EXECUTIVE SUMMARY

Executive Summary

The Master Plan Study
for The Coastal Channels and Ports Development in The Kingdom of Thailand

(January 2001 – March 2002)

1. Background and Objectives

Development of regional economies is one of the major strategies under the implementation of the 8th National Economic and Social Development Plan in Thailand. The development of the coastal transport networks including the establishment of an effective planning for the coastal channels and ports is consistent with the region's urban-industrial development.

In order to promote the social and economic development in the Southern Seaboard, Royal Thai Government has given priority to the arrangement of economic infrastructures.

In the meantime, although Harbour Department is continuing the nationwide maintenance dredging operation year by year, the siltation problems at the coastal ports and channels also remain in a serious situation to have effect on the regional development and the coastal shipping development.

In recognition of the background mentioned above, the objectives of the Study are set forth as follows:

(1) To formulate a master plan for the channels and ports development and their maintenance/management plan including comprehensive dredging management plan up to the year 2020
(2) To formulate a short-term development plan and conduct a feasibility study for the selected channels and ports up to the year 2010
(3) To transfer the technology to HD through study activities.

2. Implementation of Study

The Study implemented the following surveys to formulate a master plan for the channels and ports development, and their maintenance/management plan including comprehensive dredging management plan in the southern coast on the Gulf of Thailand.

- Dredging and maintenance/management condition survey, socio-economic data collection, review and analysis of coastal shipping and existing master plans
- Discussions about promotion measures for the coastal shipping with Office of Maritime Promotion Commission (OMPC) and its consultants to confirm the government policies
- At Sichon, Sakom and Thepha, sand drift condition survey conducted in predominant season of sand drift for analyses of channel siltation and sedimentation

- Environmental conditions survey conducted for formulation of a implementation plan with environmental preservation strategy

Through analyzing and examining of above surveys, the master plan was formulated in priority coastal channels. Based on a selection criteria, Sichon channel, Songkhla channel and Bang Ra Pha channel were selected for the feasibility study. After the natural and environmental condition surveys had been conducted in three channels, the feasibility was examined by economic and financial analyses, and by an environmental impact assessment on the short-term development plans.

3. Conclusions

3-1 Major Findings on Coastal Channels and Maintenance Dredging

- The cutter suction dredgers consist of C-1, C-25, C-37 and C-39. Among them, C-25 and C-37 are designed for excavation at much deeper depths than the channels CDC II is currently maintaining. They are also designed for discharging at much longer distances than the actual operation. Coastal Dredging and Maintenance Division control six trailing suction dredgers (hopper dredgers) and assign them for channel maintenance. In 2001, H-4, H-8, H-10 and H-12 were engaged in maintenance dredging of CDC II channels, mostly Songkhla channel, during the site survey. As far as the observation of H-10 and H-12 hopper dredgers, they are mostly engaged in traveling so that excavation time is too short. Consequently, the dredging output is very small.

- According to "Annual Implementation Report" for fiscal years from 1996 to 2000, the expenses for the maintenance dredging of CDC II channels are allocated as follows: Pak Phanang (53%), Songkhla (22%), Pattani (6%) and other channels (19%). The three major channels required 81% of the spending and other channels consisting of 27 navigation channels and 14 irrigation channels consumed only 19%. In terms of volume, the three major channels share of the total was: 16% Pak Phanang, 51% Songkhla and 6% Pattani. The other 41 channels share only 27%.

3-2 Bottlenecks on Coastal Channels and Maintenance Dredging

- Songkhla: The navigation channel is much shallower than the design depth. The water depth at the quay wall is very shallow (-5 m) in comparison with the design depth of -9 m.
- Pak Phanang: Siltation is heavy and shallow not in the river but in the sea. Dredging in the 27km long channel was conducted almost every year. The navigation channel is shallower than the design depth (-4m).
- Pattani: The present depth for Pattani is -3m against the design depth (-5m). The depth of navigational channel must be maintained to accommodate many large fishing boats.
- Sichon: The single jetty channel is not sufficient to protect the channel from becoming shallow.

- Dual jetty channels: The dual jetties do protect the channel from becoming shallow. Beach erosion is serious on the down stream side of littoral drift.
- No jetty channels: Backhoes are used for maintenance dredging, when channels are aggravated heavy sedimentation.

3-3 Coastal Changes Analyses

- The JICA Study Team conducted bathymetric and shoreline survey at Bang Ra Pha and compared the survey results with the topography in 1996. The deposition on the upstream side of the littoral drift is estimated 45,000 m^3 per year and erosion on the downstream side is estimated 32,000 m^3 per year.
- N-line Model Analysis on the shoreline changes that the team conducted resulted in the estimated rate of littoral transport as Sichon: 2.5 x 10^4 m^3 per year, Sakom: 1.1 x 10^5 m^3 per year and Thepha: 1.0 x 10^5 m^3 per year.

3-4 Cargo Demand at Songkhla Port

- The general cargo demand for the short-term development in 2010 is forecast from 433,000 to 528,000 tons. Since the private coastal shipping berths on the Songkhla Lake are capable of handling only up to 350,000 tons per year and the expansion of private piers is prohibited, one new general cargo berth is required to handle the excess cargoes.

- The forecast for general cargoes to be transported by truck in 2010 between the Study Area ((Songkhla, Pattani and Narthiwat provinces) and Eastern Seaboard (Laem Chabang Port, Map Ta Phut Port) is about 297,000 tons. On the assumption that about half of the cargoes can be shifted from the road to coastal transport, Ro/Ro ships would transport 150,000 tons in 2010. One Ro/Ro berth is, therefore, included in the short-term development of Songkhla Port

3-5 Master Plan

3-5-1 Short-term Development

The JICA Study team recommends 12 projects to be implemented as short-term development. Only two channels should be provided with facilities related to the coastal shipping, namely Sichon and Songkhla. For Sichon, an additional jetty and light beacons should be provided. For Songkhla, a coastal shipping terminal having one coastal berth and one Ro/Ro berth should be constructed. More works on shore protection works should be provided for the channels protected by dual jetties. Sand bypassing should be implemented at three channels: namely, Bang Ra Pha, Tanyong Pao and Panare. Total cost for the short-term development including sand bypassing, but excluding engineering fee, physical contingency and VAT is estimated at about 633.3 million Baht.

3-5-2 Long-term Development

The JICA Study team recommends 10 projects to be implemented as long-term development. For

Songkhla, the coastal shipping terminal should be expanded to have one each of additional berths of both coastal and Ro/Ro. Sand bypassing should be implemented at 10 channels: namely, Songkhla, Na Thap, Sakom, Thepha, Bang Ra Pha, Tanyong Pao, Panare, Bang Maruat, Sai Buri and Narathiwat. Total cost for the long-term development including sand bypassing, but excluding engineering fee, physical contingency and VAT is estimated at about 481.5 million Baht

3-5-3 Site Selection of Coastal Shipping Facilities at Songkhla

The site for the coastal shipping facilities is planned adjoining to the exiting international container terminal (Chaophaya Terminal International Co., Ltd., CTI) on its east side along the navigation channel to the lake. The main reasons for the selection are to avoid the expansion area for the international container terminal and the archaeological preservation area, and to minimize the maintenance dredging for the new berths.

The following facilities are to be provided as short-term development:

- Coastal shipping berth (130 m and 7.5 m deep)
- Ro/Ro berth (150 m long and 6.5m deep) equipped with Movable Bridge
- Transit shed (2,700 m^2 floor), Administration Bldg. (600 m^2 floor)
- Open Yard (7,050 m^2), Parking lots (7,500 m^2), Access Road, Access Bridge, Gate, Utilities

The total project cost is about 420 million Baht and construction will take about four years.

3-5-4 Short-term Development in Sichon Channel

The existing single jetty was constructed in 1996. Since then, sediment deposit has taken place near the jetty and the shallow seabed in the channel hampers ship maneuvering. It probably augments wave intrusion to the fishing village. One more jetty is required to prevent the channel from shoaling and protect the village from storms.

The new jetty is planned identical to the existing jetty: namely, rubble mound type of jetty in parallel to the existing one with 700m length and 4m crown elevation. Provision of four light beacons is recommended. The total project cost is about 86 million Baht and construction will take about 1.5 years.

3-5-5 Short-term Development in Bang Ra Pha Channel

The sand bypassing is more economical than the jetty extension. The extension of the jetties requires four times as many detached breakwaters as the sand bypassing. The recommended project, therefore, consists of sand bypassing of 50,000 m^3 per year and construction of four detached breakwaters. The cost for 6 years is estimated at about 48 million Baht.

3-6 Economic and Financial Analysis

3-6-1 Economic Analysis on Coastal Shipping Facilities at Songkhla Port

Economic benefits of savings in transport costs and road maintenance costs are treated as quantitative benefits. The project cost consisting of initial investment cost, operation cost and maintenance cost are converted to quantified economic costs. Based on the costs and benefits above, the economic analysis computes that the EIRR of the coastal terminal development is 22.0%; the benefit over cost ratio (B/C ratio) is 1.87; and the net present value (NPV) is 240.27 million Baht when the discount rate of 12% is taken into account. It is concluded that the coastal terminal development is worth being implemented from the viewpoint of the national economy of Thailand.

3-6-2 Financial Analysis on Coastal Shipping Facilities at Songkhla Port

Port service fee level, as a key determinant of the revenue, was assumed in such a way that a comparative advantage of port users against road users in terms of transport costs can be assured: that is, 120 Baht/ton for general and container cargos and 40 Baht/ton for Ro/Ro cargos. The cost for the operation and maintenance are estimated referring to existing port activities. Based on these assumptions, the financial analysis reveals a negative FIRR (financial internal rate of return) of -2.3% within the 25 years time horizon, meaning that the coastal terminal development could not be justified from the financial standpoint without a substantial resource involvement of the government sector through a subsidy or another form of special grant for local economy stabilization purpose. In order to make the coastal terminal development financially feasible, about 80% of the initial investment cost needs to be covered with the subsidy.

A sensitivity test also indicates that in order to obtain more than 12% FIRR, a condition with 30% revenue increase and 50% cost reduction is necessary when no subsidy components are taken into account.

3-6-3 Economic Analysis on Short-term Development in Sichon Channel

Benefits which the project will generate are savings in fuel consumption, savings in prevention of loss of marine catches due to reduction of waiting time to enter the channel, and savings in channel dredging cost. The economic analysis concludes that EIRR is 5.6%, Benefit over Cost Ratio (B/C ratio) is 0.61and Net Present Value (NPV) is -19,718 thousand Baht when the discount rate of 12% is taken into account. No financial analysis was conducted since it is obvious that navigation channel does not produce any revenue fees from the fishermen.

3-6-4 Economic Analysis on Short-term Development in Bang Ra Pha Channel

Benefits which the project will generate are the elimination of landing ships on seashore, reduction of transport time and prevention of loss of catch. As there are only 110 small fishing boats, the economic analysis concludes that EIRR is not available. Benefit over Cost Ratio (B/C ratio) is 0.16 and Net Present Value (NPV) is about -26,457 thousand Baht when the discount rate of 12% is taken into

account. No financial analysis was conducted for the same reason as Sichon Channel.

3-7 EIA on Short-term Developments

As resettlement problem is being solved in relation to the expansion of the container terminal of the Songkhla Port, it will thus solve the issue for the development of coastal shipping. Care must be taken for archeological monuments in laying out the port development plan. Regarding the improvement of Sichon channel and Bang Ra Pha channel, no serious environmental impacts are foreseen.

3-8 Recommendations on Coastal Channels and Maintenance Dredging

- **Implementation of Additional Jetty and Sand Bypass**

At Sichon channel, one more jetty is required to prevent the channel from shoaling and protect the village from storms. At every double jetty channel, deposition areas took place in the upstream side of littoral drift and erosion areas in the downstream side. The best measure to protect the navigational channels and to reduce the coastal erosion in the downstream side of littoral drift is to take a sand bypassing system in the study area.

- **Dredger Deployment Plan with Priority on Dredgers**

The dredging operation for the channel maintenance should be planned with the priority put on the equipment. In Songkhla channel, two hopper dredgers (H-10 and H-12) should be used for initial dredging (design depth -9m), and after that, one hopper dredger should be used for maintenance dredging. For maintenance of Pak Phanang channel, it is recommended to use C-25 and C-37 simultaneously.

- **Improvements on Dredging Operation and Management**

- To maintain a proper water velocity inside the discharge pipeline on dredging operation of cutter suction dredgers. To this end, providing diffuser at the end of the discharging pipeline, and/or reducing the diameter of impellers inside the dredge pumps.
- To position the cutter head at such position that the excavating face can be twice as thick as the cutter head diameter. For C-37, readjusting the front end of the ladder.
- To change the shape of cutters to fit the shallow depth.
- To continue the excavation until the time when the weight of the dredged materials in the hopper does not increase any more, or the maximum confinement of the dredged materials in the hopper is practically achieved.
- To instruct specific dredging area to the dredger crew.
- To monitor the progress based on the survey data, loading records and excavation time records.
- To identify the personnel at the manager level at Headquarters responsible for correct and efficient dredging.
- To employ a combination of a long-arm backhoe, grab bucket and suction pump to deepen the quay wall of Songkhla Container Terminal.

3-9 Recommendations on Implementation of Project

- The coastal terminal development at Songkhla Port is worth being implemented from the viewpoint of the national economy, because the computed EIRR of 22.0% is much higher than the opportunity cost of capital (12%) in the current Thai economy.

- At Sichon and Bang Ra Pha channel, from the results of economic analysis, the project is not economically feasible. However, taking into account such qualitative benefits as the aspect of the overall improvement of social stability in the community through job creation and income generation by keeping fishery activities, the project is considered to be worthy as the social welfare.

- For the implementation of the coastal terminal development at Songkhla, in consideration of the difficulty in its financial feasibility, an optimal scheme of PPP (Public and Private Partnership) should be explored. A viable scheme is proposed that the government sector construct the facilities with the subsidy equivalent to 80% of the total investment cost while the private sector assumes the responsibility for the operation and maintenance, introducing a revenue sharing system where the private operator can gain a 15% return on its investment in the long-term and pay the government sector 21% of the total revenue collected from the port service fees. A cashflow analysis implies that by receiving 21% of the shared revenue, the government sector will be able to manage soundly the debt service of long-term loans for the remaining 20% of the initial investment.

3-10 Summary of Conclusion and Recommendations

As discussed in 3-8 and 3-9, the recommendation are summarized as below:

Issues	Measures
1. Sedimentation and Siltation in Channel	
○Shortage of civil structure works	Additional jetty construction, Sand-bypassing
○Inefficient dredging works - Dredger deployment - Dredging Operation - Management	 Appropriate dredger deployment according to capacity of dredger and channel conditions Technical improvement Management organization improvement
○Maintenance Dredging	
- Songkhla	Dredging operation improvement of hopper suction dredger Deepening the quay wall. 2 Hopper dredgers for initial dredging
- Pak Phanang Channel	Adjustment of cutter suction dredge and dredging operation Improvement 2 Cutter dredgers for maintenance dredging
2.Increasing Cargo Demand	2 Berths construction at Songkhla Port

MEMBERS

Members of the study team and the counterparts are as follows:

Harbour Department

Mr. Wanchai Sarathulthat	Director General
SEN.LT. Vinai Cheysupakate RTN.	Deputy Director General
Mr. Tawalyarat Onsira	Deputy Director General
Mr. Fuang Panichgit	Director of Technical Division
Mr. Vathin Pannarunothai	Chief of Engineering Section, Technical Division
Miss. Wasana Ungprasert	Chief of Foreign Relations Section, Technical Division
Mrs. Vilawan Siringampen	Chief of Policy and Planning Section, Technical Division
Miss. Soontharee Pirom	Environmentalist, Technical Division
Mr. Pramot Sojisupom	Chief of Hydrology Section, Survey & Chart Production Division
Mrs. Chanintorn Varavanawong	Transportation Officer 7, Technical Division
Mr. Kollawatch Phasanondh	Dredging Engineer, Coastal Dredging and Maintenance Division
Mr. Kanoksak Hirunthanont	Civil Engineer, Coastal Dredging and Maintenance Division
Mr. Manop Khameanngan	Chief of CDC II, Songkhla
Mr. Arun Ketmaraca	CDC II, Songkhla
Mr. Teerapong Woonaphruk	CDC II, Songkhla
Mr. Danai Sripitak(*)	Chief of Planning Section, Coastal Dredging And Maintenance Division
Mr. Siriwat Seangchao(*)	Dredging Engineer, Coastal Dredging and Maintenance Division
Mr. Danai Kumnungnate(*)	Civil Engineer, Technical Division
Mr. Kittirat Matekul(*)	Civil Engineer, Technical Division
Miss. Piyarat Pitiwatanakul(*)	Environmentalist, Technical Division
Miss. Soontharee Pirom(*)	Environmentalist, Technical Division
Mrs. Kamolporn Rongrongrojarek(*)	Foreign Relations Officer, Technical Division
Miss. Nongluk Ritthidate(*)	Transport Officer, Technical Division

(*) : Counterpart Personnel

Study Team

Mr. Nobuo ENDO	Team Leader
Mr. Shingo SHIRATORI	Port and Navigation Channel Planning / Demand Forecast
Mr. Takeyasu KIKUTA	Sand Drift (1)
Dr. Sucharit KOONTANAKULVONG	Sand Drift (2)
Mr. Mitsuhiko HASEGAWA	Dredging Planning
Mr. Yoshio WAKAMATSU	Dredging Vessel
Mr. Kenji SAKAI	Natural Conditions / Environmental Consideration
Mr. Moriyoshi SAKURADA	Engineering Design / Cost Estimate / Construction Program
Mr. Kiichi KIKEGAWA	Management and Operation
Mr. Masatoshi KANEKO	Financial and Economic Analysis
Mr. Hiroyuki TATEYAMA	Coordinator

Chapter 1 Introduction

1. Introduction

1.1 Background of the Study

Harbour Department of the Ministry of Transport and Communications of Royal Thai Government (HD) maintains many channels: small to large, domestic to international, commercial to fishing and irrigation. At Songkhla on the southern coast of the Gulf of Thailand, the Coastal Dredging Center II (CDC II) of HD maintains 44 channels. Volume to dredge for the channel maintenance every year has been reported for a long time as 6 million m^3. This large demand of dredging work is the fundamental pressure for the HD to have requested the technical assistance of Japan International Cooperation Agency (JICA).

The Royal Thai Government (RTG) has the policy to promote the maritime transport because it is more economical than road transport when the hauling distance is large between the cargo origin and destination. Transport between the southern coast and the eastern seaboard of Thailand is the typical case to be promoted where cargoes can either be transported by truck – approximately 1,088 to 1,250 km hauling distance – or by ship – approximately 610 to 670 km hauling distance. The Office of Maritime Promotion Commission (OMPC) is the agency responsible to conduct study on the coastal shipping in Thailand. To ensure the safe navigation of the coastal channels for the maritime transport, OMPC requested technical assistance.

In response to the request of RTG, the Government of Japan (GOJ) decided to conduct "The Master Plan Study for The Coastal Channels and Ports Development in The Kingdom of Thailand" (hereinafter referred to as "the Study"), within the general agreement framework of technical cooperation between Japan and Thailand, which was set forth in the Agreement on Technical Cooperation between GOJ and RTG on November 5, 1981.

JICA sent a preparatory survey mission to Thailand in October 2000 and conducted preliminary research including field works. As a result of the study of this mission, the "Scope of Work" of the requested study was settled and an "Agreement" was signed by JICA and HD on October 5, 2000. According to the Agreement, JICA dispatched a study team (JICA Study Team) to Thailand in February 2001.

1.2 Objectives of the Study

In recognition of the background mentioned above, the Objectives of the Study are set forth as follows:

(1) to formulate a master plan for the channel and port development and plan their maintenance/management including comprehensive dredging management plan up to the year 2020
(2) to formulate a short-term development plan and conduct a feasibility study for the selected channels and ports up to the year 2010
(3) to transfer technology to HD through study activities.

1.3 Implementation of the Study

Since February 2001, the JICA Study Team visited Thailand twice to conduct site surveys and investigations: from February 4 to May 31 and from August 1 to October 18, 2001. HD has been cooperating with the JICA Study Team as the counterpart for the smooth execution of the survey and investigation and providing advice and comments on the Study. For the ports development study, OMPC provided its data and information to the JICA Study Team to coordinate particularly the cargo demand forecast of the coastal shipping.

The JICA Study Team observed the maintenance dredging operation of CDC II, and obtained information about natural conditions along the coastline from Khanom to Tak Bai. The team produced the master plan for the coastal channels and ports development in the area under CDC II management. It also produced recommendations for improvement of the dredging operation. And finally, using the collected data and information, the team conducted feasibility study on the three selected channels.

This report compiles all the results that the JICA Study Team has produced in the order of the logical sequence of the study.

1.4 Usage of the Study Results

The most noteworthy item of the study results is that the quantity the CDC II has annually to dredge is originated from the long-time preconceived operation norms for both the cutter suction dredgers and hopper suction dredgers. In case of the former, they are built for dredging much

deeper depth and discharging much longer distance than is actually the case. The channels are too shallow and the disposal area is very near. For the latter, much attention has not been paid to the actual loading of soil into the hopper. Thus operators have spent more time for traveling than for excavating.

The JICA Study Team in this report provides practical recommendations for improvement of operating dredgers. Some crew has already applied the team suggestions and produced better performance. This report will help the field people improve their performance and yield more output. CDC II people should recognize that with the exiting equipment the dredging targets are achievable when their operation is improved.

OMPC is requested to refer to the feasibility study on the short-term port development at Songkhla for the coastal shipping. It is suggested that OMPC review the feasibility and implement the coastal terminal development as soon as possible.

Chapter 2 Present Shipping Conditions in Study Area

2. Present Shipping Conditions in Study Area

2.1 Transport Status of Coastal Shipping in Thailand

2.1.1 Cargo Traffic in Thailand

Transportation is one of the most important economic sectors in Thailand. Figure 2.1.1-1 reports the volumes of domestic freight as 441 million tons in 1999, when the average traveled distance was 237.5 km. The traffic volumes were over 450 million tons in 1996 and 1997. Figure 2.1.1-2 reports the annual growth rate of domestic cargo traffic. Thailand has experienced an average annual growth rate of 4.3 % in its freight volume during the period 1990 to 1999. However, the freight volume has declined slightly by 1.3 % since 1997 mainly due to the impact of economic downturn.

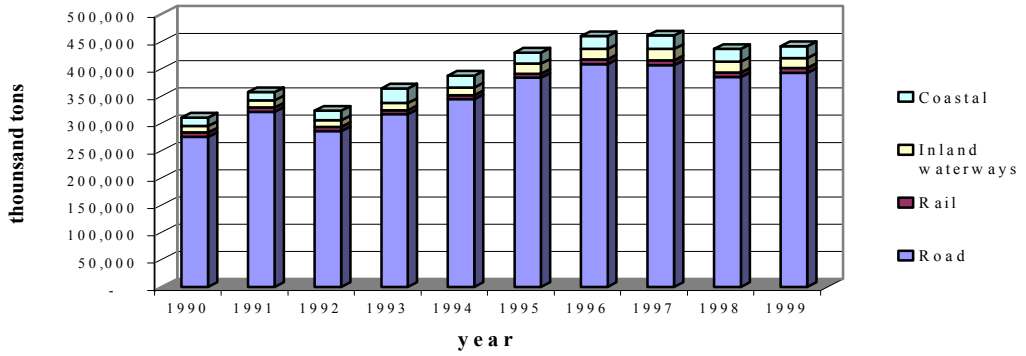

Figure 2.1.1-1 Volume of Domestic Cargo Traffic
Source: Transport Statistics by MOTC

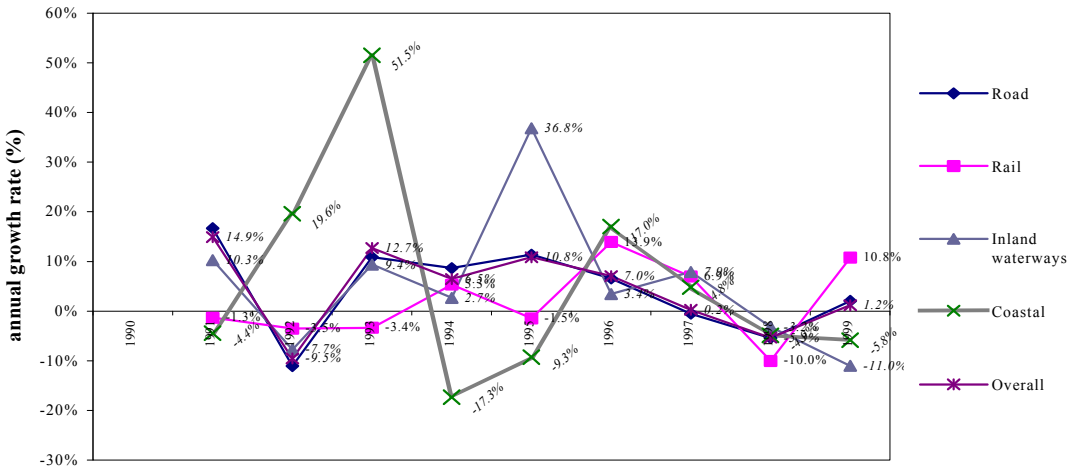

Figure 2.1.1-2 Annual Growth Rate of Domestic Cargo Traffic
Source: Transport Statistics by MOTC

There are four primary modes of freight transportation: road, rail, inland waterway, and coastal transportation. Most transportation activities relied on road transport while the other modes shared only a marginal part in traffic volumes. Airfreight has less than 0.1 % share in the total domestic market.

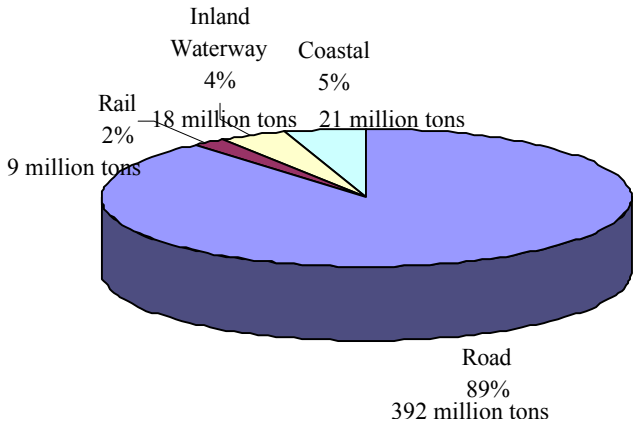

Figure 2.1.1-3 Modal Split for Freight in 1999
Source: Transport Statistics by MOTC

As described in Figure 2.1.1-3, 392 million tons or 89 % of total freight volumes are carried by road transport. The average travel distance was 241.5 km. The dominance of road transport is mainly because of its door-to-door service, minimal double handling cost and required transport procedure, and well established road connection. Besides, the cost of road construction and maintenance is largely borne by government instead of road users. The relatively high degree of reliance on road transport rather than other modes has resulted in several problems such as road congestion, accidents, pollution, inefficiency in energy consumption, and high social cost. Road transport has experienced average annual growth rate of 4.3 % during the period 1990 to 1999. The decreasing trend between 1997 and 1998 was accelerated by the impact of economic crisis, resulting in a decrease in transport demand for freight such as sand, gravel, cement, and building materials. However, road transport demand grew around 2 % in 1999.

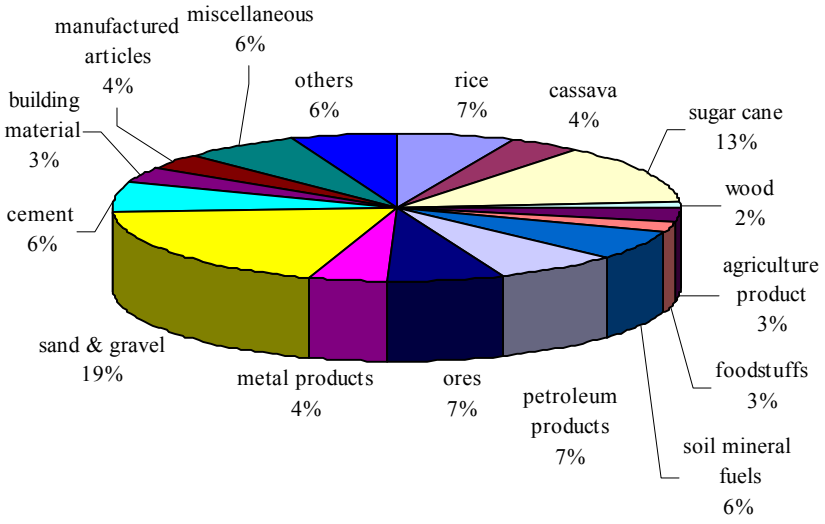

Figure 2.1.1-4 Commodity Groups Transported by Truck in 1999
Source: Transport Statistics by MOTC

Major commodities transported by truck are sand and gravel, sugar cane, rice, petroleum product, and cement (Figure 2.1.1-4). The important places of origin and destination of each major commodity and its average distance are summarized in Table 2.1.1-1.

Table 2.1.1-1 Origin and Destination of Major Commodities Moved by Trucks

Commodity	Major Origins	Major Destinations	Average Distance (km.)
Sand, gravel, clay, and slag	Eastern, western, & central region	Bangkok	107.5
Sugar cane	Western & northeast region	Bangkok	56.0
Petroleum products	Eastern region	Bangkok, northeast, & central region	325.5
Cement	Eastern, central, & southern region	Bangkok	237.1
Solid mineral fuels	East & western region	Bangkok	210.2
Ores and metal waste	Northern region	Bangkok	97.9
Rice	Northeast, western, & northern region	Bangkok	475.6
Miscellaneous	North, northeast, & southern region	Bangkok	425.1
Cassava	Eastern & northeast region	Bangkok	216.8

Source: Ministry of Transport and Communications, Department of Land Transport

Rail transport has been increasingly used for delivering specific bulk or heavy cargoes such as crude oil, petroleum products, bagged cement and, container cargoes. In 1999, 9 million tons or 2 % of total freight volume were carried on trains over an average distance of 321.8 km. Rail transport has maintained an average annual growth rate of 1.9 % during 1990 to 1999.

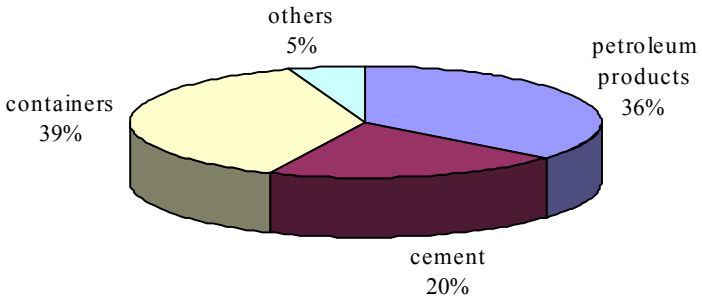

Figure 2.1.1-5 Commodity Groups Transported by Train in 1999
Source: Transport Statistics by MOTC

The growing trend of demand for rail transport is estimated as a result of the introduction of the container route linking the inland container depot (Bangkok) with Laem Chabang port (Chonburi) since the late 1990s. A growth rate of 10.8 % was observed in 1999. However, there are still several barriers for rail transport in competing with road transport which include poor transport network, inefficient terminal facilities, inefficient rolling stock, high freight rate, and high investment and operating cost.

Commodities transported by train mainly consist of petroleum product, containers, and cement (see Figure 2.1.1-5). The important places of origin and destination of each major commodity and its average distance are summarized in Table 2.1.1-2.

Table 2.1.1-2 Origin and Destination of Major Commodities Moved by Trains

Commodity	Major Origins	Major Destinations	Average Distance (km.)
Petroleum Products	Phitsanulok, Chonburi, Rayong, Saraburi	Bangkok, Chonburi, Khonkhan, Lampang	510.6
Cement	Saraburi	Bangkok	236.8
Containers & Miscellaneous	Chonburi, Bangkok	Bangkok, Chonburi	118.3

Source: Ministry of Transport and Communications

Inland waterway and coastal transport are the alternative modes for freight delivery. In 1999, 17.9 million tons or 4 % of total freight volume were carried on inland waterway ships over an average distance of only 118.1 km. Major rivers used for freight transport are Maeklong, Thachin, Noi, and Chaopraya. The cargo items most transported by inland waterway ships were sand and gravel, petroleum products, cassava, and rice (see Figure 2.1.1-6). Major ports of origin are Bangkok, Ratchaburi, Samutsakorn, and Pathumthani while major ports of destination are Chainart, Ayuttaya, Samutprakarn, Ratchaburi, and Bangkok. The inland waterway transport has experienced an average annual growth rate of 5.4 % during the period 1990 to 1999. The decreasing tendency since 1995 was due to the economic downturn in many industries, which used and/or supplied materials hauled by inland waterway ships such as cement and building construction materials.

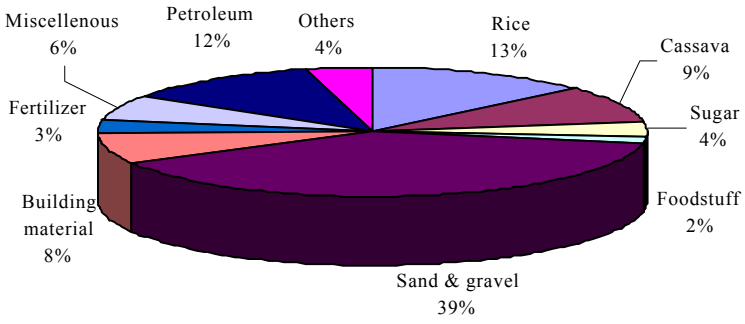

Figure 2.1.1-6 Commodity Groups Transported by Inland Waterway Ship in 1999
Source: Transport Statistics by MOTC

The coastal transport has a share of about 22 million tons or 5 % of total freight volumes over an average distance of 225.3 km. Coastal trade is dominated by petroleum products, which represents about 95 % of total coastal traffic volumes. The rest is distributed among metal products, rubber, agriculture, cassava, foodstuffs, and others (see Figure 2.1.1-7).

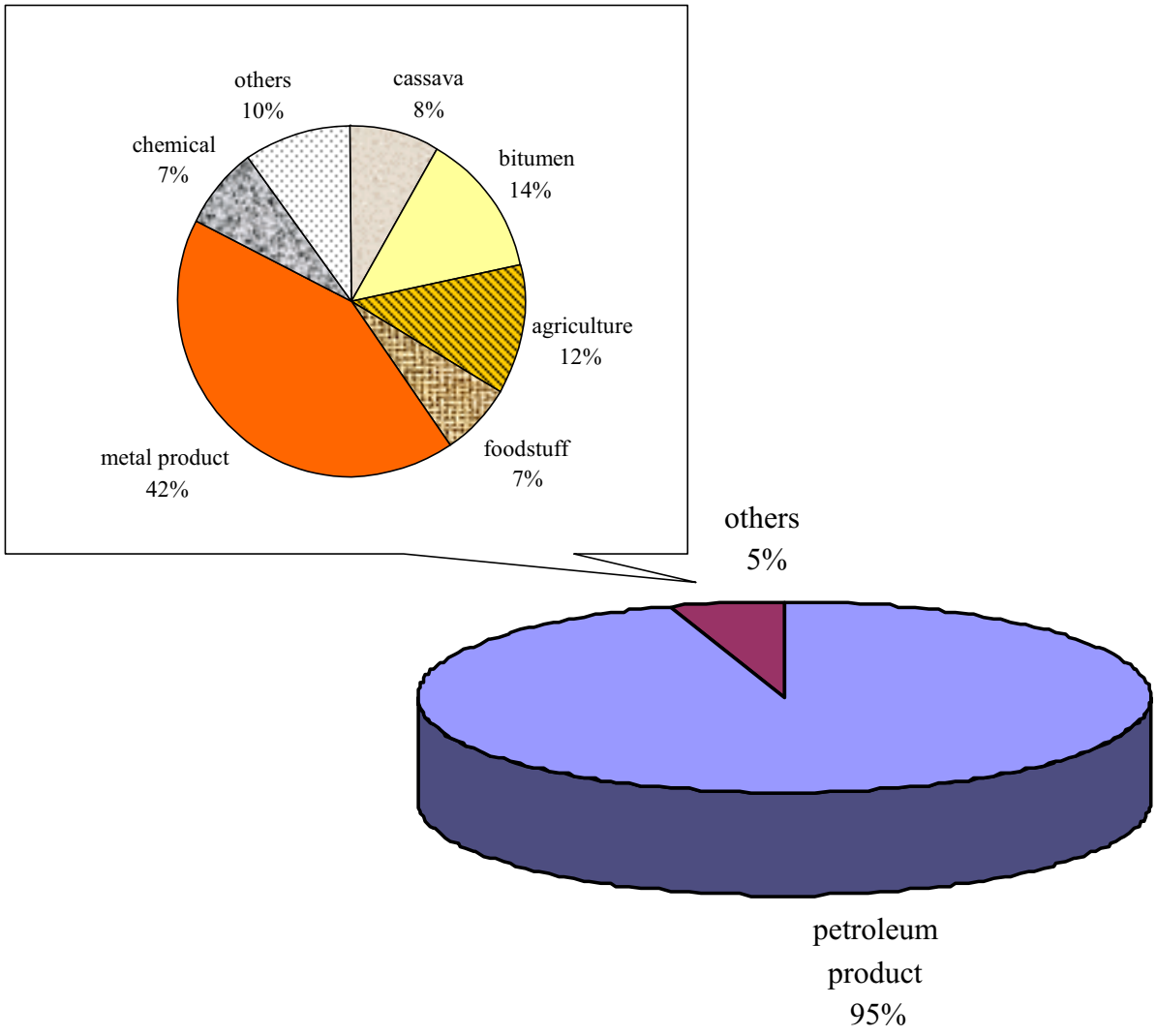

Figure 2.1.1-7 Commodity Groups Transported by Coastal Vessels in 1999
Source: Transport Statistics by MOTC

The major origin and destination of each commodity and average transport distance are reported in Table 2.1.1-3. Coastal transport has experienced an average annual growth rate of 5.7 % during the period 1990 to 1999. Like the inland waterway transport, the decreasing tendency of coastal transport since 1996 is due to the economic downturn in many industries using or supplying materials hauled by coastal vessels such as petroleum products, metal products, and cement. Some commodities, particularly, miscellaneous cargoes have shifted to road carriage.

Table 2.1.1-3 Origin and Destination of Major Commodities Moved by Coastal Vessels

Commodity	Major Origins	Major Destinations	Average Distance (km)
Petroleum products	Chonburi & Rayong	Bangkok, Samutprakarn, Samutsakorn, Chachoengsao, Suratthani, Songkhla	219
Maize	Bangkok, Chonburi	Songkhla	830
Bitumen	Rayong, Chonburi	Samutprakarn, Suratthani	256
Agricultural products	Suratthani, Chonburi	Chachoengsao, Songkhla	576
Animal Fodder	Bangkok	Songkhla	796
Foodstuffs	Chonburi, Bangkok	Songkhla	704
Metal products	Prachubkirikhun	Bangkok, Rayong	146
Cement	Petchaburi	Chonburi, Bangkok	156
Mineral and Building materials	Suratthani	Chonburi, Petchaburi	454
Fertilizer	Bangkok, Rayong	Songkhla	766
Chemicals	Rayong	Samutprakarn	208
Miscellaneous and Container	Bangkok	Songkhla	677
Equipment	Bangkok, Suratthani	Songkhla	495

Source: Ministry of Transport and Communications

Both inland waterway and coastal transport have offered port-to-port services and shared similar problems in competing with road transport. Major problems are, for instance, the shallowness and narrowness of some channels, inefficient port handling equipment, poor intermodal connection, strict transport regulations, low service frequencies, and the cost of waterways utilization that is largely paid by carriers.

2.1.2 Passenger Traffic in Thailand

The integrated passenger transport statistics are not well organized in Thailand. Such statistics were only provided by the Ministry of Transport and Communications, which deals only with urban public passenger transport and inter-city land transport, railway transport, and aviation. Figure 2.1.2-1 shows the passenger traffic volumes in Thailand. There were 1,222 million passenger trips in 1998. Passenger traffic has declined at an average annual rate of 3.6 % since 1993. As in Figure 2.1.2-2, urban public passenger transport is the most important sector in passenger transport and represents 95 % of total traffic volume. However, its volume has declined while that of air transport exhibits a large growth in recent years (see Figure 2.1.2-3).

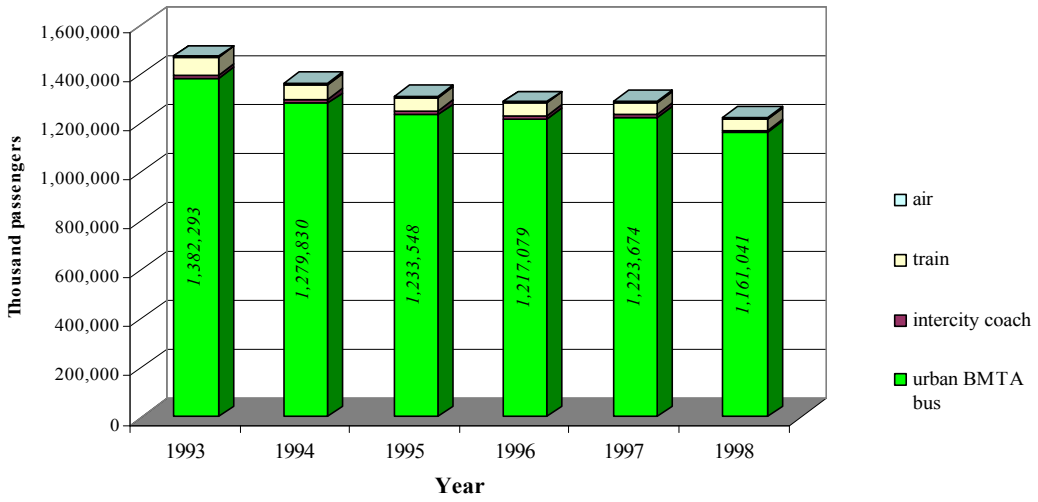

Figure 2.1.2-1 Passenger Traffic in Thailand

Source: Transport Statistics by MOTC

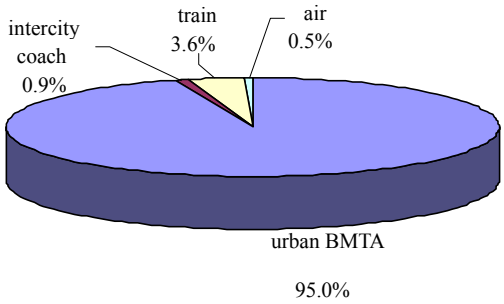

Figure 2.1.2-2 Modal Split of Passenger Traffic in 1998

Source: Transport Statistics by MOTC

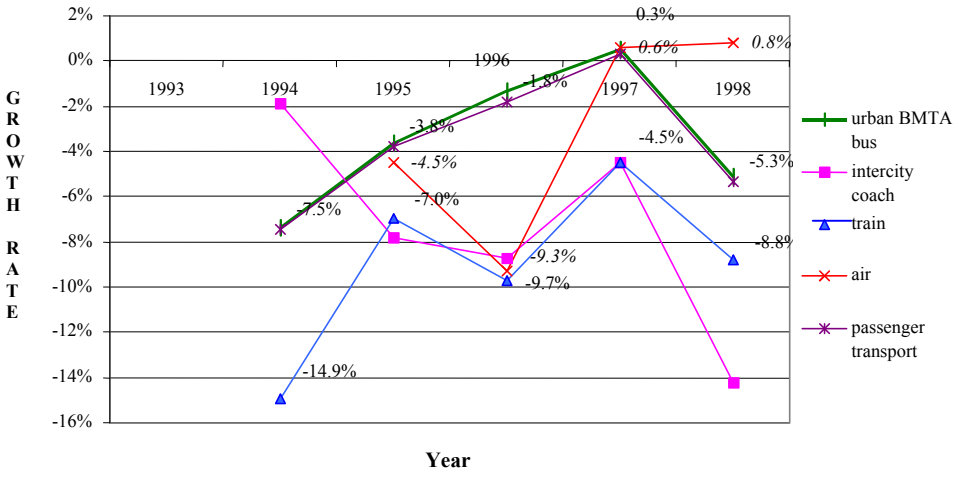

Figure 2.1.2-3 Growth Rate of Passenger Traffic in Thailand

Source: Transport Statistics by MOTC

Due to limited data availability, the origin and destination of passenger traffic is presented only for rail and air transport. For rail transport, major origins are Bangkok, Ayutthaya, Nakhon Ratchasima, and Narathiwat and major destinations are Phrae, Phitsanulok, Saraburi, and Lopburi. For air transport, major origins and destinations are routes linking between Bangkok and Chiang Mai, Phuket, Hat Yai, Chaing Rai, Khon Kaen, and Udon Thani.

2.2 Present Status of Coastal Shipping

2.2.1 Coastal Vessels

Table 2.2.1-1 describes the breakdown of coastal vessels in 1999. There were 52,469 vessels available for coastal trade accounting for 2.5 million GRT evenly divided between motorized vessels and non-motorized vessels. Excluding fishing vessels, steel barge and tankers are the most important vessels used for coastal trade; they represent 82.1 % of total coastal vessel capacity.

Table 2.2.1-1 Number of Coastal Vessels in 1999

Type		Number of Vessels	Gross Tons
Motorized Vessels	General Cargo Vessels	1,067	40,309
	Passenger Vessels	2,302	39,543
	Passenger & Cargo Vessels	566	15,217
	Container Vessels	4	64
	Refrigerated Vessels	1,032	23,666
	Tanker	160	106,063
	Gas Vessels	18	14,050
	Oil and Gas Vessels	6	3,282
	Fishing Vessels	38,476	882,286
	Others	6,502	145,919
Total of Motorized Vessels		**50,133**	**1,270,399**
Non-motorized Vessels	Wooden Lighter	69	6,201
	Steel Lighter	2,131	1,255,290
	Others	136	9,003
Total of Non-motorized Vessels		**2,336**	**1,270,494**
Total of Coastal Vessels		**52,469**	**2,540,893**

Source: MOTC

In analyzing the status of coastal shipping, the classification of coastal vessels was examined. According to the classification proposed by the HD, the coastal vessels are considered as “near coastal voyage”. In such classification, a vessel linking between domestic coastal ports and one linking with other ASEAN neighboring countries are both registered as coastal vessels. As a result of unclear statistical separation between the coastal vessels and the near coastal voyage, the registered number of coastal ships in Thailand is supposed to be overstated.

2.2.2 Liquid Cargo Carriers

As seen from Table 2.2.1-1, Thailand has a total of 184 coastal liquid cargo vessels which transported 123,395 GRT in 1999. There are 14 major carriers in the Thai Ship Owner Association (TSA) offering transport services for liquid cargo. They possess a total of 87 vessels accounting for 94,490 GRT (see Table 2.2.2-1).

Table 2.2.2-1 Liquid Cargo Carriers

	Name of Carriers	Number of Vessels	DWT	GRT	Avg Age (years)
1	Big Sea	7	15,766	7,450	23.0
2	BPP Supply	14	13,666	10,306	29.7
3	CSK Marine	2	3,872	1,897	25.5
4	Navakun Transport	4	2,807	2,596	22.3
5	PINK Transports and Trading	2	5,705	2,633	30.5
6	PSV Supply	5	9,732	5,143	31.2
7	Siam Gas & Oil Transport	6	NA	NA	NA
8	Thai Oil	5	17,546	11,901	9.2
9	TPI Oil	7	4,322	3,534	4.0
10	Unique Gas & Petrochemicals	6	6,849	7,319	23.5
11	VL Enterprise	4	8,737	4,585	21.8
12	VSP Marine Shipping	11	48,284	27,698	30.0
13	Vision Marine	6	10,751	4,966	24.0
14	World Wide Transport	8	9,897	4,464	23.9
Total		**87**	**157,934**	**94,490**	**23.5**

Source: Thailand Ship owner's Association (TSA) Maritime Directory 2000

2.2.3 Other Cargo Carriers

Although Table 2.2.1-1 shows a large number of vessels carrying non-petroleum products, there are only four major carriers offering coastal shipping services by motorized vessels as outlined in Table 2.2.3-1. The rest of freight carried on motorized vessels are mostly delivered by fishing boats with a maximum size not greater than 500 DWT.

Table 2.2.3-1 Profile of General Cargo Carriers

Company Name	Number of Vessels	DWT	Average Age of Vessel	Regular Routes
Harinsut	11	14,555	21	Bangkok, Songkhla, Chonburi
Nam Yuen Yong Shipping	6	1,533	9	Chonburi, Surat Thani, Songkhla
Voranavin	3	3,000	7	No regular routes
Ocean Land Transport	2	3,000	5	No regular routes

Source: Thailand Ship owner's Association (TSA) Maritime Directory 2000

2.2.4 Lighters

As seen from Table 2.2.1-1, there were 2,131 steel lighters which account for 1.25 million GRT. Most steel lighters are used for coastal shipping, in particular, on routes linking Bangkok and Chonburi, Surat Thani and Chonburi, and routes linking inland waterway ports with international ports. Examples of major lighter services include Bangkok Transport, Cargo Barges Transport, JNP Transport, NH Lighter, Narai Transport, Navawathana, Ocean King, Thai Gulf Development Transport, Thai Lighter and Service.

2.2.5 Main Ports

(1) Bangkok Port

Bangkok port is a river port located at Klongtoey, Bangkok and is an operating unit of the Port Authority of Thailand (PAT). Service has been introduced since 1951 and the port currently has the following main service features:

- 10 berths for serving general cargoes
- Six berths for serving container cargoes
- Two berths for serving lighter
- 61 dolphins at Klongtoey and Bang Hua Sau for serving 15 ships
- Four bouys at Sathupadit for serving four ships

Due to its location on a river, Bangkok port has encountered the problem of limited channel depth of only 8.5 m. This existing depth does not allow access to vessels greater than 12,000 tons or having more than 8.2 m draft or having length greater than 175 m. In addition, the government has recently limited Bangkok port to cargo throughput no greater than 1 million TEUs. The port is now being gradually privatized.

(2) Laem Chabang Port

Laem Chabang is a deep seaport located at Chonburi and is the other operating unit of the Port Authority of Thailand (PAT). It has been in service since 1991 and operates eight berths. It is now under the second phase development project which will increase port capacity by six to eight berths.

(3) Map Ta Phut Port

Map Ta Phut port is a deep seaport located in Rayong, the major heavy and petrochemical industrial zone in Eastern Seaboard, and is under the direct supervision of Industrial Estate Authority of Thailand. Map Ta Phut port has offered a wide range of services for general cargo ships, container ships, bulk carriers, and tankers. In 1999, there were six port operators in Map Ta Phut. They are:

- Alliance Refining Company Limited (ARC). ARC is a private dedicated berth used for handling petroleum products.
- Thai Tank Terminal (TTT). TTT is a public port used for handling liquid cargoes.
- Thai Prosperity Terminal (TPT). TPT is a public port used for handling bulk and container cargoes.
- National Fertilizer Public Company Limited (NFC) is a private dedicated berth used for handling fertilizer and other bulk cargoes.
- Rayong Bulk Terminal Company Limited (RBT) is a private dedicated berth used for handling ores, copper, and metal products.
- Map Ta Phut Tank Terminal Company Limited (MTT) is a private dedicated berth used for handling liquid cargoes.

(4) Songkhla Port

Songkhla port is a public seaport located at the mouth of Songkhla Lake. It was established in 1988 by Harbor Department and awarded the concession to Chaophaya Terminal International Co., Ltd. to develop and provide port services for handling frozen cargo, general cargo, and container cargo. Songkhla port infrastructure has a total berth length of 510 m, 30 m apron width, and 9 m berth design depth, which allows it to accommodate vessels not greater than 20,000 GRT, having depth up to 8.5 m, length up to 175 m, and width up to 25 m. Songkhla port is now facing a congestion problem and is planning to expand its capacity in the near future.

(5) Phuket Port

Phuket port is a public seaport located at Phuket. It was established in 1988 by Harbor Department and awarded the concession to Chaophaya Terminal International Co., Ltd. to develop and provide port services for handling general cargo and container cargo. Phuket port infrastructure has a total berth length of 360 m, 30 m apron width, and 10 m berth depth which allows it to accommodate vessels not greater than 20,000 GRT, having depth up to 8.5 m, length up to 190 m, and width up to 25 m.

2.2.6 Coastal Ports

(1) Coastal Ports in Chaopraya River

Chaopraya river is the most important river used for freight and passenger transport in Thailand. There are about 80 ports located along the bank of river. These ports of Chaopraya river can be separated into three sections as follows:

- The first section is the inner zone starting from Klong Mai (33rd km) up to Sathorn bridge (45th km). This section totals 12 km and allows the entering ships to have a maximum draft of 7.6 m. In the first section, there are eight ports located on the east and

20 ports located on the west, and five bouys at Rama IX bridge. Apart from these ports, there are four shipyards located on the east: namely, Bangkok Shipyard, Harinsut Shipyard, Sea Shipyard, and Chaopraya Shipyard.

- The second section is the middle zone starting from Klong Mai (33rd km) up to Klong North Samrong (21st km). This section totals 12 km which is the densest area of the Chaopraya river. For ships entering this section, their depth must not exceed 8.2 m. There are 35 ports located on the east and five ports on the west, and 36 dolphins enabling service to six ships simultaneously. Apart from these ports, there is one shipyard located on the east, Rama III Shipyard.
- The third section is the outer zone starting from Klong North Samrong (21st km) up to kilometer zero. This section totals 21 km. For ships entering this section, their depth must not exceed 8.2 m. There are 17 ports located on the east and 21 ports located on the west, and nine dolphins enabling simultaneous service to four ships. Apart from these ports, there is 1 shipyard located on the east, - Italthai Marine -and two shipyards on the west, both belonging to Ashima Shipyard.

Among the above ports, the following ports are eligible to publicly handle international throughput:

- Bangkok Modern Terminal
- Thai Prosperity Terminal
- Chaopraya Port Services
- United Thai Shipping

(2) Coastal Ports in Eastern Region

The coastal ports in the eastern region include those situated in Trat, Chantaburi, Rayong, Chonburi, and Chachoengsao.

- **Trat:** coastal ports in Trat can be divided into general cargo ports and fishery ports. Most coastal ports are concentrated in an area close to Cambodia such as Klong Yai. Therefore, most important traffic volumes connect Trat with Kao Kong and Sihanoukville in Cambodia. Ports located in this area include Chalalai port, Kasemsiri port, and Kalapangha port. The next concentration area is Laem Ngop. Ports in this area are Laem Ngop port and Koa Chang Ferry Port. Other ports are situated in Trat river but still have low service activities because of shallow channels. At present, Trat is developing a deep seaport at Ban Had Lek – Klong Yai as a part of medium term development scheme proposed by National Economic and Social Development Board (NSEDB).
- **Chantaburi:** Chantaburi has very little water freight transport activity after the introduction of a new road network system. Most ports are designed to serve fishery, particularly, ports in Laem Singh, Tha Mai, and Ban Chalab. However, Chantaburi is planning to develop Laem Singh to be a deep seaport serving general cargo, agricultural products, and passengers.

- **Rayong:** Port in Rayong has a high density of cargo throughputs and passengers. It has maintained a high growth rate since the early 1990s. Most industrial and cargo ports are situated in Map Ta Phut while fishery ports are situated in Ban Pay, Pasae, and Makhampom Bay.
- **Chonburi:** Ports in Chonburi are concentrated in Laem Chabang and Sriracha which include Laem Chabang public port, three oil refinery ports (Thai Oil, Esso, and PTT), and four large private ports (Siam Seaport, Sriracha Harbor, Sriracha Silo, and Thai Public Port). In 1999, there were about 3,300 vessels calls to Laem Chabang port and 16.5 million tons of cargo or 1.8 million TEUs were loaded and discharged. In addition to Laem Chabang, Satthaip was one of the most important deep seaport in Chonburi prior the emergence of Laem Chabang. Satthaip port was established in 1966 and designed to serve 5.4 million tons of cargo per year. Main fishery ports are Pattaya, Sriracha, Kor Loi, and Sila Bay.
- **Chacheongsao:** Shipping activities are usually concentrated only in Bangpakong river. Major ports include Bangpakong Terminal (container port), World Gas, Bangpakong petroleum port, and bulk cargo port (cassava).

(3) Coastal Ports in Central Region

The coastal ports in the central region are represented by the ports in Bangkok, Samutprakarn, and Samutsakorn. Main shipping activities are concentrated in ports located in Chaopraya river. Other important activities involve the handling of petroleum products and canned foods in Thachin river.

(4) Coastal Ports in Western Region

The coastal ports in the western region are represented by the ports in Samut Songkram, Petchaburi, Prachubkirikhan. Most shipping activities are concentrated in Samut Songkram (Maeklong river), Petchaburi (Ban Laem), and Prachubkirikhan (Bangsaphan).

- **Samut Songkram:** Apart from many small fishery ports, there are some petroleum ports located in Mae Klong River such as of Shell and Southern Region Fuel.
- **Petchaburi:** Small traffic volumes have been seen in Petchaburi. The largest port is the petroleum port owned by Petchaburi terminal with 40 m quay length, 25 m apron width, and 12 m quay depth. This allows it to accommodate 30,000 DWT ships.
- **Prachubkirikhan:** Prachub port is the most important cargo port in Prachubkirikhan. It is owned by Saraviriya group to handle the shipment of metal products and other general cargoes.

(5) Coastal Ports in Southern Region (Eastbound)

The eastbound ports of the southern region encompasses ports in Chumporn, Surat Thani, Nakon Si Thammarat, Songkhla, Pattani, and Narathiwat. .

- **Chumporn:** Ports in Chumporn are generally divided into two types: fishery and petroleum. The fishery ports are owned by fishing pier organization located in Lang Suan and Muang districts. The petroleum port is owned by TPI located in Muang district providing dolphin and buoy with the 24.5 m quay length, 5.5 m apron width, and 3.5 m quay depth.
- **Surat Thani:** Ports in Surat Thani can be divided into passenger, fishery, and cargo ports. The passenger port is located in Don Sak while fishery and cargo ports are generally concentrated at the Tarpi river mouth in Muang district. Major cargo ports include Tar Thong, Tipco Asphalt, Shell, PTT, ESSO, Siam Gas, Nakornluang Cement, and Unique Gas. These cargo ports have faced a shallow channel problem. They generally have about 3 – 5 m of depth and allow only 500 – 1,500 GRT ships to enter.
- **Nakon Si Thammarat:** Most ports in Nakorn Si Thammarat are fishery port and concentrated in Pak Phanang and Sichon districts. The cargo ports are located in Khanom and Pak Phanang. Khanom port is a jetty used to handle ores and metal wastes such as Gypsum, Barite, and Dolomite and has 8-9 m of depth. PTT port is a petroleum jetty located in Pak Panang having 11 meters quay length, 4 m width, 2 m depth and allows only ships less than 600 GRT to enter.
- **Songkhla:** Songkhla is considered to be the hub of the eastbound cargo of southern region and has been ranked the second in fishery product volume.
- **Pattani:** Most ports are fishery ports. Although there is a cargo port built by Harbor Department, very few cargo throughputs have been recorded. Most ports in Pattani have limited channel depth of 3-4 m.
- **Narathiwat:** Most ports in Narathiwat are fishery ports and generally located in Muang and Takbai districts.

(6) Coastal Ports in Southern Region (Westbound)

The westbound of southern region incorporates ports in Ranong, Phangnga, Phuket, Krabi, Trang, and Satun.

- **Ranong:** Shipping activities in Ranong, both fishery and general cargo, are mostly linked with Myanmar. Ranong multi-purpose port was built by HD in 2000 and now is in the process of evaluating contract concession bidding.
- **Phangnga:** Most ports in Phangnga involve fishery and passenger services and are not frequently used for freight transport.
- **Phuket:** Phuket is regarded as the hub of the westbound cargo of southern region. It includes Phuket deep seaport, petroleum port, passenger port, and fishery port.

- **Krabi:** Ports in Krabi involve cargo, passenger, and fishery ports. Main ports include Krabi Development, Jienvanich Transport, and Southern Port. Krabi Development Port is located at the river mouth and has 4.5 – 6.5 m depth and allows 2,500 DWT ship access. For Jienvanich Transport and Southern port, their jetty has maintained the maximum depth of 13 m.
- **Trang:** Most ports are river ports and concentrated in Kantang district. Major port is Kantang port which has 5 m depth and allows 3,500 – 6,000 DWT ships to enter.
- **Satun:** Most ports in Satun involve passenger and fishery ports and are located in Muang district. There is only one cargo port which is used for transporting cargo and passengers to Malaysia (Langawi).

2.2.7 Problems and Obstacles of Coastal Shipping

(1) Infrastructure

- Most coastal ports are situated in poor locations. Hence, many ports face difficulties of shallow and narrow channel that prevent ships from transporting their full capacity.
- Most coastal ports are not well linked with other modes of transport, especially with the well-conditioned road and rail network.
- Most coastal ports do not have sufficient and qualified handling equipment for specific cargoes. This causes poor service, long operating time and high costs.
- Obstacles like fishing nets and stakes interfere with navigation.

(2) Rules and Regulations

- The process of acquiring a ship is difficult and cumbersome. For example, the name of the ship's master mariner is required in the ship registration.
- Numerous documents are required for the ship and cargoes, such as Ship Condition Certificate, Ship Radio Certificate or Cargo Unloading Permission, etc.
- Other requirements are:
  - Issuing of loading permission of hazardous cargo. Moreover, a ship condition certificate is required for permission of loading hazardous cargo.
  - Issuing of departure permission with cargo-loading operation within less than six hours.
  - Requirement of navigation pilot for ship longer than 50m.
- Prohibition of foreign registered ship for coastal merchant services.

(3) Administration Problems

- Tax structure and customs regulations differences between land transport and sea transport such as fairway dues, lighting fee, document evidence for coastal transport.
- Too many govermental agencies are involved for development of coastal shipping projects.
- Budgets for improving ports and waterways in coastal transport are insufficient.
- Lack of governmental support for encouraging any additional investiment from private sector.

(4) Natural Limitations

- Lack of weather warning system of tropical storms in Gulf of Thailand.
- Port development planning should consider ecological, environmental, social and cultural impacts.

2.3 Coastal Shipping in Study Area

2.3.1 Socio-economic Conditions in Study Coastal Provinces

(1) Location

The Study channels are located in the four coastal provinces, Nakhon Si Thammarat, Songkhla, Pattani, Narathiwat on the Gulf of Thailand coast (see Figure 2.3.1-1).

(2) Population

The population in the study coastal provinces in 1999 totaled about 4.0 million, accounting for about 6.4 % of the national population of about 61.7 million (see Table 2.3.1-1). The average annual growth rate of population in the study coastal provinces from 1994 to 1999 was 1.2 %, which is greater than the national rate.

(3) The Gross Provincial Product (GPP)

The GPP in the Study coastal provinces in 1998 accounts for about 2.6 % of the Gross Domestic Product (GDP) (see Table 2.3.1-2).
The GPP per capita in the coastal regions in the same year is less than the GDP per capita. The average annual growth rate of GPP in the study coastal provinces from 1995 to 1999 is 6.1%, i.e., less than the national rate by 4.8%.

(4) The Gross Provincial Product (GPP) by Sector

In this section, the sector breakdown of the GPP is examined, focusing on the Study coastal provinces. The primary sector, comprising agriculture and mining in the Study coastal provinces in 1997 accounts for 41 % of total GPP (see Table 2.3.1-3). The secondary sector including manufacturing and construction and the tertiary sector account for 12 % and 47%, respectively. Compared with the national figures, in the study coastal provinces, the percentage of the primary sector is especially large. Furthermore, agriculture including fishery accounts for 90% of primary sector in the Study coastal provinces. Fishery accounts for 35% of the product of agriculture and 13% of GPP in the study coastal provinces. Accordingly, fishery in the Study coastal provinces is an important industry, especially in Pattani province.

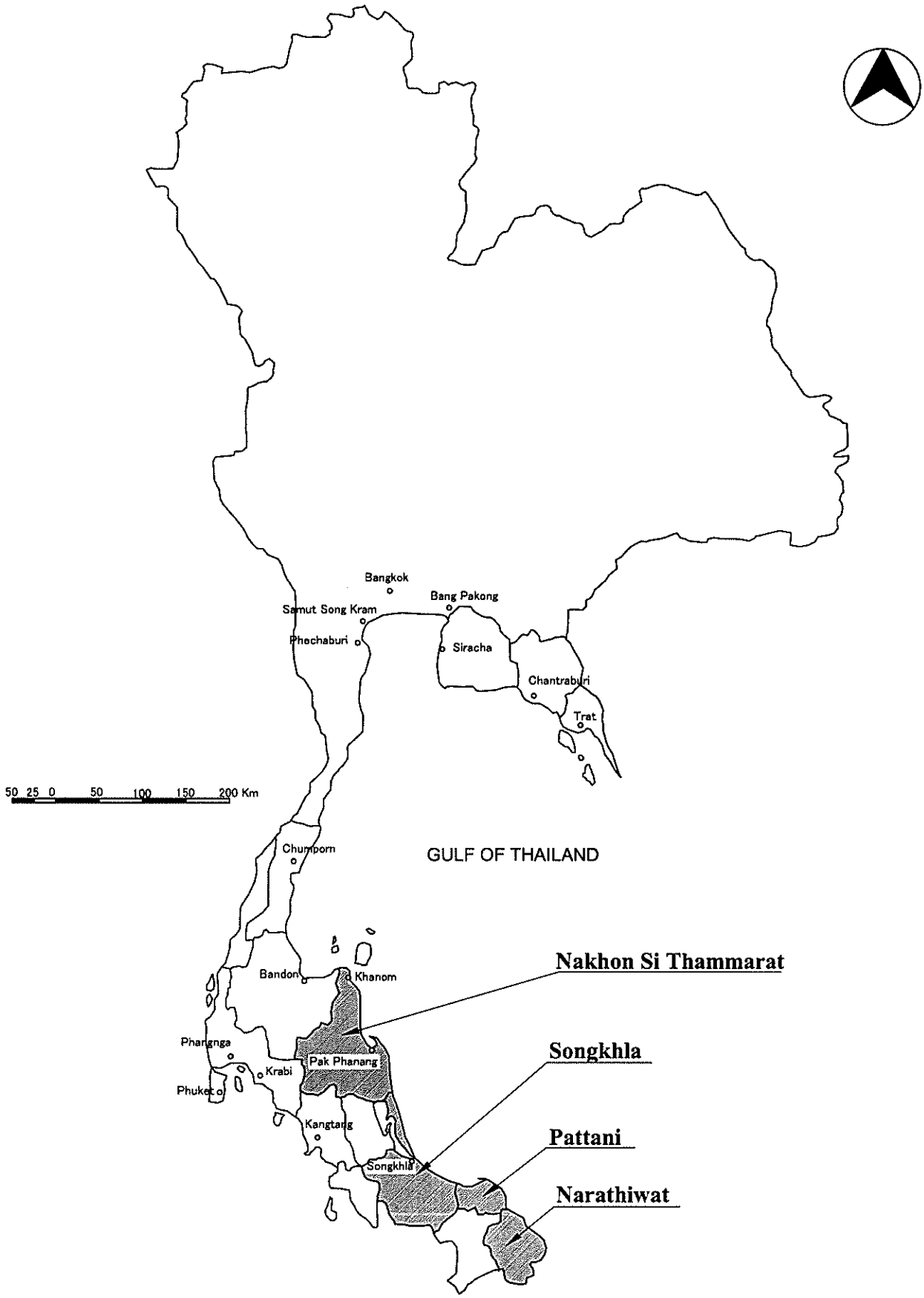

Figure 2.3.1-1 Study Coastal Provinces

Table 2.3.1-1 Population From Registration Record: By Region and Province, 1970-1999

Region/Province	1970	1980	1990	1994	1995	1996	1997	1998	1999	Average Growth Rate (1994-1999)
Whole Kingdom	34,397,374	46,861,338	56,303,273	59,095,419	59,460,382	60,116,182	60,816,227	61,466,178	61,661,701	
					0.6%	1.1%	1.2%	1.1%	0.3%	0.9%
Study Coastal Provinces	2,207,219	3,010,572	3,620,082	3,803,366	3,840,121	3,883,753	3,940,696	3,993,431	4,029,315	
					1.0%	1.1%	1.5%	1.3%	0.9%	1.2%
Nakhon Si Thammarat	928,520	1,261,408	1,427,001	1,488,776	1,488,947	1,503,156	1,511,857	1,521,057	1,525,557	
					0.0%	1.0%	0.6%	0.6%	0.3%	0.5%
Songkhla	621,849	849,601	1,090,083	1,144,349	1,159,672	1,166,519	1,191,233	1,210,921	1,223,833	
					1.3%	0.6%	2.1%	1.7%	1.1%	1.4%
Pattani	330,217	457,760	537,542	563,159	572,191	582,120	590,735	599,219	608,276	
					1.6%	1.7%	1.5%	1.4%	1.5%	1.6%
Narathiwat	326,633	441,803	565,456	607,082	619,311	631,958	646,871	662,234	671,649	
					2.0%	2.0%	2.4%	2.4%	1.4%	2.0%

Source: Bureau of Registration Adiministration, Department of Local Administration, Ministry of Interior, Thailand in Figures 6th Edition (2000-2001), Alpha Research Co., Ltd.

Table 2.3.1-2 Gross Provincial Product (At Constant 1988 Prices)

(Millions of Baht)

	1992	1993	1994	1995	1996	1997	Average Growth Rate
Whole Thailand G D P.	2,830,916	3,170,258	3,634,498	4,185,632	4,608,490	4,727,307	
Growth Rate		12.0%	14.6%	15.2%	10.1%	2.6%	10.9%
Study Coastal Provinces	90,100	98,097	108,074	116,452	121,407	120,661	
Growth Rate		8.9%	10.2%	7.8%	4.3%	-0.6%	6.1%
Nakhon Si Thammarat	29,119	32,465	36,163	39,102	41,800	41,740	
Growth Rate		11.5%	11.4%	8.1%	6.9%	-0.1%	7.6%
Songkhla	36,651	39,739	43,420	47,046	48,725	48,239	
Growth Rate		8.4%	9.3%	8.4%	3.6%	-1.0%	5.7%
Narathiwat	11,311	11,441	12,215	13,064	13,669	13,802	
Growth Rate		1.1%	6.8%	7.0%	4.6%	1.0%	4.1%
Pattani	13,018	14,451	16,276	17,240	17,213	16,880	
Growth Rate		11.0%	12.6%	5.9%	-0.2%	-1.9%	5.5%

Source: NESDB

Table 2.3.1-3 Share of Gross Provincial Product by Sector in 1997 (At Constant 1988 Prices)

	Whole Thailand	Study Coastal Provinces	Nakhon Si Thammarat	Songkhla	Pattani	Narathiwat
Agriculture	11%	37%	31%	34%	55%	44%
Crops	7%	17%	18%	14%	9%	37%
Livestock	1%	2%	2%	2%	3%	1%
Fisheries	2%	13%	8%	11%	39%	0%
Forestry	0%	0%	0%	0%	0%	2%
Agricultural services	0%	0%	0%	0%	0%	0%
Simple agri.processing products	1%	4%	3%	6%	4%	4%
Mining and quarrying	2%	4%	10%	0%	0%	1%
Manufacturing	29%	7%	7%	8%	5%	4%
Construction	6%	5%	5%	6%	2%	3%
Electricity and water supply	2%	3%	4%	3%	2%	2%
Transportation and communication	8%	7%	6%	10%	4%	6%
Wholesale and retail trade	16%	15%	16%	13%	16%	19%
Banking,insurance and real estate	7%	5%	4%	7%	3%	3%
Ownership of dwellings	2%	3%	4%	3%	3%	4%
Public administration and defence	4%	4%	4%	4%	4%	5%
Services	13%	10%	9%	13%	7%	9%
GDP or G P P.	100%	100%	100%	100%	100%	100%

Source: NESDB

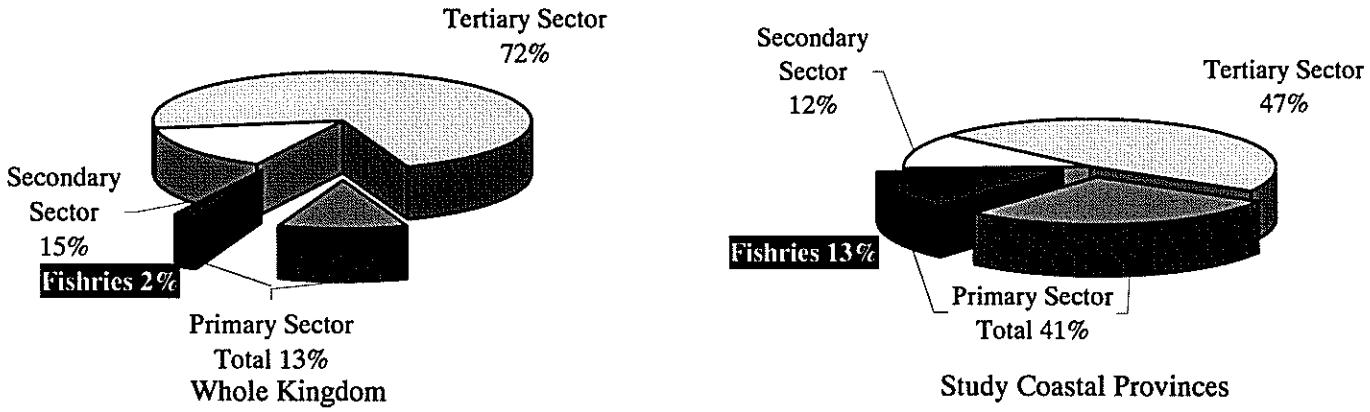

Figure 2.3.1-2 GPP (At Constant 1988 Prices) by Sector in 1997

Source: NESDB

2.3.2 Present Status of Coastal Shipping in Study Area

(1) Coastal Shipping Activities in Study Area

Main coastal shipping ports are located in Songkhla, Pak Phanang, Tha Sala and Pattani in the Study Area. Songkhla Port in Study Area is the major port for coastal shipping activities as shown in the following Figure 2.3.2-1.

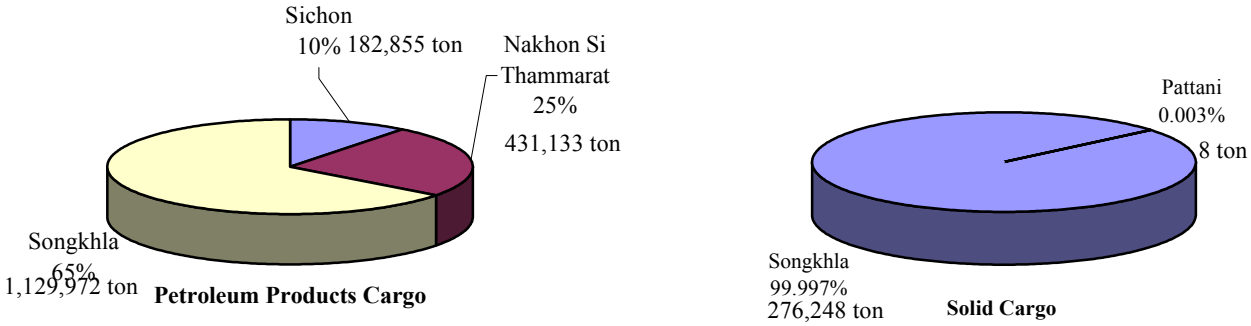

Figure 2.3.2-1Petroleum Products and Solid Cargo Volume and Share in Study Area (1999)
Source: Custom House

(2) Coastal Ports in Songkhla

Location of coastal shipping ports in Songkhla is described in Figure 2.3.2-2. The coastal ports in Songkhla consist of petroleum ports and solid cargo ports. The expansion of PTT berth as a petroleum port will be constructed at the northern part of the existing jetty in the year 2001.

The following four coastal wharves were operated for solid cargo handling. Only Railway Jetty - rail track has been removed - is a public berth under the State Railway of Thailand (SRT); the other berths are privately organized (see following Table 2.3.2-1). In the regulations of Songkhla province, the expansions of berths were prohibited in the area of the sea.

Table 2.3.2-1 Coastal Ports (Solid Cargo) in Songkhla

Coastal Berth	Cargo Handling Company	Shipping Company
Harinsut 1	Harinsut Transport Co., Ltd.	
Harinsut 2		
MPP Transport Co., Ltd.	Graitainer Co., Ltd.	Nam Yung Yong Shipping Co., Ltd
Railway Jetty (SRT)	Voranavin Co., Ltd.	

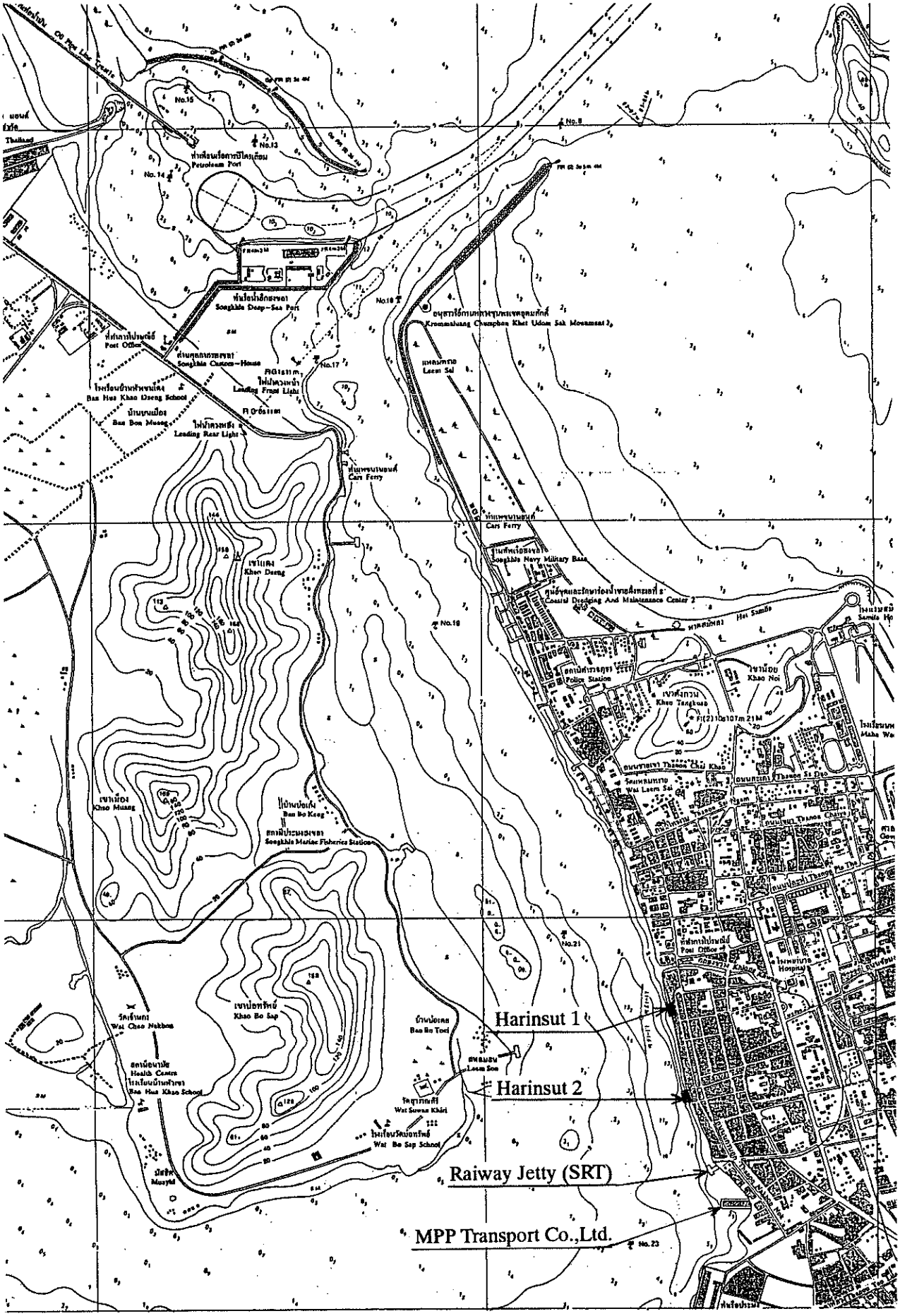

Figure 2.3.2-2 Coastal Cargo (Solid) Ports in Songkhla

The dimensions of vessels owned or operated by coastal shipping companies in Songkhla are as follows:

Table 2.3.2-2 Dimensions of Coastal Vessels (Solid Cargo) in Songkhla

Shipping Company	Main Route	Vessel Name	GRT (ton)	Width (m)	Molded Depth (m)	Draft (m)	Length (m)	Remarks
Harinsut Transport Co., Ltd.	BKK-SKL	Harin 2	418.86	9.60	6.80	4.50	49.50	
		Harin 9	194.44	9.00	5.10	4.40	49.50	
		Harin 10	485.33	11.00	6.33	4.70	64.40	
		Harin 12	495.32	11.50	6.40	4.70	63.00	
		Harin 14	499.99	11.50	6.20	4.70	67.55	
		Harin 15	499.77	11.50	6.20	4.70	65.85	
		Harin 16	1,095.00	11.50	6.11	4.70	68.43	
		Harin 17	1,165.12	11.50	6.10	5.50	69.90	
		Harin 19	767.00	9.50	5.70	5.00	57.38	
		Harin 20	1,408.00	11.60	7.30	5.70	73.40	
		Harin 21	1,273.00	11.80	6.60	5.50	73.00	
Nam Yuen Yong Shipping Co., Ltd.	LCB-SKL	M.V. Chiang Mai	2,161.00	17.07	6.71	3.50	76.66	194TEU
		M.V. Chiang Dao	695.89	14.50	3.60	3.00	45.00	64TEU
		M.V. Chiang Yun	670.48	14.50	3.60	3.00	49.50	48TEU
		M.V. Chiang Kan	670.48	14.50	3.60	3.00	49.50	72TEU
		M.V. Chiang Tun	670.48	14.50	3.60	3.00	49.50	72TEU
		M.V. Chiang Gon	670.48	14.50	3.60	3.00	49.50	72TEU
Voranavin Co., Ltd.	MTP-SKL	Voranavin 7	531.98	10.00	4.50		41.50	
		Voranavin 9	531.98	10.00	4.50		41.50	
		Pan Thai 11	531.98	10.00	4.50		41.50	

Source: HD and Shipping Company

Note: BKK: Bangkok, SKL: Songkhla, LCB: Laem Chabang, MTP: Map Ta Put

Graitainer Co., Ltd. and Nam Yuen Yong Shipping Co., Ltd. started container handling operation in 1999 as feeder services from the coastal private berth (MMP port) in Songkhla to Laem Chabang Port. Before starting this system, the cargoes (rubber and furniture) had been land-transported to Penang Port in Malaysia. Monthly container handling volume reached more than 200 TEU.