CHAPTER 2

OUTLINE OF THE PORT OF SAN FERNANDO

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2-1 General Outlook

The Port of San Fernando is located in the southwestern part of San Fernando, La Union in northwestern Luzon. San Fernando Port is situated in the southwestern corner of San Fernando Bay. Much of the Bay has a satisfactory depth of more than –10 m, extending from the harbor entrance for about 3 km, almost to the bay's head, and wide enough to make the coming and going of large vessels an easy matter. Though large shallow areas consisting of coral reefs are found on its east and west sides, the bay's mouth is about 750 m in width between the reefs.

A small cape juts out, forming the western side of San Fernando Bay, and most of the protruding area is reserved for US military use and the VOA broadcasting station.

There are two small rivers or creeks flowing into the Bay, but those two rivers do not have any serious influence on the marine condition of San Fernando Bay and no dredging work will be needed to protect the navigation channel and anchorage from littoral drift.

The soil conditions are generally good for constructing port and harbor facilities, although relatively soft mediocre strata have been found in the recent geological survey.

Marine conditions are generally good, but during the monsoon/typhoon season high waves enter directly into the basin and berthing areas because there is no breakwater at the Port of San Fernando. Therefore it is difficult to secure safe berthing and cargo handling during high waves. Some vessels are forced to move temporarily out of the berthing areas.

Though San Fernando is a small town with a population of about 68,000, it is the capital of the province of La Union as well as the regional center of Region I. The area around San Fernando Bay is divided between residential, commercial and agricultural uses.

The Port of San Fernando is the premier port in northwestern Luzon and it is the only important terminal for sea transportation in Region I. The port is used to export mining products and cement which are produced and manufactured in the region. Besides these cargoes the Port of San Fernando is used for exporting and importing other commodities as well as for domestic transportation. The cargo volume handled at the Port was about 1,000,000 tons in 1982. The comprehensive socio-economic features of Region I have already been described in Chapter 1. They include demographic, economic, and other relevant profiles of the region.

The Port supports the regional socio-economic activities of Region I, which can be defined as the hinterland of the Port of San Fernando as stated in Chapter 4. From the topographic, geographic and socio-economic points of view, San Fernando has the potential for more vigorous port activities in future.

2-2 Port and Harbor Facilities

The San Fernando Port has three main piers, the PPA pier, the Shipside pier and the Philex pier. (The PNOC pier is now under construction inbetween the PPA and the Philex piers.)

2-2-1 Present conditions of the piers

(1) PPA pier

This pier was constructed in 1952. It has a reinforced concrete structure 200 m long and 19 m wide, an 80 m long causeway, and a marginal wharf 30 m long. The depth of the water is –5 m at the shore end and –15 m at the seaward end. PMU San Fernando controls and operates the port area including three warehouses (1,180 m^2) and an open storage area (34,000 m^2).

(2) Shipside pier

This private pier is supposed to have been built in about 1960. It is a timber pier 259 m long and 24 m wide. However the pier and other facilities, such as warehouses, were severe damaged by the typhoon in 1982. The water depth is –8 m at the shore end and –15 m at the seaward end. Shipside Incorporated was granted the development rights on a 19 hectar portion of the US military reservation at Poro in 1960 by the government of the Philippines and the United States of America. The Development Grant Rights will expire in 1985 and the whole area including the existing pier is supposed to be available for future port development.

(3) Philex pier

This private pier is 200 m long with a water depth of –8 m at the seaward end. Philex Mining has a total port area of 34,000 m^2 with four warehouses and an open storage. The pier is mainly used for the loading copper concentrates of the Philex mining company. Other mining companies such as Benguet Consolidated Industries, Inc., Benguet Exploration, Inc., Benguio Gold Mines, Inc., Western Minolco Corporation and Black Mountains, Inc. also load their concentrates through the Philex pier and Shipside pier.

The overall condition of these piers are not necessarily good and the Shipside pier especially is aged and obsolete. Therefore, its maintenance and repair cost will grow to a considerable amount in the next several years.

2-2-2 Cargo handling and other maritime services

Two arrastre/stevedoring companies are undertaking cargo handling operations (loading and unloading) at the PPA and the Shipside piers. They are Northern Carrier Inc. and Shipside Inc. They have some mobile cranes (30 t), trucks (15 t) and two forklifts.

Other maritime services such as pilotage (compulsory), tug assistance (1,100 HP), bunker supply and watering are easily available at the port. Atlantic Gulf and Pacific Company (AG & P), which is located inside the Shipside Inc. compound, keeps a dockyard facility for tending small general cargo vessels and fishing boats.

Other private companies including Shell, Caltex and Petrophil Incs. are also using some parts of the shore areas around the Bay of San Fernando for various purposes.

2-2-3 Port activities

The number of vessels and cargo volumes for the past five years (1978 – 1982) are shown in the following tables. During this period the number of vessels visiting the Port each year ranged from 334 to 702. The number of ocean going vessels remained almost constant at around 130. For domestic trade vessels, the variation was mainly due to fishing boats.

Otherwise the number of domestic trade vessels was relatively stable (Table 2-2-1).

Table 2-2-1 Number of Vessels at the Port of San Fernando, 1978 – 1982

	1978	1979	1980*	1981*	1982
Ocean Going Vessels	136	128	139	119	120
Domestic					
Fishing Boats	0	346	202	83	74
Tankers, G.C. Vessels and others	198	228	163	149	158
TOTAL	334	702	504	351	352

Note: *) Data for 1980 and 1981 lacked one month. Thus, the number of vessels was estimated by multiplying the total ship calls in other months by 12/11.
o Detailed data is shown in Appendix 2-1.

The cargo volume throughput at the Port of San Fernando ranged from 794,000 tons to 1,054,000 tons for 1978 – 1982. Domestic cargo remained almost constant around 450,000 tons, while foreign cargo volume slumped by 200,000 tons in 1979 but went up 220,000 tons in 1980 (Table 2-2-2).

Table 2-2-2 Cargo Volume at the Port of San Fernando, 1978 – 1982

(000 MT)

	1978	1979	1980	1981	1982
Foreign	553	356	575	521*	581
Domestic	463	438	454	377*	473
Total	1,016	794	1,029	898	1,054

Note: *) The data on cargo volume for 1981 lacked one month. Thus, cargo volume for the whole year was estimated by multiplying the total volumes in other month by 12/11.
o Detailed data is shown in Table 5-1-1.

The Port of San Fernando presently has the following defects in its port activities;

(1) Difficulty in securing safe berthing due to high waves during monsoon season (already stated in 2-1 of this Chapter)

(2) Long waiting time of vessels

(3) Shortage of cargo handling equipment

(4) Handling of dangerous cargo at the same pier and at the same time as other cargoes.

When a general cargo vessel loading/unloading fertilizer is berthing, other vessels often have to wait for many days. Because they are transhipping fertilizer to other countries, mainly China, both sides of the pier occupied by vessels for a long time. That is why some vessels are forced to wait at anchor for more than 10 days.

Oil tankers and other vessels are berthing at the same pier at the same time due to the lack of specialized berthing facilities for oil tankers. Such mixed handling of dangerous cargo (oil products) with other cargoes is not favorable from the view point of safety. The above-mentioned shortcomings have to be improved to allow more efficient and economical port activities in the future.

2-3 Port Management Unit

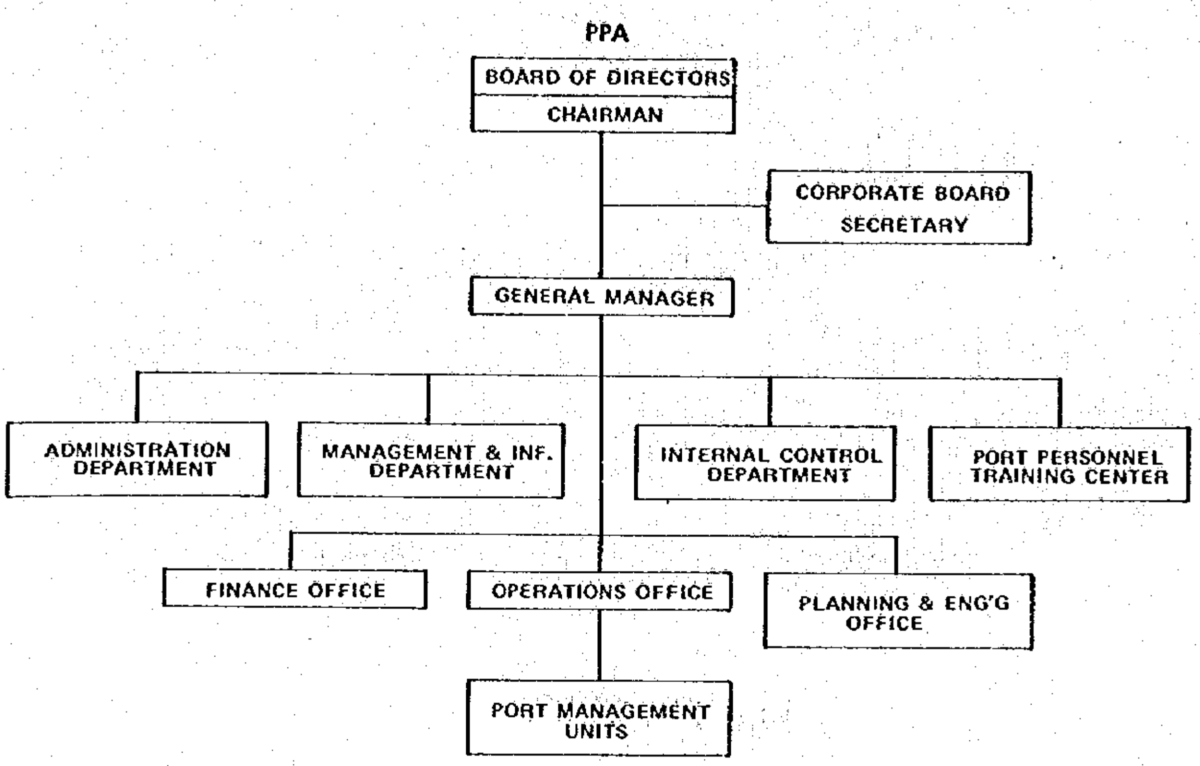
The PPA was created in July 1974 under Presidential Decree No. 505 and subsequently amended by P.D. 857 in December 1975. The PPA has an administrative and operational branch (PMU) in every port district of the Philippines.

The PPA Field Office at San Fernando (PMU San Fernando) is managed and operated by the port manager, under whom there are five main sections;

(1) Port Operations Section
(2) Administrative Section
(3) Port Safety and Security Section
(4) Engineering and Maintenance Section
(5) Finance Section

Organization charts of PPA and PMU San Fernando are shown in Fig. 2-3-1.

PMU San Fernando also supervises the sub-ports, municipal ports and private ports situated in the provinces of Ilocos Norte, Ilocos Sur, La Union, Pangasinan and Zambales. (Fig. 1-5-2)



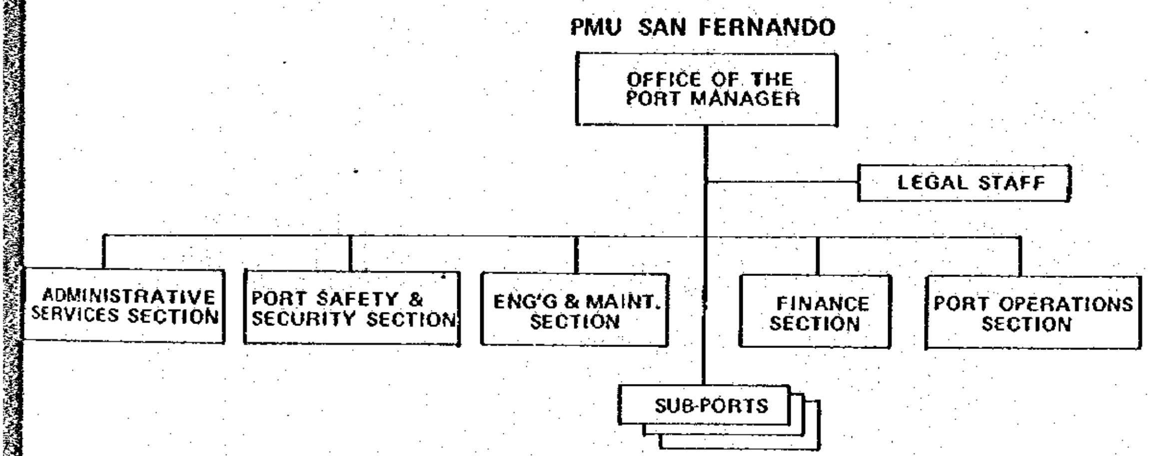


Fig. 2-3-1 Organization Chart of PPA and PMU San Fernando

CHAPTER 3

NATURAL CONDITIONS

CHAPTER 3 NATURAL CONDITIONS

3-1 Geography and Geology

3-1-1 Geography and geology of La Union

The project area is situated in the northwest of Luzon Island and is under the administrative jurisdiction of Region I. The province of La Union, which covers the western part of Region I, is geographically devided into mountainous and coastalplains areas. The mountains, known as the Cordillera Central, are to be found in the eastern part of the province with an altitude of 2,000 m above sea level. Minor rivers, which originate from the mountain ranges, have formed small plains through which they pass before flowing into the South China Sea.

Geologically speaking, the subsoil features of central western Luzon Island are composed of a variety of strata namely jurassic system, palaeogene system, neogene system and quaternary system. Furthermore, the bed rock is composed of a wide range of rocks named sedimentary rock, intrusive rock, metamorphic rock and volcanic rock. The geological map of La Union is shown in Appendix 3-1.

3-1-2 Geography and geology of the San Fernando Bay

San Fernando Bay where the project port is located roughly rectangular has width of approximately 3 km and a depth of 3 km. The mouth of this bay opens to the northwest. The coastal area of this bay can be classified into three zones;

(1) Hilly areas extending along the western side of the Bay and scattered on the east side

(2) Alluvial lowland at the head of the Bay and along its eastern side

(3) Coral reef and sandy seashore

The cape on the west side of the Bay projects westward and is characterized by rolling hills with an elevation of 25 m above sea level. On the east side of the Bay scattered hills rise to a height of around 60 m. The creeks which flow into the Bay at its head and on its eastern side, have helped to built up the surrounding alluvial lowlands from deposits of sand and silt.

The coral reef covers a large area of the west side of the Bay, projecting northeastwards from the shore of the cape, which it vertually surrounds. On the east side of the bay mouth, the coral rises 2 – 15 m to the foot of the hilly area. A sandy beach extends around the head of the Bay.

Geologically speaking, this area is characterized in the strata as follows; most of the alluvial stratum is partially composed of strata from the former half of the tertiary period, and partially of strata from the alluvial and diluvial periods.

The geological map of the Bay is shown in Fig. 3-1-1. The hill on the western cape of the Bay is composed of sandstone. The strata observed in the cliff on the northeast side of the Bay are mainly composed of repeated layers of thoroughly hardened shale, sandstone, and gravelly rock, etc., forming at places strike N – S and dip shift W – E 10°. It is considered that these strata were formed from the oligocene epoch to the miocene epoch in the tertiary period of the cenozoic era.

The cross section of the alluvial lowland along the A-B line in Fig. 3-1-1 is illustrated as shown in Fig. 3-1-2. It is believed that the bearing stratum (cohesive soil) underneath the alluvial lowland was formed in the diluvial epoch and several types of sedimentation overlay this stratum.

This sedimentation lies in the following order (from the bottom); cohesive soil (2), sandy soil (1), sandy soil (2) and cohesive soil (3). Sandy soil (2) forms a natural bank which, extending between the western cape and the head of the Bay, is supposed to have helped the formation of the alluvial lowland behind the Bay.

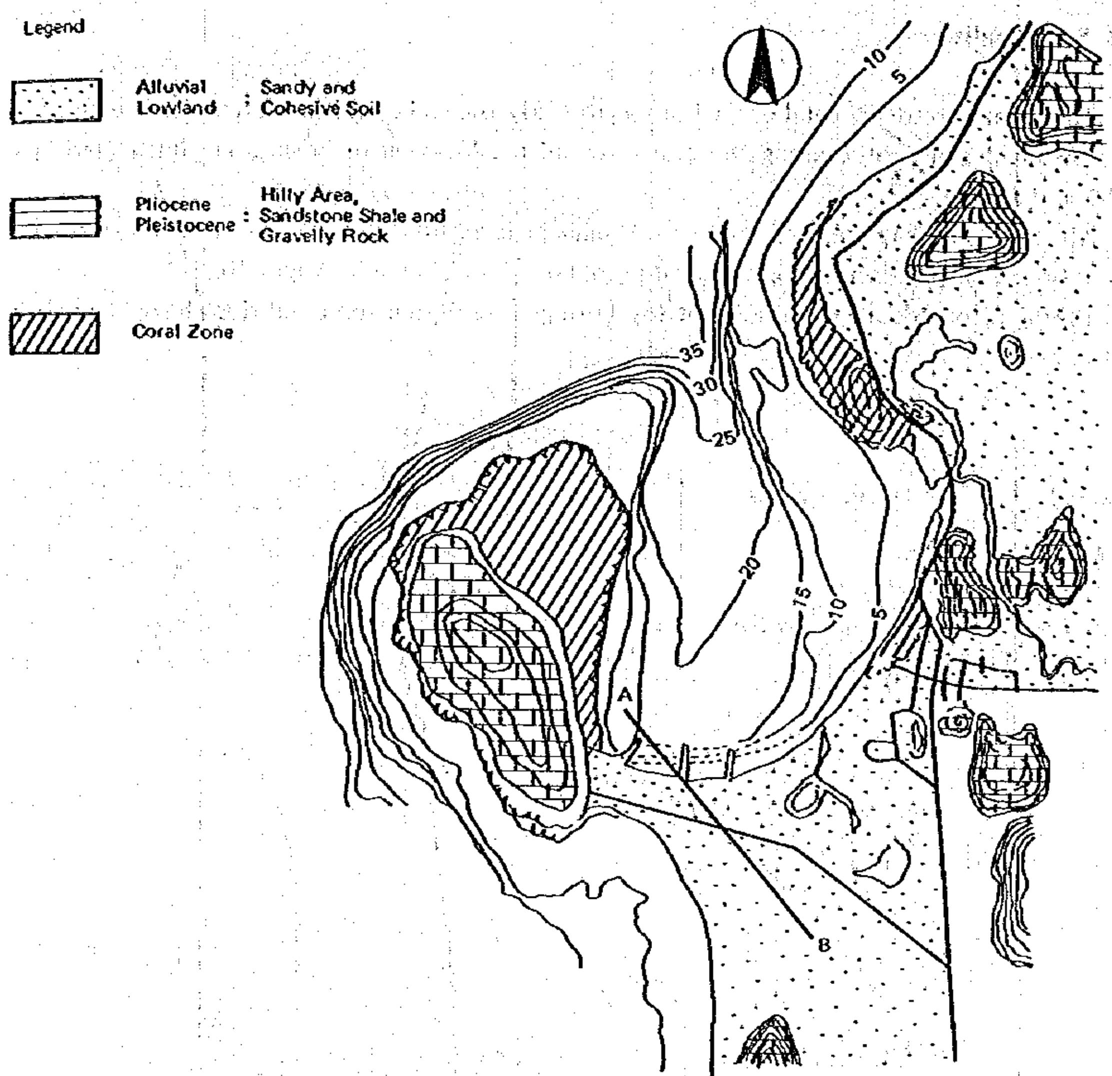


Fig. 3-1-1 Geological Map of the San Fernando Bay

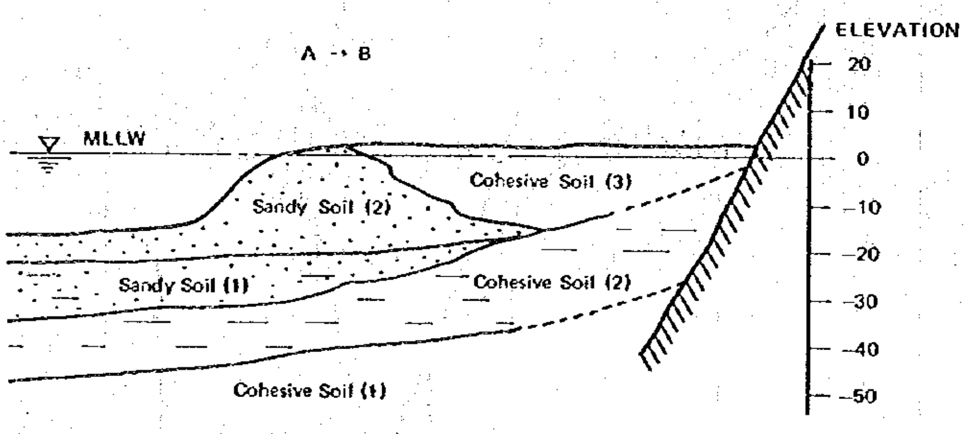


Fig. 3-1-2 Cross Section of the Alluvial Lowland of the A-B Line

3-2 Soil Conditions

The team executed a total of six borings to study the soil conditions around the planning site. The assumed soil profile along the seashore and the location of borings are illustrated in Figs. 3-2-1 and 3-2-2.

All the soil samples were tested in Manila. The results of wet unit weight (γt-value) and unconfined compression strength (qu-value) obtained are shown in Appendix 3-2.

Taking into account the results of the borings, the design soil conditions have been assumed as follows;

Legend	Soil Characteristics	Elevation (m)	Internal Friction/ Cohesion	Wet Unit Weight (t/m^3)
As 2	Fine sand	MLLW -5.0 ~ -13.0	$\phi = 20°$	1.65
As 1	Silty sand	MLLW -10.0 ~ -32.0	$\phi = 25°$	1.75
Ac 2	Sandy silt and silty clay	MLLW -10.0 ~ -45.0	$C = 0.0075 Z + 0.3$	1.65
Dc 1	Silty clay	MLLW -15.0 ~ -50.0	$C = 0.0425 Z + 0.3$	1.75

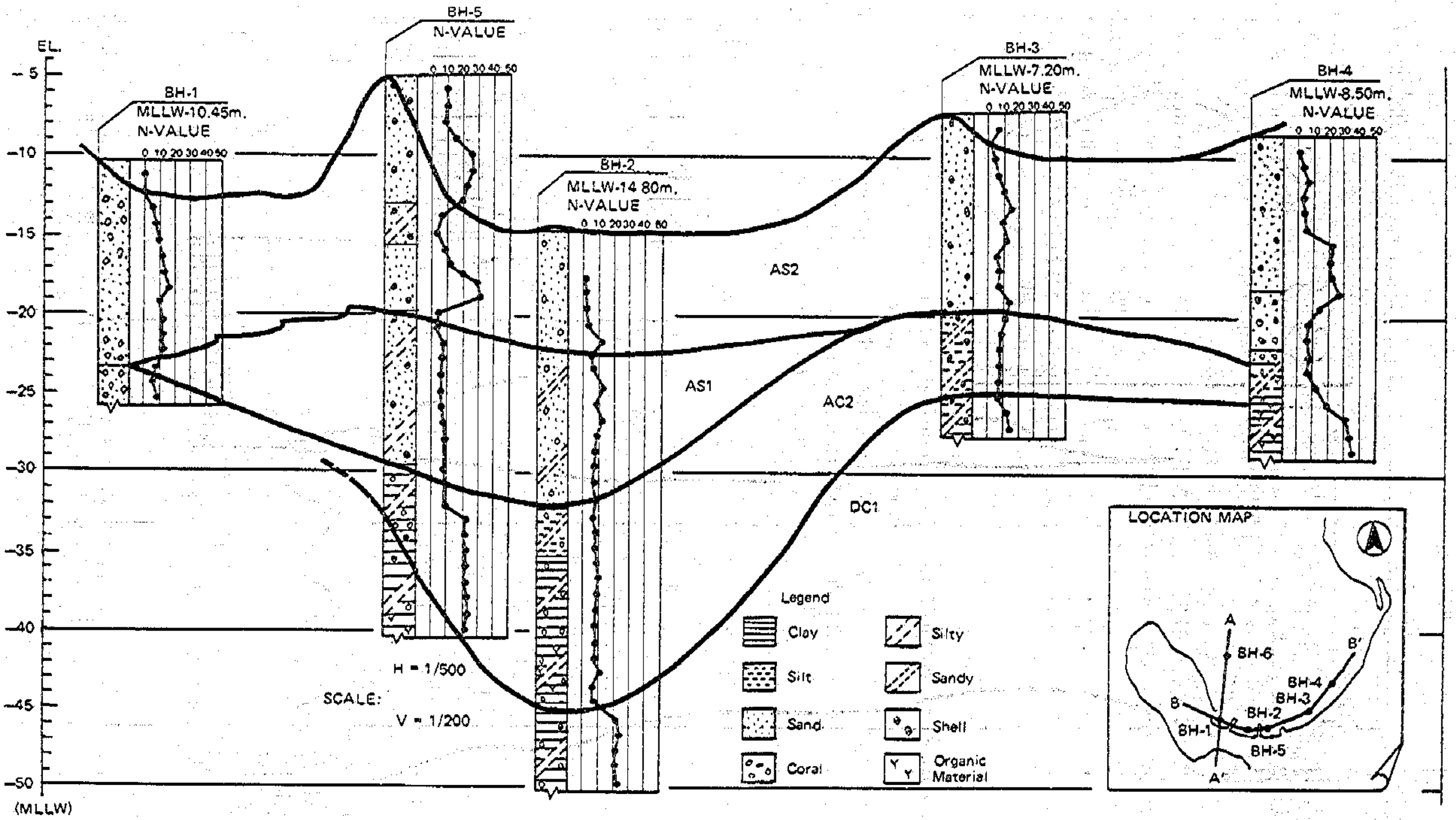


Fig. 3-2-1 Soil Profile of B-B' Line

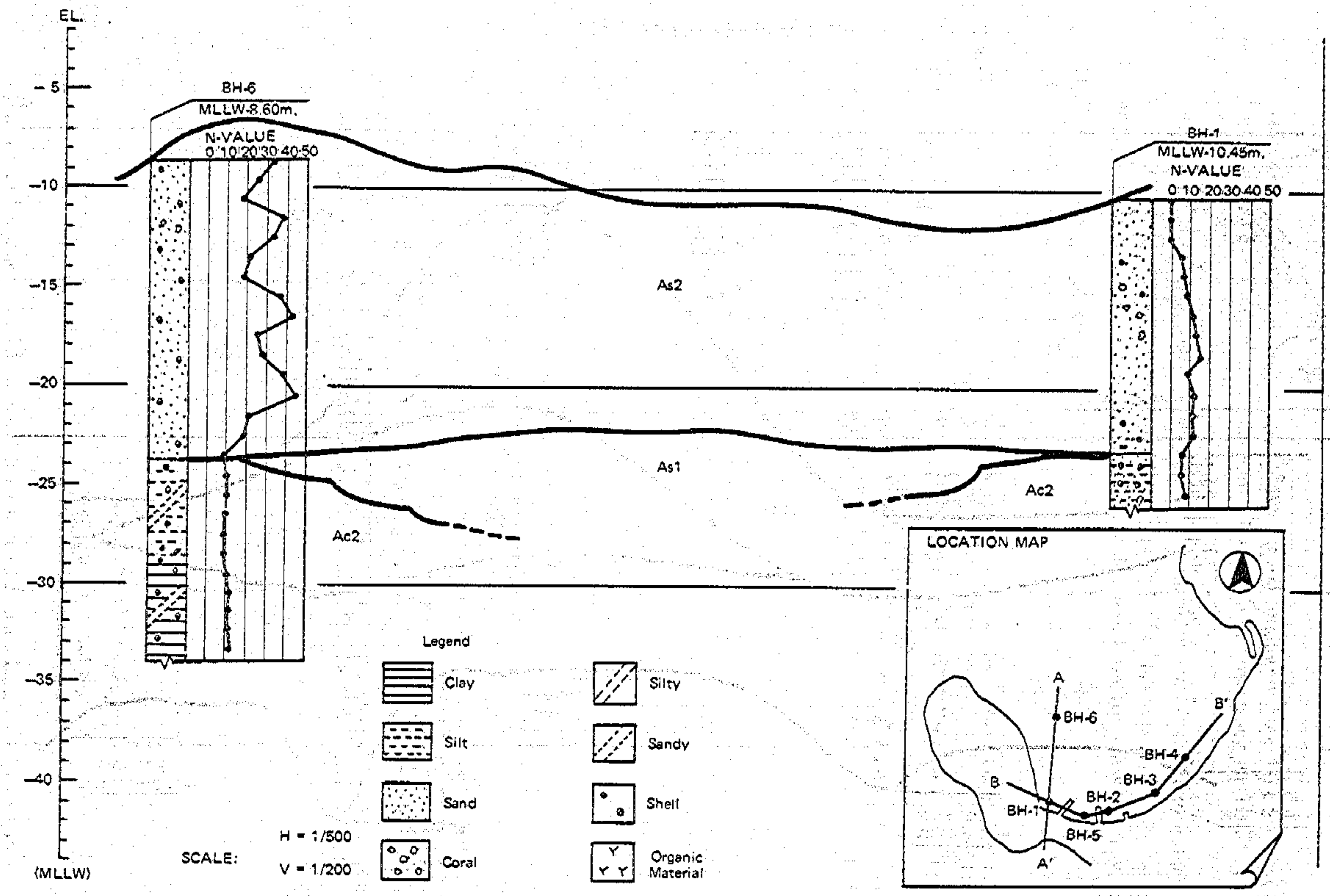


Fig. 3-2-2 Soil Profile of A-A' Line

3-3 Meteorology

3-3-1 General

Around San Fernando, the climate is divided into two distinct seasons: a dry season and a wet season. The dry season covers the period from November to April and the rest of the year is the rainy season. Typhoons occur frequently in June and July.

3-3-2 Precipitation

As shown in the isohyetal map of Appendix 3-3, in the vicinity of San Fernando, the annual precipitation is about 2,000 – 2,500 mm.

The data obtained from the Dagupan branch office of the PAGASA shows that the annual precipitation in Dagupan is on the order of something over 2,000 mm, rainy days averaging 111 days per year as shown in Appendix 3-3.

3-3-3 Wind

The prevailing wind velocity is 3 knots with occurrence of 23.8% and the maximum wind velocity is 26 – 30 knots (32.7%), as shown in Appendix 3-4.

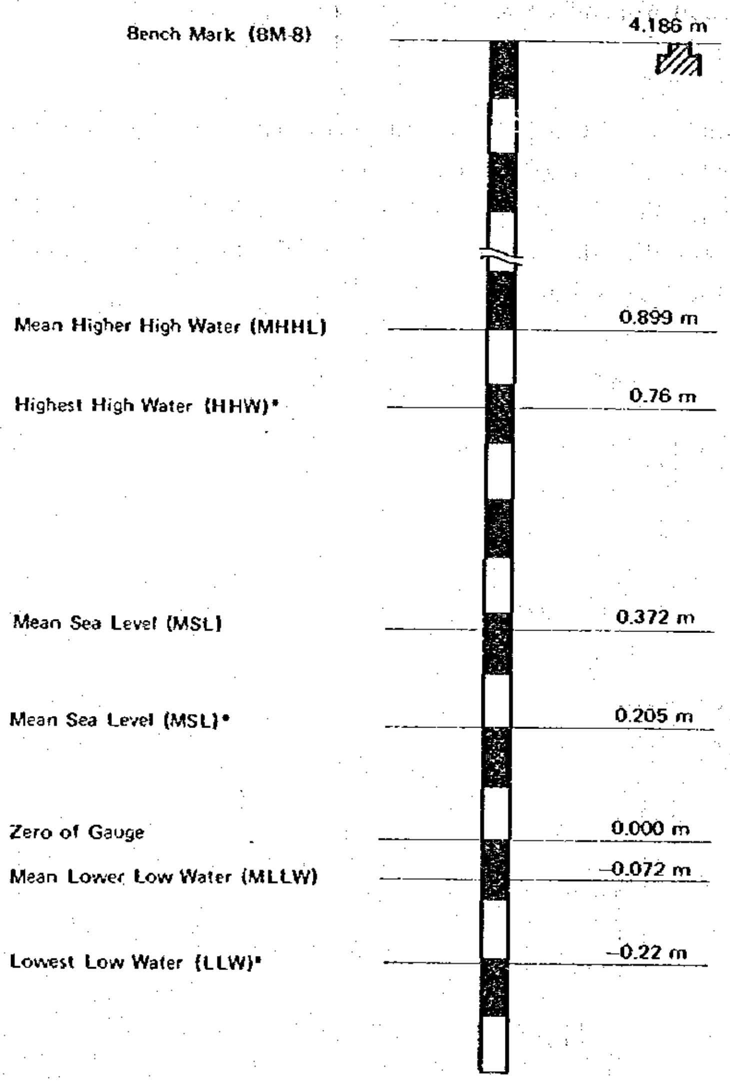
The prevailing wind direction is SE – SSE from April to November and NW – NNW from December to March. The direction of the maximum wind velocity is from the W – N throughout the year, accounting for 74% as shown in Appendix 3-4.

3-4 Oceanology

3-4-1 Tide

The tidal diagram derived from the site observation data and its harmonic analysis is shown in Fig. 3-4-1. On the other hand, the Team studied the description in "Tide and Current Tables, Philippines, For the Year 1983" (Special Publication No. 500) published by BCGS, Ministry of National Defence, Republic of the Philippines. The Team got the following results;

HWL ..... MLLW + 0.910
MSL ..... MLLW + 0.372
LWL ..... MLLW – 0.205



Note *) These values were calculated from the site observation data.

Fig. 3-4-1 Tidal Diagram

3-4-2 Tidal current

Tidal current observation was carried out in the Bay by both float and current meter methods. The results of both methods are shown in Appendix 3-5.

The maximum tidal currents during the site observation have a very low velocity of 0.09 m/sec in the S to SE direction during the flood tide and of 0.15 m/sec in the N direction during the ebb tide.

So the influence of tidal current on port construction and operation will be negligible.

3-4-3 Littoral drift

Six bottom samplings and a fluorescent sand tracing were carried out to observe the littoral drift at the Bay, but no conspicious trend could be found during the site observation. This is reasonable when considering that no big rivers with large volume water flow enter the Bay and that the maximum tidal current is nowhere more than 0.2 m/sec inside the Bay.

Moreover, the stable appearance of both the sea bottom and the shoreline has been well supported by the comparison of the existing topographic data with the newly obtained sounding data and by informations from the inhabitants to the effect that there has been little variation in the shape and composition of the shoreline in the past several decades.

Accordingly, in planning for this site, littoral drifts are not believed to raise any large problems for the construction or maintenance of the port and harbor facilities.

3-4-4 Waves

The wave estimation in this study was carried out by applying wave deformation theory to model deepwater waves which were obtained from the estimations of wind velocity and direction.

For reference, wave observation at the site was conducted from May 25 to June 25, 1983. However, so far no data sufficient for wave estimation has been obtained because of calm weather.

(1) Estimation of deepwater waves

1) Typhoon season

In this study, records obtained at PAGASA of 140 typhoons in the 32 years from 1948 to 1979, which seemed to have affected the Port of San Fernando in many ways, were prepared and used for the estimation of wave heights and periods for the prevailing directions N, NNW, and NW.

The frequency distributions of wave heights and periods are shown in Fig. 3-4-2. The predominant height of wave is 3 – 4 m with occurrence of 36% and the predominant wave period is 7 – 8 sec with occurrence of 64%. Fig. 3-4-3 shows a wave of about 7 m in height with an 11 sec period which has a probability of being exceeded once in 30 years. A. Table 3-6-1 in Appendix 3-6 shows the annual maximum wave heights and periods by direction.

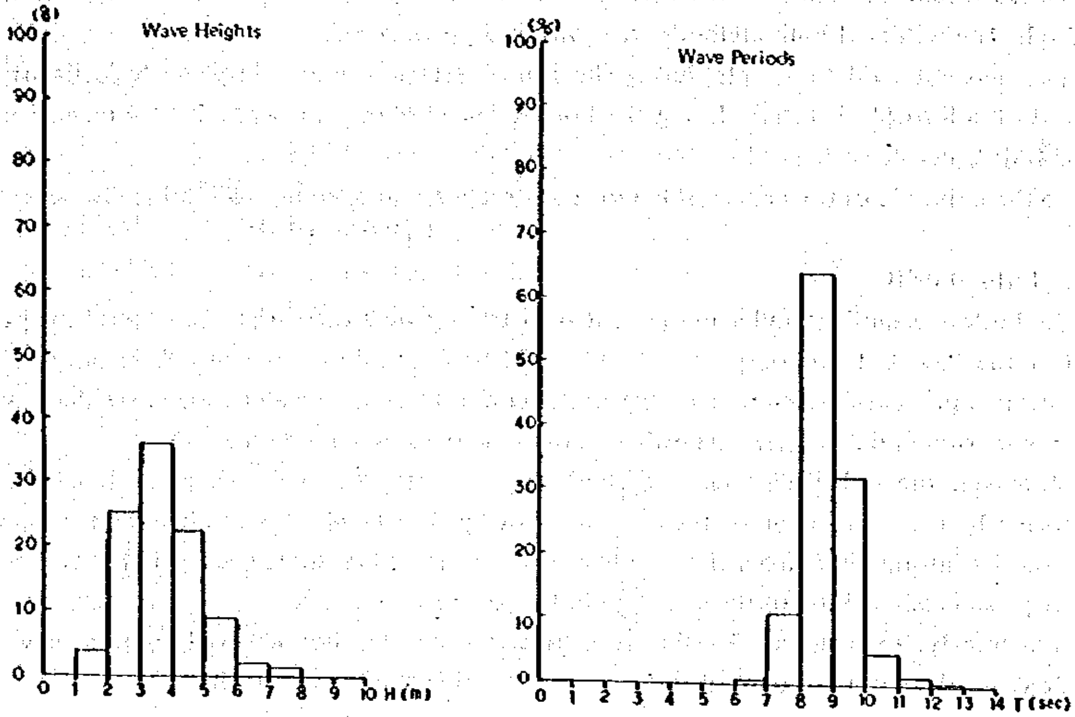


Fig. 3-4-2 Histogram of the Deepwater Wave Heights and Periods, 1948 – 1979

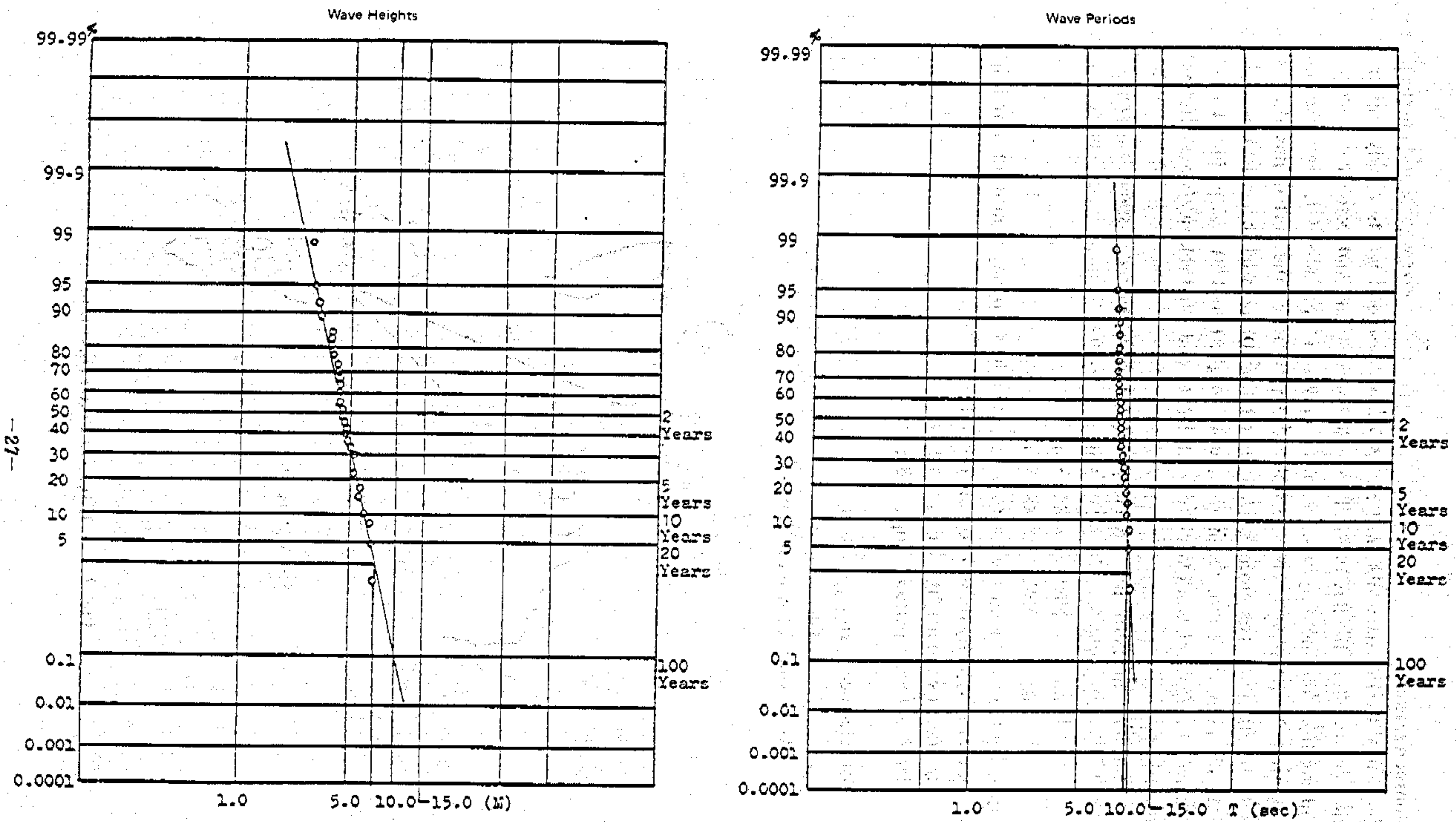


Fig. 3-4-3 Deepwater Wave Heights and Periods of Return Period.

2) Monsoon season

According to the data obtained at PAGASA, monsoon winds greatly influence the maritime conditions of the Bay of San Fernando between June and October.

Judging from the monthly wind velocity shown in Appendix 3-4, the maximum wind velocity from N. NNW and NW directions which influence the Port during the monsoon seems to be 30 knots. Therefore, a wind velocity of 30 knots has been used for estimating waves in the monsoon season. Significant wave height (Ho 1/3) and period (To 1/3) have been derived by applying wind velocity/fetch length and wind velocity/wind duration to the S-M-B method.

The following three effective fetch lengths (F) were calculated as shown in Fig. 3-4-4.

Wind direction N, F = 640 km
-- do -- NNW, F = 840 km
-- do -- NW, F = 880 km

Supposing the wind is steady for 24 hours, then the following significant wave height and period for a wind velocity of 30 knots are obtained.

Significant wave height $Ho_{1/3}$ = 4.1 m
Significant wave period $To_{1/3}$ = 8.1 sec

For reference $Ho_{1/3}$ = 2.0 m
$To_{1/3}$ = 6 sec
(At 20 knots of wind velocity)

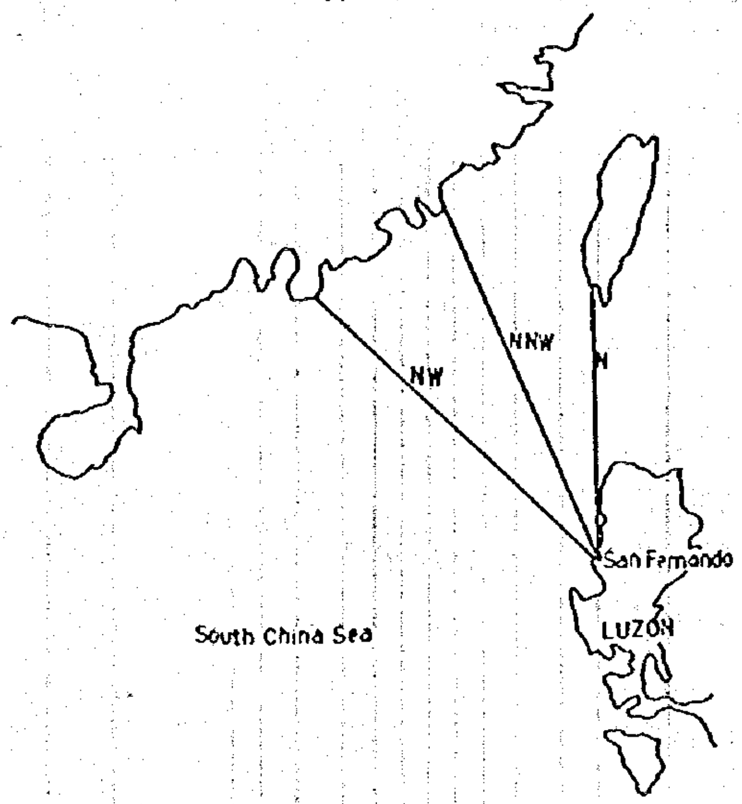


Fig. 3-4-4 Effective Fetch Direction

(2) Estimation of invading waves

Waves in the Bay were estimated by taking account of refraction and diffraction. In other words, wave heights in the Bay were derived by multiplying the deepwater wave height by coefficients of refraction and diffraction. Coefficients of refraction have been obtained by drawing refraction diagrams by direction and period of the waves as shown in Appendix 3-6. Coefficients of diffraction have been obtained by applying the theory of wave energy dispersion.

As a result, the ratios of the wave heights in the Bay to the deepwater wave heights are estimated in Figs. 3-4-5(1), (2) and (3), and the wave heights along the seashore are estimated as shown in Fig. 3-4-6.

As mentioned above, it is expected that the invading waves will influence the port's construction and operation, and it is necessary to take this into account during planning.

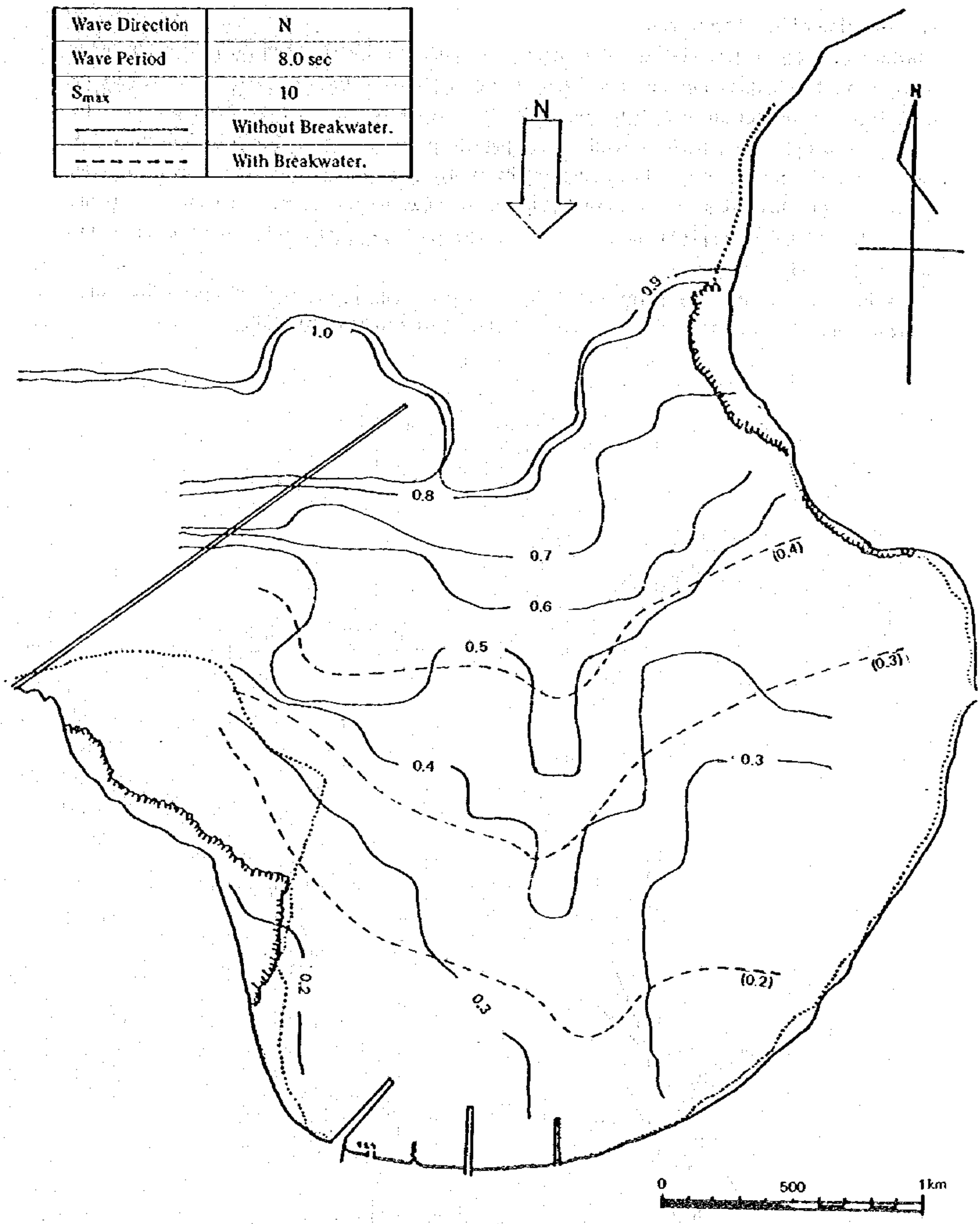


Fig. 3-4-5 (1) Ratio of Invading Wave Heights to Deepwater Wave Heights in the Bay.

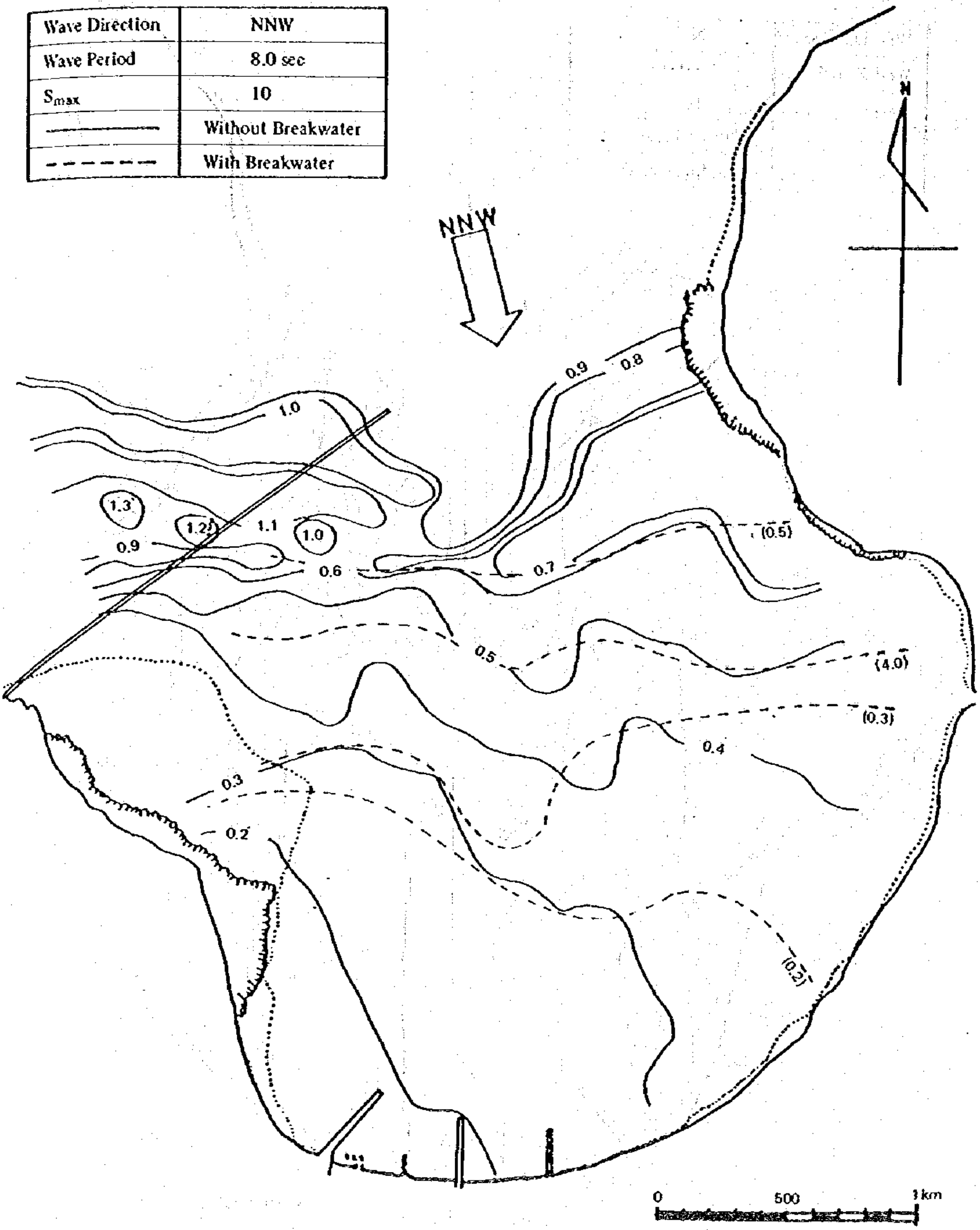


Fig. 3-4-5 (2) Ratio of Invading Wave Heights to Deepwater Wave Heights in the Bay.

Wave Direction	N
Wave Period	8.0 sec
S_{max}	10
————————	Without Breakwater
– – – – – –	With Breakwater

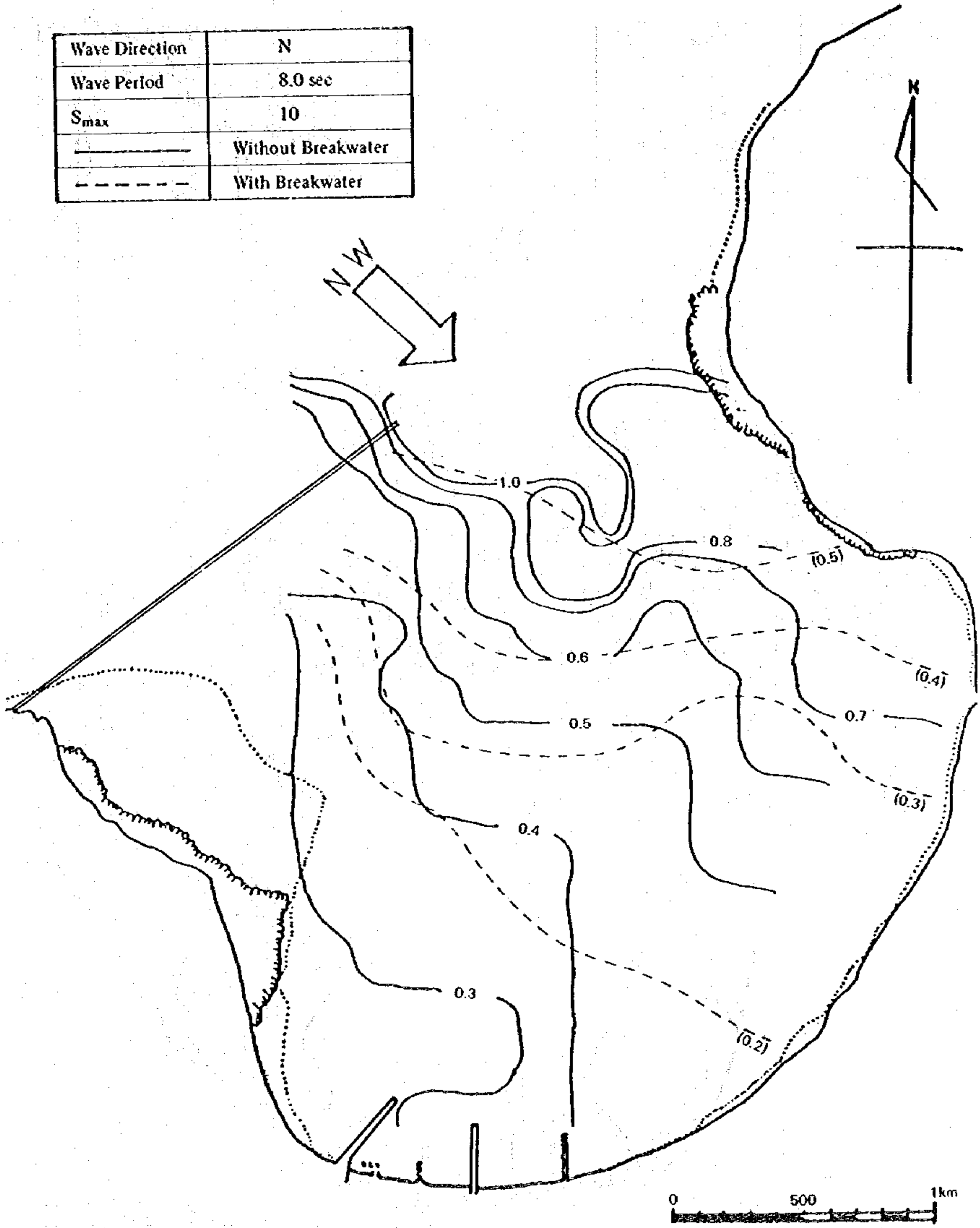


Fig. 3-4-5 (3) Ratio of Invading Wave Heights to Deepwater Wave Heights in the Bay.

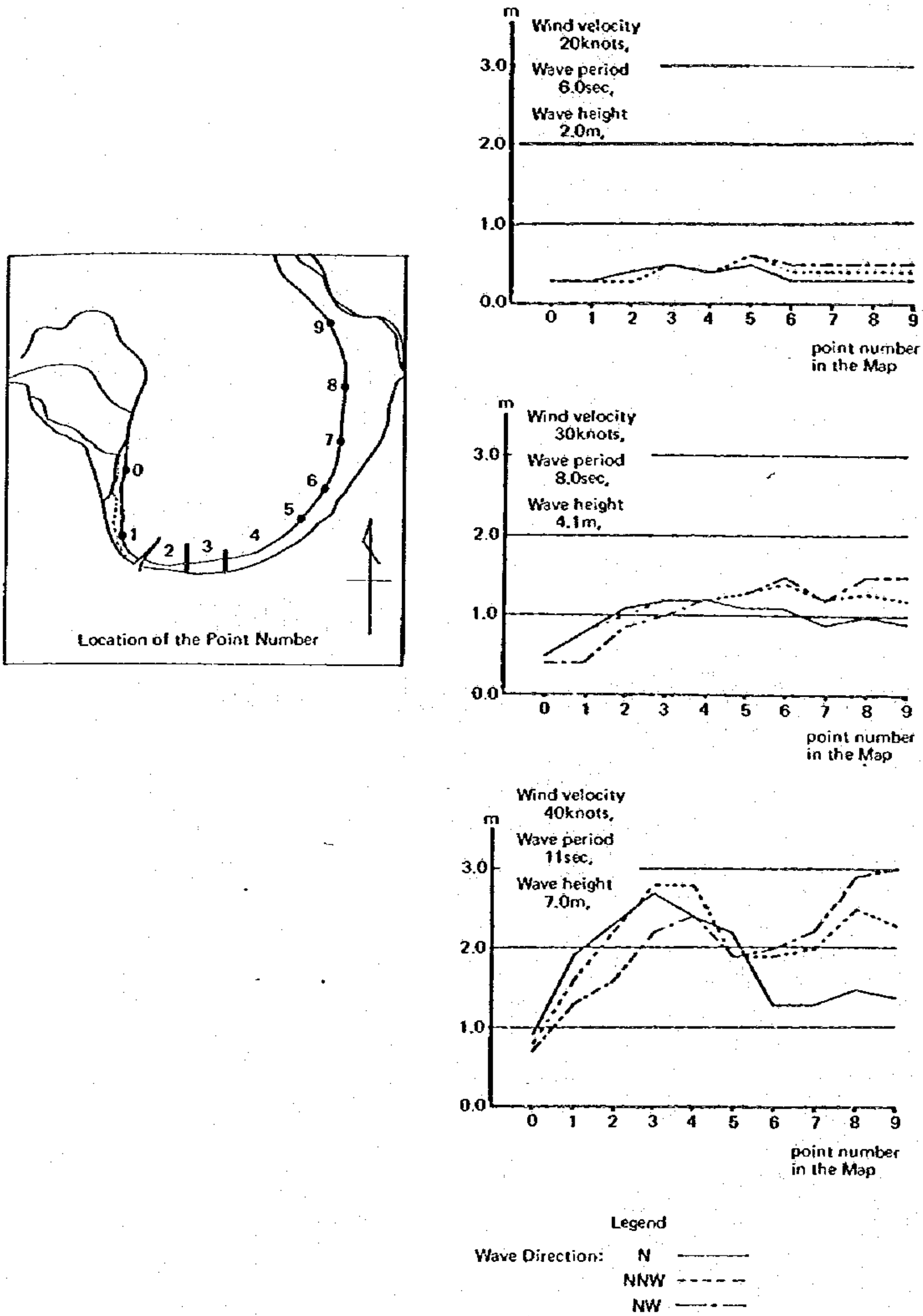


Fig. 3-4-6 Estimated Heights of Invading Waves of the Shoreline in the Bay.

CHAPTER 4

HINTERLAND AND ITS PERSPECTIVE

CHAPTER 4 HINTERLAND AND ITS PERSPECTIVE

4-1 Hinterland

4-1-1 General

In determining the hinterland of the port, many factors are to be considered. The location of the hinterland depends upon such factors as geographical conditions around the port, networks of land transportation, the level of commercial activities in the related areas and the conditions of other ports located around the port in study. Theoretically, the area of the hinterland varies according to the kind of cargo, and may sometimes shift in the course of regional development. Hinterlands, especially their outskirts, of adjacent ports sometimes overlap each other.

However, in this study, the geographical profile, the network of roads, and the condition of the sub-ports are considered to determine the hinterland of the Port of San Fernando.

4-1-2 Geographical profile

As illustrated in the geographical sketch (Fig. 4-1-1), the Cordilleria Central lies along the eastern boundary of Region I, economically separating it from Region II. In the southwest, the Zambales Mts. run southward from the western part of Pangasinan province through Zambales province in Region II. A plain extends along the coast line and spreads out in the southeastern part of Region I, covering eastern Pangasinan province.

In short, Region I is surrounded by sea and mountains, except the Pangasinan plain, which extends all the way to Metro Manila.

In addition, San Fernando is located a little south of the geometrical center of Region I. However, since the socio-economic level is higher in such southern provinces as La Union, Benguet and Pangasinan, San Fernando is also the socio-economic center of Region I.

4-1-3 Road network

Reflecting the above mentioned geographical profile, National Highway #3, the only primary road in Region I, runs north along the coast from Metro Manila through San Fernando to the northeast boundary with Region II. (Fig. 1-5-1)

There are several east-west routes in Region I. However, there are no paved roads except two branches which connect National Highway #3 with the provincial centers of Bangued in Abra province and with Baguio in Benguet province. Therefore, transportation across the boundary between Region I and Region II is difficult.

The trunk road connecting San Fernando and Metro Manila, National Highway #3, is paved and its condition rather good, allowing sea born cargo to flow easily from San Fernando to Metro Manila and vice versa. Therefore, for port oriented cargo, excluding liner vessel cargo which prefers the Port of Manila, the southern end of San Fernando's hinterland can be defined at a point halfway to Metro Manila along National Highway #3. This point is roughly on the boundary between Region I and Region III.

In short, from the view point of road network, hinterland of the Port of San Fernando can be defined as Region I.

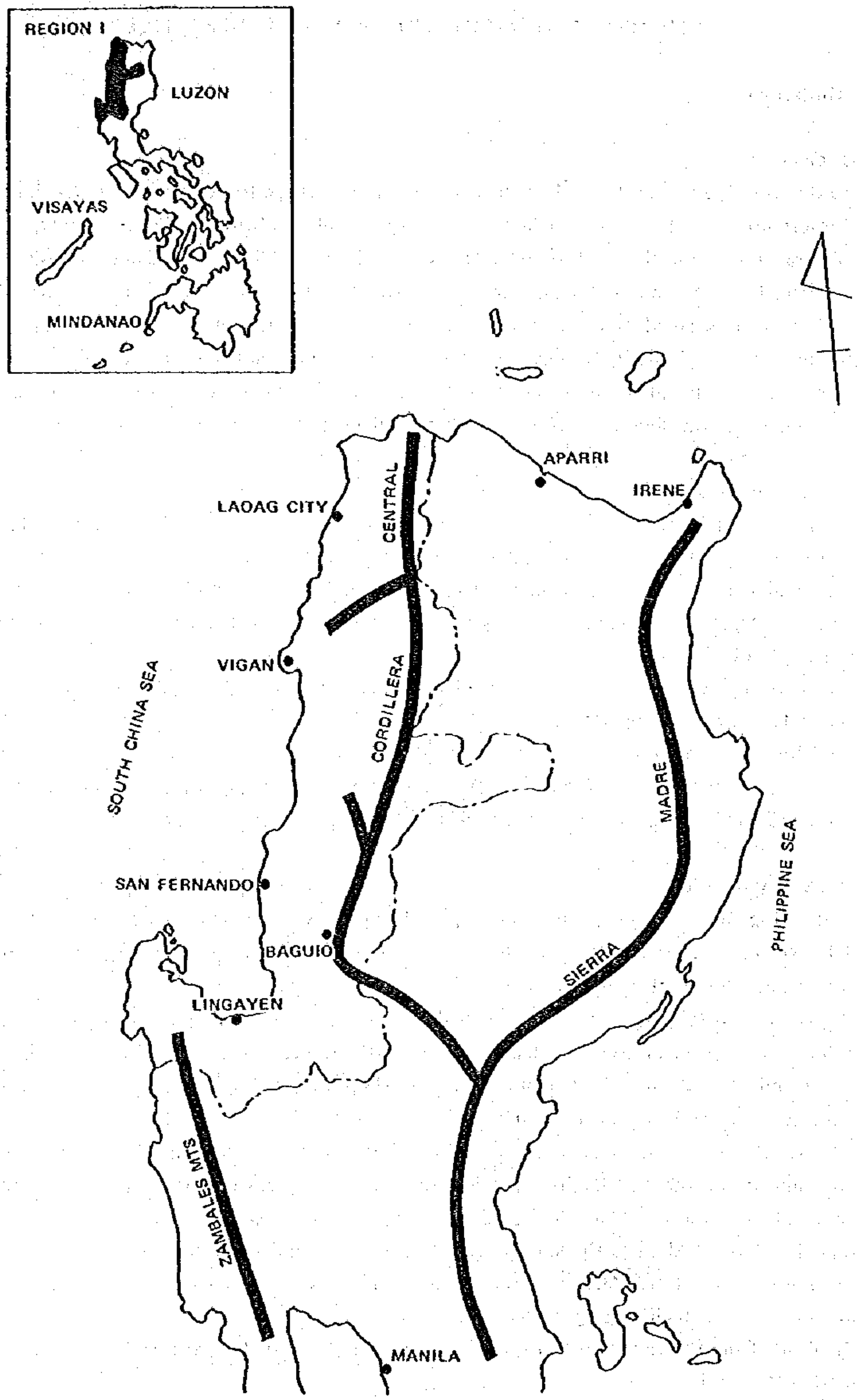


Fig. 4-1-1 Geographical Sketch of Northern Luzon

4-1-4 Condition of the ports in Region I

Taking into account the existing facilities and the natural and socio-economic conditions of the sub-ports, the only potential competitors of the Port of San Fernando are the following two ports. The Port of Currimao acts as the window for the export of the mineral ores produced in the northernmost portion of Luzon. The Port of Sual will be the major fishery port in Region I.

4-1-5 Conclusion

Taking into consideration these conditions, the hinterland served by the Port of San Fernando can be defined as Region I.

For reference, the hinterland of the Port of Irene, located in the northernmost part of Region II, was defined as the Cagayan river basin up to 1987 and thereafter as the whole of Region II. Therefore, it is reasonable and practical to define Region I as the hinterland served by the Port of San Fernando.

4-2 Economic Perspective of Region I

Since Region I is defined as the hinterland, the economic perspective of Region I will be dealt in this section.

4-2-1 Macroeconomic frame work

The short term development of Region I has been promoted under the "Five Year Regional Development Plan 1983 – 87 (Region I)" (hereinafter referred to as the Five Year Regional Plan), which was recently adjusted by the regional NEDA office to reflect the latest economic performance. In the long run, the development of the Philippines is based on the "Long Term Philippine Development Plan up to the Year 2000" (hereinafter referred to as the Long Term Plan up to the Year 2000) prepared by NEDA in 1976. This is the only and latest long term plan authorized by the Government.

Thus, the demographic and economic frame for the short term development plan of the Port of San Fernando targetted up to the year 1990 was based on the Five Year Regional Plan. Since this Five Year Regional Plan ends in 1987, however, the target figures in the Long Term Plan up to the Year 2000 are applied for the period 1987 – 2000.

Table 4-2-1 gives the GRDP, population and per capita GRDP projected in the Five Year Regional Plan. The growth rates of GRDP and population adopted in this study are shown in Table 4-2-2. The national growth rates for the same period are given in Table 4-2-3 as reference.

The annual growth rate of population in Region I is estimated to be lower than the national growth rate. This is mainly because the current high rate of migration to Metro Manila will continue in the years to come, although the rate may decrease to some extent.

Table 4-2-1 Projected GRDP, Population and per Capita GRDP in Region I, 1983 – 1987

Year	GRDP		Total Population		Per Capita GRDP	
	million ₱ at 1972 prices	Growth Rate (%)	(.000 persons)	Growth Rate (%)	₱ at 1972 prices	Growth Rate (%)
1983	3,893.0	–	3,726.0	–	1,044.8	–
1984	4,138.0	6.3	3,783.0	1.5	1,093.8	4.7
1985	4,406.0	6.5	3,838.0	1.4	1,148.0	5.0
1986	4,701.2	6.7	3,892.0	1.4	1,208.4	5.3
1987	5,135.0	9.2	3,944.0	1.3	1,302.0	7.7
Compound Annual Growth Rate (%) 1983 – 1987	–	7.2	–	1.4	–	5.7

Source: NEDA, "Five Year Regional Plan"

Table 4-2-2 Regional Projected Growth Rate of GRDP, Population and per Capita GRDP in Region I

(%)

Period	Compound Growth Rate		
	GRDP	Population	Per Capita GRDP
1983 – 1987	7.2	1.4	5.7
1988 – 2000	7.7	2.0	5.6

Source: 1983 – 1987, NEDA "Five Year Regional Plan"
1988 – 2000, NEDA "Long Term Plan up to the Year 2000"

Table 4-2-3 National Projected Growth Rate of GDP, Population and per Capita GDP

(%)

Period	Compound Growth Rate		
	GDP	Population	Per Capita GDP
1983 – 1987	6.3	2.2	4.0
1988 – 2000	8.3	2.8	5.4

Source: 1983 – 1987, NEDA "Five-Year Philippine Development Plan, 1983 – 1987"
1988 – 2000, NEDA "Long Term Plan up to the Year 2000"

Based on the expected growth rate (Table 4-2-2), absolute figures of GRDP, population and per capita GRDP are calculated as shown in Table 4-2-4. Fig. 4-2-1 illustrates the growth of GRDP and per capita GRDP in Region I until the year of 2000.

Table 4-2-4 Actual and Estimated GDP/GRDP, Population and per Capita GDP/GRDP, 1972 – 2000

	National					Region I				
	Population as of June, 1 (million Persons)	GDP				Population as of June, 1 (,000 persons)	GRDP			
		GDP		Per capita GDP			GRDP		Per capita GRDP	
		at Current Prices (billion ₱)	at 1972 Prices (billion ₱)	at Current Prices (₱)	at 1972 Prices (₱)		at Current Prices (million ₱)	at 1972 Prices (million ₱)	at Current Prices (₱)	at 1972 Prices (₱)
Actual										
1972	38.92	56.1	56.1	1,441	1,441	3,099	2,620	2,620	845	845
1973	40.01	71.8	60.9	1,795	1,522	3,155	3,424	2,904	1,085	920
1974	41.12	99.6	64.1	2,422	1,588	3,212	4,229	2,773	1,316	863
1975	42.07	114.6	68.4	2,724	1,626	3,269	5,267	3,144	1,612	962
1976	43.46	133.2	73.6	3,065	1,694	3,322	5,685	3,142	1,712	946
1977	44.67	155.6	78.0	3,483	1,746	3,375	6,433	3,225	1,907	956
1978	45.89	179.3	82.6	3,907	1,800	3,430	6,572	3,028	1,917	883
1979	47.10	220.5	88.3	4,682	1,875	3,485	7,943	3,181	2,279	913
1980	48.32	266.0	92.7	5,505	1,918	3,541	9,523	3,318	2,689	937
1981	49.53	304.8	96.2	6,154	1,942	3,610	11,455	3,615	3,172	1,001
1982	50.74	338.5	99.0	6,671	1,951	3,668	12,504	3,657	3,409	997
Estimated										
1983	51.86		105.2		2,029	3,726		3,893		1,045
1984	53.00		111.9		2,111	3,783		4,138		1,094
1985	54.16		118.8		2,195	3,838		4,406		1,148
1986	55.35		126.4		2,284	3,892		4,703		1,208
1987	56.58		134.4		2,375	3,944		5,135		1,302
1988	58.16		145.5		2,502	4,023		5,530		1,375
1989	59.79		157.6		2,636	4,103		5,956		1,452
1990	61.46		170.7		2,777	4,185		6,415		1,533
2000	81.00		378.9		4,678	5,101		13,470		2,641

Source: Actual ..... NEDA
Estimated ..... Table 4-2-1

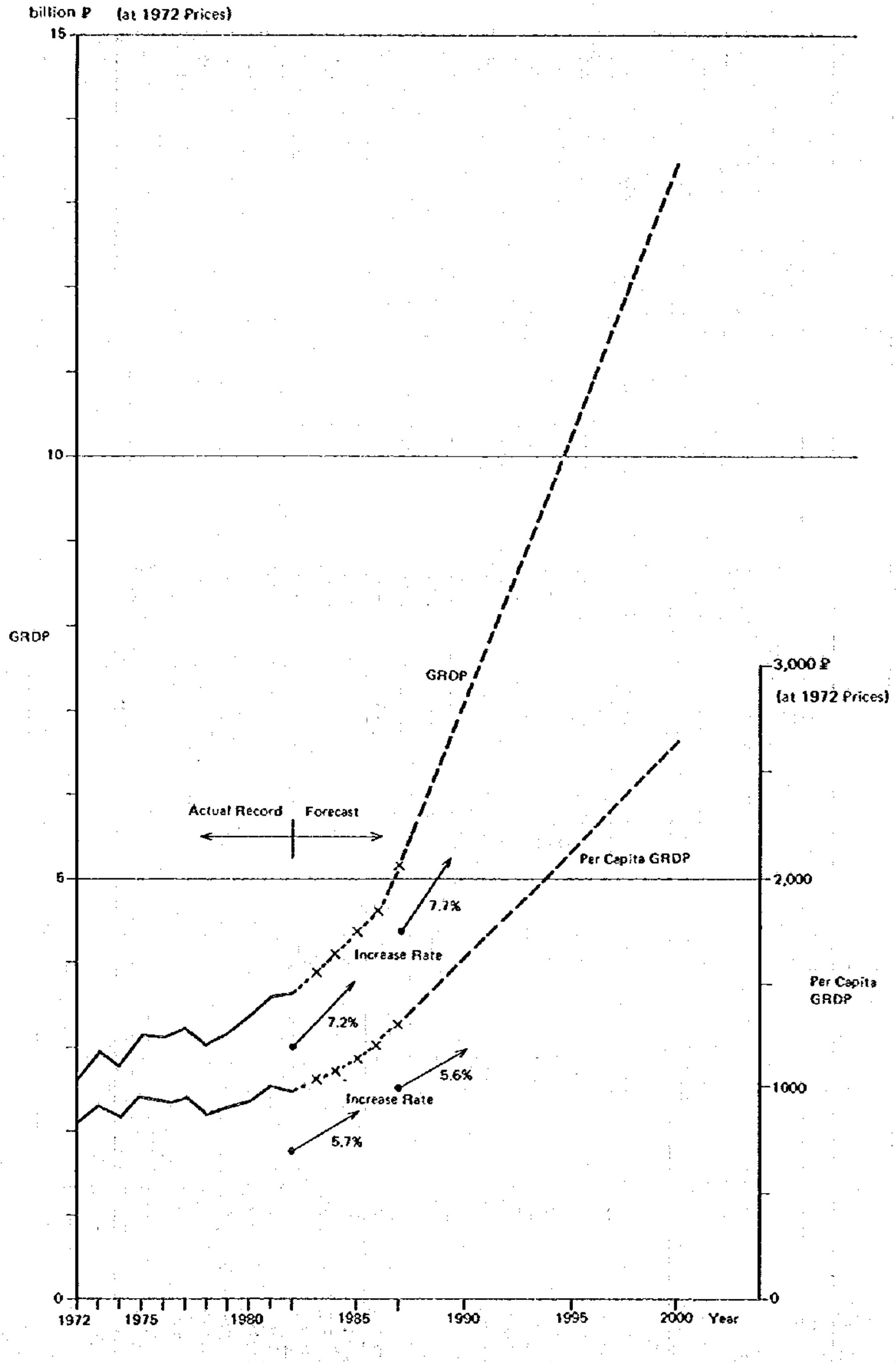


Fig. 4-2-1 Forecast of GRDP and per Capita GRDP in Region I

4-2-2 Perspective by sectors

(1) General

As in the case of the macroscopic economic estimation, the by sector estimations for 1990 and 2000 are based on the Five Year Regional Plan and the Long Term Plan up to the Year 2000, respectively.

However, reflecting recent economic performance, the value added in the industry sector (for 2000) is reduced by 40%, and that in the services sector by 30%.

Table 4-2-5 shows the estimations by sector in 1990 and 2000.

Table 4-2-5 Projected GRDP by Sector in Region

(million P at 1972 Prices)

	1981 (Actual)		1987 (Estimated by NEDA)		1990 (Estimated)		2000 (Estimated)	
GRDP Total	100%	3,615	100%	5,135	100%	6,415	100%	13,470
Agriculture	37	1,338	35	1,787	33	2,116	23	3,162
Industry	25	901	29	1,466	33	2,098	45	6,098
Service	38	1,376	36	1,882	34	2,201	32	4,210
Annual Growth Rate			1981 – 1987		1987 – 1990		1990 – 2000	
Total			6.6%		7.2%		7.7%	
Agriculture			4.9		5.8		4.1	
Industry			8.5		12.7		11.1	
Service			5.4		5.4		6.7	

Agriculture, which has had the most important position in the economy of Region I, can not be expected to grow greatly as a whole, because of its geographical limitations. On the other hand, in order to support the high rate of population increase, it is required to expand employment opportunities and to develop the regional economy. Accordingly, emphasis will have to be placed on the industrial sector, which is expected to grow annually by more than 10%. In fact, the national and regional governments are providing various programs to foster industry in Region I. Especially, the EPZ Project at San Fernando and the Industrial Estate Project at Bacnotan, La Union, whose outline will be given in 4-2-4, will (in harmony with infrastructure support) greatly stimulate industrial development in Region I.

The following are the economic estimations by major sector.

(2) Agriculture

Palay production will be geared toward increasing its productivity by, for example, improvement of technological skills and further expansion of the irrigation which presently covers only 30% of the cultivated area. With these programs, palay production will grow annually by

3.5% as it has done before.

As far as the general strategy of agricultural activities for the future is concerned, priority will be given to the following two directions, that is, the fresh vegetable supply to Metro Manila and increased production of cash crops. The production of vegetables has shown considerable annual growth rate over 20% recently and will continue this trend in future. As for cash crops, cotton production will increase tremendously, taking the place of tobacco which is presently the staple crop of the region but is estimated to decrease gradually. Besides these crops, garlic, ginger, mango and other fruits will be increasingly cultivated because these foods and crops can be planted in newly developed mountaineous areas.

(3) Fisheries

Fish production during the period 1976 – 80 increased at a compound annual growth rate of 13% from a level of 14,469 tons in 1976 to 26,289 tons in 1980. This was attributed to the remarkable growth of municipal fishing by 2.5 times from 5,976 tons to 14,459 tons. However, this type of fishing is not expected to grow greatly because its potential has already been mostly developed.

On the other hand, commercial deep fishing will be developed on a large scale. This is because the South China Sea has rich fishery resources and because a fishing port is under construction at Sual and will be completed in near future. With financial assistance from OECF, the fishing port is planned to have not only port facilities but cold storage facilities. Its completion will be accompanied by the development of the fish processing industries.

(4) Mining and quarrying

The mining and quarrying subsector is the largest of the industry subsectors and is expected to grow greatly as shown in the Five Year Regional Plan. (Table 4-2-6)

Table 4-2-6 Projected Gross Value Added of Industry Sector in Region I, 1983 – 1987

(million ₱ at 1972 Prices)

Subsector	1983		1984		1985		1986		1987		Average Annual Growth Rate
		%		%		%		%		%	1983–87
TOTAL	973.0	100.0	1,078.0	100.0	1,194.3	100.0	1,323.2	100.0	1,466.0	100.0	12.67
Mining and Quarrying	367.8	37.8	407.5	37.8	452.6	37.9	500.2	37.8	552.7	37.7	12.57
Manufacturing	290.9	29.9	327.7	30.4	367.8	30.8	412.8	31.2	461.8	31.5	14.69
Construction	265.6	27.3	282.4	26.2	298.6	25.0	316.2	23.9	334.2	22.8	6.46
Electricity, Gas and Water	48.7	5.0	60.4	5.6	75.3	6.3	94.0	7.1	117.3	8.0	35.20

Source: NEDA "Five Year Regional Plan"

This expectation comes from high potential for mining and quarrying in Region I. Region I has 19% of the national copper resources and 59% of the gold resources. Benguet and Ilocos Norte are the two centers of this industry. There are a lot of mining companies, both large and small, in these provinces but many companies have stopped operation because of damage caused by international market fluctuations. However, since this industry can acquire a foreign currency, the national and regional governments are searching for systems and programs to guard the mining companies from demand and supply fluctuations. Sooner or later, effective schemes will be formed and executed.

Another important resources of limestone lies along the coastal area near San Fernando, La Union. This resource made it possible for two large cement factories to locate in this area. Peso devaluation might have a favorable influence on limestone production because it will stimulate cement export activities.

(5) Manufacturing

Tobacco processing and cement production are the two major manufacturing operations in Region I. While the former is not expected to grow, the latter will grow favorably because the domestic market in Region I will be expanded by the many infrastructure projects and because the export market is estimated to increase steadily.

Other manufacturing operations are small and medium scale business, for example, food processing, fish processing, textiles, wearing apparel and primary metal products. The Five Year Regional Plan places emphasis on fostering and strengthening these industries.

The promotion of these small-medium industries will certainly support the growth of the regional economy during this Five Year Regional Plan period. However, in order to maintain its growth thereafter, it is indispensable to and invite develop large-scale industries. Recognizing the above-mentioned situation in Region I, the national and regional governments are planning to locate an EPZ and an Industrial Estate at San Fernando and Bacnotan, La Union, respectively. When realized, these projects would not only invite new enterprises but foster various related industries in Region I.

4-2-3 Improvement of infrastructure

Refecting upon the fact that large-scale industries have not been developed in Region I, the necessity for the following government incentives has been noticed;

- Adequate government support to and invite foster large-scale industries to Region I, for example, the EPZ project and the Industrial Estate project
- Infrastructure support complete enough to enable large-scale industries to operate without inconvinience, for example, port and road transportation, electricity, water supply, etc.

As well as the EPZ project and the Industrial Estate project, many infrastructure improvement projects have been planned by the national and regional governments. Of these projects, supported by financial assistance from international financial institutions, a considerable number of projects are on going and pipelined as shown in Table 4-2-7.

Table 4-2-7 Major Infrastructure Projects in Region I

Project Title	Location	Implementation Period	Cost	Funding Source
TRANSPORTATION ROADS AND BRIDGES				
o MNR Improvement Project	La Union-Ilocos Norte	On-going	₱107.2 million $ 3.9 million	OECF
o Luzon Road Improvement Project	Pangasinan For Region I	On-going	₱154 million $ 22 million	ADB
o Rural Roads Improvement Project (MLG)	Ilocos Sur For Region I	On-going	₱ 50 million $ 8.8 million	IBRD
o 5th IBRD Highway Project	Benguet & Mt. Province For Region I	1984 – 89 pipelined	Total: ₱29275 million LC : ₱ 1440 million FC : $ 175 million	IBRD
PORTWORKS				
o Nationwide Fishing Port Project (Package I)	Sual, Pangasinan	1980 – 84 pipelined	Total: ₱109.1 million LC : ₱ 75.35 million FC : $ 4.5 million	OECF
COMMUNICATIONS				
o Rural Telecommunications Development Project, Phase II	Region I	1983 – 87 on-going	Total: ₱542 million LC : ₱150 million FC : $ 49 million	OECF 11th Yen Credit Loan & Phil. Gov't.
WATER RESOURCES				
o Palsiguan River Multi-Purpose Project – Stage I	Ilocos Norte	1979 – 1987 on-going	Total: ₱446.461 million LC : ₱236.123 million FC : $ 28.045 million	Phil. Gov't. & OECF PH-845
o National Irrigation Systems Improvement Project (NISIP I & II)	Region I	on-going	₱25.184 million	IBRD-1526 PH
o Phil Rural Infrastructure Project (Irrigation Component) PRIP	Abra	on-going	Total: ₱14176 million LC : ₱7.18 million FC : 7.58 million	Phil. Gov't. & World Bank

Source: NEDA Regional Office

4-2-4 EPZ and Industrial Estate projects

As already explained in 4-2-2, the realization of the EPZ and Industrial Estate projects is indispensable to attainment of the economic targets set for the years 1990 and 2000. The feasibility study revealed that the EPZ project would be economically and financially feasible. As to the Industrial Estate project, the pre-feasibility study indicated that it had possibility for high feasibility.

The following is an outline of the EPZ Project.

Purposes of EPZ	(1) To increase the country's dollar receipts by accelerating the establishment of export-oriented and import-substituting industries. (2) To develop and invite large-scale industries in Region I and to promote various industries with forward and backward linkages.
Place	San Fernando, La Union
Land Scale	48.5 ha
Potential	(1) The port of San Fernando with deep water which enables invited enterprises to receive or ship large amounts of goods with low transportation costs (2) The shorter distance by 250 nautical miles to the USA and Japan compared with the distance from Manila. (3) Abundant and inexpensive labour capable of speaking English
Number of Factories	Approximately 40 factories
Number of Employees	12,000 persons

As to the Industrial Estate project at Bacnotan which is located only 14 km from the Port of San Fernando, its outline is almost the same as that of the EPZ project.

Unlike the EPZs of Bataan or Baguio, this EPZ will be constituted of big and heavy industries which can make good use of the port for transportation; for example, glass-making, ceramics and tiles, cement and concrete products, nicotine sulfare, primary metal products, and simple machinery and parts. The development of the Port of San Fernando will surely offer a special attraction to domestic and foreign investors in these industries.

CHAPTER 5

CARGO VOLUME FORECAST

CHAPTER 5 CARGO VOLUME FORECAST

5-1 Macroscopic Approach

5-1-1 History of cargo throughput of the Port of San Fernando

The cargo handled at the port of San Fernando in 1982 totaled about 1,042,000 tons. No passenger traffic is reported. This is one of the characteristics of the Port of San Fernando. The total cargo volume shows heavy fluctuations between 1978 and 1982. This has been caused by the variation of cement exports. The total cargo tonnage excluding cement has been increasing steadily (Table 5-1-1).

Table 5-1-1 Cargo Volume at the Port of San Fernando, 1978 – 1982

(.000 MT)

	1978	1979	1980	1981	1982
Grand Total	1,016	794	1,030	973	1,042
Domestic	(463)	(438)	(452)	(441)	(483)
Foreign	(553)	(356)	(578)	(532)	(559)
Total (excluding Cement)	760	749	830	834	919
Oil Products Total	408	406	404	392	406
Domestic	(408)	(406)	(403)	(392)	(406)
Foreign	(–)	(–)	(1)	(–)	(–)
Cement Total	256	45	200	139	123
Domestic	(21)	(4)	(9)	(13)	(16)
Foreign	(235)	(41)	(191)	(126)	(107)
Fertilizer Total	45	57	79	88	180
Domestic	(1)	(3)	(1)	(–)	(–)
Foreign	(44)	(54)	(78)	(88)	(180)
Coal Total	28	9	19	20	58
Domestic	(17)	(9)	(19)	(20)	(58)
Foreign	(11)	(–)	(–)	(–)	(–)
Mineral Ores Total	207	209	243	273	181
Domestic	(–)	(–)	(–)	(–)	(–)
Foreign	(207)	(209)	(243)	(273)	(181)
Others Total	72	68	85	61	94
Domestic	(16)	(16)	(20)	(16)	(3)
Foreign	(56)	(52)	(65)	(45)	(91)

Source: o PPA Annual Statistical Report 1978 – 1980
o For the year of 1981 and 1982, data are obtained at the PMU San Fernando

5-1-2 Macroscopic estimation of cargo volume

The cargoes handled at a port are closely linked with the economic activities in the hinterland. In forecasting the amount of cargo handled at the port, therefore, a linear regression model is generally applied. The indices commonly used as explanation variables are the gross regional domestic products (GRDP) and/or the production from manufacturing and mining. In this study, GRDP is used.

As stated above, the past trend of cement export was strongly affected by the demand-supply situation in the Southeast Asian countries rather than by the economic activities in Region I. Thus, in applying a linear regression model, the cement cargo is excluded from the total cargo volume.

The forecast equation is;

$$Y = 0.215\,X + 84.63 \quad R = 0.9$$

where, X = GRDP of Region I (unit; million ₱ at 1972 prices)

Y = Total cargo volume excluding cement export (unit; thousand tons)

R = Correlation coefficient.

The total cargo throughput (excluding cement export) at the Port of San Fernando in 1990 and 2000 is forecast to be approximately 1,500,000 and 3,000,000 tons respectively applying the expected value of GRDP (Table 5-1-2).

Table 5-1-2 Cargo Volume (excluding cement) in 1990 and 2000

Year	GRDP of Region I (million ₱ at 1972 Prices)	Cargo Volume (.000 MT)
1990	6,400	1,500
2000	13,500	3,000

5-1-3 Macroscopic and microscopic approaches

In the following sections, cargo volume is estimated by major items and added up to arrive at the total volume of cargo in 1990 and 2000. The figure obtained by this approach (hereinafter called the microscopic approach) will be compared with the value obtained by macroscopic approach (Table 5-1-2).

Taking into account the values obtained by the two different approaches, the total cargo throughput at the Port of San Fernando in 1990 and 2000 will be determined.

This is discussed in Section 5-8.

5-2 Fertilizer

5-2-1 General

The volume of fertilizer handled at the Port of San Fernando is affected by two kinds of demand. One is the fertilizer demand in Region I, the hinterland of the Port of San Fernando. The other is the transhipment demand for other countries especially China (Table 5-2-1).

Table 5-2-1 Cargo Volume of Fertilizer by Kind of Demand, 1978 – 1982

(.000 MT)

	1978	1979	1980	1981	1982
Consumption in the Hinterland	45	57	79	40	82
Transhipment – Import	0	0	0	24	49
– Export	0	0	0	24	49
Total	45	57	79	88	180

Source: o PPA Annual Statistical Report 1978 – 1980
o For the years of 1981 and 1982, data are obtained at the PMU San Fernando

5-2-2 Demand for fertilizer in Region I

(1) Forecasting approach

The fertilizer demand in Region I is broken down into two components; 1) basic demand and 2) additional demand generated by the expansion of the irrigated area.

1) Basic demand for fertilizer

The basic demand for fertilizer is forecast based on the actual consumption in Region I by taking into account the expected growth rate of cultivated area and the estimated increase rate of fertilizer use per-unit-area.

The following equation is used in calculating the basic fertilizer demand.

$$\boxed{\begin{array}{l}\text{D}\\ \text{Basic}\\ \text{Demand for}\\ \text{Fertilizer in}\\ \text{Region I}\end{array}} = \boxed{\begin{array}{l}\text{A}\\ \text{Actual Consumption}\\ \text{of Fertilizer}\\ \text{in Region I}\end{array}} \times \left(1 + \boxed{\begin{array}{l}\text{B}\\ \text{Expected Growth}\\ \text{Rate of Cultivated}\\ \text{Area in Region I}\end{array}}\right)^{n}$$

$$\times \left(1 + \boxed{\begin{array}{l}\text{C}\\ \text{Estimated Increase}\\ \text{Rate of Fertilizer}\\ \text{Use per-unit-area}\end{array}}\right)^{n}$$

where n = number from base year to calculated year.

2) Additional demand due to the expansion of irrigated area

In addition to the "basic demand", ordinary increase in the fertilizer use per-unit-area, fertilizer use is drastically increased when an area is brought under irrigation. After irrigation, it becomes possible for farmers to plant high yield breeds with heavy fertilization, which promises farmers a high rate of return (Appendix 5-1). Therefore, the irrigation plan is taken into account in calculating the additional demand for fertilizer.

C		A		B
Additional Demand for Fertilizer in Region I	=	Area Planned to be Irrigated	x	Additional Fertilizer Use per-unit-irrigated-area

(2) Assumptions in forecasting the basic demand for fertilizer

A. Actual consumption of fertilizer in Region I.

There are no data available on the actual fertilizer consumption in Region I. Therefore, the national consumption of fertilizer and the percentage of regional acreage used for palay are employed to estimate consumption, since in the Philippines fertilizer is almost exclusively consumed for palay production.

The estimated consumption in Region I is 78,900 tons or 9.9% of the national fertilizer consumption (Appendix 5-2).

This result coincides with the 82,000 tons of actual fertilizer volume handled at the Port of San Fernando and consumed in the hinterland in 1982 (Table 5-2-1).

B. Expected growth rate of cultivated area in Region I

The area used for palay cultivation has increased gradually during the period from 1970 to 1982 (Appendix 5-3). This means that the land suitable for crop production has already been cultivated in Region I and that agriculturally marginal land is now under cultivation (Appendix 5-4).

The Plan of MHS for the year 2000 estimates that cultivated area in Region I will increase only 1.1 times (by 0.4% annually) from 1976 to 2000 (Appendix 5-5). Since it is difficult to estimate trends in cultivation, taking the safer side, palay acreage is assumed to remain constant up to the year 2000.

C. Estimated increase rate of fertilizer use per-unit-area

It is well known that increased use of fertilizer can contribute to increase crop production (Appendix 5-6).

The level of fertilizer use in the Philippines, however, is still low. The following reasons are pointed out; i) shortage of irrigated area where farmers can plant high yield breeds, ii) lack of funds for farmers to purchase fertilizer, and iii) hesitation of farmers because of the difficulty in forecasting the amounts and prices of the harvests.

In spite of these difficulties, however, it is strongly believed that the amount of fertilizer use per-unit-area will increase steadily. The annual increase rate of fertilizer use per-unit-area is forecast with reference to both the actual trends and the value estimated by authorized institutions.

As for the actual trends, fertilizer use per-unit-area increased at the yearly rate of 4.4% from 1970 to 1981 (Appendix 5-7).

On the other hand, the FAO estimates in the report of "Agriculture; towards 2000" that fertilizer use per hectare will increase by 5.3 to 6.5% yearly in the ASEAN countries from 1975 to 2000 (Appendix 5-8).

Farmers will purchase more fertilizer as their house-hold income increases and as the understanding of the effectiveness of fertilizer use is developed. Future fertilizer use, therefore, is estimated to grow at a higher rate than the past average rate of 4.4%. On the other hand, it is also reasonable to believe that almost all fertilizer will continue to be used in cultivating palay. Taking all things into consideration, the annual growth rate of fertilizer use is assumed to be 6.5% as in the case of the FAO palay estimation.

D. Basic demand for fertilizer in Region I

Based on the assumptions mentioned above, the basic demand for fertilizer is expected to reach 139,100 tons and 261,000 tons in 1990 and 2000 respectively.

Year	Basic Demand for Fertilizer in Region I
1990	139,100 MT
2000	261,000 MT

Basic Demand is calculated using following formula

$A \times (1 + B)^n \times (1 + C)^n$

where,

A = Actual consumption of fertilizer in Region I .... 78,900 MT

B = Expected growth rate of cultivated area in Region I 0.0%

C = Estimated increase rate of fertilizer use per-unit-area 0.065

n = "n" means the number from base year (1981) to targeted years (1990, 2000).

(3) Assumptions used in forecasting the additional demand due to expansion of irrigated area

As stated in the forecasting approach section, the additional demand for fertilizer can be obtained by multiplying the following two factors; A) area planned to be irrigated and B) additional fertilizer use per-unit-irrigated-area.

A. Area planned to be irrigated

The National Irrigation Authority has a program to irrigate a total of 61,500 ha between 1982 and 1990 (Appendix 5-9). Since there is no irrigation plan available after the year 1990, the same pace of irrigation as is planned for the 1982 to 1990 period is assumed, thus generating an additional irrigation area of 68,300 ha between 1991 and 2000.

B. Additional fertilizer use per-unit-irrigated-area

Farmers are assumed to generally increase the use of fertilizer when their land is irrigated. However, there is no data available on the increase in fertilizer use following irrigation.

Obviously, estimating such data is quite difficult and unreliable. Accordingly, the amount of fertilizer use per-unit-newly-irrigated-area is taken as 0.227 tons per ha which is the average fertilizer use including both irrigated and non-irrigated land.

C. Additional demand for fertilizer in Region I

The additional demand is forecast at 14,000 and 29,500 tons in 1990 and 2000 respectively (Table 5-2-2).

Table 5-2-2 Additional Demand for Fertilizer in Region I

Year	Area Planned to be Irrigated (.000 ha)	Additional Fertilizer Use per-unit-irrigated-area (tons/ha)	Additional Demand due to Extension of Irrigated Area (.000 MT)
	(a)	(b)	(c)=(axb)
1990	61.5	0.227	14.0
2000	129.8	0.227	29.5

(4) Amount of fertilizer required in Region I

The amount of fertilizer for 1990 and 2000 required in Region I can be calculated to be 153,100 and 290,500 tons respectively (Table 5-2-3).

Table 5-2-3 Demand for Fertilizer in Region I in 1990 and 2000

(000 MT)

Year	Basic Demand for Fertilizer	Additional Demand due to Extension of Irrigated Area	Grand Total
1990	139.1	14.0	153.1
2000	261.0	29.5	290.5

All of the fertilizer required in Region I is assumed to be imported via the port of San Fernando. This assumption is based on the fact that there is no other port in Region I where a large amount of fertilizer can be handled. The Port of Manila is also inadequate because of the lack of bulk handling facilities.

5-2-3 Transhipment of fertilizer

(1) Transhipment service

Fertilizer has to be delivered to farmers in bags. In order to meet the need of end consumers in an importing country, fertilizer used to be imported in bags. In recent years, however, fertilizer has come to be imported more and more in bulk by large vessels so that producers can reduce transportation costs.

Not every importing country has a port with deep water and bagging facilities. When fertilizer is directed to a country with no such ports, a producer or a distributor has to convert bulk into bags somewhere on the way and to transfer them from large vessels to small vessels. These services are called "transhipment services".

(2) Forecasting approach

The amount of transhipment cargo in the Port of San Fernando can be obtained by multiplying the following two factors.

C Amount of Transhipment Cargo in the Port of San Fernando	=	A Demand for Transhipment Service in East Asian Countries	x	B Share of the Port of San Fernando

(3) Assumptions in forecasting

A. Demand for transhipment services in East Asian countries

To forecast demand for transhipment services, extensive interviews were held with experts on fertilizer trade. These investigations revealed that the following four countries can be presumed to remain major importers needing bagged fertilizer for more than several years to come (Appendix 5-10).

(.000MT)

Country	Approximate Import Volume at Present
China	5,000
Indonesia	400
Philippines	300
Viet Nam	500

<u>China</u>

In consequence of detailed research on China which has a large demand, it has become clear that a total of 2,800,000 tons is imported in bags directly (Appendix 5-11). Furthermore, it is said that the Port of Beilung is scheduled to start local bagging services in 1983 with a capacity of 600,000 tons per year. Consequently, the demand in China is estimated to be 1,600,000 tons in near future (Table 5-2-4).

Table 5-2-4 Demand for Fertilizer Transhipment Services in China

(.000 MT)

Import Volume of Fertilizer in China	Direct Import from Exporting Countries in Bags	Amount of Local Bagging Services in China	Demand for Transhipment Services in China
(a)	(b)	(c)	(d)=(a−b−c)
5,000	2,800	600	1,600

Other Countries

Since, after several years, Indonesia is expected to become a selfsupporting country in respect to fertilizer, it is excluded in calculating the demand for transhipment both in 1990 and 2000.

As for the Philippines, it will probably import fertilizer in bags directly from Indonesia and Malaysia which will have facilities for bagging services when ASEAN fertilizer projects are completed after a few years. Since the Philippine government has been involved in these fertilizer production projects as a member of ASEAN, the Philippines will have to receive some portion of the production based on the shares of paid-stock. Therefore, transhipment for other ports of the Philippines is also excluded.

Regarding demand forecast for transhipment services to China and Viet Nam in 1990 and 2000, the estimate was made in spite of a shortage of available data and information.

According to the study of FAO, demands for fertilizer both in China and in Viet Nam are estimated to increase at the yearly rate of 6 or 7%. On the other hand, both China and Viet Nam seem to have plans to increase production. Furthermore, there are factors that might reduce demand for transhipment services;

- o Development of ports where fertilizer can be handled in bulk
- o Additional construction of ports with local bagging services like the Port of Beilung

However, it is, for the time being, difficult for China to develop all the deep water ports which are required to handle the expected volume of bulk cargoes. Besides, fertilizer transhipment in the Port of Beilung is temporary until the Paoshan steel plant project begins operation, as the port was primarilly constructed for transhipping iron ore for this plant.

In due consideration of above mentioned matters, demands for transhipment services to China and Viet Nam are considered to maintain the current level of 2,100,000 tons at least both in 1990 in 2000 (Table 5-2-5).

Table 5-2-5 Demand for Fertilizer Transhipment Services in East Asian Countries

(.000 MT)

	1990	2000
China	1,600	1,600
Indonesia	0	0
Philippines	0	0
Viet Nam	500	500
Total	2,100	2,100

B. Share of the Port of San Fernando

a) Competitive conditions in transhipment services

The following conditions are needed to be competitive in transhipment services;

- o A port located near the importer and far from the supplier
- o A port with deep water where large vessels can enter
- o A port where low cost and good quality workers are available
- o A port with fine weather
- o A port with large warehouses in the vicinity

b) Rival ports in East Asian countries

The Port of Singapore and the Port of Taichun in Taiwan are considered to be powerful competitors with the Port of San Fernando for supplying transhipment services to China and Viet Nam. Comparison with rival ports is shown in Table 5-2-6.

Table 5-2-6 Comparison with Rival Ports

Port	Cost	Capacity (.000 MT/year)	Remarks
the Port of Singapore	A little more expensive than other ports	1,200	o Mechanical cargo handling with modernized equipment
the Port of Taichun	$ 16 – 17/tons	400 ~ 500	o Manpower cargo handling o Political matter (Prohibitions against importing from Taiwan)
the Port of San Fernando	$ 16 – 17/tons	300 ~ 400	o Manpower cargo handling o Shortage of storage space

Source: Obtained from Interviews

Although the facilities are inferior to those of its competitors, the Port of San Fernando has the advantage of low cost which is the key factor to success in this small margin business.

In comparison with the Port of Taichun, the Port of San Fernando does not have the disadvantage of political matters.

c) Competitive ports within the Philippines

At present, four ports in the Philippines are supplying transhipment services for fertilizer. Those are the Ports of Manila, Iloilo, Davao and San Fernando.

Table 5-2-7 shows the disadvantages of each port as a port for transhipment services for fertilizer. The Port of San Fernando has the following advantages that can more than offset the disadvantage of storage space shortage.

- o Deep water which allows 50,000 DWT vessels to enter
- o Lower labor costs than the Ports of Manila
- o Short distance to China

d) Share of the Port of San Fernando

Table 5-2-8 shows the actual data on transhipment of fertilizer in the Port of San Fernando.

Table 5-2-7 Comparison with Other Ports within the Philippines

Port	Disadvantages
the Port of Manila	o Expensive labour cost o Low productivity resulting from difficulty in gathering good workers o Loading and unloading at the anchorage area because of lack of bulk handling facilities o Congestion
the Port of Iloilo*	o Difficulty in entering of large vessels with more than 10,000 DWT because of shallow water
the Port of Davao	o Long distance to China (Almost double, when compared with the distance between the Port of San Fernando and China) o Anxiety about communication troubles because of being far from head offices in Manila
the Port of San Fernando	o Shortage of storage space (warehouses)

Note: *) Even after IBRD Project, the depth will not be enough for transhipment business.
o The Port of Irene is also shallow even after development.

Table 5-2-8 Transhipment Cargo Volume of Fertilizer at the Port of San Fernando, 1980 – 1983

	1980	1981	1982	1983
Transhipment Cargo* of Fertilizer	–	48	98	272**

Note: *) Transhipment Cargo has been counted both as import cargo and as export cargo in port statistics.
**) This value in 1983 is the total of the transhipment volume from January to September.

Source: PMU San Fernando

Transhipment services have just started in the Port of San Fernando, however the transhipment volume of fertilizer is rapidly increasing. For reference, the current share of the Port of San Fernando is estimated at 7.2% (Appendix 5-12).

On the whole, the Port of San Fernando can be presumed to have a competitive advantage over its rivals. It is necessary, however, to take into account the fluidity of transhipment demand which always seeks a port with lower cost.

Depending largely on the demand for China is another concern, because China might change it's policies on the promotion of domestic industry, allocation of foreign currency, and so on. After all, although the Port of San Fernando seems to have a strong position in the transhipment market, the market itself is quite uncertain. Therefore, in order to avoid an overly optimistic view, the market share of the Port of San Fernando is determined at the rather low rate of 10% for both 1990 and 2000.

(4) Volume of transhipment cargo at the Port of San Fernando

Based on the assumptions mentioned above, the volume of transhipment cargo at the Port of San Fernando is forecast to be 210,000 tons both in 1990 and 2000 (Table 5-2-9).

In calculating the cargo volume forecast, this amount will be doubled because transhipment cargo is imported once and exported to other countries later.

Table 5-2-9 Transhipment Cargo Volume of Fertilizer in 1990 and 2000

Year	Demand for Transhipment Services in East Asian Countries (.000 MT)	Share of the Port of San Fernando (%)	Cargo Volume of Transhipment at the Port of San Fernando (.000 MT)
	(a)	(b)	(c)=(axb)
1990	2,100	10	210
2000	2,100	10	210

5-3 Cement

5-3-1 General

(1) Cement industry in Region I

There are 18 cement plants located throughout the Philippines (Appendix 5-13). Two of them, Bacnotan Consolidated Industries Inc. (BCI) and Northern Cement Corporation (NCC) are located near the Port of San Fernando. As of 1981, sales by BCI and NCC were 180,000 and 570,000 tons respectively. Total sales of these two plants have been accounting for 16 – 20% of the national sales. In terms of export, however, the combined market share of these two plants amounts to close to 30%. The historical sales of BCI and NCC are shown in Appendix 5-14.

(2) Forecasting approach

Products of these two plants are sold in Luzon or exported. With regard to domestic sales in Luzon, Cement is distributed by trucks. As is stated in the NTPP report, in the field of cargo traffic within Luzon, truck transportation excels ship transportation in terms of speed and cost. This situation is expected to continue in future as well. Therefore only the cement sold for export is included in forecasting cement cargo handled at the Port of San Fernando.

Total cement sales both domestic and export, however, are also forecast in order to get the cargo volume of coal, which is thought to have a close relation with total cement production (Section 5-5-2).

5-3-2 Export of cement

(1) Export market

In estimating cement exports, the export market for Philippine cement should be defined first. Then, the amount is considered. The export market is determined depending upon transportation cost from the Philippines to the importing countries and the quality of the cement.

Transportation cost for cement is expensive. For example, shipping charges from Japan to Malaysia and the Middle East are $12/ton and $20/ton respectively. These costs account for 32–54% of the F.O.B. price of $37/ton (in case of bulk).

Since, in the case of the Philippines, the quality competitiveness is not so high, export to areas other than the Middle East and South East Asia will be difficult in terms of price competitiveness. The Middle East, however, is shifting to import in bulk clinkers rather than bagged cement. As a matter of fact, 95% of the exports from the Philippines are for South East Asia (Appendix 5-15). Considering this, the target area for Philippine cement export is assumed to be only South East Asia.

(2) Major export and import countries

The past records of major exporting/importing countries are shown in Appendices 5-16 and 5-17. Among South East Asian countries, India, Hong Kong and Singapore are the main importers combining for more than 7 million tons of cement annually. All of these countries have been increasing their imports.

The individual supply and demand situations of the Rep. of Korea, Taiwan, Thailand, Pakistan and India are referred to in Appendix 5-18.

(3) Export from the Philippines

Export from the Philippines as a whole is shown in Appendix 5-14. The figure is stable at around 800,000 tons except for 1979. As to 1979, an export restriction was imposed because production dropped significantly and Government pressure was applied to meet domestic needs before exports. Of total exports, BCI and NCC account for 28.5% on the average.

By country of destination, Indonesia, Bangladesh, India, Viet Nam and Hong Kong are large importers (Appendix 5-19).

(4) Export forecast

As mentioned in 5-3-2(1) all the exports are assumed to go to South East Asian countries. The exports from Region I are estimated using the following formula:

Exports from Region I	=	A Import Forecast of Major South East Asian Countries	x	B Market Share of Cement Export from the Philippines		C Combined Share of BCI and NCC in the Philippines
	x	D Location Factor				

A. Import forecast of major South East Asian countries

Future imports of major South East Asian countries (Hong Kong, Singapore, India and Indonesia) are estimated using the Least Square Method based on the past import figures for 1972 – 1980 (Appendix 5-20).

The results are 11.1 and 15.6 million tons for 1990 and 2000 respectively.

B. Market share of cement export from the Philippines

As stated in 5-3-2 all cement exported from the Philippines is assumed to be destinated for the South East Asian countries represented by Hong Kong, Singapore, India and Indonesia. After the exclusion of the 1979 figure as an exception, the average share of the Philippines during the period of 1972 – 1980 was about 16.3% (Appendix 5-21).

C. Combined share of BCI and NCC in the Philippines.

The combined share is assumed to be 28.5% based on the 1979 – 1982 average (Appendix 5-14).

D. Location factor

Both BCI and NCC are located about one hour's ride inland from the port area. This may represent some disadvantage as compared with the seabased Mindanao plants.

Therefore, 80% is assumed for the Location Factor, in order to forecast on the safe side.

By the year 2000, however, there is the possibility for BCI, NCC and/or an other company to locate another plants in the port area, thus the Location Factor is assumed to be 100% for 2000.

Based on these assumptions, cement export is estimated at 412,000 and 724,000 tons for 1990 and 2000 (Table 5-3-1).

Table 5-3-1 Cargo Volume of Cement Export in 1990 and 2000

Year	Imports of the Four Major Countries (.000 MT)	Philippine Market Share (%)	Combined Share of BCI and NCC (%)	Location Factor	Estimated Cement Export (.000 MT)
	(a)	(b)	(c)	(d)	(e)=(axbxcxd)
1990	11,090	16.3	28.5	0.8	412
2000	15,580	16.3	28.5	1.0	724

5-3-3 Domestic demand

In forecasting future demand in developing countries, the time series (trend) analysis has limitations in application, as drastic change in economic structure and/or industries tends to occur in such countries.

The functional nature of consumption is shown in Fig. 5-3-1. Per capita consumption of cement is shown on the vertical axis, per capita GNP on the horizontal axis.

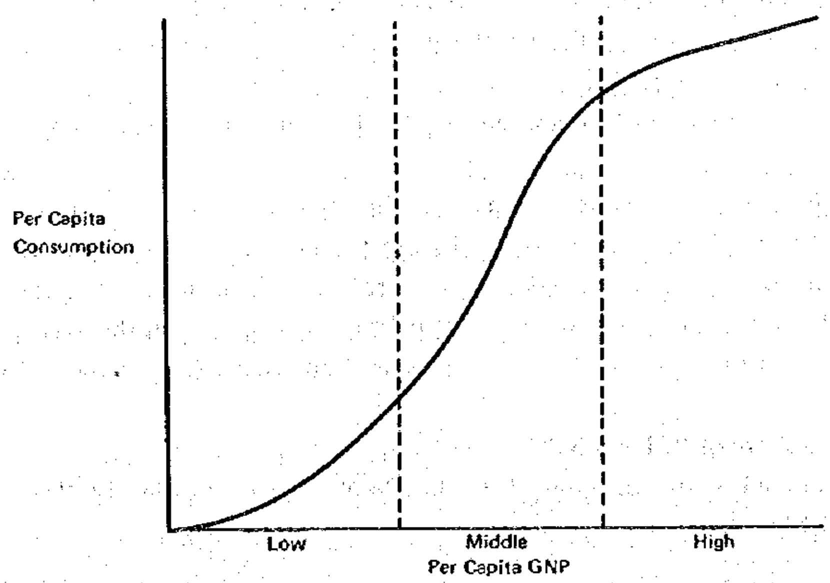


Fig. 5-3-1 Per Capita Cement Consumption and GNP

As the per capita GNP increases from a low level to a middle level, the consumption starts growing exponentially and then saturates when the per capita GNP reaches a high level.

If the trend of a low per capita GNP is applied to forecast consumption level, the consump-- tion level, the consumption level will be under-estimated, because market is growing rapidly after the per capita GNP has reached the middle range.

Thus, in this study, the domestic demand is estimated using the following formula.

Domestic Demand of Cement in Region I	=	A Per Capita Cement Consumption Rate	x	B Future National Population	x	C Combined Share of BCI and NCC

The per capita consumption of cement and per capita GNP of South East Asian countries for 1971 and 1980 are plotted in Appendix 5-22, where the strong relationship between per capita GNP and per capita consumption of cement is shown.

On the other hand, to obtain the saturation level of cement consumption, industrialized countries with per capita GNP of more than $5,000 were investigated. In these countries, per capita consumption ranges from 500 to 700 kg except in the USA and the UK (Appendix 5-23).

In estimating the future consumption level, Malaysia is taken as an example since her per capita GNP is a little above than that of the Philippines, and the population density, which influences the consumption of cement, is similar. In other words, it is assumed that the Malaysian per capita consumption of cement will be attained in the Philippines when the per capita GNP of the Philippines reaches the level of the present per capita GNP of Malaysia. In Appendix 5-22, the per capita cement consumption of the Philippines is assumed to increase along the dotted line, which combines the present situations of both the Philippines and Malaysia.

Since the per capita GNPs for 1990 and 2000 are assumed to be $1,028 and $1,732 respectively, the corresponding consumption rates from Appendix 5-22 are 108 kg for 1990 and 192 kg for 2000.

Table 5-3-2 gives the estimated domestic demand in Region I.

Table 5-3-2 Domestic Demand of Cement in Region I in 1990 and 2000

Year	Per Capita GNP ($/person)	Per Capita Cement Consumption (Kg/person)	Population Forecast (million)	National Domestic Demand (.000 MT)	Domestic Demand in Region I (.000 MT)
	(a)	(b)	(c)	(d)=(bxc)	(e)=(d)x14.9%
1990	1,028	108	61.5	6,642	990
2000	1,732	192	81.0	15,552	2,317

Note: Assumptions and calculations are described in detail in Appendix 5-24.

The production level of cement in Region I is obtained by adding the export forecast mentioned in 5-3-2 to the domestic demand reached above, as shown in Table 5-3-3.

Table 5-3-3 Cement Production in Region I in 1990 and 2000

(000 MT)

Year	Domestic Demand	Export	Production
	(a)	(b)	(c)=(a+b)
1990	990	412	1,402
2000	2,317	724	3,041

5-4 Oil Products

5-4-1 General

The Port of San Fernando is functioning as the oil products distribution center for Region I. Three oil distributors (Shell, Petrophil and Caltex) are based in adjacent areas of the Port of San Fernando.

Almost all the oil products handled at the Port of San Fernando come from the oil refinery centers in Bataan and Batangas.

Table 5-4-1 gives the history of the oil cargo volume handled at the Port of San Fernando. In estimating the future volume of oil cargo, however, the portion which has been used as fuel by the two cement plants (BCI, NCC) located near the Port of San Fernando should be deducted from the base of estimation because these two plants are converting their fuel from oil to coal.

The amount of oil to be deducted is estimated in Appendix 5-25.

Table 5-4-1 Cargo Volume of Oil Products, 1978 – 1981

(000 MT)

Year	Cargo Volume at the Port of San Fernando	Amount of Oil to be Converted to Coal	Difference
	(a)	(b)	(c)=(a–b)
1978	408	65	343
1979	406	58	348
1980	404	75	329
1981	392	72	320

Source: (a) PPA, "Annual Statistical Report"
(b) Appendix 5-25

5.4-2 Forecast of oil products

The forecast of oil consumption in Region I is not available. Since, however, the Ministry of Energy has a long term oil import plan for the whole Philippines, oil consumption in Region I can be estimated by employing some ratio which relates the consumption of the whole Philippines and that of Region I.

From this point of view, forecasts were made by two different methods.

(1) Method 1

Since the oil consumption data was unavailable, the amount of oil imported by the Philippines and the amount of oil products handled at the Port of San Fernando are assumed to represent the consumption level of oil in the Philippines and that in Region I respectively. Then, oil consumption per unit GDP in the Philippines is compared with the oil consumption per unit GRDP in Region I (Table 5-4-2).

Detailed calculation is shown in Appendices 5-26 and 5-27.

Table 5-4-2 Oil Consumption per Unit GDP/GRDP, 1978 – 1981

Year	Oil Consumption per Unit GDP (MT/.000 ₱)	Oil Consumption per Unit GRDP (MT/.000 ₱)	Ratio
	(a)	(b)	(c)=(a÷b)
1978	0.138	0.113	1.22
1979	0.133	0.106	1.25
1980	0.118	0.096	1.23
1981	0.106	0.088	1.20
Average	0.124	0.101	1.22

Source: (a) Appendix 5-26
(b) Appendix 5-27

According to Table 5-4-2, the ratio of oil consumption per unit GDP to oil consumption per unit GRDP in Region I has been rather stable with a four year average of 1.22.

The spread between the amount of oil consumed per unit GDP in the Philippines and GRDP in Region I results from the difference in the industrial structures. The lack of oil consuming industries in Region I appears to be the main reason for this difference. Although industrial structure is expected to change in Region I in the future, the structure in the Philippines will likewise have some change. Therefore, it would be reasonable to assume the ratio presented in Table 5-4-2 will stay constant up until the year 2000.

Hence, oil products to be handled at the port of San Fernando are calculated by the following formula.

$$\boxed{\text{Cargo Volume of Oil Products at the Port of San Fernando}} = \frac{\text{GRDP}}{1.22 \times \text{GDP}} \times \boxed{\text{Oil Imports to the Philippines}}$$

The figures discussed in Chapter 4 and used for the future GDP and GRDP. Estimated Philippine oil imports are shown in Appendix 5-28.

As a result, the cargo volume of oil products to be handled at the Port of San Fernando will be shown in Table 5-4-3.

Table 5-4-3 Cargo Volume of Oil Products in 1990 and 2000 by Method 1

Year	Oil Import (million tons)	GDP (billion ₱)	GRDP (billion ₱)	Cargo Volume of Oil Products (.000 MT)
	(a)	(b)	(c)	(d)=(axc÷b÷1.22)
1990	10.2	170.7	6.4	316
2000	16.1	378.9	13.5	476

Source: (a) Appendix 5-28
(b) (c) Table 4-2-4

Currently the oil cargo handled at the Port of San Fernando is around 400,000 tons and declining (Table 5-4-1). Table 5-4-3 shows the declining trend will be reversed sometime in the future. This is ture because after the conversion from oil fuel to other types of energy is completed, where possible, the consumption of oil will again increase along with economic growth.

(2) Method 2

The history of the oil cargo handled via the Port of San Fernando versus the total Philippine imports is shown in Table 5-4-4.

Table 5-4-4 Share of the Oil Products at the Port of San Fernando, 1978 – 1981

Year	Oil Import (million MT)	Oil Products at the Port of San Fernando (million MT)	Share of the Port of San Fernando (%)
	(a)	(b)	(c)=(b÷a)
1978	11.4	0.343	3.0
1979	11.7	0.348	3.0
1980	11.0	0.329	3.0
1981	10.2	0.320	3.2
Ave.	11.1	0.335	3.1

Source: (a) Appendix 5-26
(b) Table 5-4-1

Suppose that the share of the Port of San Fernando stays at 3.1%, the cargo volume for 1990 and 2000 would be as in Table 5-4-5.

Table 5-4-5 Cargo Volume of Oil Products in 1990 and 2000 by Method 2

Year	Oil Import (million MT)	Share (%)	Cargo Volume of Oil Products (.000 MT)
	(a)	(b)	(c)=(axb)
1990	10.2	3.1	316
2000	16.1	3.1	499

Source: (a) Appendix 5-28
(b) Table 5-4-4

(3) Conclusion

Since the results of the forecasts made by both methods are similar, the cargo volumes of oil products to be handled in 1990 and 2000 are determined as given in Table 5-4-6.

Table 5-4-6 Cargo Volume of Oil Products in 1990 and 2000

(.000 MT)

Year	Cargo Volume of Oil Products at the Port of San Fernando
1990	320
2000	500

5-5 Coal

5-5-1 General

Historically, coal has not been a major cargo at the Port of San Fernando. Since the oil crisis, however, conversion of cement plants from oil to coal in the Philippines has been strongly recommended by the Government to reduce imported oil. In line with this government policy, the two cement manufacturers (BCI, NCC) located near the Port of San Fernando are both converting fuel from oil to coal. In order to handle the increasing coal volume, PNOC pier is now under construction.

Other than cement plants, power plants will be coal consumers in case coal-firing power plants are located in Region I. This is discussed in Appendix 5-29.

However, as there are no concrete plans for constructing coal-fired power plants in Region I, only the coal demand from cement plants is taken into account as the cargo volume handled at the Port of San Fernando.

5-5-2 Demand of coal by cement plants

(1) Forecasting approach

The amount of coal required at the cement plants can be obtained by multiplying the following three factors.

Demand of Coal by Cement Plants	=	A Cement Production in Region I	x	B Fuel Convertion Rate	x	C Coal Consumption Rate as Fuel

(2) Assumptions in forecasting

A. Cement production in Region I

Cement production in Region I is shown in Table 5-3-3.

B. Fuel conversion rate

Even though oil will be converted to coal, this replacement will not be complete. The fuel conversion rate will differ depending on the relative price of oil and coal and on the quality of the coal and on the stability of the coal supply. The managers of the two factories are expecting that 80 – 100% of fuel needs will be filled by coal.

Based on this information the fuel conversion rate is assumed to be 90% for both 1990 and 2000.

C. Coal consumption rate as fuel

The coal consumption rate is defined as the amount of coal needed as fuel to produce one metric ton of cement in case no oil is used. According to interviews, the weighted average of coal consumption rate for BCI and NCC is 0.25 whereas the average for the Japanese cement industry is 0.13.

These data show that as of 1983, the two cement plants need two to two and half times as much fuel coal to manufacture a ton of cement as do the average Japanese cement manufacturers. However, the amount of energy needed will be reduced yearly. Hence, in estimation, the consumption rate in the year 2000 is assumed to be improved to the current level of the Japanese industrial average of 0.13. The ratio for 1990 is determined to be 0.20, as the average of the current rate and the rate in 2000 (Fig. 5-5-1).

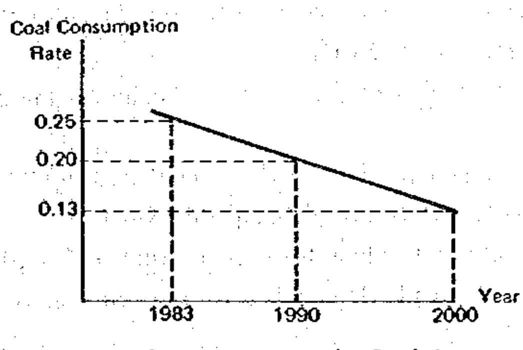


Fig. 5-5-1 Assumed Improvement in Coal Consumption Rate

(3) Cargo volume of coal

Based on the assumptions mentioned above, the amounts of coal required by the cement plants are forecast as 250,000 and 360,000 tons for 1990 and 2000 respectively.

Table 5-5-1 Cargo Volume of Coal in 1990 and 2000

Year	Cement Production in Region I (.000 MT)	Fuel Conversion Rate	Coal Consumption Rate of Fuel	Demand of Coal (.000 MT)
	(a)	(b)	(c)	(d)=(axbxc)
1990	1,402	0.90	0.20	252
2000	3,041	0.90	0.13	356

5-6 Mineral Ores

5-6-1 General

Although northern Luzon is abundant in mineral ore reserves, as of 1983, only copper concentrates are exported by Philex and Lepanto through the Port of San Fernando.

The chrome ore produced in the mountain area of Zambales is shipped from the Port of Masinloc.

To export copper concentrates, Philex has its own specialized pier next to the PPA pier in the Port of San Fernando. Lepanto, however, doesn't have its own pier, it ships most of its exports from the Shipside pier.

5-6-2 Future cargo volume

(1) Forecasting approach

The future cargo volume of mineral ores can be estimated by multiplying the following three factors.

[Cargo Volume of Mineral Ores] = [A Present Value Added in the Mining and Quarrying Sub-sector] x (1 + [B Expected Growth Rate of Value Added])

x [C Conversion Rate of Value Added to Cargo Volume at the Port of San Fernando]

(2) Assumptions in forecasting

A. Present value added in the mining and quarrying sub-sector

In 1981, the value added in the mining and quarrying sub sector was ₱384 million (at 1972 prices). As shown in Table 5-6-1, this amount has been almost constant at around ₱400 million for the past four years.

Table 5-6-1 Value Added in Mining and Quarrying in Region I, 1978 – 1981

(million ₱)

Year	Value Added
1978	399
1979	401
1980	408
1981	394
Ave.	401

B. Expected growth rate of Value Added

According to the Five Year Regional Plan and Long Term Plan up to the Year 2000 by NEDA and to the Regional Multi Year Human Settlement Plan by MHS, both the industry sector and the mining and quarrying sub-sector are expected to grow at a rather high rate (Table 5-6-2).

Table 5-6-2 Expected Growth Rate of Value Added by Sector

(%)

	Industry Sector	Mining & Quarrying Sub-sector	Source
Region I			
1978 – 81	6.8	-0.4	Past records
1983 – 87	10.8	10.0	Five Year Regional Plan (NEDA)
Philippines			
1976 – 2000	11.1	9.2	Long Term Plan up to the Year 2000 (NEDA)
1977 – 2000	10.8	—	Regional Multi Year Human Settlement Plan (MHS)

Based on the estimated growth rate shown in the Five Year Regional Plan, and on the data from the Long Term Plan up to the Year 2000, the value added figures for the mining & quarrying sub-sector would be those shown in Table 5-6-3.

Table 5-6-3 Estimated Value Added for Mining and Quarrying

(million ₱ at 1972 prices)

Year	Value Added
1983	368
1987	553
1990	720
2000	1,735

C. Conversion rate of value added to cargo volume at the Port of San Fernando

Assuming that the cargo volume of mineral ore grows in proportion to the gross value added of the mining and quarrying sub-sector in Region I, the cargo volume generated can be estimated.

The past records show the ratio of the amount of value added of the mining and quarrying to the cargo volume of mineral ore shipped through the ports under the management of PMU San Fernando has been stable over the last five years (Table 5-6-4).

The average is 1.7 MT per every thousand pesos of value added.

Table 5-6-4 Ratio of Value Added of Mining and Quarrying to the Cargo Volume at the Port of San Fernando

Year	Value Added (million ₱)	Cargo Volume of Mineral Ores (.000 MT)	Ratio of Value Added to Cargo Volume (MT/.000 ₱)
	(a)	(b)	(c)=(b÷a)
1978	399	207	0.52
1979	401	209	0.52
1980	408	243	0.60
1981	394	273	0.69
Ave.	401	233	0.58

Source: (a) NEDA "Five Year Regional Plan"
(b) PPA "Annual Statistical Report"

(3) Cargo volume

Assuming that the share of the Port of San Fernando will remain the same, the cargo volume of mineral ores would be 418,000 and 1,006,000 tons for 1990 and 2000 respectively (Table 5-6-5).

Table 5-6-5 Cargo Volume of Mineral Ores in 1990 and 2000

Year	Value Added in Mining and Quarrying (million ₱)	Ratio of Value Added to Cargo Volume (MT/.000 ₱)	Cargo Volume of Mineral Ores at the Port of San Fernando (.000 MT)
	(a)	(b)	(c)=(axb)
1990	720	0.58	418
2000	1,735	0.58	1,006

Source: (a) Table 5-6-3
(b) Table 5-6-4

(4) Japanese market

As mentioned before, most of the copper concentrates shipped from the Port of San Fernando is sent to Japanese smelters.

The consumption of copper in the world, Asia and Japan is given in Fig. 5-6-1. The world consumption is declining after it peaked at 9.8 million tons in 1979. Consumption in the Japanese market is not so bad, staying almost constant for the past four years.

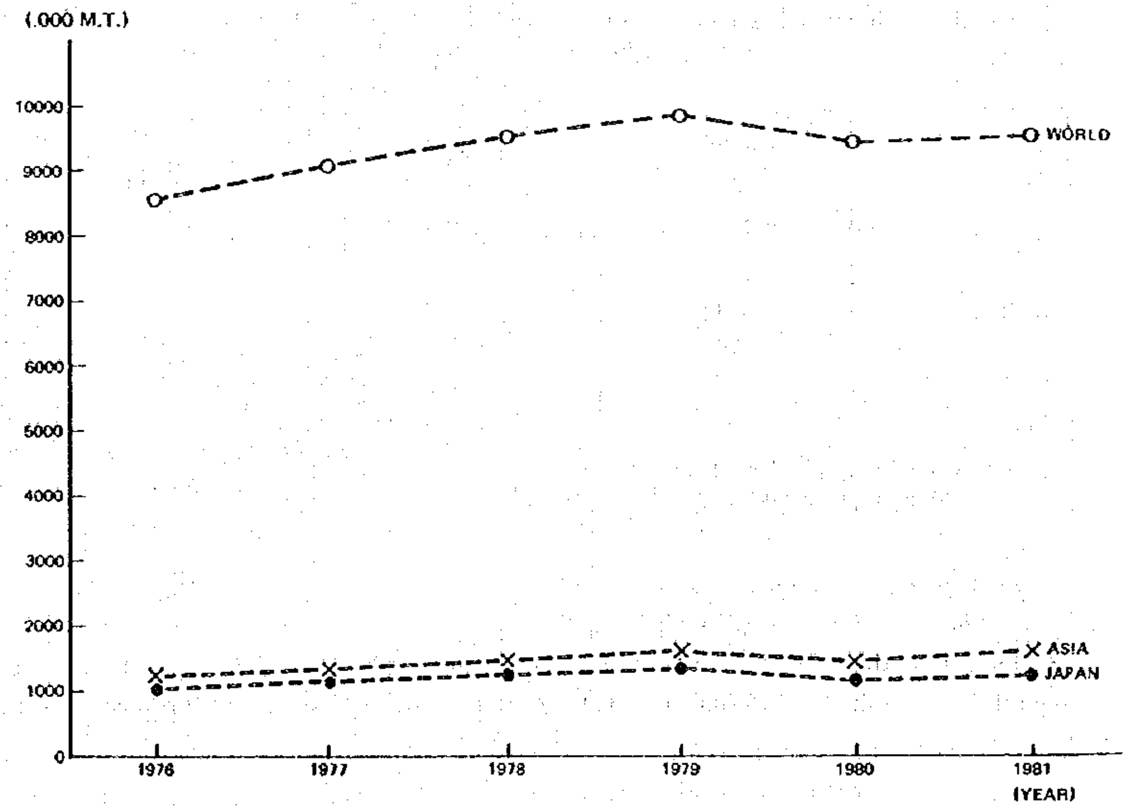


Fig. 5-6-1 Consumption of Copper

(5) Smelting plants in the Philippines

The copper smelting plant in Leyte, one of the government's eleven big projects, started operation in May 1983. The Philippine Government is eagerly promoting the construction of a second smelting plant.

Increased smelting within the Philippines is a factor that will reduce the export of copper concentrates leading to the decline in the mineral cargo volume of the Port of San Fernando.

5-6-3 Conclusion

According to the information obtained in interviews with Philex and Lepanto, their views were a mixture of optimistic and pessimistic ones. Therefore it is reasonable that the cargo volume for 1990 is estimated with some uncertainty range. The lower end of the range is the current level of 200,000 tons while the upper end 400,000 ton figure resulted from the estimation of 5-6-2.

As to the cargo volume for the year 2000, the one million tons estimated in 5-6-2 is adopted because, in the long run, both the world economy and the economy in the Asian region are expected to recover from the slump.

5-7 Others

5-7-1 History of "Others" throughput

"Others" include steel and metal products, machinery, agricultural products, general cargo and so on. These cargoes can be roughly classified into two components; industrial goods and consumer goods. In the Port of San Fernando, "others" has been accounting for between 8 and 11% of the sum of major cargoes since 1978 (Table 5-7-1). This figure is rather low compared with other ports in the Philippines such as the Ports of Cebu, Iloilo, Tacloban, etc. The following reasons are pointed out; i) the low level of industrialization in Region I, ii) the low standard of living and iii) the availability of more convenient land transportation for domestic trade, because of its location near Manila.

As to the cargo volume for domestic and foreign trade, the domestic trade has apparently been smaller than foreign trade at the port of San Fernando. Of "others", domestic cargo has been making up only 20 to 30%. This also comes from the present low standard of living and the more convenient land transportation between Manila and San Fernando.

5-7-2 Assumptions in forecasting

Various cargoes are included under the name of "others". It is difficult, therefore, to estimate the cargo volume of "others" based on such detailed analysis as was made in the case of major items. In forecasting this volume, the following assumptions are made;

(1) "Others" are broken down into two components. One is industrial goods such as steel products, machineries, glass, etc. The other is consumer goods such as bottled cargo, cereals and flours, agricultural products, animal feeds, etc.

(2) For industrial goods, steel is assumed to represent industrial goods as a typical cargo and only the cargo volume of steel is estimated. In estimation, the total amount of steel required in Region I is assumed to be imported via the Port of San Fernando.

(3) For consumer goods, everything handled at the Port of San Fernando is assumed to be domestic cargo. In estimating the cargo volume, the ratio of domestic trade to the total cargo volume of "others" is assumed to remain at the same level as at present.

Table 5-7-1 Cargo Volume of Others, 1978 – 1982

		Others [Ratio of Others to Sum of Major Cargoes]			Total Volumes of Major Cargoes (Excluding Cement)
			Domestic	Foreign	
1978	(.000 MT)	72	16	56	688
	(%)	100	23	77	
		10			100
1979	(.000 MT)	68	16	52	681
	(%)	100	24	76	
		10			100
1980	(.000 MT)	85	20	65	745
	(%)	100	24	76	
		11			100
1981	(.000 MT)	61	16	45	758
	(%)	100	27	73	
		8			100
1982	(.000 MT)	94	3	91	825
	(%)	100	3	97	
		11			100

Source: PMU San Fernando

5-7-3 Forecasting of steel required in Region I

(1) Method I

Since steel is a fundamental material for industry, the per capita steel consumption of a country is strongly related to that country's per capita GDP.

Based on these assumptions, a cross section analysis was attempted among the countries whose per capita GDP was below three thousand dollers (Appendices 5-30 and 5-31). As a result, following formula is drawn;

$$Y = 0.08415\,X - 24.69 \quad (R = 0.792)$$

where, X = Per capita GDP ($ at 1978 prices)

Y = Per capita steel consumption (kg in 1978)

R = Correlation coefficient

Actual per capita steel consumption in the Philippines, however, is positioned above the estimated line (Fig. 5-7-1). Accordingly, the fit line is shifted upward so that it is drawn through the actual per capita steel consumption as of 1978 in the Philippines.

The new formula for the shifted line is:

$Y = 0.08415\,X - 8.58$

X, Y, R; Refer to the previous formula

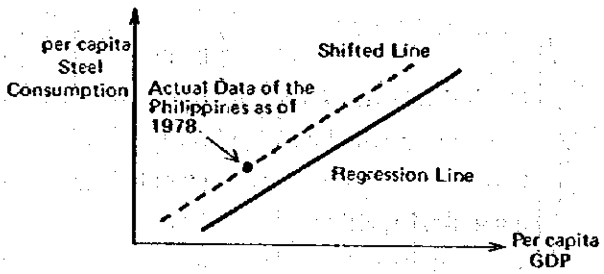


Fig. 5-7-1 Per Capita Steel Consumption and GDP in the Philippines

In order to calculate the per capita steel consumption in Region I, per capita GRDP in Region I for 1990 and 2000 are estimated to be $431 and $742 respectively (Appendix 5-32).

Table 5-7-2 shows the estimated steel consumption in Region I for 1990 and 2000.

Table 5-7-2 Steel Consumption in Region I in 1990 and 2000

Year	Per Capita GRDP in Region I ($ at 1978 prices) ($/person)	Per Capita Steel Consumption (kg/$.person)	Population (.000 persons)	Steel Consumption in Region I (.000 MT)
	(a)	(b)*	(c)	(.000 MT)
1990	431	27.7	4,185	115.9
2000	742	53.9	5,101	274.8
cf1987	366	22.2	3,944	87.6

Note: *) (b)=0.08415x(a)-8.58

(2) Method 2

The second method firstly identifies the industries which require large volumes of steel, secondly estimates the volume to be used in each industry and thirdly sums up these volumes. Since there is no such data available in the Philippines, the data for Japan is referred to Appendices 5-33, 5-34 and 5-35.

The following are the major steel using industries;

- o car manufacturing
- o receptacle manufacturing
- o pipe line manufacturing for oil transporation

o housing construction
o civil works (bridges, dams, water supply, etc.)

Taking into account the economic situation in Region I, the following two fields are specified as steel users in Region I.

o housing construction
o civil works

The demand for steel in Region I can be forecast based on the next formula.

$$\text{D: Steel Consumption in Region I} = \Sigma\left(\text{A: Capital Investment in Housing and Civil Works in Five-Year Regional Plan} \times \text{B: Exchange Rate from Peso to Yen} \times \text{C: Standard Steel Consumption per unit Capital Investment by Segmented Item}\right)$$

Steel Consumption in Region I for 1987 is calculated to be 125,300 tons (Table 5-7-3).

Table 5-7-3 Steel Consumption in Region I, 1987

	Investment in Region I		Standard Steel Consumption per unit Investment (MT/million ¥) **	Steel Consumption in Region I (MT)
	(million ₱) *	(million ¥)		
	(a)	(b)	(c)	(d)=(bxc)
Housing	200	5,041	0.11	555
Highway	320	8,055	1.23	9,908
Port	40	1,016	1.16	1,179
Power	1,844	46,477	1.78	82,729
Water Supply	44	1,112	1.10	1,223
Irrigation	1,344	33,878	0.62	21,004
Flood Control	192	4,849	1.45	7,031
School	13	323	0.22	71
Public Housing	17	426	1.54	656
Hospital	23	582	1.54	896
Total	–	–	–	125,252

Note: *) Refer to Appendix 5-36.
**) Refer to Appendices 5-37 and 5-38.

o When total investment for five years is shown in the Five Year Regional Plant, the total is divided by five and alocated year by year.
o Calculation to convert from Peso to Yen is on the following page.

Investment Shown in Peso	$\div 7.5114 \overset{P/\$}{\underset{*}{}} \times 203.6 \overset{Y/\$}{\underset{**}{}} \times \dfrac{132.6}{142.6\ ***}$

where *) Exchange rate in 1980
**) Exchange rate in 1980
***) Deflator of Construction Works

(3) Comparison of method 1 and method 2

The result of estimation for 1987 by method 2 is 50% higher than the 86,700 tons estimated for 1987 by method 1. The difference in estimation between these two approaches, however, is acceptable considering the following assumptions and backgrounds:

- o Standard steel consumption per unit investment in Japan is used in method 2 and presumably this figure is higher than that for the Philippines
- o Since Japan is a country with a large steel production, more steel per unit investment must have been used.

Therefore method 1 is taken as the figure for the demand for steel in Region I for 1990 and 2000 since method 1 is on the conservative side and it is difficult to forecast the demand for the year 2000 by method 2.

5-7-4 Cargo volume of "Others" in 1990 and 2000

In estimating domestic trade cargo volume of the "others", the assumption of 5-7-2 (3) is used; that is the proportion of domestic trade to the total "others" volume continues to be 30%.

Table 5-7-4 Cargo Volume of "Others" in 1990 and 2000

Year	Cargo Volume of Steel (Foreign Trade) (.000 MT)	Cargo Volume of Domestic Trade (.000 MT)	Total
	(a)	(b)=(a)x3/7	(c)=(a+b)
1990	115.9	49.7	165.6
2000	274.8	117.8	392.6

As a result, the "others" volume is estimated to be 165,600 and 392,600 tons for 1990 and 2000 respectively.

5-7-5 Other transhipment

As well as the fertilizer transhipment discussed in 5-2-3, some chemical compounds have to be transhipped to China was conducted at the Port of San Fernando in Sept. 1983 and in the future the transhipment of plastic pellets is expected to start. Thus, there is a high probability of transhipment business other than fertilizer transhipment. However, since concrete estimation of such transhipement volume is difficult at this moment, other transhipment cargo except fertilizer is not included in the cargo volume forecast.

5-8 Summary of Cargo Volume Forecasts

(1) Comparison between the macroscopic and microscopic estimations

According to the macroscopic approach as explained in 5-1, the total cargo volume of the Port of San Fernando, excluding cement exports, is estimated to be 1,500,000 and 3,000,000 tons for 1990 and 2000 respectively.

On the other hand, according to the microscopic estimation, major cargoes except for cement total between 1,511,000 and 1,711,000 tons for the year 1990 and 2,969,000 tons for the year 2000. The range in total cargo volume for 1990 results from the range in the estimation of mineral ores for 1990 (from 200,000 to 400,000 tons).

Taking the lower estimation (200,000 tons), these two approaches result in very similar estimates.

Adding 400,000 and 700,000 tons of estimated cement cargo volume for 1990 and 2000, the total cargo volume including cement amounts to 1,900,000 and 3,700,000 tons respectively (Tables 5-8-1 and 5-8-2).

Table 5-8-1 Cargo Volume by Macroscopic Approach in 1990 and 2000

(.000 MT)

Year	Total excluding Cement	Cement	Total
	(a)	(b)	(c)=(a+b)
1990	1,500	400	1,900
2000	3,000	700	3,700

Table 5-8-2 Cargo Volume by Microscopic Approach in 1990 and 2000

(.000 MT)

Year	Other than Cement	Cement	Total
	(a)	(b)	(c)=(a+b)
1990	1,511 – 1,711	400	1,911 – 2,111
2000	2,969	700	3,669

(2) Cargo volume by major item

A summary of total future port traffic is given in Table 5-8-3.

Table 5-8-3 Summary of Future Cargo Traffic

(.000 MT)

	Actual			Estimated					
	1982			1990			2000		
	Foreign	Domestic	Total	Foreign	Domestic	Total	Foreign	Domestic	Total
Total Cargo Volume	559	483	1,042	1,282	618	1,900	2,680	1,020	3,700
Fertilizer	180	–	180	570	–	570	700	–	700
(of which Transhipment)	(98)	–	(98)	(420)	–	(420)	(420)	–	(420)
Cement	107	16	123	400	–	400	700	–	700
Oil Products	–	406	406	–	320	320	–	500	500
Coal	–	58	58	–	250	250	–	400	400
Mineral Ores	181	–	181	200	–	200	1,000	–	1,000
Others	91	3	94	112	48	160	280	120	400

CHAPTER 6

PORT PLAN

CHAPTER 6 PORT PLAN

6-1 Port Construction Site

Just behind San Fernando Bay coast line lie residential, commercial, agricultural and port areas. US military establishments exist on the western cape of the Bay. The existing port facilities are located at the southwestern base of the Bay where marine conditions are comparatively favorable. As the Shipside pier and the adjacent area of 19.0 ha are placed under the management of PPA after 1985, when the term of the Development Right Grant given to the Shipside Inc. expires, an area of 21.6 ha (including the present PPA premises of 2.6 ha) will be made available for future port development.

The Bay is deep enough for large vessels, although due to the development of reefs, there are extensive shallow areas on the east and west sides. The Bay opens to the north-northwest, with a mouth about three kilometers wide allowing offshore waves from the north-northwest to come into the Bay.

There are two small rivers that flow into the Bay. Though the volume of the inflow of these rivers is unknown, the construction of port facilities will not affect the waterflow and sand drift of the rivers, unless facilities are planned for sites around the estuaries.

Soil conditions are generally satisfactory for the construction of port facilities, as described in Chapter 3. Alternative sites for construction are shown in Fig. 6-1-1.

Table 6-1-1 shows the comparison of the alternative sites for the development of the Port of San Fernando, prepared on the basis of the natural and socio-economic conditions surveys of the project area. It shows that Sites 1 and 2 are suitable, for port construction, and of these sites, Site 2 is better for the short term development plan (up to 1990).

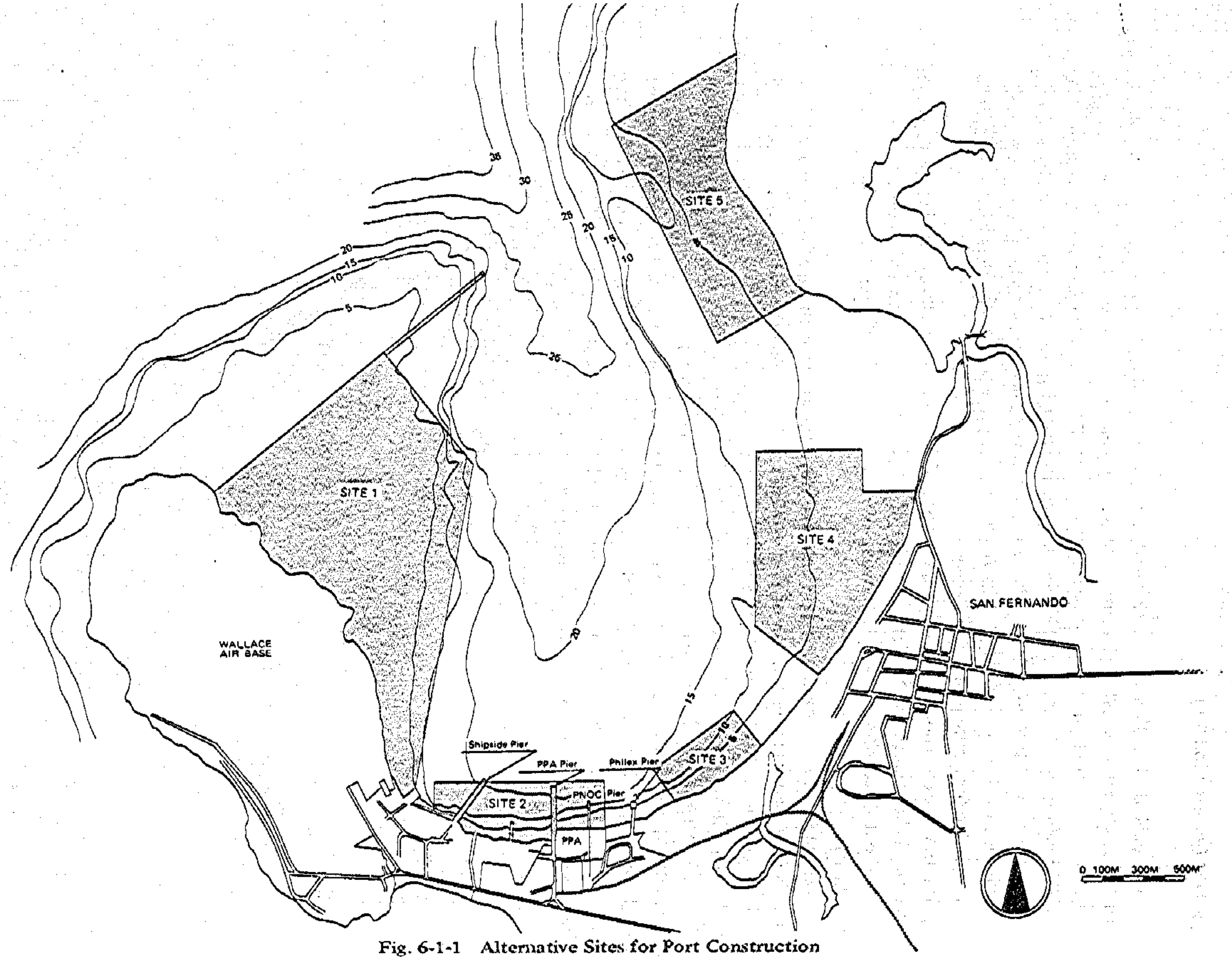


Fig. 6-1-1 Alternative Sites for Port Construction

Table 6-1-1 Comparison of Alternative Sites

<table>
<tr><th>Alternative Site</th><th>Advantages</th><th>Disadvantages</th><th>Tentative Conclusion</th></tr>
<tr><td rowspan="2">1</td><td>o less effect by waves
o easy to acquire large space by reclamation
o easy access to the existing port area</td><td></td><td rowspan="2">eligible site</td></tr>
<tr><td colspan="2">o remove from the town center</td></tr>
<tr><td>2</td><td>o possible to make efficient use of the existing port area
o easy to maintain the functional relations with the existing facilities</td><td>o some effect by waves</td><td>eligible site for the short term development plan</td></tr>
<tr><td>3</td><td></td><td>o some effect by waves
o difficult to acquire enough space for port activities
o separated from the existing public port by the Philex pier</td><td></td></tr>
<tr><td rowspan="2">4</td><td>o possible to get large space by reclamation</td><td>o subject directly to waves
o remote from existing port area
o to lose the natural beach adjacent to the town center</td><td rowspan="2"></td></tr>
<tr><td colspan="2">o adjacent to the town center</td></tr>
<tr><td>5</td><td></td><td>o inroad of NNW and NW waves
o remote from the existing port area</td><td></td></tr>
</table>

6-2 Main Factors Concerned with Port Planning

6-2-1 Shipsize

On the basis of the shipsizes of vessels which actually visit the Port of San Fernando and also those of vessels which are in operation of Japan in Appendix 6-1 and in view of the trend of increasing shipsize, especially for bulk carriers, the tonnages shown in Table 6-2-1 are taken as the maximum size of ships under this plan.

Table 6-2-1 Maximum Size of Vessels

Type of Vessel	Dead Weight Tonnage	Remarks
General Cargo Vessel	15,000 DWT	foreign trade
Bulk Carrier	50,000 DWT	for fertilizer for mineral ores
Coal Carrier*	5,000 DWT	domestic trade
Oil Tanker**	16,000 DWT	domestic trade

Note: *) According to PNOC, 5,000 DWT coal carriers are used to carry transhipped coal from Batangas to San Fernando

**) Oil carriers of 16,160 DWT are actually in operation from Batangas or Bataan to San Fernando

6-2-2 Length and water depth of berths

From an analysis of the dimensions of the ships under 30 years of age which are listed in Lloyd's Register of Ships, and in the Register of Japanese Shipping, it was found that the length overall and the full-load draft of ships have certain correlations with shipsize (Appendix 6-2).

Therefore, the length overall and the full-load draft of the ships of the maximum size (as mentioned in 6-2-1 above) may be determined as shown in Table 6-2-2. As it is necessary to provide some allowance for both the length overall and the full-load draft to account for the bow line and stern line and for the keel clearance, the length and the water depth of berths are determined as shown in Table 6-2-3.

Table 6-2-2 Length Overall and Full-load Draft of Vessels

Type of Vessel	Dead Weight Tonnage (DWT)	Length Overall (m)	Full-Load Draft (m)
General Cargo Vessel	15,000	160	9.0
Bulk Carrier	50,000	230	12.0
Coal Carrier	5,000	100	7.0
Oil Tanker	16,000	160	9.0

Table 6-2-3 Length and Water Depth of Berths

Type of Vessel	Dead Weight Tonnage (DWT)	Length of Berth (m)	Water Depth of Berth (m)
General Cargo Vessel	15,000	185	−10.0
Bulk Carrier	50,000	285	−14.0
Coal Carrier	5,000	130	−7.5
Oil Tanker	16,000	185	−10.0

6-2-3 Number of berths

(1) Short term development plan (up to 1990)

The plan for the year 1990 must be sufficient for handling the estimated cargo volume of 1,900,000 tons which was mentioned in Chapter 5.

From the view point of berth allotment and for the estimation of the required number of berths, cargoes to be handled at the Port of San Fernando are classified into three categories as shown in Table 6-2-4. Those categories are 1) oil products and coal which it is desirable to handle at the PNOC pier originally designed exclusively for coal, 2) mineral ores (mainly copper concentrates) which are mostly handled at the Philex pier, and 3) other items which are handled at the PPA owned berths including the pier currently operated by the Shipside Inc.

Table 6-2-4 Cargo Volume and Berth Allotment in 1990

(,000 MT)

	Cargo Volume in 1990	Berth to be Alloted
Oil Products and Coal	570 (oil products 320 coal 250)	PNOC Pier
Mineral Ores (copper concentrates)	160 (mineral ores 200 x 80%)	Philex Pier
Other Items	1170	PPA Facilities

Note: *) The share of mineral ores handled at the Philex pier varied from 68% to 79% in the years from 1978 to 1982. In this plan, 80% of mineral ores are assumed to be handled at the Philex pier.

1) Oil products and coal

Unloading of oil products is currently carried out at the PPA pier and the Shipside pier. From the viewpoint of safety, however, it is desirable that the handling of oil products be separated from that of non-dangerous cargoes and be concentrated at assigned berths.

The throughput of oil products in 1990, target year of the short term development plan, is estimated at 320,000 tons which corresponds to 80% of the average figure for the last five years. From the actual performance of 1980 – 1982, the number of oil tankers calling at the Port in the target year is calculated at six per month and their stay at berth is only two days per calling.

While, on the other hand, the estimated volume of coal in 1990 is 250,000 tons and this volume can be transported by a weekly service of one 5,000 DWT coal carrier and handled in one day by an unloader with a capacity of 400 tons per hour. This means that coal carrier will visit the port once a week and stay only one day for each calling.

Therefore, with additional facilities for oil tanker berthing and oil handling and with some arrangements for berth assignment, the PNOC pier will be able to handle both coal carriers and oil tankers. This will eliminate a dangerous situation which might be caused by a mixed berthing at the PPA pier of oil tankers and other vessels.

2) Mineral ores

According to the records of the last three years, 80% of the mineral ores, mainly copper concentrates, handled at the Port of San Fernando were loaded at the Philex pier, and the rest at the pier operated by Shipside Inc.. It is assumed, therefore, that 80% of all mineral ores handling in 1990, i.e. 160,000 tons, will be loaded at the Philex pier, and the remaining 40,000 tons (20% of the total) will be handled at the PPA pier.

The Philex pier is equipped with mineral ores handling facilities with a capacity of 400 – 600 tons per hour, and behind that there are enough storage spaces to export more than 200,000 tons a year.

The berth line of the pier is nearly at a right angle to the direction of the incoming off-shore waves which come directly into the berthing area, maintaining fairly high waveheight in spite of sea bed friction. Besides, the water depth of berths is around –8 m, not deep enough to accommodate fully loaded large bulk carriers.

Thus, the berthing conditions of the Philex pier are not so favorable. Judging from the actual performance of the pier, however, it is reasonable to estimate that the Philex pier will be able to handle 160,000 tons in 1990.

3) Other items

Other cargoes, i.e. cement, fertilizer and miscellaneous cargoes are mostly foreign trade cargoes, and will be handled at the PPA pier. The total volume of cargoes is estimated to be 1,170,000 tons in 1990, including 40,000 tons of mineral ores.

It is not an easy task to accurately estimate how many berths will be needed in a given port, because the calculation to determine the number of berths must be based on a variety of factors.

These factors are; i) the conditions of port facilities, ii) the productivity of harbour workers, iii) the volume of cargo loaded on or discharged from each vessel and so on. The required number of berths is usually calculated from the estimated cargo handling capacity of the port or theoretically determined by queuing simulation.

As explained in Appendix 6-3, the average tonnage of non-liquid cargoes handled per meter run at the Port of San Fernando is reasonably expected to be 1,000 tons. In other words, 200,000 tons of cargo can be handled at a 200 m berth. This means that more than five large berths will be needed to handle 1,170,000 tons of cargo. From the results of a calculation made by using queuing simulation (Appendix 6-4), it is concluded that five large berths including the existing PPA pier must be in service in 1990 to cater to the calling vessels expected for the same year.

(2) Master plan

The master plan (target year 2000) must be sufficient for handling the estimated cargo volume of 3,700,000 tons, mentioned in Chapter 5. Also, it must give due consideration to the safety and efficiency of port activities.

From this point of view, the number of berths in the target year should be determined on the following basic considerations:

1) Dangerous cargoes, such as oil products, should be handled at berths specifically allocated for their handling, separately from non-dangerous cargoes.
2) Foreign trade bulk cargoes should, if the volume is large, be handled at specially designed berths which are equipped with high capacity handling facilities. It is desirable that those berths be located at a site where the depth of water can easily be increased to match the increase in the size of bulk carriers.
3) Cargoes to and from the processing plants which are expected to be located in the port area will be handled at their own berths. In the master plan, some of the reclaimed area is allocated for the location of a cement plant.
4) Other cargoes will be handled at the general cargo berths. For some kinds of cargo handled at the Port of San Fernando, new modes of transportation, such as the use of container vans, may probably be used. It is therefore necessary to design the berths so that they have enough space and are able to install new types of handling equipment.

As to item 1), judging from the actual performance in the Port of San Fernando and also from the examples of Japanese ports, two berths are necessary to handle the 500,000 tons of oil products.

As to item 2), the import of fertilizer and the export of mineral ores are expected to be done in bulk. They will need specially designed berths. In the case of fertilizer, a berth capable of accommodating 50,000 DWT class bulk carriers, as proposed in the short term development plan, will have enough capacity to handle imported fertilizer until 2000, the target year of the master plan. As for mineral ores, however, construction of a new pier will be necessary, because the existing Philex pier is, as mentioned before, not favoured with good sea conditions. The new pier must be deep enough to accommodate large ore carriers and, in addition, be equipped with loading facilities of high efficiency.

On the assumption that the existing Philex pier will handle 200,000 tons of mineral ores out of the estimated total tonnage of 1,000,000 tons, one more berth which can accommodate 50,000 DWT class ore carriers will be required for the remaining 800,000 tons. It is desirable that this berth will be located at a site which has sufficient water depth to accomodate the larger ore carriers expected to come in future.

As to item 3), the following observations will be made. Inexpensive waterfront land will, if coupled with efficient port facilities, be a big stimulant to the location of processing industries, especially those which use a large quantity of overseas raw materials.

The "Long Term Plan up to the Year 2000" and other national or regional long term development plans suggest the possibility and necessity of new location of many kinds of processing industries. Though it is difficult to forecast what kind of processing industries will be located in the port area of San Fernando, it is assumed that cement is one of the most likely.

As already mentioned in Chapter 5, the tonnage of cement export in 2000 is forecast at 700,000 tons. This implies that, in addition to the existing ones, a new cement plant will most probably be located in San Fernando.

A cement plant requires the transportation of a large volume of raw materials and its products. It is therefore reasonable that they would like a location in the waterfront area or some other site where cheap and efficient mass transportation is available. For the purpose of this master plan, assumptions are made that an additional cement plant will be built on the newly reclaimed land and that the balance between the forecast tonnage of cement exports in 2000 and in 1990 will be produced by the new plant and shipped through its own berths. For the import of fuel coal and export of cement, two berths capable of accommodating 15,000 DWT class vessels will be needed with some allowance for future expansion.

As to item 4), the volume of cargo to be handled at the PPA berths is estimated at around 1,000,000 tons, which means that five berths capable of accommodating 15,000 DWT vessels must be in operation.

Maritime container services, which started about 15 years ago, have come to dominate the major shipping routes in the world. It is assumed that many commodities handled at the Port of San Fernando in 2000 will be packed in containers. However, the volume of containerized cargo may not be large enough to justify the construction of a specialized container berth.

It is, therefore, desirable to construct conventional cargo berths having large spaces behind the quay walls, so that containerized cargoes can also be handled at the same berths.

(3) Conclusion

From the above observations, it will be concluded that the berths listed in Table 6-2-5 must be in service in 1990 and 2000.

Table 6-2-5 Number of Berths in Service in 1990 and 2000

	1983	1990	2000	Remarks
PPA	2	5	8*	including one berth for bulk carrier for fertilizer
Shipside	2	removed	removed	
Philex	1	1	1	
PNOC	1 (under construction)	2**	2	
Berth Owned by Cement Plant			2	
Berth for Ore Carrier			1	
Berth for Oil Tanker			2	

Note: *) The existing PPA pier is assumed, because of its narrow width, to berth only port service boats in 2000.

**) One berth is used for oil tankers up to 1990.

6-2-4 Space for port activities and industries

To ensure the efficient cargo handling, there must be ample space behind the quay walls, in which to establish transit sheds, storage yards, roads and other port-related public facilities. Also, it will be necessary to provide spaces in the port area for the location of manufacturing industries whose operation is largely dependent upon the port activities.

(1) Area for transit sheds

Transit sheds must be planned for some kinds of commodities, i.e. cement, bagged fertilizer and general cargoes. The area of the transit sheds is determined by the following equation

$$S = \frac{1}{\alpha} \times \frac{1}{\omega} \times \frac{N}{R}$$

where, S = the area of transit shed (m^2)

α = effective floor rate

ω = storing capacity ($tons/m^2$)

N = volume of cargoes using transit shed (tons/year)

R = turnover rate.

According to the Japanese technical standard for port facilities and the actual performance in the typical Japanese ports, the values of α and R are 0.6 – 0.7 and 20 – 25 respectively, and ω varies according to the kind and type of cargoes, as enumerated in Appendix 6-5. These values can be applied in the formulation of the development plan of the San Fernando Port, in which case 0.6 is taken for α and 25 for R.

Table 6-2-6 shows the area of transit sheds required for the movement of cargoes in 1990 and 2000.

Table 6-2-6 Area of the Transit Sheds in 1990 and 2000

(,000 m^2)

Commodity \ Year	1990	2000
Cement	9	16
Fertilizer	*17	*22
Others	5	13
Total	31	51

Note: *) Including bagging service area

(2) Area for open storage yards and warehouses

Of the cargoes to be handled at the Port of San Fernando, coal and mineral ores need open storage yards, and for cement, bagged fertilizer and other general cargoes, warehouses are necessary.

According to the technical standards mentioned in 6-2-4(1) and the actual performance in the typical Japanese ports, the area for the storage facilities can be determined by the same equation as that for the transit shed. In this case, 0.7 and 8 – 12 should be used for the values of α and R respectivery, and the figures enumerated in Appendix 6-5 should be used for the value of ω.

By taking 8 for the value of R, the necessary areas for open storage yards and warehouses will be calculated as shown in Table 6-2-7.

Table 6-2-7 Area of Open Storage Yards and Warehouses in 1990 and 2000

(,000 m²)

Facilities / Commodity \ Year	Warehouses 1990	Warehouses 2000	Open Storage Yards 1990	Open Storage Yards 2000
Cement (bag)	21	37	–	–
Fertilizer (bag)	12	22	–	–
Coal	–	–	20	32
Mineral Ores	–	–	21	53
Others	13	32	–	–
Total	46	91	41	85

(3) Area for oil products' depot

The tonnage per unit area of the oil products' depot existing in the Port of San Fernando is about 12 tons/m², about 2.0 times as large as that of similar facilities planned for the major Japanese ports.

In the short term development plan, the estimated volume of oil products is 320,000 tons, about 20% less than the actual tonnage recorded in the last several years. Therefore, no additional area will be required for the depositing of oil products. On the other hand, the master plan forecasts the volume of oil products at 500,000 tons, requiring an area of 8.3 ha for their depositing, and this area should be allocated in the master plan for the oil products' depot, including some room for future expansion, and also giving due consideration to the safety of port activities.

(4) Area for port-related public facilities

1) Roads

As there is no convenient railway service, the transportation to and from the hinterland areas of cargoes which are handled at the Port of San Fernando is mostly carried out by road.

The peak volumes of traffic generated by port activities are usually calculated by the following equation.

$$N = \frac{V \times \alpha}{\omega} \times \frac{\beta}{12} \times \frac{\gamma}{30} \times \frac{1+\delta}{\epsilon} \times \alpha$$

where, N = number of vehicles at peak hour

V = annual volume of cargoes handled (tons)

α = share of vehicles ($\alpha = 1$)

ω = load of a truck (tons)

β = rate of monthly variation

γ = rate of daily variation

ϵ = rate of loaded vehicles (trucks loaded with cargoes/total number of trucks)

δ = rate of vehicles related with port services

σ = rate of hourly variation.

From the data used for port planning in Japan as well as from the analysis of the monthly record of cargo movement in the Port of San Fernando, the variables in this equation are given values of $\alpha = 1.0, \beta = 1.7, \gamma = 1.6, \omega = 7, \epsilon = 0.5, \delta = 0.5$ and $\sigma = 0.13$

Thus, the peak hour number of vehicles in the years 1990 and 2000 are estimated at 600 and 2,000 respectively.

The trunk road passing by the study area is considered, judging from its present conditions, to be able to accommodate such peak hour traffic in 1990 and, with some small improvements such as the widening of the paved lanes, also in 2000. Generally speaking, as the economy of the region develops, the road trafic will increase. It is therefore desirable that a network of higher grade trunk roads be considered when formulating a comprehensive regional development plan.

The port will need at least two access roads to ensure the effective utilization of the land in the port area.

The necessary number of lanes is theoretically obtained by dividing the peak hour traffic load by standard number of vehicles per lane, i.e. 600 ~ 650 vehicles/lane. Thus two lanes provide enough capacity for the traffic volume estimated above. However, the access roads are often congested and are apt to disturb port activities. For this reason it is desirable to acquire enough space for at least 4 lanes per road, i.e. 22 m width in anticipation of future development. That is: sidewalk (3.0 m) + road way (7.0 m) + medium strip (2.0 m) + roadway (7.0 m) + sidewalk (3.0 m) = 22.0 m.

2) Space for other public facilities

In the port area, space must be reserved for the harbor-master's office, canteens, lavatories, parking areas, green zones and other port-related public facilities.

There is, however, no criterion for determining what area is adequate for these public facilities. In this plan, space will be allocated in the appropriate places in consideration of the layout plan of the port facilities such as the transit sheds, warehouses, open storage yards and roads, and also making reference to the examples of similar ports.

(5) Space for industrial activities

In Region I, there is one EPZ in Baguio and, in addition, EPZA is planning to put up a processing zone in an area near the Port of San Fernando. Further, a plan is being made for the establishment of an Industrial Estate in Bacnotan. The sites of these industrial estates, however, were selected in inland districts or in areas at some distance from the sea.

To promote economic development, as projected in the regional development plans, it is most desirable to induce processing industries to locate in the port area of San Fernando so that they can take advantage of shipping services for the transportation of their materials and products.

Though it is very difficult to specify the kind and scale of the industries that can be induced in that port area, sufficient space should be reserved in the master plan for the location of such industries as cement, metal, heavy machinery and some kinds of export-oriented industries. If such a plan has once been formulated as the Master Plan of the Port of San Fernando, the conditions for industrial operations will see a great improvement, which will lead to the inducement of processing industries to locate their plants in the district of San Fernando.

In this plan, about 17 ha will be allocated for the additional cement plant and about 35 ha for heavy or export-oriented industries.

6-3 Basic Considerations for Layout Planning

The layout plan of port facilities will be prepared on the following basic considerations;

(1) To ensure the safety of port activities,

- o the face lines of berths should have orientations such that vessels can be easily berthed or dispatched and are less affected by invading waves.
- o each berth should have the space necessary for a basin in front. In case of finger-type piers, the distance between the two piers should be at least equivalent to the length of the largest vessel expected under the plan.
- o in the master plan, the construction of breakwaters should be considered to protect the basins from waves coming in from the north-northwest.
- o the face lines of berths should be so arranged as to disperse the energy of the invading waves, and if necessary, some buffer ponds should be planned to reduce the magnitude of wave energy.
- o specialized berths for the handling of dangerous cargoes such as oil products should be located, as much as possible, separately from other berths.
  In case that such seperation of berths in infeasible, berth assignment should be made so as not to allow a loaded oil tanker and another vessel to moor in nearby berths at the same time.

(2) To ensure the efficiency of port activities

- o the layout of new berths should give due consideration to the functional coordination between those berths and the existing port facilities. This is especially important for the short term development plan.
- o each berth should have enough space behing the quay wall for apron, transit sheds, warehouses, roads and other port-related facilities. In the case of a pier type public berth, the pier should have a sufficient width so as to facilitate cargo handling between the berth and backup areas.
- o the layout plan of port facilities and the land use plan should be harmonized with each other.

(3) To be flexible for the future development

- o as much space as possible should be reserved behind the berths to prepare for the future