5. National and Regional Development Plan

5.1 National Development Plan

5.1.1 National Economic Development Plan

During the early 1990s,Vietnam experienced a rapid change in the transitional process to a market economy. An important policy issue in the late 1990s will be how to accelerate industrialization of the country.

The following two documents which have been recently published by the government address the main tasks and targets of socio-economic development to the year 2000.

- "Orientations and Tasks of the 1996-2000 Five Year Plan for socio-economic Development" (Report to the 8th National Congress of the Communist Party of Vietnam, June 1996)

- "Socio-economic Development and Investment Requirements for the Five Years 1996-2000" (Government Report to the Consultative Group Meeting, December 1995)

The main tasks and targets of the Socio-economic Development and Investment Requirements for the Five Years 1996-2000 are as follows.

1) Achieving an economic growth rate that exceeds that of the previous 5 years. GDP is projected to grow at an average annual rate of 9-10 %, with the agriculture sector (including forestry and fishing) projected to increase by 4.5 to 5 %, industry by 13-14 %, and the service sector by 11-12 % per year. By the year 2000, the share of industry in GDP is projected to be about 34-35 %, agriculture about 19-20 %, and the service sector about 45-46 % of GDP.

2) Improve national fiscal performance. Increased national income, and a rapid increase in state tax revenue collection to about 21-22 % of GDP, will contribute to the target of reducing the fiscal deficit and ensuring that it remains under 5 % of GDP, and will increase Government capacity to control inflation to an annual rate of less than 10 %. other important goals are: improving our international balance of payments and meeting foreign debt servicing obligations; developing the financial market, especially for

medium and long term finance; increasing total investment capital by 2.2 times compared with the previous 5 years; and maximizing mobilized domestic savings to reach a target level equivalent to 15 % of GDP.

3) Develop and increase the effectiveness of external economic relations and expand import and export markets. Export earnings are projected to increase at an annual rate of about 24 to 28 %, while import costs are projected to increase at an annual rate of 22-24 %. This requires measures to increase the competitiveness of goods and services, and to satisfy the necessary conditions for participation in regional free trade agreements. Efforts will continue to improve the investment environment, to increase domestic capability to absorb foreign investment and technology, to facilitate implementation of ODA financed projects, and to attract more external resources to develop socio-economic infrastructure.

4) Solve critical social issues. Promote implementation of population and family planning strategies; implement job creation programs; increase capability in science and technology; develop education and training, culture, information, and health care; gradually improve the living standard of the people; and create distinct changes in society to bring into play the domestic resources needed to promote and sustain the development process.

5) Create the necessary prerequisites, in terms of human resources, infrastructure, capital, technology, and institutional policies needed to achieve faster growth during the early part of the next century.

6) Continue strengthening economic reforms, closely linking this with administrative reform, to establish a comprehensive market mechanism, and ensure more effective implementation of law and order in society. Maintain social stability and national security.

On the other hand, Orientations and Tasks of the 1996-2000 Five Year Plan for socio-economic Development includes the following infrastructure development programme related to ports.

Consolidate and expand the capacity of existing seaports, and gradually build the ports of Cai Lan, Chan May, Lien Chieu, Dung Quat, Ben Dinh-Sao Mai and Vung Tau. To build the Can Tho port into the central port of the Mekong delta, raising its capacity to 0.5 million tonnes in 2000. To dredge and redirect riverflows, upgrade the

main riverports, ensure smooth river navigation for up-to-1000-tonnes capacity barges in the Northern Delta and for 2000-tonnes capacity vessels into the hinterland in the Southern Delta.

Concerning investment, Socio-economic Development and Investment Requirements for the Five Years 1996-2000 stated the followings.

1) In recent years, Vietnam has achieved a high economic growth rate with very modest investment (the Incremental Capital Output Ratio (ICOR) is only about 2.0-2.5) because Vietnam is still at a low level of development.

2) During the next few years the ICOR is expected to increase, because more investment should be made in creating new capacity, and to promote the construction of new infrastructure. Given the emphasis on laying the foundations for development during the 21st century, ICOR during the period 1996-2000 is projected to increase from 3.0 to 3.3. Thus, the investment requirement needs for the five years 1996-2000 is estimated at USD 41-42 billion (1995 prices), a 2.2 fold increase compared with that of the previous five years 1991-1995.

3) Vietnam aims to mobilize domestic resources amounting to 15 % GDP for investment in development. This is equivalent to more than half of the total projected social investment.

4) Together with economic growth, economic policies and institutions will continue to be reformed in order to strengthen their capacity, and parallel efforts will be made to encourage savings and investment by enterprises and households along with increased levels of government savings, in order to achieve resource mobilization targets.

5)Together with domestic resources, external funds will continue to be mobilized mainly in the form of ODA and FDI, in order to achieve the total target for investing in development, during the period 1996-2000, of 30 % of GDP. Development resources are projected as follows.

Investment	Billion USD
Domestic	21
Foreign	20~22
- ODA	7~8
- FDI	13~14

Source: Ministry of Planning and Investment

5.1.2 National Port Development Master Plan

Vietnam National Maritime Bureau (Vinamarine) prepared a master plan entitled "Development Plan for Seaports in Vietnam" in June, 1995, and revised the master plan in early 1997. The master plan suggests that the major direction of development is to invest in building big port groups with a view to accommodate container ships of 50,000 DWT, dry bulk cargo ships of 70,000-80,000 DWT and oil tankers of 50,000-200,000 DWT. Pointing out that handling productivity is low compared with regional countries, it also proposes that modern handling technology be introduced in the existing ports to meet the current trend of containerization.

Regarding port planning and management, the master plan emphasized that the development plan and scale of ports should be defined in line with the socio-economic demand of each specific region and balanced development of the economic regions of the country.

Cargo throughput in the year 2000 is estimated at 106,500,000 tons and in the year 2010 at 267,000,000 tons. While cargo growth rate is not indicated, it is approximately 20% for the period of 1995-2000 and 10% for the period of 2001-2010. There is also an other forecast in the masterplan which estimates the cargo throughput in the year 2000 at 80 million tons, of which international cargo is 62 million tons, and in the year 2010 at 216 million tons, of which international cargo is 159 million tons.

Communist Party of Vietnam released a report entitled "Orientations and Tasks of the 1996-2000 Five Year Plan for Socio-economic Development" in June 1996. A chapter of the report assigned to infrastructure development programme mentioned that the ports of Cai Lan, Chan May, Lien Chieu, Dung Quat, Ben Dinh-Sao Mai and Vung Tau shall be built gradually to consolidate and expand the capacity of existing seaports. Can Tho Port will be built as the central port of the Mekong Delta, raising its capacity to 0.5 million tons in 2000. Main river ports shall be upgraded to ensure smooth river navigation for up to1000-ton capacity barges in the Northern Delta and for 2000-ton capacity vessels into the hinterland in the Southern Delta.

Cargo throughput projection taken from the above two reports is as follows:

1) Developments in Dredging and Port Construction in Vietnam[1]

Estimated Cargo Volume throughout Vietnam Seaport System 2000-2010:

Year 2000: 106,500,000 tons/year

Inclusive of a) Vietnam oriented Cargo: 93,500,000 tons/year;

b) Crude oil 20,000,000 tons/y and General dry cargo 73,500,000 tons/y;

c)Transit cargo from Lao PDR, Thailand, Cambodia, China: 3,500,000 tons/y;

d) International transhipment: 9,500,000 tons/year

Year 2010: 267,000,000 tons/year

Inclusive of a) Vietnam oriented cargo: 209,500,000 tons/year;

b) Crude oil 40,000,000 tons/y and General dry cargo 169,500,000 tons/y;

c) Transit cargo from Lao PDR, Thailand, Cambodia, China: 9,500,000 tons/y;

d) International Transhipment: 49,000,000 tons/year

Estimated Cargo Volume by Port Complexes:

Year 2000: 106,500,000 tons/year

Breakdowns:

Haiphong-Cailan 15 ports: 20,000,000-22,000,000 tons/y

Thanh Hoa-Nghe Tinh Area 7 ports: 3,000,000-4,000,000 tons/y

Quang Binh-Quang Ngai 8 ports: 18,500,000-20,000,000 tons/y

Binh Dinh-Binh Thuan 8 ports: 3,000,000 tons/y

Hochiminh-Vung Tau: 39,000,000-44,000,000 tons/y

Cuu Long Delta 11 ports: 4,400,000-4,800,000 tons/y

Year 2010: 267,000,000 tons/year

Breakdowns:

Haiphong-Cailan 15 ports: 44,000,000-47,000,000 tons/y

Thanh Hoa-Nghe Tinh Area 7 ports: 17,000,000-18,000,000 tons/y

Quang Binh-Quang Ngai 8 ports: 42,000,000-43,000,000 tons/y

Binh Dinh-Binh Thuan 8 ports: 5,000,000-6,000,000 tons/y

Hochiminh-Vung Tau: 78,000,000-86,000,000 tons/y

Cuu Long Delta 11 ports: 7,800,000-8,700,000 tons/y

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[1] Summary of Vimnamarine's Development Plan for Seaports in Vietnam, 2nd Asian and Australasian Ports and Harbour Conference, April 1997, Hochiminh City, Vietnam National Maritime Bureau

2) Orientations and Tasks of the 1996-2000 Five Year Plan[2]

Development policy of seaports:

- To consolidate and expand the capacity of existing seaports
- To gradually build the ports of Cai Lan, Chan May, Lien Chieu, Dung Quat, Ben Dinh-Sao Mai and Vung Tau.
- To build the Can Tho port into the central port of the Mekong Delta

[2] Five Year Plan for Socio-economic Development, June 1996, Vietnam, Chapter II Programmes and Areas of Development, 3. Infrastructure development programme

5.2 Regional Development Studies

5.2.1 JICA Central Region Integrated Development Study

"The Study on the Integrated Regional Socio-economic Development Master Plan for the Key Area of the Central Region of the Socialist Republic of Viet Nam" with target year of 2010 was implemented from November 1995 to January 1997. The study area includes Quang Tri, Thua-Tthien Hue, Quang Nam-Danang and Quang Ngai province. Industrial development zones surveyed by the study are summarized in Table 5.2.1 and Figure 5.2.1.

Table 5.2.1 Industrial Development plan of the Study Are

Province	Name of IE, EPZ and FTZ	Land Area Gross (ha)	Land Area Net (ha)	Land Area (%)	Number of Companies	Number of Employees (person)	Industrial Output (Mil.US$)
Thua Thien Hue	Chan May Port FTZ	1,200	200	75	87	17,400	3,000
	Phu Bai Airport Industrial Complex	400	300	75	150	25,000	5,000
	Van Xa IE	200	150	75	60	7,600	1,900
Quang Nam Danang	Danang EPZ	63	47	75	25	6,000	1,800
	Lien Chieu-Hoa Khanh IE	800	600	75	170	40,000	7,000
	Dien Nam - Dien Ngoc IE	418	314	75	180	30,000	2,300
Quang Ngai	Dung Quat Port IE	1,800	735	41	29	9,700	15,000
	Tinh Phong IE	200	140	70	40	6,000	580
	Quang Ngai Town IE	100	75	75	20	3,600	970
	Pho Phong IE	300	180	60	60	12,000	3,500

Source: JICA Central Region Integrated Development Study 1997

5.2.2 Master Plan Study on Coastal Shipping Rehabilitation and Development Project (JICA 1997)

Although Vietnam has experienced rapid economic growth over the past few years, transport infrastructure development cannot keep pace with such growth due to inadequate finance, insufficient technology and inexperienced management. This study was carried out to improve the coastal shipping system.

1) Objectives of the Study

- To formulate a master plan on coastal shipping development and its related subsector up to the year 2010;
- To prepare a short-term implementation plan consisting of priority projects to be incorporated into the aforementioned master plan; and
- To facilitate technology transfer to counterpart officials within the study scope by means of workshops and discussions.

2) Conclusions

Table 5.2.2 Traffic Demand Forecast 2000 - 2010

	Unit	Year 2000	Year 2010
Total Freight Volume	mil. tons	121.5-140.1	388-576
Sea Transport	mil. tons	50.2-60.4	167-258
Sea Foreign Trade	mil. tons	36.0-46.0	135-223
Sea Domestic Trade	mil. tons	14.2-14.4	32-35
Total Passenger Volume	mil. passenger	1,084-1,258	4,978-5,827
Sea Transport	mil. passenger	1.7	3.7

Coastal shipping in Vietnam has great development potential. There is a growing demand which can be economically and effectively handled by coastal shipping as planned industrial developments are implemented and regional economies in the north and south become more integrated. The economic benefits of coastal shipping development are significant as indicated by the estimated EIRR of 34%.

While the development potential of coastal shipping is significant, there are a number of conditions to be met to realize the expected effects of coastal shipping improvement. They include the following:

-Incorporation of coastal shipping into the overall transportation policy framework:
- Improvement of relevant infrastructures:
- Improvement of management of shipping operators:

- Improvement of regulatory environment.

3) Recommendations

Since the proposed development of coastal shipping system covers the whole country, it is recommended that three specific areas selected for short-term priority projects shall be implemented at the earliest possible time. They are:

- Program on north-south coastal shipping trunk route development;
- Program to meet international requirements; and
- Program on maritime human resources development.

In addition, to provide an appropriate policy environment for development of coastal shipping, the following recommendations are made for the government:

- For MOT to provide a clear policy statement and introduce more transparent regulations for coastal shipping which provide a level playing field for competing shipping operators;

- For the government to implement a program of equity and privatization of state and provincial-owned ship operators;

- For VINAMARINE to allow the autonomous management of ports with delegated responsibilities for finance and meeting performance targets, and the power to sub-contract various port services;

- For VINAMARINE to improve pricing of ports and waterways to encourage efficiency and adequate cost recovery;

- For MOT to strengthen VINAMARINE as the key regulatory organization for coastal shipping by ensuring adequate finance and removal of its remaining commercial functions, as well as resolving the overlapping responsibilities of VINAMARINE and IWA(Inland Waterway Administration); and

- For MOT to implement the required legal changes to introduce the improved regulatory framework regarding import and registration of ships, inspection standards of ships, quality standards for shipbuilding and repair, etc.

5.2.3 The East-West Transport Corridor Study (ADB-Maunsell, December 1996)

The East-West Transport Corridor Study has been prepared for the Asian Development Bank under the Terms of Reference for Technical Assistance. The national executing agencies are: Ministry of Communication, Transport, Post and Construction in Lao PDR, the Ministry of Transport and Communications in Vietnam and The Department of Highways in Thailand. The Mekong River Commission Secretariat acted as co-ordinating Agency.

The study is part of the development of the transport sector in the Greater Mekong Subregion. It was commissioned to investigate the feasibility of developing transport corridors extending from the ports in central Vietnam, through central Laos to northeastern Thailand. This included consideration of possible new bridges across the Mekong River, and options for port improvement.

Three corridors were nominated for investigation: The northern corridor using Road 8 and leading to the port of Cua Lo near Vinh, the central corridor using Road 9 leading to Danang, and two alternative new routes for the southern corridor from Pakse, south Laos, to the port of either Danang or Quy Nhon.

1) Road

The two existing roads, Routes 8 and 9, provide the only recognized crossing points along the more than 500km length of the Animate Range forming the Lao/Vietnam border in the study area. Traffic volumes across the Lao/Vietnamese border, at about 200 vehicles/day for both roads combined, indicate the low level of east-west movement at present. Movements at the three Thai/Lao border crossing points are greater, but still very low compared to the projected volume if no national borders existed.

Review of the transport economic evaluation concluded that projects, if carried out in isolation, are economically worthwhile. The high values for IRR and benefit cost ratio for the projects are estimated for the Southern Corridor A (R-18) due to the relatively high volume of local traffic using the roads on the Vietnam sides. Upgrading of the existing Northern and Central corridors show lower returns on economic grounds.

Table 5.2.3 (1) Economic Appraisal of Road Projects

Route		Project cost (mUS$)	NPV (mUS$)	BCR	EIRR (%)
Northern R-8	Lao	20.3	8.6	1.6	17.4
	Vietnam	7.8	10.2	2.5	24.6
Central R-9	Lao	40.5	12.1	1.5	16.1
	Vietnam	22.6	4.3	1.3	14.7
Southern-B R-16	Lao	50.4	19.7	1.7	18.3
	Vietnam(new)	40.6	11.0	1.5	16.4
	Vietnam(14B)	30.0	32.9	2.9	29.3
Southern-A R-18	Lao	40.7	20.1	2.3	22.8
	Vietnam1	6.4	13.8	4.4	39.5
	Vietnam2	3.2	20.3	8.5	55.7

Source: The East-West Transport Corridor Study-ADB

Traffic volume on the EW Transport Corridor is estimated by two major growth scenarios, namely, the Base Case Scenario and the Dynamic Case Scenario. The estimated traffic forecast is shown in the following Table.

Table 5.2.3 (2) Estimated International Truck Flows

	1995	2000	2010	2019
Basic Case Scenario	131,700	212,200	396,600	744,000
Dynamic Growth Scenario	n.a.	23,600	138,100	492,000
Total (high case)	131,700	235,800	534,700	1,236,000

Source: The East-West Transport Corridor Study-ADB

Mekong River Bridges

Three bridges are examined in the Study as follows;

Project B1 : Pakse Bridge

Project B2 : Mukdahan - Savannakhet Bridge

Project B3 : Nakhon Phanom - Thakhek Bridge

Table 5.2.3 (3) Economic Appraisal of Bridge Projects

Bridge	Project cost (mUS$)	NPV (mUS$)	BCR	EIRR (%p.a.)
Mukdahan-Savannakhet	49.2	-10.5	0.66	7.5
NakhonPhanom-Thakhek	45.1	-8.3	0.61	8.1

Source: The East-West Transport Corridor Study-ADB

2) Ports

The investment needs of the following three ports are estimated at about US$ 559 million over a 25 year period.

Cua Lo Port: Approximately 33 % of its trade is related to international movements to /from Lao.

Danang Port: The major part of the growth is forecast as container movements. The present port at Tiensa is indicated to have an insufficient capacity for growth and the proposed new port site at Lienchieu is recommended to be built for the container trade. It is estimated that three new berths are required by 2005.

Quy Nhon Port: Quy Nhon Port is recommended to be expanded, but with a lower priority than Danang or Cua Lo in relation to the East-West Corridor Movements.

Table 5.2.3 (4) Economic and financial evaluation of port development projects

Port	Investments(1997-2019) (mUS$)	Internal rate of return (%)	
		Economic	Financial
Cualo	107	34 %	4 %
Danang	408	71 %	-ve
Quynhon	44	12 %	12 %

Source: The East-West Transport Corridor Study-ADB

5.2.4 The Master Plan Study on the Development of Steel Industry (JICA 1997)

1) Outline

The steel mill study in Vietnam commenced in September, 1996 and the final report of the study will be submitted in December, 1997. This study includes the master plan of the steel industry up to the year 2010 and the pre-feasibility study of the new plant.

Three alternative sites of the steel mill are proposed at Mui Ron near Vung Ang, Cua Sot near Thach Khe Mine and Dung Quat.

Major items to be studied are selection of the most feasible site, evaluation of domestic raw materials and designing process of the new plant.

2) Demand forecast in the master plan stage

Annual domestic consumption is projected at 6.4 million tons in 2010. New steel plant will provide 3 million tons of flat products and 1 million tons of billet annually. The rest will be provided by existing steel works and imports.

3) Evaluation of domestic raw material

The largest deposit of Thach Khe iron mine located in Ha Tinh province is classified as magnetic ore with zinc. This type of iron ore is not preferred for new plant compared with other foreign ones. Therefore, only a small volume of Thach Khe iron ore

will be purchased.

Hongai coal field in Quang Ninh basin is most attractive but this coal is anthracite which is not suitable for producing coke. There is no plan to purchase domestic coal.

4) Site selection

Mui Ron and Dung Quat have similar possibility for establishing of steel mill at master plan level. Differences of two sites are small as following:

- The initial investment cost of infrastructure of Mui Ron site is 18 million US$ cheaper than that of Dung Quat site.
- Dung Quat site can save 5 million US$/year of product transportation cost to the market than Mui Ron site.
- FIRR of Mui Ron is 6.67% and that of Dung Quat is 6.71%.

5.3 Road Development Plan

5.3.1 Haivan Pass Tunnel Project

Haivan Pass is located at the border spread over Thua Thien-Hue and Danang city. Above the pass on the mountain, many vehicles were caught in engine/mechanical troubles because of the steep slope and sharp turns. Falling rocks and landslides frequently occur and sometimes fall on vehicles with great force. This pass is the most dangerous point along Highway Route 1 and road improvement is of urgent necessity. The current length of this pass is about 20 km.

The World Bank conducted the pre-feasibility study on this pass up to June 1996. Three alternatives are considered in the report. But two routes are finally adopted. One route passes along the coast side with three tunnels. Three tunnels have lengths of 1.8 km, 2.5 km and 1.6 km respectively. The other route passes one long tunnel with a length of 5 km along the mountain side.

OECF contracted loan agreement of 5.5 billion Yen with the Government of Vietnam on this project. The completion of the project is expected in the year 2004 .

5.3.2 North South Highway

North South Highway will run along the western longitudinal axis and will be the second trans-Vietnam Highway, with Route 1 being the first.

1) Purpose of the Project

Tha main purpose is to develop the socioeconomic structures of west Thanh Hoa and Nghe An, linking all northern central provinces (to Danang) and to promote the strategic

development of the Central highlands.

2) Outline of the Project

The highway will stretch over 1,710 km in length, about the same length as the existing Route 1. The road, 23 meters in width, will have four principal lanes for motorized vehicles and two escape lanes.

3) Schedule of the Project

The highway will be built in two phases depending on the actual socio-economic conditions.

Phase 1 (1998-2005) : Build and upgrade the road over its length (1,710 km) with two lanes.

Phase 2 (2005-2010) : Widen the road and build it into a four-lane highway.

5.4 Industrial Zone Development Plan

5.4.1 The Dung Quat Industrial Zone (DQI)

The Dung Quat Industrial Zone (DQI) lies within two districts, Binh Son (Quang Ngai) and Nui Thanh district. Dung Quat Bay is located in the Northeast of Quang Ngai, in the coast of the East sea. An oil refinery with a capacity of 6.5 million tons per year is planned in the hinterland of the Dung Quat Bay. Following the development of the first oil refinery, the development plan encompasses further expansion of the refinery (the second), petrochemical plants, ship building and repairing, agriculture, forestry and sea product processing, steel manufacturing, automobile assemblies and others. Scale of each industry is estimated as in Table 5.4.1 and Table 5.4.3.

The DQI is expected to be one of the cores of the industrial belt between Da Nang and Quang Ngai. According to the "Study on the Integrated Regional Socio-Economic Development Master Plan for the Key Area of the Central Region of the Socialist Republic of Vietnam", it is also expected to generate significant benefits such as:

- Large foreign currency savings through the mainly import substituting production of the refineries and petrochemical industries
- Considerable creation of direct and indirect employment opportunities at all skill levels
- Accelerated infrastructure development, which will benefit not only the vicinity of the DQI but also the Province and the whole region, and
- Considerable technology transfer, which will take place during construction of the project and the life cycle of the various industries to be located in the DQI.

5.4.2 Infrastructure of DQI

According to the report mentioned above, the infrastructures which should be constructed in relation to DQI project are considered as follows.

1) Electric Thermal Power Station

The new power plant should be constructed to meet the power demand of DQI and to supply surplus electricity to the national grid. This plant is to be heavy oil supplied from the oil refineries of DQI.

2) Water Supply

Water supply and sanitation facilities should be equipped not only to support the industrial development but also in order to preserve the environment in the DQI and the adjacent area. At present, there are no water supply and sanitation facilities. In the course of industrial development, water supply facilities, sewage disposal facilities, storm water drainage and solid waste disposal facilities are proposed.

The water supply facilities will use water of B7 irrigation canal, Pho Tinh Reservoir and Nuoc Truong Reservoir as raw water. And sewage purified by the treatment plant will be discharged to the East Sea.

3) Road Planning

The road near the construction site is only 2 to 3 meters in width and it runs through wet land with small bridges. Therefore, roads in the DQI and adjacent area will be designed for heavy industrial use. In addition, a by-pass road for Qung Ngai Town and two parallel access roads from national highway No.1 will be needed.

Route No.18 (Pakse-Attapeau-No.14-Dung Quat) may be developed on a long-term basis and will serve cargo transportation between the south region of Lao PDR and part of Northeast Thailand and Dung Quat Port.

5.4.3 Other Industrial Areas in Quang Ngai Province

Some other industrial development plans are worked out by Quang Ngai Province, namely, industrial area in the west of Quang Ngai town, Tinh Phong industrial area and industrial area in the south of Quang Ngai. Sugarcane-sugar processing industry, wine & superior alcohol industry, mineral water & soft drink industry and others are planned there. Scale of each industrial area is estimated as in Table 5.4.2.

Table 5.4.1 Main Projects in DQI

Item	Scale(ha)
First Refinery	250
Second Refinery	270
First Petrochemical Complex	280
Second Petrochemical Complex	350
Ship Building and Repairing for Manufacturing and Assembling Oil Rig	225
Agriculture, Forestry and Sea Product Processing Industry	350
Light Industry	435
Provincial Industry Zone	420
Construction Materials Industry	200
Automobile Assembly Industry	480
Steel Mill	180
Metal Processing	330
Pilot High Agricultural Production	560

Source : Report on Study and Investigation for Establishment of Dung Quat Deep Sea Port and Industrial Zone in Quang Ngai Province (Institute of Physics-Hochiminh City Branch, Vietnam National Center for Natural Science & Technology:1994)

Table 5.4.2 Other Industrial Areas in Quang Ngai Province

Names of Industrial Areas	Development Abilities(ha)
West of Quang Ngai town	100
Tinh Phong industrial area	100
South of Quang Ngai	300

Source : The Quang Ngai Province's Overall Planning for Socio-economic Development in the period from 1996 to 2010 (Quang Ngai Peoples Committee, 1996)

Table 5.4.3 Main Configuration of the Dung Quat Industrial Estate

Name of Industry	Production Capacity	Industrial Land	Freight Volume
Petroleum Refinery No.1(year 2003)	6.5 mill.t/year	110ha	6.500 mil.t/year 5.938 mil.t/year
Petroleum Refinery No.2(year 2006)	6.5 mill.t/year	110ha	6.500 mil.t/year 5.454 mil.t/year
Petrochemical No.1 (year 2003) and Petrochemical No.2 (year 2006)	1.197 thous.t/year	100ha	0.063 mil.t/year
Electric Thermal Power Plant (year 2002)	150 MW	8ha	0.165 mil.t/year (oil)
Electric Thermal Power Plant (year 2005)	150 MW	7ha	0.165 mil.t/year (oil)
Ship Repair and Breaking (year 2007)	Ship Breaking upto 250,000 (500,000 t/year) Repair 80,000 to 250,000 DWT X 50/year	100ha	1.5 mil.t/year
Steel Scrap and Recycling Mill Electric Arc Furnace and Rolling Mills (year 2007)	Electric Arc Furnace 500,000 tons Hot & cold Mills	100ha	2.5 mil.t/year
Iron and steel related industries year(2008)	14 kinds of industries Output:121 mil.US$	110ha	1.7 mil.t/year
Petrochemical related industries (year 2008)	8 kinds of industries Output:103 mil.US$	90ha	1.5 mil.t/year
Total		735ha	31.985 mil.t/year

Source : The study on The Integrated Regional Scio-economic Development Master Plan for The Key Area of The Central Region of The Socialist Republic of Vietnam (Development Strategy Institute, Ministry of Planning and Investment : 1997)

5.5 Review of Dung Quat Port Development Plan

Quang Ngai People's Committee proposed and the Prime Minister approved the masterplan of the Dung Quat industrial zone, which is to develop the first petrochemical oil refinery in Vietnam by the year 2010. The masterplan aims at forming a complex of heavy industries behind the planned Dung Quat deep seaport and Chu Lai international airport. The planned port is expected to serve as a gateway to the south region of Lao PDR and the northeast of Thailand.

Petro-Vietnam made a feasibility study on the development of Dung Quat Oil Refinery and submitted a F/S report for the consideration of the Government at the end of March 1997. The Prime Minister and National Congress have already approved the development of oil refinery in Dung Quat, the report proposed an implementation plan of the development in two phases.

Quang Ngai People's Committee has organized a task force to promote the resettlement of local residents in the development area. Ministry of Transport will launch the construction work of road from Route No.1 to the planned port in 1997. The year 2000 is the target year of the completion of the first oil refinery.

Brief summary of the above mentioned development studies is as follows (see Table 5.5.1 for details):

(1) A Brief Introduction to Dung Quat Industrial Zone[1]

Port capacity planned: 20,000,000-30,000,000 tons/year

Industrial sections: 1,800 ha

(2) Study and Investigation for Establishment of Dung Quat Deep Seaport and Industrial Zone in Quang Ngai Province[2]

Physical capacity of the planned port: 80,000,000-100,000,000 tons/year

Inclusive of

Container handling capacity: 6,000,000 containers/year

Oil refinery: 6,000,000-15,000,000 tons/year (250 ha- 270 ha)

Petrochemical industry: (280 ha- 350 ha)

Ship building/repairing for manufacturing; Assembling oil rig: (225 ha)

[1/] Management Board of Dung Quat Industrial Zone Project, Quang Ngai Provincial People's Committee, 1996

[2/] Institute of Physics-Hochiminh City Branch, Vietnam National Center for Natural Science & Technology, June 1994

Steel mill: 2,000,000 tons/year (180 ha)
Metal processing works: (330 ha)
Agriculture, forestry and sea product processing industry: (350 ha)
Light industry: (435 ha)
Construction materials industry: (200 ha)
Car assembling factory: (480 ha)
Pilot project for high agricultural production: (560 ha)
Provincial industry zone: (420 ha)
Thermal power generation plant: 300-600 MW (22 ha)

(3) Petro Vietnam Dung Quat Oil Refinery 1st Stage Plan[3]

Capacity of Oil Refinery: 130,000 B/D (6,500,000 tons/year)

Crude oil: Vietnamese production

Crude oil transportation:	80,000-100,000 DWT tanker
Export of products:	20,000-30,000 DWT tanker
Domestic export:	5,000-6,000 DWT tanker

Consumption in the central region: 12-15 percent of total production

(4) Orientations and Tasks of the 1996-2000 Five Year Plan for Socio-economic Development[4]

Referring to the industrial development program of Vietnam, the report mentioned that the oil refinery shall be built with a capacity of 130,000 B/D (crude oil 6.5 million tons/year) and a petrochemical plant shall be constructed at the second phase of the oil refinery development.

[3] Petro-Vietnam, April 1997
[4] Communist Party of Vietnam, June 1996

TABLE 5.5.1 Review of Previous Cargo Forecast

Dung Quat Port

Studies	Year 2000	Year 2010	Future
Master Plan of Industrial and Infrastructure Development 1996-2010, August 1996, Prime Minister Decision		Thanh Hoa-Khanh Hoa 50 mil	Thanh Hoa-Khanh Hoa 200 mil
Central Vietnam Development Masterplan, November 1996, JICA	Central Region: 6.8 mil Tien Sa: 3.3 mil	Central Region: 42.8 mil (Oil Ref: 21.8 mil) Tien Sa: 3.3 mil Chan May/New Danang: 8.1 mil Dung Quat: 31.2 mil	
Introduction to Dung Quat Industrial Zone, 1996, Quang Ngai Province			Capacity: 20-30 mil
Dung Quat Deep Seaport and Industrial Zone Study, June 1994, Institute of Physics	Oil Refineray: 6-15 mil		Capacity: 80-100 mil
The Project of the Oil Refinery No.1, March 1997, Petro Vietnam	Crude oil: 6.5 mil		

Total Cargo Throughput in all Vietnam Ports

Studies	Year 2000	Year 2010
Vinamarine's Development Plan for Seaports in Vietnam, April 1997	Total: 106 mil Im/Ex 62 mil	Total: 267 mil Im/Ex 159 mil
Prefeasibility Study in Construction of Lien Chieu-Nam O Port, May 1995, MOT	60-70 mil	150-200 mil
Port Traffic Demand Survey for Masterplan Study on Coastal Shipping, May 1996, JICA Study Team and TESI	Ttl: 55-56 mil (Transit:2-3) (Tranship:5-10)	Ttl: 149-164 mil (Transit: 9) (Tranship: 20-30)

6. Demand Forecast

6.1 Methodology for Demand Forecast

6.1.1 Methodology

Two methods, a macro forecast and a micro forecast are generally used to forecast the future cargo volume. The macro forecast is based on the assumption that the cargo volume handled by the port reflects the economic activity in the port's hinterland. The total cargo volume is estimated using the historical relation between the cargo volume and macro economic indices. The other is a micro forecast which estimates the cargo volume of each commodity individually based on related indices, the forecast demand and supply situation and the development plans. The flow chart of the forecast method is shown in Figure 6.1.1 (1) and Figure 6.1.1 (2)

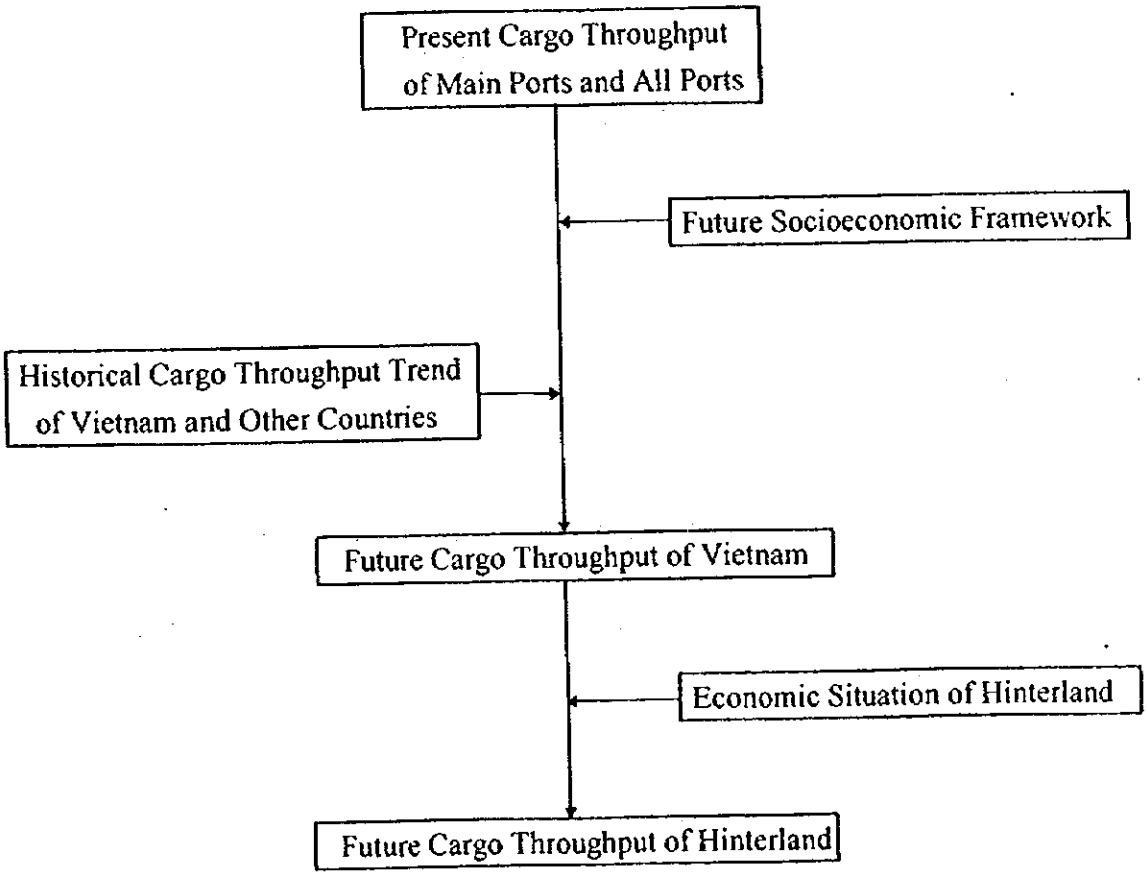


Figure 6.1.1 (1) Flow Chart of Macro Forecast

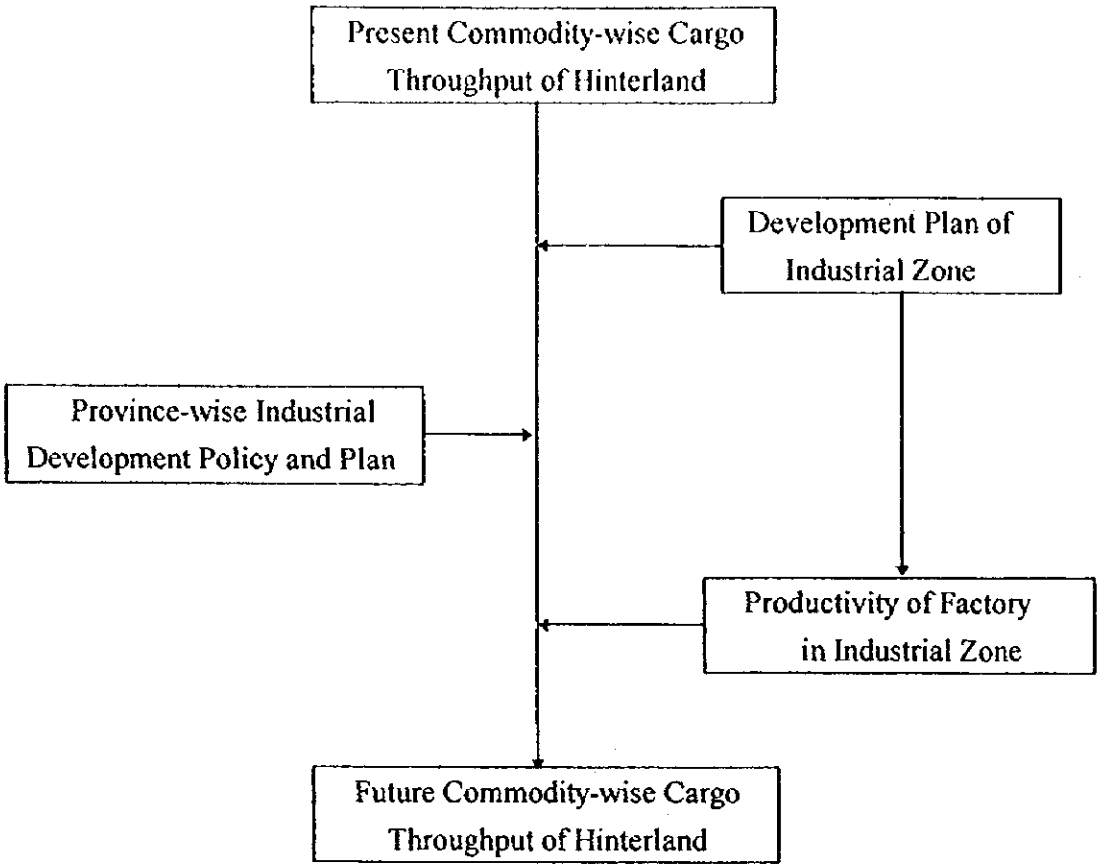


Figure 6.1.1 (2) Flow Chart of Micro Forecast

6.1.2 Hinterland

In order to forecast the future cargo volume of the Ports of Chan May, Lien Chieu and Dung Quat located in the study area, the hinterland should be defined. Danang port is located 54km away from Chan May port, 24km from Lien Chieu Port, 129km from Dung Quat port. Presently the national road No.1 is the main artery of distribution. Improvement of bridges and the main roads such as the national road No.1 and the opening of Hai Van Tunnel will improve traffic and distribution efficiency. Therefore, the hinterland of three ports could be regarded as a coincident area.

Taking into consideration the present hinterland of Danang port, future sea-lane and road network, geographical conditions, location and functional roles of ports around the study area, industrial policy including agricultural and industrial production planning

and transport planning in the study area and surrounding provinces, the hinterland of three ports is assumed to be the following five provinces and one city.

- Quang Tri Province
- Thua Thien Hue Province
- Danang City
- Quang Nam Province
- Quang Ngai Province
- Kon Tum Province

6.2 Socio-economic Framework

6.2.1 Population

Population of Vietnam in 1995 is 73,959,000 while that of the study hinterland is 4,972,000, or 6.72% of the total. The breakdown in the study hinterland is as follows: 541,000 in Quang Tri Province, 1,003,000 in Thua Thien Hue province, 1,948,000 in Danang city and Quang Nam province, 1,184,000 in Quang Nagi Province, 260,000 in Kon Tum Province.

Future population of all Vietnam and the study hinterland in 2010 and 2020 is estimated in Table 6.2.1(2) based on the growth rate forecast by Ministry of Planning and Investment-Development Strategy Institute (PIM-DSI) and Transport Development and Strategy Institute (TDSI) shown in Table 6.2.1(1). The ratio of the population to the study hinterland of the national population in 2010 and 2020 is estimated at 6.73%, almost the same as that in 1995. Forecast population growth of the study hinterland is shown in Figure 6.2.1.

Table 6.2.1 (1) Population Growth Rate

Unit: %

Area	-2000	2000-2010	2010-2020
Quang Tri	2.6	1.9	1.3
Thua Thien Hue	2.3	1.6	1.1
Danang & Quang Nam	2.0	1.4	1.0
Quang Ngai	2.2	1.6	1.1
Kon Tum	2.5	1.8	1.2
All Vietnam	2.1	1.6	1.1

Table 6.2.1(2) Population Forecast

(Unit: Person)

Area	2010	2020
Quang Tri	742,000	845,000
Thua Thien Hue	1,317,000	1,469,000
Danang & Quang Nam	2,517,000	2,782,000
Quang Ngai	1,547,000	1,726,000
Kon Tum	352,000	396,000
Hinterland Total	6,476,000	7,217,000
All Vietnam	96,174,000	107,292,000

6.2.2 GDP

GDP at current prices in 1994 is US$ 21.021 billion of which US$ 1.040 billion or 4.95% is derived from the hinterland. Province-wise GDP at current prices in the study hinterland is as follows: US$81.8mill. for Quang Tri Province, US$253.0mill. for Thua Thien Hue Province, US$482.2mill. for Danang City and Quang Nam Province, US$176.2mill. for Quang Ngai Province, US$46.4mill. for Kon Tum province.

Future GDP of all Vietnam and hinterland in 2010 and 2020 is estimated in Table 6.2.2(2) based on growth rate forecast by MPI-DSI and TDSI shown in Table 6.2.1(1). GDP of the study hinterland and its ratio in the nation's GDP are predicted to increase every year reaching 6.57% in 2010 and to 8.03% in 2020 (See Figure 6.2.2(1) and 6.2.2(2)).

Table 6.2.2(1) GDP Growth Rate

Unit: %

Area	-2000	2000-2010	2010-2020
Quang Tri	7.0	8.5	6.5
Thua Thien Hue	12.0	15.0	11.0
Danang & Quang Nam	11.0	13.0	9.9
Quang Ngai	8.0	13.0	9.9
Kon Tum	7.0	8.0	6.1
All Vietnam	9.5	10.5	8.0

Table 6.2.2(2) GDP Forecast

Unit: Mill.US$

Area	2010	2020
Quang Tri	277.6	521.0
Thua Thien Hue	2,020.3	5,946.5
Danang & Quang Nam	3,061.6	7,869.1
Quang Ngai	949.1	2,439.6
Kon Tum	150.3	271.8
Hinterland Total	6,458.9	17,047.9
All Vietnam	98,346.9	212,323.7

6.2.3 GDP per Capita

GDP per capita in 1995 based on Population and GDP is US$ 311, while that of the hinterland in 2010 and 2020 is estimated at US$ 231. Province-wise GDP per capita is as follows: US$162 for Quang Tri Province, US$283 for Thua Thien Hue Province, US$270 for Danang City and Quang Ngai Province, US$161 for Quang Ngai Province,

US$191 for Kon Tum Province.

Future GDP per capita of all Vietnam and the hinterland is summarized in Table 6.2.3. Forecast GDP per capita growth of all of Vietnam and the study hinterland are shown in Figure 6.2.3. GDP per Capita of the study hinterland is projected to exceed that of the nation in 2020 on the strength of large scale industrial development plans of Thua Thien Hue Province, Danang City, Quang Nam Province and Quang Ngai Province which are expected to bring substantial benefits to regional economies.

The difference in GDP per capita among provinces is pronounced. For example, in the study hinterland, GDP of Thua Thien Hue Province which has the largest GDP per capita in 2020 is forecasted to be approximately 6.6 times greater than that of Quang Tri Province of which GDP per capita is the smallest. At the national level in 1995, GDP per capita of Ba Ria-Vung Tau Province, which has the largest GDP per capita is approximately twenty times greater than that of Cao Bang Province while GDP per capita of Ho Chi Minh city is approximately six times greater than that of Cao Bang Province.

Generally, in the course of development, the economic gap between developed areas and less developed areas tends to expand, since investments concentrated in commercial and industrial sector in developed areas. Once initial investment boom has subsided, however, economic growth in developed areas tends to slow down and the gap among the regions or provinces is often eliminated or begins to shrink through expansion of economic activities which induces capital flow into less developed areas and measures such as policies to promote industry in less developed areas.

Table 6.2.3 GDP per Capita Forecast

Unit: US$

Area	2010	2020
Quang Tri	374	617
Thua Thien Hue	1,534	4,047
Danang & Quang Nam	1,216	2,830
Quang Ngai	613	1,413
Kon Tum	428	686
Hinterland Total	997	2,362
All Vietnam	1,023	1,979

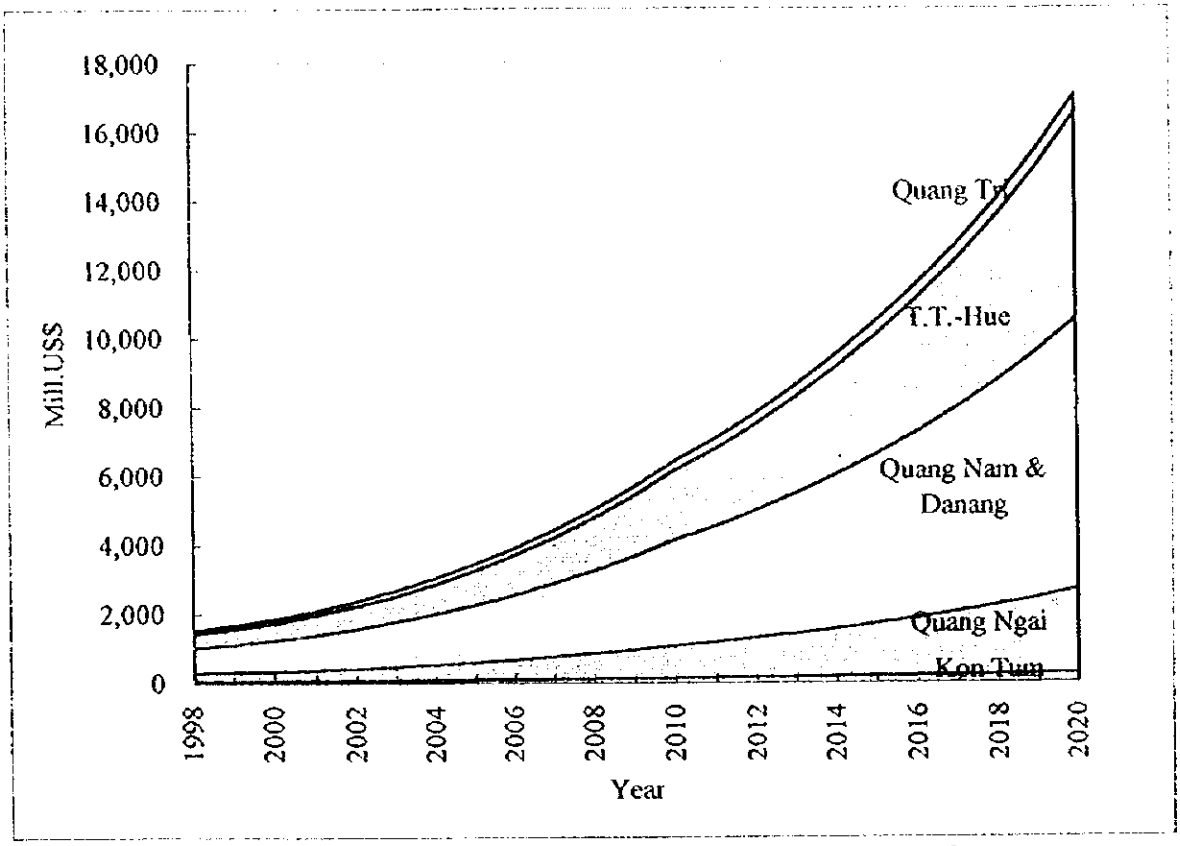


Figure 6.2.1 Province-wise GDP Forecast of Hinterland

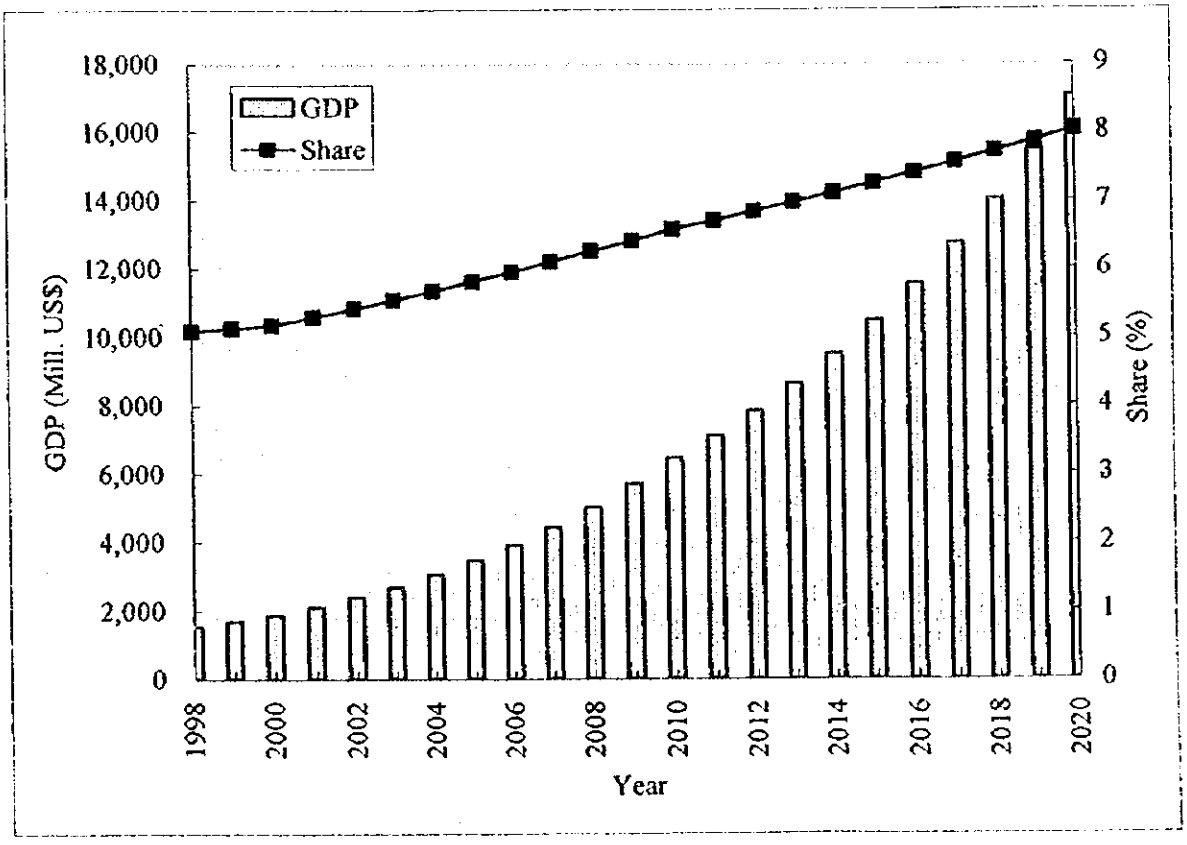


Figure 6.2.2(1) GDP Forecast and Share of Hinterland

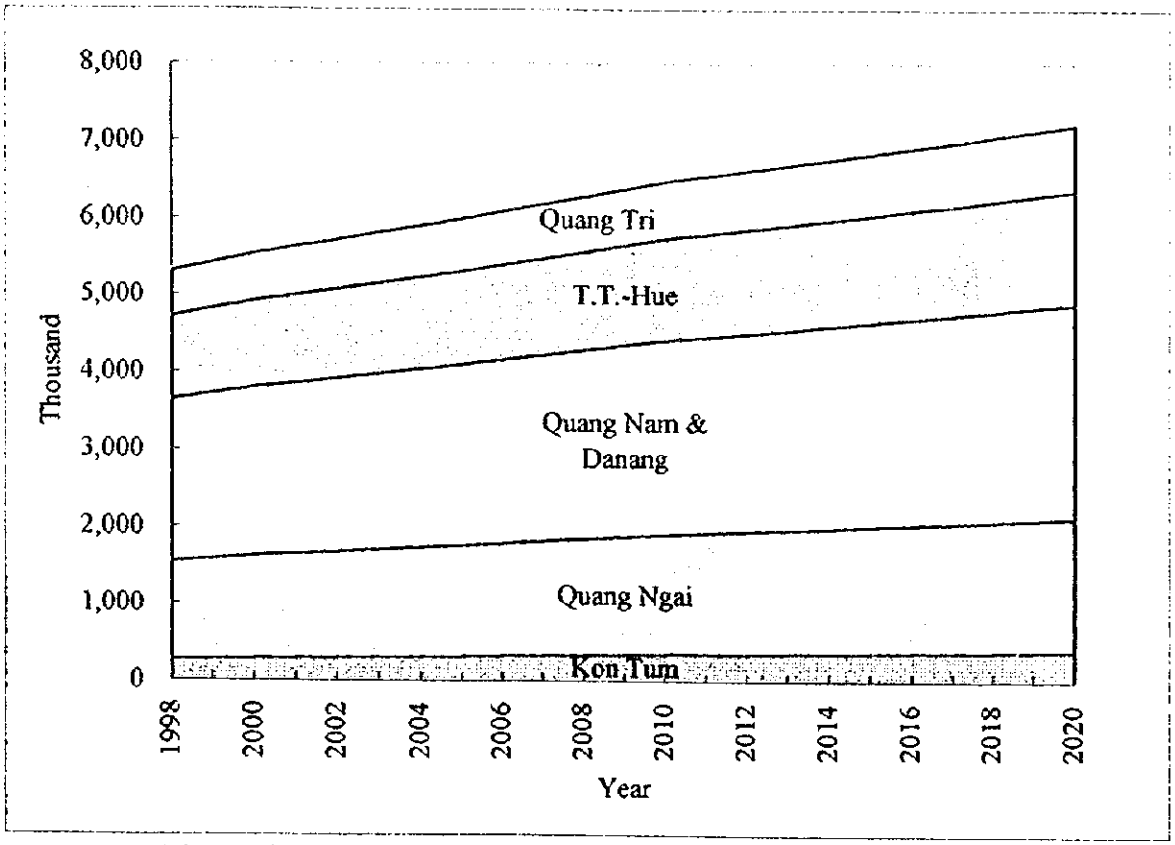


Figure 6.2.2(2) Province-wise Population Forecast of Hinterland

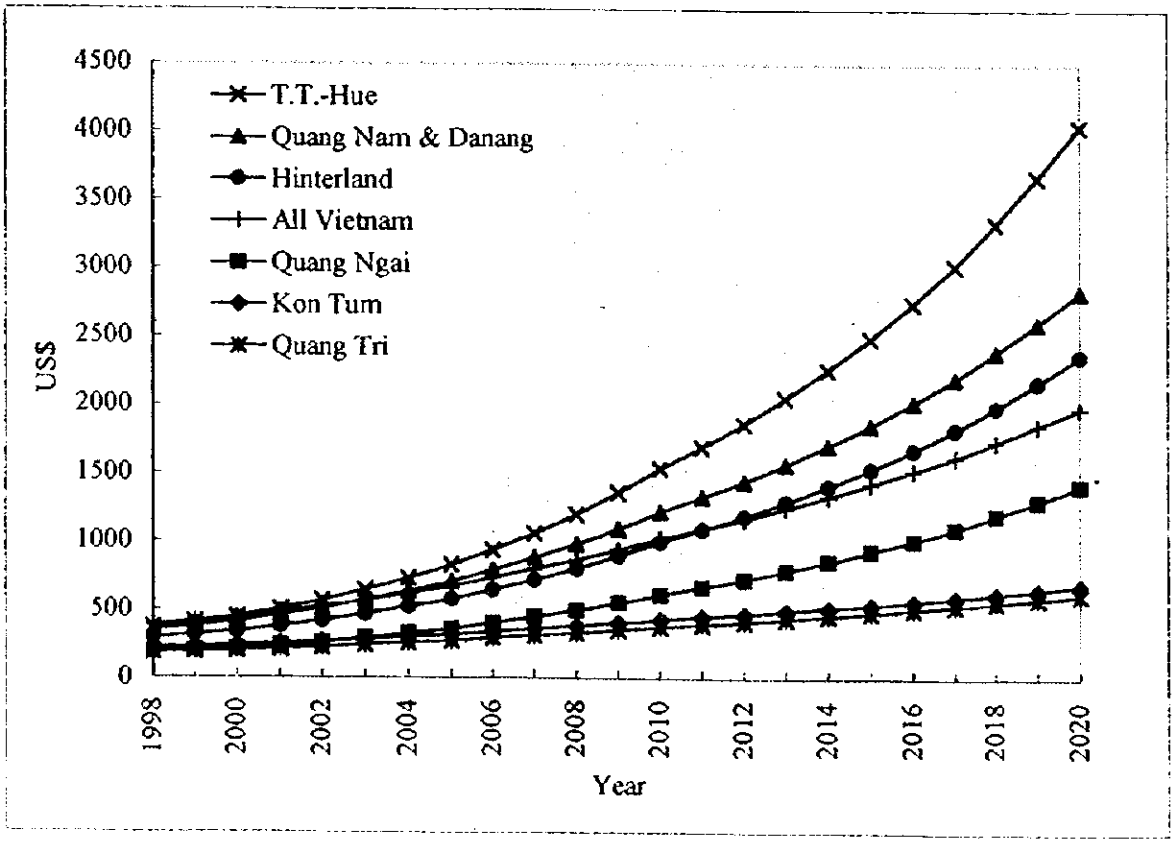


Figure 6.2.3 Province-wise GDP per Capita Forecast of Hinterland

6.3 Macro Forecast

6.3.1 Dry Cargo

(1) Scenario I

Total dry cargo handling volume of main ports (Hai Phong, Danang, Saigon, Quang Ninh, Nghe Tinh, Qui Nhon, Nha Trang, Can Tho) as shown in Table A6.3.1 has a close relation with GDP. Thus, total dry cargo handling volume of the study hinterland can be forecast the following equation based on correlation of above two historical trends.

Concerning GDP growth rate, Scenario I adopts growth rates from the MPI forecast [9.5% (1995-2000), 10.5%(2000-2010), 8.0%(2010-2020)] .

$$Y = (0.46280X - 4384.5) \times S$$

Y : Total cargo volume (Thousand Ton)

X : GDP (Million US$), modified 1987 constant price

S : GDP share of the study hinterland

Correlation coefficient: r = 0.972037

Forecast results in 2010 and 2020 are as follows and cargo volume growth since 2000 projected to 2020 is shown in Figure 6.3.1(1)

Scenario I

Unit: ton

	2010	2020
Total Dry Cargo	7,496,000	20,194,000

(2) Scenario II

Scenario II is almost the same as the scenario I except GDP growth rate which is assumed at 8.2%, the average GDP growth rate from 1991 to 1995.

Forecast results in 2010 and 2020 are as follows and cargo volume growth since 2000 projected to 2020 is shown in Figure 6.3.1(1)

Scenario II

Unit: ton

	2010	2020
Total Dry Cargo	5,654,000	15,624,000

(3) Scenario III

The import dry cargo volume per capita tends to increase as GDP per capita increase as shown in Figure 6.3.1(2) and correlation coefficient is 0.881158. Vietnam's current cargo situation is found on the upper line in Figure 6.3.1(2). Thus, import dry cargo volume of the study hinterland can be estimated by the following equation based on upper case of correlation between above two factors.

$$Y = (0.31374X - 0.49909) \times S$$

Y : Total cargo volume (Thousand Ton)

X : GDP per capita (Thousand US$), modified 1989 constant price

S : Population of the study hinterland (Thousand)

The export dry cargo volume of main ports has a close relation with GDP. Thus, export dry cargo volume of the study hinterland can be forecast by the following equation based on correlation of above two historical trends and GDP growth rate forecast by MPI..

$$Y = (0.12635X - 82.97) \times S$$

Y : Total cargo volume (Thousand Ton)

X : GDP (Million US$), modified 1987 constant price

S : Population share of the study hinterland

Correlation coefficient: r = 0.85408

Domestic cargo volume is forecasted to increase in accordance with economic growth as well as foreign trade. Thus, domestic cargo volume of the study hinterland can be estimated by actual domestic share of total cargo handling volume of all Vietnam in 1995 shown in Figure 6.3.1(3).

Forecast results in 2010 and 2020 according to above method are as follows and cargo volume growth since 2000 projected to 2020 is shown in Figure 6.3.1(1).

Scenario III

Unit: ton

	2010	2020
Import Dry Cargo	2,003,000	3,989,000
Export Dry Cargo	2,173000	4,693,000
Domestic Dry Cargo	785,000	1,632,000
Total Dry Cargo	4,961,000	10,314,000

6.3.2 Liquid Cargo (Petroleum Product)

(1) Scenario I

Total petroleum product demand has a close relation with GDP. Thus, total petroleum product demand of the study hinterland can be forecast using the following equation based on correlation of above two historical trends and average GDP growth rate from 1991 to 1995.

$$Y = (0.099156X - 1148.0) \times S$$

Y : Total cargo volume (Thousand Ton)

X : GDP (Million US$), modified 1987 constant price

S : GDP share of the study hinterland

Correlation coefficient: r = 0.960919

Forecast results in 2010 and 2020 are as follows and demand growth since 2000 projected to 2020 is shown in Figure 6.3.2.

Scenario I

Unit: ton

	2010	2020
Total Petroleum Product	1,198,000	3,331,000

(2) Scenario II

Total petroleum product demand is estimated by analyzing "The Report of the Study on the Development Plans of Petroleum and Petrochemical Industries for the Central Part of Vietnam" by Japan Construction Institute. Average annual demand growth rates of petroleum products either in Vietnam in 1992-1994 or in the ASEAN countries in 1971-1993 are used for the forecast.

Forecast results in 2010 and 2020 are as follows and demand growth since 2000 projected to 2020 is shown in Figure 6.3.2.

Scenario II

Unit: ton

	2010	2020
Total Petroleum Product	1,148,000	2,351,000

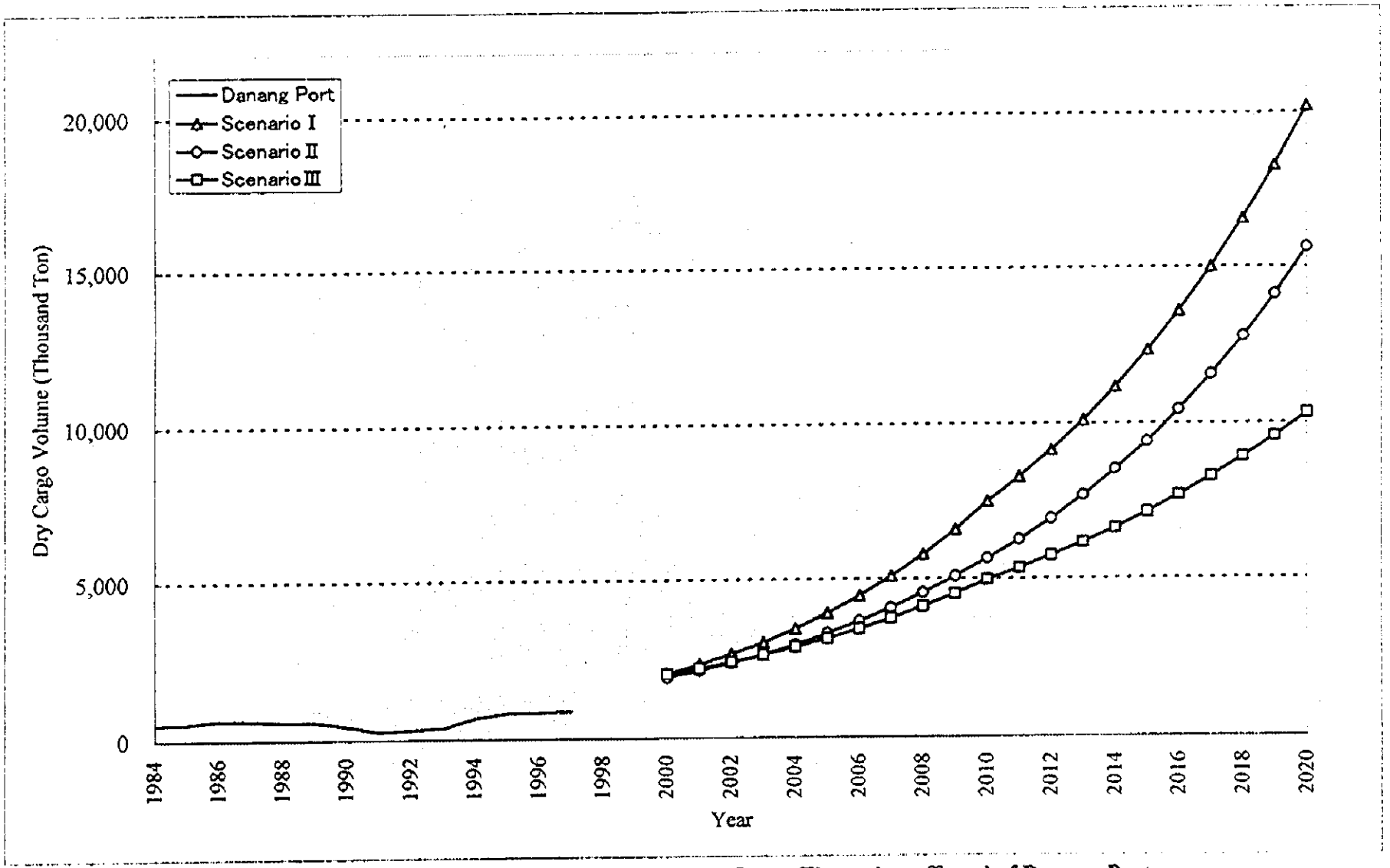
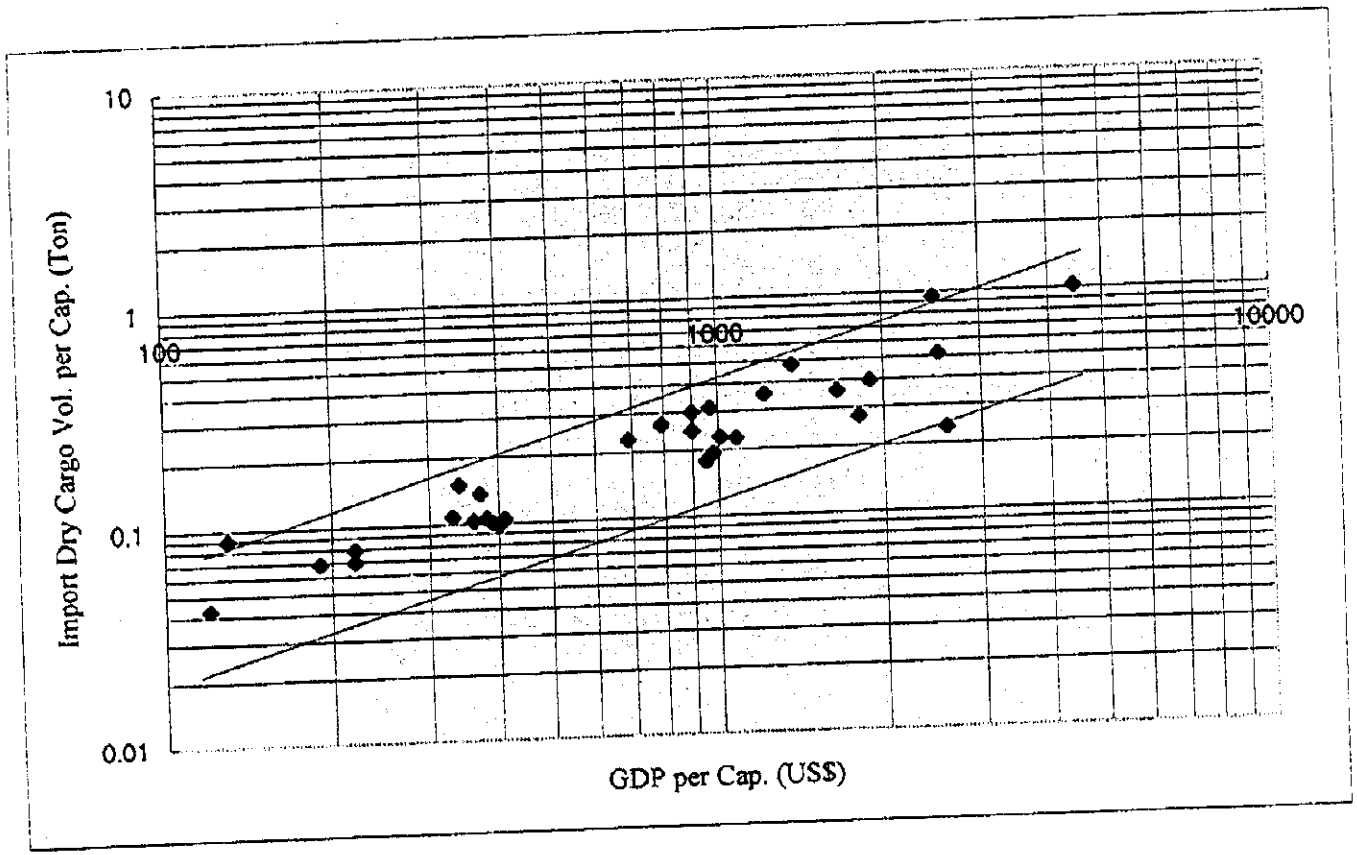


Figure 6.3.1(1) Cargo Throughput Forecast and Cargo Throughput Trend of Danang Port



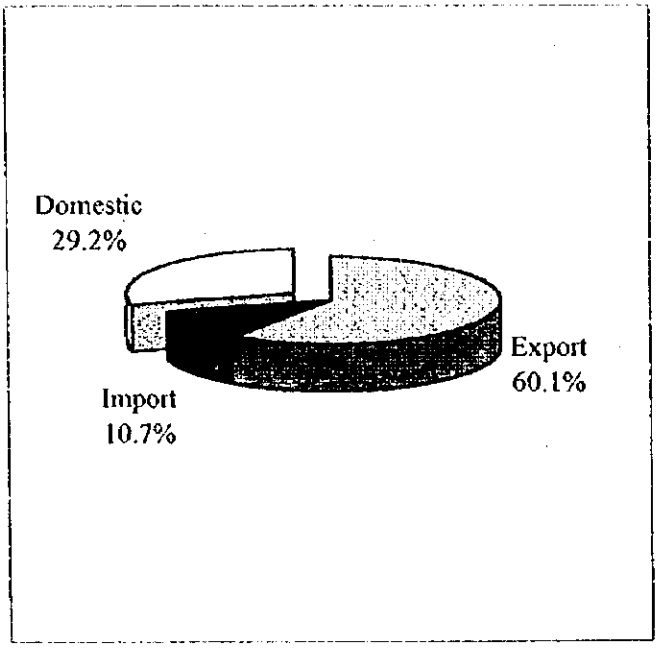
Country	GDP/Cap. (US$)	Cargo Vol. /Cap (Ton)
Portugal	4,460	1.022
Iran	2,590	0.238
Algeria	2,520	0.518
Venezuela	2,480	0.949
Poland	1,890	0.395
Panama	1,800	0.274
Costa Rica	1,650	0.359
Turkey	1,370	0.479
Thailand	1,220	0.355
Peru	1,080	0.225
Cameroon	1,010	0.229
Ecuador	980	0.193
Congo	970	0.313
El Salvador	950	0.177
P. New Guine	900	0.246
Morocco	900	0.300
Dominica R.	790	0.265
Philippines	690	0.230
Guinea	410	0.104
Togo	400	0.098
Pakistan	390	0.100
Ghana	380	0.105
Kenya	370	0.136
Haiti	360	0.102
Benin	340	0.150
Nigeria	330	0.108
Madagascar	220	0.070
Sierra Leone	220	0.079
Bangladesh	190	0.069
Somalia	130	0.090
Ethiopia	120	0.043

Statistics in 1989

The following countries are included:
- -Countries having population larger than one million
- -Countries having GDP per Cap. less than US$ 5,000

The following countries are excluded:
- -Countries where large volume of transship and transit cargoes are handled
- -Countries which import large volume of cargoes overland
- -Countries which are selfsufficient in grains and manufacturing products

Figure 6.3.1(2) Correlation between Import Dry Cargo Vol. per Cap. and GDP per Cap.



Classification	Volume (Ton)	Share (%)
Export	9,757,000	60.1
Import	1,742,000	10.7
Domestic	4,745,000	29.2
Total	16,244,000	100.0

Source: Coastal Shipping Study (JICA)

Figure 6.3.1(3) Cargo Classification of Vietnam in 1995

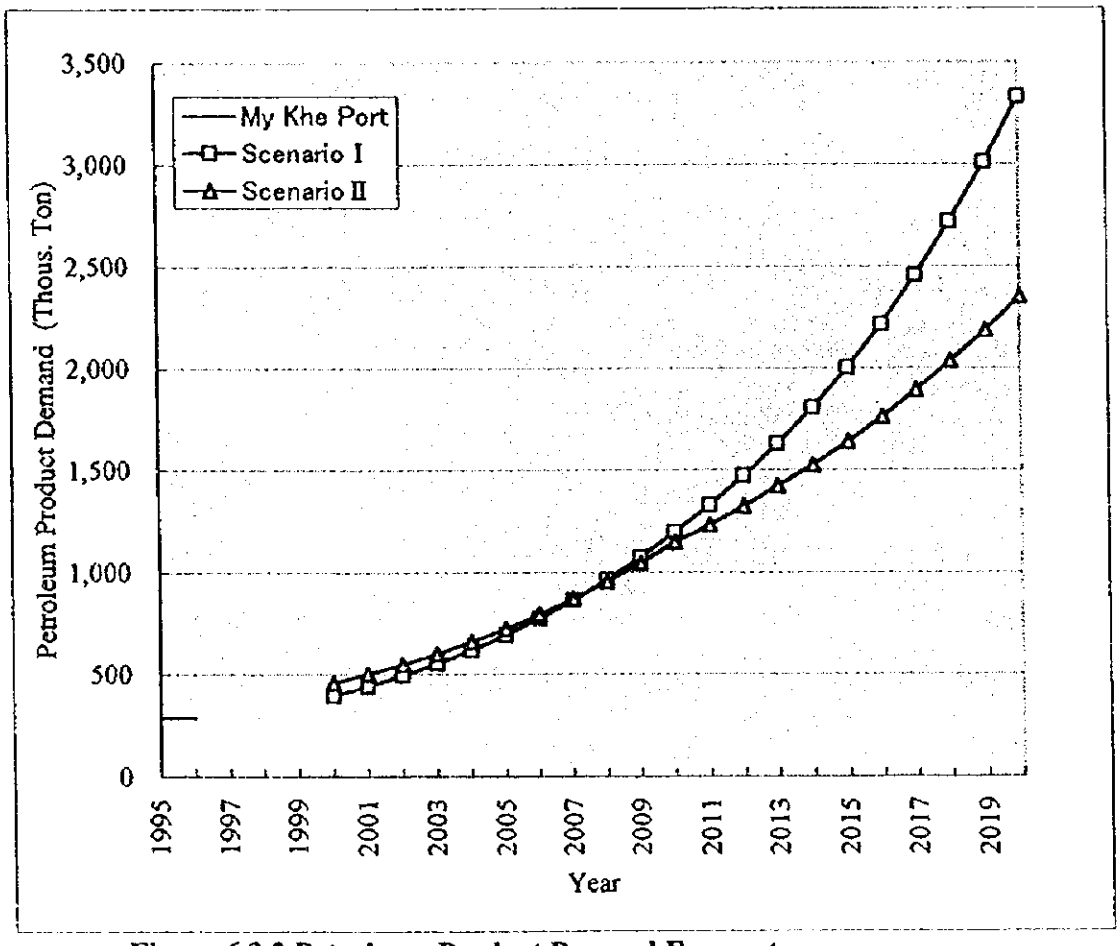


Figure 6.3.2 Petroleum Product Demand Forecast and Cargo Throughput (except for Transit) of My Khe Port

6.4 Commodity-wise Forecast

The major kinds of cargo from/to the DQI and other industrial areas in Quang Ngai province are crude oil, petroleum products, petrochemical products and iron & steel products. In this study, principal facilities listed in Vietnam's reports are assumed to start operation by 2020. The volume of each commodity group is estimated as follows.

6.4.1 Crude Oil

Crude oil is used for Oil Refinery Facilities planned in DQI. By the year of 2010, the first oil refinery will start up. The volume of crude oil handled at the port is estimated at about 6.5 million tons per annum, 60 percent of which is domestic crude oil. Furthermore, the second phase oil refinery operation will commence by 2020. The total crude oil volume will reach about 13 million tons at that time. The ratio of domestic crude oil supplied to the second refinery facility is 50%. Therefore, the volume of domestic and imported crude oil in 2020 is 7.15 million tons and 5.85 million tons respectively.

Unit : ton

		2010	2020
Foreign	Import	2,600,000	5,850,000
Domestic	Unloading	3,900,000	7,150,000

6.4.2 Petroleum Products

A part of petroleum production from the refinery is used for Petrochemical Plants and Petrochemical Related Industries as feed stock. The remainder is shipped and used to meet domestic market demand. The shipping volume of petroleum production is estimated to be 6 million tons in 2010. In 2020, the volume will amount to 11.4 million tons.

Unit : ton

		2010	2020
Domestic	Loading	6,000,000	11,400,000

6.4.3 Petrochemical Products

The Petrochemical Plants and The Petrochemical Related Industries use petroleum produced in the oil refinery and make petrochemical products to meet domestic demand. The ratio of shipping volume to northern or southern part of Vietnam is assumed to be 90%

of the total. Volume is estimated to be 0.25 million tons and 0.5 million tons per annum in 2010 and 2020 respectively.

Unit : ton

		2010	2020
Domestic	Loading	250,000	500,000

6.4.4 Scrap Steel

As the material for the Scrap & Recycling Facility, 1.5million tons of scrap steel will be imported. Also, it is estimated that Iron & Steel Related Industries will use 1 million tons of scrap steel, half of which is assumed to be provided from the Scrap & Recycling Facility, and half from foreign countries. Hence, the volume of imported scrap steel is estimated to be 2 million tons per annum in 2020.

Unit : ton

		2010	2020
Foreign	Import		2,000,000

6.4.5 Iron and Steel Products

The volume of iron & steel products from the Scrap & Recycling Facility is 1 million tons. A portion of this is estimated to be transported by land to meet regional demand. Also, about 0.8 million tons will be used for Iron & Steel Related Industries and others as material.

On the other hand, the volume of products from Iron & Steel Related Industries will be 0.7 million tons per annum, 90 percent of which is assumed to be shipped to other domestic regions.

Hence, the total shipping volume of iron & steel products is estimated to be 0.8 million tons per annum in 2020.

Unit : ton

(in case of the Scrap & Recycling Facility)

		2010	2020
Domestic	Loaded		800,000

If a full scale steel industry with blast furnace is located in Dung Quat, 5 million tons of iron ore and maximum of 2 million tons of coal will be unloaded at the port. Then, about 1.3 million tons of product would be provided to Iron & Steel Related Industries and other industries as material. The remainder, maximum of 3.2 million tons of product, is estimated to be shipped to meet domestic market demand.

In this case, the Scrap &Recycling Facility would not be constructed, because there is no place available in the area. Therefore, scrap steel would not be handled at the port.

(in case of a full scale steel industry)

Unit : ton

		2010	2020
Domestic	Unloaded		7,000,000
Domestic	Loaded		3,185,000

6.4.6 Other Products/Materials

Other products produced in DQI are considered to be agricultural, forestry and sea processing products, light industrial products, construction materials and car assemblies. In addition, some foodstuffs are estimated to be produced at other industrial areas west and south of Quang Ngai province. The volume of these products/materials is estimated by the relation between net area and productivity. The net area of each industrial facility will be 41 % of the gross area, according to the "Study on the Integrated Regional Socio-Economic Development Master Plan for the Key Area of the Central Region of the Socialist Republic of Vietnam". Also, for the forecast of commodity volume, statistical data of Japanese industries is referred to. Basically, the shipping ratio is assumed to be 80 % of each cargo from/to DQI and 10% from other industrial areas. Half of products from DQI will be shipped to foreign countries.

The shipping volume can be calculated by the following formula.

Shipping volume of each commodity
= Net area of each industry × Productivity × Shipping ratio

As for mining/clinker and construction materials, the volume is forecasted separately. The net area and unit productivity of each facility is shown in Table 6.4.1.

(Agricultural, Forestry and Sea Product/Materials)

Unit : ton

		2010	2020
Foreign	Export		90,000
Domestic	Unloaded		388,000
Domestic	Loaded		90,000

(Light Industrial Product/Material) Unit : ton

		2010	2020
Foreign	Import		561,000
Foreign	Export		126,000
Domestic	Unloaded		561,000
Domestic	Loaded		126,000

(Mining/Clinker) Unit : ton

		2010	2020
Domestic	Unloaded	250,000	300,000

(Construction Material) Unit : ton

		2010	2020
Domestic	Unloaded	250,000	
Domestic	Loaded		160,000

(Car Assembly) Unit : ton

		2010	2020
Foreign	Export		63,000
Domestic	Loaded		63,000

(Foodstuff) Unit : ton

		2010	2020
Domestic	Loaded		249,000

6.4.7 Total Cargo Throughput

The total forecast volume of cargo handled at the Dung Quat Port in the Master Plan is shown in Table 6.4.2.

In 2010, 13.25 million tons of Oil/Oil Products and others will be handled. On the other hand, foreign and domestic cargo volume in 2020 is estimated to be 8.69 million tons and 22.237 million tons respectively.

(Total Volume : Mater Plan) Unit : ton

		2010	2020
Foreign	Export		279,000
Foreign	Import	2,600,000	8,411,000
Domestic	Loaded	6,250,000	13,388,000
Domestic	Unloaded	4,400,000	8,399,000

Table 6.4.2 Cargo Volume at the Dung Quat Port

unit : 1000ton/year

Commodities	2010				2020			
	Foreign Trade		Coastal Shipping		Foreign Trade		Coastal Shipping	
	Export	Import	Loaded	Unloaded	Export	Import	Loaded	Unloaded
1 Oil/Oil Products		2,600	6,000	3,900		5,850	11,400	7,150
2 Agri.Products					90		339	388
3 Mining/Clinker				250				300
4 Steel/Scrap						2,000	800	
5 Cement				250			160	
6 Manufacturing			250		189	561	689	561
Sub Total	0	2,600	6,250	4,400	279	8,411	13,388	8,399
Sub Total	2,600		10,650		8,690		21,787	
Total	13,250				30,477			

Note : "Manufacturing" includes petrochemical products, light industrial products and car assemblies

The alternative plan, the case in which an iron industry is located in Dung Quat, is shown in Table 6.4.3. Foreign and domestic cargo volume in 2020 is estimated to be 6.69 million tons and 31.802 million tons respectively.

(Total Volume : Alternative Plan) Unit : ton

		2010	2020
Foreign	Export		279,000
Foreign	Import	2,600,000	6,411,000
Domestic	Loaded	6,250,000	16,403,000
Domestic	Unloaded	4,400,000	15,399,000

Table 6.4.4 Cargo Volume at the Dung Quat Port in Alternative Plan

unit : 1000ton/year

Commodities	2010				2020			
	Foreign Trade		Coastal Shipping		Foreign Trade		Coastal Shipping	
	Export	Import	Loaded	Unloaded	Export	Import	Loaded	Unloaded
1 Oil/Oil Products		2,600	6,000	3,900		5,850	11,400	7,150
2 Agri.Products					90		339	388
3 Mining/Clinker				250				7,300
4 Steel							3,815	
5 Cement				250			160	
6 Manufacturing			250		189	561	689	561
Sub Total	0	2,600	6,250	4,400	279	6,411	16,403	15,399
Sub Total	2,600		10,650		6,690		31,802	
Total	13,250				38,492			

Note : "Manufacturing" includes petrochemical products, light industrial products and car assemblies

6.4.8 Container Volume

The manufacturing products, such as light industrial products and car assemblies of foreign trade, are suitable for containerization. The container volume can be forecasted by future containerization ratio and unit weight per TEU. Then, containerization ratio can be estimated by using the theoretical logistic curve on the past throughput of Hai Phong Port. Unit weight per TEU calculated by cargo statistics in 1995 of Danang Port is 14.6 ton/TEU for export, 12.0 ton/TEU for import. The equation for containerization ratio forecast and container volume forecast in target year is as follows.

(Export) $$Y = \frac{0.80}{1 + 0.6522^{t-3.268}}$$

(Import) $$Y = \frac{0.80}{1 + 0.7010^{t-5.344}}$$

Y : Ratio of containerization

t : Number of years from 1990

(Ratio of Containerization)

		2010	2020
Foreign	Export	80.0%	80.0%
Foreign	Import	79.7%	80.0%

(Container Volume) Unit : TEU

		2010	2020
Foreign	Export		10,356
Foreign	Import		37,400

6.4.9 Cross Check with the Result of Macro Forecast

Commodity-wise forecast (micro forecast) of dry cargo in 2010 and in 2020 of the port for cargo handling located in the study hinterland is summarized in the Table 6.4.5.

Table 6.4.5 Cargo Throughput by Micro Forecast

Unit: Ton

Province	Port	2010	2020
Quang Tri	Cua Viet Port	71,000	93,000
Thua Thien Hue	Chan May Port※	1,985,000	3,947,000
	Thuan An Port	80,000	90,000
Danang City	Danang Port and Lien Chieu Port※	5,173,000	8,636,000
Quang Ngai	Dung Quat Port※	750,000	6,077,000
	Sa Ky Port	42,000	92,000
(Total)		8,101,000	18,935,000

※new port

On the other hand, macro forecast of dry cargo in the study hinterland is summarized in the Table 6.4.6. Two forecasts present similar figures as seen in the Figure 6.4.1 and yet the micro forecast exceeds Scenario I of the macro forecast by 603,800tons in 2010, while Scenario I of the macro forecast exceeds the micro forecast by 1,257,900tons in 2020.

Table 6.4.6 Cargo Throughput by Macro Forecast

Unit: Ton

Scenario	2010	2020
I	7,496,000	20,194,000
II	5,654,000	15,624,000
III	4,961,000	10,314,000

Table 6.4.1 Cargo Volume from/to Industrial Areas in 2020 (Master Plan)

unit:1000t/year

Facility	Area(gro) (ha)	Area(net) (ha)	Comodity	Cargo/Area (1000t/ha)	Cargo (1000t)	Foreign Trade		Coastal Shipping		Shipping Total	Land Trans.
						Export	Import	Loaded	Unloaded		
Oil Refinery	520	220	Crued Oil	-	13,000		5,850		7,150	13,000	
			Petroreum	-	11,400			11,400		11,400	
Petrochemical	630	190	Product	-	563			500		500	63
Steel Scrap &	180	100	Scrap	-	1,500		1,500			1,500	
Recycling Mill			Steel	-	1,000			170		170	830
Steel Related	330	110	Scrap	-	1,000		500			500	500
Industries			Steel	-	700			630		630	70
Agri.-For.-Sea	910	373	Material	2.6	970				388	388	582
Processing			Product	0.6	224	90		90		180	44
Light-Provincial	855	351	Material	4.0	1,402		561		561	1,122	280
Industry			Product	0.9	315	126		126		252	63
Construction	200	82	Mining	-	300				300	300	0
Materials			Cement	-	200			160		160	40
Car Assembly	480	197	Material	1.6	315					0	315
Industry			Product	0.8	157	63		63		126	31
Foodstuff Industry	400	164	Product	15.2	2,493			249		249	2,244
Total	4,505	1,622	Material	-	18,487	279	8,411	13,388	8,399	30,477	5,062
			Product	-	17,053	8,690		21,787			

Table 6.4.3 Cargo Volume from/to Industrial Areas in 2020 (Master Plan with iron industry)

unit:1000t/year

Facility	Area(gro) (ha)	Area(net) (ha)	Comodity	Cargo/Area (1000t/ha)	Cargo (1000t)	Foreign Trade		Coastal Shipping		Shipping Total	Land Trans.
						Export	Import	Loaded	Unloaded		
Oil Refinery	520	220	Crued Oil	-	13,000		5,850		7,150	13,000	
			Petroreum	-	11,400			11,400		11,400	
Petrochemical	630	190	Product	-	563			500		500	63
Full Scale of Steel			Material	-	7,000				7,000	7,000	
Industry			Steel	-	4,500			3,185		3,185	1,315
Steel Related	330	110	Steel	-	1,000					0	1,000
Industries			Steel	-	700			630		630	70
Agri.-For.-Sea	910	373	Material	2.6	970				388	388	582
Processing			Product	0.6	224	90		90		179	45
Light-Provincial	855	351	Material	4.0	1,402		561		561	1,122	280
Industry			Product	0.9	315	126		126		252	63
Construction	200	82	Mining	-	300				300	300	0
Materials			Cement	-	200			160		160	40
Car Assembly	480	197	Material	1.6	315					0	315
Industry			Product	0.8	157	63		63		126	31
Foodstuff Industry	400	164	Product	15.2	2,493			249		249	2,244
Total	4,325	1,522	Material	-	23,987	279	6,411	16,403	15,399	38,492	6,048
			Product	-	20,553	6,690		31,802			

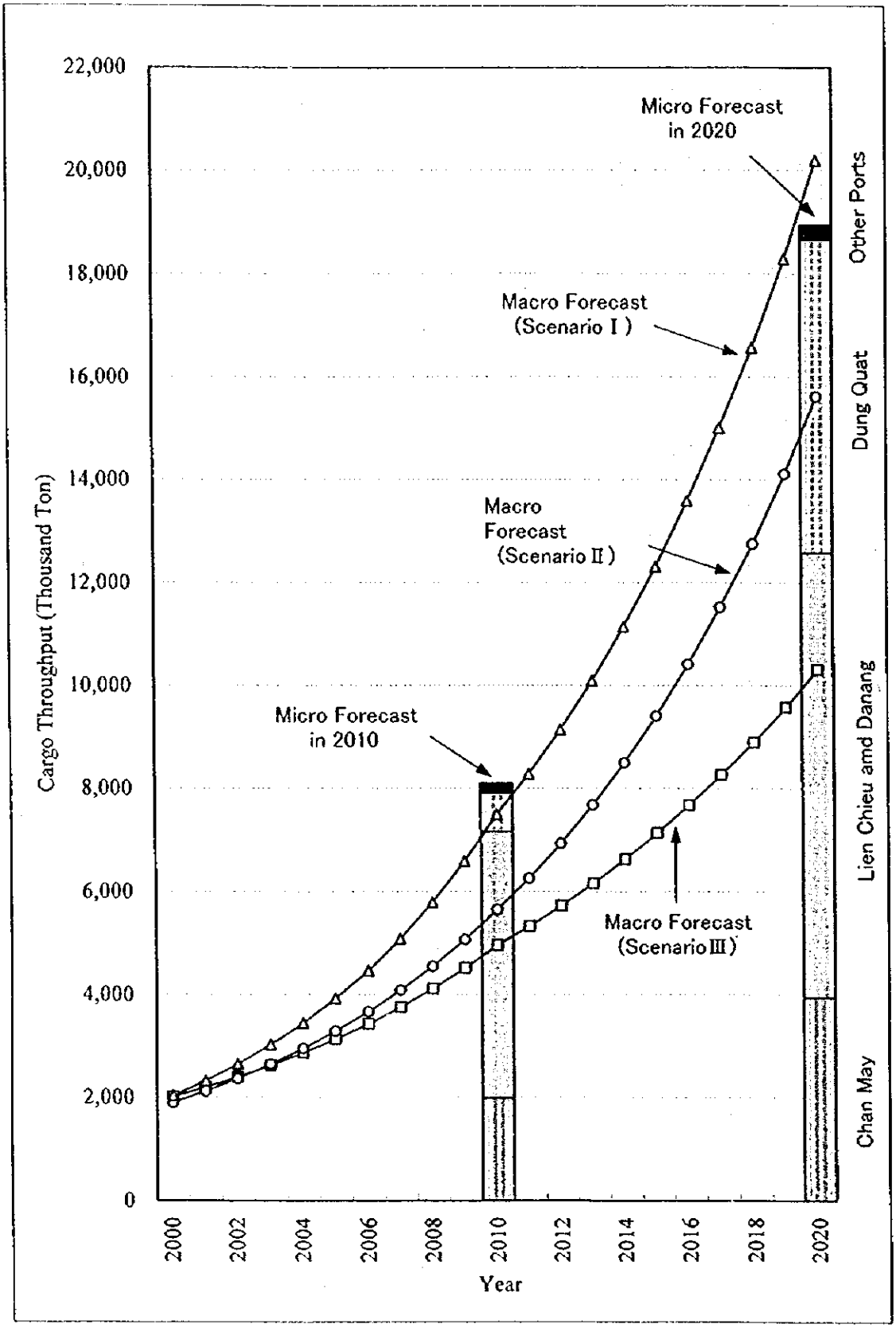


Figure 6.4.1 Comparison between Macro Forecast and Micro Forecast (Dry Cargo)

6.5 International Transit Cargo

The majority of Laotian trade is conducted via Bangkok port. According to the long-term forecast up to 2020, this situation is thought to change only slightly. Once Lao and Vietnam join ASEAN, trade and commerce between Thailand and Vietnam will be energized, and the flow of capital, skilled workers and goods will greatly increase. It is possible that the volume of foreign trade will be expanded if transport infrastructure in Lao, which is situated between the two countries, is improved. Though cargo has been transported via Bangkok port up to now, traded goods may use Vietnamese ports, especially those of Northeast Asia.

In order to realize the shift from the current trade route via Bangkok port to Vietnamese ports, certain preconditions must be met. But while the share in the flow of goods to both parties can be expected to greatly increase, transit cargo is excluded. In other words, after manufacturing and production in Thailand, goods can be assembled and finished in Vietnamese factories and then exported. In that case, this cargo would be treated as cargo originating from Vietnamese factories. In the meantime, conditions which must be satisfied for the change to occur are listed below.

1) Cargo of Thailand is subject to customs inspection within the ASEAN region at the first point of origin and free pass charge shall be paid. But there will be no special taxation on goods passing through Lao and Vietnam, which means that border clearance shall be very quick.
2) Transport vehicles within the ASEAN region require a transit permit, but transport activities can be performed freely in Thailand, Lao and Vietnam.
3) Road conditions in Lao and Vietnam must be improved through paving and increasing lane width so that vehicles can run at the same speed as on roads in Thailand.
4) The service level of Vietnamese ports in terms of cost, security and vessel allocation must be equal to that of Bangkok port.

If these conditions are not met, it will not be possible to demonstrate the short distance merit of Vietnamese ports and there will be no change in the transport route of cargoes traded with Northeast Asia. It may take a number of years before all conditions are satisfied. It will take many years before the road system is completed and it will take at least as many years to establish the necessary rules and regulations. In this study, it is thought that most conditions can be met by 2010.

On the assumption that the transport conditions can be satisfied, it is necessary to identify what types of cargoes will be transported via Vietnamese ports.

1) Cargoes originating in areas in close proximity to Vietnamese ports
2) Cargoes from areas east of Vietnam
3) Types of cargo which can be bagged or directly stocked in container box and transported by land

Two common methods, a macro and a micro forecast, were used to forecast the volume of trade. In the macro forecast, the trade volume was forecast up the year 2010 and again to 2020 based on various economic indices related to import and export trends. The micro forecast estimated the volume of each commodity individually up to 2020 based on reports such as the national development plan. Conventional cargo was forecast based on future economic indices and currents trends.

Lumbering is prohibited in principal but some lumber is being exported nonetheless. And the development of the many new hydro-electric power plants which are planned will be accompanied by the felling of trees. Therefore, it is thought that lumber exports will continue at their present level. However, as the majority of the demand will come from Thailand and Vietnam, the export volume to Northeast Asia is not expected to be large. With the development of Bolovens Plateau in Lao, there will likely be an increase in coffee exports. And fertilizer imports will increase as part of the plan to increase rice production in the whole country without using the traditional slash-and-burn method.

The type of oil to be imported will be mainly light fuel. The consumption volume is forecast to be only about 10 % of that of Vietnam and Thailand, or 2-3 million tons. Therefore, rather than construction of an oil refinery in Lao, the best approach is to import oil after it is refined in Thailand and Vietnam.

6.5.1 Socioeconomic condition of Lao PDR and Thailand

(1) Lao PDR

Based on the National Development Plans in Lao PDR, namely 1996-2000 SOCIO-ECONOMIC DEVELOPMENT PLANS, the national economic growth target is to achieve an average growth of 8-8.5% per year, of which:

1) Average annual increase of gross agriculture-forestry product is approximately 5%
2) Annual increase of gross industry and handicraft product is 12% approximately
3) Annual increase of gross service product is 10-11%

1. By the year 2000, the population is expected to grow to 5.2 million with an average GDP per capita of approximately US$500.
2. Endeavors must be exerted to attain the following structural composition : agriculture-forestry 48%, industry-handicraft 22% and services 30% of the GDP.

Table 6.5.1 Growth Rates of Indicators of Lao PDR (Unit : %)

Year	Growth Rate (%)				
	Population	GDP	Agriculture-GDP	Industry-GDP	Service-GDP
1995-2000	2.83	8.0	5.0	12.0	10.5
2001-2010	2.66	8.3	5.0	11.5	10.0
2011-2020	2.36	8.6	5.0	11.0	9.5

Source :World Population Projection 1995 by World Bank
1996-2000 Socio-Economic Development Plans, October 1996, by Government of Lao

(2) Thailand

According to the national development plan, "The Eighth National Economic and Social Development Plan (1997-2001), Government of Thailand", the long term vision is planned as follows : by the year (2020) the Thai economy will be the eighth largest in the world, with an average per capita income of not less than 300,000 baht or about US$12,000 at 1993 constant prices. Average annual growth rate of GDP of Thailand from 1971-1995 is computed at 7.5%. If growth rates of GDP are set at 8.4, 7.7, 6.9% for 1996-2000, 2001-2010, 2011-2020 respectively, GDP per capita in 2020 can clear the target value.

By the year 2020 targeting areas are thought to be developing each sector

corresponding to the increased border trade with Lao PDR and Vietnam and agricultural development. Growth rate of agriculture GDP of target areas is set 0.5% higher than that of Thailand because of high agricultural contribution of these areas. Growth rates of service sector are projected slightly higher than the national average and those of the industrial sector are thought to be at the same level as the national average. Specifically, growth rates of agricultural GDP, industrial GDP and service GDP are assumed at 4.0, 9.0 and 8.0 % respectively. Growth rates of Regional GDP from 1996-2000, 2001-2010 and 2011-2010 are computed at 7.2, 7.4 and 7.6% for R-9 hinterland and 7.3, 7.5 and 7.7 % for R-16/18 hinterland. Average growth rates from 1996-2020 of the two areas are the same at 7.5 %, which corresponds with the national target.

6.5.2 Macro Forecast of Transit Cargoes

International transit cargo from/to Northeast Thailand and Lao PDR is estimated based on the assumption that imports of the two countries will increase to the level of 0.12 tons per capita in Lao and 0.23 tons per capita in Thailand. These figures are obtained from the correlation between import volume and GDP per capita of more than 30 countries in the world. Correlation equation is as follows:

$$\text{Import dry cargo} = 0.1011 * (\text{GDP/capita})^{0.7131} \quad \text{(ton)}$$

where, GDP/capita : US$ in 1989 constant price

Of the hinterland's export and import cargo volumes, it is assumed that 50% of Laotian cargo will be transported via Vietnamese ports and 25% of Northeast Thai cargo will be transported via Vietnamese ports. Transit cargo projection is summarized in Table 6.5.2 (1).

Table 6.5.2 (1) Projection of Import (Dry Cargo)

Area Year	GDP per capita (US$ in 1989)	Population (000)	Cargo Volume per capita (ton)	Cargo Volume (000 ton)	Vietnamese Transit (000 ton)
Lao R-9					
2010	830	1,243	0.076	95	47.4
2020	1500	1,570	0.116	183	91.3
Lao R-16/18					
2010	830	1,118	0.076	85	42.6
2020	1500	1,413	0.116	164	82.1
Thailand R-9					
2010	1950	3,739	0.140	524	131.0
2020	3890	3,921	0.229	899	224.9
Thailand R-16/18					
2010	1940	4,357	0.140	609	152.1
2020	3880	4,569	0.229	1,046	261.6

Export dry cargo is assumed at 92% of import dry cargo based on trends of Thai trade.

Table 6.5.2 (2) International Transit Cargo by Macroscopic Forecast

(unit : ton)

	Year 2010			Year 2020		
Hinterland	Export	Import	Total	Export	Import	Total
Lao R-9	43,600	47,400	91,000	84,000	91,300	175,200
Lao R-16/18	39,200	42,600	81,800	75,600	82,100	157,700
Thai R-9	120,600	131,000	251,600	206,900	224,900	431,800
Thai R-16/18	140,000	152,100	292,126	240,600	261,600	502,200
Total R-9	164,200	178,400	342,600	290,900	316,100	607,000
Total R-16/18	179,200	194,800	374,000	316,200	343,700	659,900

6.5.3 Microscopic Cargo Forecast

Available trade volume at the site is expected as follows.

(1) Bolovens Plateau development project (Lao PDR)

Bolovens Plateau spreads over Champasack, Saravane and Sekhong provinces in Lao PDR. In the year 2010, the volume of coffee exports is expected to be 60,000 tons from the harvest area of 59,000 hectares. In the year 2020, export volume is estimated at 70,000 tons due to the expanded irrigation area.

Table 6.5.3 (1) Bolovens Plateau Development Project

year	Harvest Area (ha)	Annual Production (ton)	Export (ton)
1985	12,452	6,068	2,900
1994	19,190	8,270	4,324
1995	20,155	8,575	3,949
2010	59,000	65,000	60,000
2020	59,000	78,000	70,000

(2) Forest products (Lao PDR)

Export of log is not allowed in Lao PDR. It is possible only from the waterflooded area of dam site. Lak Sao located on the Route 8 is the major forest business center and around 10,000 cubic meters of log are exported to Japan from Lak Sao via Vinh. In case of Southern Lao, the same type of wood as in Malaysia is available. But the transportation cost from Malaysia to Northeast Asia is lower than from Lao because of the lower land transportation cost. Therefore, major exporting markets of Southern Laotian log are assumed to be Thailand and Vietnam.

Some timber factories in Savannakhet and Pakse can be assumed to produce exporting goods to Northeast Asia. Exporting volumes from Savannakhet and Pakse are assumed at 9% and 11% of Lao projected forest factory products corresponding to ratio of plantation area. Actual export volume from southern Lao to Northeast Asia is thought to be small. From interviews with Japanese investors, 3,000 tons of finished wood products were exported from Vientiane via Bangkok. Considering other forest statistics, 150,000 tons of forest products is assumed as the export volume in 2010 and 2020. As the export volume to Northeast Asia, only 15,000 tons of processed wood are projected by each respective target area assuming a factory similar to the one established in Vientiane.

Table 6.5.3 (2) Export of Forest Products

Total exporting forest products in 2020	150,000 ton
R-9 Hinterland	15,000 ton (10%)
R-16/18 Hinterland	15,000 ton (10%)

(3) Forest Products (Northeast Thailand)

From the distribution of wood shops in the two study areas, exporting capacity by area is thought to be around 2 % of Thai forest products by each hinterland (see Table A 6.5.3 (4)).

Since 26,000 tons of sawn timber and 805,000 tons of rubber products are forecast to be exported to Northeast Asia in 2010 and 2020, 16,000 tons of this total are estimated to pass through the ports of central Vietnam.

Table 6.5.3 (3) Export of sawn timber

	Volume & share in 1990	Estimated export volume To Northeast Economies in 1994
Japan	23,852 cu.m. 48 %	26,900 cu.m. 48 %
Singapore	7,812 cu.m. 16 %	-
USA	4,570 cu.m. 9 %	-
Italy	4,196 cu.m. 8 %	-
Denmark	1,984 cu.m. 4 %	-
Hong Kong	1,873 cu.m. 4 %	2,240 cu.m. 4 %
Northeast Asia Total	25,725	29,140
Total	49,459 cu.m. 100 %	56,000 cu.m. 100 %

Source :Forestry Statistics 1990 , Statistical Yearbook Thailand 1995

Table 6.5.3 (4) Export of natural rubber by country 1993-1994

	in 1993	In 1994
Japan	480,652 ton	559,007 ton
China	233,076	237,115
USA	194,526	227,131
South Korea	90,910	108,167
Malaysia	71,764	113,045
Northeast Asia Total	804,638 (54%)	904,289 (37%)
Total	1,492,794	2,424,373

Source :Statistical Yearbook Thailand 1995

(4) Rice (Northeast Thailand)

Thailand is the biggest exporting country of rice in the world. Japan imported an average of 392,000 tons /year of rice from Thailand in 1993 and 1994(see Table A 6.5.3 (5)). Northeast Thailand is a major production area of rice; export volume is estimated at 210,000 tons through R-9 and 270,000 tons through R-16/18.

Table 6.5.3 (5) Estimated Export of Rice (Unit : ton)

Hinterland	Production in 1993	Consumption annum 300kg/capita	Available Export Volume	Assumed Export Volume
R-9 Mukdahan	1,384,000	1,170,000	214,000	210,000
R-16/18 Ubon Ratchathani	1,660,000	1,380,000	280,000	270,000

(5) Fertilizer (Lao PDR)

Lao government established an agricultural development plan for rice production. The target production volume is 2 million tons, which is equivalent to providing 400 kg/year of rice to 5 million people. The study team estimated that rice consumption will be 300 kg/year and wheat consumption will be 100kg/year in 2020.

In order to increase rice production, fertilizer is a useful means. To meet the increasing demand for wheat, wheat imports will gradually increase through current trading route.

Table 6.5.3 (6) Consumption and Import of Fertilizer in Lao

	Harvest Area	Fertilizer Consumption	Fertilizer Import
Lao R-9	120,000 ha	12,000 ton	12,000 ton
Lao R-16/18	111,000 ha	11,100 ton	11,000 ton

(6) Fertilizer (Northeast Thailand)

According to annual statistics of Thailand in 1994 and 1995, 1 million tons of fertilizer are imported from the Republic of Korea while total imported volume was 3.5 million tons. Consumption volume of fertilizer in 2020 is projected at 101,000 ton/year for R-9 hinterland and 143,500 ton/year for R-16/18 hinterland respectively.

Production of fertilizer is expected in 2020 by the chemical industry in Thailand, but the study area in the Northeast Region will purchase around half of its annual

consumption fertilizer by import via central Vietnamese ports.

Table 6.5.3 (7) Consumption and Import of Fertilizer in Northeast Thailand

	Harvest Area	Fertilizer Consumption	Fertilizer Import
Thailand R-9	1,010,000 ha	101,000 ton	51,000 ton
Thailand R-16/18	1,435,000 ha	143,500 ton	71,000 ton

(7) Daily Goods (Lao PDR and Thailand)

Daily goods imports are estimated by unit volume in correspondence with GDP per capita as shown in Table 6.5.3 (8).

Table 6.5.3 (8) Daily Goods Imports in 2020

	GDP per capita (US$)	Assumed Daily Goods per capita (kg/person)	Population (person)	Estimated Import Volume (ton)
Lao R-9	1,500	30	1,570,000	47,000
Lao R-16/18	1,500	30	1,413,000	42,000
Thailand R-9	3,890	50	3,921,000	196,000
Thailand R-16/18	3,880	50	4,569,000	228,000

Table 6.5.3 (9) Daily Goods Imports in 2010

	GDP per capita (US$)	Assumed Daily Goods per capita (kg/person)	Population (person)	Estimated Import Volume (ton)
Lao R-9	830	30	1,243,000	37,000
Lao R-16/18	850	30	1,118,000	34,000
Thailand R-9	1,950	30	3,739,000	112,000
Thailand R-16/18	1,940	30	4,357,000	131,000

(8) Other Miscellaneous Cargo (Lao PDR)

Other exporting goods will be raw materials and finished products. Major commodities to be considered are garment, manufactured products, mineral (gypsum), food etc.

Other importing goods will be finished products or intermediate products. Major

commodities considered are car, cement, electric product, factory machine, steel etc.

(9) Other Miscellaneous Cargo (Northeast Thailand)

Agricultural products other than rice and manufactured products are estimated to be exported to Northeast Asia via Vietnamese ports. Other imports are construction materials, factory machines and intermediate products from Northeast Asian countries.

(10) Trading Cargo Volume

Trading cargo volumes of hinterland in 2020 and in 2010 are estimated by totaling above volumes. But those include both cargoes through Bangkok and Vietnamese ports.

Table 6.5.3 (10) Trading Cargo Volume in 2020 (Unit : ton)

Export	Agri-Product	Forest Product	Other	Total
Lao				
R-9	0	15,000	10,000	25,000
R-16/18	70,000	15,000	10,000	95,000
Thailand				
R-9	210,000	16,000	10,000	236,000
R-16/18	270,000	16,000	10,000	296,000
Total				
R-9	210,000	31,000	20,000	261,000
R-16/18	340,000	31,000	20,000	391,000
Grand Total	550,000	62,000	40,000	652,000

Import	Fertilizer	Daily Goods	Other	Total
Lao				
R-9	12,000	47,000	40,000	99,000
R-16/18	11,000	42,000	40,000	93,000
Thailand				
R-9	51,000	196,000	40,000	287,000
R-16/18	71,000	228,000	40,000	339,000
Total				
R-9	63,000	243,000	80,000	386,000
R-16/18	82,000	270,000	80,000	432,000
Grand Total	145,000	513,000	160,000	818,000

Table 6.5.3 (11) Trading Cargo Volume at Site in 2010 (Unit : ton)

Export	Agri-Product	Forest Product	Other	Total
Lao				
R-9	0	15,000	10,000	25,000
R-16/18	60,000	15,000	10,000	85,000
Thailand				
R-9	210,000	16,000	10,000	236,000
R-16/18	270,000	16,000	10,000	296,000
Total				
R-9	210,000	31,000	20,000	261,000
R-16/18	330,000	31,000	20,000	381,000
Grand Total	540,000	62,000	40,000	642,000

Import	Fertilizer	Daily Goods	Other	Total
Lao				
R-9	12,000	37,000	40,000	89,000
R-16/18	11,000	34,000	40,000	85,000
Thailand				
R-9	50,000	112,000	40,000	202,000
R-16/18	70,000	131,000	40,000	241,000
Total				
R-9	62,000	149,000	80,000	291,000
R-16/18	81,000	165,000	80,000	326,000
Grand Total	143,000	314,000	160,000	617,000

6.5.4 High Case and Low Case

(1) Schedule of Relevant Projects

In 6.5.3, available volume as international transit cargo is estimated, and this is thought to be maximum. Actual trade volume through Vietnamese ports is determined by the transport condition. This is decided by completion of 4 projects of road improvements, 2 projects of bridge construction and 1 tunnel project. Starting of AFTA in the study area is also important. Favorable project schedule is assumed as high case and delayed schedule as low case. Favorable schedule is assumed as follows:

AFTA	- Vietnam and Lao are expected to enter AFTA in 2006 after first official start in 2001 by the first group.
Road 9	- Estimated construction period (2000 – 2003)
Mukdahan Bridge	- Estimated construction period (2000 – 2003)
Haivan Tunnel	- Completed up to 2004
Road 14, 14B	- Completed up to 2004
Road 16	- Estimated construction period (2010 – 2013)
Road 18	- Estimated construction period (2004 – 2007)
Pakse Bridge	- Estimated construction period (1997 – 2000)

Table 6.5.4(1) Estimated Completion Schedule of Relevant Projects

◎:High Case ○:Low Case

Project	2000	-	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	--	2018	-	2020
AFTA						◎			○								
Road 9			◎			○											
Mukdahan Br.			◎			○											
Haivan Tunnel				◎													
Road 14/14B							◎				○						
Road 16													◎		○		
Road 18							◎				○						
Pakse Br.	◎																

(2) High Case and Low Case

In the high case, international transit cargo will start to be handled at central

Vietnamese port from the year 2003 for Route 9 and 2007 for Route 16/18; after 13 years all available cargo will be shifted to the routes completely. In the low case, this shift will be delayed 3 years for Route 9 and 4 years for Route 16/18. Also, the shifting interval is estimated as 16 years. Available cargo at site is transported to/from Vietnamese ports by rate which is estimated based on condition of transport routes. Above rate is set for high and low cases as in Tables 6.5.4 (2) and (3).

Table 6.5.4(2) Ratio of Cargo Flow to Vietnam (High Case)

	2003	2004	2005	2006	2007	--	2010	----	2015	2016	---	2020
R-9	0.20	0.30	0.40	0.50	0.55	--	0.70	----	0.95	1.00	---	1.00
R-16/18	0.00	0.00	0.00	0.00	0.20	--	0.50	----	0.75	0.80	---	1.00

Table 6.5.4(3) Ratio of Cargo Flow to Vietnam (Low Case)

	2006	2007	--	2010	2011	2012	--	2015	---	2019	2020
R-9	0.20	0.30	--	0.55	0.60	0.65	--	0.80	---	1.00	1.00
R-16/18	0.00	0.00	--	0.00	0.20	0.30	--	0.55	---	0.75	0.80

(3) Style of Cargo

Containerized rate of cargo depends on two factors: the characteristics of the commodity and the land transport condition such as free pass cargo. In other words, the containerized rate of international transit cargo is set higher than non-transit cargo.

For exports, containerized rates of coffee and rice are set at 100 % and forest products and other miscellaneous at 50 %. For imports, containerized rate of daily goods is set at 100 % and fertilizer and other miscellaneous at 50 %.

(4) Transit Cargo Volume

Transit cargo volume by style is calculated by using above two coefficients. Transit cargo volumes in 2005, 2010, 2015 and 2020 are estimated by road route(see Tables 6.5.4 (4) and (5)).

Table 6.5.4 (4) Transit Cargo through Route-9 (Unit : ton)

Cargo Case	Direction	Year 2005	Year 2010	Year 2015	Year 2020
High Case	Import	75,000	154,000	248,000	314,000
Container	Export	93,000	163,000	223,000	236,000
	Total	168,000	317,000	471,000	550,000
High Case	Import	29,000	50,000	68,000	71,000
BreakBulk	Export	9,000	17,000	23,000	26,000
	Total	38,000	67,000	91,000	97,000
High Case	Import	104,000	204,000	316,000	385,000
Total	Export	102,000	180,000	246,000	262,000
	Total	206,000	384,000	562,000	647,000
Low Case	Import	0	121,000	209,000	314,000
Container	Export	0	128,000	187,000	236,000
	Total	0	249,000	396,000	550,000
Low Case	Import	0	39,000	57,000	71,000
BreakBulk	Export	0	13,000	20,000	26,000
	Total	0	52,000	77,000	97,000
Low Case	Import	0	160,000	266,000	385,000
Total	Export	0	141,000	207,000	262,000
	Total	0	301,000	473,000	647,000

Table 6.5.4 (5) Transit Cargo through Route-16/18 (Unit : ton)

Cargo Case	Direction	Year 2005	Year 2010	Year 2015	Year 2020
High Case	Import	0	123,000	218,000	351,000
Container	Export	0	177,000	269,000	366,000
	Total	0	300,000	487,000	717,000
High Case	Import	0	40,000	60,000	80,000
BreakBulk	Export	0	11,000	18,000	26,000
	Total	0	51,000	78,000	106,000
High Case	Import	0	163,000	278,000	431,000
Total	Export	0	188,000	287,000	392,000
	Total	0	351,000	565,000	823,000
Low Case	Import	0	0	160,000	280,000
Container	Export	0	0	198,000	292,000
	Total	0	0	358,000	572,000
Low Case	Import	0	0	44,000	64,000
BreakBulk	Export	0	0	13,000	20,000
	Total	0	0	57,000	84,000
Low Case	Import	0	0	204,000	344,000
Total	Export	0	0	211,000	312,000
	Total	0	0	415,000	656,000

Table 6.5.4 (6) Summary of International Transit Cargo

Year	2010		2020	
Case	Low	High	Low	High
R-9	301,000	384,000	647,000	647,000
R-16/18	0	351,000	656,000	823,000
Grand Total	301,000	735,000	1,303,,000	1,470,000

Table 6.5.4 (7) Transit Cargo of High Case in Dung Quat

Dung Quat	Year	2005	2010	2015	2020
Import	BreakBulk	0	36,000	54,000	72,000
Export	BreakBulk	0	10,000	16,000	23,000
Total	BreakBulk	0	46,000	70,000	95,000

Table 6.5.4 (8) Transit Cargo of Low Case in Dung Quat

Dung Quat	Year	2005	2010	2015	2020
Import	BreakBulk	0	0	40,000	58,000
Export	BreakBulk	0	0	12,000	18,000
Total	BreakBulk	0	0	52,000	76,000

6.5.5 Land Transport Cost

In term of a land transport cost, unit cost per kilometer shall be reflect condition of road. Namely, flat is easier than mountain and pavement is faster than gravel. Cost comparison table indicates estimated land transportation cost based on the modified Thailand regulations. If toll of bridge is assumed at 150 Thai Baht and free pass charge in other countries is assumed at 1,000 Thai Baht, a table of land transport cost is computed at Table 6.5.5. In cases of Pakse and Savannakhet, transportation cost is cheaper than Bangkok route, but in other cases that is higher than Bangkok route because of higher unit cost in mountain area. In later case, total cost including sea transport cost, waiting cost, etc. must be evaluated. And then transit port shall be decided.

Table 6.5.5 Land Transport Cost by Truck per 20' Container

(unit : US$/TEU, US$1=30THB)

Origin & Destination	Dung Quat	Bangkok
Savannakhet(R-9)	544	589
Pakse(R-16)	451	672
Pakse(R-18)	523	672
Mukdahan(R-9)	566	534
UbonRatchathani(R-16)	568	522
UbonRatchathani(R-18)	640	522

6.5.6 Sea Transportation Cost

Table 6.5.6 shows a comparison of freight rates of container handling in following cases: from the ports of Vietnam to Kaohsiung Port, Yokohama Port and Los Angeles Port, from the ports of surrounding ports to Kaohsiung Port, Yokohama Port and Los Angeles Port. The freight rates on containers transported from Bangkok and Singapore to Kaohsiung and Yokohama is quite low.

Table 6.5.6 Comparison of Freight Rates (Unit: US$ / 20feet)

From / To	Kaohsiung Port	Yokohama Port	Los Angeles Port
Hai Phong Port	750 (Direct)	1,200 (Via Hong Kong)	2,750 (Via Singapore)
Danang Port	850 (Direct)	1,300 (Via Kaohsiung)	2,750 (Via Singapore)
Saigon Port	600 (Direct)	1,100 (Via Kaohsinug)	2,520 (Via Singapore)
Bangkok Port	-	700 (Direct)	1,240 -
Singapore Port	350 (Commercial FDR)	450 (Direct)	-

Note : freight rates include surcharge

6.6 Cargo Throughput of Master Plan

Total cargo throughput including international transit cargo is shown in Table 6.6.1.

Table 6.6.1 Cargo Throughput in 2020

Commodities	Foreign		Domestic	
	Export	Import	Loading	Unloading
Oil Products	0	5,850	11,400	7,150
Agriculture Products	90	0	339	388
Mining, Clinker	0	0	0	300
Steel and Scrap	0	2,000	800	0
Cement	0	0	160	0
Manufacturing Products	189	561	689	561
International Transit Cargo	23	72	-	-
(Sub Total)	302	8,483	13,388	8,399
(Total)		30,572		

Unit: Thous.Ton

7. Master Plan for Port Development

7.1 Port Development Policy

7.1.1 Basic Concept of Port Development of the Key Area in the Central Region

(1) The final goal of the port development of the region is to realize a well balanced national development by creating the third core of social and economic activity of the country following the other two advanced areas, namely Hanoi and Ho Chi Minh.

(2) In order to achieve the above objective, an effective port development strategy that leads to the promotion of regional development through the various port activities should be designed.

(3) The functional allotment among the ports in the three sites designated by the Scope of the Study should be clearly identified considering the geographical, social, political and economic conditions of each site, which means that unreasonable duplication of the port functions among these ports should be avoided.

(4) By building up a well conceived functional network, the three ports could function as one port which would contribute greatly to the expected regional development.

(5) Improvement of the port related infrastructures such as road, railway, power/water supply, industrial estate and so on should be planned and executed in principle according to the scale and function of the port development and construction planning/schedule of each target port. In actual planning works on the target ports of the Study, however, the existing plans or concepts on the development of port related infrastructures announced officially by the Vietnamese authorities shall be recognized as the status quo.

(6) Careful attention shall be paid to reasonable conservation of social and natural conditions.

(7) The full-scale development of the port function for the cargo traffic from/to the neighboring countries including Laos, Cambodia and Thailand needs to be planned generally from a medium/long term point of view, considering the uncertain situations of the countries in terms of economic and transport policies, or perspectives of future improvement of road / rail systems and cross border facilities.

(8) The actual construction of the required port facilities should be commenced only after relevant conditions such as industrial location, improvement of related infrastructures, social/

economic situations, official decision on each target site of the region and so on, are satisfied and confirmed.

(9) Considering the scale of economy and financial capability of Vietnam, the initial scale of port development needs to be planned and adjusted accordingly.

7.1.2 Functions of Dung Quat Port

Dung Quat Bay is convenient for the development of a deep sea port from the viewpoint of water depth, shelter from NE monsoon waves and soil conditions. In case that the first oil refinery of Vietnam will be developed in the hinterland of the Bay, Dung Quat Port will serve for the transportation of crude oil, petroleum products and construction materials. Once the refinery is completed, petrochemical plant and other downstream industries will be developed in the area and the Port will serve for the transportation demand for these industries. Ship breaking industry and steel industry are also planned in the hinterland and the Port will also serve for im-export of materials and products of these factories.

Although the Dung Quat Port can also serve for commercial cargoes physically, the Port is located far from the center of the Central Region and may not be so convenient for collecting commercial cargoes from all over the region. Requirements for a commercial hub port are to accommodate post Panamax container ships and to have a large volume of cargo to enable shipping lines to make frequent calls at the port. It is therefore important that the Key Area of the Central region should have a large port complex to attract shipping lines and consequently cargoes from a wider hinterland.

Since Dung Quat is located 120 km south of Danang City, the formation of a port complex with Danang may be difficult in this case. Given the development of the Dung Quat industrial area, Dung Quat Port will mainly serve industrial cargoes originating from and destined to the industrial park. Once the port is developed, it will be possible to serve as a commercial port for the limited hinterland, as a feeder port . It may also serve for international cargo from/to Lao PDR and North-East Thailand if the Route No.18 (Lao PDR) and a new route 24A between Dac To and Dung Quat are completed. However, there is no significant difference between the distance from Bac To to Dung Quat or to Danang, so the Dung Quat Port may handle a limited volume of commercial cargo.

7.2 Requirements for New Port

7.2.1 Industrial Port

Providing the region with a maritime transportation means, port plays a key role in encouraging investors to select the area for the development of their manufacturing factories, warehouse, cargo distribution center and other transportation facilities. However, the development of a new port requires a large amount of investment and a long period of construction. Hence, strategic development of ports is required from the viewpoint of early completion of facilities to cater to industries planned in the hinterland.

A new industrial port should fulfill the following requirements in compliance with the development of hinterland.

- To provide factories and importers & exporters in the hinterland with easy access to the waterfront;
- To cope with deep draft bulk/oil vessels, namely 60,000-80,000 DWT dry bulk carriers, 30,000-50,000 DWT tankers for oil products and 100,000-200,000 DWT crude oil tankers;
- To minimize the cost and period of breakwater construction so as to encourage private investors to establish their facilities in the hinterland.
- To mitigate adverse effects on the environment caused by industries;

7.2.2 Commercial Port

Since Dung Quat Port will be developed as an industrial port, commercial port function is not much expected in the port. However, once a port developed, it can serve for seaborne cargo from/to its hinterland. Transportation of heavy machinery and construction materials needs a berth for heavy cargo carriers, conventional cargo ships and coastal shipping vessels. A new port development in Dung Quat should comply with the following requirements with a view to meeting the demand for industrial park in the backyard.

- To ensure the calmness of the port waters;
- To accommodate feeder container vessels and coastal shipping vessels;
- To be flexible enough to cope with unforeseen change in future demand;
- To ensure easy access from the hinterland.

7.2.3 Target Ship Size

(1) Dry Bulk Carriers and Tankers

Maximum size of crude oil tanker is 476,000 DWT, however, it is deemed that 250,000 DWT is the maximum size of ordinary crude oil tankers to be chartered and 100,000 DWT type tanker may be convenient for Dung Quat Oil Refinery. Maximum size of ore/coal carriers is 250,000 DWT type and 200,000 DWT type may be the maximum size of ordinary chartered ones. Bulk carriers of 30,000-60,000 DWT may be handy for the import of the scrap metals.

Crude oil tankers will be accommodated at the Single Point Mooring Buoy, which will be installed in the offshore area of the Dung Quat Oil Refinery Project area with a depth of minus 20 m. Product oil carriers calling at Dung Quat will have a wide range in size from 500 - 60,000 DWT. Product oil tankers used for international transportation are 30,000 DWT class or more and, recently, 40,000 - 45,000 DWT class tankers are often deployed in this market. Newly built tankers over 30,000 DWT have segregated ballast tanks in accordance with the international agreement.

Besides product oil carriers, Dung Quat Port will receive asphalt tankers, chemical tankers, liquid sulfur tankers, sulfuric acid tankers and other special purpose tankers in connection with the establishment of the petro-chemical industry.

(2) Possible Size of Feeder Container Vessels

Container vessels usually deployed in the Asian region are 20,000 DWT class or less with a capacity of 1,000 TEUs. Feeder container ships are 5,000 - 8,000 DWT and semi-container ships are also employed.

(3) Coastal Ships

Conventional coastal ships will be gradually replaced by Ro/Ro and ferry boats on a long-term basis. Car carriers and other specialized vessels will be introduced in the near future. Sizes of typical coastal ships are listed in Table 7.2.1 and, therefore, deep berths for coastal ships are designed at a depth of 8 meters.

TABLE 7.2.1 Dimensions of Possible Calling Vessels

Vessel Type	L	B	d	
Product Oil Carrier				Volume
45,000 DWT	175	32	12.0	56,000 m3
30,000 DWT	165	26	11.0	41,000 m3
18,000 DWT	150	26	10.8	23,000 m3
6,000 DWT	106	16	6.9	
5,000 DWT	104	16	6.5	
3,000 DWT	92	14	5.7	
Car Carrier				
42,000 GT (17,000 DWT)	185	29	9.0	
32,000 GT (15,000 DWT)	180	32	9.8	
31,000 GT (16,000 DWT)	190	32	8.2	
31,000 GT (27,000 DWT)	196	32	8.5	
Bulk Carrier				
60,000 DWT	220	32	12.4	
40,000 DWT	201	29	11.7	
36,000 DWT	183	29	10.9	
Ro/Ro				
7,000 DWT	140		7.5	
6,000 DWT	150		7.0	
5,700 DWT	140		6.9	
Container Ship				Container
20,000 DWT	160	27	8.5	1,000 TEU
4,000 DWT	110		6.2	200-300 TEU
1,000 DWT	82		3.8	110 TEU
Cement Carrier				
12,000 DWT	135		8.0	
9,000 DWT	123		7.3	
General Cargo Ship				
10,000 DWT	140	20	8.4	
7,000 DWT	129	18	7.5	
5,000 DWT	103	15	6.8	
3,000 DWT	86	13	5.9	
2,000 DWT	74	12	4.9	
Passenger Ship (Ocean Going)				Passengers
77,000 GT	261	32	7.9	1,950
49,000 GT	241	30	7.5	960
29,000 GT	193	25	6.6	600
Ferry Boat (Long Distance)				
20,000 GT	200	30	6.8	
15,000 GT	190	29	6.8	
12,000 GT	185	24	6.5	
9,500 GT	160	22	6.2	

Note 1/ GT: Gross Tonnage
2/ DWT: Deadweight Tonnage
3/ L:Length over all, B:Moulded breadth; d:Moulded draft

7.3 Port Facilities

As shown in Chapter 6, the cargo transportation demand through Dung Quat Port is estimated at about 30.7 million tons in the year 2020, of which 24.4 million tons are crude oil and oil products. Container throughput may be around 75,000 TEUs inclusive of empty ones.

Coping with these cargo throughputs, Dung Quat Port requires two deep sea tanker berths, four berths for coastal shipping tankers, two deep sea bulk berths for scrap metals, and 10 berths for coastal shipping cargoes. All requirements for the new port of Dung Quat are summarized in Table 7.3.1

TABLE 7.3.1 Requirement for New Berths (in 2020)

Location	Berth	Length (m)	Alongside depth (m)	Target Ship Size
E1-2	General cargo	300	-8	7,000 DWT class general trampers; Ro/Ro vessels; Heavy cargo carriers
E3-5	Product oil tanker	3 dolphin berths	-8	6,000 - 1,000 DWT class oil tankers
D1-3	Product oil tanker	3 dolphin berths	-8	6,000 - 1,000 DWT class oil tankers
D4-5	Product oil tanker	2 dolphin berths	-13	50,000 - 8,000 DWT class oil tankers
W1-2	Bulk Carrier	600	-13	60,000 DWT class bulk carriers
W3-6	General cargo	600	-8	7,000 DWT class general trampers; Bulk carriers
W7-9	General cargo	300	-5.5	2,000 DWT class conventional vessels
E6	Small crafts	250	-4	Tug boats, Pilot boats, Customs' ships, others

Cargo handing capacity of a berth is estimated by the standard performance of cargo handling operations at each berth, i.e. 3,000 tons/year per one meter of 2,000 DWT class conventional berths, 3,750 tons/year per one meter of 5,000-10,000 DWT class conventional berths, and 4,500 tons/year per one meter of deep water berths for general trampers. Capacity of product oil tanker dolphin is estimated at about 4,000,000 tons per year at each of -13 m dolphin berth and 700,000 tons at each of -8 m dolphin berth.

General cargo tramper berths are planned to have an alongside depth of 8 meters and a total length of 300 meters at E1-E2. Back yard has a total area of 7.6 ha for open yard. Total reclaimed land area behind the berths E1-E6 is 25 ha, which is available for open yard, warehouses, oil tanks, oil distribution base, reception facilities, and other port related activities.

Two bulk cargo berths are planned for Panamax type bulk carriers with an alongside depth of 13 m and a length of 300 m each to serve for industries to be located in the hinterland. Four general cargo tramper berths are also planned at W3-W9 with an along side depth of 5.5-8.0 m and a total length of 900 m.

In a case that an iron industry is developed in the backyard, an alternative to Dung Quat Port Development Master Plan is included as an option. The alternative plan has iron ore and coal import berths with a length of 1,000 m and a alongside depth of 20 m to accommodate 200,000 DWT class bulk carriers. The plan also has a product shipping berth with a total length of 1,500 m and a draft of 10 m. Breakwaters have the same layout in the Master Plan and the Alternative Master Plan so as to cope with either case of the development in Dung Quat. ISP is also the same in either case.

Here, to determined the scale of berth, vessel type and sizes will first be explained. Cargo forecast is carried out by commodity basis, and as a result the vessel type can be specified for each cargo, for example a container vessel, a bulk carrier, and so on. Once the vessel type is specified, the alternative dimensions of each type of vessels can easily be found. These are general dimensions of each type and not necessarily applicable to the vessels which will possibly call the studied ports. The sizes of the possible vessels calling the specific port are to be examined. The most desirable and probable vessel sizes are examined taking into account the following issues;

- status of the port , that is, distinction between a mother port and a feeder port etc.
- cargo volume, that is, large vessels cannot call for a small amount of cargo and on the other hand small vessels are inadequate and inefficient for a large amount of cargo.
- calling conditions, that is, loading factors of vessels depend on their sea route.
- natural conditions, that is, the depth of berthing facilities largely depends on the natural conditions in the actual planning.

In the next step, the scale of berth, such as length and depth is determined according to the standard size of ships shown in Table A 7.3.1 as to add some allowance depending on ship size.

Four lane road will be necessary for port access from the hinterland. Port access road will be firstly built as a construction work road from planned oil refinery and Route No.1. Dredging of the access channel is not necessary as the port entrance has a depth of -13 m, however the turning basin requires dredging of more than 5 million m^3 for the Master Plan. (see Table 7.3.2)

TABLE 7.3.2 Port Facilities in Master Plan

Facilities	Quantity	Remarks
Main Breakwater	1,660 m	Deepest section: -15.5 m
West Breakwater	2,170 m	Depth at the top: -11 m
Berths	Dolphin (-8/-13 m): 8	See Table 7.3.1 for details
	1,800 m (-5.5 to -13 m)	
Land Reclamation	1,370,000 m^2	(East and west wharves)
Dredging	5,050,000 m^3	Channel depth: -13 m
Others	-	Oil handling facilities

7.4 Port Development Options

7.4.1 Characteristics of Development Site

Dung Quat Bay is located 120 km south of Danang and 35 km from Quang Ngai City. The bay is sheltered form NE waves and winds by 2,200 m long Co Co Cape, however the development site is exposed to N and NNE waves. By building a breakwater, it will be possible to acquire a large area of deep clam waters to develop a deep sea port. Access channel can be developed up to minus 15 m or more without any difficulties.

Seabed of the bay is mainly formed with sand, which has enough bearing capacity to build a breakwater, and the foundation layer lies about minus 20-25 m. While the water area for E1-E5 berths has a soft/medium clay layer with a thickness of 17 m, the bay areas are generally in good condition to develop a deep sea port.

Backyard of the port is low productivity, low value agricultural land and has a total area of 14,000 ha over the territories of Binh Son district of Quang Ngai Privince and southern part of Nui Thanh district of Quang Nam Province. First oil refinery in Vietnam is planned in the backyard as well as an industrial park for other heavy industries. The port is a possible gateway to Lao PDR and Northeast Thailand through the Route No.18 if this new road is developed.

7.4.2 Alternatives to Master Plan

Several cases of the layout of breakwaters and berths are designed for comparison. Option 1 (see Figure A7.4.1) has the deepest oil dolphin berths with a depth of more than minus 15 meters and oil jetty with a depth of minus 8 meters. The seabed depth of the main breakwater is about minus 14.5 to 16.5 meters. This Option has general tramper and bulk carrier berths along the west breakwater, and a ship repair dock next to the west wharf.

Options 2 (see Figure A7.4.2) has the main breakwater at the depth of minus 13.5 to 15.5 meters, one meter shallower than the Option 1, which will reduce the cost and period of breakwater construction. However, it increases the volume of dredging and reduces the space for coastal oil tankers. Consequently, a deep water dolphin berth is changed to a pier extended from the main breakwater, which increases the construction cost of the oil berth. Location of the west breakwater and west wharf is slightly shifted to shallower water areas.

Option 3 (see Figure A7.4.3) has the layout of the main breakwater in much shallower waters with a depth of minus 13 to 15 .5 meters and has a shorter length of the

west breakwater. The layout aims at reducing the cost for breakwaters while the cost for dredging increases to some extent. This option has a general tramper and bulk cargo wharf on the landfill along the Co Co Cape.

Option 4 (see Figure A7.4.4) has the smallest harbor waters with a view to reducing the occupancy of port facilities in the Dung Quat Bay. Consequently, this option can furnish one berth for 50,000 DWT class product oil tankers and 8 berths for 5,000 DWT class tankers.

Comparative evaluation of the alternatives is shown in the Table 7.4.1, and Option 1 is proposed as the Master Plan for Dung Quat Port Development.

TABLE 7.4.1 Comparative Evaluation of Alternatives

Items	Option 1	Option 2	Option 3	Option 4
Calmness of harbor waters	◎ Good	◎ Good	○ Fair	◎ Good
Period required for the first stage of the development	◎ Short	○ Fairly Short	◎ Short	○ Fairly Short
Ship maneuvering to/in harbour waters	◎ Good	○ Fair	○ Fair	△ Poor
Volume of dredging	◎ Small	○ Fair	△ Large	△ Large
Construction cost of the main breakwater	△ Fairly Large	○ Medium	○ Fairly Small	○ Fairly Small
Possibility for future development	◎ Good	○ Fair	○ Fair	△ Poor
Impacts on sand drift and other surrounding environment	○ Fair	○ Fair	○ Fair	○ Fair
Overall Evaluation	◎ Good	○ Fair	○ Fair	△ Poor

Note:
◎ Good, Reasonable
○ Fair, Medium
△ Poor

7.5 Port Development Master Plan

7.5.1 Port Layout Plan

Maximum size of calling vessels at Dung Quat is deemed to be 60,000 DWT class bulk carriers and 45,000-50,000 DWT of oil tankers. Two oil dolphin berths with -13 m draft and three oil dolphin berths for coastal ships are designed along the main breakwater. East wharf has two alongside berths for general cargo trampers with a depth of 8 m and three oil dolphin berths for coastal tankers. West wharf is designed to cater to Panamax bulk carriers and general cargo trampers carrying mainly steel scrap, manufacturing goods, agricultural products, and other breakbulk cargo.

Taking into consideration that much larger vessels may call at port with half load, deep sea berths are designed with a total length of 600 meters and a depth of 13 meters. Conventional cargo vessels, Ro/Ro vessels, container feeder vessels and other coastal vessels will be able to call E1-E2 and W3-W9, which has a total length of 1,200 m with an alongside depth of 5.5-8.0 meters.

To prevent beach erosion in the unsheltered area and sand accretion in the sheltered area, length and location of groin(s) shall be carefully examined and determined at the detailed design stage.

Access channel has a width of 300 m, which is 1L of the largest calling vessel. Turing basin has a diameter of 2L of the largest calling vessel at each berth. Port facilities layout of Master Plan is shown in Figure 7.5.1. Location of the new port in Dung Quat Bay is shown in Figure A7.5.1 (Appendix) and Port Development Master Plan of Dung Quat area is shown Figure A.7.5.2 and (Appendix).

7.5.2 Calmness of Harbor Waters

(Offshore Waves)

Direction-wise wave height occurrences are estimated from wind data obtained by European Center for Medium Range Weather Forecast, which covers all the sea by every 2.5 degrees. Offshore wave heights at N15° E110° (Quang Nagi offshore) are estimated as shown in Table A7.5.1 in Appendix. ENE is predominant in wave directions and more than 50 percent of the waves occurrences are from NE and ENE.

(Wave Refraction and Shoaling)

Energy of offshore waves decreases in approaching the shoreline due to refraction, shoaling and diffraction. Reduction ratio of offshore waves is estimated by means of computer simulation. At the mouth of the planned new port, offshore waves are estimated to decrease to 84% in Dung Quat Bay. Wave refraction diagram from offshore to the development site is shown in Figure A7.5.3 - A7.6.8. (Appendix).

Maximum wave height during a period of two years[1] is assessed at 3.6 m from N and NNE at the planned entrance of Dung Quat Port. Offshore waves change their directions to N when approaching the development site of Dung Quat (see Table 7.5.2).

(Wave Diffraction in Harbor Waters)

Wave disturbance to berths is checked by calculating wave diffraction in the harbor waters. Reflection factor used in the simulation is 0.9 at upright quaywalls or seawalls, 0.5 at low reflection structures and 0.1 at natural beach.

Wave height in front of the planned deep sea oil dolphin berth (D5) is estimated at about 0.8 m against the above mentioned maximum offshore wave. (see Table 7.5.3.) A large ship could safely receives waves up to 1 m from the bow or astern and waves up to 0.7 m from the side. For cargo handling operations, wave disturbance should be less than 0.5 m and this level will be assured throughout 98 percent of a year. Wind speed should also be less than 10 m for cargo operations. Details of wave diffraction are shown in Figures A7.5.9-A7.5.11.

TABLE 7.5.3 Wave Heights[1] in Harbor

(meters)

Wave Direction / Area	NNW	N	NNE
Off Breakwater	1.1	3.6	3.6
Berth D5	0.3	0.8	0.6
Berth W1	0.05	0.05	0.05

Note 1/ High wave height which may occur once every two years

[1]/ From 1 January 1993 to 31 December 1994, Swells are estimated based on Pierson and Moskowitz Spectrum and wind waves are based on Wilson's Equation

7.5.3 Ship Maneuvering

Approach channel is designed to have a width of 300 meters, approximately 1L of the maximum calling vessel. Turning basin is also designed to have a diameter of 600 meters, approximately 2L of the maximum calling vessel, assuming tug boat services. Figure A7.5.12 illustrates ship maneuvering for port entry and berthing.

7.5.4 Port Access Road

Port related traffic is estimated at about 13,400 a day, of which trucks are 8,900 and passenger cars are 4,500 per day. Peak hour traffic is estimated at about 1,900 per hour in 2020.

As the traffic capacity is 650 per hour for two lane road and 2,400 per hour for four lane road, port access road is designed to have 4 lanes with a width of 22 meters or more.

7.5.5 Optional Port Layout Plan (Steel Industry)

If a full scale iron industry with furnace is located in Dung Quat, a waterfront area of more than 2 km would be required. It would also require deep sea berths with a depth of 20 m and a quay length of 1,000m. In addition, product shipment berth will be required with a depth of 10 m and a length of 1,500 m. Port layout plan for this case is designed as shown in Figure A7.5.13.

Since the layout of breakwaters is the same as the Master Plan in Figure A7.5.2, decision can be made after completion of the Initial Stage Development Plan.

TABLE 7.5.2 Maximum Significant Wave Height and Direction During a Period of Two Years

Dung Quat Offshore

Direction	Height (m)	Frequency (sec)
NNW	1.50	4.8
N	4.80	8.4
NNE	4.20	8.1
NE	3.80	9.9
ENE	4.00	8.3
E	3.10	7.3

Dung Quat Port Entrance

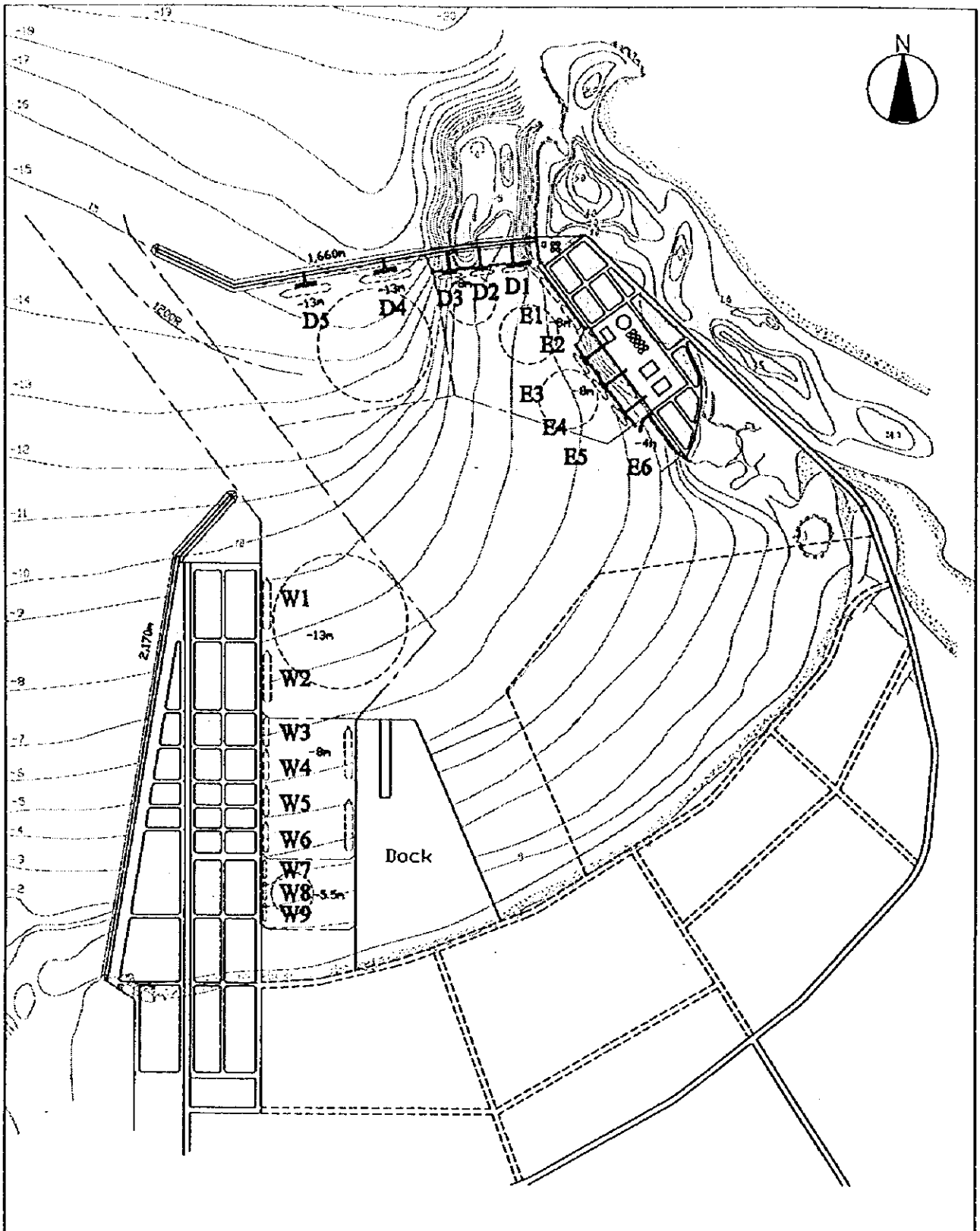
Direction	Height (m)	Frequency (sec)	Change in the WaveDirection (dgree)
NNW	1.1	4.8	0
N	3.6	8.5	0
NNE	3.6	8.1	▲12
NE	3.2	9.9	▲24
ENE	3.0	8.3	▲36
E	1.4	7.2	▲54

△ Clock-wise
▲ Anti Clock-wise

Shoaling Coefficient

Direction	Height	Frequency	Change in the WaveDirection (degree)
NNW	0.75	0.99	0
N	0.76	1.01	0
NNE	0.86	1.00	▲12
NE	0.83	1.00	▲24
ENE	0.75	1.00	▲36
E	0.46	0.98	▲54

△ Clock-wise
▲ Anti Clock-wise



JICA Port Development Study in Central Region	Figure 7.5.1
Dung Quat Port Development Masterplan	0 200 400 600 800 1,000 m
Final Report 1998	FILE DQ-DF-MP-A4

8. Initial Stage Development Plan

8.1 Industrial Development

According to the Dung Quat Industrial Zone plan, oil refinery, petrochemical plant, ship building and repairing, agriculture, forestry and sea product processing, steel manufacturing, automobile assemblies are planned in future. A the phase of initial stage of port development plan, first oil refinery with a capacity of 6.5 million tons per year and first petrochemical plant is assumed to be operating.

8.2 Cargo Throughput

(1) Crude Oil

The volume of crude oil handled at the port is estimated at about 6.5 million tons per annum at the first phase, 60 percent of which is domestic crude oil.

Unit : ton

Foreign	Import	2,600,000
Domestic	Unloading	3,900,000

(2) Petroleum Products

The shipping volume of petroleum production from the refinery is estimated to be 6 million tons in the initial stage, all of which will be shipped to other domestic regions..

Unit : ton

Domestic	Loading	6,000,000

(3) Petrochemical Products

The volume of petrochemical products from the petrochemical industry attached to the first phase of refinery is estimated to be 0.25 million tons.

Unit : ton

Domestic	Loading	250,000

(4) Others

Other cargoes handled at the Dung Quat Port in the initial stage are considered to be temporary construction materials such as mining and cement for the first phase of oil refinery industry.

(Construction Material)

Domestic	Unloading	500,000 ton

(5) Total

Total cargo throughput including international transit cargo is summarized in Table 8.1.1.

Table 8.1.1 Total Cargo Throughput

Unit: Thous.Ton

Commodities	Foreign		Domestic	
	Export	Import	Loading	Unloading
Oil Products	0	2,600	6,000	3,900
Mining, Clinker	0	0	0	250
Cement	0	0	0	250
Manufacturing Products	0	0	250	0
International Transit Cargo	10	36	-	-
(Sub Total)	10	2,636	6,250	4,400
(Total)		13,296		

8.3 Ship Calls

Based on trends of the past net tonnage of calling vessels and future cargo volume, future number of calling vessels in 2010 is estimated for each ship type. The number of each vessel type in the past four years at Danang Port is shown in Table 8.3 1.

Table 8.3.1 Number of Ship Calls at Danang Port

Type of Ship	1994	1995	1996	1997
Cargo Ship (Foreign)	152	173	217	229
Cargo Ship (Domestic)	95	60	64	147
Passenger Ship	31	28	36	35
(Total)	278	261	317	411

Source: Danang Port Authority

The projected vessel calls in 2010 are estimated as follows.

Table 8.3.2 Number of Ship Calls (ISP)

Type of Ship (DWT)			Number of ships /year
Oil Tanker	Foreign	50,000	87
Oil Tanker	Coastal	5,000	2,475
General Cargo (Construction Materials)	Coastal	1,000-5,000	139
Bulk Cargo (Cement)	Coastal	1,000-3,000	104
General Cargo	Foreign	3,000-10,000	26
Ro / Ro	Coastal	4,000-7,000	45
Total			2,875

8.4 Port Facilities and Layout for ISP

8.4.1 Stage-wise Development

Scale of development affects the viability of a port development project, in particular at the first stage of the development. Special attention should therefore be paid to the scale of economy. Industrial port usually has a base cargo and can invite regular ship calls. Industrial development projects in the hinterland may bear part of the port construction cost. However, commercial port has no guarantee of regular ship calls. A new commercial port also requires a close connection with city to provide shippers, consignees and shipping service agents with offices, bank services, telecommunication services and other city services.

Initial stage development plan should therefore be carefully designed from a view point of the scale of initial investment and the timing of completion of the project. Stage-wise development plan of Chan May Port is shown in Figure 8.4.1, in which the construction works start from the main breakwater from Co Co Cape. At the first stage of the development includes one deep water oil dolphin berth for large product oil tankers, four oil dolphins for coastal oil product carriers and two conventional cargo berths.

The main breakwater will be built with a length of 970 m to shelter these berths. Dredging of channel and basin will be carried out up to - 13 meters to cater to large product oil carriers.

8.4.2 Port Facilities for ISP

In the initial stage development, Dung Quat Port is required to cater to 1,000 - 50,000 DWT class product oil tankers. Total volume of oil products is planned to be 6,500,000 tons per year, in which 6,000,000 tons will be shipped out from the port. Two conventional berths with an alongside depth of –8 m (under CDL) are planned to accommodate heavy cargo carriers, conventional cargo ships, Ro/Ro ships, cement carriers and others coastal ships. Small craft berth is designed with a length of 200 m and a depth of -4 m (indicated as E6 in Figure 8.4.2) to serve for port service ships and work vessels.

Of a 970 m long breakwater, 370 m is extended to the direction of 263° and 600 m to the direction of 260° to shelter the berths against waves from N-NW. A 150 m groin is temporarily planned at the mouth of Tra Bong River to protect the beach from erosion. The length and location of the groin shall be carefully examined in the detailed design stage.

Port facilities planned for the ISP are summarized in Table 8.4.1 and port facilities layout plan is shown in Figure 8.4.2. Initial Stage Development Plan of Dung Quat is shown in Figure A.8.4.1 (Appendix).

TABLE 8.4.1 Port facilities planned for the ISP

Port Facilities	Sizes	Remarks
Berths		
D1-2; E3-4 (Oil Berth)	Dolphin, D –8 m	Product oil tankers up to 6,000 DWT Handling capacity: 600,000-800,000 tons/berth
D4 (Oil Berth)	Dolphin, D –13 m	Product oil tankers up to 50,000 DWT Handling capacity: 4,000,000-4,500,000 tons/berth
E1-2	L 300 m, D –8 m	Conventional berths for 7,000 DWT class general cargo trampers; Ro/Ro vessels; cement carriers and others
Small craft berth	L 200 m	Tug boats, Pilot boats, Customs ships and others
Land Reclamation	225,000 m2	Wharf
Breakwater	L 970 m	Depth of breakwater construction site: -15 to -15.5 m
Channel & Turning Basin	D –13 m, Volume 784,000 m3	Dredging to - 13 m

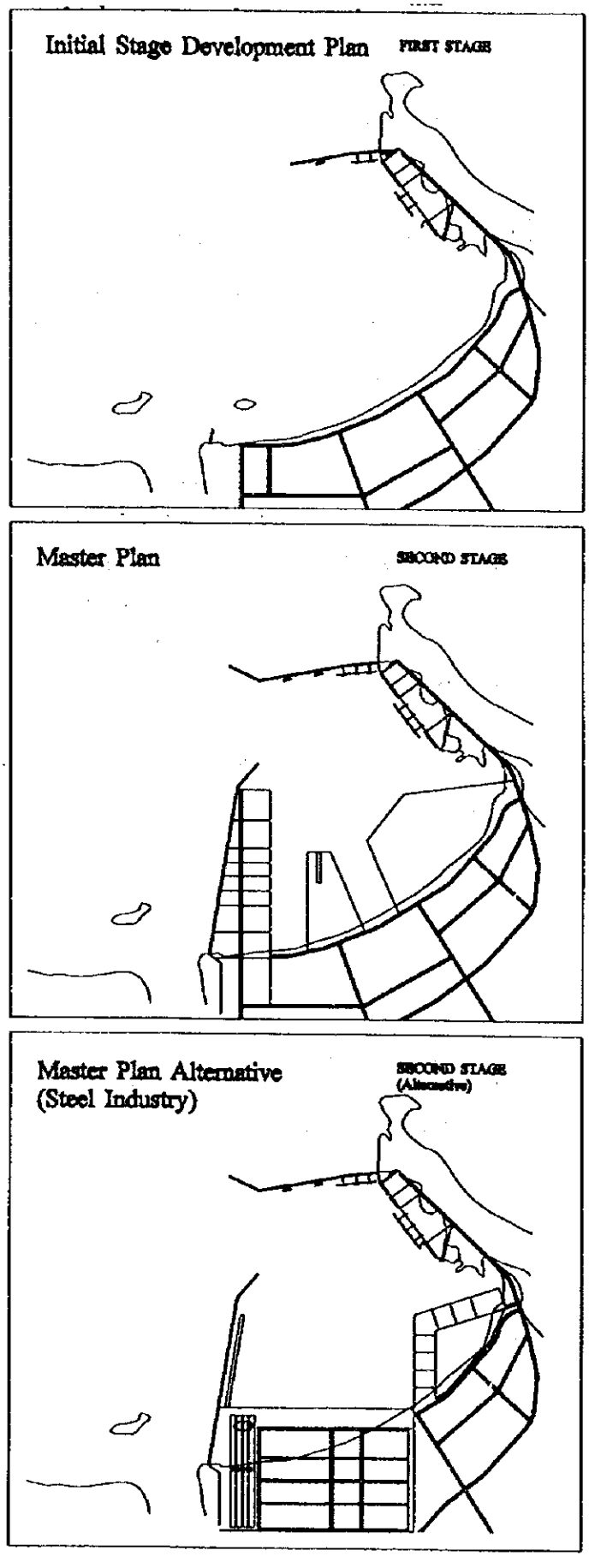
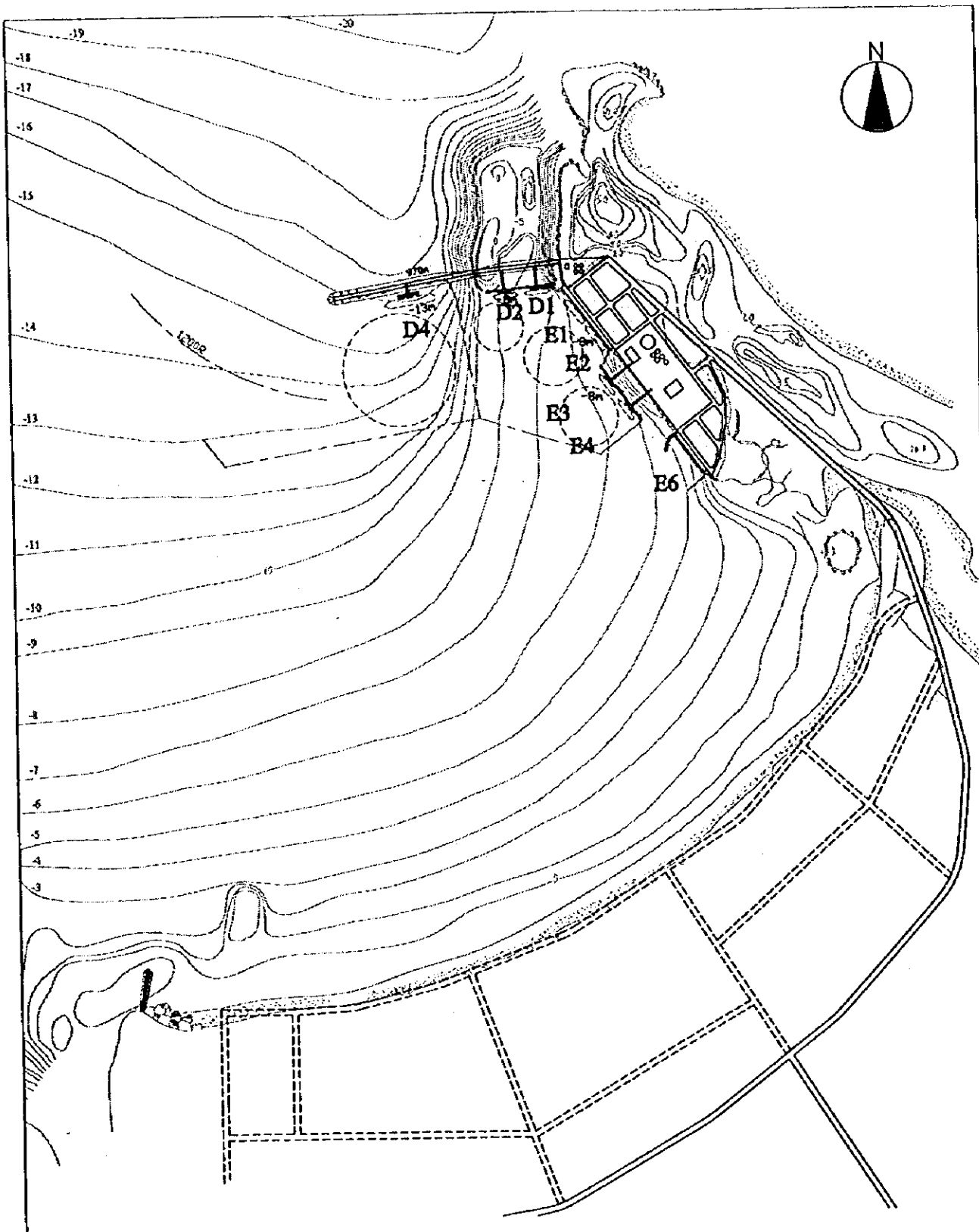


Figure 8.4.1 Dung Quat Development Stage Plan



JICA Port Development Study in Central Region	Figure 8.4.2
Dung Quat Port Initial Stage Development Plan (ISP)	0 200 400 600 800 1,000 m
Final Report 1998	FILE DQ-ISP-A4

8.5 Implementation Plan

The construction works start from the main breakwater, of which 370 m is in the shallow water connecting the coast and the reef. It will take a short period to construct this part of the breakwater. Then the berth E1 will be built and used for oil refinery plant construction and for port construction. The breakwater will be extended another 600 m to shelter oil berths D3-D5 in the next stage.

Construction schedule of the port entirely depends on the development of oil refinery. Since the breakwater beyond the 370 m section is costly and takes long period for construction, it will be appropriate to build the 370 m section of breakwater and oil tanker berths D1-D2, E3-E5 at the first stage. While the port only serves for coastal tankers with these berths, it will have no difficulty in delivering oil products to Vietnamese ports.

Prior to ISP, a small scale development will be able to cope with the development of the oil refinery in Dung Quat. Small scale ISP will be able to handle half of the planned product oil, i.e. 3,500,000 tons compared with 6,000,000 tons of ISP.

TABLE 8.5.1 Small Scale ISP

Facilities	Quantity	Capacity
Breakwater	370 m	
Oil tanker dolphin	5 berths (D1-2; E3-5)	3,500,000 tons /year[1/]
Turning basin	Depth -8 m	Dredging up to -8 m[2/]

Note 1/ Phase I of the oil refinery project plans to produce 6,500,000 tons of product oil and to ship out 6,000,000 tons. This small scale ISP can cover more than half of its planned production and shipment, which may be acceptable for several years.

Note 2/ ISP is designed to dredge up to -13 m.