12. Economic Analysis

12.1 Methodology

12.1.1 Purpose

The purpose of the economic analysis is to appraise the economic feasibility of the development plan for the new port and show whether the project is justifiable from the view point of the economy by assessing its contribution to the national economy.

12.1.2 Methodology

An economic analysis was carried out according to the following method. The port development plan will be defined and compared with the "Without Case". There are various methods to evaluate the feasibility of this type of development project. Here, the economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the feasibility of the project. The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal.

12.2 Prerequisites

12.2.1 Base Year

The "Base Year" here means the standard year in the estimation of costs and benefits. Taking into consideration the base year in cost estimation of construction, 1997 is set as the "Base Year" for this study.

12.2.2 Project Life

Taking into consideration the depreciation period of civil engineering structure, the period of calculation (project life) in the economic analysis is assumed to 30 years for the main facilities and period for construction.

12.2.3Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = 130 ¥ = 12,280 VND, the same rate as used in the cost estimation.

12.2.4 "With" and "Without " Case

A cost-benefit analysis is conducted on the difference between the "With" case where investment is made and the "Without" case where no investment is made. In other words, incremental benefits and costs arising from the proposed investment are compared.

In this study, following conditions are adopted as the "Without" case.

1) No investment is made for construction of new port and new industrial area.
2) When the cargo from/to the study hinterland exceeds the handling capacity of Danang Port, the cargo which can not be handled in Danang Port is assumed to be handled in Qui Nhon port and Nghe Tinh port or transported by land.

12.3 Economic Prices

12.3.1 Methodology

The economic analysis for short term development plan is estimated by economic prices based on the border concept. There are various methods to convert the market prices into border prices. Here, the border prices (economic prices) are calculated by eliminating transfer items, such as taxes, subsidies, etc.

In general, all the costs and benefits are divided into three categories : labor, tradable goods and non-tradable goods. And labor is further classified into skilled labor and unskilled labor. As for skilled labor, the economic price is determined by multiplying the market wage by the conversion factor for consumption. On the other hand, the economic price of unskilled labor is determined by multiplying the nominal wage by the shadow wage rate and the conversion factor for consumption. The prices of tradable goods are expressed in CIF and FOB value for import goods and export goods respectively.

These values show the actual border prices. However, as the border price of non-tradable goods cannot be converted directly, the border price of the inputs needed to produce the non-tradable goods is considered. After some classification of the non-tradable goods, the economic price of a small amount of the non-tradable goods is calculated by multiplying the market prices by the standard conversion factor directly. The procedure used for economic analysis is shown in Figure 12.3.1.

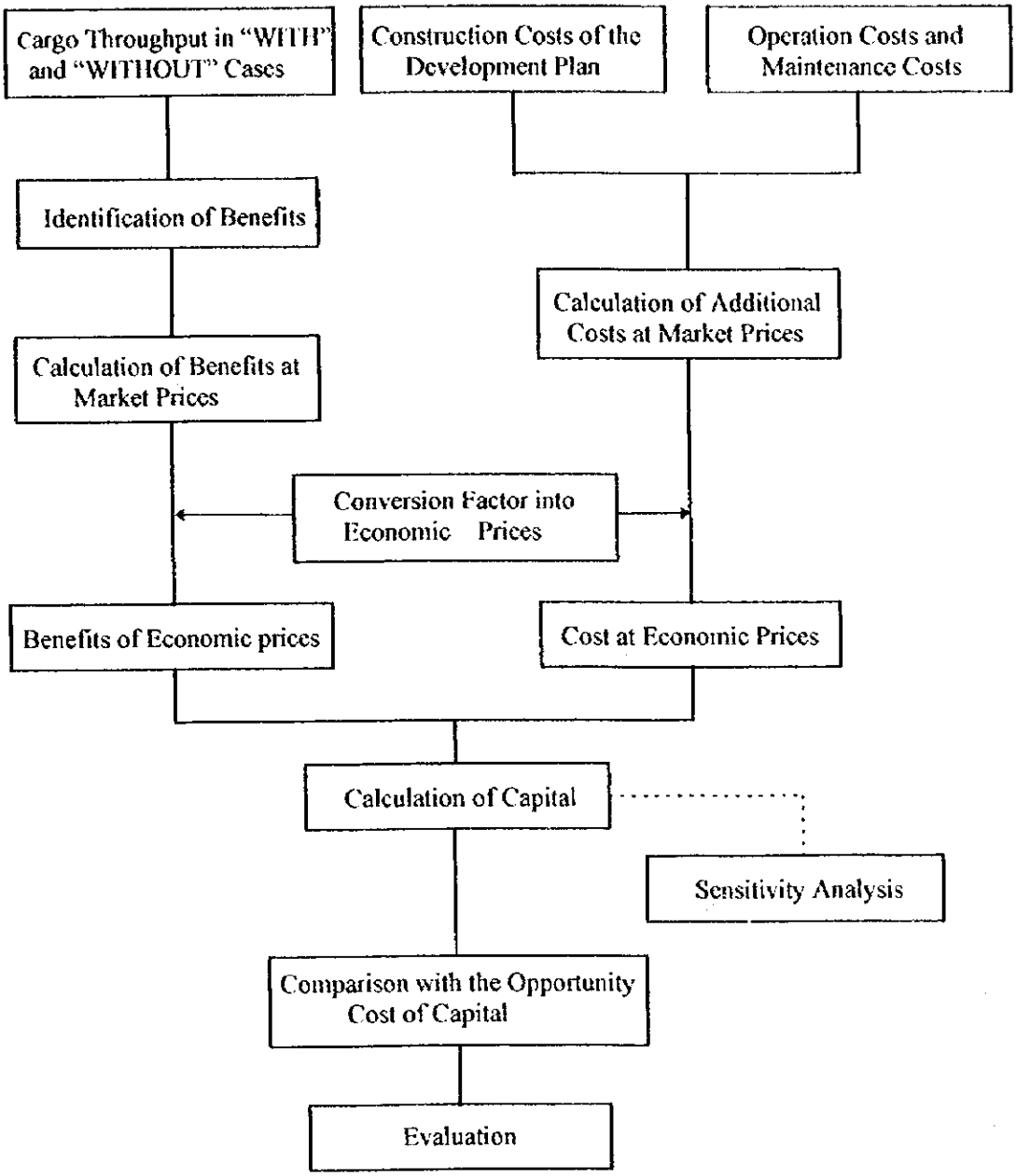

Figure 12.3.1 Procedure of the economic analysis

12.3.2 Applying conversion Factors

(1) Standard Conversion Factor (SCF)

The standard conversion factor is used to determine the economic prices of certain goods which cannot be directly revalued at border prices. These goods include most non-tradable goods and services. The standard conversion factor is expressed by the following formula.

$$SCF = \frac{(X + M)}{(X - Tx) + (M + Tm)}$$

where, X: Value of exports
M: Value of imports
Tx: Value of taxes on export
Tm: Value of taxes on import

In this study, the SCF of 0.994 is adopted using the above equation based on the past records of trade and customs.

(2) Conversion Factor for Consumption

The conversion factor for consumption is used for converting the prices of consumer goods from domestic market prices to border prices. This is particularly required in converting domestic labor costs to corresponding border prices. The CFC is usually calculated in the same manner as the SCF, replacing total imports and total exports by imports and exports of consumer goods only.

In this study, the SCF of 0.985 is adopted using the above equation based on the past records of trade and customs.

(3) Conversion Factor for Labor

For the economic analysis, labor costs should be measured in terms of the opportunity cost of skilled labor; that is, the value of the marginal product of labor forgone elsewhere because of its use in a given project.

1) Conversion for Skilled Labor

The cost of skilled labor is calculated based on actual market wage rate, assuming that the market mechanism is functioning properly. However, as these are domestic prices or market prices, they should be converted into border prices by multiplying the actual market wage rate by the CFC. The convention factor for skilled labor is calculated by the following formula.

$$\text{Convention Factor for Skilled Labor} = \text{Market Wage Rate} \times \text{CFC}$$
$$= 1 \times 0.985$$
$$= 0.985$$

2) Conversion Factor for Unskilled Labor

The opportunity cost of unskilled labor is generally far below the actual wage rate, since the rate is controlled by a minimum wage system and other regulations, nevertheless there are many unskilled labors.

When the project is conducted, the inflow of unskilled labor to the project is mainly from the agricultural sector which is relatively elastic in its use of labor. Therefore, it is often assumed that the opportunity cost of unskilled labor is equal to the per capita income of the agricultural sector. According to Statistics of the World Bank, value added of agriculture sector is US$ 5.606billion and labor force of agriculture sector is 25.2million persons in 1996. Opportunity cost is calculated by the following formula.

$$\text{Opportunity Cost} = \frac{\text{Value Added of Agriculture Sector}}{\text{Labor Force of Agriculture Sector} \times 365}$$
$$= 5{,}606{,}000{,}000 \;/\; 25{,}200{,}000 \;/\; 365$$
$$= \text{US\$0.609/day}$$

The average wage of an unskilled laborer is US$3.58/day according to the study team's investigation. Thus, the conversion factor for unskilled labor is obtained using the following formula.

$$\text{Conversion Factor for Unskilled Labor} = \frac{\text{Opportunity Cost}}{\text{Unskilled Labor Wages}} \times \text{CFC}$$
$$= 0.609 \;/\; 3.58 \times 0.985$$
$$= 0.168$$

12.4 Benefits and Costs of Project

12.4.1 Benefits of the Project

As benefits brought about by the master plan of the study port, the following items are identified. In this study the monetary benefits of items 1), 2) and 3) are calculated.

1) Savings in land transportation costs
2) Value added by new industrial development
3) Saving in sea transportation costs by international transit cargo
4) Promotion of regional economic development
5) Increase in employment opportunities and incomes

(1) Savings in Land Transportation Cost

If a new port is not constructed at Lien Chieu, excess cargo of Danang Port which is produced and consumed in the study hinterland excluding the new industrial zone is assumed to be handled at Qui Nhon Port and Nghe Tinh Port. And then these cargoes are to be transported from/to the study hinterland by land transportation. After the implementation of the project, all cargoes will be transported from/to the new port, Lien Chieu Port.

The benefit from the project can be calculated by the following formula.

Savings in land transportation costs
= Difference in handling cargo volume between "With" and "Without" cases
× Difference in land transportation cost (unit cost)

(2) Value Added by New Industrial Development

Contribution of port development project to the whole industrial development in the area is deemed as a benefit of the project, amount of which is calculated by the share of the contribution of port development to the whole benefit of industrial development. The value of the whole industrial development is calculated from the unit value added per development area. Based on statistical data in Japan, the unit value added per hectare is adjusted for application in this study, since Japanese industries use land very densely

compared with other countries on account of its extremely high cost.

According to the ratio of port construction cost to all infrastructure construction cost of the industrial zone, it is assumed that the share of benefit originated in the port will be 19.8 % of whole value added which will accrue from the industrial zone. As to infrastructure construction cost of the industrial zone, it is estimated based on "The Study on the Integrated Regional Socio-Economic Development Master Plan for the Key Area of the Central Region (JICA)" and cost estimation data of Quangnam-Danang Export Processing and Industrial Zones Authority.

Therefore, the benefit for vacant plots of industrial zone can be calculated by the following formula.

Value added of industrial factories
= Net area of each industry × Value added per area (unit cost)
× Share of benefit originated in the port

On the other hand, value added of steel is forecasted based on future production plan in Lien Chieu Industrial zone by Vietnam Steel Cooperation. As to cement, Ha Van Cement Company is constructing jetty to handle cement materials in Lien Chieu district using its own fund. Its handling capacity is estimated at 600,000tons per year initially, but it will increase up to 1,000,000tons per year after the breakwater included this projects composed. Thus, value added of cement could be assumed higher than the original capacity of 600,000tons per year.

(3) Saving in Sea Transportation Costs

Sea transport cost of transit cargo from/to Lao PDR and Thailand is saved in case of transport via central Vietnamese port. The benefit can be calculated by the following formula.

Savings in sea transportation costs
= Number of vessels × Reduced days × Vessel running cost (US$/day)

Benefits of the project is summarized in Table 12.4.1(1),(2).

12.4.2. Cost of the Project

The items that should be considered as costs of the projects (difference between "With" case and "Without" case) are construction costs, re-investment costs, maintenance costs and operation costs. The project costs must be converted from market prices into economic prices for the economic analysis.

(1) Construction Costs

Construction costs are divided into such categories as foreign currency portion, local currency portion, skilled labor, unskilled labor and others. The costs of local currency portion and others at market prices are converted to economic prices by multiplying by the SCF. The costs of skilled labor and unskilled labor at market prices are converted to economic prices by multiplying by the CFC for skilled labor and the conversion factor for unskilled labor respectively. Construction cost converted to economic prices are shown in Table A12.4.2(1).

(2) Re-investment Costs

The re-investment costs for facilities and equipment after their useful lifetimes are considered.

(3) Maintenance Costs

The costs of maintaining the port facilities are estimated as a fixed proportion (1% for structures, 4% for handling equipment) of the original construction costs and the maintenance dredging cost is estimated in addition.

(4) Operation Costs

Personnel costs are based on the estimation in the following section "Financial analysis" and the costs are converted to economic prices by multiplying by the CFC for skilled labor.

Administration costs are set at 15.2% of the personnel costs except for labor and operator . The economic prices of the administration costs are calculated by multiplying the market costs by the SCF.

Costs of the project is summarized in Table A12.4.2(2), (3).

12.5 Economic Viability

12.5.1 Calculation of EIRR

The economic internal rate of return (EIRR) based on cost-benefit analysis is used to appraise the economic feasibility of the project. The EIRR is the discount rate which makes the costs and benefits of a project during the project life equal. It is calculated by using the following formula. Results of the EIRR calculation are shown in Table 12.5.1(1) and the EIRR calculation table are shown in Table A12.5.1(2), (3). Here, sensitivity analysis is made in which costs increase by 10% and benefits decrease by 10%.

$$\sum_{i=1}^{n} \frac{Bi - Ci}{(1 + r)^{i-1}} = 0$$

where, n: Period of economic calculation (project life)
Bi: Benefits in i-th year
Ci: Costs in i-th year
r: Discount rate

Table 12.5.1(1) Result of EIRR Calculation
(Short-term Development Plan)

Scenario	EIRR	(Sensitivity)
High Growth	19.4%	16.3%
Low Growth	18.4%	15.5%

In addition, the EIRR of long-term development plan is calculated as shown in Table 12.5.1(4). Since details of construction plan is not decided, the EIRR is estimated on the assumption that the investment will be equally distributed in the term of construction and cost of project is estimated by using market prices.

Table 12.5.1(4) Result of EIRR Calculation
(Long-term Development Plan)

EIRR	(Sensitivity)
19.5%	17.3%

12.5.2 Net Present Value and Benefit Cost Ratio

On the assumption that discount rate is 8%, 12% and 16%, the Net Present Value (NPV) and the Benefit Cost Ratio (BCR) of short-term development plan is summarized in Table 12.5.1(4), (5).

Table 12.5.1(4) Net Present Value

(Short-term Development Plan) Unit: Thous.US$

Discount Rate	8%	12%	16%
High Growth Case	203,707	86,744	28,134
Low Growth Case	187,634	74,071	19,174

Table 12.5.1(5) Benefit Cost Ratio

(Short-term Development Plan)

Discount Rate	8%	12%	16%
High Growth Case	2.35	1.68	1.25
Low Growth Case	2.28	1.60	1.18

12.5.3 Evaluation

There are various views concerning the critical percentage of EIRR to judge whether a project is feasible or not. In general, a project is deemed feasible if the EIRR exceeds 15%.

As for this project, even though the economic calculation only takes into account the items which are easily quantified, the EIRR exceeds 18% even in the case of low economic growth. Therefore, this short-term development plan is viable from the viewpoint of the national economy.

Table 12.4.1(1) Total Benefits

(Short-term Development Plan, High Growth Case) Unit: Thous.US$

Year	Saving Costs		Value Added			Total
	Land Transportation	Sea Transportation	Production from Planning Plots in IZ	Steel in Lien Chieu IZ	Cement Hai Van Cement Co.	
2004	6,097	273	11,855	4,311	0	22,536
2005	6,727	365	13,549	4,850	145	25,636
2006	7,356	463	15,243	5,389	836	29,287
2007	7,986	752	16,936	5,928	1,527	33,130
2008	8,536	927	18,630	6,467	2,218	36,778
2009	9,141	1,124	20,323	7,006	2,909	40,504
2010	9,809	1,323	22,017	7,545	3,600	44,293
~2036	9,809	1,323	22,017	7,545	3,600	44,293

Table 12.4.1(2) Total Benefits

(Short-term Development Plan, Low Growth Case) Unit: Thous.US$

Year	Saving Costs		Value Added			Total
	Land Transportation	Sea Transportation	Production from Planning Plots in IZ	Steel in Lien Chieu IZ	Cement Hai Van Cement Co.	
2007	6,590	284	12,179	0	1,527	20,580
2008	7,067	381	13,397	0	2,218	23,063
2009	7,571	485	14,615	0	2,909	25,579
2010	8,074	539	15,833	0	3,600	28,046
2011	8,551	852	17,050	0	4,040	30,493
2012	9,028	1,056	18,268	0	4,480	32,832
2013	9,532	1,255	19,486	0	4,920	35,193
2014	10,088	1,464	20,704	0	5,360	37,616
2015	10,592	1,611	21,922	0	5,800	39,924
2016	13,083	1,764	23,140	0	6,240	44,226
~2041	13,083	1,764	23,140	0	6,240	44,226

13. Port Management and Operations Plan

13.1 Port Administration

13.1.1 Port Administration

The Vietnamese maritime administrative framework is under the Ministry of Transport (MOT). Ports are divided into the following two categories. Basically, Vietnam National Maritime Bureau (VINAMARINE) is responsible for the sea ports, and Inland Waterway Bureau (IWB) is responsible for the river ports.

There are also two different forms of port administration. Four ports, Saigon Port, Haiphong Port, Quang Ninh Port and Tan Cang Port, and all other specialized ports governed by state-owned corporations are under their own delegated management control. The management corporation of Saigon Port, Haiphong Port, Quang Ninh Port and other specialized ports are given charters and responsibilities as public organizations under either the central or local government. Tan Cang Port is an exceptional general port in terms of being administered by the Ministry of Defense.

The management of ports is performed (except in the case of Tan Cang Port) by the following public organizations.

a) central government (MOT)
b) local government (Province, City authorities)
c) a state-owned corporation organized and operated by the Prime Minister (Vietnam National Shipping Lines: VINALINES)
d) state-owned corporations organized and operated by other central government ministries
e) public corporations organized and operated by provincial governments

(1) VINAMARINE

VINAMARINE is responsible for regulatory functions in the maritime sector and for some ship, port and shipyard operational management functions. In the past, VINAMARINE acted as coordinator of maritime enterprises and assumed governmental responsibility for managing Vietnamese shipping activities including seaports, merchant fleets, shipyard, ship servicing companies and registration of ships. The role of functions of VINAMARINE are defined in Prime Minister's Decree which defines VINAMARINE's responsibilities as:

- developing plans for the maritime industry and acting as owner of state maritime infrastructure,
- developing maritime law,
- drafting policy on international maritime projects and controlling operations of foreign maritime organization,
- undertaking activities to ensure maritime safety,
- administrating sea-going vessels and operations, sea ports and navigational aids through developing plans, issuing licenses, managing infrastructure in accordance with government instructions, and providing search and rescue services.

Now almost all these commercial functions have been transferred to VINALINES (ship and port management) or VINASHIN (a similar organization in shipyard management), leaving VINAMARINE mainly to concentrate on its important regulatory function. This is performed through its head office, three branch offices, 17 port authorities and other agencies directly under its control.

The port authorities are delegated to monitor enforcement of maritime rules and regulations, including those covering maritime safety, environmental pollution and maritime sanitation in all Vietnamese seaways and seaports. Remaining non-regulatory functions of VINAMARINE include operations management of

- the ports of Quang Ninh, Nghe Tinh, Da Nang, Qui Nhon, Nha Trang and Can Tho, and
- the Vietnam Maritime Commercial Stock Bank (Maritime Bank).

Following the transfer of management and staff to VINALINES, certain weaknesses in the Investment Planning, Legal and Safety Inspection Departments have been identified.

(2) VINALINES

The first and second largest ports in Vietnam, Saigon Port, Haiphong Port and Cai Lan Port are managed by Vietnam National Shipping Lines (VINALINES). VINALINES is a state-owned corporation and it was established under Decision No.250/Ttg by the Prime Minister in January 1996, in order to engage in comprehensive shipping and maritime related activities, including the management and operation of main ports. VINALINES started its operation on 1st January 1996. VINALINES took over the management of three ports from VINAMARINE when it was established. Although these three ports are inclusively under MOT, they are supervised directly by the Prime Minister in the same

way that VINALINES is administered.

VINALINES undertake the following activities:

- shipping, port operation, maritime services and other maritime related business,
- export/import of specialized materials, equipment and labor deployment, and
- participation in shipping joint-venture, business corporations with foreign and domestic partners and carrying out other businesses and tasks assigned by the government.

(3) Inland Waterway Bureau

The Inland Waterway Bureau (IWB) was established on 30th January 1993 and is responsible for administration of inland waterways transport in Vietnam. IWB is mandated, firstly, to supervise water-borne transportation on rivers, lakes and river port waters and some sea routes between rivers and, secondly, to manage inland waterways, river ports and state-owned river vessel operators.

VINAMARINE used to administer part of the rivers but IWB is now responsible for provision of infrastructure for all river waters after the issues of Government Decree. However since Vietnam Maritime Safety Agency (VMS), under the control of VINAMARINE, still manages the entry channels of rivers, the physical boundary between IWB and VINAMARINE is unclear.

13.1.2 Port Management and Operations in the Central Port (Danang Port)

(1) Roles and Functions

VINAMARINE, which is under the Ministry of Transport, is charged with the administration of the shipping industry in Vietnam. VINAMARINE administrates the Port of Danang through Danang Port Authority and Port Authority of Danang.

Danang Port Authority is responsible for:

- Cargo loading and unloading, delivery and consigning, and cargo maintenance
- Pilotage and tug boat services
- Construction and repair of small and medium size construction works
- Land transportation from the port
- Navigational services and others

Danang Port Authority owns a waterway & road transport enterprise, a construction enterprise and other related servicing enterprises such as tallying and weighing cargo, water and fuel supply and garbage disposal.

On the other hand, Port Authority of Danang is responsible for entry/exit procedures of vessels, management of port access channels and collection of port dues.

(2) Organization

The organization chart of Danang Port is shown in Figure 13.1.1. The organization is focused on cargo handling, and has a number of divisions and departments to carry out this task. Some of them are independent as "enterprises". Number of staff and workers is about 1,100 excluding 200 temporary workers.

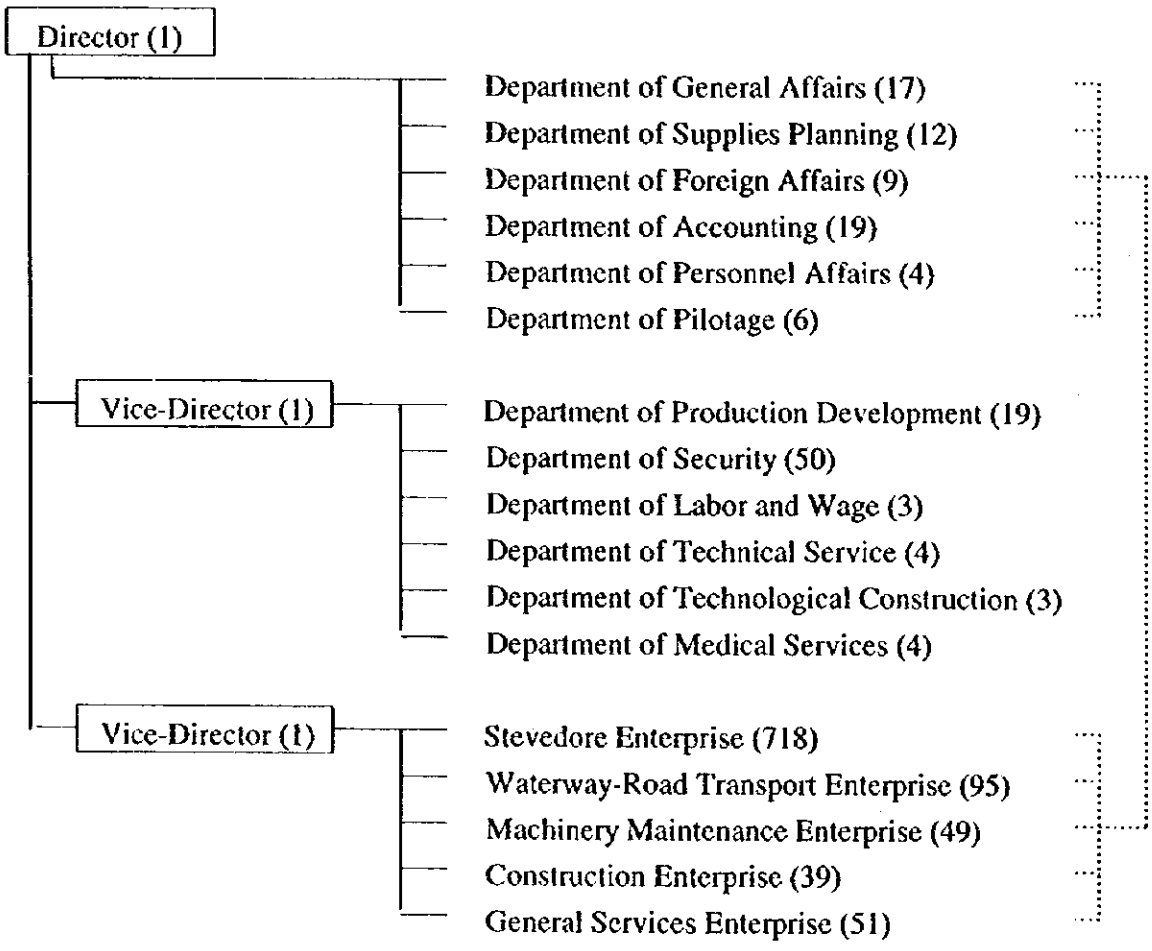

Figure 13.1.1 Organization of Danang Port

Danang Port owns organized port related enterprises, such as cargo handling service and cargo transport services which it carries out using its own staff. At currently personnel cost accounts for a large portion of port expenditures and it may increase in near future in line with economic growth. The labour force should be rationalized under adequate personnel management.

As various port operations are monopolized, it is difficult to improve the efficency and quality of services.

(3) Port Administration and Operations

Port administrators have an insufficient sense of accountability in developing ports. In this connection, most data is not stored and statistics are not utilized even though they are quite important. There is also a lack of systematic training to improve staff's capability.

Quay side cranes and ship cranes are used to load/unload containers directly. Road transportation has a problem associated with the weight limitation on bridges. Cargo handling equipment and warehouses are 15-20 years, so that replacement or rehabilitation is necessary to ensure productive and safe cargo handling.

(4) Tariff

The port tariff is classified into two kinds: port user charges and port entry dues. The port user charges include berthage dues, charges on cargo handling, storage charges, assistant service charges, and others. The port entry dues include tonnage dues, clearance fees, pilotage dues, navigational maintenance dues and others (See Table A13.1.1).

Port charge system for coastal shipping vessels differ from that for international shipping vessels. The difference is two to four-fold in port user fees and five to ten times in port entry fees (excluding pilotage fee).

(5) Computerization

A computer system is now developed in Danang Port. The system is intended to cover all kinds of cargo-related activities in the port. In the future, a computer network will be established between ports and shipping agencies.

(7) Supply of Port Services

Table 13.1.1 shows suppliers of port services at the Danang Port. As shown in the table, private companies provide a few port services.

Some activities are suitable for privatization, which others are not. It depends on objects and functions of each port activity. From the point of the national economy and public benefit, suitability of each activity for privatization is evaluated as follows.

a) Control & regulation management (Activities: No 1 - 4)

These activities are not suitable for privatization. Control and regulation management has a great influence on other port activities. Essentially, regulation is just the opposite of privatization. These activities are not profitable in a liberalized competitive market, so private companies will not provide.

b) Construction and maintenance of infrastructure, port management (activities: No5-10)

Regarding these activities, suitability for privatization is shown as follows according to characteristics of each activity.

- Planning of port development

  A master plan of the port should be made from the viewpoint of long term development. Therefore, the master plan should be drawn by the public sector.

- Construction and maintenance of infrastructures

  Generally speaking, a huge investment cost is required to construct port infrastructures. Infrastructures such as channels, breakwaters and roads are nonprofitable and public in nature, therefore private participation is not expected. Except profitable infrastructures -though it is practically only container terminals- construction and maintenance of infrastructure should be implemented by public sector.

- Management of infrastructures

  It is natural that the body which constructs the infrastructure is also responsible for its management. For example, in berths constructed by the public sector, public sector should be in charge of management, while in berths constructed by private companies, private companies should have competence to manage infrastructures.

- Marine service

Regarding these activities, initial investment costs are not as large as the above infrastructures, and they are profitable. Therefore, it is suitable for provision by private companies.

(c) Construction, maintenance and operation of superstructures (No 11)

These are the most profitable business in port activities. Provision body should be able to respond to market needs while maintaining high productivity, therefore, provision by private companies is suitable.

13.1.3 Privatization

(1) Privatization in Vietnam

The Government recently conceded that there is a need for infrastructure and a need for foreign capital given the high costs involved in infrastructure projects. Decree No.87 / CP provided the legal framework for the new approach, allowing 100% foreign capital enterprises, joint ventures, and business cooperation contracts. Infrastructure development on a BOT basis has become an investment vehicle.

(2) Privatization of the ports

Throughout the world, there is a tendency for port management and operation to move toward privatization. Many port authorities have already adopted privatization or are considering its adoption. However, it is very difficult to define and evaluate this so-called "privatization" because of peculiarities among individual ports and countries. In addition, each port authority has its own control and duties.

Main objectives of privatization are as follows.

1) Introduction of liberalized competitive markets to the port

Possession and management of the port by the public sector generally means a monopoly by the public sector. By introduction of privatization, competition in the market improves quality and quantity of port services. A reduction in port service prices and improvement in port productivity can also be expected.

2) Improvement of efficiency of port management body

Some public organizations are not flexible in managing financial systems or in coping with user's needs because they tend to emphasize safety, fairness and so on. Private sector, however, responds to movements of the market quickly because the objective is to maximize profit. Therefore, it is expected that efficiency and flexibility of the organization are improved through privatization.

3) Diversification of fund raising methods

Fund raising methods concerned with privatization are divided roughly into two patterns. One is to utilize private funds as with construction by BOT (Built Operate and Transfer) system, the other is selling public property to private companies.

However, it is important to recognize that these effects of privatization such as improvement of efficiency of port management body and diversification of fund raising methods work only on the condition that liberalized competitive markets are well cultivated. Immoderate introduction of privatization in immature competitive markets is accompanied by risk to public benefit.

Table 13.1.1 Suppliers of Port Services at the Danang Port

Activities	Danang Port Authority	Port Authority of Danang	Other Public Sector	Private Company
a) Control & regulation management				
1. Authorization of Master Plan			○ *1	
2. Regulation of port development			○ *1	
3. Customs clearance			○ *2	
4. Quarantine			○ *3	
b) Construction and maintenance of infrastructure, port management				
5. Planning of port development	○		○ *1	
6. Port security control				
1) Coast guard		○		
2) Security (land area)	○			
7. Construction of infrastructure				
1) Channels			○ *1	
2) Breakwaters			○ *1	
3) Berths			○ *1	
4) Yards			○ *1	
5) Roads			○ *1	
8. Maintenance of infrastructure				
1) Dredging		○		
2) Breakwaters	○			
3) Berths	○			
4) Yards	○			
5) Roads	○			
9. Port management				
1) Charge, due collection	○	○		○
2) Berthing arrangement	○			
3) Permission for use	○			
4) Entrance / Departure of ships	○			
10. Marine services				
1) Pilot	○			
2) Tug boat	○			○
3) Mooring	○			
4) Water supply, Bunkering	○			○
c) Construction, maintenance and operation of superstructures				
11. Construction, maintenance and operations of superstructures				
1) Warehouses, CFS	○			
2) Cranes (Loading / Unloading)	○			
3) Equipment for loading / unloading	○			
4) Tally, Truck	○			

Note : *1 Vinamarine, *2 Custom Department, *3 Provincial Government

13.2 Port Development and Management Options

13.2.1 Patterns of Port Development, Management and Operations Body

(1) Basic concept of Port Management and Operations Body

Ports are managed in a variety of ways depending on the state system, local characteristics, economic conditions, etc. In order to raise the capacity of the port management body to its highest level, it is necessary to keep the following essential principles strictly.

1) Autonomy

In view of the importance of the port to the national economy, it is desirable that proper relations be established with the central government while maintaining the independence of the port management body.

2) Financial independence

The management system is required to have its own budget, maintain a reasonable level of port charges, and be able to further depreciate and renew facilities besides repaying debts.

3) Principle of competition

For port management, it is essential to have a clear definition of responsibilities and a rational organization based on it, so that an adequate profit level can be maintained without disregarding competition with the outside world.

4) Unitary management

It is vital for the management system to have the necessary and sufficient authority over the port area and main functions.

(2) Patterns of Port Development, Management and Operations Body

Port management and operation systems differ by each port. However, in order to establish a new system for the new port, Danang port will be adopted as a typical example in the ports of central region.

Possible patterns of development, management and operations for the new port are shown in Table 13.2.1.

Table 13.2.1 Patterns of Port Development, Management and Operations Body

Pattern		A	B	C	D	E	F
Master Plan		○					
Construction	Channels	○		○		○	○
	Breakwater						
	Infrastructure					●	●
	Superstructure			○	●		
Ownership	Land	○		○	○	○	●
	Terminal facilities			●*2	●*2	●*2	
Berthing Scheme		○	○*1	●	●	●	●
Terminal Operations		○	●	●	●	●	●
Tug & Pilotage		○ or ●					

Note1: ○: Public, ●: Private, (*1 : Exclusive system, *2 : Land lease system)

Note2: ▓▓ Recommended patterns

The main advantages and disadvantages of each pattern are as follows;

(1) Case A, B

1) Advantages

- Since public sector owns the berths, public sector can improve facilities or equipment easily in case of need according to a master plan in the future.
- (Case B) Generally speaking, cargo handling performed by private stevedoring companies is more efficient than that by public sector.

2) Disadvantages

- (Case A) Generally speaking, cargo handling efficiency of public sector is lower compared with the private sector due to the absence of competition in the market.
- (Case B) There is possibility that only some selected shipping companies can use the berth and other shipping companies stop calling to the port.

(2) Case C, D

1) Advantages

- In case of need for the master plan in the future, public sector can improve facilities or equipment since it owns the land, although the berths are occupied by a private company.
- (Case D) Since the superstructure is built by the private sector, this type is useful when the public sector does not have sufficient funds and the construction of port is urgent.

Table 13.2.1 Patterns of Port Development, Management and Operations Body

Pattern		A	B	C	D	E	F
Master Plan		○					
Construction	Channels	○		○		○	○
	Breakwater						
	Infrastructure					●	●
	Superstructure			○	●		
Ownership	Land	○		○	○	○	●
	Terminal facilities			●*2	●*2	●*2	
Berthing Scheme		○	○*1	●	●	●	●
Terminal Operations		○	●	●	●	●	●
Tug & Pilotage		○ or ●					

Note1: ○: Public, ●: Private, (*1 : Exclusive system, *2 : Land lease system)

Note2: [▒▒] Recommended patterns

The main advantages and disadvantages of each pattern are as follows;

(1) Case A, B

1) Advantages

- Since public sector owns the berths, public sector can improve facilities or equipment easily in case of need according to a master plan in the future.
- (Case B) Generally speaking, cargo handling performed by private stevedoring companies is more efficient than that by public sector.

2) Disadvantages

- (Case A) Generally speaking, cargo handling efficiency of public sector is lower compared with the private sector due to the absence of competition in the market.
- (Case B) There is possibility that only some selected shipping companies can use the berth and other shipping companies stop calling to the port.

(2) Case C, D

1) Advantages

- In case of need for the master plan in the future, public sector can improve facilities or equipment since it owns the land, although the berths are occupied by a private company.
- (Case D) Since the superstructure is built by the private sector, this type is useful when the public sector does not have sufficient funds and the construction of port is urgent.

2) Disadvantages

- (Case C) Since the public sector is responsible for construction work, public sector needs to provide funds.

(3) Case E

1) Advantages

- In case of need according to a master plan in the future, public sector can improve facilities or equipment since it owns the land, although the berths are occupied by a private company.
- Since a private company reclaims land from the sea and builds the berth, public sector does not need to provide funds.

2) Disadvantages

- In the case that a private company performs reclamation, inappropriate development of public property can not be prevented. Therefore the master plan should be drawn by the public sector.

(4) Case F

1) Advantages

- Since a private company reclaims land from the sea and builds the berth, public sector does not need to provide funds.

2) Disadvantage

- Because the berths are owned by a private company for a long time, public sector can not improve port facilities or equipment easily in case of need for the implementation of own development plan in the future. In particular, in the case that main berths of the port are occupied by specific shipping companies, there is a risk that public sector cannot control the port.

13.2.2 Port Development and Management Options

(1) Port Development, Management and Operations Plan

Based on the analysis above, recommendations on the new system of port development, management and operations for Masterplan are as follows:

1) Master plan for the new port must be drawn by the public sector and construction of infrastructure such as the breakwater, dredging and so on must also be performed by

the public sector.

2) The land shall be owned by the public sector, even if a private company constructs infrastructure through the reclamation. Public sector shall be in a position to develop facilities or equipment in case of need for the implementation of its master plan.

3) Construction of terminals including the pavement and superstructures, can be carried out by the private sector. Port services such as cargo handling, pilotage, tug boats, and other service activities shall be carried out by the private sector to provide efficient services.

(2) Organization for Master Plan

As a result of the above examination, management and operations system of the New Port is summarized as follows.

1) Port management body
   a) Administration Division
      - Employee's payroll and welfare
      - Inspects the management of business
      - Provides pilots
   b) Business Division
      - Makes masterplan and short-term plans
      - Promotes port sales and takes statistic
      - Establishes the Port Authority's policy
   c) Engineering Division
      - Improves technical ability
      - Plans and executes civil engineering work
      - Provides technical training to employees

2) Port operations body
   - Stevedoring enterprise
   - Water transport and ship enterprise
   - Construction enterprise
   - Machinery maintenance enterprise
   - Tug boat and other port service enterprise

13.2.3 Methods to Support Efficient Management and Operations

(1) Port Promotion and Statistic System

Port promotion activities are one of the most important factors to attract port users and to secure adequate level of revenue. In order to accomplish this aim, following actions by a port management body are necessary.

- To collect information on port user's requirements.
- Establishment of port promotion strategy focusing on the most effective target groups of users.
- Under the action program based on the above strategy, the port management body should call for sales at shipping companies or shippers through active appeals in getting their understanding on the real merits of utilizing the new port.

It is necessary to introduce a statistics system, to support formulation of the port plan, port strategy and promotion of the port. Examples of data and information to be prepared are as follows:

- Origin/destination, type of cargo and volume (TEU for containers)
- Vessel type, specification (length, width, draft and others)
- Data on freight handling efficiency : berthing time, items and volume of loading/unloading, loading/unloading time, machinery and equipment for loading/unloading, number of workers and others
- Conditions and users of wharves, loading/unloading machinery and equipment, warehouse, yard and others

(2) Tariff

Port management body should set its tariff at a proper level to obtain sufficient income for maintaining financial soundness and making the necessary investments. On the other hand, tariff should be set taking levels of neighboring ports into consideration to attract port users. Port management body should always study tariffs of the ports of neighboring country.

In Vietnam, fees for vessels for overseas and coastal services are charged differently. In most countries that exercise different fees, the level of difference is up to twice of the domestic fees. In Vietnam, setting different fees may be unavoidable, since the

industry is still immature. However, the current level of difference in Vietnam is way to large. The difference should be corrected.

Navigational maintenance dues is particular high among the various tariffs. Currently Vietnam Maritime Safety (VMS) is collecting the fee from all the ports which are divided into 3 areas. Each port management body should adopt a self-supporting accounting system in which it collect tariffs including tonnage and clearance fees and maintains maritime routes.

(3) Training System

With respect to staff training, the port management body should send several staff members and operators to foreign ports to acquire knowledge or skill based on the latest management and operation or cargo handling techniques. They should pass on their knowledge or skill to other staffs or operators. Also, specialists could be employed or invited from abroad. Since field training is very useful for skill acquisition, the employment or invitation of technical supporting experts or engineers makes it possible to accelerate technology transfer.

In order to keep knowledge or skill based on the latest techniques, the port management body needs to develop its own training courses in order to make up for the lack of expertise in the new port. It is also important to instill in them cost-conscious and the need for efficiency in conducting their duty and assignment. The following training courses are necessary to foster capable operation staff, operators and engineers.

1) Training for administrative staffs

In this course, staffs can gain basic knowledge on general administration. In addition, more specialized courses on financial management, accounts system, related laws, regulations and so on, should be established.

2) Training for engineers

For better understanding of port construction and maintenance, training courses on civil engineering, architecture, electrical engineering, mechanical engineering and so on should be established and experts for each field should be fostered.

3) Training for operators

In the courses of cargo handling, operation of port equipment, operators can attain a higher level of skill and thus the efficiency of port operations will be enhanced.

4) Training for computer operators

For the employees who belong to not only cargo operation sections but administrative sections, it is necessary to participate in training courses about on-line operation of terminal computers. The company compiling programs and setting up net work systems should dispatch instructors to every section where terminal computers are installed. Participants of training need to operate computers by themselves with the aid of instructors.

(4) Establishment of effective maintenance system

Maintenance work on the structures can be divided into two categories, namely the routine maintenance and the urgent rehabilitation. While the former consists of preventive measures in which required cost is minor, the latter consists of corrective measures against large scale damage in which required cost is large. In general, if preventive maintenance is appropriately performed, the required cost for corrective maintenance works will be minimized.

In order to perform effective maintenance, the following measures are considered.

1) To prepare a list of facilities together with possible damage.
2) To carry out monitoring of the present usage and damage inspection periodically.
3) To maintain a sufficient supply of all spare parts.

(5) Computerization

Computer system includes the connection between ports in country and abroad. This kind of connection should be established not only between ports but also between the port and the port related organizations and agents such as customs and shipping agencies in order to simply the present documentation procedure by Electric Data Interchange (EDI) Systems.

13.3 Port Development and Management Options for Short-term Development Plan

13.3.1 Port Development, Management and Operations Plan

(1) Development, Management and Operations for Short-term Development Plan

In Vietnam, construction and management of port facilities such as quaywall, reclamation, access road, cargo handling equipment, building and so on are the responsibility of the public sector. Cargo handling/storage and navigation service are provided for port users by the public sector. Also, private companies are not capable of providing, stevedoring and storage service themselves. In the present situation, it is difficult to introduce the ordinary competition in port services such as stevedoring and warehousing.

Based on the above current situation and analysis in Chapter 13.2, recommendations on the new port development, management and operation for Short-term Development Plan are as follows:

1) Construction of infrastructure such as the breakwater, quaywall, landfill and so on must also be performed by the public sector. Construction of superstructure such as cargo handling equipment, building works and so on can be carried out by the public sector.

2) Port services such as cargo handling, pilotage, tug boats, and other service/activities shall be carried out by the public sector. In order to provide efficient services, private sector can be in a position to lease facilities or equipment and provide port services.

(2) Port Management Body

As has been the case in major ports in Vietnam, nationally developed ports shall be administered by the public sector which is an appropriate organ to administer national property. Possible patterns of administration are presented below.

a) VINAMARINE

As has been the case in most ports in Vietnam, port management body, namely Lien Chieu Port (a tentative name) shall be established for administration.

b) Provincial Government

As has been the case in most Japanese ports, Port and Harbor Bureau shall be set up in Danang City to administrate new ports.

The situation seems to be premature to implement case-b plan, since People's Committee of Danang City does not have a sufficient organization or expertise. Therefore the case-a is considered more recommendable. It is also recommended that VINAMARINE which belongs to MOT also administers ports as explained in 13.1.1.

Port management body, Lien Chieu Port (a tentative name) shall be set up in VINAMARINE to construct, operate and administer infrastructure and superstructure. Port management body shall be responsible for construction, operating and administering ports and harbor and for supervise in cargo handling. It will also collect port entry dues, navigational maintenance dues, cargo handling fees and the like. Vietnam Maritime Safety (VMS) in VINAMARINE shall be responsible for maritime safety control such as administration of arrival and departure of vessels, registration of vessels and ensuring safety of navigation.

However, current monopoly condition on loading and unloading business needs to be changed by employing market economy and competition concepts. To provide efficient, low cost and safe loading and unloading service, port management body should lease out terminal facilities to private firms to allow them to handle stevedoring, warehousing and other port services (See Table 13.3.1).

TABLE 13.3.1 System of the Port Development, Management and Operation

System	Direct Management	Land Lease
Infrastructure Breakwater Channel and Basin Quaywall Land fill (excluding Paving) Revetment Inner road	to be developed and operated by Lien Chieu Port	to be developed and operated by Lien Chieu Port
Superstructure Yard pavement Cargo Handling Equipment Building		to be developed by Lien Chieu Port and operated by the private sector

13.3.2 Organization for Short-term Development Plan

An example of proposed organization chart for managing and operating system in short-term plan is shown in Fig.13.3.1. Number of officials in the chart is estimated based on the case of major port in Vietnam, while number of workers is calculated using the forecast cargo volume. Required number of employees in short-term plan is 1,075.

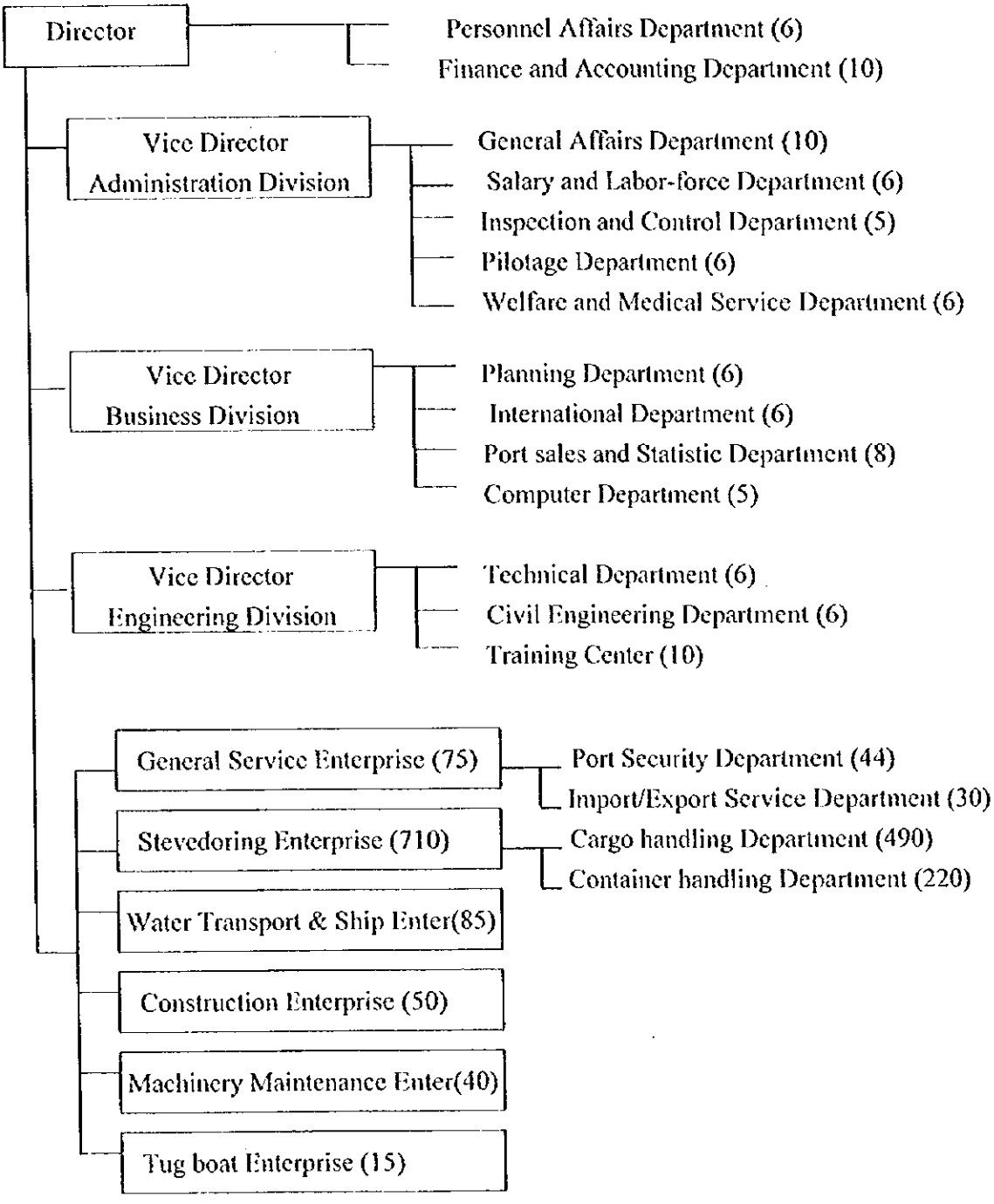

Figure 13.3.1 Example of Organization of the New Port

14. Financial Analysis

14.1 Purpose and Methodology

14.1.1 Purpose

The purpose of the financial analysis is to examine the viability of the project itself and the financial soundness of the port management body during the project life. (Here the project means the short-term development plan.)

14.1.2 Methodology

(1) Viability of the Project Itself

The viability of the project itself is analyzed using the Financial Internal Rate of Return (FIRR) by means of the Discounted Cash Flow Method. Sensitivity analysis is conducted to measure the impact of changing conditions on the financial status of the project. The FIRR is calculated as the discount rate in the following formula:

$$\sum_{i=1}^{n} \frac{B_i - C_i}{(1+r)^{i-1}} = 0$$

where n : project life

B_i : benefit in the i-th year

C_i : cost in the i-th year

r : discount rate

(2) Financial Soundness of the Port Management Body

The financial soundness of the port management body is appraised using the following indices calculated based on the projected financial statements in order to examine the project's profitability, creditworthiness and efficiency.

1) Profitability

The long-term success of the port management body depends on the funds it can generate for reinvestment and growth, along with its ability to provide a satisfactory return on investments. The principal way of calculating this earning power of a port management body's assets is to compute the return on net fixed assets by using the following equation.

$$\text{Rate of Return on Net Fixed Assets (\%)} = \frac{\text{Net Operating Income}}{\text{Net Fixed Assets}} \times 100$$

2) Loan Repayment Capacity

The degree of financial risk inherent in an operating equity before and after undertaking a project can be shown by the debt service coverage ratio as calculated as follows:

$$\text{Debt Service Coverage Ratio (times)} = \frac{\text{Net Operating Income} + \text{Depreciation Cost}}{\text{Debt Service}(= \text{Repayment Amount of Principal and Interest for Long - term Loans})}$$

3) Efficiency

The operating ratio shows the operational efficiency of the organization as an enterprise.

$$\text{Operating Ratio (\%)} = \frac{\text{Operating Expenses}}{\text{Operating Revenues}} \times 100$$

However the operating ratio depends on the amount of investment through its depreciation costs. Instead, the working ratio is preferable to compare the efficiency by excluding the effect of the depreciation costs.

$$\text{Working Ratio (\%)} = \frac{\text{Operating Expenses} - \text{Depreciation Costs}}{\text{Operating Revenues}} \times 100$$

Satisfactory level for each index is shown as follows:

Financial Indices	Satisfactory Level
FIRR	over the weighted average interest rate of the funds
Rate of Return on Net Fixed Assets	over the weighted average interest rate of the funds
Debt Service Coverage Ratio	higher than 1.00 over 1.75 preferable (according to the World Bank)
Operating Ratio	below 70 ~ 75% (ditto)
Working Ratio	below 50 ~ 60% (ditto)

14.2 Prerequisites

14.2.1 Prerequisites of the Financial Analysis for the project

(1) Scope of the Financial Analysis

The financial analysis is implemented from the viewpoint of the port management body, according to the Short Term Development Plan. Based on the examination of the cargo handling forecast in chapter 8.2, cargo handling volume by two case is defined as follows:

<Case 1> Cargo handling volume in High Growth Case.
<Case 2> Cargo handling volume in Low Growth Case.

(2) Fund Raising

Fund raising is divided into two kinds, foreign and domestic funds. In the projects, all costs of foreign procurement are assumed to be raised by foreign funds (soft loan) and the domestic procurement costs are assumed to be raised by domestic funds in principle. Conditions of loans are as follows:

1) Foreign funds[1]

Covered range	: 85% of the initial investment costs of the project
Loan period	: 30 years including a grace period of 10 years
Interest rate	: 1.8% per annum
Repayment	: Fixed amount repayment of principal

2) Domestic funds

Covered range	: 15% of the initial investment costs of the project
Loan period	: 15 years (with no grace period)
Interest rate	: 9.0% per annum
Repayment	: Fixed amount repayment of principal

Any cash shortage should be covered by short-term loans from a domestic bank with an annual interest rate of 8.5%. Cash excess will be deposited to a domestic bank with an annual interest rate of 8.0%.

[1] These conditions are quoted from those of the OECF (Japan) in 1997.

(3) Project Life and Base Year

1) Project life

Taking account of the conditions of the long-term loans and service lives of the port facilities, the project life for the financial analysis is determined as 30 years after construction.

2) Base year

In principal, all costs and revenues are indicated in prices as of December 1997 (US$1.00 =12,280VND.). Neither price inflation nor increases in nominal wage are considered during the project life.

(4) Revenue

1) Cargo handling volume and calling vessels

Cargo handling volume and calling vessels are estimated based on the demand forecast mentioned in chapter 8.2. The particulars of the projected numbers are shown in Table A14.2.1 and Table A14.2.2.

2) Revenue

Revenues from port activities are calculated based on the new tariff which was revised in 1998. The port management body gains the following revenues.

a) Port entry dues
- tonnage dues, navigational maintenance dues, clearance fees and pilotage dues

b) Port user charges
- berthage dues, cargo handling charges, storage charges, tug assistance charges, mooring and unmooring charges, tallying charges and other service charges

The details of revenues are shown in Table A14.2.1 and Table A14.2.2.

(5) Expenditure

1) Investment

Initial investment costs are shown in Chapter 11.4 and are summarized in Table A14.2.3. The depreciable facilities and equipment are renewed based on their service lives. The service lives of the facilities and equipment are decided by the Ministry of Finance in Vietnam. The port management body raises the funds for reinvestment from its own internal funds.

2) Personnel cost

Annual personnel costs are estimated based on the required number of employees and unit personnel costs. Unit personnel costs for workers, officials and executives are assumed to increase by 20% over the current salary levels of Danang Port considering a raise in salary and welfare costs.

3) Administration cost

Annual administration costs are assumed as 15.2% of the total annual personnel costs excluding workers costs. This ratio is based on the actual one of Danang Port in recent years.

4) Maintenance and repair cost

Annual maintenance and repair costs for the port facilities are calculated as follows:

Cargo handling equipment : 4.0% of the original procurement cost
Other facilities : 1.0% of the original construction cost

Maintenance dredging is implemented once in five years and the costs are calculated as 18% of the initial dredging costs.

5) Depreciation cost

The annual depreciation costs of the port facilities and equipment are calculated by the straight line method, based on their service lives. In this analysis, residual values at the end of project life are not considered because selling of fixed assets on that occasion is actually difficult.

6) Tax

a) Turnover tax

This is a tax charged on all operating income and the rate is 4%.

b) Land-using tax

This is charged on the area of port and the rate is different from the each place.

c) Income tax

This is charged on profit after-income tax and the rate is 25%.

14.2.2 Sensitivity Analysis

Sensitivity Analysis is conducted to examine the impact of unexpected future changes. The following three cases are envisioned.

Case 1 : The revenue decreases by 10%
Case 2 : The project cost increases by 10%
Case 3 : The revenue decreases by 10% and the project cost increases by 10%

Unexpected future changes could be as follows:

(1) Decrease of the revenue
- Decrease of the estimated cargo volume
- Decrease of the tariff level

(2) Increase of the project cost
- Movement of foreign exchange rate
- Increase of the facilities construction cost by soil condition
- Sudden rise in building materials' prices

14.3 Evaluation and Conclusion

14.3.1 Viability of the Project

The results of the FIRR calculation are summarized in Table 14.3.1. More details of the calculation are shown in Table A14.3.1 and Table A14.3.2, respectively.

TABLE 14.3.1 Results of FIRR Calculation for the Short Term Development Plan

	Original Case	Case 1 reve.10% down	Case 2 cost 10% up	Case 3 reve.10% down cost 10% up
High Growth Case	5.7%	4.5%	4.6%	3.3%
Low Growth Case	5.1%	4.0%	4.1%	3.0%

Weighted average interest rate of the funds is 2.9% in this study. In all cases of Scenario 1 and 2, FIRR exceeds this rate. Therefore, this project is deemed to be financially feasible.

14.3.2 Financial Soundness of the Port Management Body

Projected financial statements and financial indicators for port management body are shown in Table A14.3.3 and Table A14.3.4.

(1) Profitability

Rate of Return on Net Fixed assets will exceed the average interest rate of the funds after the year 2004 in the case 1 and 2011 in the case 2.

(2) Loan Repayment Capacity

Debt Service Coverage Ratio will exceed 1.0 after the year 2004 and in the case 1 and 2007 in the case 2. There will be no problem with the repayment of long-term loans using the annual operating revenues.

(3) Operational Efficiency

Working Ratio keeps below 50% after the year 2004 in the case 1 and 2007 in 2. Operating Ratio keeps below 70% after year 2004 in the case1 and 2007 in the case 2. This means that the operation will be efficient.

(4) Appraisal

As shown from above indicators, it can be judged that financial soundness of the port management bodies is at an appropriate level.

14.3.3 Conclusion

Results of financial analysis of the case 1 and 2 have shown that FIRR of each case is, while not high, in an acceptable range. Financial soundness of the port management body, checked by Rate of Return on Net Fixed Assets, Debt Service Coverage Ratio, Operating Ratio and Working Ratio, maintains an appropriate level.

However, FIRR shows a lower level in the case 2, so port management body should make continuous efforts to secure forecast cargo volume, to improve cargo handling efficiency and to reduce operating expenses.

14.4 Project Funding

(1) International Balance of Payments

International balance of payments of Vietnam has tended to run a deficit both in terms of current account balance of payments and capital account balance of payments. However, statistics by Asian Development Bank indicate that Vietnam's overall balance of payments shaved a surplus in 1995 (See Table A14.4.1) while the current account balance of payments for the year closed with a deficit of US$2,132 million. It was attributable to improved capital account bolstered by the following factors.

1) Resumption of loan extended by international financial institutions in 1993 and increased financial assistance by the West following the lifting of the embargo by the United States in 1994.
2) Sound increase in foreign direct investment

Vietnam recorded US$25.1 billion of outstanding external debt in 1994 including US$22.2 billion of long term borrowing. Newly rendered loans and repeated rescheduling have bloated Vietnam's outstanding external debt posing a heavy burden to the nation's economy (See Table A14.4.2).

Despite continued deficit in international balance of payments, the nation's foreign reserves continued to grow from US$440 million in 1993 to US$880 million in 1994 to US$1.19 billion (estimated) in 1995. Still Vietnam is in tight position since increase in foreign reserve is attributed to increased borrowing from IMF and rescheduling of debt. However it is necessary to expand public investment because this project will provide indispensable infrastructure to the development in central region of Vietnam. In addition this project will have little adverse effect on the nation's fiscal administration since US$1.6 billion of investment will be extended in the form of long term low interest loan.

(2) Project Funding

Given the situation explained above and in Chapter 14.2, this project should be mainly funded by long term public funds. The following points should be taken into consideration to lighten the burden imposed on main constructor as much as possible.

1) The government shall provide funds in the form of subsidy or low interest loan since

ports are important national assets which play a major role in the nation's economic development.

2) The port management body shall encourage active participation of private enterprises in certain areas where it is possible such as cargo handling to raise private funds.

3) A portion of the budget for the planned industrial zone can be allocated to the port development plan, given the significance of the new port not only as the center of distribution but also the core of the development of industrial zone in the hinterland.

Furthermore it is also important to curtail labor costs which account for the greatest part of public spending.

15. Preliminary Environmental Impact Assessment

15.1 Natural Environment

15.1.1 Overview

This chapter presents the findings of a comprehensive environmental survey conducted in the Lien Chieu project area in December 1997 and January 1998, and discusses the implications of these findings on the proposal to develop a major sea port at Lien Chieu.

Field surveys were carried out to investigate the flora, fauna, marine life, water quality and sediment composition within the project area by local experts under the direction of the Tropical Technology Center which is based in Ho Chi Minh city. The survey team presented a Final Report to the JICA Study Team in February 1998, which forms the basis of the comments set out below.

A preliminary environmental baseline survey had been conducted by the same team in May 1997 in the Lien Chieu project area as part of an earlier study of three possible sites for this port development. The findings of this earlier study were presented in the Interim Report, The Study on the Port Development Plan in the Key Area of the Central Region - Lien Chieu, which was submitted in September 1997.

The findings of this earlier investigation indicated that the natural environment in the Lien Chieu project area was already highly modified by human activity and did not appear to contain any flora, fauna or marine life of particular natural or conservation value. The results also indicated that the water quality within Lien Chieu Bay was subject to some degree of pollution, in particular relatively high concentrations of suspended solids which exceeded Vietnamese coastal water quality standards for bathing, recreation and aquatic cultivation. These relatively high concentrations probably reflect the highly developed hinterland of Danang Bay and are typical of coastal waters where the immediate catchment is urban or intensive agriculture.

Following the selection of Lien Chieu as the preferred site for the development of this major sea-port, a second comprehensive and detailed environmental survey was designed and commissioned to focus specifically on the Lien Chieu project area and provide a detailed assessment of the potential environmental impacts which would need to be addressed if a major sea-ports is to be developed in this area.

This chapter presents the findings of this detailed environmental survey and provides a detailed assessment of the potential environmental impacts which will need to be addressed by the port developers and operators in the event that a major sea-port is constructed at Lien Chieu.

Lien Chieu is located in the north-western corner of Danang bay, between the Cu De river and Ham So Mot (Tunnel No. 1), which is a rocky outcrop at the north-eastern end of Danang bay where the foothills of the Ha Van Pass and Hoi mountain come down to the sea. The beachfront at Lien Chieu, extending in a gradual curve of golden sand between the cape and the Cu De river, is approximately 2 km long. The flat hinterland behind the beach extends back for between 2 km and 3 km only, to the foothills of the southern flanks of Hoi mountain and the Hai Van Pass mountain range. The National Highway 1 crosses this flat hinterland a few hundred meters back from the shoreline, before swinging east and then north across the seaward side of Ham So Mot and continuing the climb up towards the Hai Van Pass.

Some suburban ribbon development, smallholders with garden plots (generally of < 1 ha), households and trade stores, occurs on either side of the National Highway No. 1 and the railway line as the traverse the Lien Chieu hinterland. The width of this ribbon development varies, but is generally no more than a hundred meters either side of the highway. Beyond this, on the landward side, garden plots ad rice paddies, interspersed with small areas of woodland, extend back across the coastal plain. On the seaward side, the garden plots grade into sparse woodland, mainly of coconut palm, *Casuarina* and *Eucalyptus* species, on a thin sandy soil. This sparse woodland extends along the beachfronts of Lien Chieu and down into Nam O cape.

The location of the Study Area is shown in Figure 15.1.1 (1).

15.1.2 Flora

(1) Methodology

Flora surveys were carried out three times in each of the survey areas, marked P, Q ad O in Figure 15.2.2, in December 1997, January and February 1998. The boundaries of these three areas are:

Area P : A part of Kim Lien and Thuy Tu communes between the shoreline, the railway, the Cu De river and Longitude line No. 193.2;

Area Q : A part of Kim Lien and Thuy Tu communes between National Road No. 1,

the railway, the Cu De river and Longitude line No. 193.2;

Area O : A part of Nam O 2 and Nam O 3 communes between the shoreline National Road No. 1, the Cu De river and Latitude line No. 1783.

The survey pattern was based on a grid survey with grid dimensions of 100 meters x 150 meters. This high grid density was possible because of the relatively small size of the study areas, and provided high intensity coverage of each survey area and consequently a greater degree of accuracy of the results obtained.

Longitudinal survey lines, in an approximately north-south direction, were located:

a. Along the National Highway No. 1;
b. Along the railway;
c. Along the edge of the tidal zone and edge of the residential area;
d. Crossing the residential area, parallel to the railway and tidal zone.

Transverse survey lines crossing the survey area between the National Highway No. 1 and the tidal zone were located:

a. Along a line at the foot of the Ha Van pass (the frontier post) between National Highway No. 1 and the tidal zone.
b. Along a line to the north of Lien Chieu station, between National Highway No 1 and the tidal zone;
c. Along a line passing through Lien Chieu station;
d. Along a line located along the northern side of Cu Nhi (Lien Chieu) river;
e. Along a line to the north of Kim Lien station;
f. Along a line to the south of Ha Van Cement factory;
g. Along a line located along the northern side of the Cu De river;
h. Along a line located along the southern side of the Cu De river.

(2) Results and Evaluation

As most of the study area has undergone some degree of development, there is no significant natural habitat remaining and consequently, there is no significant natural vegetation. Most of the existing vegetation consists of common plants of the garden, road-side and river-side. There is very

little agricultural development (in area Q there is approximately 1.5 ha of rice field which produces 2.5 - 3.0 tons of rice per hectare), and most plants are distributed in gardens, and alongside the Kim Lien village and Cu De rivers and along the road-sides.

The commonly distributed house garden plants include soya, green peas, fruit such as banana, lemon, bitter melon, tatters, jack fruit and tomato, ornamental plants and plants grown for fuelwood, shade and sand-fixing. Sand-fixing is an important function of the coastal vegetation within the Lien Chieu district, where much of the substrate is loose or semi-consolidated sand which would be readily mobilized by storms and excessive wave action were it not for the anchoring that is provided by the vegetation along the shoreline.

Important sand-fixing species that were recorded during these surveys include the tree species *Casuarina quisetifolia, Acacia mangium* and *A. auriculifermis*, and the herbs *Oxalis corniculata, Spinifex littoreus, Mimosa invisa, M. indica* and *Catharanthus roseus*. These species are widespread along the shoreline, between the high water mark and the residential areas behind the shorefront, and form a protective woodland fringe along much of the Lien Chieu shoreline. The herbs provide an effective ground-cover to stabilize the beach sand, whilst the trees provide a deeper anchorage and help to prevent mass movement of the sandy shoreline.

These sand-fixing species provide an important function along the Lien Chieu shoreline, and in areas where the existing shoreline will remain post-development, protection of these species or replanting as necessary should be undertaken to provide protection and anchorage for sand.

A full inventory of the flora surveys results is given in the Survey Report. None of the species recorded are of any particular natural or conservation value, although many are commonly used for food, medicine and as ornamental plants in house and garden.

Thus, the development of a major sea-port in this area will not result in the loss, or damage to, an notable or particular floral conservation value in this area. However, the importance of the sand-fixing shoreline species noted above should be recognized, and where areas of open sand beach are to remain post-development, these areas should be planted with these species in order to stabilize the shoreline, unless some other effective means of shoreline stabilization is established in such areas.

15.1.3 Fauna

(1) Methodology

Fauna surveys were carried out on three occasions in the survey areas P, Q and O, following the survey census routes marked as 1, 2 and 3 in Figure 15.3.1.1 (1). The surveys were carried out at three times of the day, morning, afternoon and evening in order to record all species, many of which are active at different times of the day. The morning period spanned the dawn, from 04.00 to 09.30, the afternoon period spanned the hours before sunset 15.00 to 17.00, and the evening period spanned the nocturnal hours 19.00 to 22.00.

(2) Results and Evaluation

1) Feeding Fauna

The survey results show that the feeding fauna of the area is poor in numbers and variety of genera. Random interviews of 86 families in the three areas, P, Q and O, showed only 16 families, approximately 18% feed cattle, pigs and domestic fowl. This probably reflects the fact that many people living within the area are fishermen, rather than farmers, and that the growing of animal food plants in the very sandy soil which characterises the area would be difficult.

2) Natural Fauna

a. Mammals

Very few mammals were observed during these surveys, and all were small mammals that are common throughout the region. These included the weasel (*Mates pennanti*), Swinhoe's ground squirrel, (*Callosciurus swinhoeius*), the common house mouse (*Musmusculus spp.*) and field mice. Interviews with local residents provided further information, indicating that the common fox (*Vulpes spp.*), the porcupine (*Hystrix spp.*) and the pangolin (*Manis spp.*) had been observed in the study area.

No mammals of particular note or conservation value were observed or recorded from the survey areas, and given the lack of natural habitat and the frequency of disturbance and modification to the environment in this area, it is most unlikely that any unusual mammals occur here. The species that have been recorded on these occasions are all species that are common throughout the area and known to tolerate disturbance and the proximity of human settlement.

b. Birds

Similar results were obtained for the bird fauna. Bird numbers and variety of species are poor, and all the species observed or recorded were common species with no notable or conservation value. A full inventory of the observed species is set out below in Table 15.1.1.

Table 15.1.1 Results of Bird-life Survey

Family	Scientific Name	Common Name	*
Trau (*Meropidae*)	*Nyctyornis athertoni*	Big Trau	C
Trau (*Meropidae*)	*Merops orientalis birmanus*	Red-headed Trau	O
Kingfishers	*Halcyon pileatala*	Black-headed Kingfisher	O
(*Alcedinidae*)	*Alceaiatthis bengalensis*	Bong chanh	O
Sparros (*Ploceidae*)	*Passer montanus malaccensis*	House sparroa	C
Zosterops	*Zosterops japonica simplex*		C
Flycatchers	*Orthotomus sutorius inerpectantus*	Long-tailed tailorbird	O
(*Muscicapidae*)	*Phylloscopus borealis borealis*	Northern warbler	R
	Phylloscopus inormatus inormatus	Chim chich may lon	O
	Mouricola solitaria philippensis	Philippine mountain colley	O
	Copsychus saularis saularis	Magpie - robin	C
Mynas (*Sturnidae*)	*Acridotheras cristatellus brevipensis*	Black Myna	R
Bulbuls	*Pycnonotus jocosus jocosus*	Red whiskered bulbul	C
(*Pycnoridae*)	*Pychnonotus aurigaster germaini*	Yellow-bottom bulbul	O
Minivets	*Hemipus picatus*	Black minivet	O
Wagtails (*Motacillidae*)	*Motacilla flaova macronys*	Yellow wagtail	O
Herons (*Ardeidae*)	*Egretta garzetta garzetta*	White stork	R
Pheasants (*Phasianidae*)	*Gallus gallus gallus*	Jungle fowl	O
Rails (*Rallidae*)	*Porzana paykulli*	Brown swamp hen	O
Plovers (*Charadriidae*)	*Pluvialis dominica*	Yellow plover	R
	Charadrius dubius curonicus	Sea plover	R
Pigeons (*Columbidi*)	*Stretopelia chinensis tigrina*	Spotted dove	O
Cuckoos (*Cuculidae*)	*Cuculus micropterus micropterus*	Indian cuckoo	R
	Centropus toulow bengalensis	Small boucal	O
Goose (*Hirundinidae*)	*Hirundo rustica gutturalis*	White-bellied goose	O

Source: JICA Study Team

* Frequency of sightings; C is usually met on the survey: common
O is sometimes met on the survey: occasional
R is rarely met on the survey: rare

c. Reptiles

The numbers and variety of reptile species recorded from the survey areas were low. This will be primarily due to the lack of suitable undisturbed habitats within the study area. However, the fauna specialist also reported that the low temperatures prevalent at this time of year, associated with the rainy season, result in a decrease in reptile activity, especially the species of salamander, and consequently they are less likely to be observed at this time of year.

None of the reptile species observed were of particular or notable value.

Table 15.1.2 Results of Reptile Survey

Local Name	Common Name	Scientific Name	*
Ran ho mang banh	Copperhead	*Naja hannah*	R
Ran moi	Wall lizard	*Lacerta muralis*	C
Tac ke	Common gecko	*gecko gecko*	R
Ky giong hoa	Flower salamander	*Ambystoma maculatum*	R
Thach sung	House gecko		C

Source: JICA Study Team

* Frequency of sightings: C is usually met on the survey: common
O is sometimes met on the survey: occasional
R is rarely met on the survey: rare

d. Insects

None of the insect species recorded from the survey were of particular note nor of specific conservation value, which is shown in Table 15.1.3.

e. Natural fauna summary

No notable species, nor any of specific conservation value were recorded from the survey areas. The few species that were recorded from the area were all species commonly found throughout the central coastal region of Viet Nam. Thus the development of a major sea-port at Lien Chieu is not expected to have any significant effects on the natural fauna values of the region, nor will such a development result in the loss or other adverse effect on any species of particular or notable conservation value.

Table 15.1.3 Results of Insect Survey

Local Name	Common Name	Scientific Name	*
Kien do	Red ant	*Formica rufa*	O
Mong trau	Horse bee	*Tabanus bovinus*	R
Ong duc go lon	Large carpenter bee	*Xylocopa virginica*	O
To vo	Wall bee	*Chalicodoma muraria*	O
Bo canh cam	Green beetle	*Anomalia viridis*	O
Bo xen toc	Long-homed beetle	*Cerambyr*	R
Bo rua chin cham	Nine spotted lady bug	*Coccinella novenmotata*	O
Sau rom thong	Pinn lappet	*Dendrolimus pini*	R
Bo ngua	Mantis	*Mantis religiosa*	O
Cao cao	Green grasshopper		C
Chuon Chuon	Dragonfly		O
Bo xit xanb	Southern green stink bug	*Nezara viridula*	C
Cou cuon chieu	Small millipede	*Schizophyllum*	O
Buom cai trang	Cabbage white butterfly	*Pieris brassicae*	O
Buom phuong	Orange tree butterfly	*Papilio demoleus*	C
Buom phuong den	Black swallowtail	*Papilio ajax*	C
Moi	White ant		O

Source: JICA Study Team

* Frequency of sightings: C is usually met on the survey: common
O is sometimes met on the survey: occasional
R is rarely met on the survey: rare

15.1.4 Marine Life

(1) Methodology

The location of the marine life survey transect lines in the Lien Chieu project area is shown in Figure 15.1.1 (2). The marine survey methods employed were based on the transect line/quadrat survey methods described in Kenchington R.A., 1978, 1984 and Wilkinson C. and Baker V., 1994 [1].

Coral reefs were sampled with quadrats at 5 m to 7 m intervals along the transects where corals were present. Line intercept transects, at depths of 3 m and 10 m, were used to visually assess

[1] Visual survey on large areas of coral reefs. In "Coral reefs-research methods" Kenchington R.A., UNESCO, Paris, 1978. Large area surveys of coral reefs. Kenchington R.A. UNESCO Reports in Marine Science No. 21, 1984. Survey manual for tropical marine resources. Wilkinson C. and Baker V. (Ed.). AIDAB, Townsville, Australia, 1994.

the sessile benthic community of coral reefs. A visual census of coral reef fishes was carried out along 50 m to 100 m transects during daylight hours. Manta tow were used to visually assess the benthic communities over larger areas.

Surveys on seaweed and seagrass beds were carried out using the transect line/quadrat method to assess the community structure, species composition and percentage cover. Beam trawls were towed behind a small boat to sample juvenile fish, prawn, shrimp and crab species amongst these beds.

Sampling soft bottom communities was carried out using sledges, grabs, trawls and various seine, gill and trap nets.

(2) Results and Evaluation

The sea bed of Danang bay is mainly composed of mud. The sandy flats which extend from the shoreline to the isodepth of 6 fathoms cover an area of approximately 5,000 ha. Tidal muddy estuary flats in the vicinity of the river mouths occupy about 200 ha., and there are some shoals and sand-bars in the Cu De river and Han river, and lying offshore from the Han river mouth.

Of particular note is the presence of approximately 100 ha of coral reefs in the Danang bay, including around the Nam O cape and Ham So Mot rock outcrops, which are directly adjacent to the proposed port development site at Lien Chieu. The Nam O cape rock outcrop is at the head of the eastern side of the Cu De river mouth, whilst the Ham So Mot rock outcrop is adjacent to the army base which lies directly north, north-east of the proposed port development area. There are also some fringing reefs along the shoreline of Danang Bay.

Generally the marine biodiversity of the study area is fairly high, consisting of more than 56 taxa of phytoplankton, 75 taxa of zooplankton and more than 80 taxa of large organisms. The numbers of taxa of the larger organisms recorded from the area are:

- Marine flora >9 taxa
- jellyfish 2 taxa
- coral 5 taxa
- gastropods 6 taxa
- bivalves 4 taxa
- cephalopods 5 taxa

- sea prawns 5 taxa
- sea crabs 3 taxa
- food fish 27 taxa
- coral fish 14 taxa

Although the biodiversity (the number of taxa) recorded during these surveys was fairly high, the abundances of most taxa are fairly low, with many being recorded as scarce or fairly scarce. These relatively low numbers of individual taxa have probably resulted from a number of adverse effects including over-fishing in the near shore environment, and the loss or deterioration in the condition of feeding, spawning and nursery habitats within Danang bay.

a. Coral Reefs

Coral reefs are an important feeding, spawning and nursery habitat for many marine organisms, as well as being an important indicator of the health and quality of the marine environment. The observations from these surveys and from those conducted during the preliminary marine life surveys in early 1997 (Interim Report, September 1997) showed that the condition of the corals in Danang bay was generally very poor.

Only 5% of the coral reefs in Danang bay have a living coral cover of more than 50%, and none have a 100% healthy, living coral cover. This means that 95% of the coral reefs surveyed contained less than 50% of healthy living corals. 65% of the coral reefs at Danang were found to be in a bad condition (with a living coral cover of 0 - 25%), 30% were in a poor condition (living coral cover of 25 - 50%), and only 5% were in a fair condition (living coral cover of 50 - 75%). At the transects 7 and 11, at Ham So Mot and Nam O cape, respectively, which are the corals closest to the proposed development site, the coral reefs were in an even worst condition. At these locations, 95% of the coral reef were found to be in a bad condition, that is, with a living coral cover of 0 - 25%, and only 5% of the reef had a living coral cover 25 - 50%. Under these circumstances it is unlikely that these coral reefs would ever recover, and for many species their value as feeding, spawning and nursery areas is already very severely compromised.

The potential causes of such severe degradation are several, and include such diverse human activities as explosive fishing, coral mining for lime manufacture, elevated levels of suspended solids and contaminants in the sea-water as a result of upland deforestation, more intensive agricultural practices, increased urban run-off, storm water discharges and industrial waste discharges in the hinterland of Danang bay. The particularly had condition of the reefs around Lien Chieu probably

arises from the enclosed nature of this part of Danang bay, which probably does not benefit to the same extent from the natural flushing and cleansing effects of tide and storm that other, more exposed, parts of the bay receive.

Whatever the cause of the very marked deterioration in the coral reefs around Danang bay, and the intensive development of the bay's catchment is most probably an important influential factor in this deterioration, the poor condition of these coral reefs will significantly reduce their biodiversity conservation value and their fisheries value. Although it is highly likely that there will be further deterioration in their condition as a result of impacts associated with port development, the overall significance of these impacts on Danang bay's biodiversity and fisheries values is unlikely to be significant.

The coral reefs around the Ham So Mot rock outcrop are almost certainly likely to suffer significant damage during the construction of breakwaters at Lien Chieu as the preliminary designs show a major breakwater running from this outcrop across the front of Lien Chieu bay. Inevitably the construction of this breakwater will generate major impacts on the corals which are in the immediate vicinity. The coral reefs around Nam O rock outcrop are also fairly close (approximately within 1 km) to a proposed breakwater construction site on the south-eastern side of Lien Chieu bay, and are likely to suffer some significant impacts such as those caused by sediment laden water and possibly direct physical damage. As these coral reefs are already in very poor condition, further environmental stress may well result in the loss of the coral reef, particularly the reef at Ham Su Mot. However, as noted above, the loss may not be significant at the regional level in terms of biodiversity value and fisheries values due to their already existing poor condition. Furthermore, although such a loss may have an effect on the local biodiversity value of this area, this can reasonably be regarded as inevitable given the nature and scale of the proposed development and should be balanced against the socio-economic benefits that the development will bring to the area.

b. Seaweeds and Seagrass Communities

Seaweeds and seagrass communities were estimated to be abundant by the survey team, occupying an area of 5 hectares at the sites that were surveyed, mainly at transects Nos. 1, 7 and 11. However, as pointed out in the survey report, the area of seaweed and seagrass beds estimated at some sites along the transects represents only a small percentage of the total are occupied by these marine flora as they are closely associated with coral reefs, rocky flats and soft bottoms, often in the vicinity of estuaries.

Seaweeds and seagrasses are one of the marine vegetal communities having the highest production in Danang bay. They provide a sheltered, nutrient-rich habitat for a diverse variety of marine flora and fauna, including many of the larger organisms, some of which are important for local inshore fisheries. These communities may suffer significant impacts during the construction phase of any marine development and accordingly measures should be taken to contain and minimise such damage during construction the proposed port development at Lien Chieu. This is discussed in more detail in Section 15.4 of this chapter.

c. Marine Phytoplankton

More than 56 taxa of phytoplankton were recorded during the three marine surveys. The highest numbers (biomass) and diversity of species were found along the transects nearest the river mouths, namely Nos. 2, 3, 4, 7 and 8. The lowest biomass and biodiversity values were obtained from samples taken from the transects furthest from the river mouths, Nos. 1, 5 and 10. This probably reflects the higher nutrient concentrations in river waters which receive considerable nutrient enrichment from surface run-off and drainage, particularly in the lower reaches of the river where more intensive agriculture and human settlement contribute significant nutrient loads to the river catchment.

Most of the phytoplankton species recorded have little value apart from their position at the base of the food chain. None of the species recorded have any notable or conservation value which should be protected.

d. Marine Zooplankton

More than 75 taxa of zooplankton were recorded from these surveys. Generally their distribution followed that of the phytoplankton upon which they depend for food, with the greatest numbers being recorded from transects close to river mouths.

Most of the zooplankton species recorded have little value apart from their importance as a food source for many of the large marine organisms. None of the species recorded have any notable or conservation value which should be protected.

e. Large Marine Organisms

Although more than 80 taxa of larger marine organisms were recorded during these three

surveys, the abundance of individual taxa were low, with most species being recorded as scarce or fairly scarce. As stated above, the relatively low numbers of individual taxa probably results from the combination of a number of varied adverse effects, which could include over-fishing, a deterioration in the availability and quality of feeding, spawning and nursery habitats, and a deterioration in the water quality, particularly in the more enclosed portions of Danang bay such as Lien Chieu bay.

Because of the relatively low abundance of commercially exploitable taxa, their potential and actual economic value is also relatively low, with the economic value of most taxa restricted to their value for local consumption. None of the recorded species have any particular notable value or conservation value such as inclusion in the IUCN Red Data Book.

A full inventory of the marine life survey results is given in the original Final Report.

15.1.5 Water Quality

(1) Methodology

The water quality of coastal marine and river waters was monitored at 10 sites around the Danang bay area as shown in Figure 15.1.1 (3). Surface water samples were collected from 7 coastal marine sites and from 3 river water sites at the following locations:

L.C.	1	:	located on Cu Nhi (Kim Lien) river at the road bridge (Lien Chieu bridge);
L.C.	2	:	located on Cu De river at the road bridge (Nam O bridge);
L.C.	3	:	located at the northern end of Kim Lien bay;
L.C.	4	:	located at the southern end of Kim Lien bay, offshore from Cu De river mouth;
L.C.	5	:	located in Danang bay,
L.C.	6	:	located in Danang bay,
L.C.	7	:	located in Danang bay,
L.C.	8	:	located in Danang bay, to the east of the Han river mouth;
L.C.	9	:	located in Danang bay at the mouth of the Han river;
L.C.	10	:	located on Han river at the road bridge (Nguyen Van Troi bridge).

Water samples from all ten locations were taken on three occasions from the middle depth of water. On each occasion, three samples were taken, giving a total of nine samples from each water

monitoring site.

The water quality sampling locations were divided into two groups, based on their proximity to the proposed development site and the likelihood of water quality impacts occurring at these sites as a result of the proposed development.

Three sites, L.C. 2, L.C. 3 and L.C. 4 are in the immediate potential water quality impact zone and are therefore expected to show the greatest effects of any water quality impacts that might arise from the development. Accordingly, water samples taken at these locations were analyzed for a wide range of parameters to provide an adequate baseline for the assessment of potential impacts on water quality. These three sites were referred to as the Basic Locations.

The inventory of water quality parameters monitored at these Basic Locations, together with the units of measurement, are set out below:

1. Temperature °C
2. pH
3. Suspended Solids (SS) mg/l
4. Chemical Oxygen Demand (COD) mgO_2/l at sites L.C. 3 and L.C. 4
5. Biological Oxygen Demand (BOD) mgO_2/l at sites L.C. 2
6. Dissolved Oxygen mg/l
7. Odor
8. Total Dissolved Solids (TDS) mg/l
9. Electrical Conductivity µS/cm
10. Salinity %
11. Arsenic 10^{-3}mg/l
12. Ammonia mg/l
13. Cadmium mg/l
14. Chromium trivalent, hexavalent mg/l
15. Copper 10^{-3}mg/l
16. Total Iron mg/l
17. Lead 10^{-3}mg/l
18. Fluoride mg/l
19. Manganese mg/l
20. Mercury 10^{-3}mg/l
21. Zinc 10^{-3}mg/l

22. Cyanide mg/l
23. Sulphide mg/l
24. Petroleum mg/l
25. Pesticide mg/l
26. Coliform MPN/100 ml
27. Phenol mg/l

All samples were analyzed by standard methods according to TCVN, 1995 and APHA, 1992.

Samples from the other sampling sites, referred to as the Additional Locations, which were more remote from the proposed port development area at Lien Chieu, were analyzed for a limited set of indicative parameters:

1. Temperature
2. pH
3. Suspended solids
4. COD/BOD depending on their type (COD was analyzed in sea-waters, whereas river water samples were analyzed for BOD).

(2) Results and Evaluation

The tables below summarize the results of water quality monitoring at the ten locations identified in Figure 15.1.1 (3). The values given for each parameter are common averages ± one standard deviation (X ± δ). In most cases, the averages are derived from nine individual results, obtained from each monitoring station as per the methodology set out in Section 15.1.5. (1) above.

A full inventory of the individual water quality results obtained from each sampling location during the survey is provided in the Final Report.

Table 15.1.4 Water Quality Results: River Water Samples; Cu Nhi River, Cu De River and Han River

Parameter	LC 1	LC 2	LC 10	TCVN Std.
Temperature (°C)	27.12 ± 1.36	28.48 ± 0.58	26.99 ± 1.09	30
pH	6.53 ± 0.33	7.55 ± 0.53	7.96 ± 0.15	6.5 - 8.5
S. Solids (mg/l)	22.57 ± 7.54	1.64 ± 2.2	17.70 ± 4.68	25 - 200
BOD_5	2.75 ± 1.22	4.0 ± 2.5	3.11 ± 0.84	10 - 20
Dissolved O_2	5.38 ± 0.57	6.27 ± 0.07	6.35 ± 0.30	>2
Elec. Conduct.	510 ± 500	24.51 ± 16.18	6294 ± 7948	-
Salinity	3.10 ± 2.78	14.48 ± 10.09	9.34 ± 1.49	-

Source: JICA Study Team

Table 15.1.5 Water Quality Results: Sea-water Samples from Kim Lien bay and Central and Western Locations in Danang Bay

Parameter	LC 3	LC 4	LC 5	LC 6
Temperature (°C)	26.99 ± 0.95	26.34 ± 0.54	26.77 ± 0.54	26.93 ± 0.55
PH	7.72 ± 0.43	7.76 ± 0.39	7.88 ± 0.23	7.93 ± 0.19
S. Solids (mg/l)	18.6 ± 3.1	15.5 ± 3.3	11.7 ± 1.46	22.44 ± 0.19
BOD_5	54.4 ± 26.8	49.7 ± 20.4	26.92 ± 9.41	44.89 ± 13.22
Dissolved O_2	6.49 ± 0.11	6.47 ± 0.18	6.65 ± 0.19	6.57 ± 0.09
Elec. Conduct.	48.08 ± 2.76	48.48 ± 1.75	47.67 ± 3.68	47 ± 1
Salinity	30.87 ± 1.24	31.31 ± 0.93	30.03 ± 2.43	29.82 ± 0.73

Source: JICA Study Team

Table 15.1.6 Water Quality Results: Sea-water Samples from Lien Chieu Bay and Central and Western Locations in Danang Bay

Parameter	LC 7	LC 8	LC 9	TCVN Std.
Temperature (°C)	26.71 ± 0.66	26.72 ± 0.87	27.03 ±0.78	30
PH	8.03 ± 0.04	8.12 ± 0.04	8.11 ± 0.04	6.5 - 8.5
S. Solids (mg/l)	22.37 ± 8.05	19.41 ± 9.05	24.07 ± 5.54	25 – 200
BOD_5	54.44 ± 21.29	31.33 ± 2.79	62.1 ± 19.60	<35
Dissolved O_2	6.61 ± 0.11	6.72 ± 0.12	6.60 ± 0.25	>2
Elec. Conduct.	48 ± 1	39 ± 2	36 ± 2	-
Salinity	30.10 ± 0.92	24.22 ± 1.52	22.37 ± 1.09	-

Source: JICA Study Team

Table 15.1.7 Water Quality Results: Extended Parameter List, Basic Locations in Kim Lien Bay

Parameter	LC 2	LC 3	LC 4	TCVN Std.
Temperature (°C)	24.48 ± 0.58	26.99 ± 0.95	26.34 ± 0.75	30
PH	7.55 ± 0.53	7.72 ± 0.43	7.76 ± 0.39	6.5 - 8.5
Suspended Solids	16.4 ± 2.2	18.6 ± 3.1	15.5 ± 3.3	25 - 200
Bod5	4.0 ± 2.5	-	-	10 - 20
COD	-	54.4 ± 26.8	49.7 ± 20.4	<35
Diss. Oxygen	6.27 ± 0.07	6.49 ± 0.11	6.47 ± 0.18	>2
Total Diss. Solids	16.84 ± 11.11	33.03 ± 1.90	33.31 ± 1.21	-
Elec. Conduct.	24.51 ± 16.18	48.08 ± 2.76	48.48 ± 1.75	-
Salinity	14.48 ± 10.09	30.87 ± 1.24	31.31 ± 0.93	-
Arsenic	0.14 ± 0.00	0.18 ± 0.14	0.40 ± 0.31	0.1 - 0.5
Ammonia	ND*	ND*	ND*	0.1 - 0.5
Cadmium	ND*	ND*	ND*	0.005 - 0.001
Chromium	ND*	ND*	ND*	-
Copper	2.9526 ± 2.428	4.1617 ± 2.984	1.7771 ± 0.7764	0.02 - 0.01
Total Iron	0.014 ± 0.007	ND*	0.013 ± 0.004	0.1 - 0.3
Lead	0.4942 ± 0.049	0.936 ± 0.524	0.998 ± 0.369	0.05 - 0.1
Fluoride	1.276 ± 0.258	0.960 ± 0.097	1.240 ± 0.261	1.5
Manganese	0.006 ± 0.006	0.002 ± 0.001	0.002 ± 0.001	0.1
Mercury	0.312 ± 0.086	ND*	0.026 ± 0.000	0.005 - 0.01
Zinc	3.4182 ± 2.792	1.2321 ± 0.368	0.8219 ± 0.146	0.01 - 0.1
Cyanide	0.50 ± 0.11	ND*	ND*	0.01 - 0.02
Sulphide	0.0483 ± 0.007	0.04889 ± 0.006	0.0436 ± 0.013	0.005 - 0.01
Petroleum	1.43 ± 0.60	1.48 ± 0.86	1.16 ± 0.51	0.3
Pesticide	0.164 ± 0.138	0.036 ± 0.028	0.045 ± 0.020	0.05 - 0.01
Coliforms (MPN/100)	4379 ± 10518	486 ± 781	8 ± 6	1000
Phenol	0.0019 ± 0.0004	0.0015 ± 0.000	0.0020 ± 0.0004	0.001 - 0.002

Source: JICA Study Team

* ND: Not Detected. The quantity of this parameter that may be present in this sample is below the limits of detection of the analysis method employed. It should be noted that the value ND does not imply that there is no amount of this substance in the water, but rather than, if it is present, it is in amounts so small that the analytical method cannot determine the quantity.

The results of individual parameters are discussed below, followed by more general comments on the water quality of Kim Lien bay, and Danang bay in general, and the implications of these findings for the proposed development at Lien Chieu.

Comparison of the results with Vietnamese TCVN standards is based upon TCVN 5943 -

1995. Given the nature and use of Kim Lien bay, the coastal water quality standard used is that applied to waters other than for purposes of bathing, recreation and aquatic cultivation.

a. Temperature

Sea-water temperature ranged between 25.7°C and 28.4°C. River water temperatures ranged between 25.6°C and 29.4°C. The highest and lowest temperatures were recorded from the Cu Nhi river, reflecting the much smaller volumes and shallower water depth in this water body.

b. pH

pH values ranged from 7.1 to 8.16 in sea-water samples, and between 6.01 and 8.15 in river water. The pH values recorded from the Cu Nhi river were all below pH 7.0, and three of these samples were below the TCVN standard of 6.5 - 8.5. The cause of these depressed pH values is unclear, but may result from high levels of photosynthetic activity in the shallow water in mid-morning (the time of sampling), although the survey record also records a marked odor from the water on this occasion.

c. Suspended Solids

Suspended solids concentrations in seawater ranged from 10 to 25 mg/l in Kim Lien bay, and between 10 and 35 mg/l at the sites in Danang bay. These values are considerably lower than the concentrations recorded in the earlier environmental baseline survey of May 1997, when concentrations ranged between 54 and 106 mg/l. In general all the samples compiled with the TCVN coastal water quality standard, although some of the samples taken from the main body of Danang bay exceeded 25 mg/l, which is the maximum standard for bathing and recreational use.

Suspended solids concentrations in river waters were recorder in the range 13 - 19.4 mg/l in Cu De river, 13 - 32 in the Kim Lien river, and 13.5 - 26 in Han river. All the river samples were well within the TCVN surface water quality standard of 80 mg/l, for purposes other than domestic water supply.

d. Chemical/Biological Oxygen Demand

Chemical and biological oxygen demand values provide a good indication of the degree of organic pollution in a water sample by measuring the amount of oxygen that is consumed by the water

during the breakdown of organic material that is present in that water. The more organic material that is present in the water, the greater the amount of oxygen that is consumed. This is referred to as the oxygen demand of the water.

Chemical oxygen demand in seawater samples from Kim Lien bay showed considerable variation, between 18 and 93 mgO_2/l, with the highest values recorded from the northern, more enclosed, portion of the bay. 12 of the 18 samples taken from Lien Chieu bay exceeded the TCVN standard for coastal waters, which is 35 mgO_2/l. 9 of the samples exceeded 50 mgO_2/l. These results clearly indicate a significant degree of organic pollution prevalent throughout the near-shore waters of the bay.

A similar range of values was recorded from the sampling sites in Danang bay, which ranged between 24 and 89 mgO_2/l. Approximately half these samples exceeded the TCVN standard, showing that significant levels of organic pollution extent throughout the waters of Danang bay. It is interesting to note that all the samples taken from location L.C. 9, at the mouth of the Han river, exceeded the TCVN standard.

Biological oxygen demand in river waters varied between 0.5 and 8.5 mgO_2/l, which is below the TCVN BOD_5 standard of 10 - 20 mgO_2/l.

e. Dissolved Oxygen

Dissolved oxygen concentrations in seawater varied between 6.2 and 7.0 mg/l. A wider range of variation was recorded from river waters, where concentrations of between 4.8 and 6.7 mg/l were recorded. All these values lie well within the normal range of oxygen concentrations encountered in sea and river waters.

f. Arsenic

Arsenic concentrations in seawater varied between ND (the detection limit[2]) and $0.86 \cdot 10^{-3}$ mg/l, which is well below the TCVN standard of $50 \cdot 10^{-3}$ mg/l.

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[2] The detection limit is the smallest concentration of substance that can be detected by the method used. The presence of amounts smaller than this cannot be detected and so to be accurate, a value of Not Detected (ND) is given in the record of the result.

Arsenic concentrations in the Cu De river varied between ND and $0.14 \cdot 10^{-3}$ mg/l, well below the TCVN standard of $200 \cdot 10^{-3}$ mg/l for water other than that used for domestic supply.

g. Ammonia

Ammonia was not detected in any of the sea or river water samples.

h. Cadmium

Cadmium was not detected in any of the sea or river water samples.

i. Chromium

Chromium was not detected in any of the sea or river water samples.

j. Copper

Copper concentrations varied between 0.47 and $8.72 \cdot 10^{-3}$ mg/l in seawater samples, with the higher concentrations occurring in samples from the northern, more enclosed portion of Lien Chieu bay. However, all the concentrations recorded were below the TCVN standard for coastal waters of $20 \cdot 10^{-3}$ mg/l.

Copper concentrations varied between 0.44 and $5.74 \cdot 10^{-3}$ mg/l in river water samples taken from the Cu De river. The TCVN standard for copper in water other than those for domestic water supply is 1 mg/l ($1000 \cdot 10^{-3}$ mg/l).

Despite these concentrations being well below the relevant standards, they do indicate some degree of industrial/agricultural chemicals pollution in the catchment of Cu De river and Kim Lien bay.

k. Total Iron

Total iron concentrations varied between ND and 0.02 mg/l in the seawater samples, well below the TCVN standard of 0.1 mg/l.

The concentrations in samples from the Cu De river ranged from ND to 0.03 mg/l. The TCVN standard is 2 mg/l for purposes other than domestic water supply.

l. Lead

Lead concentrations varied between 0.43 and 1.94 10^{-3} mg/l in the seawater samples, well below the TCVN standard of 100 10^{-3} mg/l for coastal waters.

Lead concentrations in samples from the Cu De river ranged from 0.4 to 0.56 10^{-3} mg/l. The TCVN standard is 100 10^{-3} mg/l for purposes other than domestic water supply.

m. Fluoride

Fluoride concentrations varied between 0.87 and 1.53 mg/l in the seawater samples, which is closed to the TCVN standard of 1.5 mg/l for coastal waters.

Fluoride concentrations in samples from the Cu De river ranged from 1.0 to 1.8 mg/l. The TCVN standard is 1.5 mg/l for purposes other than domestic water supply.

n. Manganese

Manganese concentrations varied between ND and 0.003 mg/l in the seawater samples, well below the TCVN standard of 0.1 mg/l.

The concentrations in samples from the Cu De river ranged from ND to 0.016 mg/l. The TCVN standard is 0.8 mg/l for purposes other than domestic water supply.

o. Mercury

Mercury was only detected in one seawater sample at a concentration of $0.026 \cdot 10^{-3}$ mg/l, which is below the TCVN coastal water standard of $10 \cdot 10^{-3}$ mg/l.

Mercury concentrations were not detected in any of the samples from the Cu De river. The TCVN surface water standard is $2 \cdot 10^{-3}$ mg/l.

p. Zinc

Zinc concentrations in the seawater samples varied between 0.68 and $1.9 \cdot 10^{-3}$ mg/l, which are all well below the TCVN standard of $100 \cdot 10^{-3}$ mg/l.

The concentrations in samples from the Cu De river varied between 0.32 and $6.29 \cdot 10^{-3}$ mg/l, which are all well below the TCVN standard of $2000 \cdot 10^{-3}$ mg/l (2 mg/l) for purposes other than domestic water supply.

q. Cyanide

Cyanide was not detected in any of the seawater samples. The TCVN standard for coastal waters is 0.02 mg/l.

Cyanide concentrations in the samples from the Cu De river varied between ND and 0.66 mg/l. Only three of the samples, all collected on the same occasion, contained detectable concentrations of cyanide, at 0.39 mg/l, 0.46 mg/l and 0.66 mg/l. The TCVN standard for surface waters other than for purposes of domestic water supply is 0.05 mg/l. The exceedence of the standard by one of the samples, and the fact that cyanide was only detected on one occasion, suggests the occurrence of a "spot" event from a localised pollution source. The results indicate that in general cyanide contamination of the river is not a major pollution problem.

r. Sulphide

Sulphide concentrations in the seawater samples varied between 0.032 and 0.064 mg/l. These exceed the TCVN standard of 0.01 mg/l for purposes other than domestic water supply, and probably result from the anoxic breakdown of relatively high concentrations of organic material in the water. These results support the view that the waters of Kim Lien bay are significantly polluted by organic material, as indicated by the elevated levels of chemical and biological oxygen demand referenced above.

Sulphide concentrations in the waters of the CU De river varied between 0.042 and 0.064 mg/l. Although there is no TCVN standard for this parameter in surface waters, these results, like those from the seawater, suggest elevated levels of organic pollution in this river at the sampling location.

s. Petroleum

Petroleum concentrations varied between 0.3 and 3.0 mg/l in the seawater samples, indicating concentrations of this parameter above levels normally occurring in coastal environments. However, these elevated concentrations are not uncommon in semi-enclosed coastal waters, such as Kim Lien bay, where the catchment contains fairly intensive urban development. There is no TCVN standard for this parameter.

Petroleum concentrations varied between ND and 2.0 mg/l in the river water samples taken from the Cu De river. Likewise these concentrations exceed those normally encountered in clean surface waters, but are not uncommon in waters draining intensively developed catchments.

t. Pesticide

Pesticide concentrations in the seawater samples varied between 0.007 and 0.08 mg/l. The TCVN standard for total pesticides in coastal waters is 0.05 mg/l. Approximately half the samples exceeded this value, indicating a significant presence of agriculturally-derived pollution in the waters of Kim Lien bay.

Pesticide concentrations in the Cu De river water samples varied between 0.12 and 0.35 mg/l, which exceed the TCVN standard for surface waters other than for domestic water supply purposes of 0.15 mg/l. As above, theses results indicate a significant level of agriculturally-derived pollution in the catchment of the Cu De river.

u. Coliforms

Coliform values were measured as MPN/100 ml of water which is the Minimum Probable Number of coliform bacteria per 100 ml of water. This is the measurement used in the TCVN standards and provides an accurate measure of coliform contamination in natural waters. The TCVN standard for coastal waters is 1000 MPN/100 ml.

Coliform concentrations in the seawater samples varied between 0 and 2,300 MPN/100 ml. However, only on one occasion were these higher values recorded. At other times, the highest values recorded were 20 MPN/100 ml, which are well below the TCVN standard. The cause of these high values on the first occasion of sampling may result from a localized bacteria contamination event, or possibly from contamination of the three samples ex situ. In either case, the results generally indicate

that bacterial contamination of the waters of Kim Lien bay is unlikely to be a significant pollution problem.

Coliform concentrations in the Cu De river water samples varied between 2 and 34,000 MPN/100 ml. The TCVN standard for surface waters other than those used for domestic supply purposes is 10,000. Only one sample out of nine exceed this value, and it is interesting to note that the two other samples collected from that location on that sampling occasion were significantly lower at 280 MPN/100 ml and 170 MPN/100 ml. This marked difference in coliform concentrations amongst samples collected from the same location at the same time may reflect an ex situ contamination of the sample, particularly as all other samples are significantly lower. Overall, the results indicate that the Cu De river does not appear to be seriously affected by coliform contamination, although the results do show a level of coliform contamination consistent with an agricultural catchment, at least in the lower reaches of the river.

v. Phenol

Phenol concentrations in the seawater samples varied between 0.0014 and 0.0025 mg/l. The TCVN standard for phenol in coastal waters is 0.002 mg/l and three of the twelve samples analyzed for this parameter exceeded this standard. This is consistent with a partially enclosed coastal water body which receives drainage from an intensively developed catchment such as Kim Lien bay and the adjacent waters of Danang bay.

Phenol concentrations in the Cu De river samples varied between 0.0014 and 0.0023 mg/l, which are all well below the TCVN standard of 0.02 mg/l for surface waters other than those for domestic supply purposes.

w. General Comments

The results of monitoring a comprehensive range of parameters in the coastal waters of Kim Lien bay indicate that these waters are being, at least marginally, affected by agricultural, urban and industrial pollution, no doubt derived from the intensively developed adjacent hinterland. As further development progresses, unless more stringent environmental controls are enforced, it is likely that this water quality will deteriorate further.

The results of this water quality survey indicate that the waters of Danang bay, and Lien Chieu bay in particular, are significantly polluted by organic material, no doubt in part at least derived from

the intensive human settlement and urban development around the bay shore. In many cases untreated human wastes are discharged into the bay, either directly or through the drainage channels and creeks which carry storm water, runoff and waste materials from these areas. Unless this situation can be reversed, which appears unlikely at this time, the level or organic pollution within these waters is unlikely to decline and may indeed increase over time. Given this situation, it appears most unlikely that the status and health of marine life within the bay will improve, in particular the very poor condition of the coral reefs at Ham So Mot and Nam O cape.

Pesticide concentrations exceeded the TCVN standards in both the coastal waters of Kim Lien bay and in the Cu De river, which is the major inflow to the bay. Phenol, a contaminant frequently derived from the cleansing agents and organic solvents used in agriculture and small industries, were also elevated above TCVN standards in several of the samples analyzed. These results indicate that contamination from agriculture and small scale industries within the catchment of Kim Lien bay is already occurring. The significance of these current levels of contamination cannot be accurately defined, but they will no doubt be contributing to the adverse effects on marine life in the bay which have been recorded earlier in this chapter.

Concentrations of petroleum derivatives up to 3.0 mg/l were also recorded from the coastal waters of Kim Lien bay. These concentrations are relatively high and may derive from local on-shore storage areas, port operations in other part of Danang bay, or from runoff and drainage from the adjacent hinterland, in particular the developments along National Highway No. 1. Their presence in these waters, at these concentrations, will be contributing to the adverse effects on marine life that have already been noted. The development of a major port in this area is likely to contribute further to the contamination of these waters by petroleum derivatives, but the significance of this additional contribution on the health and status of marine life is likely to be less than in a pristine environment as the particularly susceptible species and marine communities, such as coral reefs, will have already been marginalized by the existing levels of contamination.

At the present time, the concentrations of metal contaminants such as copper, cadmium, lead, zinc and mercury which are indicative of industrial contamination, are below the appropriate TCVN standards and do not give immediate cause for concern. However, with the development of industrial zones in the immediate catchment of Lien Chieu, contamination of the bay's waters by these elements is likely to increase. As the proposed port development site at Kim Lien bay is located in a partially enclosed and sheltered portion of Danang bay, where the flushing effects of tide and storm are less, a fairly rapid build-up of industrial contamination could occur unless more stringent environmental controls are enforced at an early stage in development.

In summary, the water quality of the coastal waters in Kim Lien bay has already been adversely affected by various pollutants, in particular organic material but also including a number of substances usually associated with intensive agricultural and urban development. The development of a major sea-port and industrial zone within this area will inevitably add to the pollution load, not only in the amount, but also in the nature and composition of the pollutants. This will have significant effects on the water quality and marine life of the bay which is already undergoing environmental stress from existing pollution sources. Further stress must be avoided if the current health and condition of Kim Lien bay is to be protected. This can only be achieved by the application of stringent environmental controls at an early stage of the port development and throughout the construction and ongoing operations of the port.

However, it is crucial that this is accompanied by similar stringent environmental controls being applied to the development and operation of industrial sites in any proposed development zones within the area. To apply environmental controls to only the port development will, in the long run, prove to be ineffective in protecting the marine environment from serious environmental stress.

15.1.6 Sediment Composition

(1) Methodology

The sea-bed sediment composition was monitored at three sites around Kim Lien bay. The location of these sites is shown in Figure 15.1.1 (4).

The following parameters were analyzed in each sample:

			Number of samples
1.	Humidity	%	9 (3 per site)
2.	Ignition Loss	%	3 (1 per site)
3.	Organic matter	%	9 (3 per site)
4.	Organic carbon	%	9 (3 per site)
5.	Organic nitrogen	%	9 (3 per site)
6.	Organic phosphorus	%	9 (3 per site)
7.	Sulphide	%	3 (1 per site)
8.	Ammonia	µg/g	9 (3 per site)
9.	Nitrite	µg/g	9 (3 per site)
10.	Nitrate	µg/g	9 (3 per site)

11.	Phosphate	µg/g	9 (3 per site)
12.	Copper	µg/g	3 (1 per site)
13.	Cadmium	µg/g	3 (1 per site)
14.	Chromium	µg/g	3 (1 per site)
15.	Lead	µg/g	3 (1 per site)
16.	Nickel	µg/g	3 (1 per site)
17.	Zinc	µg/g	3 (1 per site)
18.	Mercury	µg/g	3 (1 per site)
19.	Arsenic	µg/g	3 (1 per site)

All samples were analyzed by standard methods according to TCVN, 1995 and APHA, 1992.

(2) Results and Evaluation

The tables below present the summary results of sediment analyses from the three sea-bed sediment sampling sties, SD1, SD2 and SD3 in Lien Chieu bay. The full set of data from all these analyses are presented in the Final Survey Report.

Table 15.1.8 Sediment Composition: Kim Lien Bay

Parameter		SD 1	SD 2	SD 3
Humidity	%	77.9 ± 1.6	74.2 ± 1.8	60.7 ± 11.3
Ignition loss	%	0.37	1.3	9.96
Organic matter	%	0.153 ± 0.109	0.207 ± 0.019	0.513 ± 0.264
Organic carbon	%	0.074 ± 0.053	0.102 ± 0.012	0.255 ± 0.131
Organic nitrogen	%	0.009 ± 0.004	0.016 ± 0.003	0.020 ± 0.011
Organic phosphorous	%	0.023 ± 0.017	0.021 ± 0.002	0.029 ± 0.012
Sulphide	%	0.1	0.2	0.1
Ammonia	µg/g	0.223 ± 0.070	0.687 ± 0.535	3.740 ± 2.762
Nitrite	µg/g	0.015 ± 0.005	0.059 ± 0.043	0.002 ± 0.003
Nitrate	µg/g	0.124 ± 0.079	0.558 ± 0.694	0.229 ± 0.118
Phosphate	µg/g	0.065 ± 0.034	0.293 ± 0.143	2.077 ± 1.411
Copper	µg/g	2.10	1.90	3.40
Cadmium	µg/g	<0.1	<0.1	<0.1
Chromium	µg/g	0.47	0.57	0.62
Lead	µg/g	0.03	0.03	0.02
Nickel	µg/g	1.29	0.84	1.32
Zinc	µg/g	0.74	0.70	0.66
Mercury	µg/g	<0.05	<0.05	<0.05
Arsenic	µg/g	2.79	0.90	0.70

Source: JICA Study Team

Some results are single analyses and are given as a single number, e.g. 0.37;

Some results are an average of three analyses and are given as the common average

± one Standard Deviation, et. 77.9 ± 1.6

These results indicate that the sea-bed sediments within the development area at Lien Chieu are inorganic in composition, with only low concentrations of organic matter which varied between 0.04% and 0.70%, and generally below 0.3%. Approximately half the organic matter was present as organic carbon. The concentrations of organic nitrogen varied between 0.004% and 0.030% and the concentration of organic phosphorus between 0.005% and 0.045%. Sulphide at between 0.1% and 0.2% was present in all samples analyzed for this parameter (3).

Nutrient concentrations, ammonia, nitrite, nitrate and phosphate were fairly low in most of the samples, although the concentration of ammonia in two of the samples from site SD 3 were elevated by a factor of 10 times over most of the other ammonia concentrations. These two samples gave values of 6.854 µg/g and 4.277 µg/g, whereas most other samples fell within the range 0.140 µg/g to 0.394 µg/g. The cause of this difference is unclear, particularly as the other sample taken from this location approximately one month later returned the lowest ammonia value recorded, 0.140 µg/g.

The heavy metal concentrations of these sediments appears fairly low when compared to other tropical coastal sediments. The table below gives analytical data obtained in 1995 from coastal sediments in Malaysia.

Table 15.1.9 Heavy Metal Concentrations from Tropical Coastal Waters

Parameter		Jura, Penang Range	Jula, Penang Average	Strait of Johore Range	Strait of Johore Average
Copper	µg/g	9.93 - 43.0	17.2 ± 10.5	11.8 - 92.9	30.7 ± 22.5
Cadmium	µg/g	0.04 - 0.24	0.13 ± 0.05	0.11 - 0.36	0.18 ± 0.06
Chromium	µg/g	11.5 - 59.6	46.6 ± 15.7	21.9 - 62.8	45.2 ± 11.2
Lead	µg/g	17.3 - 35.5	27.4 ± 7.3	26.4 - 69.9	42.3 ± 11.0
Nickel	µg/g	19.2 - 44.0	32.6 ± 6.7	21.2 - 46.8	30.2 ± 6.6
Zinc	µg/g	36.7 - 83.7	60.1 ± 15.5	68.5 - 230.7	132.5 ± 52.6
Arsenic	µg/g	3.2 - 8.1	6.2 ± 1.5	6.4 - 64.0	19.7 ± 6.9

Source: JICA Study Team

A comparison of the Lien Chieu results with these Malaysian results indicates that the

sediments in Lien Chieu contain much lower concentrations of heavy metal elements and on this basis appear to be much "cleaner" than those described in Table 15.1.9.

However, the implications of this assessment on the potential contaminating effects of dredging and dredge materials deposition for the proposed port development at Lien Chieu is uncertain as many factors apart from the concentration of elements in the dredge sediments affect the release and mobilization of heavy metal elements from the sediment.

Nevertheless, the relatively low concentrations of heavy metals in the Lien Chieu sediments does suggest that heavy metal contamination of the water column by dredge materials, either during extraction or during deposition, may not be such a significant problem as would otherwise be the case.

15.1.7 Air Quality

Although air quality was not monitored during this environmental baseline survey, air quality measurements were being carried out in the area during late 1996 and 1997 by others. This air quality survey focused on the area around the Hai Van Cement works, which is currently under construction. This is located mid-way along the coast of Lien Chieu bay, and as such is centrally located within the proposed port development area. The results of these surveys are set out in the table below.

Table 15.1.10 Air Quality at Lien Chieu

Location	Date	Wind Speed	Dust mg/m³	Lead mg/m³	NO_2 mg/m³	SO_2 mg/m³	CO mg/m³
1	28/11/96	2.1 m/s	0.59	ND	ND	0.007	-
1	20/12/97	2.3 m/s	0.82	0.0003	0.0006	0.009	2.5
2	28/11/96	2.1 m/s	0.9	-	0.35	0.7	0.7
2	05/11/97	1.9 m/s	0.88	0.0009	0.02	0.031	3.1
3	05/07/97	2.7 m/s	1.93	0.000583	ND	0.74	6.12
3	12/11/97	2.1 m/s	0.87	0.000317	ND	0.452	3.74
4	28/11/96	2.2 m/s	0.2	ND	ND	ND	-
4	20/12/97	2.3 m/s	0.035	0.007	0.009	0.008	3.2
5	28/11/96	2.1 m/s	0.32	0.005	0.008	0.006	-
5	20/12/97	2.3 m/s	0.45	0.007	0.09	0.008	3.2

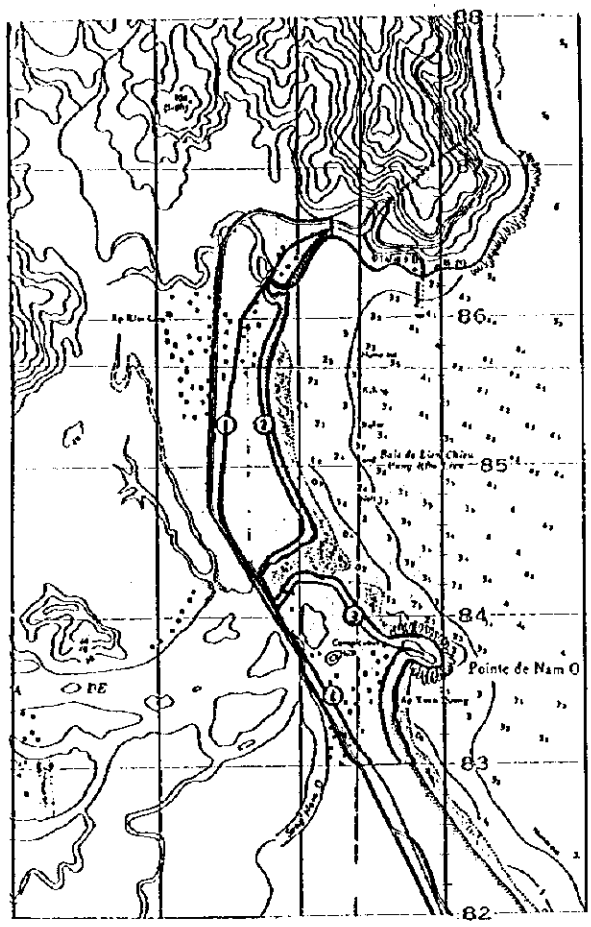
Source: Danang Technology and Science Apply Center, Environmental Protection Center, Danang, and Environmental Protection Center, Ho Chi Minh city.

The locations 1 to 5 are all located at varying distances of between 20 meters and 250 meters from the Hai Van cement works, and thus all are in a central location with respect to the proposed port development site at Lien Chieu.

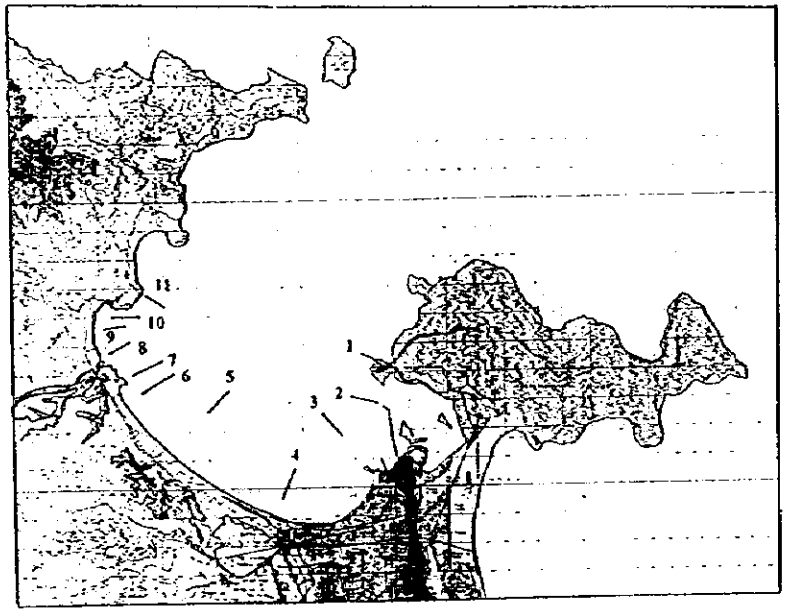
These results suggest that air quality in the area is generally fairly "clean", with dust present in the order of 1 mg/m^3, and generally low levels of lead and nitrogen oxides. The results for sulphur dioxide show considerable variation, varying between < 0.006 and 0.74 mg/m^3, which may reflect variations in plant and machinery emissions during the construction operations of the cement works.

The relative "clean" air quality around this construction site (cement works) suggests that air flows at the site are sufficient to disperse many aerial pollutants fairly rapidly, avoiding the build up of pollutant concentration. This is quite common in a coastal situation, where constant winds prevail to disperse any air-borne materials. The results of the wind speed measurements corroborate this view.

These findings suggest that any pollution caused by aerial emissions during the construction and subsequent operation of a major sea-port at Lien Chieu are likely to be fairly rapidly dispersed by natural air flows at the site. Furthermore, once construction is completed, the amounts and concentrations of aerial emissions from port operations will be relatively small compared to pollutant emissions from the cement works and other industrial developments in the adjacent hinterland. Thus the port operations are unlikely to result in significant air quality impacts on the local environment, relative to other aerial emission impact sources in the area.

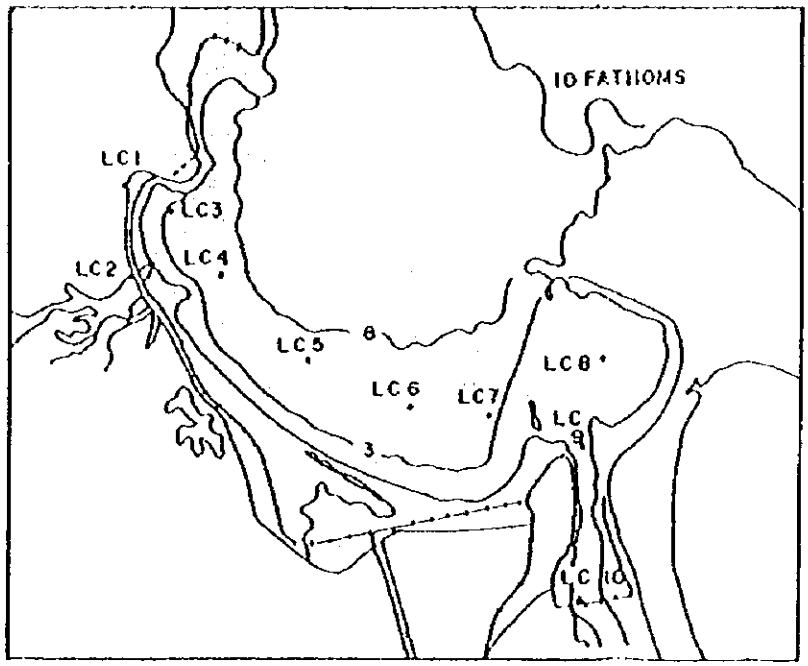


(1) Fauna and Flora

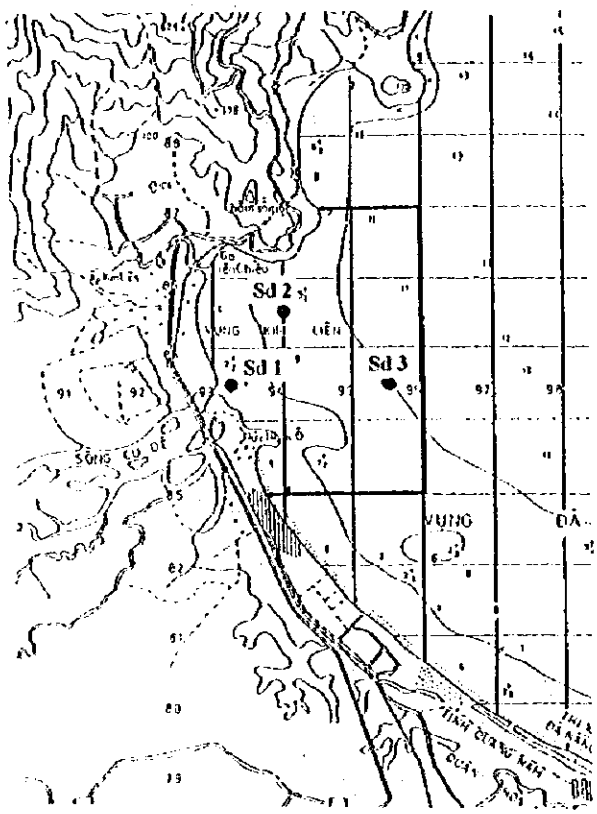


(2) Marine Life

Figure 15.1.1 Locations of Natural Environmental Survey by the JICA Study Team (1)



(3) Water Quality



(4) Sediment

Figure 15.1.1 Locations of Natural Environmental Survey by the JICA Study Team (2)

15.2. Social Environment

15.2.1. Introduction

The project area is, as shown in Figures 15.2.1~2, located in Lien Chieu district of Danang city, which is located and also the biggest city in the Central part of Vietnam at around 108° 07' of eastern longitude and 16° 09' of northern latitude. The hinter land borders with the South China Sea in the East, Hai Van pass in the North, National Road 1A in the West and limited by the northern latitude 16° 08'.

The project area is situated right on the main communication route from North to South of Vietnam with the National Road 1A and the transnational railway passing by the area, which covers a part of Hoa Hiep district, including part of Thuy Tu (1 neighborhood) and Nam O 1 (1) communes, whole Xuan Duong (5) and Nam O 2 (12) communes, and most of Kim Lien (15) commune.

(1) Social Economic Survey

The objectives of this social survey are:

a. To investigate life conditions of residents in the project area;
b. To evaluate anticipated effects of the project in respect of resettlement, economic activities, fishing activities and possible accidents;
c. To estimate the rough costs for compensation of the relocation and resettlement of houses and residents, based on the current regulations of Danang city;
d. To identify problems related to relocation and resettlement of the residents in sub-area P; and
e. To make recommendations on relocation and resettlement to ensure the smoothly project development as well as the same, if not better, life conditions of relocatees as before relocation.

With the stated objectives, a survey was conducted in two stages together with collecting additional information on households and economic activities in project area. In both stages, the basic questionnaire used for interview is that provided by JICA Study-Team.

In the first stage, a general survey was conducted for the whole area, including the core sub-area P and adjoining sub-areas O and Q. The total number of households in project area is 2,415 with population of 12,462. The randomly sampling method was used to get a sample of households to be interviewed with the size of sample is 3% of total

households. The survey results in a database of 76 households, of which 18 in sub-area P, 44 in sub-area O and 14 in sub-area Q. This survey allows comparing the main characteristics of these sub-areas.

With the purpose to focus on the core sub-area P, an additional interview was conducted for 12 households in sub-area P in the second stage of survey. As a result, another database of 30 households for sub-area P is set up to test the significance of some environmental perception variables and possibility of move with various conditions as well. The survey results and analysis will be, therefore, presented for the whole sample of 76 observations when compare three sub-areas O, P and Q, and for the sample of sub-area P (sample P) of 30 observations when there are differences between two samples.

(2) Archeological Survey

The historical heritage and cultural properties have been surveyed in area O, P, and Q. The list of them was prepared.

The investigation has been carried out by observing scene of relics on field combining with interviewing, collecting information related from officers and rural population and from ancient handwriting. At the same time, the Survey Team has applied photography, GPS and GIS methods.

15.2.2. Social Economic Infrastructure

Lien Chieu project area is located within the Danang City, in a suburban area. Within neighborhoods the road system is still poor and still has rural character. The main and only way, connecting Hoa Hiep and the city is two-lane National Road 1A, which in fact is as a "street" in sub-area O, where houses are located and the main trading activities take place on both sides of the road. This leads to traffic accidents as reflected in responses of residents in this sub-area.

The communication between the area and the core city is carried by public buses (12-24 seats), most of which are owned by individuals. Bicycle is a popular means of transportation. Every four households have a motorbike.

Table 15.2.1 Infrastructure in the Project Area of Lien Chieu

Infrastructure	Total of Hoa Hiep	Project Area
Education		
Pre-school	11	7
1st level (1-5class)	5	4
2nd level (6-9 class)	1	0
3rd level (10-12) class	0	0
Welfare		
Medical Post	1	0
Communication		
Telephone	28	...
Post Office	2	1
Transportation		
Cars	0	0
Trucks	20	0
Public buses	10	
Motorbikes	923	487
Boats	...	...
Commerce (markets)	4	2

Source: JICA Study Team

Table 15.2.2. Distribution of Infrastructure by Sub-area

Sub-area	Preschool	1 st primary	Post Office	Market	Motorbike
P	3	1	0	0	138
O	2	1	0	2	189
Q	2	2	1	0	160
Total	7	4	1	2	487

Source: JICA Study Team

In the whole area, there are 7 preschool childcare centers, 4 primary schools, one post office and 2 markets. In sub-area P, two preschool childcare centers for 100 children, one primary school for 548 pupils, and two local markets will be relocated if the project takes place.

15.2.3. Industries and Production of the Industries

The main economic activities in Hoa Hiep are trading, industry, farming and fishery activities. Average agriculture yield of Hoa Hiep is around 1,500 ton/year, and fishery output is about 350 ton/year. Industries in the area are chemistry, cement, seafood processing, all of which belong to Danang city, so the statistics on their production are not available for collection. Moreover, these industries are located outside of the project area. The main economic activities in project area are trading, farming and fishery. Industries

do not develop much. In sub-area P, besides Hai Van Cement plant (expansion of the existing on the other side of National Road 1A, currently under construction), there is a prawn breeder farm of Ministry of aquaculture. There are also small household businesses such as rice mill, rice noodle units and small mechanic units, which make steel door and window frames.

The prawn breeder farm was established in 1988 with capacity of 8 million of prawn breeders per year, supplying to prawn farms in the whole country. According to the vice-director of the farm, about 80% of output are transported by airway; the remaining 20% are transported by vehicle. This means that most customers of the farm are from remote provinces. The turnover of the farm is 400 million VND/year (approximately US$ 350,000). Total land area of the farm is 3,500m^2, of which about 1,500m^2 is built structure. The expected value of structure in the farm is from 1.5 to 2.0 billion VND.

Table 15.2.3. Small Industries in the Project Area

Sub-area	Rice Mill	Noodle processing	Mechanic
P	2	2	0
O	0	4	0
Q	2	4	3
Total	4	10	3

Source: JICA Study Team

Rice mill and noodle processing units are household business. Therefore they use labor within the family only. The earnings from this type of business are about 400,000 to 500,000 VND/month and they are exempted from paying tax. In case of mechanic units, workers in the area are hired; usually the size of these mechanic units is from 3 to 7 workers. The turnover of these mechanic units is very low, depending on the demand for civil construction, which is quite low due to low-income level of the area.

There is also Transport and Communication Training School of Ministry of Transport, which is located in sub-area P. This school was established in 1976 on the land area of 3 ha. The school provides training in long-term – 4-5 years, in middle term – 2-3 years and short term – 3-12 months courses in rail transport such as train drivers, signal, maintenance and repairing rail and bridges, repairing train wagon, and some others. The existing capacity of the school is 600 students, of which 400 students are staying in dormitory with sport facilities. According to the vice director of the school, the school has a plan to provide training in other related disciplines to meet the need of future industrial estates in Hoa Hiep and Hoa Khanh wards in skilled labor.

15.2.4. Population and Life Conditions of the Residents in the Project Area

This part of the report presents the analysis of population for the whole sample as well as each subsamples with focus on sub-area P, where needed. Statistics will be reported in the format of table, in percentage values. The t-test for some variables to evaluate their significant levels and the covariance analysis for some important variables are also conducted.

(1) Population

Based on the survey results on population of Hoa Hiep in June 1997, the total population in the hinter area is 12, 642, of which only 11,100 people, or 89.1%, have legally registered. 49% of the population is female. The distribution of the population by sub-area and by age is given in the tables below.

Table 15.2.4 Population Composition of the Project Area

Sub-area	Population		Of which, female		Density (Persons/ha)
	Total	%	Total	%	
O	5,836	46.99	2,981	50.90	128.76
P	3,505	28.13	1,660	47.36	35.76
Q	3,101	24.88	1,470	47.40	86.25
Total	12,462	100.00	6,111	49.04	69.45

Source: JICA Study Team

The most populated area is area O, population of which accounts for nearly 47% of total population in project area and the density is 128.76 people/ha, whereas in the core area P, these figures are 28.13% and 35.76 people/ha (lowest) respectively.

The average size of a household in the project area is 4.5 person (see Table 15.2.5). This figure is the highest in sub-area O (4.68) and the lowest in sub-area P (4.05). Table 15.2.5 shows that sub-area Q has the highest proportion of population in working age – 49.25%, while this figure is 47.95% and 43.69% in sub-area P and O respectively. It is noted that sub-area Q also has the highest population of age from 12 to 15 (26.86%), who will enter into working age in coming years.

Table 15.2.5 Age Structure of Households (in percentage)

Sub-area	Family size	Average Household Size	Of which				
			Under 6	From 6 to 11	From 12 to 15	Out of working age	Above 15
P	4.49	100	13.58	13.87	15.61	11.85	57.51
O	4.06	100	13.33	12.33	12.33	15.07	63.01
Q	4.68	100	14.08	16.50	13.11	13.59	57.28
Whole area	4.47	100	13.43	7.46	26.87	2.99	52.24

Source: JICA Study Team

In the sample P, the average size of a household in the area is much higher 4.7 person instead of 4.05 as showed above, and the population in the age from 12 to 15 is slightly higher – 14.18% instead of 12.32%. The significant difference in age structure of population between the whole sample and the sample P is that the population in working age in sub-area P is much lower – 41.84% instead of 47.95% as showed in the whole sample, even lower than that of sub-area O.

Table 15.2.6 Household Structure by Age of Sub-area P

	Family size	Female	Under 6	From 6 to 11	From 12 to 15	Old people	Above 15
Absolute value	4.7	2.17	0.40	0.67	0.67	0.50	2.47
Percentage value	100	46.10	8.51	14.18	14.18	10.64	52.48

Source: JICA Study Team

(2) Education

It is quite obvious to say that almost all workforce of the households (and of the sub-areas as well) do not have any kind of training (90% have received no training at all). The number of household's member who has college training is negligible.

Table 15.2.7 Educational Level of Population in Working Age in the Project Area

Sub-area	Total	College	Other	No training
P	100	2.86	17.14	80.00
O	100	4.35	6.52	89.13
Q	100	1.69	2.54	95.76
Total	100	2.51	6.03	91.46

Area Q has the highest proportion of population – 20%, who have college or university education and other types of training. In area O the percentage of population who have no training is the highest – 95.76%. In sample P, the percentage of population who has been trained is higher than that in the whole sample – 14.87% instead of 10.87%.

Table 15.2.8 Educational Level of Population in Sub-area P

	above 16	college	other train	no train
Absolute	2.47	0.17	0.20	2.10
Percent	100	6.76	8.11	85.14

Source: JICA Study Team

(3) Employment

The average employment rate of the population in the working age is 72.21% in the project area. Sub-area P has the highest employment rate with 91.46% of population having job in comparison with 58.72% in sub-area O and 78.96% in sub-area Q. It is showed in Table 15.2.9 that the main profession in sub-area O are trading, services and industry; in sub-area Q are farming; whereas in the core sub-area P major population is occupied in government sector.

Table 15.2.9. Employment Rate of Population in Working Age by Profession

Area	Employ m ent rate (%)	No. of currently working people	Farming (%)	Fishery (%)	Industry (%)	Trading and services (%)	Gov't and other (%)
O	58.72	1,839	3.81	14.14	23.38	56.06	2.61
P	**91.46**	**1,477**	**14.15**	**11.10**	**16.25**	**24.31**	**34.19**
Q	78.96	1,306	31.93	1.07	14.70	28.25	24.05
Whole Area	72.21	4,622	15.06	9.48	18.65	38.06	18.75

Source: JICA Study Team

Although trading and services are also the second large profession after

government sector in sub-area P and farming in sub-area Q according to the percentage of population working in this sector, the main difference between sub-area O and other two is that in sub-areas P and Q people, who are occupied in trading and services, used to work in industry sector and therefore have higher educational level.

There is a difference between the statistical data provided by Hoa Hiep officials and the results of survey in the structure of profession. It can be explained by the fact that only people in working age, who currently have job, are covered in the official data on employment, whereas the survey includes all members of household currently having job, despite they are in or out of working age. Table 3a shows us the job structure of surveyed households.

Table 15.2.10. Job Structure among the Members of Household Who Have Job

Area	Total	Farming	Fishery	Industry	Trade and service	Government
P	100	25.00	3.57	25.00	35.71	10.71
O	100	7.89	23.68	21.05	34.21	13.16
Q	100	4.88	12.20	20.73	57.32	4.88
Total	100	9.46	13.51	21.62	47.30	8.11

Source: JICA Study Team

According to the data of the survey, a quite large percentage of household's members are involved in trade and services sector (47.3% for the whole sample). The second large part of population is occupied in industry. This can be explained by the existence of a number of industries in Hoa Hiep and mostly in adjoining Hoa Khanh wards. Given limited agriculture land, the development of industries in the area and the urbanization process, only 9.45% of population are still occupied in farming. 13.51% of population are occupied in fishery. In fact, in a lot of cases, people have combined two or more jobs depending on the seasonality of their main job.

In sub-area O, more than half of populations are occupied in trading and services due to the fact that this commune is the most populated and there is the main market of Hoa Hiep. Following trading and services are industry and fishery. A small part (under 10%) of population in this sub-area is occupied in farming and government sector.

In sub-area Q, trading and services are followed by farming and industry in percentage of population working in the respective sector. It is also noted that region Q has an exceptional high rate of farming job and very low rate of fishing job due to the existence of agriculture land in the sub-area (38.422m2) and on the other side of National Road 1A. In near future, with the development of Lien Chieu industrial estate on the other

side of National Road 1A, the agriculture land will shrink significantly and this will force people to move or to change their profession.

Compared to sub-areas O and Q, after trading and services, fishery and industry are two professions, in which nearly 45% of population are working, and the proportion of population working in government sector is the highest. However, in sample P with 30 observations the job structure in sub-area P as shown in Table 15.2.11 is quite different: nearly half of population is occupied in trading and services, followed by industry. The proportion of population, occupied in fishery is only over 10% instead of over 23% as showed in the whole sample. The percentage of population working in government sector – 8.8% - is only slightly higher than that in other sub-areas.

Table 15.2.11. Job Structure of Population in Sub-area P

	Total	Farming	Fishery	Industry	Trade	Governme nt
Absolute	1.9	0.2	0.2	0.5	0.83	0.17
Percentage	100	10.53	10.53	26.32	43.86	8.78

Source: JICA Study Team

(4) Equipment owning

Table 15.2.12 Equipment Owning Structure

	TV	Motorbike	Own bicycle	Car	Truck	Boat	Own tug	Own other
General	0.55	0.27	0.30	0	0	0.12	0	0.01
Region P	0.67	0.39	0.28	0	0	0.11	0	0
Region O	0.43	0.20	0.34	0	0	0.16	0	0.02
Region Q	0.73	0.33	0.20	0	0	0	0	0

Note : The number is the average number of equipment of each kind per household

Source: JICA Study Team

Table 15.2.12 presents the equipment owning structure of households. The statistics in this table can be interpreted as the average number of each kind of equipment a household owns. It is clear that the owning rate of TV, motorbike and bicycle are quite high while the rates of other equipment are low or even equal to zero. The zero boat owning rate of Q area is also consistent with the low rate of fishing job of this sub-area (see above paragraph). The zero owning rates of car, truck and tug indicate the low living condition in project area. Besides, most of the equipment and brick house a household

owns were obtained thanks to the firework production some years ago, according to the explanation of interviewees.

(5) Living conditions

Regarding the living conditions, Table 15.2.13 shows that there are still about 18% of households that do not have brick houses. Almost all brick houses in the area are one-floor and ranked at 4th grade (the highest is 1st and the lowest is 5th), according to the classification of Danang city. There is no pipe water at all and the rate of having electric supply is only 89.6%. This rate is quite similar for all three sub-areas.

Table 15.2.13 Life Conditions

	Brick house	Water	Electricity
General	0.82	0	0.90
Region P	0.89	0	0.94
Region O	0.73	0	0.86
Region Q	1.00	0	0.93

Source: JICA Study Team

(6) Income

According to Hoa Hiep public servants, the average income of Hoa Hiep population is 700,000 VND/capita per year in 1997 or 58,000 VND/year, lower than that in 1996. However, the income level of 90,000VND/capita per month, or 1,080,000 VND is a criterion to classify households that need to be subsidied. In fact, the survey data shows that the average monthly income per capita in the whole area is 204,000 VND. This figure in sub-area P is the highest, followed by Q sub-area. The sub-area O has the lowest income level per capita. It is noted that there is a tendency to underestimate by the interviewees the actual income of their households.

Table 15.2.14. Income of Surveyed Households in Lien Chieu Port Area

Sub-area	No. of surveyed households	Income per capita per month (rounded in VND)	Average monthly income per capita in the hinter area (in VND)
P	18	239,000	
O	44	175,000	
Q	14	199,000	
Average			204,000

Source: JICA Study Team

The income per capita in sub-area P is a little lower in sample P than that in the whole sample – 214,000 VND instead of 239,000 VND. However, it is still the highest compared to that in other two sub-areas.

(7) Public Hazards

Table 15.2.15 Public Hazards in the Protect Area

	Noise	Water pollution	Vibration	Air pollution	Odour	Others	Vehicle	Train	Damages
General	0.091	0	0.013	0	0	0	0.013	0.090	0.026
Region P	0.167	0	0	0	0	0	0	0.167	0.056
Region O	0.091	0	0.023	0	0	0	0.023	0.091	0.023
Region Q	0	0	0	0	0	0	0	0	0

Source: JICA Study Team

The perception of environmental problems is at low level according to Table 15.2.15. For some categories such as water pollution, air pollution and odor there is no response at all. There is response in categories of noise and vibration. However according to the T-test, only noise is significant at 1% level of confidence but vibration is not significant even at 5% level of confidence. The perception of damage due to these hazards is presented by variable "dameges". The T-test for this variable shows that although it is significant at 5% level, it is not significant at 1% level.

There is a slight difference in response of residents of sub-area P between the whole sample and in sample P, regarding to the source of noise. In the whole sample, all responses see train as the major source of noise, whereas in sample P, nearly 20% of responses also see vehicle as the other source.

Table 15.2.16 Public Hazards in Sub-area P

Noise	Water pollution	Vibration	Air pollution	Odor	Other	Vehicle	Train	Dameges
0.17	0	0	0	0	0	0.33	0.14	0.33

Source: JICA Study Team

(8) Accidents

The perception of problem of accidents is presented in table 15.2.16. It is noted here that only sub-area O has responses regarding this issue. In fact, this sub-area has the

highest population density and households are densely located along both sides of the National Road 1A, which becomes narrower in this section due to trading activities. Another source of accidents is train due to the lack of barrier. Here again although "damages" (a variable representing the perception of accident problems) is significant at 5% level, it is not so at 1% level of confidence. The analysis based on the responses in the section of public hazards and accidents make it clear that the general perception about these problems is negligible.

Table 15.2.17 Accidents

	Bicycle	Motorbike	Car	Ship	Others	Vehicle	Train	Damages
General	0.026	0.026	0.039	0	0	0.039	0.026	0.039
Region P	0	0	0	0	0	0	0	0
Region O	0.045	0.045	0.069	0	0	0.068	0.045	0.068
Region Q	0	0	0	0	0	0	0	0

Source: JICA Study Team

15.2.5 Possibility to Move

Table 15.2.18 shows the percentage of "yes" responses in the section of possibility of move. Although 100% responses associated with variable "move" and "comp" mean that people are willing to move with given appropriate compensation, these responses do not give us any further useful information. The results associated with "jobmain" and "retrain" show a desire to maintain job and being retrained, however the numbers are small. No response in regard to choosing location for resettlement is observed. This fact results from the tendency of households bias toward "comp" and neglect other options, reflecting the simple thinking of residents about relocation and resettlement when interviewed. In fact, the neglect of other options, particularly regarding conditions to maintain income after relocation, in the mind of residents might be a serious problem to the development of the project as well as to the life of residents, as it happened in the case of a foreign auto-assembly plant in adjoining Hoa Khanh ward last year. This issue will be discussed in the later section.

Table 15.2.18 Conditions in order to move

	move	comp	jobmain	retrain	locachoo
General	1	1	0.143	0.077	0
Region P	1	1	0.066	0.055	0
Region O	1	1	0.136	0.091	0
Region Q	1	1	0.267	0.066	0

Source: JICA Study Team

There are higher rates of residents, who desire to maintain the current job (mainly farming, fishing) – 13.33% and to be retrained – 6.67% in the sample P than that in the whole sample (see Table 15.2.19). These responses are observed only when the expert gave interviewees guidance to think about, but not their own proactive responses.

Table 15.2.19 Conditions in order to Move of Residents in Sub-area P

move	comp	jobmain	retrain	locachoo
1	1	0.133	0.067	0

Source: JICA Study

15.2.6. Covariance Analysis among Social Environmental Variables

The correlation matrix of several important variables is analyzed. It evaluate the values in the matrix which are the correlation coefficients of pair of variables, one in row and the other in column. The value of correlation coefficients lies in the interval of [-1,1]. The absolute value close to one means that the two variables are highly correlated. The absolute value close to zero means there is no correlation between the two.

With this rule we can see that "income" do have correlation with "trained" - percentage of trained persons - in the total number of people in working age of each household, "female", "tv", ownmoto" and "brickhs". It is quite interesting to see that there is a positive correlation between "female" and "hardamag" which might interpret that the more female in the household the more perception about environmental problems. Other relationships can be inferred with the similar rule.

15.2.7 Historical and Cultural Heritage

Through three stage investigating process, the Survey Team have collected science datum related with 19 cultural - historical relics (or vestiges) lying in the three - area region named O, P and Q in the Lien Chieu (Danang) planned sea - port building region.

In order to watch the distribution of relics conveniently, we will display by order from North to South, from P to Q and then to O area; and combine the characteristics of each kind of relics, referring to Figure 15.2.3 (1) and (2).

(1) Area P

Correlative with Eastern land range of the National railway. In this area, there is only one ancient relic that is called *The Whale mausoleum* (*Lang Ong*) or *Kim Lien temple*.

1) *The Whale mausoleum (Kim Lien mausoleum) :*

Belonging to the South of group IV. Kim Lien; the mausoleum is lying on 16°08'101" North and 108°07'303 East coordinates.

To inhabitants, about from 1951 to 1952, Thuy Tu village which is next to Kim Lien hamlet used to be destroyed by French arm, so that inhabitants had to evacuate and a part of them moved to live in Kim Lien hamlet. At this place, they build a new mausoleum in order to worship the Whale. This mausoleum replaced the old one at Thuy Tu hamlet that had been worshipped nearly 100 years before. The new mausoleum, so that, had new name which is *Kim Lien mausoleum.*

At first, it was built rather simply with wood poles, thatch roof. About 10 years after that (1962) it was built permanently with brick wall, tile roof. In 1993, it was repaid much, decorated more beautifully and painted.

Nowadays, the mausoleum is lying 150m far from the seaside to the West in the 600 square meters rectangle flat sand area which is 30 meters long West -East side and 19 meters long North - South side. Around the planned project there are many kinds of planting trees such as casuarina, eucalyptus, tamarind, cactus and some wild small trees.

To the right of the screen front there is a rather high sand and land mound on which a cluster of cactus is growing; and a big part of fence is unloaded around. To the inhabitants, this mound is a tomb of a whale died at Kim Lien hamlet seaside and dripped to this place and was buried 13 years ago. This whale is rather big so it needs 15 years or more to dissolve flesh completely, and at that time, rural habitants will carry out a festival of exhuming and moving the bones of the whale to the village together with tens of bones stored up many years.

The ceremony of offering to the Whale is hold at 10 am. 16th to 2 am. 17th lunar February every year according to local traditional festival tide at the mausoleum. Besides, it is cleaned and taken care of daily. On the altars there are sufficient lamps, incenses. On the occasion of festival, fruits, wine, meat, glutinous rice, and sweet soup are arranged. There are forms of beating drum, striking gong, reading funeral oration, amusing oneself through night to day.

(2) Area Q

Belonging to Kim Lien hamlet group, this area is limited in the land range between the National highway No 1 and the National railway. There are two architecture ruins

lying together.

2) *Ancestor temple*

Ruins of it are seen in the land area growing eucalyptus, casuarina trees mixed with wild grass. It belongs to group No. 9 of Kim Lien hamlet on 16°08'080" North, and 108°07'205 East coordinates. To local person, this temple was built at Nguyen Gia Long generation (beginning of XX century).

Because of 30 year lasting war, the temple was destroyed, then rebuilt and then destroyed. At the present time, there is only a rectangle foundation base (10 m long and 6 m wide). Many local persons don't remember ruins of the temple because it has been deserted many recent years.

3) *Am Linh shrine (Souls of Dead persons shrine)*

The ruins are seen now 30 meters far away from the Ancestor Temple to the South, at the same area of growing eucalyptus, casuarina trees mixed with wild grass belonging to group No 9 of Kim Lien hamlet.

According to local person, the shrine had been built a long time at the XX century. Passing many years of fierce war, the shrine was destroyed seriously and has been seen as a ruins for a long time. Nowadays, all the remain of it is only a rectangle foundation base built by bricks, lime and mortar.

(3) Area O

Belonging to Nam O hamlet group area, this area is correlative with land part expanding from the limit of the National railway to the East to the edge of Danang gulf. Right now, Nam O cape concludes Nam O No 2 and No 3 to administration limit. In this area, there are many architecture relics with high density and multiform appearance that we can deal with in turn to private cultural - historical characteristics of each kind of relics. They are listed below:

4) *Champa ruins.*
5) *Ca shrine (Xuan Duong)* (called *Am Linh - Xuan Thieu shrine).*
6) *Am Linh - Xuan Duong shrine.*
7) *Am Linh shrine (Nghóa Truõng) (picture No 10- Annex VI)*
8) *Alone soul palace* (also called *Am Linh shrine)*
9) *The King fish mausoleum (Nam O mausoleum).*
10) *Madam shrine: (Madam fire)*
11) *Xuan Huong communal house.*
12) *Toc Lu worshipping house:*
13) *Nguyen family worshipping house*
14) *Tien Hien Tomb.*
15) *Bason pagoda (Hoa Son pagoda)*
16) *Nam Thanh pagoda*
17) *Thanh Cung well of Nguyen dynasty.*
18) *Thanh Cung Well* (also called *Mr.Ba well)*
19) *Lang well.*

(4) Adjacent Areas.

In the area adjoining planned Lien Chieu (Danang) port area belonging to Hoa Hiep ward, there are some cultural - historical relics that were introduced by local residents through surveying stages. All we show following is a general cultural - historical look of the area once have a port called Cu De. The list of them is as follows:

*** KIM LIEN QUATER AREA.**

20) *Kim Cu pagoda* (called *Kim Quang or Kim Lien pagoda)*
21) *Lien Chieu communal house.*
22) *Kim Cu communal house.*
23) *Son Ha communal house.*
24) *Thanh Hoang royal tomb.*
25) *The Whale mausoleum (Lieu Chieu royal tomb)*
26) *Madam shrine.*
27) *Döï tree shrine (Cao Cat shrine).*
28) *Ngöï well.*
29) *Champa* old brick architecture.

*** NAM O NO. 2 AREA.**

30) *Trung communal house (Chung communal house).*
31) *Ladies shrine.*

*** THUY TU AREA.**

32) *Nghia Trung shrine (Forsanke spirits shrine).*

*** XUAN THIEU AREA.**

33) *Long Son pagoda.*
34) *Xuan Thieu communal house.*

*** HOA VAN AREA.**

Lying to the North - West of Hoa Hiep ward (Lien Chieu - Danang) and having relics of Thanh Cung - Nguyen dynasty.

35) *Thanh Cung* - Nguyen Dynasty :

14.7.8 Value of the Historical and Cultural Heritages in Lien Chieu Area

Based on the plot of "plan of developing Lien Chieu sea port", sub-area P belonging to Kim Lien quarter will be impacted directly. In this region, according to the past survey result, there is only one relic named The *Whale mausoleum* at Kim Lien. This mausoleum was started re-building about 1950 to 1952 and recently repaired and redecorated more. Its architecture is not big, and its structure consists of brick, cement and concrete. The composition of old traditional architecture is displayed at decoration on side and ridge of the roof.

If looking at old architectural art value, this mausoleum have many limit aspects; even at modern value they are not very attractive. However, looking at cultural - social aspects, this relic relates fast to traditional religion of territorial waters and Kim Lien residents. So, when project of building Lien Chieu sea port area is implemented these relics and local residents must be protected by satisfied methods.

As we know, Kim Lien residents in common accept to move the *Whale mausoleum* to new position satisfying 2 suggests as follows :

- The government of Vietnam supplies enough expenses to move and build new mausoleum at to

place comfortable for worshipping.

- Defining satisfy time in order to let local residents having time to hold the ceremony of receiving

the whale bones buried in tomb in front of mausoleum to the back mausoleum (estimated 3 - 5

year since 1997).

Beside the *whale mausoleum* (Kim Lien) impacted directly by the work of building Lien Chieu sea port area, other relics in Q and O areas almost aren't in the planned building sea port area; therefore, they won't be impacted directly. However, attention must be paid to other impacts (direct or indirect) caused by relative acts to the work of building the sea port in the future.

On the other side, all the result of the recent survey has shown that all relics are not discovered wholly, especially ruins, relics buried under the land or sunk along the seaside. Because of this reason, in the process of building Lien Chieu sea port we must pay attention to accidental discovers in order to treat in time as require of "keeping cultural - historical heritage in an area once an old sea port named Cau đe (Cu de), and once witnessing the water battle between Nguyen Lord and Tay Son (XVIII century) ". According to local residents, anchors, string of anchors are seen in the bottom of Cu De - Thuy Tu river and many other relics in hollow area of Thuy Tu - Xuan Duong.

Forthcoming time, those three relics of *Xuan Duong communal house, Ca shrine, whale mausoleum* must be protect by local authority through appropriate protection policies.