passengers have been going through this port. The facilities of this port are already insufficient, requiring improvements in line with the progress of the development plan.

Sea transport between Cebu and Jagna ports and between Jagna port and Mindanao Island have been handled by 300 G.T. ships at frequency of three times per week. Quantities of cargoes handled at Jagna port has remained small, but the number of passengers has increased remarkably in recent years. The passenger terminal must be, therefore, improved considering the increasing number of passengers. The pier of Jagna is partially destroyed and needs immediate repair.

Except for the five ports of Tagbilaran, Tubigon, Jagna, Talibon and Ubay, all other existing ports will have no major use except as landing ports for small fishing boats. These ports should be utilized only as small-scale fishing ports and inadequate facilities need to be repaired.

On the basis of the evaluation of this prevailing capacities of sea transportation system and ports facilities in Bohol, it is recommended that the development plan for the ports will concentrate on the improvement of the facilities of the Tagbilaran, Tubigon and Jagna ports.

3. Environmental Conditions

For the study of the port facilities the following geographical, meteorological and oceanographical conditions must be taken into consideration. The probable conditions were inferred from the data on the Cebu port, since sufficient data on Bohol was not available.

1) Seismology

Bohol is an area relatively free from earthquakes and its seismic coefficient is 0.8 and 1.2 depending on foundation conditions. A coefficient of 0.8 is recommended for structure founded on rock strata and 1.2 for alluvial or poor material.

2) Foundation Conditions

Foundation conditions vary by site but generally consist of various layers of sand or silt underlain by a considerable thickness of firm clay.

3) Wind

Strong winds come from the southwest and northeast directions. The northeast wind is stronger. The annual mean velocity of wind is within 5.5 knots to 8.0 knots.

4) Tide

Tidal type:

Mean range (Mean low water - Mean high water)	1.01 meters
Diurnal range (MLLWL - MHHWL)	1.56 meters

The tidal stream in the Bohol strait goes on a north-eastern direction.

Significant Wave Heights (Meters)	Encounter Probability during 10 years period	Significant Wave period (seconds)	Encounter Probability during 20 years period
1	0.999	2	0.999
2	0.999	4	0.999
3	0.200	6	0.999
4	0.061	8	0.982
5	0.001	10	0.118
6	0.001	12	0.033

* Based on Data supplied by the P.P.A.

14.3.3 Sea Transport Demand and Development Plan of the Major Ports in Bohol

For the future development of Bohol economy, the sea transport network will undoubtedly play an important role. In particular, port development coinciding with the progress of socio-economic development of Bohol will have vital importance. A high priority must be placed upon the port development for the development of an adequate transportation network in Bohol for the following reasons:

1) Bohol is an island which is located between the two growth poles: Metro Cebu and Cagayan de Oro.

2) Inter-regional commodity movement will expand in the future and all must go through ports.

3) Wahig-Pamacsalan project can only be accomplished through smooth transportation of heavy equipment and construction materials.

In the light of their importance, it is proposed that a high priority order of the consideration should be given to the role to be played by the three major ports in Bohol, i.e., Tagbilaran, Jagna and Tubigon. In the following pages brief descriptions are given to the major characteristics of these ports.

1. Tagbilaran Port.

The quantity of cargo handled by the Tagbilaran port for the years 1977, 1978 and 1979 are shown in App. 14-14.

The mean monthly cargo throughput in 1977, 1978 and 1979 is as follows:

Year	Mean Monthly Throughput	Estimated Annual Tonnage
1977	17,390 tons	209,000 tons
1978	16,749 tons	203,390 tons
1979	16,735 tons	208,000 tons

The estimated annual tonnage derived from the above table indicates very little variation. The difference in the cargo traffic volume has been very minimal in the past few years and the growth rate of the cargo traffic of the Tagbilarant port is hardly recognizable. However, when these data are compared to the cargo throughout of the year 1976 which is recorded at 152,000 tons, an estimated growth rate of 8% can be derived.

The number of a ships entering the Tagbilaran port in the years 1977, 1978 and 1979 are indicated in App. 14-15, item (1).

Since the berthing length of the jetty is 80 m and 130 m, about three ships can be accommodated at the same time.

A maximum number of 1,638 ships per year are estimated to dock at this port, and the ships usually stay for 3 to 20 hours. Generally, two ships berth at this port in a day. And at present there are no ships that need to wait outside of the port to dock. The port can receive all present incoming traffic without any difficulty.

The assumed growth rate of cargoes to be handled by this port is 8% per year. Cargo throughout in 1985 is estimated to be 317,000 tons and the number of incoming ships to dock is also estimated to increase to a level of 2,600 ships per year.

The number of passengers going through Tagbilaran port has shown

considerable increase. Statistics on the number of arriving and departing passengers in 1977, 1978 and 1979 are shown in APP. 14-16.

The mean monthly number of passengers passing through the Tagbilaran port are as follows:

Year	Mean Monthly Number	Estimated Annual Number
1977	25,951	311,000
1978	34,532	414,000
1979	36,324	436,000

The growth rate of passengers which must be handled by the port is estimated to be 20% per year. This growth rate is considered too high to be realistic. The NEDA Region 7 office estimated the growth rate to be 10% annually, based only on the 1975 data.

If the 10% growth rate is assumed, the number of embarking and disembarking passengers will amount to 772,000 in 1985.

The frequency of ships commuting between Cebu and Tagbilaran should be increased in the future so as to allow more passengers to commute between the two Provinces. Consequently, the required number of ships should also be increased considering that there will be more sea traffic between Cebu and Tagbilaran.

At present, there is a small passenger terminal on the jetty which is rarely used. With the increase of passengers, a new passenger terminal will be needed and should be built at the end of the causeway and warehouse.

Ships sailing around the Bohol Island are those below 600 G.T. From the point of view of transport efficiency larger sized ships should be used instead. However, the maximum size of ship navigable to the Tagbilaran port is limited by the existence of coral reefs. The sea depth of the channel of the Tagbilaran port is 5.8 m and it can only receive ships up to the maximum size of 2000 G.T.

With the increase of passengers, a Roll-On Roll-Off ferry system should be introduced to sea transport between Cebu and Tagbilaran. However, a large cost will be incurred for the construction of the terminal and the purchase of the ships. If the ferry terminal is constructed at the Tubigon port, it will involve lesser costs as compared to the ferry terminal construction at the Tagbilaran port. In addition, the sailing distance between Cebu and Tagbilaran is much longer than the distance between Cebu and Tubigon. It has been a general pattern that the passengers who commute from Tagbilaran to Cebu first go to Tubigon by bus and then take a ferry from Tubion to Cebu. It is expected that this trend will continue in the future.

2. Jagna Port

The cargo throughput of Jagna Port in the year 1977, 1978 and 1979

is indicated in App. 14-17. Most of the cargoes handled by this port are agricultural products and general merchandise.

The mean monthly throughput during the three years 1977, 1978 and 1979 are as follows:

	Mean Monthly Cargo Throughput	Estimated Annual Tonnage
1977	4,109 tons	49,000 tons
1978	2,184 tons	26,000 tons
1979	2,029 tons	24,000 tons

The quantity of cargoes handled by the Jagna port is not large, and the volume had been declining in the past few years. However, the cargo to be handled by this port may increase as the development of the Bohol Province and improved trade relations with Mindanao is effectuated in the future.

A reliable estimate of the yearly growth rate of the port's cargo throughput cannot be made from the above table alone. However, a 4% growth rate for the Jagna port can be estimated on the basis of comparison with the growth rate of Tagbilaran.

The Jagna port has a 100 m long jetty which can accommodate two ships at one time. Ships dock at this port usually for 3 to 20 hours. The number of ships calling at this port is indicated in App. 14-15, item (2). From that table, the annual number of ships docking at the port for the years 1977, 1978 and 1979 are estimated as follows:

1977 - 800 ships
1978 - 552 ships
1979 - 542 ships

Since the port's berth can adequately receive the incoming ships, there will be no need for extending the jetty farther. Ships presently do not have to wait for their turn to berth at the port.

With the assumption that this port's annual growth rate of cargo throughput and incoming ships is 4%, by 1985, the volume of cargo and number of ships that must be handled by the Jagna port would increase to 61,000 tons and 1,013 ships respectively. This increase does not necessarily require an extension of the port's jetty. In the year 1990 and beyond, however, the jetty will have to be extended.

Presently, the port's jetty is partially damaged and should be repaired immediately, considering the rapid increase of the port's passenger traffic. The passenger traffic at the Jagna port for the years 1977, 1978 and 1979, are indicated in App. 14-18.

From this table, the total annual number of embarking and disembarking passengers for the years 1977, 1978 and 1979 are estimated as follows:

Annual Number of Passengers
for the year 1977 ..... 200,500 passengers

Annual Number of Passengers
for the year 1978 ..... 187,450 passengers

Annual Number of Passengers
for the year 1979 ..... 222,500 passengers

The growth rate of the number of passengers is estimated per annum to be 5%. According to the 5% growth rate, the total number of passengers will increase to 300,000 in 1985 and 380,000 in 1990.

The frequency of ship traffic regularly sailing between Jagna and other ports of call needs to be increased in the future. However, ferry service is not needed for the years to come.

3. Tubigon Port

There is insufficient data available from P.P.A. pertaining to the Tubigon port. Only the data presented in APP. 14-19, item (1).

The annual quantity of cargo handled by this port is estimated to be about 8,100 tons. The 5% annual growth rate of the cargoes can be derived by using the data of the Tagbilaran and Jagna ports as the reference ports.

The cargo throughputs for the year 1985 and 1990 are estimated to be as 11,000 tons and 14,500 tons respectively. With the implementation of the development plan for Bohol, the agricultural products loaded from this port may increase by 32,000 tons per annum. This increase may bring the total cargo throughputs for the year 1985 and 1990 to 43,000 tons and 46,500 tons, respectively.

Such an estimated increase will also cause an increase in the number of ships calling at this port, the estimated number of ships calling at the Tubigon port for the year 1985 and 1990 are estimated to be 827 ships and 894 ships respectively.

The Tubigon port has a jetty 115 m long at the end of the causeway. Four ships can dock at the jetty. And it is believed that the port's berth can adequately serve the ships of this port until 1990.

The number of passengers received by the Tubigon port has considerably increased. The passenger traffic in 1979 is indicated in Table 14.19, item (2). The total number of passengers in 1979 amounts to 218,338 people.

The growth rate of passengers of this port can be estimated at 8.8% calculated from the income elasticity value.

With the use of this growth rate of 8.8%, the annual number of passengers for the year 1985 and 1990 can be forecasted at 361,000

and 552,000 passengers, respectively.

In view of the increase in the number of passengers expected to use this port in the future, a ferry service for the passengers should be put into operation. For this purpose it is advised that a ferry passenger terminal should be constructed in front of the existing passenger and cargo shed near the bank where the port's passenger building and marshalling yard are now being located (Refer to App. 14-20.)

It will take two ferry boats to transport all of the passengers from Tagbilaran, Tubigon and Talibon.

4. Fishery Port of Cogtong Bay

As described in Chapter 10, it is proposed that all the facilities for the fishery industry should be constructed in the vicinity of the municipality of Candijay for the Cogton Bay Fishery Industry Complex Development Program. It is also recommended that the fishery port should be newly built at the south seashore of Cogtong Bay as a part of the Program.

Strong wind generally blows from the northeast or southwest direction in the Cogton Bay area, but the bay is relatively calm and the condition very favorable for the fishing port. The required sea depth for the maximum sized ship is 4.5 m.

The causeway should be constructed in such a manner that it will connect Cogtong Village which Catiil Island. The causeway should be built starting from Cogtong Village, passing through the seashore toward Catiil Island where it ends at the northeast portion of the island. The causeway ends at 500 meters away from Catiil Island, and from there the jetty will be built facing the entrance of the Cogtong Bay.

The slipway to be used for reparing ships will be constructed at the base of the causeway, near Cogtong Village. All the fishing boats will be anchored along the jetty and causeway in Cogtong Bay. The required length of the causeway is estimated to be 3.0 km and the scale of the jetty is 9 m x 60 m.

14.3.4 Development Program of the Ports in Bohol

1. Project Description

Out of the twenty four ports in Bohol, some ports have experienced a significant increase in the volume of cargo and passenger traffic as being affected by the socio-economic development pattern of the island, but there are other ports that have remained less frequently used and been deserted.

The development program of the ports in Bohol was formulated according to the following criteria and principles:

1) High growth potential of sea traffic, i.e., projected demand of cargo and passenger traffic.

2) Strategic selection of the ports which should be developed as an integral component of infrastructure of growth pole or center in Bohol.

3) Importance ascribed to the ports within a network of physical transport system in Bohol.

4) Prioritization of the improvement or development of the ports judged by the objectives or need of Bohol economy.

It is our judgement that the port development program of Bohol should be divided into the following projects:

	Project Objective	Ports
1)	Port Capacity Expansion Projects	Tagbilaran, Tubigon and Jagna
2)	Port Repair Projects	Guindulman and Jetafe
3)	New Port Construction Project	Cogtong Bay Fishing Port
4)	A Long Term Port Development Projects	Ubay and Talibon
5)	Ferry Boat System Development Project	Tubigon

The other ports, which are observed less frequently used, should be studied for an economic evaluation of their cost performance.

2. Objectives of Port Projects

1) Repair and Expansion of Capacity of the Major Ports

As described in the preceding sections, the number of passengers and the quantity of cargo handled by the ports of Tagbilaran, Jagna and Tubigon have remarkably increased. It is expected that this trend will continue in the future.

The further development of the Bohol Province will contribute much to the continuing rapid growth of the volume of passengers and cargo of these ports. A development objectives for these ports should be formulated so that the ports will be able to meet the needs of their increasing users.

2) Introduction of a Ro/Ro Ferry System to Tubigon Port

Such a development plan should include a Roll-on Roll-off (Ro/Ro) Ferry System to transport the passengers from Cebu to Bohol and vice-versa. It is proposed that a Ro/Ro Ferry System should be located at the Tubigon port to facilitate the transportation of passengers commuting from Bohol and Cebu. The construction of the Ro/Ro ferry terminal at the Tubigon port is to be considered an immediate requirement.

The ferry system will need 2 ferry boats to service the growing number of commuters. Passengers bound for Cebu from Talibon, Tagbilaran and elsewhere in Bohol will travel via Talibon (for example, by bus from Tagbilaran to Tubigon, and Talibon to Tubigon) and from Tubigon, the ferry service system will bring them to Cebu. This new route utilizing the bus and ferry system will be considered more economical and less time consuming. One boat (four trips/day) can estimately carry approximately 800,000 passengers from Talibon, Tagbilaran and Tubigon annually. The number of ferry boat using passengers can increase as the frequency of ships commuting between the two provinces increases.

3. Task Components and Schedule for Port Development

The tasks involved for the port development should be accomplished within five years. This five year period will be divided into two stages:

(a) Tagbilaran Port

First stage: Repairing of Fender

Construction of a Warehouse (40 m x 60 m)

Construction of a Jetty (120 m x 50 m)

Construction of two sheds on Jetty (30 m x 40 m)

Construction of a Passenger Terminal (30 m x 20 m)

Second stage: Construction of two Warehouses (40 m x 60 m)

Construction of a shed on Jetty (30 m x 40 m)

(b) Jagna Port

First stage: Reparing of Jetty

Reparing of Warehouse (30 m x 50 m)

Construction of Passenger Terminal (30 m x 20 m)

The extension of the Jetty will be considered as a ten-year plan.

(c) Tubigon Port

First stage: Dredging

Construction of Fenders

Construction of Warehouse (30 m x 40 m)

Second stage: Construction of Ro/Ro Ferry Terminal
- Two ferry boats should be provided for.

The widening of the causeway and the jetty will be part of the future long-term program.

(d) Guindulman Port

Second stage: Repairing of Jetty

(e) Jetafe Port

First stage: Repairing of Jetty

(f) Cogtong Fishery Port

First stage: Construction of Causeway (3,000 m)

Construction of Jetty and Slipway (9 m x 60 m)

For the smooth operation of cargo handling, at least two forklifts and four trucks should be provided in to the jetties of Tagbilaran, Tubigon and Jagna. Navigation aids must be considered to be built in addition to the above facilities.

The implementation schedule of the projects mentioned above is indicated in Table 14.4 including the medium and long term projects.

14.3.4 Cost Estimates

The estimated costs for the construction and repair of the facilities mentioned above is shown in Table 14.5. The total budget needed for the construction and repair is ₱109,380,000. The standard unit costs for the estimation is also shown in Table 14.6.

Table 14.4 Schedule of Construction and Repair of Port Facilities

NAME OF PORT	WORK OBJECTIVE	DEVELOPMENT TERM			
		SHORT (1980-1985)		MEDIUM	LONG
		FIRST STAGE	SECOND STAGE	1985–1990	1990–2000
Tagbilaran	Fender Repair				Containerization of Port Facilities
	Warehouse Construction	(1)	(2)		
	Jetty Construction	(1)			
	Shed Construction	(2)	(1)		
	Passenger Terminal Construction	(1)			
Jagna	Jetty Repair	(1)			Ro-Ro Ferry Terminal
	Warehouse Repair	(1)			
	Passenger Terminal Construction	(1)			
	Jetty Extension			(1)	
Tubigon	Dredging				
	Fender Construction				
	Warehouse Construction	(1)			
	Construction of Ro-Ro Ferry Terminal				
Guindulman	Jetty Repair				
Jetafe	Jetty Repair				
Cogtong (Fishery Port)	Causeway Construction	(1)			
	Jetty Construction	(1)			
	Slipway Construction	(1)			

Note: (1) ( ) ..... Indicates number of facilities
(2) Navigation aids are not considered on this table

Table 14.5 Budget for Port Construction and Repair (Short Term)

Name of Ports	Work Objective	Cost (Peso x10³) First stage	Cost (Peso x10³) Second stage	Note
Tagbilaran	Fender	216		() indicate the number of facilities.
	Shed (3)	1,920	960	
	Warehouse (3)	1,800	3,600	
	Jetty (1)	18,200	-	
	Passenger Terminal (1)	600	-	
Sub-Total		22,736	4,560	
Jagna	Jetty (repair)	284		
	Warehouse (1)	900		
	Passenger Terminal (1)	600		
Sub-Total		1,784	0	
Tubigon	Dredging	700		
	Fender	216		
	Warehouse (1)	900		
	Ro-Ro Ferry Terminal		10,300 (Infra.) 38,500 (Ferry)	Based on the draft final report prepared by Renardet-Sauti-Ice
Sub-Total		1,816	48,800	
Guindulman	Jetty	-	53	
Jetafe	Jetty	210	-	
Sub-Total		210	53	
TOTAL		26,546	53,413	
Cogtong Fishery Port	Causeway	16,140	-	
	Jetty (1)	1,640	-	
	Slipway (1)	100	-	
TOTAL		17,880	-	
Others:				
Cargo Handling Equipment		1,320	1,320	
Engineering Fee		6,664	2,237	About 15% x Total amount of cost (Except Ferry)
Total		7,984	3,557	
GRAND TOTAL		52,410	56,970	
		109,380		

Note: Construction Costs were estimated through the unit costs supplied by M.P.W. except for the ferry and ferry terminal.

Table 14.6 Unit Cost for Port Construction

Warehouse	₱ 750.00/sq.m
Shed	800.00/sq.m
Fender piles cluster	
5 piles	15,000.00/each
6 piles	18,000.00/each
Mooring bitt with bolts	4,000.00/each
Mooring cleats with bolts	2,500.00/each
Cement	30.00/bag
Sand	50.00/cu.m.
Gravel	50.00/cu.m.
Rubble	50.00/cu.m.
Class-I rock, 400 - 1000 kg	80.00/cu.m.
Class-II rock, 200 - 399 kg	70.00/cu.m.
Class-III rock, 50 - 100 kg	60.00/cu.m.
Concrete	390.00/cu.m.
Pile driving	1,200.00/each
Passenger terminal	600.00/sq.m.
Reinforced concrete pier:	
6 m wide	14,000.00/lin.m.*
9 m wide	21,000.00/lin.m.*
12 m wide	28,000.00/lin.m.*

* Based on the report prepared by NEDA.
The source of all other data above is M.P.W.

14.4 Airport Development Plan

14.4.1 General Consideration for Airports in Bohol

Transportation of passenger, goods and materials from Bohol island to other islands mainly relies on sea and air transportation.

There are two existing airports in Bohol. One is a secondary airport (Tagbilaran Airport) and the other (Ubay Airport) is a feeder airport. YS-11 one-way flights have been operating between the Mactan and Tagbilaran Airports at a frequency of 4 times a week. In 1974, there was a scheduled daily flight to and from Cagayan de Oro City, but the operation stopped. The Ubay airport is not paved and used occasionally by chartered flights and for emergency purposes.

Tagbilaran airport has a concerete paved run-way (1050 m x 30 m), it is still in good condition, but at least a 1200 m extention is required.

Considering the actual situation of the airports stated above, and the expected increase in the number of passengers due to the island's development, plans to develop and repair the facilities of these airports should be given serious consideration and implemented for the future expansion program of Bohol.

14.4.2 Analysis of Current Airport Problems and Trends

1. Present Condition

Tagbilaran Airport (secondary airport): Tagbilaran airport is situated 2 kimometers north from the center of Tagbilaran City. It has a concrete paved runway (1050 m x 30 m) constructed in 1966. It is still in good condition.

During the period 1974 to 1975, the Tagbilaran Airport had two (2) scheduled daily flights: one flight daily to and from Cebu City and Cagayan de Oro City respectively. There were not enough passengers, so operations between the Tagbilaran and Cagayan de Oro airports were stopped. Daily flight operations between Tagbilaran and Cebu continued up to the early part of 1976 (one flight daily). However, frequency of flight was determined by the number of passengers. In 1977, there were five flights a week, to and from Cebu City. This was reduced to three in 1978 and then increased to four in 1979. At present, YS-11 single flights have been operating between the Mactan and Tagbilaran airports at an interval of 4 times a week. A slight increase of the number of airport passengers can be attributed to the operations between the ports (seaports) of Tagbilaran and Cebu. The distance between the two ports is short (about 40 miles). Boat fares (first class) cost three times less than plane fares and travelling time is only three to four hours.

Therefore, at present, a larger number of passengers have been commuting between Cebu and Bohol by ships sailing to and from

the two provinces. Only a few foreign tourists, businessmen and others, travel by plane.

Ubay Airport (Feeder Airport): Since Ubay airport is used only occasionally by chartered flights and for emergency purposes, it is not considered vital to the overall development of Bohol.

The present airport facilities on Bohol are as follows:

	Tagbilaran Airport	Ubay Airport
Coordinates Location	0939 N 12351 E	1003 N 12428 E
Runway (m)	1050 x 30	1475 x 30
Surface of Runway	Concrete	Gravel
Stopway (m)	121 x 100	65 x 196
Strength of Runway (kg/auw)	34,318/1 45,590/2	13,609/1 17,009/2
Clearway (m)	142 x 315	65 x 196
Apron (m)	150 x 40	

Number of Passengers Travelling Between Cebu and Tagbilaran for the Past Five Years:

Years	Cebu to Tagbilaran	Tagbilaran to Cebu
1975	No data	6,866
1976	7,311	7,181
1977	7,281	7,149
1978	7,808	8,242
1979 (January to June)	4,409	4,751

2. Present Situation in the Vicinity of Tagbilaran Airport

The Tagbilaran Airpot is situated about two kilometers from the center of Tagbilaran City. It lies parallel to the North and South direction. Both North and South ends of the runway are only about 500 meters away from settlements and buildings. As winds blow from north to south, the aircrafts have to approach from the city side. This factor, together with insufficiency of the approach distance makes the airport dangerous. The use of the jet planes will create the problem of sound pollution. Therefore, the airport must be transferred to Panglao Island in the distance future.

3. Forecast of Air Passenger Demand

The volume of air passenger traffic with increase together with the increase in economic activities of Bohol. The gross domestic product is one of the indicators of such economic activities.

Taking into consideration the growth rate of GDP of Bohol and the forecast growth rate, the future growth rate of air passenger demand is assumed to be as follows:

Year	Annual Growth Rate	Number of Passengers
1979	12%	18,300
1985	15%	31,476 (est.)
1990	18%	55,083 (est.)
2000		104,658 (est.)

14.4.3 Airport Planning Objectives and Target Variables

To be able to meet the future increase of demand for air transportation, improvements and extensions of the existing airport facilities of Tagbilaran should be undertaken.

Taking the current problems of the existing airports into consideration, the following objectives will be set-up:

1. Objectives

1) To extend and improve basic airport facilities

Runway	1,200 m x 30 m (35 m includes shoulders)
Apron	2 - berths

2) To extend the terminal area

Passenger Terminal Building	200 m^2
Cargo Terminal Building	20 m^2
Parking Area	200 m^2

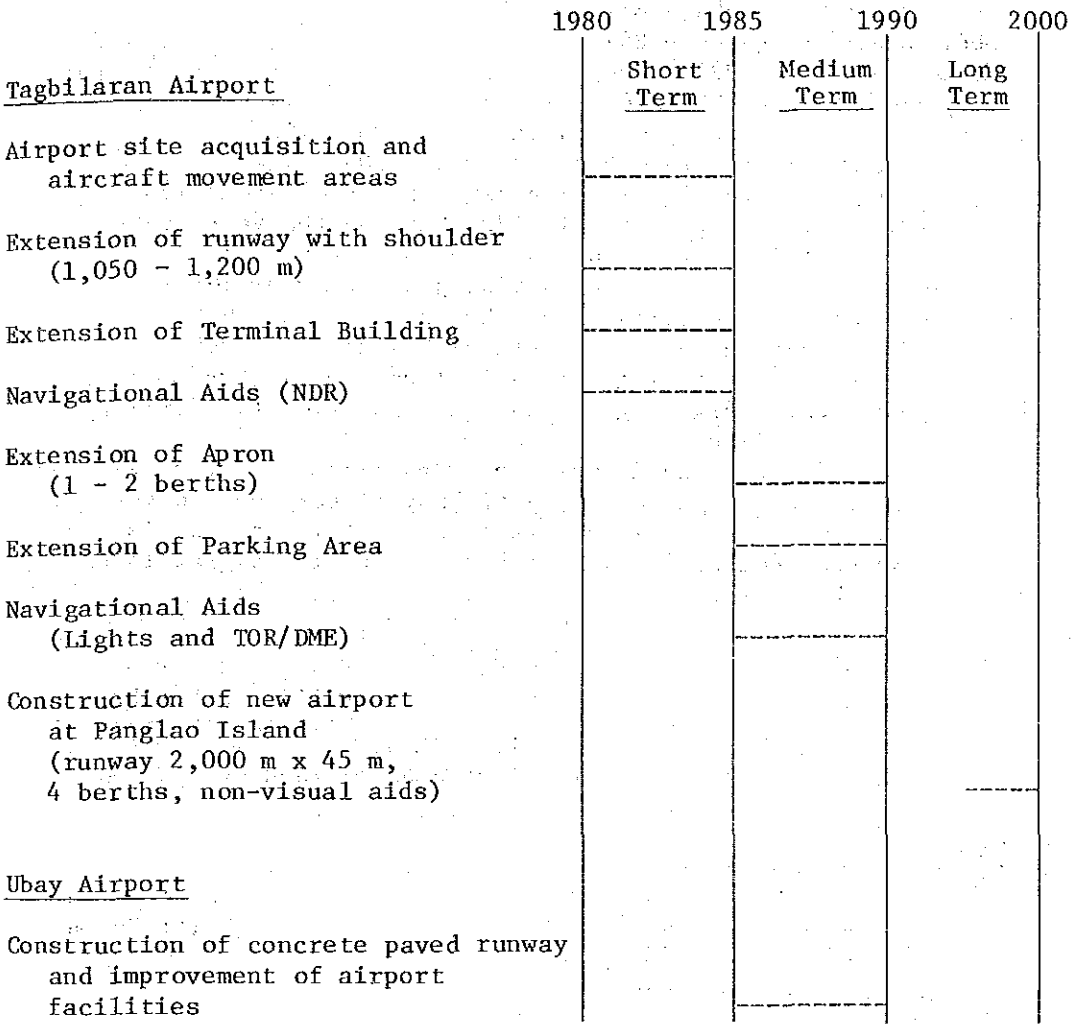
3) To provide navigational aids

NDB	(Non-Directional Radio Beacon)
VOR/DME	(VHF Omnidirectional Radio Range Distance Measuring Equipment)
Lighting	(Runway lights, runway threshold, approach lights)

4) To provide other supporting facilities

Storm drainage system, potable and fire fighting water supply, sanitary sewer disposal system)

Table 14.7 AIRPORT PROJECT TARGET (1980 - 2000)



2. Target

In order to achieve the objectives mentioned projects were scheduled in terms of importance for the following three target years (see Table 14.7).

Short term - (1980 - 85)
Medium term - (1985 - 90)
Long term - (1990 -2000)

- To extend the runway by the year 1985
- To provide navigational aids (NDB) by the year 1985
- To extend the terminal building by the year 1985
- To extend the apron (2 berths) by the year 1990
- To provide lighting and navigational aids (VOR/DME) by the year 1990
- To construct paved runway of Ubay airport by the year 1990
- To construct a new Tagbilaran airport in Panglao Island by the year 2000

Runway	2,000 m x 45 m	
Apron	4 berths	(BAC 111 - 2 berths, YS-11 - 2 berths)
Navigational Aids	ILS (Instrumental Landing System)	

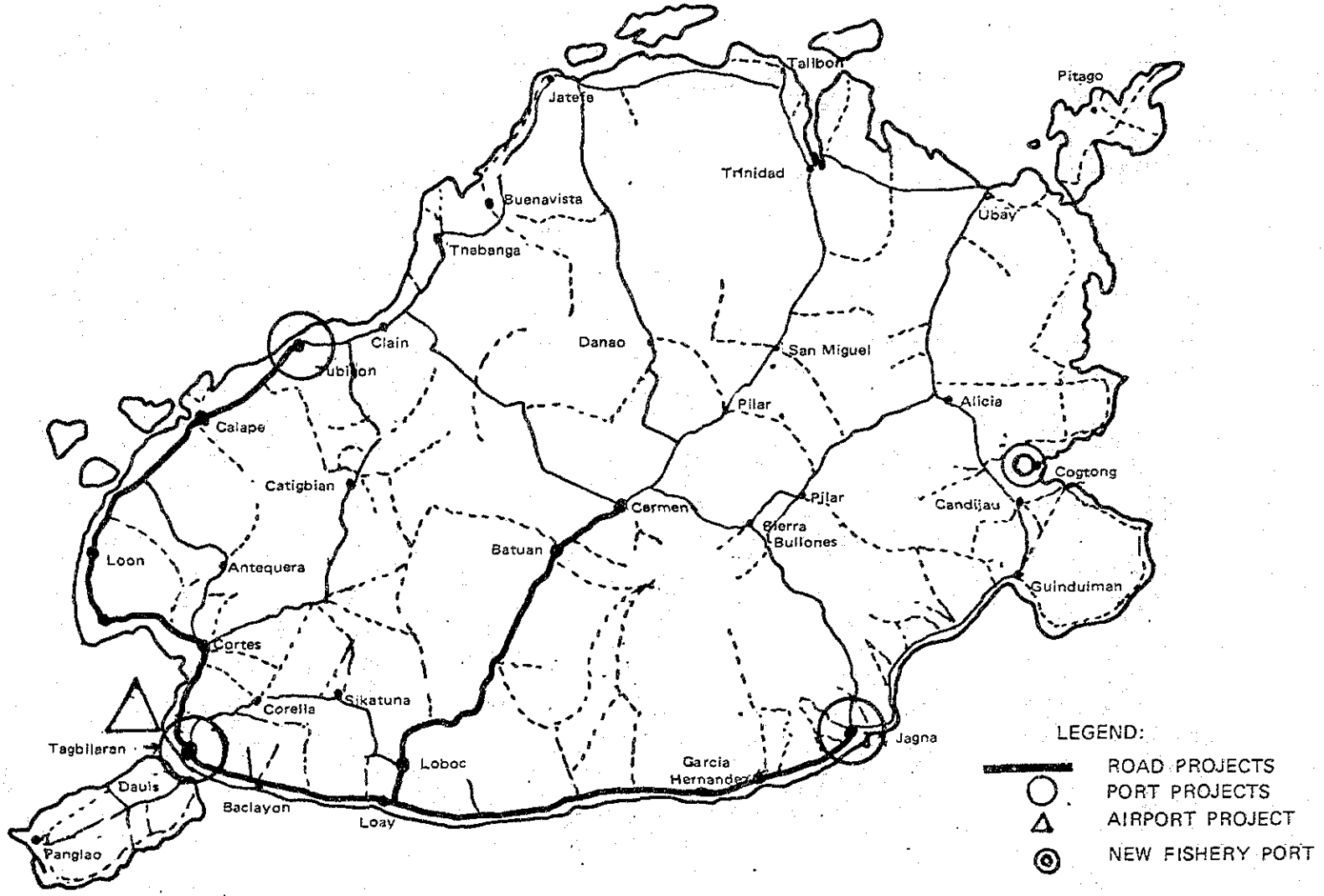
14.4.4 Airport Development Program

1. Short term Program (1980 - 85) (Unit: Pesos)

1)	Airport site acquisition		
	100 m x 150 m x ₱ 50	=	750,000
2)	Extension of Runway (150 m)		
	Earth work	=	20,000
	Clearing & Grubbing 1.5 ha. x ₱ 10,000	=	15,000
	Base and Sub-base 3,000 m^3 x ₱ 50 Course	=	150,000
	Concrete 35 m x 150 m x ₱ 300	=	1,575,000
	Sub Total	=	1,760,000
3)	Navigational Aids (NDR)	=	1,500,000
4)	Extension of Terminal Bldgs. 220 m^2 x ₱1,500	=	330,000
	Total Cost		4,340,000

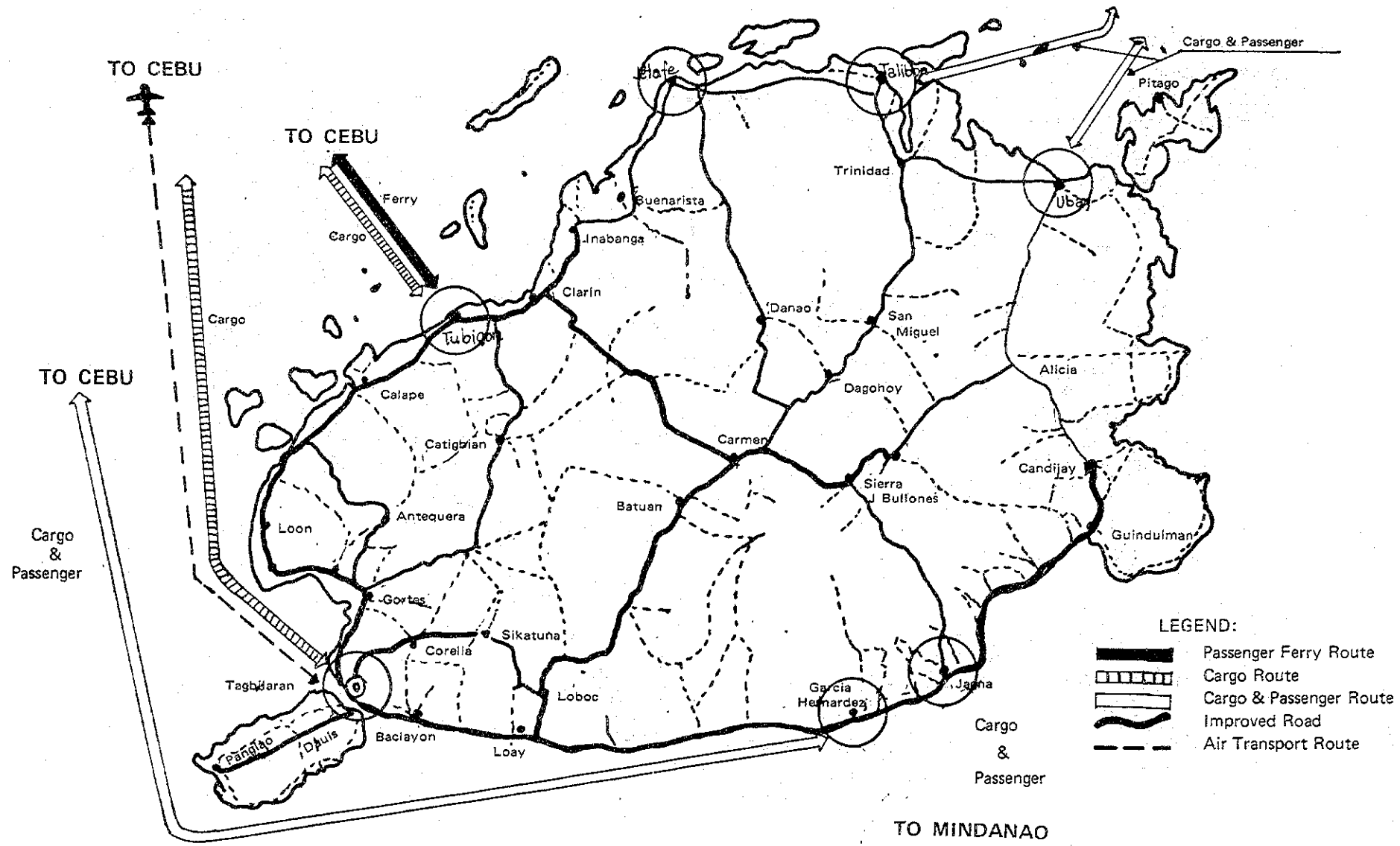
APPENDIX

HIGH IMPACT TRANSPORTATION PROJECTS (1980–1983)



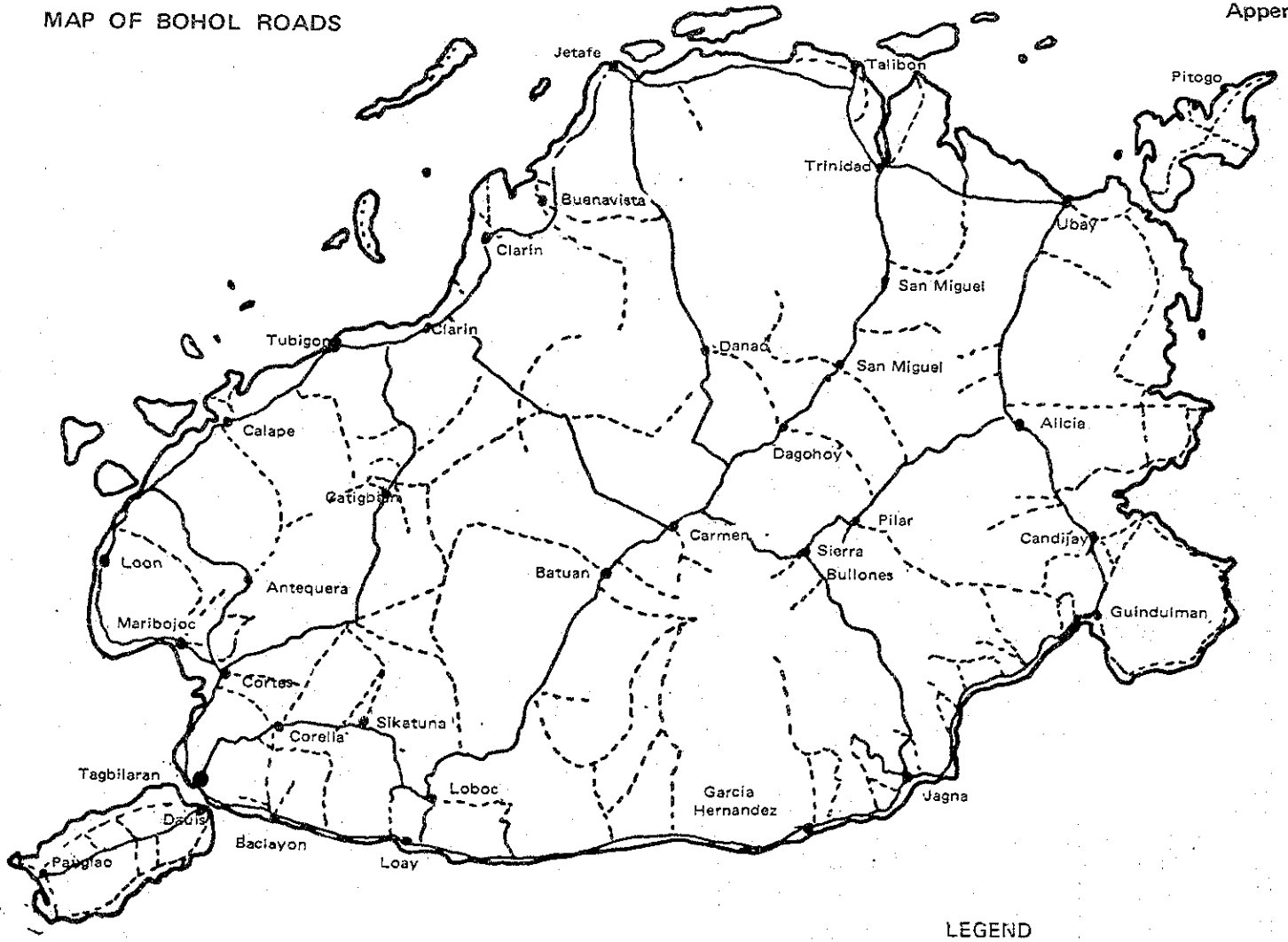
Appendix 14-2

TRANSPORTATION NETWORK FOR 1985



MAP OF BOHOL ROADS

Appendix 14-3



CARGO THROUGHPUT AND PASSENGER TRAFFIC AT TUBIGON PORT

(1) CARGO THROUGHPUT (IN 1977)

(UNIT: Ton)

Month / Item	Jan.	Feb.	Mar.	Apr.	May	June
Discharged & Loaded	404	581	950	777	825	504

(2) PASSENGER TRAFFIC (IN 1979)

Month / Item	Jan.	Feb.	Mar.	Apr.	May	June
Arrivals	4,886	11,025	8,847	13,011	5,992	6,529
Departures	5,076	11,052	9,197	11,283	14,331	7,970
Monthly Total	9,932	22,077	18,044	24,924	20,323	14,499

Source: Philippine Port Authority, Cebu

Appendix 14-6

EXISTING BRIDGES IN BOHOL (1978)

	Concrete Bridge		Steel Bridge		Bailey Bridge		Timber Bridge		TOTAL	
	Number	Total Length (m)	Number	Total Length (m)	Number	Total Length (m)	Number	Total Length (m)	Number	Total Length (m)
1st Engineering District	57	866.5	6	330.2	10	249.8	11	71.8	84	1,517.8
2nd Engineering District	50	975.7	3	141.2	38	725.6	17	238.1	108	2,801.6
Bohol Province (Total)	107	1,843.2	9	471.4	48	975.4	28	309.4	192	3,599.4
Percentage (%)	55.7	51.2	4.7	13.1	25.0	27.1	14.6	8.6	100	100

Source: Office of Highway District Engineer, 1st and 2nd Engineering District, Bohol

Appendix 14-7

MAINTENANCE COST FOR NATIONAL ROADS

	Total Length of National Roads (km)	Equivalent Maintenance Kilometer (km)	Maintenance Cost Pesos/EMK (P/EMK)	Annual Maintenance Cost (Million P)
First Engineering District	311.0	389.8(est)	11,342	4.4
Second Engineering District	260.6	326.6	11,842	3.7
Bohol Province (Total)	571.6	716.4		8.1

Source: Office of Highway District Engineer, 1st and 2nd Engineering District, Bohol.

Appendix 14-8

VEHICLE REGISTRATION DATA, BOHOL

Year	Cars	Jeepneys	Vans	Buses	Trucks	Total Motor Vehicles	Tricycles and Motorcycles
1970	783	3	44	231	414	1,475	1,844
1971	763	10	35	226	547	1,581	1,971
1972	1,096	0	41	263	713	2,113	2,722
1973	891	1	47	267	552	1,758	2,669
1974	803	95	56	294	744	1,992	2,661
1975	793	132	50	196	725	1,896	2,657
1976	815	133	60	154	442	1,604	2,724
1977	1,311	54	103	62	810	2,340	3,265

Source: Bureau of Land Transportation, (BLT), Bohol

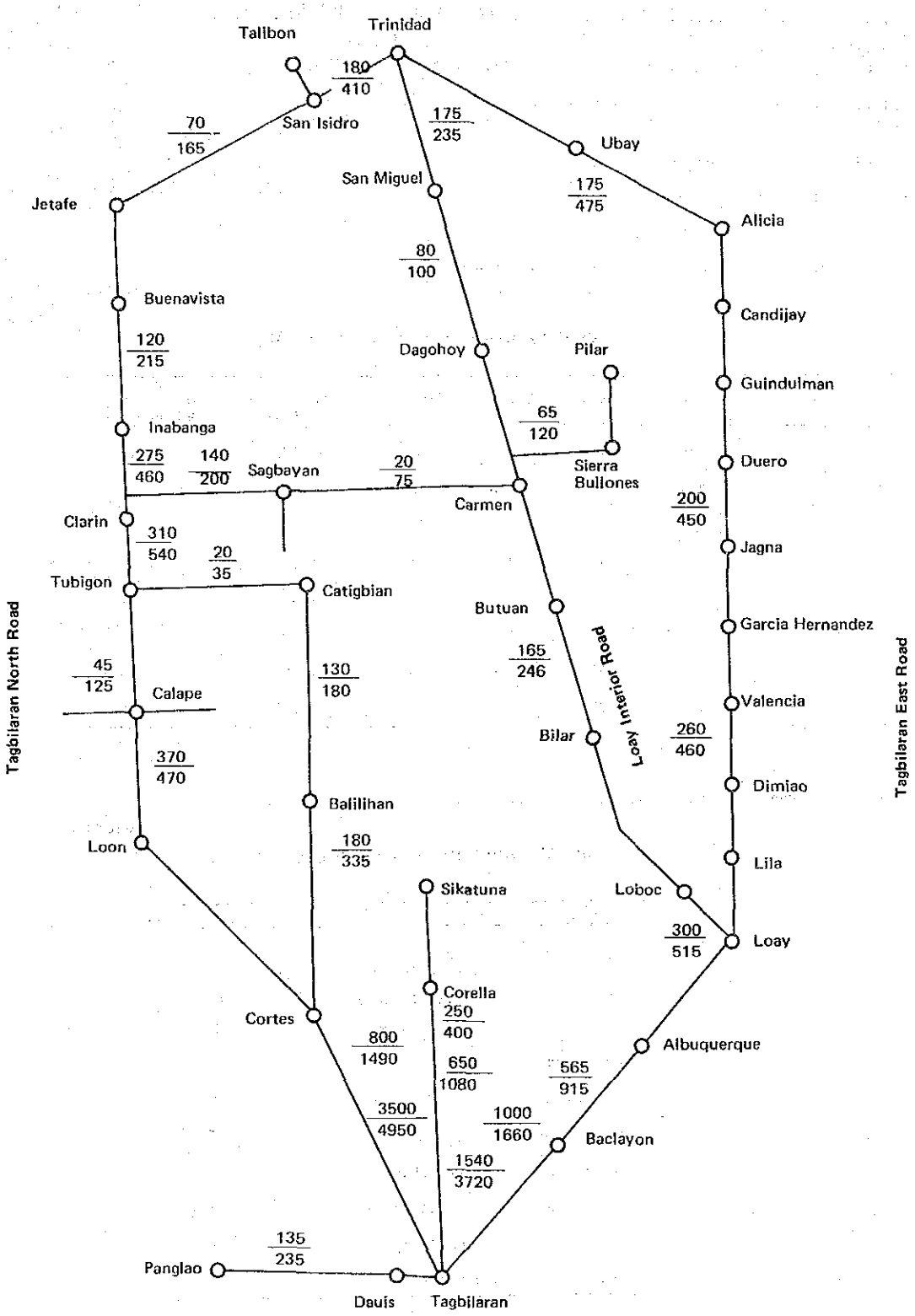
Appendix 14-9

PUBLIC TRANSPORT SERVICE ROUTES IN BOHOL

From	To	Distance (km)
Tagbilaran	Jetafe (via Tubigon & Jetafe)	122
	(via Carmen)	139
	(via Jagna & Ubay)	98
Tagbilaran	Jetafe	92
Tagbilaran	Clarin	61
Tagbilaran	Loon	27
Tagbilaran	Catigbian	34
Guindulman	Tagbilaran	84
Guindulman	Candijay	7
Jetafe	Talibon	21

Source: IBRD Road Feasibility Study Report (1979)

ANNUAL AVERAGE DAILY TRAFFIC (AADT) 1978



Notes: $AADT_1$ – Excludes Motorcycles and Tricycles

$AADT_2$ – Includes Motorcycles and Tricycles

ESTIMATED ANNUAL AVERAGE DAILY TRAFFIC (1984) (Part 1)

MAJOR ROAD SECTIONS	ACCUMULATED KILOMETER		1984 $AADT_1$	$ADDT_2$
Tagbilaran - Tagbilaran	Km	2.2	2,100	5,905
Tagbilaran - Baclayon	Km	7.7	1,350	2,270
Baclayon - Loay	Km	18.7	745	1,215
Loay - Jagna	Km	64.1	370	650
Jagna - Guindulman	Km	86.1	295	650
Guindulman - Trinidad	Km	138.8	245	665
MINOR ROAD SECTONS				
Tagbilaran - Tagbilaran	Km	(2.5)	880	1,485
Tagbilaran - Corella	Km	(7.9)	270	540
Corella - Sikatuna	Km	(6.1)	70	110
Jct. of Road 6 - Dauis	Km	(1.1)	415	1,310
Dauis - Panglao	Km	(14.0)	180	315
Loay - Loboc	Km	(5.3)	435	715
Loboc Jct. - Sierra Bullones	Km	(37.6)	225	335
Jct. Sierra Bullones - San Miguel	Km	(16.8)	95	140
San Miguel - Trinidad	Km	(19.2)	240	325
Carmen - Sagbayan	Km	(17.8)	105	105
Sagbayan - Bacane	Km	(10.6)	205	275
Carmen - Pilar	Km	(15.7)	95	170

Notes: a- Kilometers measured from project zero chainage
b- ( ) - Section Length
c- $AADT_1$ - Excludes Motorcycles and Tricycles
d- $AADT_2$ - Includes Motorcycles and Tricycles

Source: IBRD Road Feasibility Study Report. (1979)

ESTIMATED ANNUAL AVERAGE DAILY TRAFFIC (1984) (Part 2)

MAJOR ROAD SECTIONS	ACCUMULATED KILOMETER		1984 $AADT_1$	$AADT_1$
Tagbilaran - Tagbilaran	Km	3.0	3,180	6,380
Tagbilaran - Jct. Cortes	Km	8.9	1,060	1,980
Jct. Cortes - Tubigon	Km	54.0	490	620
Tubigon - Jct. Carmet	Km	62.8	430	760
Jct. Carmen - Inabanga	Km	71.9	375	635
Inabanga - Buenavista	Km	83.6	170	310
Buenavista - Jct. Talibon	Km	83.6	105	245
Jct. Talibon - Trinidad	Km	121.9	260	580
MINOR ROAD SECTIONS				
Jct. Tagbilaran - Baliliban	Km	(13.3)	235	445
Baliliban - Catigbian	Km	(13.1)	170	240
Catigbian - Jct. Tubigon	Km	(13.9)	30	45
Jct. Tubigon - Pangangan	Km	(15.2)	60	170
Sagbayan - Kabasakan	Km	(5.1)	25	20

Notes: a- Kilometers measured from project zero chainage
b- ( ) - Section Length
c- $AADT_1$ - Excludes Motorcycles and Tricycles
d- $AADT_2$ - Includes Motorcycles and Tricycles

Source: IBRD Road Feasibility Study Report (1979)

SEA TRANSPORT NETWORK MAP OF BOHOL

Appendix 14-13