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BASIC ENVIRONMENTAL STUDY OF THE PORTS OF VIETNAM AND CAMBODIA

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Hai Phong – Vietnam, 2005

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ABBREVIATIONS AND ACRONYMS

ARCBC	ASEAN Regional Centre for Biodiversity Conservation
ASEAN	Association of South East Asian Nations
BOD	Biological Oxygen Demand
Btu	British thermal unit
CHL	Chlorodane compounds
COD	Chemical Oxygen Demand
DBT	Dibutyltin
DDD	Dichlorodiphenyldichlorethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichloro-Diphenyl-Trichloroethane
DENR	Department of Environment and Natural Resources of the Philippines
DO	Dissolved Oxygen
DONRE	Department of Natural Resources and Environment (Vietnam)
DOSTE	Department of Science, Technology and Environment (Vietnam)
DWT	Dead Weight Tonne
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EPA	The United States Environmental Protection Agency
ESPO	European Sea Ports Organisation
EUR	Euro
FPSO	Floating Production, Storage and Offloading facilities
FSU	Floating Storage Units
GEF	Global Environment Facility
GT	Gross-tonnage
HC	Hydrocarbon
HCB	Hexachlorobenzene
HCH	Hexachlorocyclohexane
HIO	Hai Phong Institute of Oceanology
HP	Horse-power
IEA	Initial Environmental Assessment
IEE	Initial Environmental Evaluation
IMO	International Maritime Organisation
ISQG	Interim sediment quality guideline of Canada
lb	pound
LPG	Liquified Petroleum Gas
MBT	Monobutyltin
MMBtu	Million Btu

MONRE	Ministry of Natural Resources and Environment (Vietnam)
MPN	Most Probable Number
MRC	Mekong River Committee
NLS	Noxious Liquid Substance
NOx	Nitrogen Oxides
NTU	Nephelometric Turbidity Unit
OC	Organochlorinated compounds
PC	People's Committee
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
POC	Persistent Organic Compound
RA	Risk Assessment
SOx	Sulphuric Oxides
TBT	Tributyltin
TCVN	Vietnam's Standard
TCVN/BYT	Vietnam's Standard/Ministry of Health
TDS	Total Dissolved Solids
TEL	Threshold Effect Limit
TOC	Total Organic Compound
TS	Total Solids
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UNEP	United Nations Environmental Programme
UNESCO	United Nations' Education, Scientific and Cultural Organisation
UP-MSI	University of Philippines-Marine Science Institute
$US	US Dollar
US-EPA	United State's Environmental Protection Agency
VEPA	Vietnam's Environmental Protection Agency
VND	Vietnam Dong
VOC	Volatile Organic Compound
WHO	World Health Organization

UNITS

Btu	British thermal unit = 252 calories = 1,055 joules = 0.293 watt hours
ha	Hectare = 10,000 square metres
hr	hour = 60 minutes
knots	nautical miles per hour: 1 knot = (1852/3600) m/s
kW	kilo-Watt: 1 kW = 1000 W
l	litre
lb	pound = 0.45359237 kilograms
ml	millilitre = 10^{-3} litres
mg	milligram = 10^{-3} kilograms
µg	micro-gram = 10^{-6} milligram
ng	nano-gram = 10^{-3} micro-grams = 10^{-9} milligrams
MT	Million tonnes = 10^{3} kilograms = 10^{6} milligrams
TEU	Twenty-foot Equivalent Unit

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PREFACE AND ACKNOWLEDGEMENTS

The Basic Study has been prepared by researchers of the Department of Human Ecology, Vrije Universiteit Brussel, in partial fulfilment of the project "Establishing Scientific Support for Environmental Management for Ports in Vietnam and Cambodia" (VN/Asia Pro Eco/01 (91168)).

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More inforrnation on the details of this project and its other publications can be found at the project website http://www.indochinaecoports.org.vn.

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INTRODUCTION

During the past decade, the world seaborne trade increased from 4 billion tonnes of goods in 1990 to 6.17 billion tonnes in 2003. The world merchant fleet expanded to 857 million deadweight tons at the beginning of 2004, a 1.5 percent increase as compared to 2003 (UNCTAD 2004). The increase in the world seaborne trade has led to the development of ports. The world container port traffic expanded at the rate of 9.2% in 2002, reaching 266.3 million TEUs. In 2002, ports in developing countries handled 103.6 million TEUs, or 38.9% of the world total TEUs handled (UNCTAD 2004). There are more than 2,000 ports around the world, which handle more than 80% of trade with origins in or destinations to developing countries (WorldBank 2003).

Sea transport is one of the modes of freight transport that has many advantages as compared to the old-fashioned inland transport by road and rail. Sea transport is considered the most cost-efficient mode of transport and at the same time the most environmentally friendly one. Sea transport is able to move a large amount of cargo over a very long distance at the lowest expense (Table 1) (UNCTAD 2004).

Table 1: Comparison of major modes of freight transport (excluding airfreight and pipelines) (UNCTAD 2004)

	Inland transport		Multimodal	Water transport	
	Road	Rail		Sea	Inland waterways
Speed	5	5	4	2	1
Cost saving	3	2	3	5	4
Safety	4	5	4	4	4
Reliability	5	5	4	3	3
Flexibility	5	3	4	3	2
Availability	5	2	2	Various	Various
Environment friendly	3	1	3	5	5
Infrastructure cost	5	4	Various	3	Various
Infrastructure maintenance costs	4	5	Various	2	Various
Vehicle size	<3000 t	No restriction	<3000t	>300 t	<500 t
Cargo value	High	Various	High	Various	Low
Cargo volume	Low	Large	Low to moderate	Very large	Low or moderate
Suitable cargo packing	All	All	General cargo	All	All
Economic distance	Short	Short to average	Various	Very long	Long

Legend: very low (poor): 1, low: 2, fair: 3, high/good: 4, very high (very good): 5

A seaport is the interface between sea transport and inland transport. With the growing globalisation, seaports have become more and more important in facilitating the process of economic integration. At seaports, traditional services are provided next to value-added logistics. Increasingly, seaports provide more and more services related to industrial, trade and financial activities thus becoming economic hubs.

However, at the same time, they are major sources of pollution. Seagoing ships and heavy-duty trucks operate mostly on diesel and cause degradation of seawater and port atmosphere, and impact human health. These later impacts include a wide range of diseases from respiratory problems to cancer.

With the increasing economic transactions between continents, seaports are likely to expand to accommodate greater cargo volumes. With a coastline of more than 3,200 km and a claimed sea area of more than 1 million km^2, marine transport is a potential and growing industry in Vietnam. The number of seaports increased from 40 seaports in 1999 to 100 in 2002 and this number is planned to increase up to around 114 in 2010. By 2002, Vietnam's merchant

fleet had 880 ships with 2.4 million DWT to meet the increasing transport demands. The number of registered vessels is shown in Table 2.

Table 2: Registered vessels in Vietnam (Vinamarine 2004)

Registry area	No. of vessels	Gross tonnage (GT)	Capacity (DWT)	% of total DWT
Hai Phong Administration region	74	105,499.90	291,100.32	70.45
Da Nang Administration region	62	29,068.00	43,005.82	10.41
Sai Gon Administration region	34	48,338.80	79,122.17	19.15
Total	**170**	**182,906.70**	**413,228.31**	**100.00**

In Cambodia, the fleet consists of 564 ships with a total tonnage of roughly 2 million tonnes. However, most of the ships have an average age of more than 26 years and more than 70% of the ships are owned by foreigners (Department of Marine Merchant of Cambodia, 2004). Over the period 1989-1994 Cambodia's register was inactive. Since its reactivation in 1995, it recorded a net increase in tonnage of 3,230% (up from the 1995 level of 59,958 GT to 1,996,738 GT in 2001). During the period 1995 - 2001, the trend has been a reasonably large and constant increase in tonnage.

There are two kinds of vessels in Cambodia: the local coastal and the international fleet vessels. Most of Cambodian coastal ships are fishing vessels. The main part of this fleet is based in two ports namely, Sihanoukville and Koh Kong (Table 3).

Table 3: Cambodian fishing vessel in 2001 (FAO, 2004)

Region	Boats w/o engines	< 10 HP	10-30 HP	30-50 HP	> 50 HP	Total
Kep	133	140	52	0	0	325
Kampot	133	151	252	1	12	549
Sihanoukville	286	167	809	33	269	1,564
KohKong	71	2,518	597	93	217	3,496
Total	**623**	**2,976**	**1,710**	**127**	**498**	**5,934**

Todate, Cambodia has two international ports, one is the deep-sea port of Sihanoukville and the other is the river port of Phnom Penh. In 2000, both ports provided good facilities, in terms of both capacity and performance. The port of Sihanoukville consists of an old port and a new port. The port of Phnom Penh is 2 km long and can accommodate vessels with a draft of 4.2 rn during the dry season and 5.2 m during the rain season.

This report entails a comparison of five ports in Vietnam and Cambodia. Three of these ports are located in Vietnam (Hai Phong, Da Nang, Vung Tau) and two ports are situated in Cambodia (Phnom Penh and Sihanoukville). The three Vietnamese ports are large ports with average annual tonnage throughputs range from roughly less than 1.5 million tonnes to more than 14 million tonnes. All three ports are also major hubs for passenger transit.

In Cambodia, the Phnom Penh port, a river port, has an average annual tonnage throughput of less than 1 million tonnes and serves more than 50,000 passengers a year. The port of Sihanoukville, though the only deep-sea port in Cambodia, has an average annual throughput of less than 2 million tonnes.

Although being different in size and scale, ports in Cambodia and Vietnam all face emerging environmental problems related, among other things, to ship discharges (bilge, ballast, and sewage), oil spills (bunkering), heavy traffic, and noise.

This report gives an overview of the environmental problems in the above-mentioned ports, along with information on current management systems and institutional aspects related to environmental management in port areas. The aim of this basic study is to analyse the environmental situation in the five ports and to set priority issues for the port's environmental management. It seeks to facilitate the process of integrating environmental aspects into management plans of the ports studied in the project. The project gathers data and information essentials to the understanding of environmental issues concerning port operations and will allow port managers to start an Environmental Management System aimed at resolving the most pressing problems.

MATERIALS AND METHODOLOGY

The general framework of the study, as described in Figure 1, involved 4 steps. The first step is the inventory of the environmental issues at the 5 ports in the project. Based on the inventory results and the review of the background information from the literature, a draft of the basic study was developed. The third step was to seek for comments of the stakeholders in the project, entailing port actors, local authorities, local communities, and especially scientists. The results of the review step were then taken into account to finalise the report.

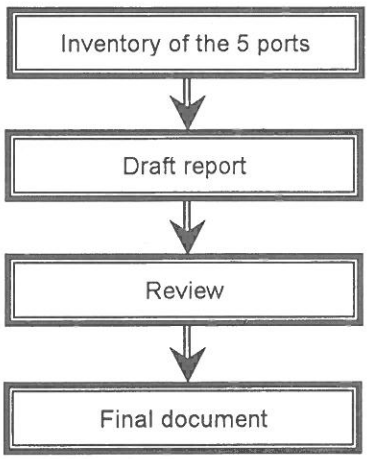


Figure 1: Steps of the study

The inventory at each port was done by local researchers, in cooperation with the port authorities. In Vietnam, the Institute for Marine Environment and Resources - IMER (formerly Hai Phong Institute of Oceanology - HIO) was responsible for the inventories at the ports of Hai Phong and Da Nang. The Sub-Institute of Geography in Ho Chi Minh City was responsible for the inventory of the port of Vung Tau. In Cambodia, the port authorities of the Phnom Penh Port and the Sihanoukville Port implemented the inventories themselves, with scientific assistance from researchers at the Department of Human Ecology, Vrije Universiteit Brussel (Belgium). The local researchers and people involved in the inventory step are listed in Box 1.

Box 1: People involved in the inventory

Port	Sources of information
Hai Phong	- Dr. Tran Dinh Lan – IMER (HIO) - Msc. Cao Thi Thu Trang – IMER (HIO) - Port Authority of Hai Phong
Da Nang	- Dr. Nguyen Huu Cu – IMER (HIO) - Port Authority of Da Nang
Vung Tau	- Dr. Nguyen Thanh Hung – Sub-Geo - Ms. Nguyen Thu Trang – Port of Phu My
Phnom Penh	- Mr. Hei Bavy - Phnom Penh Port (Director General) - Mr. Chieap Thol - Phnom Penh Port (Director) - Mr. Chor Pra - Phnom Penh Port (Harbour Master) - Mr. Hiek Phirun – Phnom Penh Port (Manager)
Sihanoukville	- Mr. Lou Kim Chhun - Sihanoukville Port (Chairman & CEO) - Mr. Ma Sunhout - Sihanoukville Port (Deputy Director General of Techniques) - Mr. Men Chann - Sihanoukville Port (Assistant to Chairman & CEO)

To facilitate the inventory and to ensure the uniformity of data, a questionnaire was developed by the researchers at the Department of Human Ecology, in cooperation with local researchers in Vietnam. The questionnaire provided guidance on the types of information needed to be considered during the inventory as well as the format of the inventory (Annex 3). The questionnaire consisted of nine sections focusing on:

1. The port and its environment
2. The port's environmental policy
3. The use of environmental management instruments in the port
4. Port management
5. Environmental legislation
6. Land use and land use changes
7. Significant environmental aspects
8. Environmental performance
9. Information on stakeholders' involvement

The selection of data to make the inventories was based on the literature. Different studies and guidelines are consulted to determine which indicators should be collected and used in assessing environmental quality at the ports and the impacts of the ports. A description of selected indicators is presented in Box 2.

Box 2: Selected indicators used in the inventory

Aspect	Indicators
Description about the port	
	- Geographic location - Port's details: name, number of berth, total berth length (m), capacity (max receivable vessel - tonnage) - Production (2000 – 2004): cargo throughput (million tonnes), container throughput (TEUs), passengers (people) - Port's facilities and human resources - Land use (ha): area of warehouse, storage, - Resource usage: electricity (kWh), petroleum products (l), freshwater (m^3) - Coastal area around the port's area: type of coastline - Biodiversity around the port's area: ecosystems, species
Environmental conditions in and around the port	
Water quality	- Physio-chemical parameters: Temperature (°C), pH, transparency (m), turbidity (NTU), TDS and TSS (mg/l) - Organic and inorganic pollution (mg/l): DO, BOD, COD, nitrite (µg/l), nitrate, ammoniac, phosphate, and coliforms (MPN/100ml) - Metals in water (mg/l): Chromium (Cr), Cadmium (Cd), Copper (Cu), Lead (Pb), Manganese (Mn), Zinc (Zn), Iron (Fe), Arsenic (As), Mercury (Hg), - Oil (mg/l) - Persistent Organic Compounds (µg/l): lindane, aldrin, dieldrin, endrin, DDT and metabolites (DDD and DDE), organotins (TBT and derivatives).
Soil quality	- Metals in sediments (water bottom) (mg/kg dry): Cadmium (Cd), Copper (Cu), Lead (Pb), Zinc (Zn), Arsenic (As), Mercury (Hg). - Oil (mg/g dry) and cyanide (mg/kg dry) - Persistent Organic Compound (µg/kg dry weight): lindane, aldrin, dieldrin, endrin, DDT and metabolites (DDD and DDE), organotins (TBT and derivatives).
Air quality	- Micro-climate conditions: Temperature (°C), humidity (%), Wind velocity (m/s), - CO, NO_2, SO_2, Pb, VOC, dusts (mg/m^3) - Noise (dBA)
Biological resources	- Degradation of ecosystems - Presence of pollutant in biological indicative species (clam, mussels, fish and resident bird) (mg/kg dry tissue): metals, persistent organic compounds
Emissions from the port	
Into the air	- CO, CO_2, NO_x, SO_2, VOC, dusts, PM (tonnes/year)
Into the water	- Amount of household wastewater (m^3/year) - Amount of oily waste from ship (m^3/year): bilge, oil sludge
Solid waste	- From ships and port's operations (tonnes/year)
Environmental legislation related to port	
	- International conventions - National and provincial laws, regulations, action plans - Sectoral regulations and plans - Port's policy, strategy
Environmental management at the port	
	- Environmental Management System - Risk Assessment - Environmental Impact Assessment

The data for the inventories came from literature about the port in question. The main sources for information on each port are listed in Box 3.

Box 3: Sources of information about the ports in the project

Port	Sources
Hai Phong	- Port's statistics (2000 – 2004) - Port's development plans (2000 – 2007) - Environmental Status Reports of Hai Phong City (1997 – 2004) - Research reports at IMER (formerly HIO) (1997 – 2003) - Projects' publications - Vietnamese legislation and standards (1995 – 2004) - Visits to the port
Da Nang	- Port's statistics (2000 – 2004) - Port's development plans (2000 – 2005) - Environmental Status Reports of Da Nang City (1995 – 2001) - Working environment inspection reports from the Da Nang Department of Health, Preventive Health Centre. - Research reports at IMER (formerly HIO) (1997, 2004) - Projects' reports (PEMSEA project) (2003-2004) - Vietnamese legislation and standards (1995 – 2004) - Visits to the port
Vung Tau	- Port's statistics (2000 – 2004) - Port's development plans (2000 – 2005) - Environmental Status Reports of Ba Ria – Vung Tau Province (1999 – 2003) - Research reports at Sub-Geo (1999 – 2001) - Vietnamese legislation and standards (1995 – 2004) - Visits to the port
Phnom Penh	- Port's statistics (2000 – 2004) - Port's development plans (2000 – 2005) - Environmental Monitoring Data from the Ministry of Environment of Cambodia (2004) - Reports from the Mekong River Commission (2002-2004) - Cambodian legislation and standards (1997 – 2004)
Sihanoukville	- Port's statistics (2000 – 2004) - Port's development plans (1997 – 2008) - Environmental Impact Assessment Report of the Rehabilitation Project for the port of Sihanoukville (1997) - Environmental monitoring results of the Rehabilitation Project for the port of Sihanoukville (2003, 2004) - Environmental Status Reports of Sihanoukville (2002, 2003) - Environmental Monitoring Data from the Ministry of Environment of Cambodia (2004) - Projects' reports (UNEP/GEF; PEMSEA) (2003, 2004) - Cambodian legislation and standards (1997 – 2004)

Other literature about marine environment in the region, port and shipping activities has also been consulted.

Based on the five inventory reports, researchers at the Department of Human Ecology combined data and information in a comparative way. Data on environmental quality of water, air and soil was reviewed and compared with standards and guidelines.

- Data on environmental quality at ports in Vietnam was compared with the Vietnamese Standards for Water Quality for either River or Coastal Area (TCVN 5942-1995 and TCVN 5943-1995 respectively, depends on the location of the samples), the Vietnamese Standards for Atmospheric Environment (TCVN 5937-1995 and TCVN 5938-1995), and the Vietnamese Acoustic Standard (TCVN 5949-1995) (Annex 1 – Vietnam's Standards). Sectoral standards were also used in several cases (Standards on water used for aquaculture – Ministry of Fishery, and standards for human health protection and for occupational health – Ministry of Health).

- Data on environmental quality in ports in Cambodia was compared with the Cambodian Standards (Annex 4 and 5 to the Sub-Decree on Water Pollution Control No: 27 ANRK.BK issued by the Royal Government of the Kingdom of Cambodia - the Council of Ministers in 1999; and the Annex 1 to 7 of the Sub-Decree on Air Pollution

Control No: 42 ANRK.BK issued by the Royal Government of the Kingdom of Cambodia - the Council of Ministers in 2000) (Annex 2 –).

However, the standard systems in Vietnam and Cambodia cover only the most common pollutants. For pollutants that are not covered by local standards, especially the pollutants in soil and biological samples, international guidelines were used. For some indicators in the coastal water in Cambodia, Marine Water Quality Criteria of ASEAN (ASEAN 2003) were used. The ASEAN Environmental Quality Criteria is being developed to be used as the regional standardised system for all countries in the ASEAN region, including Vietnam and Cambodia. For biological tissue, the Canadian Environmental Quality Guidelines were used (CCME 2003). The Canadian Environmental Quality Guidelines have been used as one of the references during the process of establishing environmental standards in Vietnam.

To allow an in depth study of the environmental situation of the five ports, the information gathered through the questionnaire was further extended by information collected using an audit tool specially designed for ports in Vietnam and Cambodia. The tool, which is called "Self Diagnosis Method for Environmental Protection" or SDEP, has been developed by the Vrije Universiteit Brussel, together with the University of Amsterdam, in consultation with local partners in the project. The tool was based on an audit methodology for European ports - the SDM or Self Diagnosis Method, which was designed by the ECOPORTS foundation. The SDEP was sent to all involved ports to be completed. As such, it provided extra information on the information already gathered by the research institutes (Annex 4).

Together with the information from the two above mentioned questionnaires, literature research contributed intensively to this basic study. Research results from various studies carried out during the period 1995 – 2005 have been collected and analysed, containing information on different aspects of the environment, from information on natural aspects, such as water quality, air quality, soil quality, biological resources, to socio-economic and institutional aspects regarding the port's development plans and the regulations supervising their activities. The sources for information came from both government offices (Vietnam National Environmental Agency – VEPA, Cambodia's Ministry of Environment, local People's Committees, local Departments of Environment, port authorities) as well as from research projects and scientific papers.

Due to the heterogeneity of the information sources, the unevenness in research done at each of the ports, and the unavailability of data about environmental impacts caused by specific ports' operations, an estimation of the emissions of ports was performed. Calculations of emissions into air and water from port activities were done using an emission factors method.

The emission E of the pollutant j based on emission factors was estimated using a general mathematical equation (Equation 1) (Economopoulos 1993):

Equation 1:

E_j = f (Source type,
Unit of activity,
Source size
Process or design particularities,
Source age and technological sophistication,
Source maintenance and operating practices,
Type and quality of the raw materials used,
Type, design and age of the control systems employed,
Ambient condition, etc.)

For emissions from non-road facilities (port's cargo handling equipments such as forklifts, cranes, derrick, etc.), Equation 1 was used in a simpler form (Equation 2):

Equation 2:

$$E_j = A_j \times EF_j$$

Where emission E of the pollutant j is the product of the level of activity A of the source of the pollutant j and the emission factor EF of the pollutant j.

For non-road engines, the "level of activity" (A_j) (HP.hr/y) is the product of 3 variables: annual hours of use (hr/y), the average horsepower (HP), the load factor of the pollution source, and the population of the pollution source. In this study, due to the lack of documented information about the specific load factor and the annual hours of use, these were considered parameters and were taken from US-EPA (1991) study. The average horsepower was calculated based on data provided by the port of Sihanoukville.

To calculate the emissions from ships in the ports, the emission factor based on ship-days-at-berth was used as suggested by Economopoulos (1993). For trucks operating at ports, the emission factor was also taken from Economopoulos (1993) for the category "heavy duty diesel vehicles".

Many documents on the methodologies for calculating A_j and EF_j have been consulted. The most important sources of information are listed in Box 4.

Box 4: Sources of information for port's emission inventory

- Emissions from non-road engines (US-EPA 1991; US-EPA 2005a)
- Emission factors for heavy duty vehicles (Economopoulos 1993)
- Emissions from marine vessels (ICF 2005; Copper and Gustafsson 2004; Trozzi and Vaccaro 1998; US-EPA 2000)
- Emissions from harbour crafts (ICF 2005)
- Conversion factors for hydrocarbon emission components (US-EPA 2003)

I. PORTS' OVERVIEW

1. Location of the Ports

As indicated on Map 1, the port of Hai Phong is located near Hai Phong city, in the North of Vietnam. The port of Da Nang is situated in the centre of the country and the port of Vung Tau is in the South of Vietnam. All three ports are located on the South China Sea. The port of Sihanoukville in Cambodia is also a seaport, situated at the bay of Kompong Som in the Gulf of Thailand. Phnom Penh port is the only inland port in this study. It is located on the Tonle Sap River, near the city of Phnom Penh, the capital of Cambodia. The Mekong River connects this port with the South China Sea.

Map 1: Location of the ports in the project

The ports of Hai Phong are located on the Cam and the Bach Dang Rivers. They are estuary ports.

(1) Hai Phong Port

(2) Chua Ve Port

(3) Dinh Vu Port

(4) Nam Trieu – Pha Rung Shipyards

Map 2: The ports of Hai Phong (Google Earth 2005, DigitalGlobe 2005)

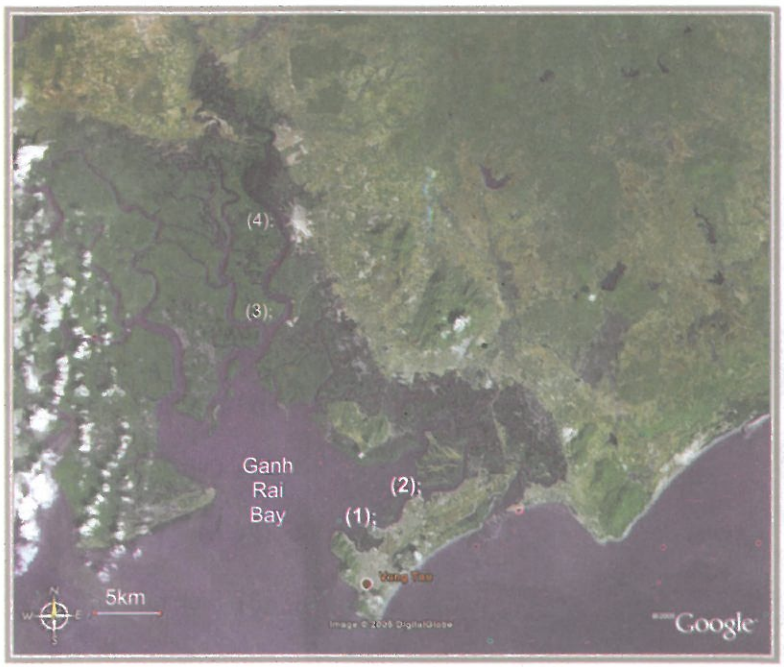
The ports of Da Nang are located in the Da Nang Bay, near tourism sites (beaches, tourist attractions, etc.)

(1) Song Han - Da Nang Port

(2) Tien Sa Port

(3) Lien Chieu Port

Map 3: The ports of Da Nang (Google Earth 2005, DigitalGlobe 2005)



Map 4: The ports of the Vung Tau port are (Image: Google Earth 2005, DigitalGlobe 2005)

The ports of Vung Tau are located next to dense residential areas of Vung Tau City and adjacent townships. Several ports on the Thi Vai River are located near to the Can Gio Biosphere Reserve.

(1) Sao Mai - Ben Dinh Port area: PTSC Port; VietsoPetro Port;

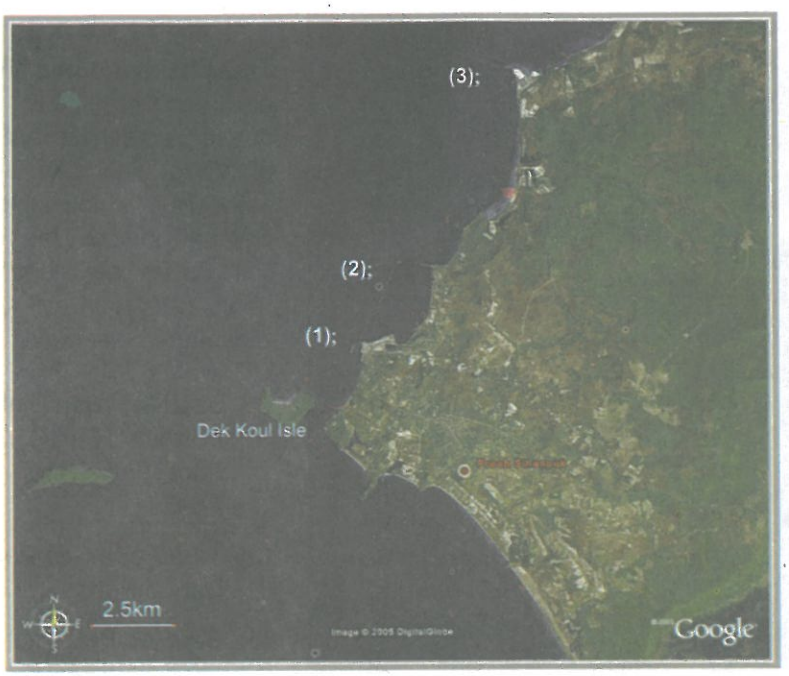
(2) Truong Sa Sea Port; Cat Lo Port;

(3) Cai Mep Port

(4) Phu My Port

Map 5: The port of Phnom Penh (Google Earth 2005, DigitalGlobe 2005)

Phnom Penh port is located on a long narrow bank of the Tonle Sap River in the centre of the city. It has access to the South China Sea via the main stream Mekong River. The distance to the border is 55 nautical miles. The port is located 4 km upstream of the conjunction of the Tonle Sap River and the Mekong River.



Sihanoukville Port is located at the bay of Kompong Som of the Gulf of Thailand. It has an old port (the Old Jetty) and a newly constructed port (the New Port). Sihanoukville port is the only sea port in Cambodia. In Map 6:

(1) Old Jetty

(2) New Berth

(3) Fishing Port

Map 6: The port of Sihanoukville (Google Earth 2005, DigitalGlobe 2005)

As can be seen from the above satellite images, all ports in the project are located near important urban areas of Vietnam and Cambodia. They are an important resource for the development of these areas, as well as for their service areas, which are much larger than the cities where they are located.

The port of Hai Phong is the second largest port in Vietnam, after Saigon Port, and is the most important one in the North of Vietnam. Its proximity to Ha Noi, the capital city of Vietnam, and its position in the Northern economic triangle make the Hai Phong port a focus for development. In the centre, the Da Nang Port is located near important tourism areas. At present, Da Nang port is the largest receiver of international cruise ships and passengers.

The Vung Tau port is the most important in Vietnam for its special role in the petroleum industry. It is the biggest port when it comes to petroleum throughput. The port provides indispensable services to petroleum exploration and transportation.

In Cambodia, there are two ports playing significant roles in facilitating its international trade. The port of Sihanoukville is presently serving about 80 % of Cambodia's total trade. The port of Phnom Penh, on the other hand, plays an important role in transportation on the Tonle Sap and the Mekong rivers.

2. Port details

Table 4 gives an overview of the cargo handled at the ports. It can be seen that from 2000 to 2003, the port of Hai Phong was the biggest container port and Vung Tau handled the most cargo during 2000 - 2004. For the year 2004, no information was available on the number of containers handled. The Phnom Penh port received the highest number of passengers out of the 5 ports in the period from 2002 to 2004. For 2000 and 2001, no information was available.

Table 4: Overview of port activities in Hai Phong, Da Nang, Vung Tau, Sihanoukville and Phnom Penh between 2000 and 2004 (*)

Year		Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
2000	Cargo amount (MT)	7.5	1.41	18.67	1.6	0.47
	Containers handled (TEU)	218,886	22,955	1,609	130,435	0
	Passengers	3,342	57,000	14,853	0	n.a.
2001	Cargo amount (MT)	8.7	1.71	22.24	1.8	0.50
	Containers handled (TEU)	227,159	25,100	507	145,292	0
	Passengers	3,214	54,200	11,275	1,177	n.a.
2002	Cargo amount (MT)	10.7	2.07	21.44	1.7	0.43
	Containers handled (TEU)	344,028	30,882	453	166,638	746
	Passengers	1,650	8,628	4,605	3,407	195,414
2003	Cargo amount (MT)	12	2.18	21.25	1.8	0.53
	Containers handled (TEU)	376,644	27,163	0	181,286	7,630
	Passengers	4,326	8,660	2,216	2,282	116,348
2004	Cargo amount (MT)	14.3	2.31	24.21	1.5	0.60
	Containers handled (TEU)	579,325	32,416	0	213,916	15,526
	Passengers	3,385	3,824	20,019	801	67,555

n.a.: not available; MT: Million Tons; TEU: container equivalent to 20 feet

(*) Data consolidated from statistics provided by port authorities of Hai Phong Port, Da Nang Ports, Vung Tau Port, Phnom Penh Port and Sihanoukville Port

For the ports of Hai Phong and Da Nang, the amount of cargo and the number of containers handled increased each year. In comparison to this, the number of passengers passing through these ports decreased. In Cambodia, the situation is more variable. The amount of cargo in both Cambodian ports experienced decreases and increases in different years. For the Phnom Penh port, the cargo amount in 2004 was higher than in 2000, while in Sihanoukville, the amount of cargo in 2004 was lower as compared to 2000. In Phnom Penh, container handling only started in 2002 and since then, an enormous increase in the number of containers handled can be noticed. Meanwhile, the number of passengers decreased. For Sihanoukville too, the number of containers handled is increasing since 2000. The number of passengers on the other hand increased during the period 2000 - 2001, while the number decreased during the last two years of the survey.

All three Vietnamese ports in this study (Hai Phong, Da Nang, and Vung Tau) are clusters of ports. For Hai Phong Port area and Vung Tau Port area, the component ports are listed in Table 5 and Table 8 respectively. These tables give an overview of ports and their number of wharves, length and maximum capacity (given by tonnage - DWT).

Hai Phong port area is home for diversified categories of shipping activities; among them are container ports, general cargo ports, fishery port, oil/petroleum ports, multi-purpose ports, etc. Most of the ports in Hai Phong port area are estuary ports, located on the Bach Dang estuary.

Table 5: Ports in the Hai Phong area (Hai Phong Port Authority 2005)

No	Port Name	Amount of wharves	Length (m)	Capacity (DWT)
1	Vat Cach	2	374	3,000
2	Lilama	1	96	3,000
3	Thang Long gas	1	90	2,000
4	Thuong Ly	1	60	3,000
5	Hai Phong Port	11	1,717	50,000
6	Ha Long Fishery Port	3	165	7,000
7	Dai Hai	Specialised for oil/petroleum handling		5,000
8	Cua Cam	3	350	5,000
9	Fishery II	1	73	600
10	Doan Xa	1	210	10,000
11	Transvina	1	120	7,000
12	Navigation Safety (Shell gas)	1	87	3,000
13	Chua Ve	3	498	10,000
14	Total Gas	Specialised for LPG handling		3,000
15	Dong Hai	1	100	600
16	Energy	1	40	300
16	Petec An Hai - Hai Phong	Specialised for oil/petroleum handling		5,000
18	Bach Dang wharf	3	720	7,000
19	Caltex	1	70	4,000
20	Dinh Vu Oil port	Specialised for oil/petroleum handling		10,000
21	Army Port K99	Specialised for oil/petroleum handling		7,000
22	Nam Vinh	1	200	5,000
23	Green Port (Viconship)	1	180	10,000
24	Ninh Tiep Anchor Buoy	2	193	10,000
25	Dinh Vu Port (New)	1	238	20,000
26	Bach Dang Ship Repair Company			
27	Pha Rung Ship Repair Company			
28	Nam Trieu Ship Yard			

Da Nang port area accommodates 10 ports with respective capacities ranging from 1,000 DWT to 30,000 DWT. The Da Nang ports are located on the Da Nang Bay and near the river mouth of Han river.. In 2004, Da Nang ports hosted 3,966 outbound and inbound trips. In total, 934 foreign ships and 3,032 domestic ships visited Da Nang ports in 2004, with total throughput of 3,817,490.8 million tonnes. Table 6 summarises shipping activities at Da Nang ports (Da Nang Port Authority 2005).

Table 6: Main indicators of shipping activities at Da Nang port

	Indicators	Unit	2003	2004
1	Total number of ports	port	10	10
2	Outbound and Inbound ship visits	trips	3,782	3,966
3	Foreign ships	visit	862	934
	- Dry cargo		630	712
	- Passenger/cruise		50	24
	- Oil/Petroleum		182	198
4	Domestic ships	visit	2,920	3,032
	- Oil/Petroleum		750	896
	- Other		2,170	2,136
5	Total throughput	million tonnes	3.57	3.82
6	Total import/export cargo	million tonnes	1.85	2.03

Table 7 describes the main characteristics of ports in the Da Nang port area.

Table 7: Ports in Da Nang Port area (Da Nang Port Authority 2005)

No	Port Name	Amount of Wharves	Length (m)	Capacity (DWT)
1	Song Han – Da Nang port	7	750	< 5,000
2	Tien Sa – Da Nang port	5	900	< 30,000
3	Nguyen Van Troi	6	700	<1,000
4	Song Han 9	1	60	<2,000
5	My Khe	Specialised for oil/petroleum handling		<30,000
6	Nai Hien	Specialised for oil/petroleum handling		<3,000
7	Lien Chieu petroleum port	Specialised for oil/petroleum handling		<7,000
8	Hai Van cement port	1	100	<5,000
9	K4/D6 petroleum port	Specialised for oil/petroleum handling		< 2,200
10	PETEC-Hoa Hiep	Specialised for oil/petroleum handling		< 5,000

Vung Tau port area accommodates 15 ports, many of which are specialised in handling oil, petroleum, LPG and related products (Table 8), located along Dinh River. Some ports belong to companies located in industrial zones, along Thi Vai River. Some other ports are located within Ganh Rai Bay, Sao Mai – Benh Dinh sea area, near beaches and tourist areas.

Table 8: Ports in the Vung Tau area (Vung Tau Port Authority 2005)

No	Port Name	Amount of Wharves	Length (m)	Capacity (DWT)
Ports in Sao Mai sea area – Dinh River				
1	VietsovPetro port	10	1,377	< 10,000
2	Downstream PTSC port	7	450	< 10,000
3	Upstream PTSC port	Specialised for oil/petroleum handling		< 5,000
4	PTSC petrol port	Specialised for oil/petroleum handling		< 10,000
5	Dong Xuyen port	Specialised for oil/petroleum handling		< 10,000
6	K2 oil port	Specialised for oil/petroleum handling		< 5,000
7	Vung Tau Commercial Port	1	250	< 5,000
8	Cat Lo aquacultural port	2	352	< 1,000
9	Cat Lo Fishery port	2	100	< 4,500
10	Truong Sa sea product port	2	352	< 1,000
Ports in Thi Vai River				
1	Oil port of Phu My 2-1 power plant	Specialised for oil/petroleum handling		< 10,000
2	Oil port of Phu My 1 power plant	Specialised for oil/petroleum handling		< 10,000
3	BARIA SERECE port (Phu My port)	7		< 60,000
4	Vung Tau PV gas port	2	210	< 20,000
5	Cai Mep Interflour port	1	270	< 30,000

The Phnom Penh port can be divided into a main berth and a passenger terminal. The main berth is 300m long and the passenger terminal is 45 m. For the time being, there are three shipping lines with a total of 7 vessels sailing regularly between Phnom Penh and Ho Chi Minh City (Vietnam) carrying mainly containers. Each of these vessels sails 2 round trips per week.

Occasionally, some of these of vessels take on board various general cargos such as tubes, steel bars, machinery, etc.

In the Sihanoukville port, there are three wharves: the old wharf is 290 m long and the new one 350 m. 10 km from the main port, there is an oil terminal with a jetty of 4.5 m.

3. The coastline

The Vietnamese coastline stretches over 3,200 km and therefore, there are differences in the coastal structures near the ports of Hai Phong, Da Nang and Vung Tau. The port of Hai Phong, in the North of the country, is an estuary port and is located near mangrove forests, coral reefs, sea grass ecosystems, and aquaculture areas. The port borders the World Heritage site of Halong bay and the Cat Ba nature reserve, which both contain beautiful beaches and other tourism resources.

The coastline of the Da Nang province stretches over 30km and Da Nang Bay occupies more than half of this coastline. The port of Da Nang is situated in the bay of Da Nang, with the depth ranging from 9 to 12m. The bay's substrate consists merely of sand. In Da Nang Bay, there are 45 anchoring points for local boats and sea-going vessels. The depths vary from 10m to 16m.

The port of Vung Tau is also located near a sensitive area: the Can Gio biosphere reserve. The ports of the Vung Tau area are located on two rivers: the Thi Vai River and the Dinh River and in the Ganh Rai bay, which is a part of the South China Sea. The eastern part of the bay is relatively deep, with a depth range of 25 to 30 m.

As compared to Vietnam, the Cambodian coastline is much shorter, only 443km. Sihanoukville is one of the three coastal provinces of Cambodia, with the coastline stretching over 128km and characterised by sandy and rocky shores. Sihanoukville has two bays: the larger one is the Kampong Som bay, covering an area that is 60km long and 30km wide. The smaller one is the Veal Ring bay. The port of Sihanoukville locates in the Kampong Som bay. There are 24 islands in Kampong Som bay, among which Koh Rong, Koh Rong Salem, Koh Takeo, Koh Russey, Koh Chung Loh and Koh Sramoch are the most important ones. Many of the islands have small beaches and fairly intact marine habitats (PEAMSEA 2003). However, in comparison with the Vietnamese islands near coastal areas, these islands do not attract many tourists as they do not yet offer tourism accommodation and facilities. On the other hand, the beaches that surround the port attract both local and foreign visitors.

The Phnom Penh port is the only inland port in this study. It is located on the Tonle Sap River, some 3 to 4 km upstream of its junction with the Mekong River.

4. Biodiversity in the study areas

Around the port of Hai Phong, 1,366 marine and blackish species have been identified, including 287 species of phytoplankton, 75 species of seaweeds, 4 sea grasses, 36 mangroves, 89 species of zooplankton, 538 species of zoobenthos, 177 corals, 157 fishes and 3 species of marine mammals. In addition, 20 species of reptiles and amphibians have been recorded in the region, along with 37 species of birds and 27 species of terrestrial mammals (Nguyen Huy Yet 2004).

Coral reefs in the Hai Phong – Cat Ba region are most seriously threatened (Burke *et al.* 2002). Although the most significant threat comes from destructive fishing, sedimentation, marine-based pollution (mostly marine shipping), and coastal development contribute substantially to coral reef degradation in the area. During the period 1996 – 1999, coral reef decreased by 20%, largely due to El Niño event in 1998 (UNEP 2003b).

In the Da Nang area, 2,131 species have been inventarised. Most of them are plants (1,338) and other terrestrial species. The reported marine species contain 81 species of seaweeds, 58 species of zooplankton belong to 34 genera, 25 families, 7 groups and 4 phyla; 120 species of benthic organisms belonging to 88 genera, 66 families, 6 classes and 4 phyla; 55 species of hard corals live in the northern part of Da Nang Bay, in the southern and northern parts of the Son Tra Peninsula. More than 500 species of fish of which, more than 30 species of economic value exist in these ecosystems. Coral reef coverage ranges from 19% to 27% at the southern part of Son Tra peninsula. At the Da Nang Bay and northern part of the Son Tra peninsula, coral reefs are distributed in the hard-bottom areas. There is no information available on the changes of coral reefs and other habitats in the area (Da Nang PC and PEMSEA 2004).

The Vung Tau Port area has a most valuable mangrove forest. 20 species of fishes and 11 species of shrimps and crabs are reported in the area.

In Cambodia, very little is known about the ecosystems near the port areas because of a lack of research (Touch 2002). Based on small surveys, coral reefs have been reported around most of the islands and estuaries, although, for both ports in this study, little information on species abundance is available.

Sihanoukville has 26,650ha of mangrove forest (Peou Vanna 2002). Coral reefs are found near the islands of Koh Rong, Koh Rong Salem, Koh Russey, Koh Takiev, Koh Thmey and Koh Ses. Although, no comprehensive and systematic studies on coral habitats in the region exist, it is estimated that coral reefs in Sihanoukville are home of about 24 species of hard corals and 14 species of soft corals (PEAMSEA 2003). The coastal waters host 70 species of corals in 33 genera and 11 families, 435 fish species from 97 families, 30 species of true mangroves, 8 species of sea grass, 4 species sea turtles (Hawksbill, Green, Olive Ridley, Leatherback), one species of dugong (Dugong dugon), several Irrawaddy dolphins, Indo-Pacific Dolphin (Sousa chinensis), Common Dolphin (Dephinus delphis), Bottle-nosed Dolphin (Tursiops truncatus), Spiner Dolphin (Stenela logirostris), and Finless Porpoise (Neophocaena phocaenoides) (Reported by Vathana and Vibol) (UP-MSI, ABC, ARCBC, DENR, ASEAN 2002).

The most important threats to coral reefs in Sihanoukville originate from over fishing (70% of the reefs at risk) and destructive fishing; marine pollution (30%), coastal development and sedimentation also contribute significantly. Around 30% of the coral reefs is threatened (at medium or high levels) by marine-based pollution (by shipping and oil infrastructure, not considering small scale damages by anchorage) (Burke *et al.* 2002).

II. SOCIO-ECONOMIC CONDITIONS AROUND PORT AREAS

All the ports in the study are located in big cities and economic centres of Vietnam and Cambodia. Their activities play a very important role in economic growth and social development of the cities.

1. *Hai Phong port*

Hai Phong port area is located in Haiphong city, a modern industrial seaport city, a major transport link and a main gateway to the sea for the Northern provinces. Hai Phong is also a critical growth pole of the Dynamic Economic Zone in Northern Vietnam and a hub for sea economic development. It is one of the oldest seaport cities of Vietnam.

The ports in the Hai Phong port area are mostly located along the Cam River. Some terminals and shipyards are located at the Nam Trieu mouth (Bach Dang river) and the Lach Tray river mouth. The ports in the Hai Phong port area are administratively located in 5 districts: Hong Bang, Ngo Quyen, Thuy Nguyen, An Lao and Cat Hai.

In the first quarter of 2003, the port of Hai Phong contributed around 120 billion VND to the city's economy, or half of the contribution of the transport sector and more than 5% of the Gross Domestic Product (GDP). In 2004, the transport and telecommunication sector contributed 17.5% of the total GDP of Hai Phong (Table 9).

Table 9: Selected indicators for Hai Phong (Hai Phong PC 2005)

	Unit	2003	2004
Total land area	Km^2	1,519.20	1,519.20
Average population	1000 people	1,754.20	1,772.50
Population density	people/km^2	1,155.00	1,167.00
Gross Domestic Product (GDP), in which:	billion VND	11,241.60	12,521.50
Agriculture-Forestry-Aquaculture	billion VND	1,492.50	1,574.60
Industry – Construction	billion VND	4,413.70	4,998.10
Services, in which:	billion VND	5,335.40	5,948.80
Transport and telecommunication	billion VND	1,928.80	2,193.90

The headquarters of many Vietnamese shipping companies including Vosco, Vinaship, Germatrans, Vinalines, Vitranchart, and Vietfrach are in Hai Phong. Dozens of domestic and major international shipping lines and shipping agents have also set up their branches and representatives' offices in Hai Phong.

2. *Da Nang port*

The ports of Da Nang are located in the bay of Da Nang City. The city has 5 urban districts, 1 rural district and 1 island district. Da Nang city is the third largest port city in Vietnam (after Hai Phong and Vung Tau) with a total population in 2004 of 765,549 people (Table 10). Nearly three quarters of the population lives in the urban areas, concentrated in its 5 urban districts: Lien Chieu, Thanh Khe, Hai Chau, Son Tra and Ngu Hanh Son. The urban land area accounts for less than one fifth (16.97%) of the total natural land (around 1.2 million km^2).

Table 10: Demographic indicators of Da Nang city (Da Nang PC 2005)

Administrative units	1999		2001		2004	
	(1)	(2)	(1)	(2)	(1)	(2)
Danang City	684,846	545	728,786	580	764,549	609
Hai Chau District	189,297	7,863	200,722	8,339	211,414	8,780
Thanh Khe District	149,637	16,085	155,743	16747	160,559	17,264
Son Tra District	99,344	1,635	105,03 0	1728	112,613	1,853
Ngu Hanh Son District	41,895	1,147	46,713	1278	50,531	1,384
Lien Chieu District	63,464	764	67,598	814	72,780	884
Hoa Vang Rural District	141,209	192	152,980	207	156,652	212
Hoang Sa Island District	...	...	...	...	...	...

(1) Population (person) (2) Population density (persons/km^2)

The ports in the Da Nang port area are situated in the districts of **Lien Chieu, Hai Chau and Son Tra**. The main economic activities of these four (probably 3, check this please) districts are industrial, commercial and services. Port development constitutes an important part of the development plans of these districts. Several industrial zones are being developed in these districts to take advantages of the seaports and maritime connections. Industrial activities will focus on processing and consumer goods to serve the export and chemical industries.

The ports play an important role in the development plan of the Da Nang city, which will support the development of other economic activities. Total industrial labour force of the Da Nang city in 2004 was 68,568 people or 9% of the total population. In 2004, around 11,000 people were working in the transport sector, more than 10% of whom were working on sea transportation. As the largest passenger seaport in Vietnam, the development of the passenger port of Da Nang also influences other commercial and service activities, such as trading and tourism.

3. *Vung Tau port*

The Vung Tau port area is located in Ba Ria – Vung Tau province. The province has 7 administrative units, including Vung Tau City, Ba Ria Provincial Town, and 5 districts. The ports are spreading in the region of Vung Tau City, Ba Ria Town and Tan Thanh district, along Thi Vai river, Dinh river and the coastline.

Ba Ria-Vung Tau is the Vietnamese oil and petroleum centre. In recent years, crude oil has become the most important export commodity of Vietnam and has brought back significant export revenue for the nation. In 2001, 16.7 million tons of crude oil was exported, fetching 3127.5 million dollars in export revenue. Together with crude oil, the associated gas has been exploited as well. For the time being, 4 – 5 million m^3 /day on average is brought ashore.

Aside from the petroleum industry, tourism and fishery are other strengths of Ba Ria - VungTau. Tourism is endowed by nature, with rich and diverse natural resources, nice beaches, famous cultural, historical and cultural relic sites and primitive forests lying along its coastline.

At the end of 2001, the province had 4,535 vessels and exploited 140,000 tonnes of different sea products. The area for breeding and growing aquatic products has reached an estimated 3,500 hectares with an output of 1.5-1.6 thousand tons. As for the processing of sea products, the province exported 18,749 tonnes of sea products in 2001 (of which frozen products accounted for 16,000 tonnes). The export value of thesesea-products was about 40 million euros.

The waterway connections in Ba Ria-Vung Tau are very favourable for port development. There are more than 20 rivers and arroyos with a combined length of about 200km, of which 17 rivers and arroyos with a total length of 167 km can be used for marine transportation. Besides, a number of rivers and coastal regions of the province are suitable for developing fluvial ports and seaports. Seaport development provides much needed support for the economic development of the province and the export industry especially crude oil export..

4. Sihanoukville port

The port of Sihanoukville is located in Sihanoukville municipality, southern Cambodia, on the Gulf of Thailand. Sihanoukville municipality comprises of 3 districts, 22 communes and 85 villages. In 1999, Sihanoukville had a population of 155,690 people with an average population density of 179 people/km^2 (Table 11).

Table 11: Demographic data of Sihanoukville (Ministry of Planning 1998)

No	Localtion (Khan)	Number of family	Family size (people)	Total population (people)	Density (people/km^2) Sihanoukville	National indicator
1	Mittapheap	-	-	67,440	359	
2	Prey Nop	-	-	75,142	164	
3	Stung Hav	-	-	13,108	88	
	Total	27,351	5.2	155,690	179	64

By 1999, only 11.3% of the households in Sihanoukville were connected to the municipal water supply system.The majority of the population used water from wells (65.8% of the households) and springs and rivers (5.1% of the households). About 39.1% of the households were connected to the city power grid for lighting and more than 57% of the households were still using kerosene lamps for lighting.

Sihanoukville is one of the three priority areas for economic development together with Phnom Penh and Siem Riep. The two most important economic actors of Sihanoukville are the deep-water seaport and tourism. Fishing is also an important factor in the economy of Sihanoukville.

5. Phnom Penh port

The Phnom Penh city was established at the intersection of the three rivers: the Mekong, the Tonle Sap and the Basac. These rivers provide potential freshwater and river ecosystem as important natural resources for economic and cultural development. The city covers 375 km^2. The area under rice cultivation accounts for 30% of the total area (or around 11,401 ha) and the other 70%(or 26,106 ha) is covered by wetlands, lakes, settlements, and roads.. Phnom Penh city is connected to most of the other provinces through the national road system.

The municipality of Phnom Penh consists of 7 Khans (districts), 76 Sangkats (communes) and 637 villages. Phnom Penh is a crowded city with a population of approximately 1,011,264 people, and a density of 2,696 people/km^2. The population in Phnom Penh consists of 2 communities: the suburban community and the urban community. The suburban community includes 510,908 people, residing in 3 Khans: Khan Doug Kour, Khan Mean Cheay and Khan Reseay Keo with a density of 1,471 people/km^2. The urban community includes 500,356 people residing in 4 Khans: Khan Chamkar Mon, Khan Doun Penh, Khan Prampir Meakkakra and Khan

Toulkok, with a density of 17,743 people/ km^2 (Table 12) (Phnom Penh Municipal Department of Planning 2004).

Table 12: Family and family size in Phnom Penh

No	Localtion (Khan)	Number of family	Family size	Total population
1	Chamkar Mon	27,243	5.80	158,143
2	Doun Penh	19,534	5.74	112,187
3	Prampir Meakkakra	15,956	5.60	89,353
4	Toul kok	24,848	5.66	140,673
5	Dengkaev	26,286	5.02	131,995
6	Mean Chey	27,960	5.73	160,135
7	Reussei Kaev	39,436	5.55	218,778
	Total	181,263	5.58	1,011,264

53.30% of the families in Phnom Penh city have access to portable water and 43.7% of the families are using water from ponds, lakes, rivers, welsl or are simply buying it. About 80.7% of the families have access to electricity.. The urban and suburban areas have 95.12% and 67.76% access to electricity services.

The main economic activities of Phnom Penh are tourism and agriculture. The labour force constitutes 67% of the city's population. Of this 67%, the proportions working in commerce, industry, and agriculture are 48%, 14%, and 5% respectively.

The port of Phnom Penh is located at Khan Doun Penh and is one of the gateways connecting the city to other cities and towns up and downstream the Tonle Sap,, the Mekong and the Bassac rivers. It is also the gateway for connecting Phnom Penh with international shipping routes through Ho Chi Minh City in Vietnam.

III. ENVIRONMENTAL CONDITIONS

1. *Water Quality*

Seaport areas are characterised by heavy traffic, both on the waterways and on land. The activities associated with seaports pollute the seas where they are located.. The various ways they do this include: waste from ships (such as oily bilge water and anti-fouling additives) and from port activities (such as dredging, ship cleaning, and the activities of workers and the use of vehicles) can cause water pollution and decrease water quality in and around port areas.

In Vietnam and Cambodia, the water quality monitoring system is poor, especially in port areas. Available data show that ports in Vietnam and Cambodia face environmental problems related to water quality. These problems are water turbidity, presence of organic pollutants, oil poliution and persistent organic compounds. Although pollution levels are still low, proper control should be put in place in order to preclude more serious problems. To control environmental pollution, the Vietnamese Government issued a catalogue of environmental standards including standards related to water quality in coastal areas as well as in rivers and lakes. The Ministry of Fishery promulgated water quality standards adapted to aquaculture.

For Cambodia, environmental standards are available for effluent discharge, water quality standards to protect bio-diversity and water quality standards to protect human health.

1.1. Physio-chemical parameters of water

The physio-chemical parameters of water include temperature, salinity, pH, colour, transparency, turbidity, and suspended substances. Monitoring of certain key physical and chemical variables in water can provide information on the ecological health of water bodies and on how the port operations are affecting water quality. Selected physical characteristics of surface water at areas of Hai Phong and Vung Tau ports are as presented in Table 13 (Luu Van Dieu *et al.* 2004; Nguyen Huu Cu 2005).

Table 13: Physical characteristics of waters at Hai Phong port areas

No	Parameter	Unit	TCVN 5942-1995 (B-level)	TCVN 5943-1995 (C-level)	Rung Ferry (Dec 2001)[1]	Bach Dang river (Lap Le Station) (Aug 2001)[2]	Cam river (Aug 2001)[2]	Dinh Vu (Aug 2001)[1]
1.	Temperature	°C	-	-	23.1	35.5	33.4	28.8
2.	pH		5.5 - 9	6.5 - 8.5	7.4	7.3	7.1	7.4
3.	Transparency	m	-	-	-	0.1	0.1	0.1
4.	Turbidity	NTU	-	-	69.6	-	-	-
5.	TDS	mg/l	80	200	8.8	**424.0**	**418.0**	-

- : no data available

[1]To be compared with TCVN 5943-1995 – Water Quality Standards for coastal waters – C-level (See Annex)

[2] To be compared with TCVN 5942-1995 – Water Quality Standards for surface waters – B-level (See Annex)

The data for 2001 showed that the water in Hai Phong port area had a high turbidity, low transparency and high temperature, especially during the summer months. Repeated monitoring results on Bach Dang River (at the Lap Le station) confirm the high turbidity of water. This is mainly due to heavy waterway traffic in the Hai Phong port area (HIO 2004, Luu Van Dieu *et al.*, 2004; Nguyen Huu Cu 2005).

In Da Nang, during the monitoring period from 1994 to 2001, 250 samples have been made at 10 monitoring stations in the bay of Da Nang (Da Nang PC and PEMSEA 2004). The average concentrations of Total Suspended Solids (TSS) at monitoring points in Da Nang Bay range from 20.082 mg/l to 36.078 mg/l. The highest concentration found was 163 mg/l at the

Xuan Thieu monitoring point. At Tien Sa station, the average concentration of TSS was 33.38 mg/l. The monitoring data shows that waters within Da Nang Bay are polluted with TSS as most of samples excess the permissible level (TCVN 5943 – 1995).

Table 14: Physical characteristics of waters at Vung Tau port areas

No	Parameter	Unit	TCVN 5942-1995 (B-level)	TCVN 5943-1995 (C-level)	VietsovPetro Port (Mar 2000)[2]	Baria – Serece Port (2004)[2]	Sao Mai Port (Jul 2001)[1]	Cat Lo Port (2004)[1]
1.	pH		5.5 - 9	6.5 - 8.5	7.4	7.7	8.0	7.7
2.	Turbidity	NTU	n.a	n.a	54.0	-	-	58.0
3.	TSS	mg/l	n.a	n.a	42.0	24.73	24.0	59.9

- : no data available n.a: not applicable

[1]To be compared with TCVN 5943-1995 – Water Quality Standards for coastal waters – C-level (See Annex)

[2] To be compared with TCVN 5942-1995 – Water Quality Standards for surface waters – B-level (See Annex)

For the Vung Tau port area, although the surface water in the Thi Vai River near the port site is saline because of seawater intrusion, the groundwater has a low concentration of dissolved solids. The groundwater meets the Vietnamese drinking water quality standards except for acidity (low pH), which ranges from 4.4 to 5.2 as compared with the recommended pH range of 6.5 – 8.5. The low pH is the result of an acidic sulphate sediment layer (Nguyen Thanh Hung 2005).

During the Feasibility Study for the Expansion of the Sihanoukville port (in 1997), water and sediment were sampled at 10 locations in the port. The laboratory results showed that the turbidity of the water was considerably high at all the locations, and that the water and sediments in this area contained chemicals such as oil, cyanide, and lead (Sihanoukville Port, 2003). It is estimated that the total yearly load of Total Suspended Solids (TSS) and Total Solids (TS) are 2,646.17 and 4,800.04 tonnes, respectively (UNEP, 2003a).

Marine water quality data for 2003 showed that pH and TSS levels around Sihanoukville port are within legal limits (Table 15).

Table 15: TSS concentrations at Sihanoukville Port (Ministry of Environment of Cambodia 2003)

Criteria	Unit	Main port	Fish port	Cambodian standard[1]
pH	-	8.18	8.10	7.0 – 8.3
TSS	mg/l	27.80	19.00	n.a

However, due to the port's rehabilitation work, dredging and land reclamation operations are taking place and causing high level of TSS at dredging and reclamation sites which all are disposal points.

Regarding Cambodian ports, the concentration of suspended solids in the water of the Phnom Penh port is generally much higher than the standard of Cambodia. It is thought to be due to the dense traffic in the port area (Table 16) (Department of Environment of Phnom Penh 2004).

Table 16: pH and concentration of suspended solids (TSS) in water at Phnom Penh Port in 2004

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
pH	7.0	7.1	7.3	7.5	7.1	7.4	7.3	7.1	7.2	7.1	7.3
TSS (mg/l)	52.8	50.3	56.5	40	70.0	**91.0**	**83.6**	**110.2**	**329.0**	**234.0**	**168.0**
	Cambodian standards for river for biodiversity conservation										
pH	6.5 – 8.5										
TSS (mg/l)	25 - 100										

[1] Cambodian standard for coastal water for biodiversity conservation (Annex 4 of the Sub-degree on water pollution control – Royal Government of the Kingdom of Cambodia)

1.2. Organic and inorganic pollution

Dissolved oxygen in water is an important element for aquatic life, from algae and macrophytes to fishes. The concentration of dissolved oxygen in water must be sufficient to allow aquatic organisms to survive and procreate. When the oxygen level in the water falls below a certain level, it causes disorders and death. When the pollutants include oxidisable organic matter (like sewage and agricultural runoff) or nutrients that stimulate growth (eutrophication), a decrease in dissolved oxygen (DO) concentrations occurs.

Organic matter in water can be classified into two categories: the biologically degradable materials and the non-biodegradable and recalcitrant materials. The Biological Oxygen Demand (BOD or BOD_5^{20}) is the amount of oxygen consumed (in 5 days) by biological processes to break down organic waste (at the temperature of 20°C). The Chemical Oxygen Demand (or COD) measures the amount of oxygen needed to oxidise all carbon compounds in a water sample, including biologically degradable materials, the non-biodegradable and recalcitrant ones. BOD and COD are indirect measures of organic pollutants in water. The higher the BOD and COD are, the higher the water pollution (see Table 6 for the values of Vietnamese standards).

The water in and around the Hai Phong port area is polluted with nutrients (ammonia, nitrite and phosphate) and lacks dissolved oxygen. The concentration of ammonia in the Cam and the Bach Dang rivers exceeds the permitted limit of the Vietnamese standard for aquaculture by 2 to 5 times. The concentration of dissolved oxygen (DO) in the Bach Dang River decreased below the standard of 4 mg/l. Nitrite concentration is 4 to 7 times higher than the limit set by the Ministry of Fisheries (10mg/l for aquaculture) (Cao Thi Thu Trang 2005).

Table 17: Concentration of some organic pollutants in waters at Hai Phong port areas

Parameter	Unit	TCVN 5942-1995 (B-level)	TCVN 5943-1995 (C-level)	Rung Ferry (Dec 2001)[a]	Bach Dang river (Aug 2001)[b]	Cam river (Aug 2001)[b]	Dinh Vu (Aug 2001)[a]
1. DO	mg/l	≥ 2	≥ 4	6.6	**3.4**	**4.1**	4.6
2. BOD	mg/l	< 25	< 20	10.6	3.7	2. 6	-
3. COD	mg/l	< 35	n.a	-	4.6	5.6	-
4. NO_2^-	µg/l	50	n.a	-	**41.0**	**46.0**	28.8
5. NH_4^+	µg/l	1000	500	-	**250.0**	**139.0**	222.2
6. NO_3^-	µg/l	15,000	n.a	-	-	-	151.6
7. PO_4^{3-}	µg/l	n.a	n.a	-	41.0	55.0	34.8
8. Coliform	MPN/100ml	10,000	1,000	1000	-	-	-

- : no data available n.a : not applicable

[a] To be compared with TCVN 5943-1995 – Water Quality Standards for coastal waters – B-level

[b] To be compared with TCVN 5942-1995 – Water Quality Standards for surface waters – C-level

In the Vung Tau port area, water quality has been monitored at several sites, including at the Thi Vai River, Phu My Port, the Dinh River and the eastern and south-western coasts of the Vung Tau peninsula. The results show that Thi Vai River is slightly polluted: The biochemical oxygen demand (BOD) ranges between 3 and 13 mg/l; the coliform count ranges from 64 to 2,400 MPN/100ml as measured during the period from March 1996 to March 1997, within the framework of the baseline study for the whole Phu My Power Generation Center (PMPGC). Repeated sampling in January and May 2000 showed increased coliform levels up to 240,000 MPN/100ml. The rise is primarily due to increased human activities and the dense residential areas brought about by the industrial development of the region (Table 18) (Nguyen Thanh Hung 2005).

Table 18: Concentration of some organic pollutants in waters at Vung Tau port areas

Parameter	Unit	TCVN 5942-1995 (B-level)	TCVN 5943-1995 (C-level)	Baria – Serece Port (2004)[b]	VietsovPetro Port (Mar 2000)[a]	Phu My Port[b]	Sao Mai Port (Jul 2001)[a]	Cat Lo Port (2004)[a]
1. DO	mg/l	≥ 2	≥ 4	2.5	4.8	4.6	4.5	3.92
2. BOD	mg/l	< 25	< 20	**379.3**	15.0	**6.0**	6.0	**95.75**
3. COD	mg/l	< 35	n.a	**1090**	24.0	9.0	8.0	-
4. NO_2^-	µg/l	50	n.a	**200**	40.0	22.0	**70.0**	**140**
5. NH_4^+	µg/l	1000	500	600	140.0	290	250.0	450
6. NO_3^-	µg/l	15,000	n.a	200	1,210	240	1,820	590
7. PO_4^{3-}	µg/l	n.a	n.a	40	40	-	-	-
8. Coliform	MPN/100ml	10,000	1,000	**150**	**24,000**	300	800	3,097

- : no data available n.a : not applicable

[a]To be compared with TCVN 5943-1995 – Water Quality Standards for coastal waters – B-level

[b] To be compared with TCVN 5942-1995 – Water Quality Standards for surface waters – C-level

At Cat Lo Port on the Dinh River, the DO ranges from 3.6 to 5.4 mg/l, just at the acceptable level. The concentrations of BOD_5 range from 51 to 145 mg/l, 10 to 30 times higher than the permissible level. In particular, from the upper stream of the Dinh River to the Cau Do area (which supplies water to the Dinh water plant), BOD_5 ranges from 10 to 14 mg/l, a 2.5 to 3.5 fold excess of the A-level of the Vietnamese standard TCVN 5942-1995. This points to of minor organic pollution in this area. The sources of the pollution are domestic waste from residential areas along the river and agricultural practices. Also, NO_3^- and PO_4^{3-} pollution is of agricultural origin. The concentrations of NO_3^- and PO_4^{3-} of the river are relatively high. Concentration of NO_3^- ranges between 0.2 and 1.2 mg/l and the corresponding concentrations of PO_4^{3-} are between 0.1 and 0.6 mg/l. These concentrations cause eutrophication, especially in warm water. The Dinh port area is crowded by ships and boats, fishing harbours, seafood processing factories and residential areas (Luu Van Dieu *et al.*, 2004; Nguyen Thanh Hung, 2005; Nguyen Huu Cu, 2005).

Also from the back beach area (Bai Sau) to Binh Chau (Xuyen Moc district), the Eastern coast of Vung Tau shows signs of organic pollution. Here, BOD_5 ranges from 5 to 11 mg/l, with average values for DO and BOD_5 of 6.4 mg/l and 5 mg/l respectively. At some beaches (Long Hai, Ho Tram) and berths (Phuoc Tinh, Ben Loi – Binh Chau), pollution by nutrients and bacteria was detected. In the water of the Eastern coast of Vung Tau, pollution is not caused by industrial effluents, but by domestic wastewater from nearby residential areas, from seafood processing factories, and from waterway transportation.

The coastal waters Southwest of Vung Tau are affected by discharges from large rivers such as the Vai River and the Dinh River, which receive the wastewater from Vung Tau City, and from the harbours. In the front beach (Bai Truoc) area, DO and BOD_5 values of 4 mg/l and 12 mg/l respectively were found. This points to organic pollution that is attributed to the illegal dumping of waste by motor-boats and ships anchored in the area. Dinh port area is also polluted by bacteria with total coliform values of up to 43,000 MPN/100ml. The beaches of Bai Dau, Bai Dua, and Bai Truoc (Vung Tau city) are also subject to bacterial pollution.

In Da Nang, the coliform density is much higher than the Vietnamese standard, especially at the sampling sites where wastewater from residences enters (such as the Han River mouth area, or near the Nguyen Van Troi Bridge). The water quality in the coastal area of Da Nang tends to decline due to port and industry activities. The concentration of ammonia (NH_4^+) is 6 to 61 times higher than the standard (water of Thanh Binh) and the coliform density is 2 to 10 times (at water of Xuan Thieu, the highest monitoring data recorded 110,000 MPN/100ml) (Da Nang PC and PEMSEA 2004, Nguyen Huu Cu 2005).

On average, the concentrations of DO and BOD in water at the Phnom Penh port are lower than the values set in the Cambodia Standard for Water Quality (Kingdom of Cambodia Royal Government, 1999) (Table 19). However, the Cambodian Standard does not specify limit levels for pollutants such as NO_2^-, NO_3^-, PO_4^{3-} as well as the threshold level for COD. The water in the Phnom Penh port is polluted by organic substances as is indirectly shown by the presence of a very high concentration of coliform bacteria (up to 15,000 MPN/100ml).

Table 19: Water quality monitored at Phnom Penh Port in 2004 (Ministry of Environment of Cambodia, 2004).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ave.	Standards[1]
DO (mg/l)	4.90	4.51	3.82	3.15	3.83	7.09	6.51	6.83	7.35	6.91	6.43	**5.58**	**2 – 7.5**
COD (mg/l)	29.79	37.63	42.28	38.44	27.72	30.09	29.6	25.08	23.52	7.84	19.60	**28.33**	**n/a**
BOD (mg/l)	2.08	2.92	3.62	3.95	3.25	1.36	1.45	1.61	1.85	1.85	2.15	**2.37**	**1 - 10**
NO_2^- (mg/l)	0.013	0.013	0.014	0.014	0.004	0.032	0.03	0.03	0	0	0.006	**0.01**	**n/a**
NO_3^- (mg/l)	0.34	0	0	0	0.25	1.0	1.0	0.98	0.33	0.39	0.27	**0.41**	**n/a**
PO_4^{3-} (mg/l)	0	0	0	0.32	0	0.27	0.20	0.17	0	0.15	0.15	**0.11**	**n/a**
Coliforms (MPN/100ml)	240	2,300	2,900	**15,000**	1,200	110	72	94	1,500	1,200	210		**< 5,000**

The concentrations of DO and PO_4^{3-} in the water near Sihanoukville are up to 2 times higher than the ASEAN standards for coastal water. The average concentrations of NO_3^- and NO_2^- measured during the period 2002/2003 are respectively 10 and 20 times higher than the ASEAN standards. However, the concentrations of ammonia and coliforms at Sihanoukville are within the permissible limits according to Cambodian standards (Table 20).

Table 20: Organic pollutants concentrations at Sihanoukville Port (Ministry of Environment of Cambodia 2003)

Parameters	Unit	Main port	Fish port	Standard[2]
DO	mg/l	6.590	6.240	2 – 7.5
NO_3^-	mg/l	0.952	1.246	Total Nitrogen: 0.2 – 1.0
NO_2^-	mg/l	0.043	3.645	
NH_4^+	mg/l	0.000	0.000	
PO_4^{3-}	mg/l	0.023	0.035	0.02 – 0.09
Faecal coliforms	MNP/100ml	< 30	< 30	Coliforms: < 1000
Enterococci	MNP/100ml	0	0	

1.3. Metallic contaminants

Metallic contaminants in water bodies can affect human health and aquatic organisms. They tend to bio-accumulate: compounds accumulate in organisms any time they are taken up and are stored faster than they are eliminated. Severe effects include reduced growth and development, cancer, organ damage, and nervous system damage. Exposure to metals, such as mercury and lead may also contribute to the development of auto-immunity, which means that a person's immune system attacks its own cells. This can lead to joint diseases such as rheumatoid arthritis, diseases of the kidneys, the circulatory system, and central nervous system (WHO 2004).

[1] Cambodian standards for river for biodiversity conservation (See Annex 2 –)
[2] Cambodian standards for coastal water for biodiversity conservation (See Annex 2 –)

Metals can enter into water bodies in and around ports. Sources of such metals include industrial activities, deposition from air polluted by emissions of locomotives and vehicles, leakage from cargo containing heavy metals (such as crude oil), discharge of bilge water and ballast water from ships, etc.

Water in and around port areas is polluted by metallic contaminants in all 5 ports studied. In general, the concentrations of metals such as copper, lead, zinc, cadmium, arsenic, chromium, etc. are higher than the permissible limits. Accumulation in aquatic species has been documented.

At Dinh Vu (Hai Phong port area) however, the heavy metal concentrations of 2003 show that the water in Dinh Vu is not polluted by heavy metals. All monitored parameters are well below the Vietnamese Standard for Coastal Water Quality (Luu Van Dieu *et al.* 2004) (Table 21).

Table 21: Selected metals in waters in the Dinh Vu area in 2004

Parameters	Average concentration (mg/l)	TCVN 5943 – 1995
Copper (Cu)	3.17	10
Lead (Pb)	5.50	50
Zinc (Zn)	**10.60**	10
Cadmium (Cd)	0.40	5
Arsenic (As)	2.16	10
Mercury (Hg)	0.30	5

The concentrations of heavy metals in the 4 other studied ports are higher than the limits. The mercury concentration in Da Nang port exceeds the Vietnamese standard by 1.4 to 6 times. Also, concentrations of iron and zinc are higher than the standards (Da Nang PC and PEMSEA 2004, Nguyen Duc Cu 2004).

In Vung Tau, the iron content is high, exceeding the Vietnamese standard (TCVN 5943-1995) at most of the sampling sites. Concentrations of heavy metals (Cu, Pb, Zn, Hg) are within the standard.

The monitoring results at Sihanoukville in 2002 and 2003 showed that the concentrations of Cr^{6+} and Cu in seawater were lower than the ASEAN standards (UNEP 2003a; Apichai Sunchindah 1998). The yearly average concentration of lead (Pb) exceeds the standard and the concentration of cadmium (Cd) is more than 5 times higher than the limits (Ministry of Environment of Cambodia 2003) (Table 22).

Table 22: Heavy metals in coastal water in Sihanoukville in 2003

Criteria	Main port (mg/l)	Fish port (mg/l)	Standards
Chromium (Cr) (VI)	0.00	0.00	< 0.05*
Cadmium (Cd)	0.10	0.06	< 0.001*
Copper (Cu)	0.00	0.00	0.02**
Lead (Pb)	0.30	0.20	< 0.01*
Manganese (Mn)	0.06	0.04	0.1**
Zinc (Zn)	0.40	0.50	0.1**
Total iron (Fe)	0.60	0.70	0.3**
Cobalt (Co)	0.16	0.14	
Lithium	0.00	0.00	
Nickel (Ni)	0.48	0.42	
Total chromium	0.00	0.00	

* Cambodia standard in public water areas for public health protection (See Annex 2 –)
* Cambodia standard in public water areas for public health protection (See Annex 2 –)
* Cambodia standard in public water areas for public health protection (See Annex 2 –)
** Vietnam's standard TCVN 5943-1995 C-level (See ANNEX 1)

High concentrations of heavy metals in water and in biological samples (See part 4 of this chapter) can be explained by the heavy traffic on the waterways in the area and by the release of untreated wastewater from nearby industrial and residential areas of Sihanoukville.

Water monitoring station at Phnom Penh Port does not carry out heavy metals monitoring. Therefore, the concentrations of heavy metals in water at Phnom Penh Port are not available.

1.4. Oil pollution

Concentrations of oil in rivers surrounding the Hai Phong port area are high (Table 23). According to the Vietnamese Standard for Surface Water in Rivers (TCVN 5942:1995), the concentration of oil should not be detectable. Concentrations of oil and grease in the Bach Dang and the Cam rivers in Hai Phong only meet the B-level (water can be used for purposes other than drinking water supply) of the Vietnamese standard (TCVN 5942-1995), while those of Da Nang area and Vung Tau area do not meet the C-level standard for coastal waters (TCVN 5943-1995).

During the period 1994 – 2001, the concentration of oil was very high in the Da Nang Bay. Average concentration of 0.29 mg/l, ranging from 0.05 mg/l to 3.90 mg/l was measured (n=76) (Da Nang PC and PEMSEA 2004) (Table 23).

Table 23: Average concentrations of oil (mg/l) in water in Hai Phong, Da Nang and Vung Tau port areas (Nguyen Huu Cu 2005, Cao Thi Thu Trang 2005, Nguyen Thanh Hung 2005, Da Nang PC and PEMSEA 2004).

Bach Dang river (Lap Le station)	Cam river	Da Nang area (2001)	Baria-Serece (2004)	Baria-Serece (1999)	VietsoPetro Port (2000)	Cat Lo Port (2000)	Sao Mai Port (2001) – Average Upper-layer water
0.26	0.21	**0.29**	**7.57**	**0.22**	**0.52**	0.14	0.16

On the Dinh River in the Vung Tau Port Area, there is a high activity of boats near the sampling sites. This results in high concentrations of oil in the water. The recorded values of oil at the sampling sites (Ganh Rai Bay-Dinh Port, VietsoPetro Port) range from 0.14 to 0.52 mg/l (Table 23). In the South-western coastal area of Vung Tau, there are 10 harbours. They serve petroleum and seafood activities in addition to commercial areas. Most of these harbours are associated with oil pollution: the oil levels almost exceed the Vietnamese Standard TCVN 5943-1995 that applied for non-bathing and non-aquaculture areas. In the petroleum port (Sao Mai port), oil concentrations of up to 0.2 mg/l have been reported. Poor to non-existent management of wastewater collection from the anchored ships is seen as one of the main reasons. Some of the harbours are not equipped with wastewater collection and treatment systems.

Water quality in the port of Phnom Penh conforms to the standards of drinking water (after appropriate treatment). However, no data are available on the concentrations of heavy metals, petroleum and toxic substances in the water.

In the port of Sihanoukville, concentrations of oil and grease in water of up to 4.0 mg/l were measured (data for 2003). Oil and grease concentrations measured at a nearby fish port produced values of 1.0 mg/l (Ministry of Environment of Cambodia 2003). These high concentrations of oil and grease in and around ports are caused by shipping activities, especially ballast water discharging. However, at present, ballast water and oily bilge discharges are not closely monitored by port authorities or other agencies. Therefore, the amounts and the characteristics of water discharged by ships are not known in any of the ports.

1.5. Persistent Organic Compounds

The results of the monitoring of chlorinated pesticide residues in the Dinh Vu area, a new industrial development area bordering the port in Hai Phong, are shown in Table 24 (data from 2003). These results show that the concentration of chlorinated pesticides in the water at Dinh Vu does not exceed the Vietnamese standard TCVN 5943-1995 (Pham Van Luong 2002; Luu Van Dieu *et al.* 2004).

Table 24: Concentrations of some POCs in Hai Phong - Dinh Vu area (Pham Van Luong 2002, Luu Van Dieu *et al.* 2004).

Average concentration (mg/l)	Lindane	Aldrin	Endrin	Dieldrin	DDD	DDE	DDT	Total
Hai Phong (2001)								0.156
Dinh Vu (2004)	0.0043	0.0036	0.0008	0.0080	0.0016	0.0044	0.0018	0.0245
TCVN 5943-1995								50

All compounds measured are chlorinated pesticides that are used against various pests, particularly in agriculture. Except for lindane, others are highly persistent organochlorine compounds and they bio-accumulate. Aldrin (which is rapidly converted to dieldrin under most environmental conditions and in the body) and dieldrin have low mobility in soil and can be lost to the atmosphere. DDT and metabolites are persistent in the environment and resistant to complete degradation by micro-organisms. DDT has a wide range of applications, such as for the control of vectors that transmit yellow fever, sleeping sickness, typhus, malaria and other insect-transmitted diseases (WHO 2004). Lindane is also a chlorinated pesticide but can be degraded in soil and in surface water it can be removed by evaporation. Except for lindane, other compounds are listed under the Stockholm Convention on Persistent Organic Pollutants (POPs) and the use of such compounds has been restricted or banned in several countries.

In Vietnam, lindane is listed as a "restricted use" pesticide which requires specialised handling and use. Other compounds are banned as pesticides in Vietnam since 1992 (Ministry of Agriculture and Food Technology 1992). However, illegal use of DDT and other compounds as pesticides is still practised. In addition, DDT is still used in Vietnam to control malaria.

The presence of pesticide residues in the coastal water of Hai Phong most likely originated from agricultural areas around sampling sites.

In Vung Tau, POCs were not found at all 5 measurements in 2001 at Sao Mai port. In Sihanoukville, analysis results in 1997 did not detect POCs in water at the port. At the ports of Da Nang and Phnom Penh, data on pesticides in water was not available.

Another persistent group of organic compound that is important and are typical pollutants in ports are organotins. The most popular organotin is tributyltin (TBT). TBT is a very toxic organic compound containing tin (Sn) and it is also an endocrine-disrupting chemical (US-EPA 2003; Matthiessen and Gibbs 1998). It is used in antifouling paints on vessels and fixed marine structures to prevent algal and barnacle growth. TBT is highly toxic to many marine organisms. TBT is a typical pollutant in ports. The use of TBT in antifouling paints on ships, boats, nets, docks, and water cooling towers probably contributes most to the direct release of organotins into the aquatic environment (Clark et al. 1988; Hall *et al.* 1996). It can be released into water in the ports when ships are moored at ports and during ships cleaning and maintenance.

In ports around the world, TBT and its derivatives (dibutyltin and monobutyltin) has been found in aquatic organisms such as mussels and fishes. In the ports in Vietnam and Cambodia, the concentration of butyltins in water has not been monitored or studied. However, studies on butyltins have been carried out in sediments and biota (See section 3.3 and section 4).

2. Air Quality

In Hai Phong port, the air quality at the cross-road inside the port has been affected by heavy traffic of trucks in and out of the port (Table 25).

Table 25: Air quality at the cross-road in Hai Phong Port (Ministry of Science, Technology and Environment 2002)

	CO (mg/m^3)	NO_2 (mg/m^3)	SO_2 (mg/m^3)	Pb (mg/m^3)	VOC (mg/m^3)	Dust (mg/m^3)	Noise (dBA)
Cross-road	3.278	0.014	0.013	0.005	-	**0.403**	72.5
TCVN 5937-1995	5	0.1	0.3	0.005	-	0.2	
TCVN 5949-1995							75

In Da Nang Port, the working conditions at the bottom-welding workshop of Song Han port did not meet the standards of the Vietnamese Ministry of Health for workshops. High temperature (35°C) and low ventilation (wind velocity = 0 m/s) were the major problems. Noise levels are very high in the bottom-welding and the sandblasting workshops, 98.9 dBA and 107.6 dBA respectively.. Concentrations of inhalable dust in many working places at Song Han port, especially during ship maintainance and repair periods, exceed the standard by 3 times (Table 26).

Table 26: Inspection results for Da Nang Port in 2003 (Da Nang Prevention Health Centre 2003)

Area	T (°C)	Humidity (%)	Wind velocity (m/s)	Noise (dBA)	Inhalable dust (mg/m^3)	NO_2 (mg/m^3)	CO_2 (mg/m^3)	CO (mg/m^3)
Tien Sa	26-29	68-75	0-1,9	63-84	1-7.4	1.5	600-800	8-13
Song Han	30-35	58-68	0-1,3	**80-107.6**	0.87-7.4	1.8	600-2,200	9
Standards[1]	≤ 32	≤ 80	1,5-3	≤ 85	≤ 2	≤ 5	≤ 900	≤ 20

Several parameters of the air quality have been measured in the Sao Mai - Ben Dinh port area (Table 27) and at the port of Phu My (Table 28).

Table 27: Air quality at Sao Mai – Ben Dinh Port area (March, 2000) (DOSTE Ba Ria – Vung Tau 2001)

Sampling site	Noise (dBA)	Content of pollutants (mg/m^3)					
		Dust	SO_2	NO_2	CO	VOC	Pb
Sao Mai – Ben Dinh port area	68	0.30	0.065	0.057	1.0	1.2	$<10^{-4}$

At Dinh Port, the measurements and comparisons with the Vietnamese standard (TCVN 5937-1995, TCVN 5938-1995, TCVN 5949-1995) showed that the concentrations of air pollutants (SO_2, NO_2, CO, Pb) were lower than the standard values. Dust concentration (varies from 0.30 – 0.37 mg/m^3) and noise levels exceeded the air quality standard (TCVN 5937-1995). These results are recorded at the sites not subject to industrial operations. The measurements involve only transportation and infrastructure works.

At Phu My port (Table 28), there is more dust than is allowed under the Vietnamese standard for ambient air quality (TCVN 5937-1995 and TCVN 5938-1995). This is related to the infrastructure of the harbour and to the construction activities on the site. It is also due to the way the ores for the fertilizer factories are loaded and unloaded. The concentrations of SO_2, NO_2, CO, VOC in and around the production areas fall within the standards set by the Ministry of Health and the Vietnamese government. The micro-climate conditions (temperature, humidity) are not aberrant.

[1] Hygiene and Safety standards defined by the Vietnamese Ministry of Health

Table 28: Air quality parameters at Phu My Port (DOSTE Ba Ria – Vung Tau 2001)

T (°C)	Humidity (%)	Wind velocity (m/s)	Dust (mg/m^3)	SO_2 (mg/m^3)	NO_2 (mg/m^3)	CO (mg/m^3)	VOC (mg/m^3)
29.2	72.1	0.5 - 3.9	1.98	0.088	0.026	3.17	2.61

The parameter *"noise"* does not meet the requirements of the Vietnamese standard (TCVN 5949-1995 - See Annex) both in the production areas (< 75 dBA) and in the residential areas (< 60 dBA) (Table 29) (Nguyen Thanh Hung 2005).

Table 29: Level of noise at Phu My Port (Nguyen Thanh Hung, 2005)

	Average integral of noise pressure (dBA)		
	Max	L_{50}	L_{EQA}
Monitored value	79,9	65,3	67,2
TCVN 5949-1995 for industrial factories intermingle in residential areas	< 75	-	
TCVN 5949-1995 for residential areas	< 60		

For the ports of Phnom Penh and Sihanoukville, no measurements of air quality or noise are available.

3. Soil Quality

3.1. Metals in sediments

In the Hai Phong port area, the concentrations of selected metals in 1999 and 2000 exceed the Canadian ISQG[1] level. This applies to Cu (2.2 times), Pb (1.6 times), Zn (1.2 times), Hg (2 times) and Cd (2.8 times). In the period 1995 - 2000, the concentrations of metals in soil at Do Son Monitoring Station, near Hai Phong port, show a slight increase for most of the analysed metals (Table 30). This means that for metals, the soil in the ports is degrading. Although the concentrations of these pollutants are still below the PEL, urgent intervention is required..

Table 30: Average concentrations of metals in sediment (mg/kg dry) at Do Son Monitoring Station (1999-2000) (Nguyen Thi Phuong Hoa 2002)

Parameter	1999	2000	ISQG	PEL
Copper (Cu)	**44.87**	**41.04**	18.70	108.00
Lead (Pb)	**43.30**	**49.70**	30.20	112.00
Zinc (Zn)	**128.00**	**153.00**	124.00	271.00
Mercury (Hg)	**0.26**	**0.27**	0.13	0.70
Cadmium (Cd)	**1.09**	**1.90**	0.70	4.20
Arsenic (As)	1.12	1.37	7.24	41.60

In the Da Nang bay, the concentrations of heavy metals in sediments were not monitored. In the Vung Tau Port Area, analytical results of toxic substances in the bottom sediments at Baria-Serece Port (Phu My Port) in 1999 showed low levels of pollution. Most of the concentrations of heavy metals in the bottom sediments of the harbours are lower than the allowable limits in the Canadian guidelines (Table 31).

[1] Canadian Environmental Quality Guidelines (CCME 2003): SQGs are numerical concentrations or narrative statements that are set with the intention to protect all forms of aquatic life and all aspects of their aquatic life cycles during an indefinite period of exposure to substances associated with bed sediments. Interim SQGs (ISQGs) are derived when data are available but limited, and information gaps are explicitly outlined.

Table 31: Metals in bottom sediments at Baria-Serece port (1999)

	Average content of pollutant in soil samples (mg/kg dry) (n=3)				
	Pb	Cu	Zn	Cd	Hg
Ba Ria-Serece port	33[a] ± 9[b] (24 - 42)[c]	15.74 ± 8.25 (9.2 – 25)	61 ± 7 (53 – 66)	< 0.2	0.061 ± 0.04 (0.021 – 0.1)
Canadian ISQG	30.20	18.70	124.00	0.70	0.13
Canadian PEL	112.00	108.00	271.00	4.20	0.70

[a] Mean [b] Standard deviation [c] Range

In the Phu My – Cai Mep and Sao Mai – Ben Dinh port areas, sediment samples were taken at 5 different sites in each port area during a survey in July 2001. The results showed that the average concentration of lead in sediments did not exceed the Canadian Guideline (Table 32). Only one sample at the Sao Mai – Ben Dinh port area exceeded the guideline value. Other metals (Hg and Cd) were not detected (Nguyen Thanh Hung 2005).

Table 32: Lead in sediments in the Vung Tau Port Area (July 2001)

Location	**Concentration (mg/kg dry)**	Canadian ISQG
Phu My – Cai Mep Port Area (n=5)	11.1[a] ± 1.72[b] (9.5 – 14.4)[c]	30.20
Sao Mai – Ben Dinh Port Area (n=5)	14.9 ± 8.94 (3.5 – 30.5)	

[a] Mean [b] Standard deviation [c] Range

In Sihanoukville, the quality of the sediment is affected by the rehabilitation project of the seaport (1997 – 2005) which causes soil erosion and sedimentation. The rehabilitation project involved dredging of an access channel and the port basin, as well as reclamation activities to expand the port area. Sampling done in 2003 showed that the sediments in Sihanoukville port contain high concentrations of iron and manganese (Table 33). Higher concentration of cadmium at the fish port than at the main port may be due to the disposal of used boat's batteries in former's waters. The disposal of used batteries into the sea is not monitored at the fishing port.

Table 33: Metals in sediments in Sihanoukville in 1997 (JICA 1997) and 2003 (Ministry of Environment of Cambodia 2003) (Unit: mg/kg dry)

Criteria	Main port		Fish port		Standards*	
	1997	2003	1997	2003	ISQG	PEL
Cadmium (Cd)	1.5	**2.0**	1.6	**12.8**	0.7	4.2
Copper (Cu)	18.0	15.5	49.0	6.4	18.7	108.0
Lead (Pb)	12.0	**30.5**	16.0	22.9	30.2	112.0
Arsenic (As)	5.5	-	5.5	-	7.24	41.6
Manganese (Mn)	-	83.30	-	200.3	-	-
Zinc (Zn)	70.0	23.8	92.0	13.2	124.0	271.0
Total iron (Fe)	-	996.5	-	1132.2	-	-
Cobalt (Co)	-	6.6	-	5.9	-	-
Lithium	-	8.90	-	4.4	-	-
Nickel (Ni)	-	11.6	-	11.6	-	-
Chromium	18.0	15.2	-	28.8	52.3	160.0

* Canadian Environmental Quality Guidelines for marine sediment.

In Phnom Penh Port although there is an environmental monitoring stationoperated by the Ministry of Environment, metals in sediments have not been measured until now.

3.2. Oil and cyanide pollution

Studies on oil and cyanide pollution were undertaken in 1999 and 2000 at several port areas in Vietnam, including the Hai Phong port area and the Da Nang port area. One measurement was done per year at each of the two monitoring stations in Hai Phong (Do Son Station) and Da Nang (Da Nang Station). The concentrations of oil and cyanide found in bottom sediments in Hai Phong area during 1999-2000 are presented in Table 34. The concentration of oil in soils showed an increasing trend (2.4 times) in the Hai Phong port. On the contrary, the cyanide concentration decreased by a factor of 1.36 during the same period (Nguyen Thi Phuong Hoa 2002, Cao Thi Thu Trang 2005). Cyanide in the coastal water mainly originates from industrial activities on the mainland and from illegal fishing practices using poison (NaCN).

Table 34: Oil and cyanide in bottom sediments in the Hai Phong and Da Nang port areas (1999-2000)

	Hai Phong Port area (Do Son Station)		Da Nang Port Area	
Pollutants	**1999**	**2000**	**1999**	**2000**
Oil (mg/g dry)	0.080	0.199	0.043	0.040
Cyanide (mg/kg dry)	4.08	2.99	5.00	11.10

In Da Nang, oil and cyanide was also detected in the sea water. Average concentrations of oil in bottom sediments in 1999 and 2000 were lower than the concentrations in the Hai Phong Port Area. Meanwhile, the concentrations of cyanide were higher (Table 34).

At Vung Tau port areas, oil and grease have also been found in the sediments in Baria-Serece port (Table 35) (Nguyen Thanh Hung 2005).

Table 35: Oil in sediments in the Vung Tau Port Area

Location	Concentration of oil (mg/kg dry)
BaRia-Serece port (n=3)	63.3[a] ± 9.29[b] (53 – 71)[c]
Phu My – Cai Mep Port Area (n=5)	57.8 ± 10.0 (41 – 67) 8
Sao Mai – Ben Dinh Port Area (n=5)	73.8 ± 7.52 (64 – 87)

[a] Mean [b] Standard deviation [c] Range

In Sihanoukville, oil and grease were not found in sediment samples at the port basin during the EIA report in 1997 (JICA 1997). Oil and grease are not monitored at Phnom Penh Port.

3.3. Persistent Organic Compounds (POCs)

Table 36 shows the concentration of pesticides in soil in the Hai Phong port area. The monitoring results show that some pesticide compounds are higher than the TELs level such as 4,4' – DDE (2.39times), 4,4'- DDD (1.7-4.3 times), 4,4'- DDT (2.7-24.5 times), even higher than the PELs level (4,4'- DDT – 6.1 times) (Nguyen Duc Cu 2004).

Table 36: Pesticides in sediments in 2003 at Hai Phong port (mg/kg dry) (Nguyen Duc Cu 2004)

Time	Lindane	Aldrin	Dieldrin	Endrin	4,4' DDE	4,4' – DDD	4,4' -DDT	Total
March	0.290	0.343	0.316	0.167	-	-	-	1.116
May	0.283	0.336	0.531	1.377	0.451	0.488	**3.247**	6.712
August	0.095	Trace	trace	2.266	0.615	**2.034**	**4.394**	9.404
November	0.256	0.088	0.377	Trace	**4.946**	**5.410**	**29.207**	40.293
TEL	0.32		0.715		2.07	1.22	1.19	
PEL	0.99		4.30		374	7.81	4.77	

In Sihanoukville port, the EIA report in 1997 (JICA 1997) for the rehabilitation project of the port reported that no PCB were detected in seabed sampling sites. For other ports, no data on POCs in sediments and soils are available.

As for organotins, the presence of butyltin (BT) and phenyltin (PT) has been reported in several studies near port areas in Vietnam. BT and PT comprise of three metabolites: mono- (MBT or MPT), di- (DBT or DPT) and tri- (TBT or TPT) each. In Hai Phong, residues of organotins were found in sediments at Do Son (Midorikawa *et al.* 2004). The concentration of organotin compounds (normalised to tin) ranged from "less than the detection limit (< 0.04 ng/g dry weight)" to 1.2 ng/g dry weight for BTs and from 0 to 3.3 ng/g dry weight for PTs (Table 37). The same study also found organotins in sediment sample at Da Nang port area (Lien Chieu cargo port). The concentration of BTs (normalised to tin) in Da Nang ranged from "less than the detection limit" to 3.2 ng/g dry weight and the concentration of PTs ranged from 0.09 to 3.6 ng/g dry weight (Table 37). The compositions of BTs showed that higher percentages of TBT were observed in all the sites in the study. That indicates that there is continuous input of TBT in those areas. On the other hand, higher concentrations of MPT in all sites indicate that TPT is already degraded in the sediments (Midorikawa *et al.* 2004).

Table 37: BTs and PTs in sediments in the ports of Hai Phong and Da Nang (ng/g dry weight) (After Midorikawa *et al.* 2004)

Location	Sampling date	n	MBT	DBT	TBT	MPT	DPT	TPT
Do Son	Mar 2002	1	< 0.04	0.78	1.2	3.3	0.16	0.07
Da Nang	Aug 2002	1	< 0.04	1.5	3.2	3.6	3.6	0.09

The lower concentrations of both BTs and PTs at Do Son site in comparison to those at Da Nang might be the result of the proximity of the sampling sites of the later to port areas. Do Son is further from Hai Phong port area while the sampling site in Da Nang is located inside the Da Nang port area. The measurements of BTs (normalised to tin) in sediment in other places in the Hai Phong port area were done in 2003 at Nam Trieu river mouth (near Bach Dang shipyard), Cam river mouth (near several shipyards and mooring sites), Hai Phong cargo port, and the Lach Tray dry dock. The results are shown in Table 38. The high ratio of TBT over MBT+DBT indicates that TBT is still being introduced into the water (Nhan *et al.* 2005).

Table 38: BTs (as tin) in sediments in Hai Phong port (ng/g dry weight) (After Nhan *et al.* 2005)

Location	Moisture (%)	Total organic matter (mg/g)	MBT	DBT	TBT	Total BTs	Ratio TBT/(MBT+DBT)
Nam Trieu	35.9	67.6	14.9	30.1	34.9	79.9	0.61
Cam	34.8	54.6	29.7	42.7	49.5	122	0.68
Hai Phong port	38.4	62.4	5.0	8.1	8.3	21.4	0.60
Lach Tray	40.2	57.5	15.5	16.7	19.4	51.6	0.63

Similarly, in the Lien Chieu cargo port of the Da Nang port area, the concentrations of BTs were also measured (Table 39).

Table 39: BTs (as tin) in sediments in Da Nang port (ng/g dry weight) (After Nhan *et al.* 2005)

Location	Moisture (%)	Total organic matter (mg/g)	MBT	DBT	TBT	Total BTs	Ratio TBT/(MBT+DBT)
Da Nang	35.6	51.2	3.9	9.9	8.4	22.3	0.61

The presence of BTs and PTs in sediment and the high ratio of TBT and TPT over their degraded metabolites indicate that TBT and TPT are still being released into the Vietnamese waters, possibly through the use of antifouling paints on vessels.

4. *Biological resources*

The impact of port's and shipping activities on biological resources are reflected in different aspects. The negative consequences can be aesthetic impairment, habitat and biodiversity losses, malformation of species, reduced reproduction abilities, etc. Toxins are bioaccumulative and as such, environmental pollution can be reflected through the presence of toxins in biological samples. A study on the presence of toxins in biological indicators can help in assessing the release of toxic substances into the environmental as well as predicting the exposure of humans to those toxins.

Table 40 shows the results of studies on pesticides in oysters in the Do Son area near Hai Phong yielded the results in Table 40. Total.The total amount of DDT in oysters in 2002 and 2003 exceeded the Canadian guidelines for tissue residue of DDT in aquatic biota considred safe for the wild life that consumes it (CCME 2003).

Table 40: Organochlorinated pesticides in oysters in the Do Son area, Hai Phong (n=7) (The Northern Marine Environment Monitoring Station 2005)

Samples	Mean concentration (ng/g dry weight)								Total (ng/g)
	Lindane	Aldrin	Endrin	Dieldrin	4,4 - DDE	4,4 - DDD	4,4 - DDT	DDD+DDE +DDT	
1. April, 2002	0.93	-	3.61	Trace	0.73	-	2.01	**2.74**	7.28
2. September, 2002	1.69	0.36	3.06		0.75	1.10	2.34	**4.19**	9.30
3. March, 2003	-	-	1.62	-	-	-	-	-	1.62
4. September, 2003	0.92	0.83	3.13	1.20	0.59	4.40	2.08	**7.07**	13.15
5. April, 2004	-	-	0.47	-	-	-	0.61	0.61	1.08
6. September, 2004	0.30	-	-	-	-	0.84	-	0.84	1.14
7. March, 2005	-	-	2.40	-	-	-	-	0	2.40
Canadian standards					-	-	-	2.8	

Note: "-": Not detected

Studies on green mussels in 4 locations in Cai Hai Province, near the Hai Phong port area yielded the results shown in Table 41 (Monirith *et al.*, 2003). The concentratrions of DDT exceed the Canadian standards.

Table 41: OC in green mussels in Cat Hai – Hai Phong (ng/g lipid weight).

Location	n[a]	SL (mm)[b]	STW(g)[c]	Lipid (%)	PCBs	DDTs	CHLs	HCHs	HCB
1	38	13 (8–16)	26 (13–53)	1.1	86	530	14	3.6	<0.90
2	34	9 (5–13)	12 (3–39)	0.9	20	300	12	12	<1.1
3	8	12 (10–13)	23 (15–31)	0.7	450	2500	24	5.7	<1.4
4	12	5.42 (4–8)	3 (1–6)	2.0	110	420	5.0	3.0	<0.50

[a] Number of individuals homogenized. [b] Shell length. [c] Soft tissue weight.

In Vung Tau port and the adjacent industrial zones, development resulted in mangrove forest loss, especially in the Tan Thanh district. However, an exact evaluation of the loss has not been performed.

In the Port of Sihanoukville, the degradation of marine resources is caused by massive coral bleaching, overfishing, disposal of dredged material, small-scale marine and coastal industries, subsistence fishermen,, local and international maritime transport operations and local tourism.

Studies on biological samples (mackerel, crab, Malabar red snapper, and clam) showed the accumulation of metals. Lead and zinc were found in most of the samples in concentrations

that are 2 to 5 times higher than the permissible limits (UNEP 2003a; Apichai Sunchindah 1998; Ministry of Environment of Cambodia 2003). Cadmium and chromium have also been found in mackerel and snapper (Table 42).

Table 42: Metals in biological samples in the coastal water of Sihanoukville (Ministry of Environment of Cambodia 2003) (mg/kg dry weight)

Parameters	Mackerel	Malabar red snapper	Clam	Crab
Cadmium (Cd)	3.20	2.30	1.40	2.10
Copper (Cu)	10.30	9.30	14.00	12.60
Lead (Pb)	5.10	5.10	10.20	5.10
Manganese (Mn)	4.20	4.30	64.50	3.40
Zinc (Zn)	95.40	28.80	179.60	128.10
Total iron (Fe)	149.30	127.80	448.60	77.50
Cobalt (Co)	3.70	2.40	2.20	3.30
Lithium	1.20	0.60	0.50	1.00
Nickel (Ni)	5.60	4.40	6.80	3.20
Total chromium	7.60	7.60	0.80	1.50

In Cambodia, according to a study in 1999, concentrations of PCBs and OC (organochlorine) pesticides such as DDT's, HCH's, CHL's, and HCB's were detected in whole body homogenates of fish samples collected in inland and coastal waters. Among all the study locations, the percentage of DDT was highest in marine fishes from Sihanoukville. Maximum concentrations of PCBs were also found in fishes collected in Sihanoukville. However, concentrations of other substances were lower in fishes in Sihanoukville than in other locations (Table 43) (Monirith et al. 1999, 2000). The concentrations of POCs in the samples collected downstream from Phnom Penh city were also contaminated by DDT and PCBs. However, the contamination was attributed to untreated wastewater from agricultural and urban areas along the three rivers.

Table 43: Comparison of the concentration of OC in Sihanoukville and other sites (mg/kg fat)

Location	No. of species	Number of samples	Fat (%)	PCBs	HCHs	DDTs	CHLs	HCB
Koh Kong (marine)	5	15	3.3[a] (1.2-7.5)[b]	15 (3.6-31)	2.2 (1.2-3.1)	79 (14-140)	3.2 (0.1-7.4)	1.2 (0.4-2.3)
Sihanoukville (marine)	**6**	**18**	**2.6 (1.1-3.5)**	**21 (4.3-72)**	**1.1 (0.5-1.5)**	**68 (8.0-240)**	**2.2 (0.2-6.3)**	**0.6 (0.3-1.0)**
Kompong Chhnang (Tonlesap)	10	21	5.0 (0.4-17)	14 (1.0-25)	4 (1.0-7.5)	450 (11-2000)	4.6 (0.5-16)	2.0 (0.2-4.0)
Kompong Cham (Mekong upper)	10	22	5.4 (1.5-11)	10 (1.0-35)	1.5 (0.16-4.0)	290 (25-840)	3.0 (1.0-6.0)	2.2 (0.7-4.6)
Kandal (Mekong lower, Tonlesap and Basac)	**4**	**5**	**8.5 (1.3-13)**	**7.5 (3.5-17)**	**1.7 (0.7-2.6)**	**100 (34-270)**	**2.1 (1.0-4.1)**	**1.6 (0.7-3.0)**
Canadian tissue residue (CCME 2003)				3.95×10^{-6}		0.014		

[a] Mean [b] Range

Heavy traffic of international boats and ship construction wharfs in this region might be the reason for the high PCB concentrations (Monirith et al., 1999 and 2000). A similar study on mussels carried out in 2002 (Monirith et al., 2003) confirmed the seawater pollution by PCB's in Sihanoukville region (Table 44).

Table 44: OC in green mussels in Sihanoukville (ng/g lipid weight)

Location	n[a]	SL (mm)[b]	STW(g)[c]	PCBs	DDTs	CHLs	HCHs	HCB
Sihanoukville port	14	96 (54–96)	5 (2–27)	220	48	< 0.40	< 0.40	< 0.40

[a] Number of individuals homogenized. [b] Shell length. [c] Soft tissue weight.

Shipping activities around the ports in the study also introduce organotins and other persistent organic compounds into the water and sediment. This causes their accumulation in biotic samples such as clams and fishes. In Vietnam, organotins have been found in biotic samples collected at the Hai Phong and Da Nang port areas (Midorikawa *et al.* 2004).

Table 45: BTs and PTs in clams in the ports of Hai Phong and Da Nang (ng/g wet weight) (Midorikawa *et al.* 2004)

Location	Sampling date	MBT	DBT	TBT	MPT	DPT	TPT
Do Son	Mar 2002	0.86 (0.1 – 1.6)[a]	0.7 (0.7-0.7)	1.4 (1.4 – 1.4)	0.3 (0.3 – 0.4)	< 0.1	0.6 (0.5 – 0.6)
Da Nang	Aug 2002	28 (5.2 – 40)	6.1 (1.6 – 10)	6.8 (2.6 – 14)	8.4 (3.9 – 11)	0.3 (0.2 – 0.5)	0.3 (< 0.1 – 0.4)

[a] Range

The concentration of BTs in clam collected near port areas of Hai Phong and Da Nang in 2003 is presented in Table 46 (Nhan *et al.* 2005).

Table 46: BTs in clams in the ports of Hai Phong and Da Nang (ng/g dry weight) (After Nhan *et al.* 2005)

Location	MBT	DBT	TBT	Total BTs
Nam Trieu	14.1	14.3	9.1	37.5
Cam	18.4	26.6	15.1	60.1
Hai Phong port	3.7	4.4	5.6	13.7
Lach Tray	6.7	9.0	6.7	22.4
Da Nang	3.0	4.4	3.8	11.3

The concentration of BTs accumulated in clam was the highest at the Cam River mouth. The area is dominated by intensive shipping activities that could be the source of BTs released into the environment.

IV. EMISSIONS AND DISCHARGES FROM PORTS

Port operations involve different actors and various activities, which have potential to produce waste in different forms: air emissions, wastewater, and solid wastes. Table 47, Table 48 and Table 49 summarise different sources of major wastes from ports.

Table 47: Sources of emissions

Activities at port	Emissions	
	Type	Characteristics
Ships called at port	combustion smoke volatile matters	
Inland transportation	mobile source smoke dust noise	pollutants (COx, NOx, SOx, VOC, etc.) dust noise
Loading, unloading and storage	non-road engine smoke dust noise	pollutants (COx, NOx, SOx, VOC, etc.) dust noise
Maintenance	VOC dust noise	VOC (solvents, paints, etc.) dust noise
Administrative and services		

Table 48: Sources of liquid waste

Activities at port	Liquid wastes	
	Type	Characteristics
Ships called at port	wet cargo residue resulting from transhipment	depends on types of cargo
	ballast water	seawater, containing exotic organisms
	bilge water	high concentration of oil and grease
	sludge	used oil and grease
	gray and black wastewater	
Inland transportation		leakage (depends on types of goods) small oil spills
Loading, unloading and storage	leakage	depends on types of cargo
Maintenance	washing water rust drainage	wastewater contains heavy metals, oil and grease drainage
Administrative and services	household wastewater	contains mostly bio-degradable materials (flush wastewater), solvents, detergent, etc.

Table 49: Sources of solid waste

Activities at port	Solid wastes	
	Type	Characteristics
Ships called at port	dry cargo residue resulting from transhipment	
	cargo losses	
	household wastes	contains bio-degradable materials (food left-over) recycled materials (paper, plastic, nylon, glass)
Inland transportation		
Loading, unloading and storage	goods remnants packaging	depends on types of cargo contains recycled materials (plastic, paper, nylon, etc)
Maintenance	scrap iron used parts	contains metals and heavy metals contains recycled materials: iron, steel, etc
Administrative and services	household wastes	contains recycled materials (paper, plastic, glass) contains bio-degradable materials (food left-over) contains chemicals (solvents, detergents, etc.)

1. Emissions into the air

Dust problems in seaports can be generated from different sources such as smokestacks of vessels within port areas, locomotives, cranes, cargo trucks, industries chimneys, power plants, etc. Dust can have impacts on human health depending on the type of dust (particulate matter of the sizes less than 10 micron, or PM10, can impair lung function, aggravate respiratory illnesses, and be associated with premature death). Dust can also be toxic to living organisms and it can create local nuisance.

Other sources of air pollution are Volatile Organic Compounds (VOCs), including benzene, formaldehyde, and toluene, each of which poses significant health risks, including cancers and birth defects (NRDC 2004b). In ports, these VOC's are generated by the operation of traffic and industries.

Other pollutants in port atmosphere are NO_x, SO_x, CO, heavy metals and dioxins. Typical industries related to the port areas as well as the air pollution they cause include: painting and cleaning ships (xylene, toluene, methylene bromide), fuel distribution facilities (vapour contains benzene, toluene, xylene, other toxic pollutants), petroleum refining industries (benzene, toluene, xylene, chromium) and loading and unloading marine tank vessels (benzene, toluene, xylene, hexane, ethyl benzene).

Exposure to these types of air pollution can cause health effects at different levels, from headaches, dizziness, respiratory distress and disease, to lung damage, cardiovascular disease, endocrine disruption, visual impairment, diminished manual dexterity, learning impairtment, seizures, and even death.

Most of the ports in Vietnam and Cambodia are facing dust and air pollution, related to heavy traffic within and around ports areas. For Cambodia, in the case of Phnom Penh port, cargo handling at the port is mainly containers. Thus, there is no big problem with dust and air quality. However, the operations of trucks and handling equipments may contribute to noise pollution and the decrease of air quality along the connection between the port and the city.

Emissions in ports can come from different sources: stationary and non-road facilities (handling equipments and electricity generator), ships mooring at ports and harbour craft (tugboats, speed boats, etc), trucks operating in the port area, etc.

1.1. Emissions from ships

Operations of ships and tugboats introduce another source of emissions in ports. Ships arriving at ports also contribute to air pollution during their manoeuvring and hostelling in ports. Most of sea-going ships use diesel with very high sulphur levels. Therefore, activities of ships in port will emit a number of air pollutants, such as NOx, SO_2, CO, TSP, PM and VOC.

According to a report by the W.H.O., (Economopoulos 1993), pollution load by ships is as follows:

Table 50: Emission factors for sea-going vessels (Economopoulos 1993)

	NOx	CO	TSP	SO_2	VOC
Unit	Kg/Ship-days in berth	Kg/Ship-days in berth	Kg/Ship-days in berth	Kg/Ship-days in berth	Kg/Ship-days in berth
Motorships	90.7	0.036	6.8	136*S	4.1

With "S" is the weight percent of sulphur in fuel used. Most of sea-going vessels use residual oil with average content of sulphur of 2.7-2.9% (SMED 2004:23, Streets *et al.* 2000). In this calculation, "S" = 2.8.

Based on these emission factors, estimation of yearly pollution load by ships in the ports of Hai Phong, Da Nang, Vung Tau and Sihanoukville was computed using the following equation:

E = N° of ship calls in one year x Average duration at berth ÷ 24 ÷ 1,000

E is the yearly emission load (tonnes/year)

The results of the computation are presented in Table 51 (for 2004).

Table 51: Estimation of pollution load from ships in ports (tonnes/year)

Port	Type of ships	Number of ship calls	Ave. duration at berth (hr)[a]	CO	NOx	SO_2	TSP	VOC
Hai Phong	Container	178	6[b]	0.00	4.04	16.95	0.18	0.18
	Cargo	1,220	40	0.07	0.00	774.29	8.34	8.34
	Passenger	4	10[b]	0.00	0.07	0.63	0.01	0.01
	Total	1402		0.07	4.11	791.87	8.53	8.53
Da Nang	Container	458	6[b]	0.00	0.00	43.60	0.47	0.47
	Tanker	1,118	24[b]	0.04	0.00	425.73	4.58	4.58
	Cargo	2,584	40	0.16	0.04	1,639.98	17.66	17.66
	Passenger	24	10[b]	0.00	0.16	3.81	0.04	0.04
	Total	4,160		0.20	0.20	2,113.12	22.75	22.75
Vung Tau	Tanker	2,938	24[b]	0.11	0.00	1118.79	12.05	12.05
	Cargo	734	40	0.04	0.11	465.85	5.02	5.02
	Total	3,672		0.15	0.11	1584.64	17.06	17.06
Sihanoukville	Container	460	24	0.02	0.00	175.17	1.89	1.89
	Cargo	114	40	0.01	0.02	72.35	0.78	0.78
	General	155	45	0.01	0.01	110.67	1.19	1.19
	Total	729		0.03	0.02	358.19	3.86	3.86
Phnom Penh	Container	167	24	0.01	15.15	63.59	1.14	0.68
	Cargo	47	40	0.00	7.10	29.83	0.53	0.32
	Passenger	24	4[c]	0.00	0.36	1.52	0.03	0.02
	Total	247		0.01	22.61	94.95	1.70	1.02

[a] The number of days-in-berth was not directly known and was computed based on WHO Guideline using number of ship calls per year and the average mooring time: typical mooring time for passenger ships is 6 hours, for freighters and general ships is 45hr, for container vessels < 40000 GRT is 24hr, for container vessels > 40000 GRT is 36hr; for bulk transport vessels < 40000 GRT is 40hr, for bulk transport vessels > 40000 GRT is 50hr, for tankers < 40000 GRT is 36hr, and for tankers > 40000 GRT is 48hr.
[b] Recorded average duration in berth of ships at Da Nang Port.
[c] Recorded average duration in berth of ships at Phnom Penh Port.

Ships moored at berths contribute significantly to SO_2 emissions at port as most of current ships are using dirty diesel with very high concentration of sulphur for power.The use of high-level sulphur diesel also contributes to TPS and PM emission.

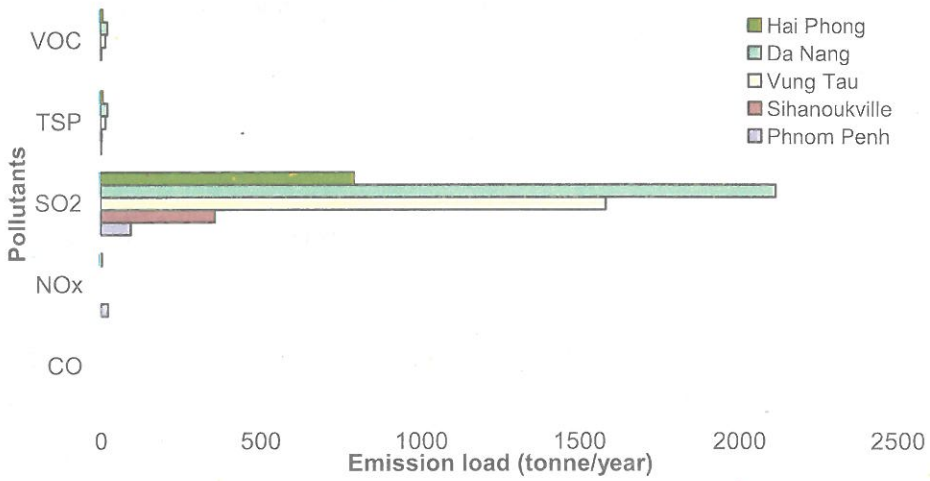


Figure 2: Emission load from ships visiting the ports in the study

Next to ships, harbour crafts (tugboats, speed boats, service boats, etc) are also important sources of emissions. To compute *emission loads from harbour crafts*, the following equation was used (ICF 2005):

Emission load = Emission factor (g/kWh) x equivalent capacity (kW) x operating hours (hours)

The emission factors for harbour craft are shown in Table 52 (US-EPA 1999):

Table 52: Emission factors for harbour crafts (g/kWh) (ICF 2005)

Minimum tugboat's capacity (kW)	NOx	CO	HC	PM10	SO_2
1000	13.0	2.5	0.27	0.3	0.63

In the port of Sihanoukville, 5 tugboats are in-service with the capacities ranging from 800 HP to 1,800 HP. The average capacity of tugboats is 1,320 HP, equivalent to 984 kW. In the port of Sihanoukville, in 2004, a total amount of 852,500 litres of diesel was fuelled to tugboats. Based on the assumption that each tugboat uses 314 litres of diesel in 1 hour in-service (Agyei 2002), the operating hours of tugboats in 2004 were 2,715 hours, equivalent to 543 hr/tug per year.

In the port of Da Nang, 10 tugboats are in service. In 2004, the amount of diesel fuelled to tugboats was 3,144,700 litres, equivalent to 10,015 hours in-service, or 1,001.5 hr/tug per year. The average capacity of tugboats in Da Nang is 1,000 kW.

For other ports, operations of tugboat were unknown. Therefore the estimation of pollution load from tugboats and other harbour crafts in the ports in Vietnam was performed based on the level of the Da Nang port and the estimation of pollution load from tugboats and other harbour crafts in the ports in Cambodia was performed based on the levels reported for Sihanoukville port. The number of tugboats operating at each of the ports is presented in Table 53.

Table 53: Number of tugboats at ports

Ports	Number of harbour-crafts	Capacity range
Hai Phong	15	218 HP – 3200 HP
Da Nang	10	350 HP – 2,700 HP
Vung Tau	28	140 HP – 2,400 HP
Sihanoukville	5	800 HP – 1,800 HP
Phnom Penh	3	350 HP, 550HP, 700HP

Total emission loads from tugboats at the ports in the study in 2004 were estimated as shown in Table 54. Table 54 also shows that sulphur oxide is the major pollutant contributed by harbour crafts in port. The levels of PM10 and VOC are also very high.

Table 54: Total emission loads from tugboats in ports in 2004 (tonnes/year)

Ports	CO	NOx	SO_2	PM10	VOC[a]
Hai Phong	37.56	37.56	195.29	9.46	4.75
Da Nang	25.04	25.04	130.20	6.31	3.16
Vung tau	70.11	70.11	364.55	17.67	8.86
Sihanoukville	6.79	6.79	35.30	1.71	0.86
Phnom Penh	4.07	4.07	21.18	1.03	0.51

[a] Conversion from HC to VOC used conversion factor of 1.053 (US-EPA 2003)

1.2. Emissions from trucks operating at ports

At seaports, air and noise pollution due to inland transportation between the ports and its service area are also important issues. In ports, mainly heavy-duty trucks running on diesel engine are in operation. Besides, there are also light-duty vehicles and passengers' vehicles.

The computations are based on the emission factors in the guideline published by WHO in 1993 (Table 55). This emission estimation does not include the emissions during idle periods (such as waiting time at a gate when going in and out, loading and off-loading of goods, etc.).

Table 55: Emission factors for heavy duty trucks kg/1000km (Economopoulos 1993)

	TSP	SO_2	NO_x	CO	VOC
Truck 3.5-16 tonnes	0.9	4.29*S	11. 8	6.0	2.6
Truck over 16 tonnes	1.6	7.26*S	18.2	7.3	5.8

With "S" is the weight percent of sulphur in fuel used. Typical values for diesel are 0.2% – 0.5%. In this calculation, "S" = 0.3.

At the port of Phu My alone (Vung Tau port area), around 300-400 truck-trips (heavy duty trucks) were recorded in 2003 (interview with port manager). In 2003, Phu My port handled around 1.5 million tonnes of cargo.

Because Sihanoukville is the only seaport in Cambodia, it is a busy port. Records taken during 4 months of 2005 (From beginning of March to end of June 2005) show 27,228 truck trips to the port, 23,747 trips from the port and a daily average of 420 truck-trips. Most of the trucks are heavy-duty diesel trucks (container trucks).

In Phnom Penh Port, there are 50 truck trips daily going in and out the port to deposit or pick up goods and containers. The traffic is continuous all year round. As Phnom Penh port is located inside the city centre, that traffic could be a source of environmental pollution and a nuisance to the local people.

For the ports of Hai Phong and Da Nang, and other ports in Vung Tau port area, there were no records of truck operations at the port. To estimate emission from truck operations at those ports, records of truck-trips and cargo handled at the ports of Phu My and Sihanoukville will be used.

	Hai Phong	Da Nang	Vung Tau (whole area)	Phu My port	Sihanoukville
Cargo amount (MT) 2003	12.00	2.18	21.25	1.50	1.80
Truck-trips/year				126,000.00	151,200.00
Regression between cargo handled and number of truck trips: *Number of truck-trips = amount of cargo handled (MT) x 84000*					
Estimated number of truck-trips	1,008,000.00	183,120.00	1,785,000.00		

Assuming that each truck has to drive 1km within the port area and half of the trucks have capacity ranging from 3.5 tonnes to 16 tonnes and the other half have capacity of 16 tonnes, the daily emissions from trucks in the ports are estimated as following:

Table 56: Total annual emission loads from trucks running in the ports (tonnes/year)

	TSP	SO_2	NO_x	CO	VOC
Hai Phong	1.26	1.75	18.35	6.70	4.23
Da Nang	0.23	0.32	3.33	1.22	0.77
Vung Tau	2.23	3.09	32.49	11.87	7.50
Sihanoukville	0.19	0.26	2.75	1.01	0.64
Phnom Penh	0.02	0.03	0.27	0.12	0.08

During idling time (waiting for loading and unloading goods, waiting to go in and out a gate, etc.), trucks also emit pollutants. For every hour of idling, a truck running on diesel can emit around 144g of NOx, 12.5g of hydrocarbon and 2.57g of PM10 (Bailey and Solomon 2004). Assuming that trucks going in and out the ports in this study idle 1 hour every trip (the average idling time of trucks at the port of Los Angeles), the total emission load per year at the ports was calculated using following equation:

E_j (tonnes/year) = IEF_j (g/hr) x TT x IT (hr)

where E is the total emission load of the pollutant j,

IEF is the idle emission factor of the pollutant j,

TT is the number of truck trips and

IT is the average idling time.

The results of the calculation are presented in Table 57.

Table 57: Annual emission loads from trucks during idling time (tonnes/year)

Total emission load	NO_x	VOC	PM10
Hai Phong	145.15	12.60	2.59
Da Nang	26.37	2.29	0.47
Vung Tau	257.04	22.31	4.59
Sihanoukville	18.14	1.58	0.32
Phnom Penh	21.77	1.89	0.39

Total emission loads from trucks' operation (during both running and idling periods) are presented in Table 58.

Table 58: Total annual emission loads from trucks running in the ports (tonnes/year)

	TSP	SO_2	NO_x	CO	VOC	PM10
Hai Phong	1.26	1.75	163.50	6.7	16.83	2.59
Da Nang	0.23	0.32	29.70	1.22	3.06	0.47
Vung Tau	2.23	3.09	289.53	11.87	29.81	4.59
Sihanoukville	0.19	0.26	20.89	1.01	2.22	0.32
Phnom Penh	0.02	0.03	22.04	0.12	1.97	0.39

1.3. Emissions from non-road facilities

To compute emission loads by *non-road facilities* at ports (forklifts, cranes, container stackers, transfer cranes, etc.), the following equation was used (US-EPA 1991, Economopoulos 1993):

$$E_i = P \times Hr \times HP \times LF \times EF_i$$

where: E = Mass emissions of i^{th} pollutants (tonnes/year)
P = Population of pollution source (units)
Hr = Annual hours of use of the pollution source (hr/y)
HP = Average horsepower of the pollution source (HP)
LF = Typical load factor of the pollution source
EF_i = Emission factor of the i^{th} pollutant (g/HP*hr)

The product of the annual hours of use (hr/y), the average horsepower (HP) and the load factor of the pollution source is called *per-source usage*. In this study, the annual hours of use

and the typical load factor are parameter as suggested by US-EPA (1991) (Table 59). The average horsepower is based on the average horsepower of the Sihanoukville port as the inventory data of stationary facilities in Sihanoukville was the most complete. In this study, only two groups of stationary facilities in ports were considered, the forklifts and the cranes. Other non-road mobile sources (such as tractors, trailers, mobile harbour cranes, etc.) were not considered due to the lack of data. Emissions from the electricity generator are computed independently.

Table 59: Per-source usage level of non-road facilities at Sihanoukville Port

Stationary facilities	Annual hours used (hr/y) (US-EPA 1991)	Average horsepower (HP)	Typical load factor (US-EPA 1991)	Per-source usage (HP*hr/y)
Forklifts	1,500	82	0.3	**36,900.00**
Cranes	629	197	0.47	**58,239.11**

For Sihanoukville port, all forklifts and cranes listed used diesel, therefore, the emission factors used were for diesel engines (Table 60).

Table 60: Emission factors for non-road facilities (gr/HP*hr) (US-EPA 1991)

Stationary facilities	CO	NOx	SOx	PM	HC
Forklifts	6.06	14.00	0.90	1.60	1.60
Cranes	4.20	10.30	0.93	1.44	1.29

The inventory of the population of pollution sources in the ports of Hai Phong, Da Nang, Vung Tau, Sihanoukville and Phnom Penh are presented in Table 61.

Table 61: Population of pollution source at the ports in the study

Ports	N° of Forklifts	N° of Cranes
Hai Phong	35	39
Da Nang	28	37
Vung Tau	41	52
Sihanoukville	16	14
Phnom Penh	20	19

Computation results of the emissions from non-road facilities for the three ports (using average horsepower of Sihanoukville port) are presented in Table 62.

Table 62: Total emission load (tonnes/year) at Hai Phong, Da Nang and Sihanoukville ports from non-road facilities

Ports	CO	NOx	SOx	PM	VOC[a]
Hai Phong	17.37	41.48	3.27	5.34	5.26
Da Nang	15.31	36.66	2.93	4.76	4.67
Vung Tau	21.89	52.37	4.18	6.78	6.66
Sihanoukville	7.00	16.66	1.29	2.12	2.10
Phnom Penh	9.12	21.73	1.69	2.77	2.75

[a] Conversion from HC to VOC used conversion factor of 1.053 (US-EPA 2003)

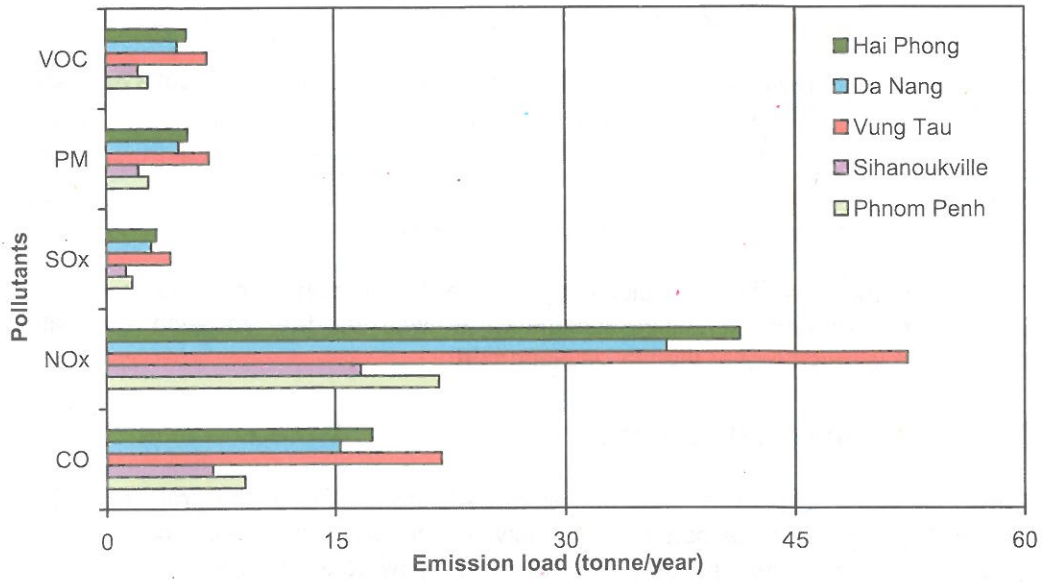


Figure 3: Emissions from non-road facilities at ports in the study (tonnes/year)

It is clear from Figure 3 that the dominant pollutant from non-road facilities at ports is nitrogen oxide, accounting for approximately 55% of the total emission loads. Although SOx and PM account for smaller proportions of the total emissions, they are key pollutants that could pose harmful effects to human health (such as respiratory illness, asthma, and bronchitis, especially workers of the ports) and on the environment (causing acidification which will harm aquatic life when deposited into the water).

Another source of emission is the *stationary engine* (such as electricity generators). Different from the port of Phnom Penh and the three ports in Vietnam, who use electricity from their national grid, the port of Sihanoukville generates all its electricity from the generator. In 2003, the generator provided 1,388,460 kWh and 1,835,220 kWh in 2004 of electricity. Total diesel used was 4,698,137 litres in 2003 and 4,811,288 litres in 2004.

At the other ports, generators are used as secondary power sources for emergencies. In the port of Da Nang, around 50,020 litres of diesel was consumed in 2004 to generate electricity. The generator supplied around 3% (2,534 kW) of the total electricity used (88,200 kW).

In the ports of Hai Phong, Vung Tau and Phnom Penh, records of diesel used for electric generators were not acquired.

The estimation of emissions into the air from the generator in Sihanoukville and in Da Nang in 2004 is computed based on the emission factors for large stationary diesel engine as given by US-EPA (US-EPA 2005a) (Table 63).

Table 63: Gaseous emission factors for large stationary diesel and all stationary dual-fuel engines (lb/MMBtu) (US-EPA 2005a)

Pollutant	NOx	CO	SOx	CO_2	PM	TOC (as CH_4)
Emission factor (fuel input)[a]	3.2	0.85	1.01S[b]	165	0.1	1

[a] The average heating value of diesel was assumed to be 19,300 Btu/lb with a density of 7.1 lb/gallon.

[b] "S" is the weight percent of sulphur in the fuel used. Typical values for diesel are 0.2% – 0.5%. In this study, "S" = 0.3.

Based on these emission factors, the total emission loads from generators at the two ports - Da Nang and Sihanoukville – are computed and the results are presented in Table 64.

Table 64: Pollution load from the generator in Da Nang and in Sihanoukville in 2004 (tonnes/year)

Port	NOx	CO	SOx	CO_2	TSP	VOC[a]
Da Nang	2.63	0.7	0.25	135.49	0.08	0.81
Sihanoukville	252.75	67.14	23.93	13,032.24	7.9	77.72

[a] Conversion factor from TOC to VOC used the conversion factor of 0.984 (US-EPA 2003)

As the generator is the sole electricity source for all port's activities in the port of Sihanoukville, the amount of diesel consumed as well as the emission generated in Sihanoukville port is much higher than in Da Nang port.

1.4. Total emission load at port

Based on above estimates, total emission loads from ports in the project in 2004 are presented in Table 65. For the port of Sihanoukville, the estimations were carried out most intensively. For all other ports, data deficiency does not allow better estimation.

Table 65: Total emission loads from all sources in 2004

Ports	Sources	Total emission load (tonnes/year)					
		CO	NOx	SOx	PM10	TSP	VOC
Hai Phong	Non-road facilities	17.37	41.48	3.27	5.34	-	5.26
	Generator	-	-	-	-	-	-
	Ships at berth	0.07	4.11	791.87	-	8.53	8.53
	Harbour crafts	37.56	37.56	195.29	9.46	-	4.75
	Trucks operation	6.70	163.5	1.75	2.59	1.26	16.83
	TOTAL	**61.70**	**246.65**	**992.18**	**17.39**	**9.79**	**35.37**
Da Nang	Non-road facilities	15.31	36.66	2.93	4.76	-	4.67
	Generator	0.70	2.63	0.25	-	0.08	0.81
	Ships at berth	0.20	0.2	2,113.12	-	22.75	22.75
	Harbour crafts	25.04	25.04	130.20	6.31	-	3.16
	Trucks operation	1.22	29.7	0.32	0.47	0.23	3.06
	TOTAL	**42.47**	**94.23**	**2246.82**	**11.54**	**23.06**	**34.45**
Vung Tau	Non-road facilities	21.89	52.37	4.18	6.78	-	6.66
	Generator	-	-	-	-	-	-
	Ships at berth	0.15	0.11	1,584.64	-	17.06	17.06
	Harbour crafts	70.11	70.11	364.55	17.67		8.86
	Trucks operation	11.87	289.53	3.09	4.59	2.23	29.81
	TOTAL	**104.02**	**412.12**	**1956.46**	**29.04**	**19.29**	**62.39**
Sihanoukville	Non-road facilities	7.00	16.66	1.29	2.12	-	2.1
	Generator	67.14	252.75	23.93	-	7.90	77.72
	Ships at berth	0.03	0.02	358.19	-	3.86	3.86
	Harbour crafts	6.79	6.79	35.30	1.71		0.86
	Trucks operation	1.01	20.89	0.26	0.32	0.19	2.22
	TOTAL	**81.97**	**297.11**	**418.97**	**4.15**	**11.95**	**86.76**
Phnom Penh	Non-road facilities	9.12	21.73	1.69	2.77	-	2.75
	Generator	-	-	-	-	-	-
	Ships at berth	0.01	22.61	94.95	-	1.70	1.02
	Harbour crafts	4.07	4.07	21.18	1.03	-	0.51
	Trucks operation	0.12	22.04	0.03	0.39	0.02	1.97
	TOTAL	**13.32**	**70.45**	**117.85**	**4.19**	**1.72**	**6.25**

- : data not available

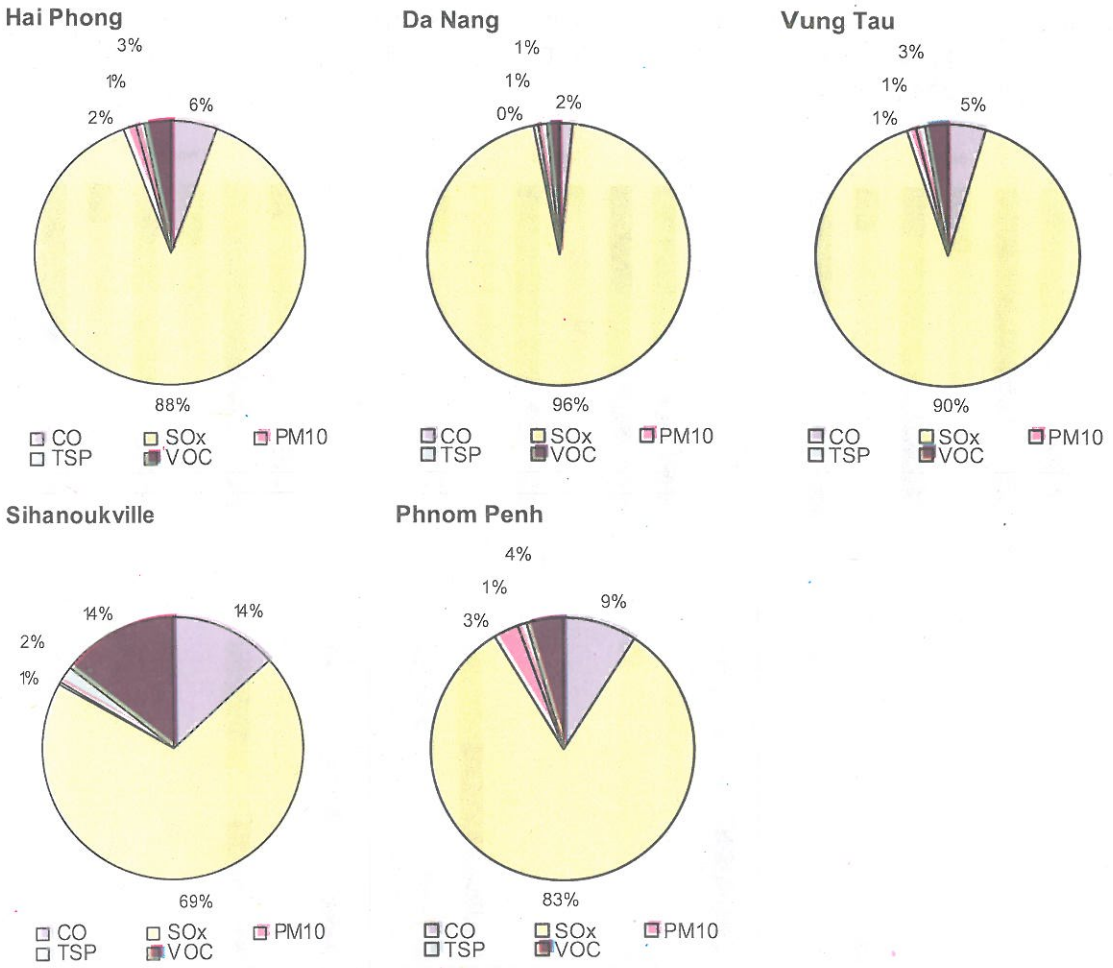


Figure 4: Annual emission load of the ports in the study

In the studied ports, SOx is the dominant air pollutant (accounts for more than three fourth of total emission load), followed by NOx (Figure 4). The largest SOx contributors are ships at berth and the use of "dirty" diesel with very high sulphur level.. In many countries, such as in Europe and in the United States, the level of sulphur in diesel used by sea-going vessel is being monitored and restricted. The European Commission has adopted the Directive 2005/33/EC of 6 July 2005 to limit the level of sulphur in heavy fuel oils (used by ships) used in the territory of EU Member states to below 1% by mass. As from 1 January 2010, the maximum sulphur content of marine fuels used by inland water-way vessels and ships at berth in Community ports will be 0.1% by mass. However, in Vietnam and Cambodia, there are no regulations related to the content of sulphur in the fuel used by ships visiting their ports.

Figure 5 shows that, in all the ports, ships, and harbour crafts account for the largest share of emission for all pollutants. Ships at berth are the largest contributors of SOx and TSP while harbour crafts and non-road facilities are responsible for the emissions of CO and PM10. Activities of trucks in the ports are the major sources for NOx emission. According to a study in 2004 at the Port of Los Angeles, activities of ocean-going vessels at berth contributed 86% of the total SO_2 emission, 55% of the total PM10 emission, and 36% of the total NOx emission (Starcrest Consulting Group 2004). At the port of Moerdijk (the Netherlands), NOx emission was the highest emission load in 2002, followed by SO_2 and VOC (Port of Moerdijk 2002). The main sources of emissions were industrial establishments in the port area.

In the ports of Hai Phong and Vung Tau, beside emissions from ships and harbour crafts, operations of trucks also contribute greatly to the total emission loads (Figure 5). In the port of Sihanoukville, the use of the generator as the principal source for energy for all activities contributes significantly to the total emission loads. It is the major source of air pollution in Sihanoukville port (Figure 5).

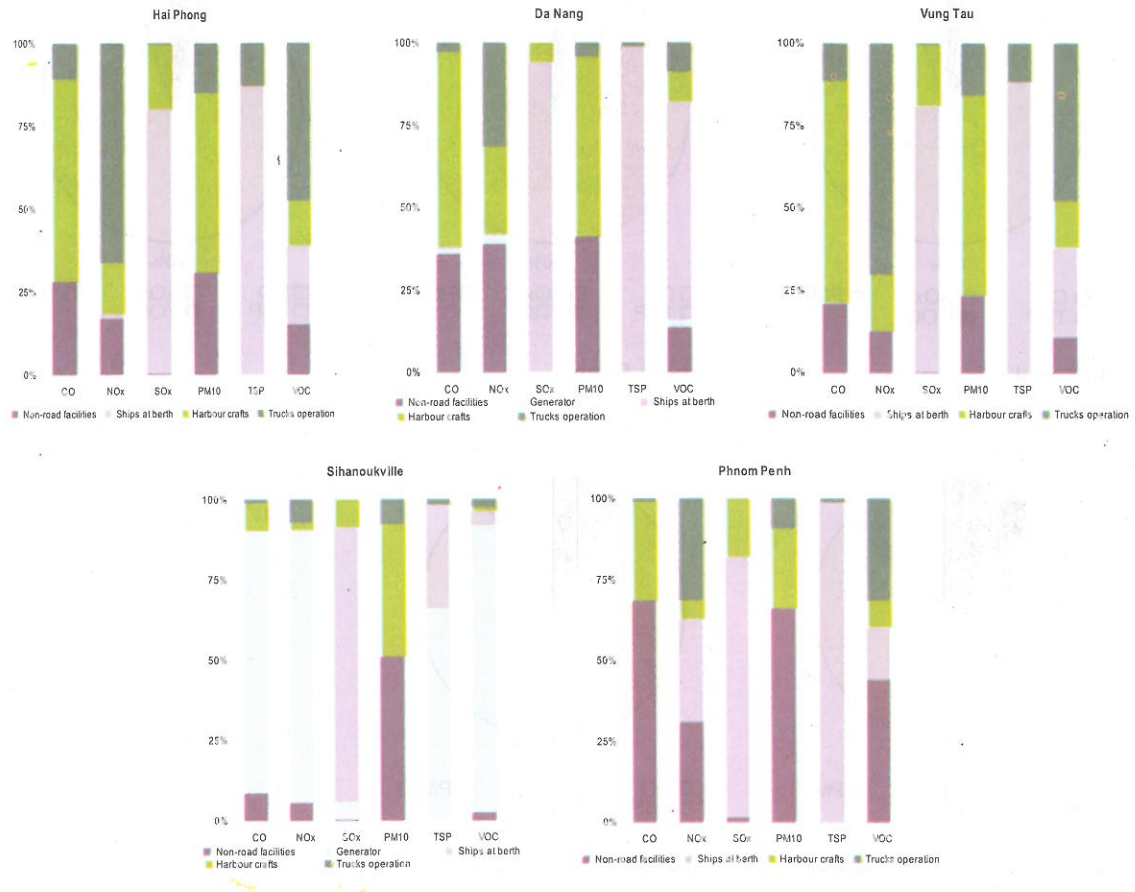


Figure 5: Contribution of sources in emission load in the ports in the study

In all the ports, the estimation of air pollutants emission loads does not consider pollution generated from goods and cargo transhipment at ports (e.g. dust generated during handling and transportation of cements, sand, coals, etc.).

2. *Wastewater*

Water quality in ports is affected by two major sources of pollution: (a) chronic pollution caused by daily operations of the ports, such as untreated wastewater, runoff, etc.; and (b) episodic pollution caused by catastrophic events, such as oil spills. The impacts of episodic events are noticeable and used to attract more immediate concerns from the government as well as the public. Chronic pollution is sometimes less obvious, but its impacts are by no means less important.

Water pollution from ship discharges may include oily/chemically contaminated ballast water, high BOD-containing sewage, and persistent materials from cargo and garbage. Drainage may contain fugitive emissions, e.g. oils, fuels, minor cargo-spills and de-icing salts. Run-off from contaminated land or chemical storage may contaminate groundwater abstracted for drinking supplies and it may contaminate adjacent land. Sewage effluent can deplete dissolved oxygen; potential for bacterial and viral contamination; change in benthos, etc.

International requirements for the prevention of pollution from chemical tankers are included in Annex II of MARPOL: "Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk". Annex II contains requirements applicable to ships carrying NLS in bulk for categorizing NLS; discharging of NLS residues or mixtures; pumping, piping and unloading arrangements; reception facilities; unloading procedures including efficient stripping and tank washing; cargo record book; surveys; International Pollution Prevention Certificate for the Carriage of Noxious Liquid Substances in Bulk; compliance with the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (so called IBC Code) or the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (so called BCH Code) by chemical tankers; carrying and discharging oil-like NLS; Procedures and Arrangements Manuals; and shipboard marine pollution emergency plans.

At ports in the project, wastewater collection and disposal systems vary between ports. At the port of Hai Phong, a drainage system of wastewater from manufacturing and domestic sources has been built and several preliminary treatment points have been constructed to treat the wastewater before discharging into the sea or the municipal drainage network. At present, some treatment methods are in use in Hai Phong port such as biological decomposition ponds, mechanical and chemical treatment ponds.

Liquid wastes from ships are currently collected by tanks, or pumping directly into onshore treatment ponds. However, illegal discharging of ballast water still occurs and there is no specialised treatment for oil and grease wastewater at Hai Phong port.

At Phu My Port, wastewater appeared at a very low discharge, not enough to form a flow during the supervision period. The samples tested in two days (November, 5th and 6th 1999) showed that water in the harbour area contained higher concentrations of pollutants (total coliform, oil) than in the outside while other parameters were almost similar. Towards the upstream area (to VEDAN Company), concentrations of nutrients as total-N, total-P were higher compared to those from Ba Ria SERECE harbour to the downstream.

Generally, concentrations of pollutants in wastewater in the port areas fall within the Vietnamese standard before the wastewater is discharged to the river, except for several cases (BOD_5, COD of the wastewater in the Baria-Serece port are higher than Vietnamese standard; NH_3 and H_2S was also found at higher values).

The Phu My Port is currently capable of receiving 60,000-DWT ships. The port production and business works will result in wastes (air pollutants, wastewater, and solid wastes). The implementation of the mitigating measures for environmental pollution is gradually taking off:

- Wastewater management: currently, domestic wastewater of the port has low discharge (< 5m^3/day), and is temporarily treated via the self-degraded tanks. Therefore, the wastewater discharge is not enough to flow into the river.
- The system for rainwater drainage is separate from the wastewater.
- Ship owners are not allowed (by the management board) to pump up the surplus water in the ships into the harbour area.

At Sihanoukville port, a sewage and drainage system has been built in the rehabilitation project. As of 2004, Sihanoukville relies fully on freshwater from underground source. A private company has been granted the access to the groundwater tables within Sihanoukville Port's area and has been operating on three wells. The extracted freshwater is of good quality and does not require special treatment before supplying to the clients. Clients of the groundwater extraction establishment are the port (for administrative and other works) and ships visiting port. In 2004, the port of Sihanoukville used 8,728 m^3 for all purposes. An amount of 18,722 m^3 was provided to ships.

At Phnom Penh port, the sewage and drainage systems of the port discharge directly into the municipal systems. However, the Phnom Penh port hardly receives wastewater from ships as most of the ships discharged their wastewater and sludge tanks at the port in Vietnam before continuing their journey to Phnom Penh.

3. *Oily wastes and other wastes from ships*

A large share of oil contamination is the result of chronic pollution from sources such as port's runoff, loading and unloading of oil tankers, removal of bilge water. The UHI (2001) reported that chronic oil contamination accounted for 70% of total oil pollution, which is more than two times as much as tanker accidents. Most of oil pollution stemmed from non-catastrophic events and frequently occurred during cargo handling operations.

According to the estimate of the NRC (2003), during the period 1990 – 1999, the average annual release of petroleum reached 1,300 thousand tonnes, in which maritime transportation accounted for 410.9 thousand tonnes, or more than 30% of the total release.

International requirements for the prevention of oil pollution from ships are included in Annex I of MARPOL, "Regulations for the Prevention of Pollution by Oil". Annex I contains requirements for surveys and inspections; International Oil Pollution Prevention Certificates; discharges of oil or oily water mixtures; reception facilities; segregated or dedicated clean ballast; crude oil washing; oil record books; oil rigs; restrictions on carrying water ballast in fuel tanks; restrictions on carrying oil in forepeak tanks; retention of oil in slop tanks; monitoring, filtering and separating equipment; sludge tanks; pumping, piping and discharge arrangements; size and arrangement of cargo tanks; double-hulling of oil tankers; subdivision and stability of oil tankers; and shipboard oil pollution emergency plans.

In Vietnam, National Oil Spill Response Action Plans have been prepared by the Vietnamese Search and Rescue Committee and in accordance to this national plan, each port (especially oil ports) has to draw an Oil Spill Response Plan. National exercises have also been organised occasionally.

In Cambodia, however, there is no contingency plan yet and the need for such a plan is obvious. It is necessary to prepare the ports in the situation of small and large oil spills. Technical and financial aspects remain major constraints in the preparation of this plan.

At Hai Phong port, the shipmaster must apply for a permit from Port Authority to remove or discharge waste and residues from the ship. Upon obtaining the permit, waste discharge may be carried out. The application letter is submitted to the Port Authority of Hai Phong. Private companies, which are permitted to collect and dispose ship's oily waste can be contracted to carry out ship's oily waste disposal. For garbage and other solid waste, the waste must be collected on board into containers, and subsequently be taken away by the servicing company (Hai Phong Port Authority 1994).

In the Hai Phong seaport, the facilities to carry out the waste collection and removal services must meet the requirements defined in the sanitary and environmental protection regulations. The shipmaster is obliged to facilitate the service activities and to pay the service cost, prior to the ship's departure. The port has to prepare the facilities to receive garbage and waste and it is allowed to charge an environmental fee.

In the first 9 months of 2005, 181 vessels applied for permission to discharge oily waste (bilge, oil sludge and ballast) at Hai Phong Port. The total amount of oily wastewater collected is 1,971.43 tonnes. At present, there are 3 private companies who are permitted to collect and dispose oily waste from ships. They are contracted directly by the vessels to collect and dispose

the waste. A part of the oily waste is sold as fuel for kilns, the other larger part (around 85%) is treated and disposed according to regulations.

Table 66: Wastes from ships collected by ports in the project

	Bilge	Oil sludge	Ballast	Liquid waste	Solid waste
Hai Phong (First 9 months of 2005)	1,187 tonnes,	742.63 tonnes	41.8 tonnes		
Da Nang	-	-	-	-	-
Vung Tau	none	none	none	none	none
Sihanoukville (2004)	180 tonnes	150 tonnes	144 tonnes	120 tonnes	2,800 tonnes
Phnom Penh (2004)	-	-	-	-	0.95 tonnes

In the port of Vung Tau, due to the limited capacity of reception facilities for oily wastewater, vessels are not allowed to discharge bilge, oil sludge and ballast water at Vung Tau port. For vessels that need to discharge oily wastewater, special arrangement will be made with the Ho Chi Minh City Port Authority and specialised ships will come to Vung Tau to collect the waste and transport to Ho Chi Minh City for disposal.

In the Sihanoukville port, oily wastewater is collected and disposed by contracting a sanitary company.

4. *Antifouling paint*

A new IMO convention (IMO, 2005) will prohibit the use of harmful organotins (TBT) in anti-fouling paints used on ships and will establish a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. Under the terms of the new Convention adopted on 5 October 2001, Parties to the Convention are required to prohibit and/or restrict the use of harmful anti-fouling systems on ships flying their flag, as well as ships not entitled to fly their flag but which operate under their own authority as well as all ships that enter a port, shipyard or offshore terminal of a Party.

Ships of 400 gross tonnage and above engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will be required to undergo an initial survey before the ship is put into service or before the International Anti-fouling System Certificate is issued for the first time. When the anti-fouling systems are changed or replaced, only a survey is required.

Ships of 24 metres or more in length, but less than 400 gross tonnage, that are engaged in international voyages (excluding fixed or floating platforms, FSUs and FPSOs) will have to carry a Declaration on Anti-fouling Systems signed by the owner or authorized agent. This Declaration will have to be accompanied by appropriate documentation such as a paint receipt or a contractor invoice.

Anti-fouling systems to be prohibited or controlled will be listed in an annex (Annex 1) to the MARPOL 73/78 Convention, which will be updated when necessary.

Both Vietnam and Cambodia have not joined the new IMO Convention and there is no enforcement of the antifouling regulations at national level. Monitoring and assessment of antifouling paints are limited to occasions when harmful incidents occur.

Ship repair is a very important source of anti-foulants such as organotins, copper, etc in water.. In the port area of Hai Phong, there are 3 large shipyards which build and repair about 80 vessels a year. The Pha Rung shipyard, the largest of the three, handled more than 50% of the ship repairing activities in 2004. The port of Vung Tau has 2 shipyards. The use of anti-fouling paint at all the shipyards in Hai Phong and Vung Tau has not been monitored. However,

according to several studies on organotins in sediments and biological samples at several port areas of Hai Phong, Da Nang and Ho Chi Minh City (Midorikawa *et al.* 2004, Nhan *et al.* 2005), organotins were found both in sediments and biological samples.There was a high ratio of TBT/(MBT+DBT) which suggests that organotins were still being introduced into the water around the port areas.

5. *Ports' wastes*

The collection, handling, transportation, and storage of oil, noxious liquids, harmful substances, sewage, garbage and litter, ballast water, and contaminated dredged material together with the risks of spillage, leakage, and illegal operations have potential impact on water (surface and ground), soil, air, habitats and humans.

International requirements for the prevention of pollution from sewage are included in Annex IV of MARPOL: "Regulations for the Prevention of Pollution by Sewage from Ships". Annex IV contains requirements for surveys, International Sewage Pollution Prevention Certificates, sewage treatment plants, discharging sewage, reception facilities and standard discharge connections.

International requirements for the prevention of pollution from garbage are included in Annex V of MARPOL: "Regulations for the Prevention of Pollution by Garbage from Ships". This Annex contains requirements for placards, garbage management plans, garbage record keeping, disposal and reception facilities.

Cambodia has joined MARPOL 73/78 convention and all of its 5 annexes. Vietnam, however, has just joined MARPOL 73/78 with its Annex I and II (IMO 2005). Currently, port waste is not well managed in Cambodian ports. Liquid waste is not well treated before discharging into water bodies. Solid waste is not monitored, classified for possible recycling, and properly disposed of. In both Vietnamese and Cambodian ports, solid waste collection and disposal are contracted out to public sanitation services and the ports assume little (or no) responsibility over the waste.

At the port of Hai Phong, along with wastes from ships, solid waste collected within the port areas (scattered materials during loading and unloading cargo, solid waste floating over the sea, etc.) is gathered at rendezvous points. The contractual sanitation company will collect the solid waste periodically based on the agreement with the port. Currently, there is a plan to build incinerators for big ports within the Hai Phong port cluster. The cost of disposal of port's garbage in 2004 was about 42 million VND/month (= 2,030 EUR/month). It is estimated that the 3,500 workers of Hai Phong Main port consume 100,000 m^3 of fresh water annually and produce 75,000 m^3 of wastewater and 145 tonnes of solid waste annually.

At Da Nang Port, with 1088 workers, it is estimated that 245,000 m^3 of freshwater is used annually, generating183,750 m^3 of wastewater annually. Workers at Da Nang port area also generate around 45 tonnes of solid waste a year (Table 67).

The main sources of solid wastes in the port of Vung Tau are related to industrial activities (highest proportion is from petroleum industries). According to reports from the Urban Construction Company of the province, the Oil Joint-venture company (shown in the petroleum waste treatment project), and the Ministry of Health, the average amount of petroleum waste was 20,600 tonnes/year (equivalent to 57 tonnes/day), in which 5,600 tonnes of waste was from the exploitation process and 15,000 tonnes came from industrial and domestic wastes related to petroleum activities. At present, the common treatment measure is to dispose of the collected waste in the municipal landfills.

For petroleum wastes, part of the wastes is transported to the shore and stored in the Nui Dinh container. Currently, the container is overloaded and there are signs of wastewater leakage which affects the groundwater in the area. VietsoPetro was in 1999, planning to build a petroleum waste treatment plant in the Hoi Bai waste treatment complex using a burning technology with a 2,4 tonnes/hour capacity..The intended investment was about US$ 5 million. However, the project has not yet been implemented.

At the Phu My port of Vung Tau port cluster, construction and domestic wastes are well-managed (effective collection, standard recycle bins placed in the harbour area ensuring the cleanliness of the area).

In 2003, Phnom Penh port used 37,183 m^3 of fresh water supplied by the municipal freshwater supply system. With an average wastewater generation rate equivalent to 75% of total freshwater input, the wastewater generation rate of Phnom Penh port in 2003 was around 27,887m^3/day.

With 509 port workers, it is estimated that Phnom Penh port generates 21 tonnes of solid waste a year (Table 67). Solid waste at Phnom Penh port is collected by a contracting company and dumped at the municipal dumping site.

In Sihanoukville port, the total amount of solid waste generated by the port itself in 2003 was 720m^3 and in 2004 this was 730m^3. The port itself organises solid waste collection and sends it to the communal dumping site. The collection capacity of the port is 850 m^3/year. With a total of 1044 port workers,,the average discharge rate in Sihanoukville port is only 0.7 m^3/year or 0.115 kg/worker/day (waste density of 100 lb/cu/yd according to US-EPA 1998).

Table 67 shows estimates of solid waste and wastewater generation at ports based on the solid waste generation rate of Sihanoukville (0.115 kg/worker/day), the fresh water consumption rate of 80l/worker/day and the wastewater generation rate equivalent to 75% of fresh water used (equivalent to 60l of wastewater per worker per day). For Sihanoukville port and Phnom Penh port, the amount of fresh water used was the actual amounts used as reported by the ports. For other ports, the amount of fresh water used was estimated based on the consumption factor of 80 l/worker/day.

Table 67: Solid waste and wastewater generation from ports

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
Port workers (people)	3500	1088	-	1044	509
Fresh water used (m^3/year)	100,800	245,000	-	8,728	37,183
Estimated wastewater (m^3/year)	75,600	183,750	-	6,546	27,887
Estimated solid waste (tonnes/year)	144.90	45.04	-	43.31	21.07

- : data not available

The above estimation is based on the consumption and discharge of port workers alone. Solid waste and wastewater generated during handling and transportation of goods (goods remnants, cargo losses, etc.) are not considered in this report due to the lack of data.

6. *Dredging material*

Dredging and disposal of dredged materials can pose different impacts on human health and the environment. The dredging process, which involves dispersing and re-settling of re-suspended sediment, can cause metal and toxic compound bioavailability, light attenuation and smothering of benthos. The entrainment can physically damage marine organisms. The

changes in bathymetry can lead to the changes in wave energy, flow conditions, sediment distribution and coastal geomorphology. Dredging in most of the cases will lead to habitat loss or alteration, loss of species, and damage to ecosystem. Disposal of dredged materials on the other hand will reallocate toxic sediments; it will increase turbidity and siltation of open waters; or lead to leaching or drainage of contaminated water into adjacent sites.

To manage dredging processes and the disposal of dredged materials, regulations have been promulgated in the United States as well as in European countries. In the United States, an Action Plan on Dredged Material Management has been prepared in 2001. The U.S Environmental Protection Agency (EPA) has also promulgated ocean dumping regulations as well as the list of EPA Recommended Dumping Ocean Sites (US-EPA 2005b).

In Europe, dredging and disposal of dredged material is regulated by the Convention for the Protection of the Marine Environment of the North East Atlantic, better known as 'OSPAR Convention' (Combined Oslo Paris Convention, 1992). The Baltic Marine Environment Protection Commission (Helsinki Commission or HELCOM) has also adopted guidelines addressing the disposal of dredged materials. According to article 11 of the Helsinki Convention, dumping of dredged materials is made subject to a prior special permit. The designation of protected areas under the Habitats Directive (92/43/EEC) also puts limitations on both dredging and disposal of dredged materials. Furthermore, the EU Council Directive 97/11/EC enforces performers of projects that entail dredging to make an assessment of environmental impacts. Several European countries have their own legislation concerning dredging, based on these Conventions. In Belgium for example, a cooperation agreement has been signed to safeguard the North Sea from the adverse environmental effects of dumping dredged materials in water covered by the OSLO Convention.

Although dredging is carried out at most of the ports in Vietnam and Cambodia, there are not any comprehensive studies on environmental impacts of the activity. In Vietnam, there are laws concerning dredging or dumping of dredged materials. Sea areas where dredging material can be dumped are allocated by the Ministry of Science and Technology and the Port Authorities. However, dredging material is not examined to identify possible pollutants.

The amount of dredged material in Hai Phong Port areas in 2004 was 2,854,000 m^3. This material was discharged either offshore, at Ruot Lon River, South River, or inland. In 2004, Hai Phong port spent 25 billion VND (equivalent to around 1.2 million EUR) on dredging.

In Da Nang port, due to its natural location in a bay with good depth, dredging takes place only at afew places to maintain a good access channel to some of the ports. In 2004, more than 530,000 m^3 of dredging material was excavated along a total of 1.6 km of access channel. Dredging material is dumped both offshore and ashore.

At Vung Tau port area, dredging is taking place in recent years as capital dredging. In 2004, nearly 600,000 m^3 of dredging material was excavated. By 2010, some ports from Ho Chi Minh City port area will be re-allocated to the Ba Ria – Vung Tau port area. The Ba Ria – Vung Tau port area will become the key port group with a focal port area in the Cai Mep – Thi Vai river. With this port development plan for this area, capital dredging will still continue for years to come. In 2005 alone, the expected dredging amount of the Vung Tau – Thi Vai Access Channel Improvement project is 10 million m^3 (Vung Tau Port Authority 2004).

Table 68: Dredging work

Port	Length of channel(s)	Amount dredged (2004)	Dredging frequency	Substrate type	Dumping site(s)
Hai Phong	15 km	2,854,000 m^3	3 times/year	Mud + sand	Offshore + ashore
Da Nang	1.6	530,383 m^3	1 time/year	Mud + sand	Offshore + ashore

Port	Length of channel(s)	Amount dredged (2004)	Dredging frequency	Substrate type	Dumping site(s)
Vung Tau	-	586,000 m^3	Capital dredging		Inland + Off shore
Phnom Penh	1.5 km	30,000 m^3	1 time/year	Mud + sand	Inland
	3 km	-	1 every 4 years		
Sihanoukville	1 km	356,359 m^3	Capital dredging	Clay, sand, silt, stone	Near shore
	Port's basin	550,967 m^3		Clay, sand, silt, stone	Near shore

In Sihanoukville, during the rehabilitation project, a huge amount of substrate materials were dug up and reallocated. In 2003, the dredged amount in the port basin was 550,967 m^3. Dredging work to deepen the access channel in 2004 resulted in 356,359 m^3 of dredged materials. During the rehabilitation project, turbidity of sea water was monitored regularly. According to the monitoring results, the turbidity of water was within the permissible levels for the construction period. Dredged materials are dumped at sea, within the Kompong Som Bay. The two selected sites located at Dek Koul island, where coral reefs exist.

Phnom Penh Port regularly conducts dredging to maintain the approaching channel. In addition, the Port has contracts with local land owners or private companies who wish to reclaim their land. As such, dredging materials are used to fill up the land in surrounding areas. Since there are not many factories along the river bank and since vessels calling to Phnom Penh never have dangerous or toxic cargo on board, it is assumed that the concentrations of toxic substances introduced into the water due to shipping activities are insignificant.

However, preliminary assessment of the environmental impacts of dredging activities shows that the water quality at ports areas during dredging period is worse than during the normal operation of the port. The turbidity - the level of dissolved oxygen and the level of total suspended solids in water are all higher than during normal operation. In Vietnam, the dredging process is governed by a regulation on dredging and maintenance activities in ports. In Cambodia, there is no specific regulation concerning this issue.

7. *Hazardous cargo*

During loading and unloading of hazardous cargo, discharges and emissions can occur, resulting in environmental pollution. Depending on the type of the cargo, different environmental pollution can also take place during the transport, transhipment, storage, processing and manufacturing. Spills, leaks, fire, explosion, discharges and emissions can have different levels of effects, from risk of injury, illness, to accident and death. There are risks to air, soil, sediment, water, groundwater and habitats within a local port area and its wider environment. In several ports located in European marine sites, cargoes may include harmful substances including oil, liquefied gas, pesticides, industrial chemicals and fertilisers, where accidents may result in their release which can adversely affect the marine environment (ABP Research 1999).

The MARPOL Convention (Annex II and III) has classified the environmental effects of harmful substances carried at sea in bulk or in packages. The environmental hazards of carrying harmful substances include damage to living resources (toxicity), bioaccumulation, hazard to human health (oral intake, inhalation and skin contact) and reduction of amenities.

Concerning management of hazardous cargo, Vietnam has ratified annexes I and II of the MARPOL Convention. Cambodia, on the other hand, has ratified all 5 annexes of the Convention.

Most of the environmental hazards in port areas are oil spill related, caused by ship sinking. No cases of oil sludge pumping to the sea have ever been recorded. Statistics from the

Vung Tau port authorities, from 1993 to 1998, noted that there were about 30 ships (both cargo-carrying and fishing) that sunk in the area. The estimated amount of oil spreading in the sea was 3,200 tons, not including the amount of oil spilling from the hundreds missing ships in the Linda storm event in 1997.

Statistics from the Survey, Research and Consultant Center for marine environment, from 1987 to 1998, noted that the coastal areas of Vietnam experienced 89 cases of oil spills.

The oil spills have caused serious consequences for the environment. For example, the ship Pan Harves (from Taiwan) and the Sai Gon ship collided with each other on September 20th 1993 and caused the Taiwanese one to sink. Together with the goods, nearly 300 tones of oil were spreading over a vast area (approx. 640 km^2) off the Ba Ria – Vung Tau coast.

In the area of the event, oil concentration in the seawater was hundreds times higher than the allowable limits resulting in the decline of primary productivity and directly affected the aquatic life. As affected by the West and South-West monsoon and the sea currents, the oil film was drifted ashore. This caused severe pollution to the aquaculture areas in the estuaries and coastal waters of Ba Ria – Vung Tau, Ho Chi Minh city, Tien Giang, and Long An.

On September 7th 2001, the ship FORMOSA ONE collided with the PETROLIMEX, causing 900m^3 of oil commodities to disperse into the Vung Tau harbour, an area of high environmental sensitivity. This was a serious accident of oil spills that impacted vast areas of the estuarine and coastal zones (859.2 km^2), including shrimp farming, mangroves, and the major bathing areas. It posed severe impacts to the economy, particularly the aquaculture, tourisms, and industrial sectors. It also affected the public health and caused environmental degradation. The total loss from the accident was estimated at 257,707 million VND (equivalent EUR 12,885 million), in which:

- Aquaculture: 52,387 million VND.
- Tourisms (2001-2002): 69,913 million VND.
- Agriculture: 6,553 million VND.
- Biotic resources: 38,373 million VND.
- Health sector and public health: 11,740 million VND.
- Coast treatment and restoration work: 63,712 million VND.
- Surveying and estimating the loss: 15,027 million VND.

Besides the events of oil spills caused by technical failure and appalling weather, the violation of the maritime law has also led to the pollution of sea environment. The main causes are the low technical levels and knowledge on the law of the mariners. From 1992 to 1998, 30 typical cases of law violations (in the area under the control of the Vung Tau port authorities) were enforced. The most popular violations were the discharges of wastewater, solid wastes, etc. into the sea while anchoring at the ports, or causing gas leakage to the sea during recharging times.

Currently, the inspection and control tasks of the port authorities are facing lots of difficulty related to inadequate and old-fashioned facilities and methods. The financial measures currently applied are more effective than the administrative measures; yet, it is not enough to deter the violations. As a result, violation cases are increasing.

V. RESOURCE USE AT PORTS

1. Freshwater usage

Freshwater is used for different purposes in the port. Freshwater can be supplied to ships called at ports, to industrial activities within the port's territory or to daily activities of port's workers. A large amount of water is also used to clean up equipments (cargo-handling equipments, trucks, etc.) and yards. In the ports in this study, there are presently no industrial activities.

Most of the freshwater is used by the port to clean equipment and storage areas or for sanitary purposes. At ports, which receive international cruise ships, the amount of freshwater supplied to ships is very high, such as in the port of Da Nang where many large cruise ships visit the port and acquire freshwater at the port for their return journeys. The ports of Da Nang consumed around 2% of the total fresh water produced in Da Nang in 2004.

Table 69: Freshwater usage

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
a. Amount of fresh water provide to ships (m^3)		90,000	-	18,722	440
b. Amount of fresh water used by the port (m^3)	100,800*	245,000	-	8,728	37,183
c. Source of fresh water:					
c1- From wells inside the port (%)			-	100.00	
c2- From municipality supplies (%)	100.00	100.00	-		100.00

* estimated amount based on the number of workers

All the freshwater used by the ports in the study comes from municipal supply, except for the port of Sihanoukville. In the port of Sihanoukville, freshwater is extracted from the ground water table. A private company is operating on water extraction and supplies freshwater for both port's operation and ships. At present, 3 wells are in operation with the depth of around 150m. An Environmental Impact Assessment has been carried out before the establishment of the water plant. According to the assessment, the maximum discharge rate of the water table inside Sihanoukville port is 500 m^3/day.

Most of the ships that visit the port of Phnom Penh are barges which travel regularly between Ho Chi Minh City (Vietnam) and Phnom Penh. Due to the short travel distance, the ships do not require water supply from the Phnom Penh port. They take on the water and supplies and discharge waste in Ho Chi Minh City.

2. Energy consumption

Fossil fuel consumption is the resource use of greatest concern associated with transport in general, and with shipping and operations at the port in particular. The use of fossil fuel accounts for both the depletion of non-renewable resources and the resulting air pollution. The most frequently used fossil fuel in shipping and port industries is diesel. Sea-going vessels normally use diesel with very high concentration of sulphur and subsequently emit huge amounts of SO_2 into the atmosphere. Cargo-handling equipment and heavy-duty trucks also operate on diesel.

In the ports in the study, the amount of diesel and gasoline used at each port is presented in Table 70. In all the ports, a large proportion of diesel and gasoline is used by trucks and cargo-handling equipments. Several cargo-handling equipments run on electricity.

Table 70: Diesel usage

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
a. Amount fuelled to ships (litre)	-	3,472,700	-	852,500	none
b. Amount fuelled to cargo-handing equipments and trucks (litre)	-	2,469,840	-	6,703,942	332,584
c. Amount of fuel used for electricity generator (litre)	-	50,020	-	4,811,288	none

Electricity usage at the ports in the study is mostly for lighting at docks. 30% to 50% of the electricity is used for that purpose (Table 71). In 2004, the port of Sihanoukville consumed 1,051,200 kW of electricity for lighting purpose, or 120 kW per hour, equivalent to hourly usage of 120 lanterns of 1,000W each. In the port of Da Nang, around 40% of the electricity consumed in 2004 was to light up the ports.

Lighting is a prerequisite if a port wants to do night shift to increase its handling capacity, to receive more vessels and to ensure security. Night lighting in the port is also a source of nuisance for local people. At the coastal area, night lighting also affects aquatic creatures. For some species, strong light at night and the use of flashing lights can cause confusion of biological rhythms and disorientation. For example, sea turtles are misguided by lighting (from cities and industrial centres) along the coasts and cannot find beaches to lay eggs.

Table 71: Electricity usage

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
Total electricity used in 2004 (kW)		88,193		1,857,120	188,003
a. Electricity supplies to ships (kW)		8,734		223,380	none
b. Electricity for office building,(kW)		44,780		582,540	75,070
c. Electricity for lighting at docks/terminals/etc. (kW)		34,679		1,051,200	112,933
d. Source of electricity:					
d1- From national grid (%)		97.13		0.00	100.00
d2- From its own generator (%)		2.87		100.00	0.00

Except for the port of Sihanoukville, whose electricity is generated on-the-spot, the ports in the study connect to their national grids for electricity.

For the ports of Hai Phong and Vung Tau, no data was received concerning electricity usage at ports. However, with current 24h operation at most of the ports at these two port areas, electricity consumption is expected to be high.

3. *Land use*

In order to receive higher cargo throughput, ports have to prepare development plans. Water-related expansions can lead to the loss of marine habitat, change to hydrography, bathymetry and sediments. Land-related expansions on the other hand can pose significant impacts on terrestrial and inter-tidal habitats and they can create problems of previously contaminated land. Associated construction activities lead to potential increase in noise and exhaust emissions.

Among the three Vietnamese ports in the study, Da Nang port is the largest port in terms of land area. Hai Phong port is the smallest. As the oldest port out of three, Hai Phong port has

been developing physically until recently. The ports in the Hai Phong port area stretched along the Cam river and Bach Dang river. Several ports are located that the Lach Tray river mouth.

Table 72: Land use *

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
a. Total water area (ha)	none	47.42	48.54	-	none
b. Total land area (ha)	119.4	170	146.61	110	43.61
c. Warehouse (m^2), divided by:	96,550	84,650	62,337	36,000	3,455
- Area of general warehouse	89,050	-	52,337	29,500	-
- Area of warehouse for CFS	7,500	-	10,000	6,500	-
d. Area of open stores (m^2)	394,000	125,350	392,906	75,000	-
- Container yard	223,000	10,350	21,900	25,000	-
e. Capacity of silos (tonne)	-	-	30,000	none	none
f. Bunkering capacity (m^3)	-	87,500	280,974	n.a.	460,000 tonnes

-: data not available

* Data consolidated from statistics provided by port authorities of Hai Phong Port, Da Nang Ports, Vung Tau Port, Phnom Penh Port and Sihanoukville Port

In both Vietnam and Cambodia, ports are undergoing different development schemes, related to either land, water or both. In the case of Phnom Penh port, physical expansion is nearly impossible due to land shortage constraint as the port is located within the capital city, where land is required for different forms of development. But in the case of Sihanoukville Port, the expansion plan included the development of a free-trade zone with the establishment of new factories and commercial areas. In Vietnam, ports are developing into a cluster of smaller ports with different size and functions. By extending physically in space, ports are being able to impact a larger area and communities.

VI. PORT'S DEVELOPMENT PLAN

In June 2005, the Vietnamese Government approved a Master Plan for reforming the maritime industry from now to 2010. The aim is to make the shipping industry the leading industry of the country's maritime economy in view of further international economic integration. Under the plan, additional deep-sea ports will be constructed in the northern, central and southern regions of the country, plus the important Van Phong International Seaport in the central province of Khanh Hoa's Van Phong Bay. The plan also includes the upgrade and expansion of 10 other major ports, namely Cai Lan, Haiphong in the north, Cua Lo, Danang, Dung Quat, Quy Nhon, Nha Trang in the central region, Thi Vai, Saigon and Can Tho in the south. The major port projects include the Lach Huyen Seaport project in Haiphong City, the Lien Chieu Seaport in Danang City, and the Cai Mep-Thi Vai Seaport in the southern province of Ba Ria-Vung Tau. Around VND60 trillion (€3 billion) is required to implement the plan.

Along with seaport development plan, strengthening of shipbuilding industry and fleet development is planned. Vietnamese Government is calling for investment from both foreign and domestic private sectors to implement the shipping fleet development project.

In particular, different development plans have been put in place in the three Vietnamese ports in the study. The **Port of Hai Phong** is currently implementing the following projects:

1) The "Rehabilitation and Upgrading Project of the Port of Hai Phong - phase II (2001-2006)". The total invested capital amounts to USD 119,859,932. The main works of the project are:

- Upgrading the access channel and expending the Chua Ve container terminal
- Repairing and upgrading marine equipments
- Acquisition of handling equipments and of a container management system

2) The "Bengot Lighterage Project": 56.5 VND billions are invested. The two phases of the project are:

- Establishment of a 30,000 DWT ship lighterage area. The project is scheduled to be completed in 2005.
- Construction of 3 berths for vessels up to 50,000 DWT.

3) The "Dinh Vu Multi-Purpose Port Project". The project is implemented in the in Dinhvu Industrial Zone (Figure 6: The new industrial port area of Dinh Vu). The two phases of the project are:

- Phase 1 (2001-2005): construction of 2 berths with total length of 425 m for vessels of 20,000 DWT / 1,200 TEUs.
- Phase 2 (2005-2010): construction of 4 berths for general cargo vessels with the length of 785 m.

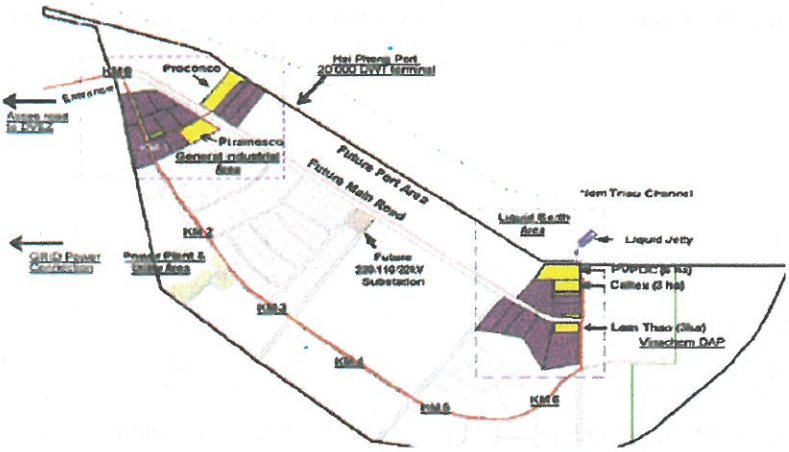


Figure 6: The new industrial port area of Dinh Vu

4) The "Laocai ICD Project" with the total invested capital of 60 VND billions. The project is to serve as a feasibility study for the project of Lach Huyen Hub Port.

In the central region, **Da Nang port** will be one of the focal points in the Master Plan for Port Development towards 2010. According to approved decision of the detailed plan of the center of central seaport group (group No.3) up to the year 2010 and orientation up to the year 2020 by the Prime Minister on 26 September 2005, the extension of Tien Sa – Da Nang Port is one of the priority projects in the stage up to 2010.

In the port of Da Nang, the 2000 – 2004 development plan involved:

- Upgrading of piers 1 and 2 at Tien Sa Port
- Lengthen the sea dyke at Tien Sa port 200m
- Acquisition of handling equipment and computers
- Construction of the Tuyen Son Bridge and of the access road to Tien Sa Port, linking it with national highways 14B and 1A.
- Increase of the port's throughput up to 4 -5 million tonnes/year.
- Broaden the yard and storage area of Da Nang – Song Han pory to 60,000 m^2 by 2006
- Safe reception of all vessels up to 35,000 DWT and container ships up to 25,000 DWT

One part of **Vung Tau port system** is based on the Thi Vai – Cai Mep river, in the territory of Ba Ria. The ports located on this river are able to receive ships having a capacity of up to 70,000 DTW. Currently, the Ho Chi Minh City port system is the largest in South Vietnam. However, the Sai Gon and Nha Be rivers allow ships of up to 15,000 DWT only. The part in the Nha Be river can receive ships of up to 25,000 DWT capacity but its meandering shape is disadvantageous for further port developments. Therefore, the Thi Vai – Vung Tau port system will in the short term support the Ho Chi Minh City port system. The Thi Vai – Vung Tau port system represents the main gate for future transport. Thus, both natural and socio-economic conditions are favourable for development of the Thi Vai – Vung Tau port area.

The directions of the port system development for the next 10 years (Table 73) are as follows:

Table 73: Forecasted cargo throughput in the Thi Vai – Vung Tau port area (million tonnes).

Types	After 2000	2010	2015
Total	***4,0***	***28,2***	***116,0***
1. Packing	0,7	2,5	3,0
2. Cargo	1,0	2,7	3,0
3. Container	1,4	3,5	78,0
4. Heavy equipment	0,2	1,0	2,0
5. Miscellaneous goods	0,3	0,6	10,0
6. Other	0,4	12,7	20,0

(i) The port system of Ba Ria – Vung Tau is to be developed with the following purposes in mind:

- Supporting the port system in Ho Chi Minh City and helping with the transportation of goods to the Mekong delta, the south-eastern area, and the sub-region of Mekong;
- Serving the industrial zones and exporting businesses;
- Helping to enhance the capacity of the petroleum services;
- Making the province an international transport gateway.

(ii) Modernisation of the current port system; use of the river front for new port developments; building up a reasonable capacity and a load port system. In the next 5 years, there must be an integrated port in the area of Thi Vai and a container port in the area of Cai Mep, receiving ships of more than 20,000-50,000 DWT capacity.

(iii) Priority is to be given to the construction of large integrated, commercial ports, specialised ports for containers and international storage ports.

(iv) Construction of a port system in harmony with the technical and social infrastructures, urban developments and especially with the transport developments of the southern economic zone.

(v) Strong combination between the demands of economic development and of national defence.

The port of **Sihanoukville** is now implementing the "PAS's Strategic Plan from 2005 to 2015". The plan is based on the following growth scenarios:

Growth scenario	General Cargo (1000t)				Container Cargo (1000t)				Grant Total (1000t)			
	2004	2005	2010	2015	2004	2005	2010	2015	2004	2005	2010	2015
High	718	810	1,367	2,130	1,045	1,179	1,991	3,102	1,763	1,989	3,357	5,232
Medium	620	658	884	1,187	903	958	1,287	1,728	1,823	1,616	2,171	2,915
Low	625	650	757	869	910	943	1,103	1,266	1,535	1,597	1,860	2,135

The plan consists of 4 projects:

1) The "Urgent Expansion Works" from 2005 to 2008 with the aim of securing fast and reliable container handling operations by improving the productivity of handling operations and Prevention of cargoes traffic congestion. The planned works are: Expansion of container berth

to 160m; Construction of administration building; Installation of maintenance workshop and utilities; Installation of repair workshop for RTG crane; Acquisition of heavy container handling equipment; and Installation of computer system for container yard.

2) The "Sihanoukville Port Free Trade Zone" from 2005 to 2009, with the aim of supporting the Phnom Penh-Sihanoukville growth corridor, supporting the activities of Sihanoukville Autonomous Port, contributing to the National Strategy for Poverty Reduction and supporting the private sector. The planned works include construction of roads, water supplies system, sewage facility, electrical facility, telephone and communication facility, etc.

3) The "Bulk Cargo Berth Project" from 2007 to 2010, aims to support the Free Trade Zone, activities of export & import bulk cargoes, establishing the Cargo Packing Area. The planned works are: the construction of a bulk cargo berth, the reclamation works, dredging works, bulk cargo yard, installation of cement silo, installation of bitumen tanks, equipping signal buoys, and the office buildings, electrical system, sewage and electricity facilities

4) The "Expansion of 265m General Cargo Berth" from 2006 till 2009, with the aim of preventing traffic congestion of import and export general cargoes up to 2015 and improving the quality of operational services. The planned works are: the construction of a general cargo berth, the construction of Quay Apron, the revetment works, and the construction of an open storage yard

In **Phnom Penh**, an expansion of the current quay is impossible due to physical constraints. However, the port plans to develop an Inland Container Depot on an area of 9 ha located about 5 Km from the current location of the port. It will be accessible by road and rail. This area will be used for stacking, cold storage, transit shed and for about half of the area, for leasing to industries. Other investment plans concern the acquisition of cargo handling equipment. An overview of planned development is represented in Table 74.

Table 74: Upgrading projects in Phnom Penh Port (Phnom Penh Port Authority 2005)

Project	Budget	Funds	Time	Planned Activities
1. Procurement Project of Phnom Penh Prot Fixed Crane	US$ 3.0 mil	Seeking	2005	Two fixed cranes are required to cope with the increase of container cargo and to improve efficient operation
2. Phnom Penh Inland Container Depot Development Project	US$ 7.0 mil	Seeking	2005 – 2007	Existing Phnom Penh Port site at PK 5 needs an upgrading and development to cope with cargo increase
3. Phnom Penh Inland Container Depot Development Project	US$ 5.0 mil	Seeking	2005 – 2007	Phnom Penh Inland Container Depot Development sites of 3 locations at Takhmao along Bassac River, Prek Anhchanh, at Kampongcham along Mekong River are required to cope with cargo increase
4. Dredging river bed along the Mekong River	US$ 4.5 mil	Seeking	2004 – 2007	
5. Dredging River bed along Tonle Sap River	US$ 21 mil	Seeking	2004 – 2007	
6. Supply of two harbour tugboats with capacity of 550 hp	US$ 1.5 mil	Japan Grant	2004 – 2007	
7. Rehabilitation of River Port	US$ 6 mil	Japan Grant	2005 – 2007	

VII. ENVIRONMENTAL MANAGEMENT IN PORTS

1. *Environmental legislation*

1.1. International regulations related to maritime transportation

There exists a long list of international conventions related to the marine environment. Operations at sea are firstly regulated by the Law of the Sea 1982, in which provisions on environmental protection were defined. The Law of the Sea 1982 also defines provisions related to maritime transportation, through the description of responsibilities of states on managing sea-going ships and sea ports. Aside from that important international law, other conventions specify different aspects of environmental protection in maritime transportation:

- *International Convention on civil liability for oil pollution damage* 1969 - CLC, amended in 1992. While Vietnam has only participated in CLC Protocol 1992, Cambodia took parts in the CLC Convention 1969 and its two protocols of 1976 and 1992.
- *International Convention on the establishment of an international fund for the compensation for oil pollution damage* 1971 – FUND. The Convention has three protocols: 1976, 1992 and 2003. Cambodia has participated in the FUND protocol of 1992. Vietnam however does not participate in this Convention and its protocols.
- *International Convention on pollution from ships* 1973, as amended in 1978 – the MARPOL 73/78. The convention has 6 annexes.
    - Annex I are regulations on the prevention of pollution by oil from ships.
    - Annex II are regulations on the prevention of pollution by noxious liquid substances. The Annex details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. Around 250 substances have been evaluated and included in the list of noxious liquid substances need to be controlled.
    - Annex III are regulations on the prevention of pollution by harmful substances carried by sea in packaged form. It contains general requirements for the use of detailed standards on packaging, marking, labelling, documentation, stowage, quantity limitations, exceptions, and notifications for preventing pollution by harmful substances.
    - Annex IV are regulations on the prevention of pollution by sewage from ships. The Annex IV contains a set of regulations regarding the discharge of sewage into the sea, ships' equipment and systems for the control of sewage discharge, the provisions of facilities at ports and terminals for the reception of sewage, and requirements for survey and certification.
    - Annex V are regulations on the prevention of pollution by garbage from ships. Under the Annex V, garbage includes all kinds of food, domestic and operational waste, excluding fresh fish, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically. Under this Annex, the disposal of plastics anywhere into the sea is strictly prohibited.
    - Annex VI are regulations for the prevention of air pollution from ships. The Annex sets limits on SO_x and NO_x emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances. The Annex also prohibits incineration of certain products onboard ships such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

In 1990, Vietnam approved the Annex I and II of the MARPOL Convention. The convention entered into force on the 18th March, 1991. Cambodia has participated in MARPOL Convention 73/78, Annex I, II, II, IV and V (IMO 2005).

- *International Convention on the Safety of Life at Sea* (SOLAS), 1974, and its protocols of 1978 and 1988. SOLAS 74 is the most important international Convention on maritime safety. It entails international standards on environmental pollution from ships. Both Vietnam and Cambodia have been taking parts in the Convention and its subsequent protocols.
- Beside these conventions, there are 4 important conventions that both Vietnam and Cambodia currently do not participate in. There are the *International Convention on Oil Pollution Preparedness, Response and Cooperation* (OPRC) 1990, the *Protocol on Preparedness, Response and Cooperation to pollution incidents by Hazardous and Noxious Substances* (HNS Protocol) 2000, the *International Convention of the Control of Harmful Anti-fouling Systems on Ships* (AFS) 2001, and the *International Convention for the Control and Management of Ships' Ballast Water and Sediments* 2004.

Table 75 represents the status of accession of Vietnam and Cambodia in international conventions governed by the International Maritime Organisation (IMO 2005). Other ASEAN's countries have also ratified many conventions related to environmental protection in the maritime sector.

Table 75: Status of the participation in international conventions by IMO (IMO 2005)

	IMO Convention 48	IMO amendments 91	IMO amendments 93	SOLAS Convention 74	SOLAS Protocol 78	SOLAS Protocol 88	Stockholm Agreement 96	LOAD LINES Convention 66	LOAD LINES Protocol 88	TONNAGE Convention 69	COLREG Convention 72	CSC Convention 72	CSC amendments 93	SFV Protocol 93	STCW Convention 78	STCW-F Convention 95	SAR Convention 79	STP Agreement 71	STP Protocol 73	INMARSAT Convention 76	INMARSAT OA 76	INMARSAT amendments 94	INMARSAT amendments 98	FACILITATION Convention 65	MARPOL 73/78 (Annex I/II)	MARPOL 73/78 (Annex III)	MARPOL 73/78 (Annex IV)	MARPOL 73/78 (Annex V)	MARPOL Protocol 97 (Annex VI)	London Convention 72	London Convention Protocol 96	INTERVENTION Convention 69	INTERVENTION Protocol 73	CLC Convention 69	CLC Protocol 76	CLC Protocol 92	FUND Convention 71	FUND Protocol 76	FUND Protocol 92	FUND Protocol 2003	NUCLEAR Convention 71	LLMC Convention 76	LLMC Protocol 96	SUA Convention 88	SUA Protocol 88	SALVAGE Convention 89	OPRC Convention 90	HNS Convention 96	OPRC/HNS 2000	BUNKERS CONVENTION 01	ANTI FOULING 01	BALLASTWATER 2004
Brunei	x	x	x	x	x			x		x	x				x					x	x		x		x								d	x	x	d		x										
Cambodia	x			x	x	x		x	x	x	x				x										x	x	x	x					x	x	x			x										
Indonesia	x	x	x	x	x			x		x	x	x			x			x	x	x	x	x	x	x									x		x	d												
Laos																																																	
Malaysia	x	x		x	x			x		x	x				x					x	x				x			x					d		x	x									x			
Myanmar	x		x	x	x			x		x	x				x										x																							
Philippines	x		x	x				x		x					x			x		x	x				x	x	x	x							x			x						x	x			
Singapore	x	x	x	x	x	x		x	x	x	x				x		x			x	x	x	x	x	x	x	x	x	x				d	x	x			x			x		x	x			
Thailand	x	x	x	x				x		x	x				x					x	x			x																								
Viet Nam	x		x	x	x	x		x	x	x	x				x					x	x		x		x										x									x			

x: accession d: denunciation grey highlighted: relevant conventions to environmental protection

1.2. Legislations on environmental protection in Vietnamese ports

Environment and nature protection have been given special attention by the Vietnamese government and administration at all levels. Legal regulations have been launched and are now subject to improvement. Vietnam also signed the UN environmental conventions, and the IMO conventions on maritime safety and prevention of environment pollution. The laws and regulations applicable to environmental protection in port in Viet Nam are listed below.

General Laws and Regulations on Environmental Protection in Vietnam

In Vietnam, a large number of laws and regulations have been promulgated aiming at protecting the country's environment, especially after the World Summit in Rio de Janeiro in 1992. General laws and regulations on environmental protection in Vietnam are applied to all sectors, including shipping industry and port operations.

- Law on Environmental Protection approved by the National Assembly on December 27th, 1993, in force on 10th January 1994.
- Decree No. 175/CP dated January 18th 1994, by the Government providing guidelines to implement laws on environmental protection.
- Instruction No.1420/QD-Mtg dated 26th December 1994 by the Ministry of Science, Technology and Environment giving instructions for implementing environmental impact assessments to the operating units.
- Decision No.1806/QD-Mtg dated 31st December 1994 by the Ministry of Science, Technology and Environment on EIA and licensing, decision on regulations and appraisal council.
- Regulation No. 1807/QD-Mtg dated 31st December 1994 by the Ministry of Science, Technology and Environment on EIA and licensing, regulations and appraisal council.
- Circular No. 715/MTg dated April 4th 1995, by the Ministry of Science Technology and Environment providing guidelines to control and approve environmental impact statements of direct foreign investment projects.
- Biodiversity Action Plan for Vietnam (BAP) was approved by the Prime Minister of the Government by his Decision 548/TTg dated December 22, 1995
- Circular No. 490/1998/TT-MTg dated 29th December 1995 by the Ministry of Science, Technology and Environment on guidelines to deal with oil spills.
- Circular No. 1100/TT-MTg dated 20th August 1997 by the Ministry of Science, Technology and Environment on the examination and approval of reports assessing environment effects.
- Circular No. 2262/TT-BKHCN&MT, dated 29th April 1998 by the Ministry of Science, Technology and Environment specifying the content of an Environmental Impact Assessment.
- Decision no. 129/2002/QD-TTg dated August 29th 2001 by Prime Minister that approves National oil spill rescue plans duration 2001-2010.
- Decree No.109/2003/ND-CP, dated 23rd September 2003, by the government on preservation and sustainable exploitation of wetlands.
- Circular No. 03/2004/QD-BTNMT dated April 2nd 2004 by the Ministry of Natural Resources and Environment on pollution prevention on the import of waste.
- Decision No. 103/2005/QD-TTg dated May 12th 2005 by Prime Minister promugating regulation oil spill rescue

Environmental Standards

The Ministry of Science, Technology and Environment (MOSTE) (now the Ministry of Science and Technology), has promulgated environmental standards since 1995, with basic standards on air, water and soil quality. Several more specialised standards were added in 2002, such as the revised standards for soil quality (for both limits of pesticide residue and heavy metals in soil). In 2005, another review has been carried out to adjust the environmental standards with the aim of having stricter control over pollution in order to enhance environmental quality in Vietnam. Box 5 introduces some basic important environmental standards that ports in Vietnam have to observe.

Box 5: List of Vietnamese Environmental Standards

Some Vietnamese Environmental Standards related to environmental regulation in ports (VEPA 2004).
Air Quality, Ambient Standards (TCVN 5937, 1995)
Air Quality, Hazardous Substance Standards (TCVN 5938, 1995)
Air Quality, Industrial Standards for Inorganic Substances (TCVN 5939, 1995)
Air Quality, Industrial Standards for Organic Substances (TCVN 5940, 1995)
Soil Quality, Pesticide Residue Limits (TCVN 5941, 1995)
Soil Quality, Heavy metals Limits (TCVN 7902, 2002)
Water Quality, Surface Water Standards (TCVN 5942, 1995)
Water Quality, Coastal Water Standards (TCVN 5943, 1995)
Water Quality, Groundwater Standards (TCVN 5944, 1995)
Wastewater, Industrial Discharge Standards (TCVN 5945; 1995)
Noise, Road Motor Vehicle Standards (TCVN 5948, 1995)
Noise in Public and Residential Areas, Standards for (TCVN 5949, 1995)

To control oil spill in ports and sea areas in Vietnam, there are two recently-promulgated standards, the Vietnamese Standard TCVN 6276-1997 and TCVN 6278-1997. The TCVN 6276-1997 defines procedures of the sea pollution prevention systems from ships issued by the Ministry of Science, Technology and Environment. The TCVN 6278-1997 defines procedures of safety precaution equipment for marine vessels issued by the Ministry of Science, Technology and Environment.

Legislations on Transport (relating to pollution prevention)

There are also many regulations in-force on transportation that put forward specific or general requirements for environmental protection and pollution prevention in the transport sector. Those regulations also apply to the shipping industry and port operations. Some important ones include:

- Decree 30/CP dated 29th January 1980, on activities of people and foreign navigation facilities in Vietnam's waters.
- Decree No. 13/CP dated 25th February, 1994, by the Government on "The regulation on the management of maritime shipping at seaports and in the maritime navigable zones of Vietnam"
- Decree on Vietnam's Marine Police, dated 28th March 1998, by the Permanent Committee for the10th National Assembly on the tasks of the Vietnam's Marine Police including the task of marine environment protection
- Decree No. 160/2003/ND-CP, dated 18th December 2003, by the government on Administering Maritime activities at Vietnamese Ports and maritime waters. In this Decree, regulations were sets out for the opening and closing of ports, shipping

operations and coordinating activities between specialised agencies at port and shipping zones in order to guarantee maritime security, order and hygiene as well as prevent environmental pollution.

- The Maritime Code of Vietnam approved by the National Assembly on June 14th 2005.
- Seaport regulations by the directors of Port Authorities.
- Decision promulgating regulations on environmental protection by Port Authorities at Vietnamese seaports.

Oil spill contingency plan

Responses to oil spill incidents are regulated by Decision No 63/2000/QD-Ttg dated 7th June 2000 by the Prime Minister on renaming and amendment duties of the Vietnamese Search and Rescue Committee and Decision No 129/2001/QD-Ttg dated August 2001 by the Prime Minister that approves the National Response Oil Spill Plan from 2001 to 2010. On 29th December 1995, the Ministry of Science, Technology and Environment issued the circular 2262 – TT/Mtg. on guidelines for the recovering of oil spill events.

The management of oil spills in seaports and in Vietnam in general is depicted in Figure 7. At each port, as designated by law, a management unit should be established to take the responsibility for oil spill rescue planning and management.

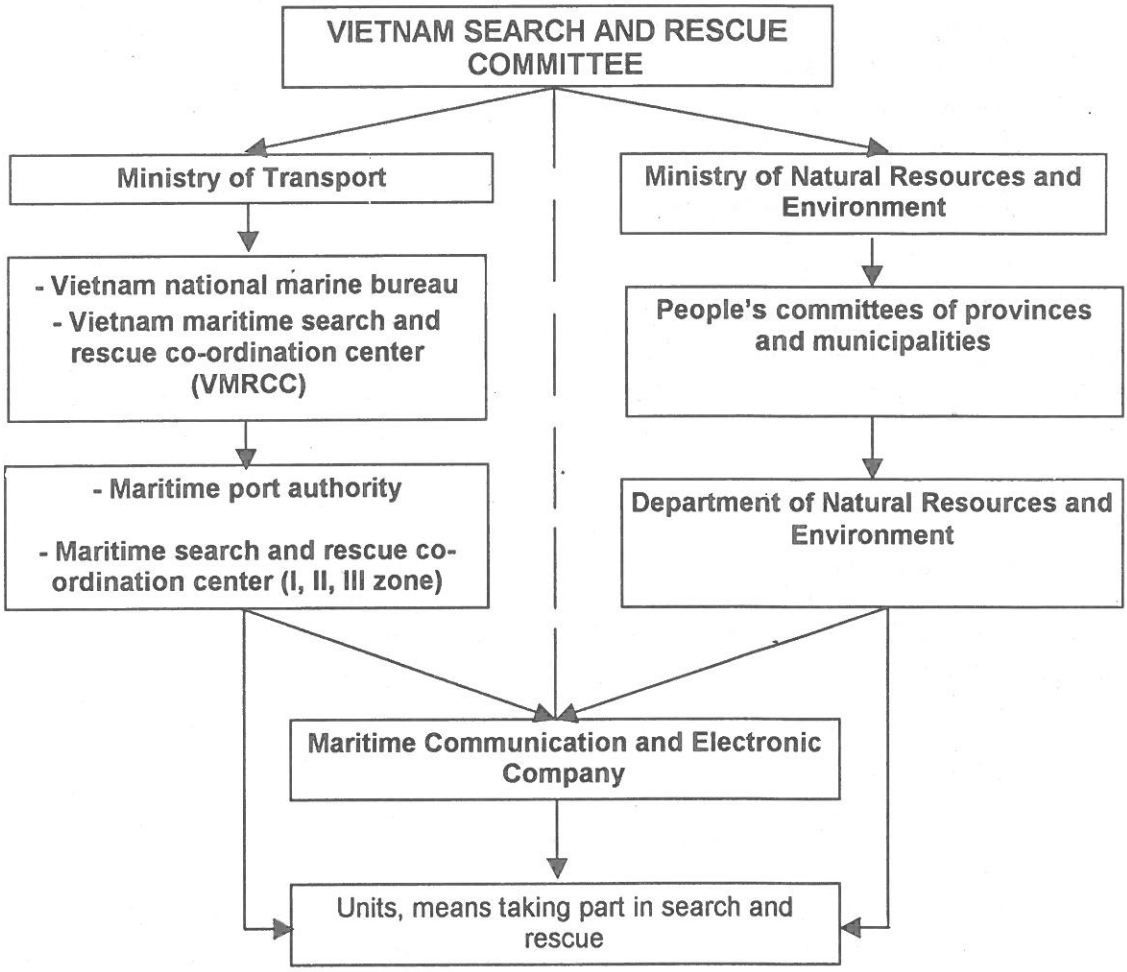


Figure 7: Model of oil spill response organisation system

Institutionally, the Vietnamese Government has promulgated and enforced guidelines to rescue oil spills and made National Plans to cope with oil accidents. The National Oil Spill Rescue Plan until 2010 was approved on August 29th, 2001, by the Prime Minister (decision number 129/2001/QD-TTg) (Box 6).

Box 6: Vietnam National Oil Spill Rescue Plan until 2010

(1) The goals:

(1.1) Until 2010: Readiness to rescue immediately and effectively any oil spill. The aim is to cause minimal damage to the environment, economy, and human life; and Complete systems of mechanism, policy, organization from central to local, rebuild professional force as the core of oil spill rescue activity.

(1.2) Until 2005: Readiness to rescue effectively in high risk areas for oil spills. These include the coastal zones of Ba Ria (Vung Tau Province), Sai Gon - Dong Nai river, the middle coastal area from Da Nang to Nha Trang, the sea and river area of Hai Phong city and Ha Long Bay.

(2) Scope and regulation of the rescue area. Classification of oil spills.

The oil spill rescue area includes the whole mainland, the islands and the territorial waters (contiguous area, economic prerogative area and continental floor of Vietnam)

Rescue of oil spills is done at any time, whatever the reason of the accident might be, whatever the organisation is that causes the damages, independently of when Vietnamese citizens or foreigners caused the problem.

The oil spill rescue areas are spread over 3 parts: the Northern, the Central and the Southern parts of Vietnam.

There exist 3 classes of rescue activities:

+ Class 1: less than 100 tonnes

+ Class 2: from 100 to 2000 tonnes

+ Class 3: more than 2000 tonnes

(3) Organisation of the implementation of the National Oil Spill Rescue Plan

The National Committee "Search and Rescue" is the office that chairs, conducts and organizes the implementation of the National Plan. It executes the following responsibilities:

- To establish regulations concerning the oil spill rescue operations all over the country. Organise, and execute the operations all over the country. Chair activities, establish the communication, enhance citizen's responsibility, mobilise and organise people to take part in all the necessary activities in a common effort to prevent the effects of the oil spill.
- To chair, co-operate with Ministry of Science, Technology and Environment (MOSTE), relative sectors to collect, and submit to the Government the annual plan, and the plan for the period 2001 - 2005. Investigate big oil spills, and report the results to the Prime Minister and the organisations for prevention, and limitation of the lowest level of the damage caused by oil spills. On a yearly basis, organise exercises on oil spill rescue. Organise the formation and training of the forces that rescue oil spills.
- To act as a National Point of reference that takes part in the international co-operation activities on oil spill rescue. Negotiate with the neighbouring countries with which one has to collaborate on oil spills, in particular when they occur in zones belonging to both countries.

(4) Roles and responsibilities of different agencies

The Ministry of Science, Technology and Environment (MOSTE) has the following responsibilities: Submit to the Government and the Prime Minister a proposal to enforce policies and legal regulations (according to jurisdiction) related to the effects of oil spills and to protect the environment; Provide guidance to the ministries, sectors, and local administrations enabling them to estimate and determine the damage, and to restore the environmental degradation caused by the oil spill; Support the National Committee "Seek and Rescue" to set up research on oil spill rescue; and Check, inspect, deal with violations, solve disputes and complains, initiate accusations according to jurisdiction.

The Ministry of Defence and Vietnam Petrolimex Co-operation have to: set up, organize and implement the available plans. They also have to expand and enforce the means they need to take part and co-operate with oil spill rescue operations according to the requirements of the National Committee "Seek and Rescue".

Establish Centres for the rescue of oil spills: in the Central area, the rescue centre is under the supervision of the Ministry of Defence. In the Central part of the Southern area, the rescue centre belongs to Vietnam Petrolimex Co-operation.

Ministries, sectors, and local authorities have to list and, investigate all the business and manufacturing organisations in their area of jurisdiction that can cause oil spills. The identified risks will be covered by a plan which entails the organisation of oil spill rescues in case of accident.

Legislations related to Industry and Agriculture

The legislations related to industry and agriculture listed below are also important environmental protection regulations that ports have to take into account in managing their environment.

- The Ordinance on the Protection and Development of Aquaculture Resource was approved by the Government of Vietnam on 25th April 1989.
- Decision No. 333 QD/CNNG-KHKT, dated 5th September 1990, by the Ministry of Heavy Industry on the regulation on environment protection in oil and gas activities off shore and measures to prevent pollution caused by activities relating to the seabed under the national jurisdiction.
- The Petroleum Law, dated 6th July 1993, on petroleum exploration and production activities carried out within the territory, the exclusive economic zone and the continental shelf of the Socialist Republic of Vietnam.

1.3. Legislations on environmental protection in Cambodian Ports

The Law of Environment which is the basic environmental protection law in Cambodia was published in September 1996. However, the sub-decrees regarding codes, standards and regulations which prescribe the procedure and requirements of EIA are still under preparation by the Ministry of Environment of the Kingdom of Cambodia. Therefore, rules and standards which should have been referred to in this study were not available during the course of the study. Currently, major environmental Laws in Cambodia include:

- Sub Decree on Harbour Rules for Foreign Ships, No. 11 (1983)
- Petroleum Regulation (28 September 1991)
- Royal Decree on the Creation and Designation of Protected Areas (1 November 1993)
- Praka No. 1033 on the Protection of Natural Areas (3 June 1994)
- Law of Land Management of Urbanisation and Construction (3 May 1994)
- MOE Praka No. 992 on the Regulation of Industrial Solid and Liquid Waste Management (1994)
- Joint Prakas of the Ministry of Environment and the Ministry of Agriculture on Prohibition of Hunting and Catching of Wildlife Animals (1996)
- Law on Environmental Protection and Natural Resource Management (1996)
- Law on Protection of Cultural and National Heritage
- Law on Petroleum Exploration and Development
- Sub-Decree on Environmental Impact Assessment dated 11 August 1999 by the Council of Ministers, Royal Government of Cambodia. The document provides guidance on the implementation of the Law on Environmental Protection and Natural Resources Management.
- Sub-Decree on Air Pollution Prevention guiding the implementation of the Law on Environmental Protection and Natural Resource Management.
- Sub-Decree on Water Pollution Control No. 27ANRK.BK dated 06 April 1999 by the Council of Ministers, Royal Government of Cambodia. The document provides guidance on the implementation of the Law on Environmental Protection and Natural Resources Management.
- Sub-Decree on Solid Waste Management dated 27 April 1999 by the Council of Ministers, Royal Government of Cambodia. The document provides guidance on the implementation of the Law on Environmental Protection and Natural Resources Management.
- Sub-Decree on Hazardous Substances
- Sub-Decree on National Committee on Land Use, Urbanisation and Construction

In Cambodia, several environmental standards have been promulgated as annexes to the sub-decrees for Environmental Protection and Natural Resource Management.

Box 7: List of Cambodian Environmental Standards

Some Cambodian Environmental Standards related to environmental regulation in ports
Water quality standard in public water areas for bio-diversity conservation (Annex 4 of the Sub-Decree on Water Pollution Control No: 27 Anrk.Bk)
Water quality standard in public water areas for public health protection (Annex 5 of the Sub-Decree on Water Pollution Control No: 27 Anrk.Bk)

2. *Port management system*

2.1. Vietnam

The Vietnamese Maritime Administration is currently organized as shown in Figure 8.

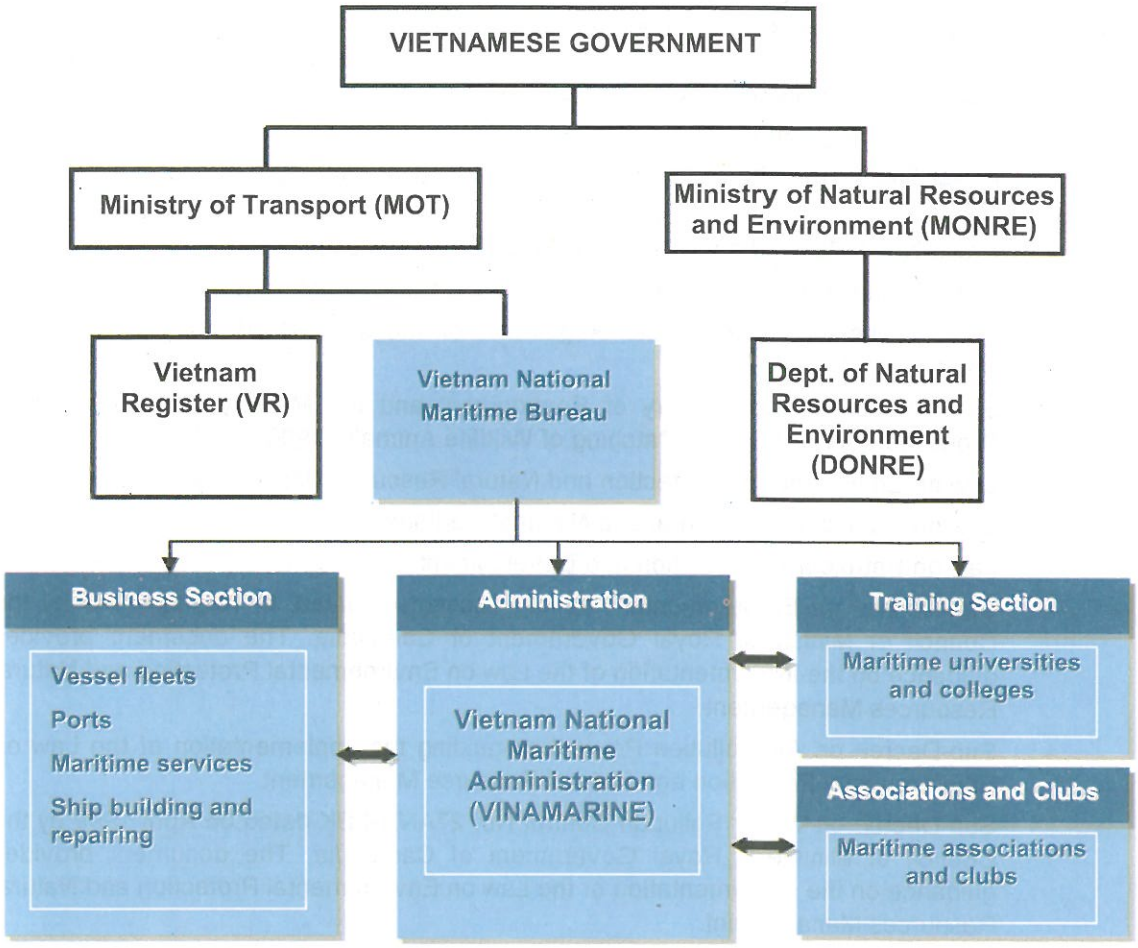


Figure 8: Organisation of the Vietnamese Maritime Administration (Vina Marine 2005)

The Vietnam National Maritime Bureau is the national maritime administration that has control over all state-owned enterprises, private companies, organisations and individuals. The 21 port authorities of Vietnam fall under the direct control of the Vietnam National Maritime Bureau and act as local maritime administration. According to Chapter IV, Article 66 of the Vietnam Maritime Code 2005, the Port Authority is the special body having the state management on maritime shipping in the marine navigable zones and waters of seaports. The Minister of Transport, after consultation with the Peoples Committees of the provinces, designates the areas under the control of the Port Authority and decides on the organisation and the instruction guidelines of the Port Authority. The Port Authorities, in collaboration with the Vietnam Register of Shipping (VIRES) controls sea-going vessels in terms of technical and environmental standards (Vietnam National Assembly 2005).

On August 12th, 1997, the Prime Minister of Vietnam issued Decision No.639/TTg on the organisation, functions, duties and rights of the Maritime Port Authorities. The text states:

- Marine Port Authorities reside directly under the Vietnamese National Maritime Bureau (abbreviated as Port Authority). They execute the state-management in marine seaports and in the navigable zones.

- The Port Authority has the following functions and rights:
  - To establish a plan for port development within their area of competence and under the supervision of the Chairman of the Vietnamese National Maritime Bureau; to organise supervision and implementation of the plan after it has been approved by the competent state authorities.
  - To co-ordinate the organisations and the offices involved in the State control of maritime shipping activities in the seaport to ensure that the port functions according to the legal regulations.
  - To control and supervise the implementation of laws to ensure safety, in particular at the port entrances and exits; to suspend construction projects which may endanger navigation safety.
  - To control and supervise legal regulations on Vietnamese and foreign demilitarised ships operating in the area of the Port Authority. In case of violation of rules and regulations to act if necessary on organisations, individuals and the ships; to inform the Vietnamese National Maritime Bureau and the statutory competent state authorities to settle the problem according to legal regulations.
  - To co-ordinate with other offices, and organisations the following functions: To mobilise suitable persons and means to organise search and rescue of people or vessels in distress; to manage environmental pollution caused by ships in the areas under the control of the Port Authority; to investigate and settle marine accidents.
  - To grant permits for vessels and boats operating inward or outward the port; to exercise temporary detention, maritime lien on leaving vessels or to carry out the warrant of arrest of outgoing vessels issued by the statutory competent authorities.
  - To impose administrative fines for the violation of rules and regulations on marine navigation safety, environmental pollution prevention, maritime sanitation and order.
  - To maintain relations with the central state and the local authorities; to implement functions, duties and rights stipulated by law or authorization of the Vietnamese National Maritime Bureau.

According to Article 66 of the Vietnam Maritime Code 2005, the Director is the highest in command in the Port Authority. The Director has the following powers and duties:

- To organise the implementation of regulations concerning the activities of the Port Authority; to supervise the rules and regulations on maritime navigation safety, **environmental pollution prevention**, maritime sanitation and order.
- To forbid vessels to enter or to leave the port if they are not seaworthy or fail to clear outstanding debts, fines for violation of rules and regulations of the ports.
- To exercise temporary detention, maritime lien on sea-going vessels or carry out the warrant of arrest of outgoing vessels issued by the statutory competent Authorities.
- To grant permits for vessels, boats and persons working within the areas under the control of the Port Authority; to revoke such permits if these vessels, boats or persons provide insufficient guarantees on marine navigation safety.
- To organise search and rescue of vessels or people in distress in the areas under the control of the Port Authority.
- To impose administrative fines for acts violating rules and regulations on marine navigation safety, **environmental pollution prevention**, maritime sanitation and order.

Regarding the role of employers in the port, the Decision No.639/TTg stated that, **to limit environmental pollution**, all port employees have to understand their tasks and responsibilities and the following measures should be applied:

- Enforce and inform on maritime and environment protection laws using popular information, books, magazines, etc. Publish summaries of legal documents and distribute them among captains and related parties.
- Respond immediately to any pollution from ships.
- In case of accident, conduct a rapid environmental impact assessment including mapping of sensitive areas as aquaculture, tourism and nature preservation sites such as those classified by UNESCO. Be prepared with guidelines and regulations for maritime operations.
- Organise seminars on environmental protection regularly; offer training courses to officials and officers, both from Vietnam and abroad.
- Strengthen the supervision and control (especially the Port State Control work guided by TOKYO MOU) over shipping activities. In this way eliminate substandard ships.
- Act in co-operation with the local and central environment protection departments. Organise an annual assessment of the response to pollution incidents. Seek the opinion of competent bodies. Evaluate programmes and instructions on their effectiveness and efficiency.
- Provide environment services that meet the standards of an international port.
- All waste from ships should be collected and handled (2010 objective).
- Work in co-ordination with VIRES (Vietnam Register of Shipping) to attain new environmental protection standards for ships.

However, in practice, organisation at ports in Vietnam varies considerably from port to ports, especially when it concerns the environmental management in ports. For example, the Port of Hai Phong is a State-owned port, which has a port authority. However, environmental management is still an open position. The pubic and private companies in the port have the responsibility for operating the terminals, stevedoring in the port, carrying out cargo handling and taking care of the environmental aspect of their activities. The port authority has not been enforcing environmental laws as well as maritime laws as described above. Nevertheless, cooperation with the Department of Natural Resources and Environment (DONRE), a government agency in charge of the environment, has been established to manage environmental issues in the port.

For the Port of Vung Tau, the organisation of and responsibilities regarding waste collection and treatment in the port is described in Table 76.

Table 76: Waste Management – Tasks and Responsibilities in the Port of Vung Tau

Stakeholder	Tasks/responsibilities
Port Authority	Can trigger improvements of the environment *It is not clear if the Port Authority has control over the development of plans and facilities to protect the environment.*
Vung Tau Ship Company	Responsible for daily collecting and transporting of ship waste ashore. Has not yet defined means for the transport, storage and treatment of ship-generated waste.
Ship Owners	When ship-generated waste services are present, ship owners have to follow the regulations for pollution control and waste management. Costs for waste treatment are paid by the ship owners.

Solid waste is collected by the local environmental service companies. The Vung Tau Ship Company is responsible for daily collecting and transporting of ship waste ashore. Costs for waste treatment are paid by the ship owners. However, the Vung Tau Ship Company has not yet defined means for the transport, storage and treatment of ship-generated waste, particularly oil sludge and waste oil after they are collected from the "zero buoy". Collection, transport, and treatment of waste are only implemented in the area of the "zero buoy". In most of the mooring areas and ports, the service has not yet been organised. Most of the Vietnamese ships are not equipped with the oil discharging and control facilities in accordance with international conventions. Solid waste and oil sludge on ships (particularly the domestic marine ships) are fully out of control.

Generally, the current management and treatment of ship-generated waste does not comply with regulations. Still, the responsibilities are not clear, in particular those of the Port Authority.

The Da Nang Port Authority manages the 9 ports, owned by different institutions (Table 77):

Table 77: Ports within the managerial authority of Da Nang Port (Nguyen Huu Cu 2005)

No.	Port name	Port Owner	Port type
1	Da Nang Port - Song Han area	Da Nang Port (belongs to VINALINES)	General port
2	Da Nang Port - Tien Sa area	Da Nang Port (belongs to VINALINES)	General port
3	Nguyen Van Troi port	Song Thu Company - IIIth Armed Zone	General port
4	9 Song Han port	Da Nang Marine Transport& Trade Company	General port
5	Mi Khe Port	Petrolimex Company Vth Zone	Oil port
6	Nai Hien port	Petrolimex Company Vth Zone	Oil port
7	Lien Chieu Oil Port	General Agency of Army Ordnance	Oil port
8	Hai Van Cement Port	Hai Van Cement Company	Specific port
9	Ki Ha port	Da Nang Steel Company & Ship Repair Co. Ltd.	General port

Each port has a Board of Directors who manages all the activities of the port. The Director is responsible for all the activities. Each port has one or two persons in charge of environmental problems, but they only spend little time on environmental matters. The environmental knowledge of the workers of the port is limited.

2.2. Cambodia

In 1994, after 20 years of civil war, the Merchant Marine Service was set up again and was later promoted to a Department. The Royal Government of Cambodia established the Department of Merchant Marine (MMD) on the 5th April 1999. The MMD is under the direct responsibility of the General Department of Transport of the Ministry of Public Works and Transport (MPWT). This Department consists of five offices including those of General Affairs, Planning and Legal Affairs, Ship Registration, Seaman Affairs and Certificates, Ports and Flag State Implementation, Coastal State and Search and Rescue. The Planning and Legal Office is responsible for developing materials and a technical basis for maritime transport in order to ensure the safety of sea and avoid environment pollution.

The **Sihanoukville Autonomous Port** (PAS) has 1130 employees. This port is managed by a Board of Directors appointed by the head of the Royal Government.

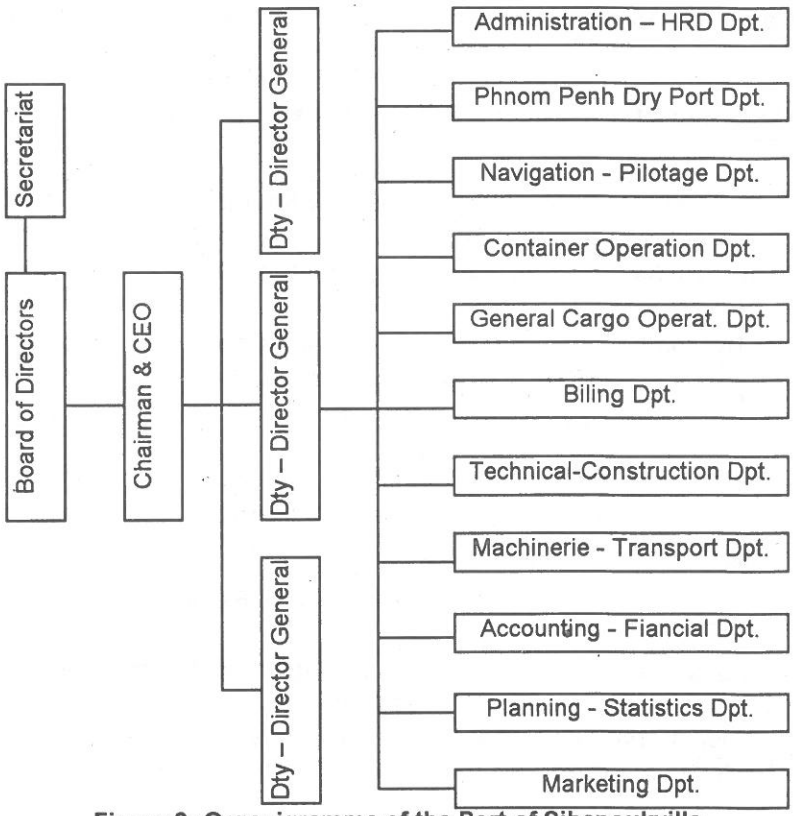


Figure 9: Organigramme of the Port of Sihanoukville

Members of the Sihanoukville Autonomous Port (PAS) Board of Directors are:

- President Director-General of PAS (Chairman)
- One Representative of Ministry of Economy and Finance
- One Representative of Ministry of Commerce
- One Representative of Ministry of Public Works and Transport
- One Representative of the Council of Ministers
- One Representative of the Sihanoukville Authority
- One Employees' Representative of PAS

The **Port of Phnom Penh** is a state-owned enterprise. However, the government allowed the port to become an autonomous body in 1997. Since then, the port has been allowed to carry out its activities in a more independent way. The tight control and supervision by the Ministry of Public Works and Transport and the Ministry of Economy and Finance was reduced.

As seen for the Port of Sihanoukville, Phnom Penh Port is managed by a Board of Directors consisting of members from the Ministry of Public Works and Transport, the Ministry of Economy and Finance, the Ministry of Commerce and the Council of Ministers.

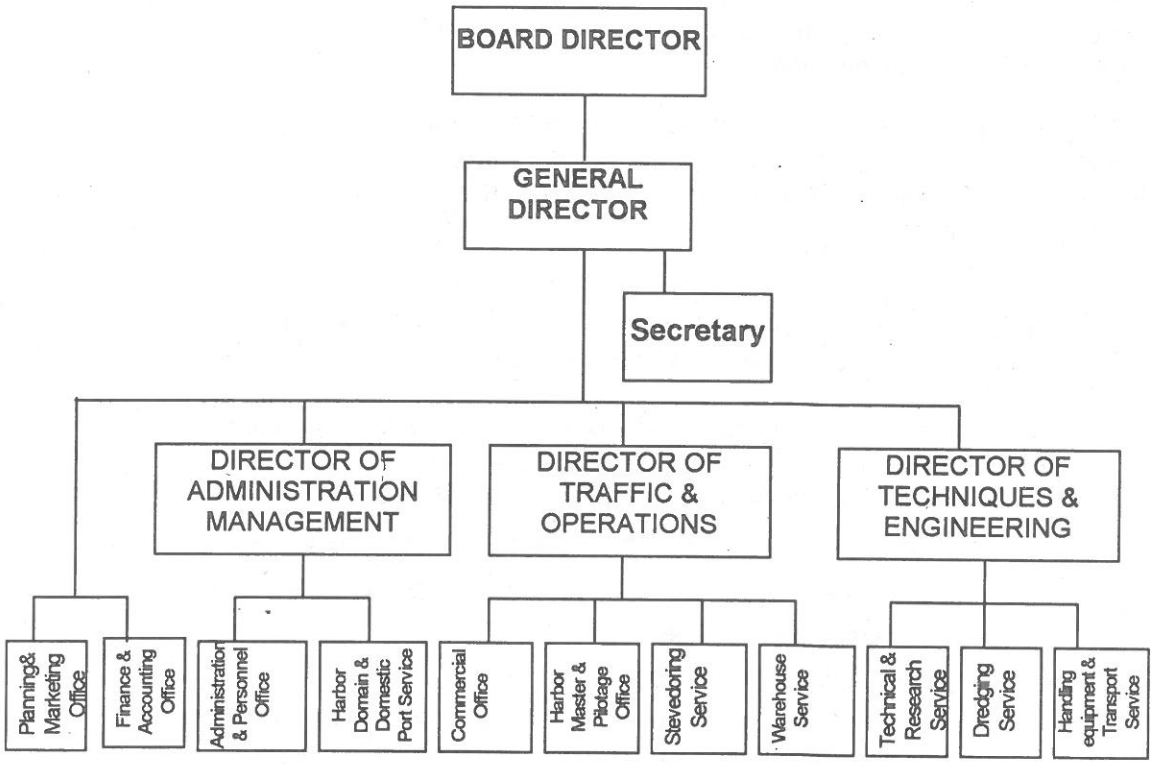


Figure 10: Organigramme of the Port of Phnom Penh

3. The ports' environmental policy

Developing an environmental policy is not a legal requirement in both Vietnam and Cambodia. However, the port companies of Hai Phong, Da Nang and Sihanoukville have developed environmental policies. The ports of Vung Tau and Phnom Penh do not have a policy towards the environment. For the port of Phnom Penh, the reason for not having one, is the lack of environmental knowledge and skills. Regarding the ports of Vung Tau and Da Nang, no reasons are given for not having one. Nevertheless, all port authorities in Vietnam have developed the Seaport Regulations, in which requirements for environmental protection and safety and security are detailed.

For both the ports of Hai Phong and Sihanoukville, compliance with all regulations (national and others) is the basis of the policy. Furthermore, the port of Sihanoukville is committed to implementing a number of international conventions and regional agreements related to sustainable development.

According to the survey results made through the Self Diagnosis of the Environmental Performance (SDEP) carried out at the ports for this study, the topics of the ports' environmental policy are listed. The topics of the policy of **Hai Phong** are:

- To identify environmental problems related to all activities in the port: collection and treatment of waste (solid waste, liquid waste), mitigation of air pollution, management of dredging and dumping materials, management of incidents and risk.
- To set objectives and targets. The global objectives of the policy are:
  - To comply with the environmental commitments endorsed in the policy
  - To manage port activities
  - To maintain technical parameters
  - To satisfy legal requirements related to the environment, safety and health as well as the requirements of finance, production and trading
  - To prevent pollution
- To establish environmental management programs
- To establish environmental monitoring programs
- To establish emergency response plans
- Environmental auditing
- Training of environmental managers

The port staff acknowledged the environmental policy and agreed to comply with it. The implementation of the policy is difficult given the economic and infrastructure situation.

The environmental policy of the port of **Da Nang** includes environmental issues such as:

- Protection of water
- Air quality
- Management of solid and liquid waste
- Prevention of fires and explosions
- Oil spill rescue plan
- Navigation safety
- Workers health

The policy was developed by the Port Authority in cooperation with the Department of Natural Resources and Environment of Da Nang and together with the workers of the port.

However, the implementation of this policy has encountered some difficulties because of the lack of equipment, knowledge and personnel. For instance, training of environmental staff is being done but not regularly.

In Cambodia, at both the **Sihanoukville Autonomous Port** and the **Phnom Penh Autonomous Port**, nobody is responsible for oil spill hazards. Both ports need to urgently to establish oil spill management committees and to develop a Contingency Plan to respond to oil spill accidents.

The topics of the port environmental policy of Sihanoukville are:

- Promoting conservation of energy and efficient use of resources
- Planning, development, management and maintenance of public housing, commercial and industrial buildings;
- Considering environmental requirements in land use and procurement of goods and services;
- Reducing waste materials;
- Improving environmental performance by setting and reviewing environmental objectives and targets;
- Communicating with and educate employees, business partners, customers and the public to achieve environmental goals.

All the objectives set in these 3 lists are very general. The ports did not give any concrete targets and any means with which to achieve them. However, Hai Phong and Sihanoukville mention setting objectives and targets as a goal for their policy.

The only element common to the 3 policies is the training of workers. Waste management is also common to the policies of Sihanoukville and Da Nang.

At Phnom Penh, regulations on port's operations are still absent and one of the priorities is to develop proper regulations and a policy for the port's operations.

4. *The use of environmental management systems in the port*

4.1. Environmental Management Systems (EMS)

So far, none of the 5 ports have established an Environmental Management System (EMS). However, all ports conduct a number of activities aimed at reducing the port's impact on the environment.

The actions undertaken by the ports of **Hai Phong** and **Da Nang** are:

- Plan for the detection and cleaning of oil spills. Some oil ports of the Da Nang area have projects for oil spill response (e.g. My Khe oil port, Nai Hien port).
- Plan for reception of ships.
- Plan for collection of wastewater from ships.
- Plan for prevention of pollution from ships.
- Plan for prevention of fires and explosions.
- Plan for collection of waste.
- Training for the full staff in order for them to acquire the appropriate skills with which to perform their tasks. This training is not yet on a regular basis in the port of Da Nang.
- Some monitoring is carried out (e.g. water quality), but not on a regular basis. In Da Nang, most figures date from the '90's. Hai Phong presents the results from environmental quality surveys carried out by the Hai Phong Institute of Oceanology.

For **Vung Tau** port area, these activities are:

- Collection of domestic and industrial waste in the port areas and daily transportation together with the waste of the locals.
- Collection, transport, and treatment of ship-generated waste are carried out in the area of the "zero buoy". In most of the anchoring areas and ports, the service has not yet been organised.
- Collection and treatment of oil sludge in some of the petroleum ports belonging to the VietsovPetro area. This is partly stored in the Nui Dinh container. Currently, the container is overloaded and there are signs of wastewater leakages which affect groundwater in the area. VietsovPetro planned to build a petroleum waste treatment plant in 1999 but the project has not been implemented so far.
- Training of workers (e.g. for fire fighting)
- Collaboration among the functional authorities (port authorities, waterway traffic control, fire prevention and fighting security guards, and other services) each time a fire, explosion, oil spill or other happens. In case of large events, the Natural Resources and Environment Service directly informs the Ministry of Natural Resources and Environment for solution at state-scale.
- Monitoring of the state of the environment. Different monitoring campaigns were carried out (e.g. surface water quality, 1999), but not on a regular basis.
- Disposal of dredged material as guided by the local government (Phu My Port).
- Dust pollution management: regular cleaning of the port area and spraying of water vapour in areas prone to high dust concentrations (Phu My Port).

For the **Sihanoukville** port area, the "EMS" activities are:

- Collection and treatment of either solid and or liquid waste from all the port buildings and port management areas. The waste is then transported to the waste disposal area by the port's garbage trucks.
- Assistance for ships by providing a port tanker to pump sewage and oil waste.
- Delivery of fines when vessels are caught discharging their waste and sewage in port waters.
- Establishment of an *oil spill management committee* to protect and clean the water that is under port management.
- Monitoring was carried out in the port area within the framework of the port development plans and of this study, in order to evaluate the environmental impacts of the port current on future activities. The different surveys were: hydrobios survey (corals, fishes, seaweeds, benthos and plankton), ocean current survey, sea water analysis, soil sediment analysis, simulation of diffusion of suspended soil, analysis of effluent of river water to sea area and geographical survey and ecosystem in the sea.

Phnom Penh carries out the following activity regarding environmental management:

- Collection of waste by the port upon request of the chief mate or master. The garbage collection company then picks up the waste from the port.

4.2. Risk Assessment

Risk Assessments (RA's) are carried out by the port of Hai Phong and the port of Da Nang. The ports of Vung Tau, Phnom Penh and Sihanoukville do not have RA's although the ports of Vung Tau and Sihanoukville reported the environmental hazards listed below.

Based on their risk assessments, the ports of **Hai Phong** and **Da Nang** drew up plans to avoid the assessed risks. These plans are:

- Plan for detection and cleaning of oil spills
- Plan for reception of ships
- Plan for collection of wastewater from ships
- Plan for prevention of pollution from ships
- Plan for prevention of fires and explosions
- Plan for collection of waste
- Training for the full staff in order to acquire the appropriate skills to perform their tasks

For **Vung Tau**, these are:

- Collisions of ships and barges. The hazard is likely to become more and more important with the increase in the number of ships entering the port. Regarding this hazard, the training of captains is an important factor.
- Leakages during the reception and delivery of gas. There are many gas ports, LPG and gas-supply services in the sea area of Vung Tau. So far, no events have been recorded. However, the risks remain because of the weather conditions, changing tides and winds, faults in the process, lack of responsibility, etc.
- Fires and explosions on ships and in storehouses. In the last 10 years, these kinds of events rarely occurred. However, the dry, hot, and strong wind may trigger them (particularly in the dry season).

For Vung Tau, it can be said that the risks for environmental accidents (collisions, gas leaking, explosions, etc.) are quite high. These events may happen any time and in any place and without warning. Therefore, in order to prevent these events or to ease quick response, clear definition of responsibilities, technical development and training of people working in the port sector is required.

In the port of **Sihanoukville**, environmental risks are associated with:

- Floodings during the rain season with water coming from highlands to the low lying port.
- The current and future increase in the number of ships associated with the increase in handling of cargoes and containers. This leads to an increased risk of collisions.
- In addition, export and import of daily use commodities are being carried out in the existing municipal port and this also causes a high density of ships in this port. It is necessary to minimize the (negative) impacts of this dense traffic on the port operations.

For Vung Tau and Sihanoukville, the environmental hazards listed above, are not recorded in any document. In the ports of Hai Phong and Da Nang, the employees have to report accidents or incidents in which they were involved or of which they became aware. Each of these accidents or incidents is analysed and there is a database for all accidents and incidents. The ports of Vung Tau, Sihanoukville and Phnom Penh do not have such a system.

Table 78 gives an overview of the status of Risk Assessment in the 5 ports described in this report.

Table 78: Overview of Risk Assessment in the ports of Hai Phong, Da Nang, Vung Tau, Sihanoukville and Phnom Penh

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
Risk Assessment conducted	yes	yes	no	no	no
Records of accidents/incidents available	yes	yes	no	no	no
Plans to avoid risks	yes	yes	no	no	no

4.3. Environmental Impact Assessment (EIA)

In Vietnam, the Law on Environmental Protection (1993) requires an EIA to be carried out for different projects. The law states that all production and business enterprises, foreign investment projects and socio-economic development project proponents must submit an EIA report (Web: EIA Centre). Basically, EIA reports are appraised at two levels: the provincial level (Peoples Committees) and the national level (MONRE). Projects considered of special importance, however, fall under the jurisdiction of the National Assembly.

All the infrastructures, facilities and developments were, each individually, developed after the assessment of the potential environmental impacts in the ports of Vung Tau. Each of the EIA's gave consent to the project under consideration. No integrated Environmental Impact Study has been conducted yet regarding the Southern Port Master Plan.

In the ports of **Hai Phong** and **Da Nang**, some EIA's were carried out, but not on a regular basis. EIA's were required after accidents or incidents such as oil spills, leakage of chemicals, etc. The steps in their EIA's consist of zoning the study area; taking water, air, sediment and biota samples; defining impacts of the accident on the environment; making a

report to the Department of Natural Resources and Environment and to the Hai Phong Peoples Committee.

In Da Nang however, EIA's are carried out every year, but only for some parameters of air quality (temperature, humidity, wind, light, noise, CO_2, CO, NO_2, dust). This is done in order to assess the workers' health. Indeed, workers have to handle cargo that is mainly clinker, cement and tiny wood (micro-particulate). The report of air environmental quality forms the base for the appraisal of workers' health.

In Cambodia, the Law on Environmental Protection and Natural Resource Management (1996) requires that an EIA is done on every project and activity, private or public and that the EIA is reviewed and evaluated by the Ministry of Environment before being submitted to the Royal Government for decision (Web: Mekong Law Centre). The procedure and contents of the IEA (Initial Environmental Assessment) and EIA have to be done in accordance with the sub-decrees that the Ministry of Environment.

When the port of **Sihanoukville** did their EIA in 1997, the sub-decree on Environmental Impact Assessment was not promulgated. In order to anticipate the future requirements of the coming sub-decrees and according to the assumption that these requirements will be similar to those of neighbouring countries, the IEE (Initial Environment Evaluation) and EIA were prepared to comply with the standards of Malaysia, Thailand and Indonesia. However, this EIA may need to be reviewed when the sub-decrees are put into force should the EIA fail to fulfil the standards of Cambodia.

In Sihanoukville, an EIA was conducted for the proposed Short-term Plan, including the Urgent Improvement Measures. The EIA did not identify project elements with potential considerable impacts and it concluded that the project was feasible. If appropriate attention is paid during the construction period, the impacts on natural and socioeconomic environment can be minimized.

In **Phnom Penh** port, an EIA was conducted when a new berth was constructed in 1994.

VIII. SIGNIFICANT ENVIRONMENTAL ASPECTS

Port operations bring big impacts on environment. Among all the possible impacts, the following have been identified by the port authority (through the SDEP) and the scientists as the most pressing.

1. Hai Phong Port

Dredging and dumping of dredged materials: Dredging activities and the dumping of dredged materials have different impacts on ecosystems in the port and surrounding coastal zones, such as increasing the turbidity of water, changing currents, disturbing soft bottom habitats, causing migration of aquatic animals and seabirds, and polluting the seabed. The turbidity of water damages adjacent ecosystems such as coral reefs and sea bed grass. The different pollutants accumulated in the sea sediment are stirred into the water and spread over the area.

Loading and unloading of goods: Materials and chemicals scattered during handling at material warehouses or cargo yards are dispersed by wind. Then rain and water runoff together with water current spread such materials even further and cause water pollution. There are diversified waste substances such as sulphite, bauxite, phosphate, ore, coal, metal, inert gases, oil-containing substances, poisonous pesticides, fertilisers, etc. all of which can directly cause water pollution or become very poisonous during their hydrolysis. They also impact air and soil quality and ecosystems.

Dumping waste from ships: The wastewater from ships is of many different kinds; such as domestic wastewater, sanitation water and ballast water. Ships, especially those carrying carrying toxic chemicals, can discharge dangerous wastewater into port waters. Generally, the negative impact of wastewater is great. It impacts on the aesthetic character of the area, creates a disgusting odour, reduces the transparency and dissolved oxygen of the waterand decreases the development or kills aquatic species. The liquid wastes easily spread into adjacent regions, negatively impact environment quality, degrade ecosystems of coral, sea grass and mangrove in the surroundings and reduce the photosynthesis of phytoplankton. They also cause eutrophication resulting in the red tide of harmful algae that badly affects coastal fisheries and aquaculture and damages the beaches, coastal resorts and tourist sites.

Ship building and repair: Ship building activities cause noise pollution as well as water pollution by paints, rust, and other chemicals.

Transport cargo and containers, ship movement: Waterway traffic causes noise pollution and also air pollution from exhaust. In some ports, dust and odours are the main environmental issues.

Oil and chemical spill: Spillage of oil and chemicals is the most dangerous environment impact in port waters. Oil and chemical spills seriously damage aquaculture, they cause heavy impacts on coastal ecosystems, lead to the death of aquatic species,and seabirds and also cause huge damage to tourism and adjacent aquacultures. The negative consequences of these incidents are persistent and require huge costs for treatment and recovery.

Fire and explosion: Fire and explosion incidents usually occur at port warehouses especially of oil and chemical tanks and other flammable goods. The most common reason for fire and explosions is faulty working procedures, non-compliance with safety regulations at work and the lack of consciousness of prevention measures. Extreme weather conditions such as long dry periods and thunderstorms can also cause fire and explosions. Fire and explosions directly damage properties, human beings and cause serious environmental pollution through oil and chemical spills, dust and smoke, and the release of other air pollutants.

Gaps in environmental management: Hai Phong has identified two gaps in environmental management. Firstly, the environmental monitoring program for the port area is weak due to lack of technical as well as financial means. And secondly, there is no program to study the impacts of the port on ecosystems and their components.

2. Da Nang Port

The following element was pointed out by the Port of Da Nang as a gap in environmental activities:

Dredged material is discharged at the side of Son Tra peninsula. This material is not treated or chemically analyzed because it is very expensive to do so. Due to the high costs of treatment, the Da Nang Port Authority proposed that an agency be placed in charge of the dredged material (reception, treatment and disposal).

3. Vung Tau Port

For Vung Tau, the environmental issues below were indicated as important and actions were sought to manage them.

The ***overflowing rainwater***, ***domestic effluents***, etc. are directly disposed of in the rivers or in the sea without being treated.

There is ***no complete system*** for the collection and treatment of ship-generated waste. Currently, waste from ships (domestic, oil sludge) is controlled by the maritime service company of the harbours. The waste is transported to the local dumping site. After being brought to ***public dumping sites***, the waste continues to release pollutants into the environment (soil, surface water, and groundwater) unless it is properly managed and fully treated.

Only some of the petroleum ports belonging to the VietsoPetro have the equipment for the collection and treatment of ***oil sludge***. Moreover, these activities are facing difficulties regarding techniques, investments, and treatment efficiency.

An integrated network for ***oil spill response*** in the areas of Ho Chi Minh City, Dong Nai and Ba Ria - Vung Tau should be established.

Regarding ***fire prevention and fire fighting***, most of the ports are only equipped with the basic facilities in compliance with the standards for construction and techniques.

The inspection and control tasks of the port authorities face significant difficulties owing to inadequate and old-fashioned facilities and methods. Currently, financial measures are more effective than administrative measures. Yet, it is not enough to deter the violations. As a result, violations are increasing.

Ship building and repair:: Chemical materials (paint, rust, etc) discharged into water cause water pollution. Odour and air pollutants are also released during ship building and repair processes.

4. Sihanoukville Port

In Sihanoukville port, the current environmental control technologies seem to be sufficient to control wastes and emissions at current production facilities. But technologies for recycling of materials have not yet been developed. Therefore, enhanced efficiency is needed regarding costs, resource consumption and environmental aspects. Depletion of natural resources will probably not pose restrictions if further development towards efficient materials re-use is pursued.

Port development – land related issues: Currently, there are nearly 600 families living within the area delineated for port expansion. The port authority is working with them to determine compensation. However, because these people have been settled there for a long time, deriving their income from local jobs (agriculture, fishing, leased-labour,), resettling them will affect the social stability of the area.

Ship discharge (of bilge, ballast and sewage): Annually, there are around 800 vessels calling at the port. The port has to accommodate the solid waste and wastewater that the ships need to discharge ashore. However, the current technical capacities of the port do not allow these tasks to be undertaken properly, especially concerning sewage. The port plans to invest in tanker trucks to ease the problem.

Dust is causing environmental pollution in the port area due to the operations of cargo trucks and locomotives. This problem is exacerbated by the climatology of the area. Nearly all-year-round, strong winds circulate dust and pollutant particles in the port area.

Water quality issue is caused by port activities as well as local residential activities. Currently, wastewater is discharged directly into the seawater.

Busy traffic in the port areas is likely to increase with the expansion of the port and the opening of the Free Trade Zone. Busy traffic causes air pollution, noise and annoyance.

Habitat degradation and loss due to waterway traffic in the area. Currently, there is no data available on the scale of habitat degradation. However, with continuous port expansion activities, siltation and soil erosion during the construction period will occur with the subsequent degradation of coral reefs and sea grass beds in the area.

5. Phnom Penh Port

Lack of proper port environmental regulation and policy: The port of Phnom Penh does not have proper environmental regulation to manage environmental issues in ports. The port also lacks human resources for environmental management.

Environmental Risk Assessment has never been conducted at Phnom Penh Port and potential threats to the environment are not known to the port authority.

Ship discharge (of bilge, ballast and sewage): Currently, ships that visit the port have to keep the waste (both solid waste and waste water) on board and bring it back to their original destinations or to Vietnam for discharge. However, the port cannot monitor the discharge of bilge and ballast water. If the port is to receive bigger sea-going vessels, it needs to develop infrastructure to receive wastes from ships.

Noise due to heavy traffic is causing environmental pollution in the port area. Current traffic to and from the port is a nuisance to the area. Traffic jams in the area increase the local air pollution.

Bunkering is an upcoming issue since there are several oil terminals along the river which may pollute the river due to leakage or oil spill accidents. At present, there is no contingency plan for oil spill accidents and the port staff is not trained to respond to such an event.

IX. PORT'S STAKEHOLDERS

1. *Profile of ports' stakeholders*

Different from big ports in Europe, where industrial activities and value added services are blooming, the ports in Vietnam and Cambodia are quite small in size and modest in range of activities. At present, ports in Vietnam and Cambodia engage mostly in ship and goods handling services. Therefore, actors at the ports are much less than in ports in Europe. The main stakeholders of the ports in Vietnam include:

- Local authorities
- Port authority
- Port company and stevedore (including workers at the port)
- Shipping agents
- Customers of the port
- Other servicing companies
- Scientific and academic community whose works are related to port's activities
- Neighbourhood

In Cambodia, the port authority is also the port company and stevedore.

Each group of stakeholders has different interests and concerns related to the port. Also, they have different views about various aspects happening in port areas. To obtain environmental management in port areas, these stakeholders need to be addressed. A survey has been done to collect information on these stakeholders. Therefore, two sets of questionnaires have been designed, targeting (1) the neighbourhood of the port and (2) the other port's actors (including port authorities at different level, port's workers, port's industry and services, scientists and other organisations) (Annex 3 – Questionnaires).

The specific purposes of the survey are:

- To investigate which stakeholders have been involved in port environmental management.
- How did these stakeholders see the current environmental situation in and around the ports?
- How have these stakeholders been involved in port environmental management?
- What are their views on what need to be done to improve environmental management in the port area?

During the survey, in total, 65 people have been interviewed based on the two predefined questionnaires. 51 questionnaires have been distributed to the category "port's actors", include people who are involved directly with the port's business. Respondents of the "port's actors" groups came from different regions and agencies in Vietnam and Cambodia and had the liberty to choose a port which they know best to give comments on. A summary on the number of answers for each of the ports in the project is given in Table 79.

Table 79: Number of respondents interviewed at each port (survey result)

		Frequency	Percent
Valid	Hai Phong Port	12	23.5
	Da Nang Port	2	3.9
	Vung Tau Port	4	7.8
	Other Vietnamese ports	10	19.6
	Phnom Penh Port	11	21.6
	Sihanoukville Port	11	21.6
	Total	50	98.0
Missing	No port name mentioned	1	2.0
Total		51	100.0

Table 80 gave an overview of the number of responses received for each country.

Table 80: Number of respondents of the ports' actors group per country (survey result)

		Frequency	Percent
Valid	Vietnamese ports	28	54.9
	Cambodian ports	22	43.1
	Total	50	98.0
Missing	No port name mentioned	1	2.0
Total		51	100.0

In total, 14 questionnaires have been distributed to local people living near to the ports (the "neighbourhood" group). 6 people were interviewed in Hai Phong, Vietnam and 8 people in Sihanoukville, Cambodia.

Table 81: Number of respondents of the neighbourhood group (survey result)

		Frequency	Percent
Valid	Hai Phong Port	6	42.9
	Sihanoukville	8	57.1
	Total	14	100.0

The number of respondents from each group of stakeholders is presented in Table 82. For two questionnaires, the category of stakeholders was not indicated.

Table 82: Profile of respondents (survey result)

Category	Frequency	Percent
(Missing: no category indicated)	2	3.9
In Vietnam	**28**	**54.9**
Vietnam Maritime Agency	2	3.9
Goods handling company	1	2.0
Ha Long Fishery Port Project	1	2.0
Hai Phong Industrial Zone Management Board	1	2.0
Hai Phong Port Company	1	2.0
Phu My Port Company	2	3.9
Port Authorities	16	31.4
Scientific community	4	7.8
In Cambodia	**21**	**41.2**
Cambodia Ministry of Environment	1	2.0
Cambodia Ministry of Public Works and Transport	1	2.0
ICM Project Sihanoukville Office	1	2.0
Phnom Penh Autonomous Port	8	15.7
Phnom Penh Environment Department	1	2.0
Sihanoukville Autonomous Port	8	15.7
Sihanoukville village	1	2.0
Total	**51**	**100.0**

2. Common environmental problems and their level of significance in ports in Vietnam and Cambodia

During the survey, local people living around the port of Hai Phong and the port of Sihanoukville have been asked to identify if an environmental issue occurs at the port (based on a predefined list of issues) and if an issue exists, to rank it based on its level of significance or importance. Three ranking levels defined are "low priority", "medium priority" and "high priority".

According to the opinions of local people living around the port in Hai Phong, the most dominant environmental issues are the degradation of air quality (including pressing issues of dust and odours), light pollution, and degradation of water quality (including the illegal discharge of ship's wastewater, ballast and bilge). More than half of the respondents positioned these issues as issues with "high priority". For the degradation of air quality in general, 3 out of 4 respondents agreed that the issue is pressing and 4 out of 4 respondents placed "dust" as a problem which should be treated with "high priority". Problems related to dredging, contaminated soil and land or habitat loss and degradation were not mentioned by the respondents as most of them do not know whether there is a problem related to these aspects. These are also hidden problems which are not easy to be noticed, as compared to air and noise problems (Table 83).

At the port of Sihanoukville, most of the respondents did not see that the port is a source of environmental problems. For most of the possible environmental issues at port, they perceived that they did not occur at the port of Sihanoukville or did not occur as pressing issues. Among the environmental issues pinned point, air quality (dust and odour problems), light pollution, water pollution and traffic problems were the most noticed, although placed at "low priority" level.

Table 83: Perception of the port's neighbourhood on different environmental issues at the ports of Hai Phong and Sihanoukville (survey results)

		Hai Phong Port		Sihanoukville Port	
		n	%	n	%
Air quality	No problem			3	37.50%
	Yes - Low priority			3	37.50%
	Yes - Medium priority	1	25.00%	1	12.50%
	Yes - High priority	3	75.00%	1	12.50%
	I don't know				
Dust	No problem			2	25.00%
	Yes - Low priority			2	25.00%
	Yes - Medium priority			3	37.50%
	Yes - High priority	5	100.00%	1	12.50%
	I don't know				
Odours	No problem			3	37.50%
	Yes - Low priority	1	25.00%	5	62.50%
	Yes - Medium priority				
	Yes - High priority	3	75.00%		
	I don't know				
Light pollution	No problem	1	25.00%	2	25.00%
	Yes - Low priority			3	37.50%
	Yes - Medium priority			2	25.00%
	Yes - High priority	1	25.00%		
	I don't know	2	50.00%	1	12.50%
Water quality	No problem			3	37.50%
	Yes - Low priority			5	62.50%
	Yes - Medium priority				
	Yes - High priority	2	100.00%		
	I don't know				
Risk of vessel accidents	No problem			8	100.00%
	Yes - Low priority				
	Yes - Medium priority				
	Yes - High priority				
	I don't know	1	100.00%		
Traffic jam, accidents	No problem	1	25.00%	4	50.00%
	Yes - Low priority	1	25.00%	2	25.00%

		Hai Phong Port		Sihanoukville Port	
		n	%	n	%
	Yes - Medium priority	1	25.00%	2	25.00%
	Yes - High priority	1	25.00%		
	I don't know				
Contaminated land and soil	No problem			4	50.00%
	Yes - Low priority			2	25.00%
	Yes - Medium priority			1	12.50%
	Yes - High priority				
	I don't know	1	100.00%	1	12.50%
Industrial effluent and emission	No problem			3	37.50%
	Yes - Low priority			3	37.50%
	Yes - Medium priority	1	100.00%	1	12.50%
	Yes - High priority				
	I don't know			1	12.50%
Risk of oil spills	No problem			4	50.00%
	Yes - Low priority			2	25.00%
	Yes - Medium priority				
	Yes - High priority				
	I don't know	1	100.00%	2	25.00%
Dredging and dredging disposal	No problem			2	25.00%
	Yes - Low priority			2	25.00%
	Yes - Medium priority				
	Yes - High priority				
	I don't know	1	100.00%	4	50.00%
Fisheries waste (land)	No problem			3	37.50%
	Yes - Low priority			3	37.50%
	Yes - Medium priority				
	Yes - High priority				
	I don't know	1	100.00%	2	25.00%
Garbage/ Port solid waste	No problem			8	100.00%
	Yes - Low priority				
	Yes - Medium priority				
	Yes - High priority				
	I don't know	1	100.00%		
Ship discharge (ballast, bilge, sewage, solid waste, smoke, etc.)	No problem			4	50.00%
	Yes - Low priority				
	Yes - Medium priority			1	12.50%
	Yes - High priority	1	50.00%		
	I don't know	1	50.00%	3	37.50%
Habitat loss/degradation (forest clearance, reduction of fish stock, etc.)	No problem				
	Yes - Low priority			1	12.50%
	Yes - Medium priority				
	Yes - High priority				
	I don't know	1	100.00%	7	87.50%

At the port of Hai Phong, a majority of predefined environmental issues were ranked at "medium priority" level (31 out of 42 issues). These are air quality, bunkering, cargo spillage, cargo storage run off, dredging, dredging disposal, dust, energy consumption, garbage/ port waste, habitat loss/degradation, hazardous cargo, industrial emissions, light pollution, noise, odours, pollution from rivers, port development (land related), port development (water related), risk from port industry activities, other risks, ship discharge (ballast), ship discharge (bilge), ship discharge (sewage), ship exhaust emissions, soil contamination, solid waste, surface run-off, traffic volume, visual impact, water quality, and waste water. The environmental problems ranked as "high priority" include the risks of oil spill, traffic accidents (both water-way and land traffic), sediment contamination and the conservation of the nature. The environmental problem caused by antifouling paints is not known to most people.

At the Da Nang Port, none of the issues was ranked as "high priority" issue. At the level of "medium priority", only degradation of water quality was mentioned. Several issues were mentioned with "low priority", such as the risk of oil spills, sediment contamination, bunkering, dust, industrial emissions, pollution from rivers, port development, risk from port industry activities, ship discharge (ballast, bilge, sewage), soil contamination, and traffic volume. At the port of Da Nang, there is no problem with antifouling paints, contaminated land, risk of land traffic accidents, air and noise pollution, or wastewater and solid waste, etc.

At the Vung Tau Port, which is the largest oil port in Vietnam, the highest priority issues are bunkering and the risk of oil spills due to tanker accidents. Other important environmental issues are ship discharge (ballast and bilge). Cargo spillage and ship exhaust emissions were also ranked as important environmental issues. The problems related to road traffic (traffic accidents, dust, traffic volume, vehicle exhaust, noise, etc.), dredging and energy consumption were ranked as "low priority". At the port of Vung Tau, problems related to the use of antifouling paints, port development or industrial activities, wastewater and solid waste, or habitat losses were not considered as environmental problems.

In Cambodia, the port of Phnom Penh faces problems with port development due to the restricted land resource, and the problem of dredging disposal. These issues were ranked as "high priority" environmental issues, along with the problems of sediment contamination and untreated wastewater. Ranked next in priority are the issues of habitat loss and degradation, degradation of air quality, the visual Impact, the problem of antifouling paints, and the garbage/port waste issue. Problems related to traffic (volume), water quality, cargo spillage, ship discharge, etc. were ranked as "low priority" issues and the risk of oil spill, water traffic accidents, traffic pollution (noise and exhaust), odour and light pollution were not seen as environmental problems at the port of Phnom Penh.

At the port of Sihanoukville, the highest priority goes to road traffic accident and problem with fisheries waste. The issues of wastewater, high traffic volume, and ship discharge ranked next the at "medium priority" level. Problems related to bunkering, surface run-off, port development, dredging disposal, dust, ship discharge (sewage), water quality, risk of oil spills, solid waste, habitat loss/degradation, dredging, etc. were ranked at "low priority" level. The issues of air quality and antifouling paints, noise, light pollution and odours were not seen as environmental problems at the port of Sihanoukville.

Table 84 details the survey results on the opinion of the ports' actors on the current environmental problems at each of the ports in the project.

Table 84: The perception related to the level of significance of each environmental issue at the ports in Vietnam and Cambodia based on the evaluation of ports' actors (survey result)

	Hai Phong Port	Da Nang Port	Vung Tau Port	Phnom Penh Port	Sihanoukville Port
	Mode[1]	Mode[1]	Mode[1]	Mode[1]	Mode[1]
1. Air quality	Medium priority	No problem	Low priority	Medium priority	No problem
2. Antifouling paints	Don't know	No problem	No problem	Medium priority	No problem
3. Bunkering	Medium priority	Low priority	High priority	Don't know	Low priority
4. Cargo Spillage	Medium priority	No problem	Medium priority	Low priority	Medium priority
5 Cargo storage run off	Medium priority	No problem	Low priority	Low priority	No problem
6. Conservation designations	Low priority	No problem	No problem	Low priority	Don't know
7. Contaminated land	Don't know	No problem	No problem	Low priority	Low priority
8. Dredging	Medium priority	No problem	Low priority	Medium priority	Low priority
9. Dredging disposal	Medium priority	No problem	No problem	High priority	Low priority
10. Dust	Medium priority	Low priority	Low priority	Low priority	Low priority
11. Energy Consumption	Medium priority	No problem	Low priority	Low priority	Don't know
12. Fisheries waste (land)	Don't know	Low priority	No problem	Low priority	High priority
13. Garbage/ Port waste	Medium priority	No problem	No problem	Medium priority	Low priority
14. Habitat loss/degradation	Medium priority	No problem	Don't know	Medium priority	Low priority
15. Hazardous cargo	Medium priority	No problem	No problem	Low priority	Low priority
16. Industrial effluent	High priority	Low priority	No problem	No problem	Low priority
17. Industrial emissions	Medium priority	Low priority	No problem	No problem	No problem

	Hai Phong Port	Da Nang Port	Vung Tau Port	Phnom Penh Port	Sihanoukville Port
	Mode[1]	Mode[1]	Mode[1]	Mode[1]	Mode[1]
18. Light pollution	Medium priority	No problem	No problem	No problem	No problem
19. Noise	Medium priority	No problem	Low priority	No problem	No problem
20. Odours	Medium priority	No problem	No problem	No problem	No problem
21. Pollution from rivers	Medium priority	Low priority	Medium priority	Low priority	Medium priority
22. Port development (land related)	Medium priority	Low priority	No problem	High priority	Low priority
23. Port development (waterrelated)	Medium priority	Low priority	Low priority	Low priority	Low priority
24. Risk of small oil spills	High priority	Low priority	No problem	Low priority	Low priority
25. Risk of spills - tanker accidents	Low priority	No problem	High priority	No problem	No problem
26. Risk from port industry activities	Medium priority	Low priority	No problem	No problem	Low priority
27. Risk of traffic accidents (water)	High priority	Low priority	Low priority	No problem	No problem
28. Risk of traffic accidents (land)	High priority	No problem	Low priority	Low priority	High priority
29. Other risks	Medium priority	No problem	Don't know	Low priority	No problem
30. Sediment contamination	High priority	Low priority	Low priority	High priority	Don't know
31. Ship discharge (ballast)	Medium priority	Low priority	Medium priority	No problem	Low priority
32. Ship discharge (bilge)	Medium priority	Low priority	Medium priority	Low priority	Medium priority
33. Ship discharge (sewage)	Medium priority	Low priority	Low priority	Low priority	Low priority
34. Ship exhaust emissions	Medium priority	No problem	Medium priority	Low priority	No problem
35. Soil contamination	Medium priority	Low priority	No problem	Low priority	Low priority
36. Solid waste	Medium priority	No problem	No problem	Low priority	Low priority
37. Surface run-off	Medium priority	No problem	Low priority	Don't know	Low priority
38. Traffic volume	Medium priority	Low priority	Low priority	Low priority	Medium priority
39. Vehicle exhaust	High priority	No problem	Low priority	No problem	Low priority
40. Visual Impact	Medium priority	No problem	Low priority	Medium priority	Low priority
41. Waster water	Low priority	No problem	Low priority	High priority	Medium priority
42. Water quality	Medium priority	Medium priority	Medium priority	Low priority	Low priority

[1] Statistical method used

3. *The involvement of the port's stakeholders in environmental management at the ports*

During the interviews with the port's neighbourhood in Hai Phong and in Sihanoukville, local people were asked if they think that the port is a risk for them. Most of the people did not see the port as a risk (83.3%, n=12). The reason for this may be related to the fact that most of the people do not know possible and actual environmental problems that a port may cause (*see* Section 0 above) and it may be related to the fact that the economic benefit of a port is seen as the more important aspect (*see* Section 0 below). However, at the old port city of Hai Phong, the number of people who see the port as a (possible) risk is more than in the newly developed Sihanoukville area. This corresponded to the opinions of the neighbourhood and the port's actors about current environmental issues at the ports (*see* Section 0 above). At the port of Hai Phong, more environmental problems were recognised by the respondents as the actual problems, and with a higher level of priority than at the port of Sihanoukville. Table 85 details results of the survey among the neighbourhood of Hai Phong Port and Sihanoukville Port.

Table 85: Opinions of ports's neighbourhood (survey result)

		Hai Phong Port		Sihanoukville		Total	
		n	%	n	%	n	%
Do you feel that the port is a risk for you?	No	3	75.0%	7	87.5%	10	83.3%
	Yes	1	25.0%			1	8.3%
	I am not sure			1	12.5%	1	8.3%

The limited knowledge of the neighbourhood may be due to limited information they were provided relating to the port's operations. Most of the people acknowledged that they were informed only about the port's business operations. Sometimes, port's social activities (for example participating in local activities on poverty reduction or social security improvement) are known to local people. However, at both ports of Hai Phong and Sihanoukville, environmental activities were not known by the local people as the ports did not inform them about that aspect (Table 86). At the port of Sihanoukville, more people were informed about the port's business operations than at the port of Hai Phong (62.5% as compared to 16.7%).

Table 86: Information provided by the ports to the neighbourhood (survey result)

Does the port inform you on their operations?		Hai Phong Port		Sihanoukville		Total	
		n	%	n	%	n	%
Business operations	No	5	83.3%	3	37.5%	8	57.1%
	Yes	1	16.7%	5	62.5%	6	42.9%
Actions towards the environment	No	6	100.0%	8	100.0%	14	100.0%
	Yes						
Social actions	No	6	100.0%	7	87.5%	13	92.9%
	Yes			1	12.5%	1	7.1%
Other	No	6	100.0%	8	100.0%	14	100.0%
	Yes						

When being asked whether they want to be informed, most of the respondents wanted to have more information about the ports. Two third of the respondents said that they want to be informed by the port. However, they did not define clearly what information they would like to receive. At the port of Sihanoukville, only 50% of the respondents answered this question but no one could make clear what information they are interested in. At the port of Hai Phong, some respondents showed their interests in the port's environmental actions next to the port's business operations (Table 87).

Table 87: Channels of communication from the ports to the neighbourhood (survey result)

		Hai Phong Port		Sihanoukville		Total	
		n	%	n	%	n	%
If you were not informed, would you like to be informed?	No	2	40.0%			2	22.2%
	Yes	3	60.0%	3	75.0%	6	66.7%
	I am not sure			1	25.0%	1	11.1%
- Business operations	No	5	83.3%	8	100.0%	13	92.9%
	Yes	1	16.7%			1	7.1%
- Actions towards the environment	No	4	66.7%	8	100.0%	12	85.7%
	Yes	2	33.3%			2	14.3%
- Social actions	No	6	100.0%	8	100.0%	14	100.0%
	Yes						
- Other	No	6	100.0%	8	100.0%	14	100.0%
	Yes						

Table 88 shows that at the port of Hai Phong and the port of Sihanoukville, it is not clear to the neighbourhood on whether the ports have a "contact point" where they can come and inquire about different aspects of the ports' operations, including environmental aspects. However, many people showed their interest in having such a contact point. A large proportion of the respondents hesitated about that possibility, as they do not think that a "contact point" is a helpful option (Table 88).

Table 88: Availability of contact point at the ports (survey result)

		Hai Phong Port		Sihanoukville		Total	
		n	%	n	%	n	%
Is there a contact point in the port which you can consult in case of any hindrance from the port?	No	3	60.0%	4	50.0%	7	53.8%
	Yes	1	20.0%	3	37.5%	4	30.8%
	I don't know	1	20.0%	1	12.5%	2	15.4%
If there is no contact point at the moment, would you like that there is such a contact point?	No	2	40.0%	1	12.5%	3	23.1%
	Yes	2	40.0%	3	37.5%	5	38.5%
	I don't know	1	20.0%	4	50.0%	5	38.5%

The survey also investigated how people want to be informed about the port's activities, including environmental actions. In Vietnam, the favourite methods of communication are radio and newspaper while the favourite method in Cambodia is television (Table 89).

Table 89: Preferred channels of communication about the port's activities (survey result)

		Hai Phong Port		Sihanoukville		Total	
		n	%	n	%	n	%
Radio	No	4	66.7%	7	87.5%	11	78.6%
	Yes	2	33.3%	1	12.5%	3	21.4%
Television	No	3	50.0%	2	25.0%	5	35.7%
	Yes	3	50.0%	6	75.0%	9	64.3%
Leaflets	No	5	83.3%	7	87.5%	12	85.7%
	Yes	1	16.7%	1	12.5%	2	14.3%
Port website	No	6	100.0%	8	100.0%	14	100.0%
	Yes	0					

4. *Assessment of port's performance on different aspects*

In general, the ports' actors saw that the ports' performance in protecting the air and water quality was at "above-average" level, with around 40% of answers rated these aspects at "average" performance and around 32% of answers rated these aspects at "good" performance (Figure 11).

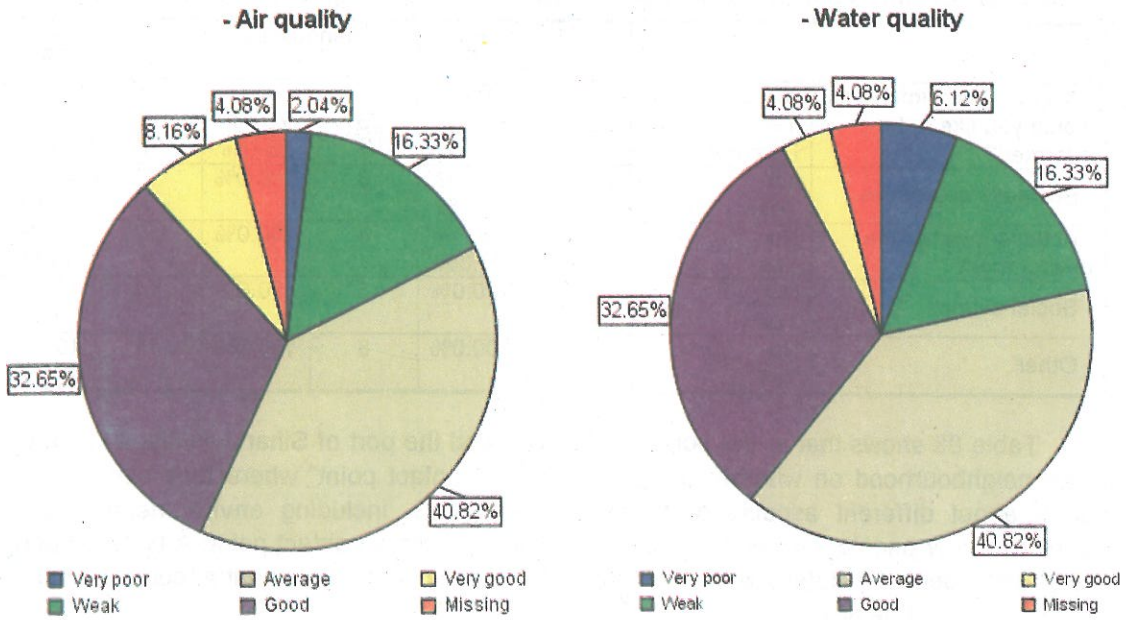


Figure 11: Assessment of the ports' performance on protecting the air and water (survey result)

For the aspects of soil quality, the performance of the ports was worse and most of the ratings were at "weak" and "average" levels. For waste management the ratings were mostly at "average" and "good" levels (Figure 12). For both aspects, most of the respondents rated the ports' performance at "average" level (around 45% of the answers). For the performance on traffic and noise management, most of the respondents believed that the ports performed rather well (Figure 13).

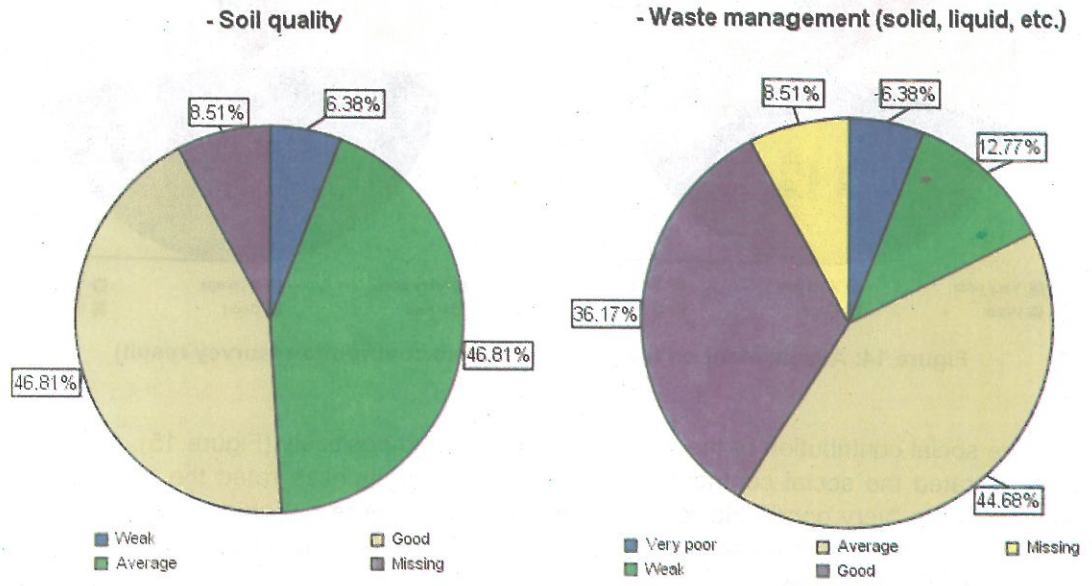


Figure 12: Assessment of the ports' performance on the protection of soil quality and solid waste management (survey result)

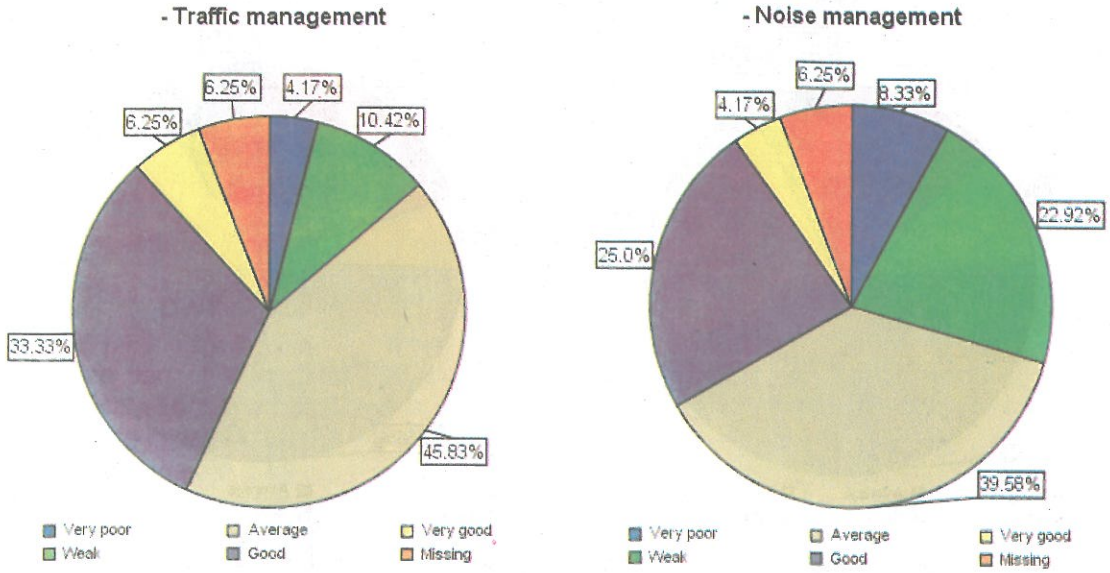


Figure 13: Assessment of the ports' performance on the protection of soil quality and solid waste management (survey result)

For economic contribution, the ports were rated at "good performance" with 44% of positive evaluations on the economic contribution in term of provision of employment and 54.5% of positive evaluations on the economic contribution in term of GDP. The economic contribution of the ports was viewed as the most successful aspect of the ports' operations.

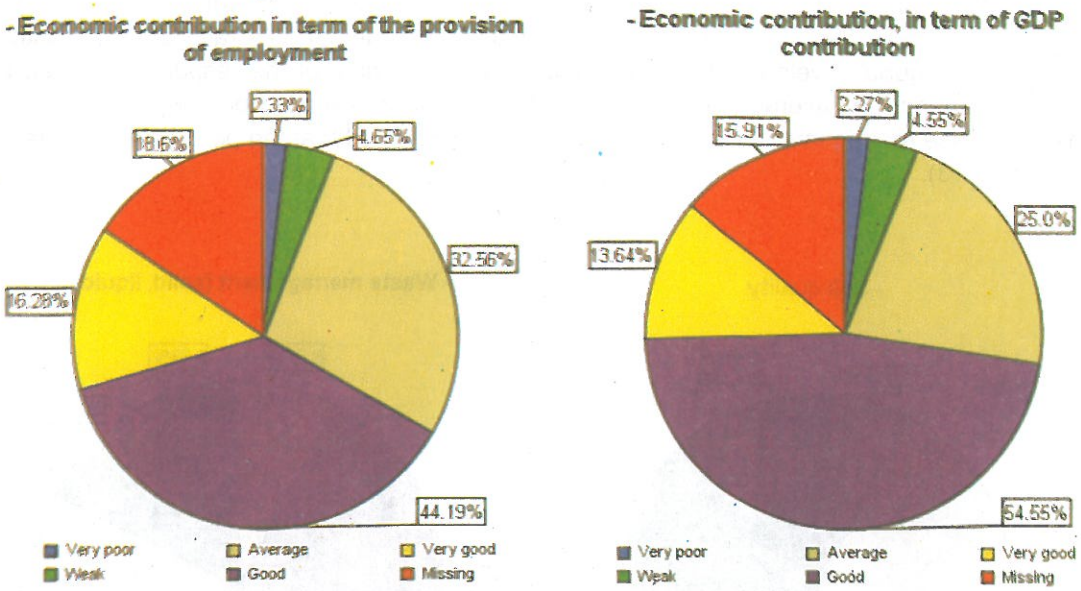


Figure 14: Assessment on the ports' economic contribution (survey result)

The social contribution of the ports was also reported positively (Figure 15). 11.4% of the responses rated the social contribution and 7.3% of the responses rated the "involvement of stakeholders" as "very good". However, many respondents were not able to assess the social contribution of the ports as these aspects were not so visible and quantifiable, especially for the "involvement of stakeholder".

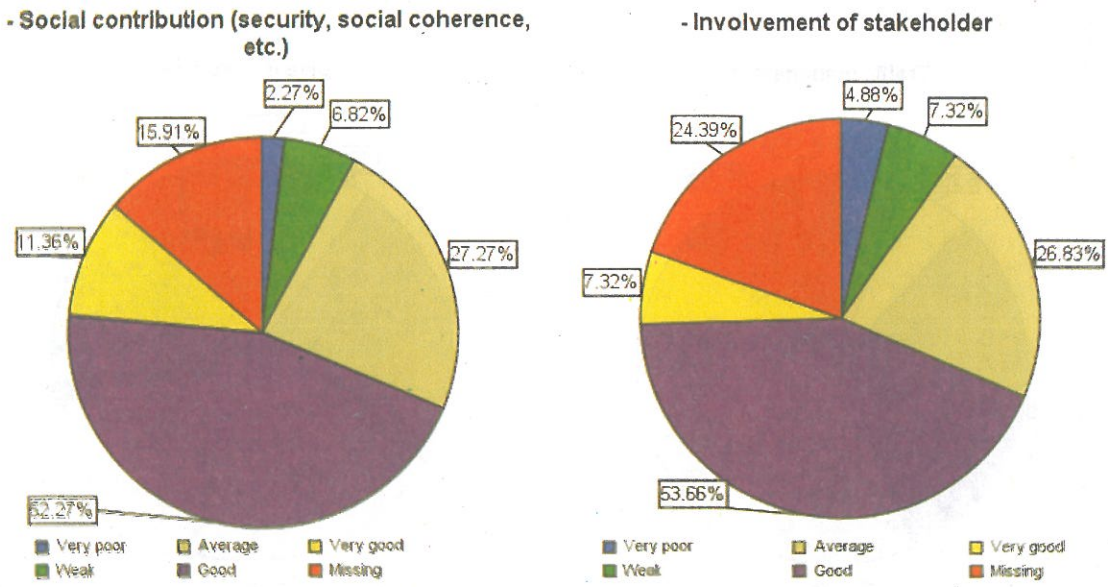


Figure 15: Assessment on the ports' economic contribution (survey result)

At the port level, in general, economic contribution of the ports is better than the environmental performance of the ports. At most of the ports, economic contribution in term of GDP as well as in term of employment was ranked at "good" level (except for the port of Phnom Penh). Meanwhile, for the six environmental aspects listed, most of the ports got "average" or "weak" with the exception of the Phnom Penh Port with two aspects evaluated as "good" performance. Social contribution and the involvement of stakeholder in port's management were ranked at "average" or "good" at all ports, despite the fact that most of the neighbouring local

people were not well informed about the port's activities (*see* Section 0 above). Table 90 details the assessment of the port's actors about the performance of each port on various aspects.

Table 90: Opinions of the port's actors on various aspects of the port performance (survey result[a])

	Hai Phong Port		Da Nang Port		Vung Tau Port		Phnom Penh Port		Sihanouk-ville Port	
	n	Mode	n	Mode	n	Mode	n	Mode	n	Mode
- Water quality	11	Average	2	Average	4	Very poor	11	Average	10	Average
- Air quality	11	Average	2	Weak	4	Weak	11	Average	10	Good
- Soil quality	11	Good	1	Good	4	Average	10	Good	10	Average
- Waste management (solid, liquid, etc.)	11	Average	2	Average	4	Weak	10	Good	10	Average
- Noise management	11	Weak	2	Weak	4	Average	11	Average	9	Weak
- Traffic management	11	Average	2	Average	4	Good	11	Average	9	Average
- Economic contribution, in term of GDP contribution	11	Good	2	Average	4	Good	7	Weak	9	Good
- Economic contribution in term of the provision of employment	11	Good	2	Good	4	Good	8	Average	8	Good
- Social contribution (security, social coherence, etc.)	11	Good	2	Good	4	Good	8	Average	9	Good
- Involvement of stakeholder	11	Average	2	Good	4	Average	8	Good	8	Good

[a] Statistical use: Mode

At the country level, Vietnamese ports were assessed as performing better on economic and social aspects than the ports in Cambodia, but they are worse than the Cambodian counterparts in environmental performance (Table 91).

Table 91: Assessment of the port's actors on the performance of the ports on different aspects (survey result[a])

	Vietnamese ports		Cambodian ports	
	Count	Mode	Count	Mode
- Water quality	27	Average	21	Average
- Air quality	27	Average	21	Good
- Soil quality	26	Average	20	Good
- Waste management (solid, liquid, etc.)	26	Average	20	Average
- Noise management	27	Good	20	Average
- Traffic management	27	Average	20	Average
- Economic contribution, in term of GDP contribution	27	Good	16	Good
- Economic contribution in term of the provision of employment	27	Good	16	Average
- Social contribution (security, social coherence, etc.)	27	Good	17	Good
- Involvement of stakeholder	25	Average	16	Good

[a] Statistical use: Mode

5. *Stakeholders' views on the environmental management plan of actions for ports*

At each port in the project, different activities could be done to improve the environmental management at the port. The respondents have given each predefined activity a relative importance by indicating whether action should be taken immediately, in a short-term environmental management plan or in a long-term environmental management plan (Table 92).

At the Hai Phong Port, actions that are seen as needing immediate attention include building treatment plant/station to solve the problems with wastewater and solid waste. Next to them are capacity building needs (trainings for staff and the establishment of specialised team to deal with environmental management issues). The existence of an "Oil Spill Contingency Plan" also needs immediate attention. The implementation of an environmental monitoring

system, the EMS and approach the ISO14001 are aspects that need to be tackled in a short-term plan. In a long-term plan, cleaning up the environment and carrying out an environmental audit need to be tackled.

At the port of Da Nang, most of the actions were identified as they should be done immediately. In contrary, for the port of Vung Tau, most of the actions were seen as actions that should be put in a long-term plan and to be tackled gradually.

Table 92: The views of the respondents on the environmental management actions that should be done by each port (survey result)[a]

	Hai Phong Port	Da Nang Port	Vung Tau Port	Phnom Penh Port	Sihanouk ville Port
Clean up the environment	2	1	0	1	0
Build wastewater treatment plan	0	2	2	1	1
Build solid waste treatment station	0	1	2	1	2
Implement environmental monitoring	1	0	2	1	1
Implement Environmental Management System (EMS)	1	0	1	0	1
Get ISO 14001	1	0	1	1	2
Train staff on environmental management	0	0	0	0	1
Draw up "Oil Spill Contingency Plan"	0	0	0	1	1
Establish environmental management team/department	0	0	1	0	1
Establish environmental fund	2	0	2	1	1
Use computer-based management system	1	1	1	1	0
Carry out Environmental Audit	2	0	1	0	1
Carry out Risk Assessment	1	0	1	0	1

Note: 0: Need immediate action; 1: Put in a short-term plan; 2: Put in a long-term plan
[a] Statistical use: Mode

In Cambodia, both at the port of Sihanoukville and the port of Phnom Penh, the respondents saw that the ports need to put most of the actions into a short-term plan so that proper preparation and timely activities can be carried out to solve and prevent environmental problems.

Some respondents suggested that, aside from the above-mentioned actions, cooperation and investment in environmental management at port level should be promoted.

CONCLUSIONS

Although these ports differ in size and capacity, ports in both Vietnam and Cambodia are facing similar environmental issues. Most notable of which is the degradation of water quality (increase of turbidity, increase of organic pollution, oil pollution, heavy metal pollution) due to port expansion, vessel movements, and port operations.

Besides water quality, air quality is also an important environmental issue in Vietnamese and Cambodian port areas. The most obvious air pollution issues at these ports are dust and noise due to heavy traffic to and from the ports. However, the concentrations of other air pollutants (CO, NOx, SOx, lead vapour) at monitored sites are below permissible levels, which shows that air quality at ports in Vietnam and Cambodia has not yet been severely degraded. Regarding soil and sediment quality, this study revealed that not much research was done in this area. Only the port of Hai Phong reported on soil pollution.

It is significant to note that some pollutants were found in biological samples, which are popular in the human food chain, such as mussels and clams. Metal contaminants and persistent organic compounds were found in biological samples. Although the concentrations of those contaminants are below harmful levels to human health, accumulation is likely to continue because contaminants are still being introduced into the environment.

In terms of emission loads from ports, Sihanoukville port pollutes the most with the highest level of emission intensity (calculated by emission per every tonne of cargo throughput) (Table 93). The ports of Hai Phong and Vung Tau have the lowest emission intensity.

Table 93: Emission intensity and resource intensity of ports in the study

	Hai Phong	Da Nang	Vung Tau	Sihanoukville	Phnom Penh
Cargo amount (MT)	14.3	2.31	24.21	1.5	0.6
Container (TEU)	-	32,416	0	213,916	15,526
Emission intensity (kg/tonne throughput)					
CO	0.004	0.018	0.004	0.055	0.022
NOx	0.017	0.041	0.017	0.198	0.117
SOx	0.069	0.973	0.081	0.279	0.196
PM10	0.001	0.005	0.001	0.003	0.007
TSP	0.001	0.010	0.001	0.008	0.003
VOC	0.002	0.015	0.003	0.058	0.010
Resource intensity					
Water use (m^3/tonne throughput)	-	145.022	-	18.300	62.705
Water use (m^3/1,000TEU)	-	10.334	0	0.128	2.423
Electricity (kW/tonne throughput)	-	38.179	-	1,238.080	313.338
Electricity (kW/1,000TEU)	-	2.721	0	8.682	12.109
Land area (m^2/tonne throughput)	83.497	735.931	60.558	733.333	726.833
Land area (m^2/1,000TEU)	-	52.443	0	5.142	28.088

-: data not available

The ports are also big consumers of resources. Aside from land occupation, ports also consume large amounts of water and energy during their operations. Resource intensity is different between ports and represents a port's efficiency. Land use efficiency is highest at the port of Vung Tau with the least land surface occupation of each throughput tonnage.

The description of most common problems at ports in Vietnam and Cambodia is summarised in Table 94.

Table 94: Environmental problems in ports in Vietnam and Cambodia

	Hai Phong Port	Da Nang Port	Vung Tau Port	Phnom Penh Port	Sihanoukville Port
Water quality	Hight turbidity Nutrient pollution Oil pollution	Bacteria pollution Heavy metal pollution Oil pollution	High turbidity Organic pollution Heavy metal pollution Oil pollution	High turbidity Organic pollution Heavy metal pollution	Organic pollution Heavy metal pollution Oil pollution DDT, PCB pollution
Air quality	Dust	Dust	Dust Noise	Dust Noise	Dust Noise
Soil quality	Heavy metal pollution Oil pollution				
Wastes (Solid and liquid)	Waste collection		Waste collection and disposal	Waste collection and disposal	Waste collection and disposal
Biodiversity	Destruction of estuarine habitats and coral reefs				Accumulation of toxins in fish and benthic species

Initial steps have been undertaken at Vietnamese ports to protect the environment. They mostly focus on ensuring sanitation within port areas, preventing fire and explosions, responding to oil spill events and compliance with regulations. In Cambodia, environmental management is a very new issue from both concept and practical aspects. Table 95 lists the most common issues in port environmental management in Vietnam and Cambodia.

Table 95: Issues in port environmental management in Vietnam and Cambodia

	Hai Phong Port	Da Nang Port	Vung Tau Port	Phnom Penh Port	Sihanoukville Port
1	Dredging and dumping of dredged materials	Dredged materials	Overflowing rainwater, domestic effluents	Port development – land related issues	Port development – land related issues
2	Loading and unloading of goods		Collection and treatment of ship-generated waste.	Ship discharge (of bilge, ballast and sewage)	Ship discharge (of bilge, ballast and sewage)
3	Dumping waste from ship		Collection and treatment of oil sludge.	Noise due to heavy traffic	Dust
4	Ship building and repairing		Oil spill response	Bunkering	Water quality issue
5	Transport cargo and containers, ship movement		Fire prevention and fire fighting,	Environmental risk assessment	Busy traffic
6	Oil and chemical spill		The inspection and control tasks	Port-city relation	Habitat degradation and loss
7	Fire and explosion		Ship building and repairing		
8	Environmental monitoring				

Awareness of environmental pollution caused by ports has risen since the nineties, resulting in worldwide research on all kinds of pollution caused by port activities. However, in Vietnam and Cambodia, the environmental situation in ports has not yet been properly studied. Inadequate means, such as low environmental technical capacity of port authorities and staff as well as a lack of monitoring systems, make it difficult to fully assess the level of different kinds of pollution as well as to set suitable mitigation measures. As a result, it is hard to implement environmental protection programmes.

By comparison, ports in Europe or the United States are much bigger than ports in Vietnam and Cambodia, which tend to be much smaller in size and operational scale. The ports in Vietnam and Cambodia, however, are also faced with the same common environmental issues as evidenced by other ports worldwide. Table 96 presents the ten most common issues in environmental management in European ports according to ESPO's questionnaire administered at 129 sea ports.

Table 96: 10 most common issues in environmental management in European ports in 1999 and 2004 (ESPO, 2005a)

Issues in 1999	Issues in 2004
Port development – water related	Garbage/Port waste
Water quality	Dredging
Dredging disposal	Dredging disposal
Dredging	Dust
Dust	Noise
Port development – Land related	Air quality
Contaminated land	Hazardous cargo
Habitat loss/Degradation	Bunkering
Traffic volume	Port development – Land related
Industrial effluent	Ship discharge (bilge)

The survey also showed that environmental management at European ports has witnessed progress in comparison to the situation in1999. Some selected indicators are:

- 86% of the ports have an environmental policy, or are developing one (an increase of 6%);
- 59% make it available to the public
- 49% have their plans aimed at improving environmental standards beyond those required under legislation (an increase of 8%)
- 69% promote, through their plans, environmental awareness among port users (an increase of 7%)
- 67% of ports have designated environmental personnel (an increase of 2%)
- 21% have an environmental manager – otherwise, the main operational responsibility generally lies with the port manager (30%) and harbour master (27%)
- 58% ensure that their personnel attend environmental management training courses
- 65% of the ports carry out environmental monitoring of the port area
- 48% have identified environmental indicators
- 65% carry out environmental impact assessment in connection with development projects.

In the United States, the Natural Resources Defence Council has analysed and evaluated the environmental performance of the 10 largest US container ports (2004). Grading criteria included indicators for *air quality* (e.g. cleaner yard equipment and cranes, reduced emissions from ships and harbour craft, reduced truck emissions, etc.), *water quality* (e.g. water quality monitoring, oil spill prevention, storm water control/treatment, etc.), *land use* (e.g. reuse of "brownfield", proper disposal of toxic materials, location of terminal, etc.), *community relation* (e.g. community outreach, public access to information, etc.) and *other factors* (ISO 14001, Green Port or sustainability programmes, energy efficiency, recycling programme, organic or native landscaping programmes, etc.). Most of the ports assessed have shown good performance in addressing environmental pollution (concerning air quality, water quality and land use criteria) but have still been noted unsuccessful in involving the public into their management activities.

The overall evaluation showed that most of the ports in this study had taken initial steps to implement mitigation and or prevention programmes and had started to consider impacts to public health and the environment. For example, at the port of Hai Phong, port operations complied with ISO 9001:2000 and ISPS regulations which will have some positive effects on the environment. However, Hai Phong port still does not have an environmental management system yet. All ports in Vietnam have implemented some measures to prevent oil pollution. These measures include the development of Oil Spill Contingency Plans and the integration of environmental protection into the ports' regulations. However, the enforcement and the coordination between Government agencies and ports' actors in carrying out environmental protection measures are still weak.

In Cambodia, the port of Phnom Penh had to make special arrangements with the city council to regulate traffic and to reduce traffic problems in the city. A special permit for trucks engaging in port operations is issued to regulate traffic time to and from the port to avoid heavy traffic during peak hours. Another long-term solution is to spread the cargo to different depots so that trucking activities will not be intensely concentrated along the main road. These were considered effective measures to reduce air and noise pollution. Nevertheless, the port does not have an environmental policy and has no plans drawn up to prevent other types of pollution.

All the ports have fallen short in addressing the full environmental impacts of their operations and the community concerns. Environmental Impact Assessment and Risk Assessment have not been done at ports and environmental monitoring has not been initiated in port areas. From this study, it became clear that environmental training of staff and environmental monitoring systems should be organised at ports, to support environmental decision-making and to start implementing environmental management systems. Since environmental management in ports is a complicated process, a step-by-step implementation should be designed to assist ports in achieving intermediate goals in environmental management. Experience from European ports shows that implementing environmental management efforts cannot be achieved all at once.

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ANNEX 1 – VIETNAM'S STANDARDS

Vietnam's Standard TCVN 5943 - 1995

WATER QUALITY - COASTAL WATER QUALITY STANDARD

1 Scope

1.1 This standard regulates parameters and the limits of pollutants in coastal water.

1.2 This standard is used to assess coastal water quality.

2 Limit values

2.1 The list of parameters, pollutants and the permissible limits in coastal waters is shown in table 1.

2.2 Sample collection, analysis and calculation methods for each parameter are regulated by corresponding standards.

Table 1: Permissible limits for parameters and pollutants in coastal waters

N°	Thông số Parameters	Đơn vị Unit	Giá trị giới hạn – Limits		
			Bãi tắm Beaches	Nuôi thuỷ sản Aquaculture	Các nõi khác Others
1	Nhiệt độ	°C	30	-	-
2	Mùi		bearable	-	-
3	pH		6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
4	Oxy hoà tan – Dissolved oxygen	mg/l	> 4	> 5	> 4
5	BOD_5 (20°C)	mg/l	< 20	< 10	< 20
6	Chất rắn lõ lửng – Total Dissolved Solids	mg/l	25	50	200
7	Asen – Asenic	mg/l	0.05	0.01	0.05
8	Amoniac (tính theo N) – Amonia	mg/l	0.1	0.5	0.5
9	Cadmi – Cadmium	mg/l	0.005	0.005	0.01
10	Chì – Lead	mg/l	0.1	0.05	0.1
11	Crom (VI) – Chromium (VI)	mg/l	0.05	0.05	0.05
12	Crom (III) - Chromium (III)	mg/l	0.1	0.1	0.2
13	Clo – Chlorite	mg/l	_	0.01	_
14	Đồng – Copper	mg/l	0.02	0.01	0.02
15	Florua – Florite	mg/l	1.5	1.5	1.5
16	Kẽm – Zinc	mg/l	0.1	0.01	0.1
17	Mangan – Manganese	mg/l	0.1	0.1	0.1
18	Sắt – Iron	mg/l	0.1	0.1	0.3
19	Thuỷ ngân – Mercury	mg/l	0.005	0.005	0.01
20	Sulfua – Sulphur	mg/l	0.01	0.005	0.01
21	Xianua – Cyanide	mg/l	0.01	0.01	0.02
22	Phenol tổng số - Total phenols	mg/l	0.001	0.001	0.002
23	Váng dầu mỡ - Oil and grease (film)	mg/l	n.d.	n.d.	0.3
24	Nhũ dầu mỡ - Oil and grease (emulsion)	mg/l	2	1	5
25	Tổng hoá chất bảo vệ thực vật – Total pesticides	mg/l	0.05	0.01	0.05
26	Coliform	MPN/100ml	1000	1000	1000

n.d.: not detectable

Vietnam's Standard TCVN 5942 - 1995

WATER QUALITY - SURFACE WATER QUALITY STANDARD

1 Scope

1.1 This standard regulates parameters and the limits of pollutants in surface water.

1.2 This standard is used to assess surface water quality.

2 Limit values

2.1 The list of parameters, pollutants and the permissible limits in surface waters is shown in table 1.

2.2 Sample collection, analysis and calculation methods for each parameter are regulated by corresponding standards.

Table 1:. Permissible limits for parameters and pollutants in surface waters

N°	Thông số *Parameters*	Đơn vị *Unit*	Giá trị giới hạn – *Limits*	
			A	B
1	pH	-	6 - 8.5	5.5 – 9
2	BOD_5 (20°C)	mg/l	< 4	< 25
3	COD	mg/l	>10	>35
4	Oxy hoà tan – *Dissolved Oxygen*	mg/l	≥ 6	≥ 2
5	Chất rắn lỡ lừng – *Total Dissolved Solids*	mg/l	20	80
6	Asen – *Asenic*	mg/l	0.05	0.1
7	Bari – *Barium*	mg/l	1	4
8	Cadimi – *Cadmium*	mg/l	0.01	0.02
9	Chì – *Lead*	mg/l	0.05	0.1
10	Crom (VI) – *Chromium (VI)*	mg/l	0.05	0.05
11	Crom (III) – *Chromium (III)*	mg/l	0.1	1
12	Đồng – *Copper*	mg/l	0.1	1
13	Kẽm – *Zinc*	mg/l	1	2
14	Mangan – *Manganese*	mg/l	0.1	0.8
15	Niken – *Nickel*	mg/l	0.1	1
16	Sắt – *Iron*	mg/l	1	2
17	Thuỷ ngân – *Mercury*	mg/l	0.001	0.002
18	Thiếc -	mg/l	1	2
19	Amoniac (tính theo N) – *Amonia*	mg/l	0.05	1
20	Florua – *Florite*	mg/l	1	1.5
21	Nitrat (tính theo N) – *Nitrate*	mg/l	10	15
22	Nitrit (tính theo N) – *Nitrite*	mg/l	0.01	0.05
23	Xianua – *Cyanide*	mg/l	0.01	0.05
24	Phenol (tổng số) - *Total phenols*	mg/l	0.001	0.02
25	Dầu, mỡ - *Oil and Grease*	mg/l	*undetectable*	0.3
26	Chất tẩy rửa – *Disinfectants*	mg/l	0.5	0.5
27	Coliform	MPN/100ml	5000	10000
28	Tổng hoá chất bảo vệ thực vật (trừ DDT) – *Total pesticides (excluding DDT)*	mg/l	0.15	0.15
29	DDT	mg/l	0.01	0.01
30	Tổng hoạt độ phóng xạ a - *Total radioactive a*	Bq/l	0.1	0.1
31	Tổng hoạt độ phóng xạ b - *Total radioactive b*	Bq/l	1.0	1.0

- Column A is applied for surface water that can be used to supply drinking water (after appropriate treatment)
- Column B is applied for surface water that can be used for other purposes. Water for agriculture and aquaculture has separate standards.

Vietnam's Standard TCVN 5937-1995

AIR QUALITY - AMBIENT AIR QUALITY STANDARDS

1. Scope

1.1 This standard specifies concentration limits of the main constituents in ambient air (carbon monoxide nitrogen dioxide, ozone, sulphur dioxide, Lead particulate, suspended particles).

1.2 This standard applied to the evaluation of ambient air quality and to the monitoring of air pollution status.

2. Limit values

The limits of the main parameters in ambient air are shown in the table 1.

Table 1: Ambient Air Quality Standards (mg/m^3)

N°	Parameter	1 hr-Averaging Time	8 hr-Averaging Time	24 hr-Averaging Time
1	CO	40	10	5
2	NO_2	0.4	-	0.1
3	SO_2	0.5	-	0.3
4	Lead (particulate)	-	-	0.005
5	O_3	0.2	-	0.06
6	Suspended particulate matter	0.3	-	0.2

Note: Standard methods of analysis of ambient air quality parameters are specified in available current TCVNs.

Vietnam's Standard TCVN 5938-1995

AIR QUALITY - MAXIMUM ALLOWABLE CONCENTRATION OF HAZARDOUS SUBSTANCES IN AMBIENT AIR

1. Scope

1.1 This standard specifies the maximum allowable concentration of some organic and inorganic hazardous substances in ambient air.

1.2 This standard applies to the evaluation of ambient air quality and to monitoring of the ambient air pollution status.

1.3 This standard is not applicable to the workplace air quality.

2. Limitation Values

Maximum allowable concentrations of the hazardous substances in ambient air are shown in the table 1.

Table 1: Maximum Allowable Concentrations of Some Hazardous Substances in Ambient Air (mg/m^3)

N°	Substances	Chemical Formula	Average over 24hrs	Maximum One Occasion
1	Acrylonitrile	CH_2=CHCN	0.2	-
2	Ammonia	NH_3	0.2	0.2
3	Aniline	$C_6H_5NH_2$	0.03	0.05
4	Anhydrious vanadium	V_2O_5	0.002	0.05
5	Arsenic (inorganic compound, as As)	As	0.003	-
6	Hydrogen arsenic	AsH_3	0.002	-
7	Acetic acid	CH_3COOH	0.06	0.2
8	Hydrochloric acid	HCl	0.06	-
9	Nitric acid	HNO_3	0.15	0.4
10	Sulphuric acid	H_2SO_4	0.1	0.3
11	Benzene	C_6H_6	0.1	1.5
12	Particles containing SiO_2			
	- dianas 85-90% SiO_2		0.05	0.15
	- diatomic brick 50% SiO_2		0.1	0.3
	- cement 10% SiO_2		0.1	0.3
	- dolomite 8% SiO_2		0.15	0.5
13	Particles containing asbestos		none	none
14	Cadmium (metal and oxide) as Cd	Cd	0.001	0.003
15	Carbon disulfide	CS_2	0.005	0.03
16	Carbon tetrachloride	CCl_4	2	4
17	Chloroform	$CHCl_3$	0.02	-
18	Tetraethyl lead	$Pb(C_2H_5)_4$	none	0.005
19	Chlorine	Cl_2	0.03	0.1
20	Benzidine	$NH_2C_6H_4C_6H_4NH_2$	none	none

N°	Substances	Chemical Formula	Average over 24hrs	Maximum One Occasion
21	Chromium-metal and compound	Cr	0.0015	0.0015
22	1,2 –Dichlorethane	$C_2H_4Cl_2$	1	3
23	DDT	$C_8H_{11}Cl_4$	0.5	-
24	Hydrogen fluoride	HF	0.005	0.02
25	Formaldehyde	HCHO	0.012	0.012
26	Hydrogen sulfide	H_2S	0.008	0.008
27	Hydrogen cyanide	HCN	0.01	0.01
28	Manganese and compound (as MnO_2)	Mn/MnO_2	0.01	-
29	Nickel (metal and compound)	Ni	0.001	-
30	Naphthalene		4	-
31	Phenol	C_6H_5OH	0.01	0.01
32	Styrene	$C_6H_5CH=CH_2$	0.003	0.003
33	Toluene	$C_6H_5CH_3$	0.6	0.6
34	Trichloroethylene	$ClCH=CCl_2$	1	4
35	Mercury (metal and compound)	Hg	0.0003	--
36	Vinylchloride	$ClCH=CH_2$	-	13
37	Gasoline		1.5	5.0
38	Tetrachloroethylene	C_2Cl_4	0.1	-

Note: Standard analysis methods of concentration of the substances are specified in available current TCVNs.

Vietnam's Standard TCVN 5949-1995

ACOUSTICS - NOISE IN PUBLIC AND RESIDENTIAL AREAS MAXIMUM PERMITTED NOISE LEVEL

1. Scope

1.1 This standard specifies the maximum permitted noise level in environment of public and residential areas.

In this standard, noise means any unpleasant or physiologically harmful sound emitted or caused by man's activities.

1.2 This standard is applied to the control of noise level of any source or activity that emitted noise into the environmental of public and residential areas.

2. Limit values

2.1 In the public and residential area, no activities of production, trade or of service or entertainment, etc. shall emit or cause noise levels exceeding the noise level prescribed in the table 1.

2.2 Noise measurement method for determination of noise level is specified in corresponding TCVNs.

Table 1: Maximum Permitted Noise Level in Public and Residential Areas (dB(A))

N°	Area	Period of Time		
		From 6^h AM to 18^h	From 18^h to22^h	From 22^h to 6^h AM
1	Quiet areas: Hospitals, sanatoria Libraries Kindergartens, schools	50	45	40
2	Residential area: Hotels, administration offices Houses, apartment houses, etc.	60	55	45
3	Commercial and service areas and mix	70	70	50
4	Small industrial factories intermingling in residential areas	75	70	50

ANNEX 2 – CAMBODIA'S STANDARDS

By the Royal Government of the Kingdom of Cambodia - the Council of Ministers: Sub-Decree on Water Pollution Control. No: 27 Anrk.Bk Phnom Penh, April 06, 1999.

Annex 4

WATER QUALITY STANDARD IN PUBLIC WATER AREAS FOR BIO-DIVERSITY CONSERVATION

1- River

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	BOD_5	mg/l	1 – 10
3	Suspended Solid	mg/l	25 – 100
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 5000

2- Lakes and Reservoirs

No	Parameter	Unit	Standard Value
1	pH	mg/l	6.5 – 8.5
2	COD	mg/l	1 – 8
3	Suspended Solid	mg/l	1 – 15
4	Dissolved Oxygen	mg/l	2.0 - 7.5
5	Coliform	MPN/100ml	< 1000
6	Total Nitrogen	mg/l	1.0 – 0.6
7	Total Phosphorus	mg/l	0.005 – 0.05

3- Coastal water

No	Parameter	Unit	Standard Value
1	pH	mg/l	7.0 – 8.3
2	COD	mg/l	2 – 8
4	Dissolved Oxygen	mg/l	2 - 7.5
5	Coliform	MPN/100ml	< 1000
5	Oil content	mg/l	0
6	Total Nitrogen	mg/l	1– 1.0
7	Total Phosphorus	mg/l	0.02 – 0.09

By the Royal Government of the Kingdom of Cambodia - the Council of Ministers: Sub-Decree on Water Pollution Control. No: 27 Anrk.Bk Phnom Penh, April 06, 1999.

Annex 5

WATER QUALITY STANDARD IN PUBLIC WATER AREAS
FOR PUBLIC HEALTH PROTECTION

No	Parameter	Unit	Standard Value
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0.03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Diedrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chloroform	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1
18	Total mercury	µg/l	< 0.5
19	Organic mercury	µg/l	0
20	Lead	µg/l	< 10
21	Chromium, valent 6	µg/l	< 50
22	Arsenic	µg/l	< 10
23	Selenium	µg/l	< 10
24	Polychlorobiohenyl	µg/l	0
25	Cyanide	µg/l	< 0.005

ANNEX 3 – QUESTIONNAIRES

Questionnaire 1:
INVENTORY OF ENVIRONMENTAL ISSUES

In the framework of the project "Establishing scientific support for environmental management for ports in Vietnam and Cambodia", we currently need to start Phase 0: "inventory". This phase entails the collection of data on environmental issues in three ports in Vietnam and two ports in Cambodia and their surrounding port areas.

To guarantee a good start to the project, we need to start this phase immediately. Therefore, basic information on environmental pollution of water; air and soil has to be inventoried for each of the five port areas. Additionally, the impact of harbour activities on fauna, flora, ecosystems, biodiversity and human health needs to be investigated and land use and land use changes have to be mapped. Also, a description of the legal framework of both countries needs to be included. All this information needs to be inventoried in a final report, which is the output of phase 0.

The paragraphs below are designed to give guidance for completing this final report.

A good final report can be made using the following three steps:

1. Complete the questions in this document
2. Go around and visit the port
3. Please review the report and make sure any item concerning 'environmental issues of port areas are included. Please also add evidence (graphs, tables, photographs, maps, illustrations, etc.) to support your arguments.
4. Please also add a full list of consulted documents for reference.
5. To facilitate the process and to ensure integrity, a blank document was added in the mail in which you found this document. Please use this blank to complete your final report.

To finish phase 0 in time, it is necessary to send us your final report before the Tuesday 20th of January, 2005. Please complete one document with required data for each port area and send us this file by e-mail.

If there are any questions or remarks to make concerning the report, please contact us as soon as possible. Please also add any information you might feel necessary for the report.

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ENVIRONMENTAL PERFORMANCE REPORT

The purpose of phase 0 is to provide details on the environmental performance of the ports during last five years. If the ports have a yearly environmental report, this can be the basis of this document. Also port handbooks, annual reports or equivalent publications often contain information, which can be used to complete this document. Information on the topics below has to be included.

- The port and its environment
- The port's environmental policy
- The use of environmental management instruments in the port
- Information on port management
- Information on environmental legislation
- Information on land use and land use changes
- Significant environmental aspects
- Environmental performance
- Information on stakeholders' involvement
- Other remarks regarding the port

In the paragraphs below, some guidelines are given to describe these items in more detail.
The best way to complete the final document is to pass these guidelines together with the 'blank' document among specialist colleagues so that they can assist in its completion.
In the 'blank' document, a table is included in which information pertaining to the following can be added.
Please indicate:

- The person in charge (editor) of each report.
- Name of the person who assisted in completing the report.
- Institute where these persons are working.
- Function/position of these persons.
- Contact information (E-mail, telephone, fax, homepage).
- Indicate which part of the report each person completed.

1. The port and its environment

The report has to contain a paragraph that describes the port and its environment. This requires information on:

- The location (geography) of the port, i.e. where in Vietnam is this port situated (North, South?). Add a map and describe.
- Port details
    - Describe how big the port is
        - How much cargo was handled last five years (tons/year)?
        - How many containers were handled (TEU)
        - Describe the number of passengers that passed through the port (number/year).

      In the 'blank' document, a table is inserted in which this information can be filled in.
    - Describe the port
        - Area of the port's navigable water (km^2)
        - Area of the port's land (km^2)
        - What types and which quantity of cargo are handled (dry bulk, liquid bulk, vehicles, petroleum, ro-ro, others)
        - How many berths are there, what is their length and depth?
        - What is the total quayage (m)?
        - Length of the largest vessel (m)
        - Draught of the largest vessel (m)
        - What kind of hinterland connections does the port have (road, rail, airport, inland waterways) + explain.
        - What types of industry are settled in the port: which companies are there and give a short description of these companies (e.g. chemical industry, storage, refrigerated cargo, ship repair, etc.).
        - Are there any residential areas surrounding the port? Please give details.
- The coastline: what kind of coastline does the port have (mangrove, beach, lagoon, etc)? Describe characteristics of this type of coast and include a picture.
- The variety of habitats and species that are found in and around the port.

2. The port's environmental policy

In a second paragraph, the ports environmental policy has to be detailed. The following questions can help to describe this.

- Does the port have an environmental policy? If yes, include this policy in the report.
- Who is responsible for the formulation and implementation of the policy?
- Is this policy made public?
- Are stakeholders' opinions sought during the development process of the policy?
- Is there a regular review of the objectives set in the policy?
- Is there a plan to put this policy into practice? If yes, include a description of this plan.
- What are the environmental objectives and targets of the plan?
- How is the plan put in practice?
- Is monitoring carried out?
- How is pollution prevented?
- Is all port staff aware of the environmental policy?
- Is there a training foreseen to introduce staff with this policy and to train them in best practices?
- Is all staff aware of the environmental impact of their tasks?

These questions are a guideline to build a paragraph on the port's environmental policy. This list of questions is not limitative and it is advisable to give more information than only information asked above.

3. The use of environmental management instruments in the port

A third paragraph in the environmental performance report of the port has to deal with environmental management instruments. The questions below can help to describe this part.

- Does the port have an Environmental Management System (EMS)? If yes, give a description of the system in the report.
- Has the port received certification for its EMS? If yes, which type of certification?
- Is training foreseen that introduces employees to this EMS?
- Is Risk Assessment (RA) carried out in the port?
- Are there actions undertaken to minimize risks? If yes, which actions?
- Does staff have appropriate training and knowledge to perform their required tasks? Do employees have to report accidents or incidents (nearly accident) in which they were involved or of which they became aware?
- Is there an analysis of these accidents/incidents?
- Is there a database with accidents/incidents?
- Did this lead to preventive actions?
- Is there made indication of incidents in with environmental impact and with impact on people?
- Was Environmental Impact Assessment (EIA) (or the so called Environmental Standards Achievement Registration) carried out in the port? If yes, for which projects was it carried out?
- Give the appropriate Cambodian/Vietnamese legislation on EIA for port operations.
- When is EIA in Cambodia/Vietnam required?
- Which steps are obligatory in EIA?

4. Information on port management

The aim of this paragraph is getting a better view on the port's organization and ownership. This has to be done by including the role and the functions of the State and the Port Authorities. Here it is important to include a schedule in the report, that overviews the port management structure. In this schedule, environmental responsibilities have to be described on each port level. For example: what are the environmental responsibilities of

- employees
- the environmental department
- chief officers
- the port director

Is there an environmental committee?
Do they have to make environmental reports? How often?
Give the name and contact information of the designated officer for

- Environmental management
- Waste management
- Emergency planning
- Strategic planning
- Air quamity monitoring
- Water quality monitoring
- Soil pollution addeddment
- Etc.

What is the port's legal position? (municipality, state, private company/other)
Who is the owner of the land? (municipality, state, private company/other)

Who operates the terminals? (public companies, private companies or other)
Who does the stevedoring? (public companies, private companies or other)
Who carries out the cargo handling? (public companies, private companies or other)

5. Information on environmental legislation

The port environmental report also has to give a description of the environmental legislation that influences port operations. Here, a table has to be included that gives an overview the existing laws, as well as a short description of their content.
References to the International Maritime Organization that are applied have to be provided.
In a previous cooperation project with Vietnam, an inventory of the legal framework was made. This is given in ANNEX 1. Please update this information for Vietnam, make sure it is complete and add a short description for each law. For Cambodia: please make a similar inventory with descriptions.

6. Information on land use and land use changes

The report also requires information on land use and land use changes. Therefore, data on:
- degradation of marine resources such as beaches, estuaries, coral reefs and mangroves
- land use (industrial zones, agricultural land, urban areas, recreational areawetlands, grasslands, forests, mangrove etc.)

development of strategic plans for future port expansion have to be included. The best way to do this is by including maps.
Are there landscaping programmes such as plant and tree plantings?
Is there any action to avoid erosion?

7. Significant environmental aspects

In the final report, an inventory of activities with significant environmental impact has to be made.
For each port activity that has an important impact, indicate:
- A description of the activity and the environmental problem related to this activity.
- A description of the impact (e.g. impact on soil, water or air, energy consumption, noise etc.)
- The person or organization responsible for managing this activity.
- Role of the port authority: is the port authority responsible for this activity and related impact? If not, is there a way the port can influence the responsible organization?
- Legal requirements that are applicable to this activity
- Remarks

In the 'Blanc' document, a table is added in which these data can be added. In this table, some examples are given as well.

8. Environmental performance

The major part of the report has to deal with environmental performance aimed at giving an overview of the ports' environmental performance in the last five years. It is advisable to include tables containing more information on:
- Water quality
- Soil quality
- Air quality
- Waste management (both solid waste and wastewater)
- Oil spill management
- Fauna, flora and ecosystems
- Dredging

Water quality

Data which was collected over the past five years and which indicates the water quality in and around the port has to be included. Such data are chemical (DO, BOD, COD, etc.) and physical parameters (pH, Temperature, turbidity, etc.) as well as levels of metals, hydrocarbons, pesticides, coliforms and TBT (tributyltin) concentration in the water. Also sediment characteristics are important in terms of contaminant status (e.g. heavy metals, hydro carbons, pesticides, TBT, etc.).
Indicate at which time intervals these measurements were made last five years. Were measurements made continuously, once a day or once a week? How often?
Please add all data that are available in national environmental monitoring stations, universities, research laboratories, etc.
The report does not only have to contain a **table** with concentrations of water contaminants, but it also has to contain an interpretation of these data. Relating measurements with standards can do this.

Besides this, it is important to relate these interpretations to human health. One has to give an answer and an explanation for the question 'Do these levels of contaminants have an impact on human health?'

Soil quality

Data on soil quality can be gathered by asking the following questions;

- What kind of soil contamination was reported in the last five years?
- Which actions were undertaken to avoid contamination of the soil in and around the port?
- Which soil quality parameters were monitored in the last five years? What were the levels of contaminantion?
- What are time intervals between monitoring?
- Is there monitoring of both the solid part of the soil and the soil water?

The report has to give a **table** with levels of soil contaminants as well as an evaluation of the contamination. This means that measurements have to be related to standards and the impact on human beings needs to be described.

Air quality

Emissions to air are an important indicator of the environmental performance of a port. Therefore, these emissions also have to be included in the report. Monitoring data of emissions of CO, SO_x, NO_x, O_3, heavy metals, Particulate Matter (PM), Hydrocarbons, Volatile Organic Compounds (VOC's), dioxins, Poly Aromatic Hydrocarbons (PAH's), etc. over the past five years can give an indication of port's actions to reduce impacts or can show the opposite. Also data on noise levels as well as odour nuisance in and around ports are an important indication of air quality. A **table** with quantitative data is preferred, but in case of absence of this information, qualitative data may be given.

Please indicate in the report, which parameters are measured in Vietnamese/Cambodian ports and indicate at which time frame measurements were made in the last five year. Also give an interpretation of last five-years' concentrations by comparing measured levels with standards.

As for water and soil parameters, the levels of air pollutants have to be related to human health. Do the measured levels impact human health?

Waste management

Besides water, soil and air quality parameters, information on waste management has to be included in the report to guarantee a good overview of the port's environmental performance.

Here, it is preferable to collect the last five year's quantitative data (e.g. ton or liters /year) on:

Solid waste

- Garbage from ships
- Garbage from docks and storage facilities
- Garbage from administrative facilities
- Maintenance residues

Liquid waste

- Industrial wastewater
  - From factories
  - From storage facilities
  - From ships
    - Bilge water
    - Ballast water
    - Wash water
  - Liquid residues containing oil or chemicals
- Domestic wastewater
  - From ships: bathrooms, toilets and kitchens
  - From the harbour: public bathrooms and kitchens

Besides including a **table** with these quantitative data, a text with an interpretation of these data is required. The questions

Is recycling or reuse of waste promoted? If yes, how is this done? can help to interpret the data.

Oil spill management

The report has to contain an overview of the number of oil spills in the last five years. The amount of oil that was spilled as well as the environmental impact and the response taken have to be detailed. The 'blank' document contains a table in which these data can be completed.

In addition, answers on the following questions can help to complete the paragraph on oil spill management.

- Is there an oil spill response plan in the port? If yes, please include a description of this plan in the report
- Is oil spill response training foreseen for port staff?

Fauna, flora and ecosystems

Port activities can affect the ecological function of adjacent mangrove habitats and wetlands. Answers on the questions below can form the basis for a paragraph on fauna and flora.

- Are there surveys to obtain information on trends in ecosystem conditions and the effects of port operations? This means: are there changes in mangrove, coral reef, sea-grss beds, marh, etc due to port operations and are these changes monitored?
- Ports can cause movements of animals, birds or fishes for example. Are there monitoring programmes that monitor these movements? Is there any action undertaken to provide new habitats for birds or other animals that are forced to move due to port operations?
- Is there any programme to study the impact of the port on the ecosystems and their components (such as the movements of species)? Please give details on such programmes.
- Also describe actions that are taken to minimize these impacts.
- Is there training foreseen for port staff that focuses on fauna awareness?
- Are there rules that limit the use of herbicides and pesticides?

Once again, this list is meant to guide you and it is not a limitative list. Any additional information on fauna and flora may be given.

Dredging

The paragraph that deals with dredging can be based on the questions mentioned hereunder.

- Is there any law concerning dredging or dumping of dredged materials?
- What is done with dredged material? Is it dumped in sea or on shore?
- Is the concentration of contaminants in dredged material analyzed?
- Is there any treatment (in complete or partially) of the dredged materials before/after dumping?

9. Information on stakeholders' involvement

Port stakeholders are any individuals or groups being directly or indirectly impacted by the port's activities. The port need to treat his stakeholders in the same way it would treat his customers or employees. Therefore, it is important to know whether or not the port informs stakeholders on its environmental activities.

How does the port inform stakeholders? For example: are there open days for interested persons? Are there opportunities for schools to visit the port? Are there community group tours? Etc.

10. Other remarks regarding the port

If you consider that there are any special items regarding the port and the environment, please bring them up for attention in this paragraph.

ANNEX 1

Legal Regulations on Environmental Management in Vietnamese Ports

Environment and nature protection have been given special attention by the Vietnamese government and administration at all levels. Legal regulations have been launched and are now subject to improvement. Viet Nam also signed the UN environmental conventions, and the IMO conventions on maritime safety and prevention of environment pollution. The remaining part of this section is a list of the laws and regulations applicable to environmental protection in Viet Nam.

Laws and Regulations on Environmental Protection in Viet Nam

- Law on environmental protection approved by the National Assembly on December 27th, 1993, in force on 10th January, 1994.
- Decree No. 175/CP dated January 18th, 1994, by the Government providing guidelines to implement laws on environmental protection.
- Decree No. 26/CP dated April 26th, 1994, by the Government on settling disputes about administrative violation of environment protection regulations.
- Circular No. 715/MTg dated April 4th, 1995, by the Ministry of Science Technology and Environment providing guidelines to control and approve environmental impact statements of direct foreign investment projects.
- Circular No. 2880/KCM-TM dated December 19th, 1996 by the Ministry of Science, Technology and Environment and the Ministry of Trade on temporary provisions on the import of waste.
- Circular No. 1100/TT-MTg dated 20th August, 1997 by the Ministry of Science, Technology and Environment on the examination and approval of reports assessing environment effects.
- Circular No. 490/1998/TT-MTg dated 29th December, 1995 by the Ministry of Science, Technology and Environment on guidelines to deal with oil spills.
- Circular No. 2262/TT-BKHCN&MT dated 30th April, 1998 by the Ministry of Science, Technology and Environment on the examination and approval of environmental assessment reports.

Laws on Transport (relating to pollution prevention)

- The Maritime Code of Viet Nam approved by the National Assembly on June 30th, 1990, in force since January 1st, 1991.
- Decree No. 13/CP dated February 25th, 1994, by the Government on "The regulation on the management of maritime shipping at seaports and in the maritime navigable zones of Viet Nam" and Decree No. 24/ND-CP dated May 30th, 2001, amended by some regulations on "The regulation of the management of maritime shipping at seaports and in the maritime navigable zones of Viet Nam " promulgated with Decree No. 13/CP of February 25th, 1994, by the Government.
- Seaport regulations by the directors of Port Authorities.
- Decision promulgating regulations on environmental protection by Port Authorities at Vietnamese seaports.

Conventions on Environmental Pollution

- International Convention on civil liability for oil pollution damage, 1969 - CLC, amended in 1992.
- International Convention on the establishment of an international fund for the compensation for oil pollution damage, 1971 – FUND.
- International Convention on pollution from ships 1973, as amended in 1978 - MARPOL 73/78. The Government of the Socialist Republic of Vietnam approved this Marpol Convention on the 18th December 1990. The convention entered into force on the 18th Mach, 1991.
- International Convention on the Safety Of Life At Sea (SOLAS), 1974, and its protocol of 1978. SOLAS 74 is the most important international Convention on maritime safety. It entails international standards on environmental pollution from ships.

Now, the government considers taking part in the International Convention on civil Liability for oil pollution Damage, 1969 - CLC, amended in 1992.

Responses to oil spill incidents are regulated by Decision No 63/2000/QD-Ttg dated 7th June 2000 by the Prime Minister on renaming and amendment duties of the Vietnamese Search and Rescue Committee and Decision No 129/2001/QD-Ttg dated August, 2001 by the Prime Minister that approves the National Response Oil Spill Plan from 2001 to 2010.

Questionnaire 2:
DETAILED INFORMATION ABOUT THE PORT

Please complete a separate form for each port

Name of the port:
Contact person (email and address):

1. Information about the port
a. Total Land area (ha)
b. Office building area (ha)
c. Warehouse (ha), *divided by:*
- Area of warehouse for fertiliser/minerals/etc.
- Area of cold stores
- Area of timber sheds
- Capacity of silos (for grain/granulates)
- Area of warehouse for dangerous good.

d. Bunkering capacity
e. Number of berths/quays
f. Total length of berths/quays
g. Max ship can enter the port (DWT)
h. Function of the ports (multipurpose/specialised in oil handling/commercial port/recreational port)

Facilities of the port and fuel usage
e. N° of cranes (conventional cranes) – separate by horsepower
f. N° of cranes (heavy-duty cranes for container) – separate by horsepower
g. N° of forklifts
h. N° of tug boats (list by capacity)
k. N° of trucks operating in the port (list by types or capacity)
l. Fuel used by tugboats
Other facilities
Add more lines as needed.
You can also attach a list of facilities/equipments if it is easier for you

2. Port workers
a. Number of port's workers (divide by functions)
b. Total amount of solid waste collected
c. Estimate rate of collection
d. Frequency of collection

3. Information about ships called at ports and ship discharges
a. Number of ships called at port
- Number of container ships < 40000 GRT
- Number of container ships > 40000 GRT
- Number of tanker < 40000 GRT
- Number of tanker > 40000 GRT
- Number of general cargo vessels < 40000 GRT
- Number of general cargo vessels > 40000 GRT
- Number of passenger ships (cruise ships)
- Number of other ships (Ro-Ro, barges, etc)

b. Total number of crew (people)
c. Total number of passenger
d. Bunkering (actual amount)
e. Solid waste (tonne/year)
- Paper, cardboard
- Plastic
- Glass
- Organic waste (left-over, etc)

f. Bilge/Ballast/Oil sludge discharged

4. Information about ship building and ship repairing activities
a. Types of antifouling product
b. Amount of antifouling product used (*insert rows if necessary)*
c. Ship maintenance (sanding/blasting) product *(insert rows if necessary)*
Ship maintenance (wash water) (m^3)
Attach port's reports, ship yard reports

5. Water consumption
a. Amount of fresh water provide to ships (m^3)
b. Amount of fresh water used by the port (m^3)
c. Amount of fresh water used for industrial purposes (m^3)
d. Other purposes (m^3)
e. Source of fresh water:
e1- From wells inside/of the port (m^3)
e2- From river through port's water plant (m^3)
e3- From municipality supplies (m^3)
e4- Other (m^3)

6. Energy consumption
a. Electricity supplies to ship
b. Electricity for office building
c. Electricity for lighting at docks/terminals/etc.
d. Source of electricity:
d1- From national grid (kwh)
d2- From its own generator (kwh)
d3- Other (kwh)

7. Petroleum consumption
a. Amount fuelled to ships
b. Amount fuelled to port's cranes, locomotives, trucks, forklifts, derricks, cars, etc.
c. Amount of fuel used for electricity generator
d. Oil spills during fuelling

8. Dredging
a. Length of channel dredged (km)
b. Volume dredged (m^3)
c. Amount dredged (tonne)
d. Dredging frequency (time/year)
e. Composition (or characteristics of dredged materials)

Questionnaire 3:
STAKEHOLDER SURVEY 1 – QUESTIONNAIRE FOR THE NEIGHBOURHOOD

PORT ENVIRONMENTAL MANAGEMENT

STAKEHOLDER SURVEY

In the framework of the project "**Establishing scientific support for environmental management for ports in Vietnam and Cambodia**", co-funded by the Asia Pro Eco Programme of the European Commission, we carry out this survey to understand the stakeholders of the port, their attitude towards the port's operations and their opinion on different issues at the port. Therefore, we would like to have your valuable opinions on environmental issues and environmental management practices in a port that you know.
Your opinions will be treated confidentially. The information collected will be used anonymously and only for scientific purposes.
Thank you very much for your cooperation!

A/ GENERAL INFORMATION ABOUT THE RESPONDENT

1/ Your name: .....

2/ Age: .....

3/ Village: .....

4/ District: .....

5/ Name of the port you are filling information for: .....

B/ PORT ENVIRONMENTAL ISSUES:

6/ In your opinion, which of the following is/are the current environmental issue(s) at the port *(please select all relevant issues and rank each of the issue by priority)*:

Issue	No, there is no problem	Yes, there is a problem. I rank its priority as:			I don't know. I am not sure
		Low	Medium	High	
1. Air quality	☐	☐	☐	☐	☐
2. Dust	☐	☐	☐	☐	☐
3. Noise	☐	☐	☐	☐	☐
4. Odours	☐	☐	☐	☐	☐
5. Light pollution	☐	☐	☐	☐	☐
6. Water quality	☐	☐	☐	☐	☐
7. Risk of vessel accidents	☐	☐	☐	☐	☐
8. Traffic jam, accidents	☐	☐	☐	☐	☐
9. Contaminated land and soil	☐	☐	☐	☐	☐
10. Industrial effluent and emission	☐	☐	☐	☐	☐
11. Risk of oil spills	☐	☐	☐	☐	☐
12. Dredging and dredging disposal	☐	☐	☐	☐	☐
13. Fisheries waste (land)	☐	☐	☐	☐	☐
14. Garbage/ Port solid waste	☐	☐	☐	☐	☐
15. Ship discharge (ballast, bilge, sewage, solid waste, smoke, etc.)	☐	☐	☐	☐	☐
16. Habitat loss/degradation (forest clearance, reduction of fish stock, etc.)	☐	☐	☐	☐	☐
17. **Other** please specify:	☐	☐	☐	☐	☐

7/ Do you feel that the port is a risk for you?

☐ Yes ☐No ☐I am not sure

If Yes, please indicate why so?

.....

.....

.....

8/ Did the port inform you on any of their operations?

☐ Business operations

☐ Actions towards the environment

☐ Social actions

☐ Other (please specify): .....

9/ Through which communication channel did the port inform you on the above?

☐ Radio
☐ Television
☐ Leaflets
☐ Port website
☐ Other (please specify): .....

10/ If you were not informed, would you like to be informed?

☐ Yes ☐No ☐I am not sure

If Yes, on which aspects?

☐ Business operations
☐ Actions towards the environment
☐ Social actions
☐ Other (please specify): .....

11/ If you want to be informed, through which communication channel do you want to receive information?

☐ Radio
☐ Television
☐ Leaflets
☐ Port website
☐ Other (please specify): .....

12/ Is there a contact point in the port which you can consult in case of any hindrance from the port (noise, dust, pollution, etc)?

☐ Yes ☐No ☐I don't know

13/ If there is no contact point at the moment, would you like that there is such a contact point?

☐ Yes ☐No ☐I am not sure

THANK YOU VERY MUCH FOR YOUR COOPERATION!

STAKEHOLDER SURVEY 2 – QUESTIONNAIRE FOR THE PORT'S ACTORS

PORT ENVIRONMENTAL MANAGEMENT

STAKEHOLDER SURVEY

In the framework of the project "**Establishing scientific support for environmental management for ports in Vietnam and Cambodia**", co-funded by the Asia Pro Eco Programme of the European Commission, we carry out this survey to understand the stakeholders of the port, their attitude towards the port's operations and their opinion on different issues at the port. Therefore, we would like to have your valuable opinions on environmental issues and environmental management practices in a port that you know.

Your opinions will be treated confidentially. The information collected will be used anonymously and only for scientific purposes.

A/ GENERAL INFORMATION ABOUT THE RESPONDENT

1/ Your name: .....

2/ Office and address: .....

3/ Which port you are filling information for: .....

4/ Your relation to that port:

4.1/ ☐ Port authority

4.2/ ☐ A port manager/stevedore

4.3/ A worker in the port:

☐ Administrative staff

☐ Warehouse department

☐ Cargo-handling equipment conductor

☐ Truck driver

Other (please specify your function): .....

4.4/ ☐ Governmental authority (please specify): .....

4.5/ An industry working with port (please specify)

☐ Shipping agent

☐ Servicing (please specify): .....

☐ Manufacturing (please specify): .....

☐ Other (please specify your business): .....

4.6/ ☐ Customer

4.7/ ☐ Other (please specify): .....

5/ Working duration at port::

..... hour/day
.....day/month
.....day/year
..... working sessions

B/ PORT ENVIRONMENTAL ISSUES:

6/ In your opinion, which of the following is/are the current environmental issue(s) at the port *(please select all relevant issues and rank each of the issue by priority)*:

Issue	No, there is no problem	Yes, there is a problem. I rank its priority as:			I don't know. I am not sure
		Low	Medium	High	
1. Air quality	☐	☐	☐	☐	☐
2. Antifouling paints	☐	☐	☐	☐	☐
3. Bunkering	☐	☐	☐	☐	☐
4. Cargo Spillage	☐	☐	☐	☐	☐
5 Cargo storage run off	☐	☐	☐	☐	☐
6. Conservation designations	☐	☐	☐	☐	☐
7. Contaminated land	☐	☐	☐	☐	☐
8. Dredging	☐	☐	☐	☐	☐
9. Dredging disposal	☐	☐	☐	☐	☐
10. Dust	☐	☐	☐	☐	☐
11. Energy Consumption	☐	☐	☐	☐	☐
12. Fisheries waste (land)	☐	☐	☐	☐	☐
13. Garbage/ Port waste	☐	☐	☐	☐	☐
14. Habitat loss/degradation	☐	☐	☐	☐	☐
15. Hazardous cargo	☐	☐	☐	☐	☐
16. Industrial effluent	☐	☐	☐	☐	☐
17. Industrial emissions	☐	☐	☐	☐	☐
18. Light pollution	☐	☐	☐	☐	☐
19. Noise	☐	☐	☐	☐	☐
20. Odours	☐	☐	☐	☐	☐
21. Pollution from rivers	☐	☐	☐	☐	☐
22. Port development (land related)	☐	☐	☐	☐	☐
23. Port development (water related)	☐	☐	☐	☐	☐
24. Risk of small oil spills	☐	☐	☐	☐	☐
25. Risk of spills from tanker accidents	☐	☐	☐	☐	☐
26. Risk from port industry activities	☐	☐	☐	☐	☐
27. Risk of traffic accidents (water)	☐	☐	☐	☐	☐
28. Risk of traffic accidents (on land)	☐	☐	☐	☐	☐
29. Other risks:	☐	☐	☐	☐	☐
30. Sediment contamination (marine)	☐	☐	☐	☐	☐
31. Ship discharge (ballast)	☐	☐	☐	☐	☐
32. Ship discharge (bilge)	☐	☐	☐	☐	☐
33. Ship discharge (sewage)	☐	☐	☐	☐	☐
34. Ship exhaust emissions	☐	☐	☐	☐	☐
35. Soil contamination	☐	☐	☐	☐	☐
36. Solid waste	☐	☐	☐	☐	☐
37. Surface run-off	☐	☐	☐	☐	☐
38. Traffic volume	☐	☐	☐	☐	☐
39. Vehicle exhaust	☐	☐	☐	☐	☐
40. Visual Impact	☐	☐	☐	☐	☐
41. Waster water	☐	☐	☐	☐	☐
42. Water quality	☐	☐	☐	☐	☐
43. **Other** please specify:	☐	☐	☐	☐	☐

C/ PORT ENVIRONMENTAL MANAGEMENT:

7/ Do you know if the port has specialised personnel to deal with environmental issues?

☐ Yes ☐No ☐I don't know

8/ Do you know if the port has an environmental policy?

☐ Yes ☐No ☐I don't know

9/ Do you know if the port has an EMS?

☐ Yes ☐No ☐I don't know

10/ Do you know if the port has ISO 14001 already?

☐ Yes ☐Yes, they planned to have it ☐No ☐I don't know

11/ Do you know if the port has any plans to expand?

☐ Yes ☐No ☐I don't know

12/ Do you know if the port has carried out an Environmental Impact Assessment (EIA)?

☐ Yes ☐No ☐I don't know

13/ Do you know if the port has an Oil Spill Contingency Plan?

☐ Yes ☐No ☐I don't know

D/ YOUR INVOLVEMENT IN PORT ENVIRONMENTAL MANAGEMENT

14/ Have you ever been involved in the port's planning/management process?

14.1/ Have you ever been asked for your opinion on the port's development plan?

☐ Yes ☐No

14.2/ Have you ever given opinion to any port's development plans?

☐ Yes ☐No

14.3/ Who have contacted you for such opinion:

☐ Port Authority
☐ Port Operator/Stevedore
☐ Governmental authorities (please specify):.....
☐ Research institutes (please specify): .....
☐ Non-governmental organisation (NGO) (please specify): .....
☐ Other (please specify): .....

14.4/ Your opinions have been consulted through:

☐ Consultation meeting
☐ Interview
☐ Questionnaire
☐ Official letter
☐ Other (please specify): .....

14.5/ Do you want to be involved in the port environmental management process?

☐ Yes ☐No ☐I am not sure

14.6/ If you want to be involved, how do you want it to happen?

☐ To be invited to consultation meeting
☐ To be interviewed
☐ To receive questionnaire asking for opinion
☐ To receive official letter asking for opinion
☐ Other (please specify): .....

E/ SOLUTIONS TO PORT ENVIRONMENTAL ISSUES:

15/ What is your general opinion on the port's performance towards the following aspects:

Your assessment / *Aspect*	Very poor	Weak	Average	Good	Very good
- Water quality	☐	☐	☐	☐	☐
- Air quality	☐	☐	☐	☐	☐
- Soil quality	☐	☐	☐	☐	☐
- Waste management (solid, liquid, etc.)	☐	☐	☐	☐	☐
- Noise management	☐	☐	☐	☐	☐
- Traffic management	☐	☐	☐	☐	☐
- Economic contribution, in term of GDP contribution	☐	☐	☐	☐	☐
- Economic contribution in term of the provision of employment	☐	☐	☐	☐	☐
- Social contribution (security, social coherence, etc.)	☐	☐	☐	☐	☐
- Involvement of stakeholder	☐	☐	☐	☐	☐

16/ ***What do you think the port should do to improve its environmental conditions?***

	Need immediate action	Put in a short-term plan	Put in a long-term plan
Clean up the environment	☐	☐	☐
Build wastewater treatment plan	☐	☐	☐
Build solid waste treatment station	☐	☐	☐
Implement environmental monitoring	☐	☐	☐
Implement Environmental Management System (EMS)	☐	☐	☐
Get ISO 14001	☐	☐	☐
Train staff on environmental management	☐	☐	☐
Draw up "Oil Spill Contingency Plan"	☐	☐	☐
Establish environmental management team/department	☐	☐	☐
Establish environmental fund	☐	☐	☐
Use computer-based management system	☐	☐	☐
Carry out Environmental Audit	☐	☐	☐
Carry out Risk Assessment	☐	☐	☐
Other (please specify):	☐	☐	☐
Other (please specify):	☐	☐	☐

THANK YOU FOR YOUR COOPERATION!

ANNEX 4 – THE SDEP

Project

ESTABLISHING SCIENTIFIC SUPPORT FOR ENVIRONMENTAL MANAGEMENT FOR PORTS IN VIETNAM AND CAMBODIA

VN/Asia Pro Eco/01(91168)

Co-funded by Asia Pro Eco Programme

SELF DIAGNOSIS FOR ENVIRONMENTAL PERFORMANCE (SDEP)

Contact details

1a. Name of Port: .....

1b. Country: .....

1c. Name of contact person: .....

1d. Contact Email address: .....

1e. Port Website address: .....

INTRODUCTION

This Self Diagnosis for Environmental Performance (SDEP) has been designed in the framework of the project "Establishing scientific support for environmental management for ports in Vietnam and Cambodia". This project is co-financed by the European Commission.

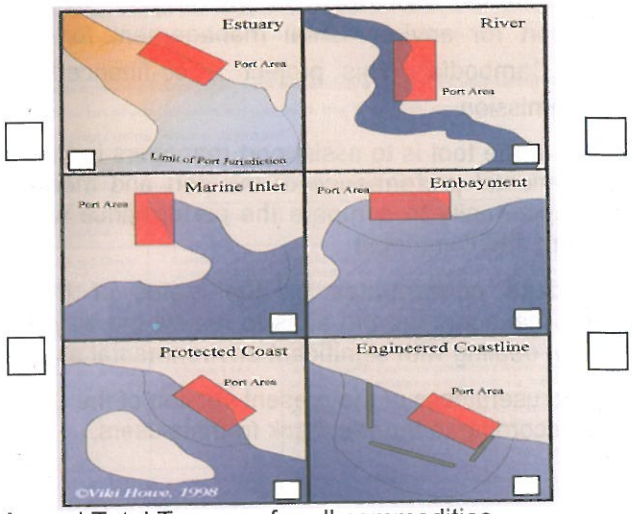
The main aim of the tool is to assist port managers in the review of the environmental performance of the port and moreover, it provides the opportunity to compare the performance with other ports in Vietnam and Cambodia.

The questionnaire concentrates on the status of the port's environmental management and aims to review the way the port authority is now dealing with significant environmental aspects.

The quality and usefulness of the present version of the SDEP will be improved according to the feedback from its users.

PART 1: PORT DESCRIPTION

2. Please indicate the location of your port by ticking the appropriate box



3. Please state Annual Total Tonnage for all commodities

< 0.5 million tonnes	☐	3 – 5 million tonnes	☐
0.5 – 1 million tonnes	☐	5 – 10 million tonnes	☐
1 – 3 million tonnes	☐	> 10 million tonnes	☐

4. Please state Number of Passengers (people/year)

None	☐		
< 1,000	☐	5,000 – 10,000	☐
1,000 – 3,000	☐	10,000 – 50,000	☐
3,000 – 5,000	☐	> 50,000	☐

5. Please specify the types of traffic handled.

Please tick the major activities in your port area.

Port Area Commercial Activities	Cargo Handling Please indicate units (e.g. million tons, TEUs)	Quantity
☐ Aggregates (sand, gravel..)	☐ Aggregates (sand, gravel..)	.....
☐ Ship repair, marine engineering	☐ Dry bulk	.....
☐ Petroleum product processing	☐ Liquid bulk (non oil)	.....
☐ Ro-Ro	☐ Semi bulk	.....
☐ Marinas / Leisure	☐ Trade cars / Vehicles	.....
☐ Chemical Industry	☐ Perishable Goods	.....
☐ General manufacturing	☐ Petroleum / Oil Products	.....
☐ Fish market and processing	☐ Roll-on, roll-off	.....
☐ Storage and packaging	☐ General cargo	.....
☐ Refrigerated Cargo	☐ Containers	.....
☐ Other:	☐ Other:	.....
☐ Other:	☐ Other:	.....
☐ Other:	☐ Other:	.....

PART 2: MAIN ENVIRONMENTAL ISSUES

6a. Which of the following issues are current problems in your port? Please indicate the level of significance of each of the selected problems.

ISSUE	TICK✓	Level of significance		
		Low	Medium	High
1. Air quality	☐			
2. Antifouling paints	☐			
3. Bunkering	☐			
4. Cargo Spillage	☐			
5 Cargo storage run off	☐			
6. Conservation designations	☐			
7. Contaminated land	☐			
8. Dredging	☐			
9. Dredging disposal	☐			
10. Dust	☐			
11. Energy Consumption	☐			
12. Fisheries waste (land)	☐			
13. Garbage/ Port waste	☐			
14. Habitat loss/degradation	☐			
15. Hazardous cargo	☐			
16. Industrial effluent	☐			
17. Industrial emissions	☐			
18. Light pollution	☐			
19. Noise	☐			
20. Odours	☐			
21. Pollution from rivers	☐			
22. Port development (land related)	☐			
23. Port development (water related)	☐			
24. Risk of small oil spills	☐			
25. Risk of spills from tanker accidents	☐			
26. Risk from port industry activities	☐			
27. Other risks	.....			
28. Sediment contamination (marine)	☐			
29. Ship discharge (ballast)	☐			
30. Ship discharge (bilge)	☐			
31. Ship discharge (sewage)	☐			
32. Ship exhaust emissions	☐			
33. Soil contamination	☐			
34. Surface run-off	☐			
35. Traffic volume	☐			
36. Vehicle exhaust	☐			
37. Visual Impact	☐			
38. Water front drainage	☐			
39. Water quality	☐			
40. **Other(s)**...please state:	.....			
41. **Other(s)**...please state:	.....			

6b. From the list that you have ticked, please RANK THE TOP 5 issues that you want to tackle by priority, (1 = the highest priority)

1 Highest priority	.....
2	.....
3	.....
4	.....
5 Lowest priority	.....

6c. Concerning your 5 most important problems listed in 6b, which of the following information you have about them? Please provide briefly information that you have.

	Data on the nature of the problem	***Information on the source of the problem (the cause)***	***Information on the impacts of the problem***	***Information on possible solutions to the problem***	***Information on the legal aspects of the problem***
	Example: *There is a high risk for oil spills*	*Example:* *The risk is caused by oil tankers visiting the port*	*Example:* *Impacts on water and substrate*	*Example:* *- An oil spill response plan has to be designed* *- Shipping routes have to be changed* *- Personnel needs training to avoid accidents*	*Example:* *In 2004, the government developed a new law that raises fines for oil spills, implements new safety standards, changes navigational rules and imposes a fee to establish fund for state and local oil spill response and training*
1					
2					
3					
4					
5					

6d. Concerning your 5 most important problems listed in 6b, do you implement following activities? If you do, please give brief description.

	Monitoring the problem. Please name the criteria monitored (frequency of monitoring, what is monitored).	***Addressing the problem in port management plan.*** Please give name and date of the plan.	***Assigning responsible person(s) to deal with the problem.*** Please give name and position.	***Provide more information on the procedure to deal with the problem***
	Example: *- The yearly number of oil spills is monitored* *- The quantity of oil spilled is monitored*	*An 'oil spill management plan' will be implemented form the first of January 2006.*	*The harbour master, Mr X (name) is responsible for the implementation of the 'oil management plan'. He will have assistance of 25 technicians.*	*The draft of the 'oil spill management plan' is added in attachment to this document.*
1				
2				
3				
4				
5				

PART 3: ENVIRONMENTAL POLICY AND PROGRAMMES

7. Does your port experience difficulties in implementing environmental legislation due to any of the following factors?

No difficulties ☐
Costs/ Expense ☐
Provision of Equipment ☐
Provision of Training ☐
Provision of Guidance ☐
In-house skills shortage ☐
Knowledge shortage ☐
Priority given to environment ☐
Identifying responsible external agencies ☐
Identifying responsible person within the port ☐
Multiplicity of agencies ☐
Lack of information about legislation ☐
Confusing information on legislation ☐
Changes in national standards ☐
Other(s), please state: .....
Other(s), please state: .....

8a. Does you port have a policy/plan to implement environmental management?

YES ☐ NO ☐

8b. Does your port plan to design a policy/plan to implement environmental management?

YES ☐ NO ☐

8c. What is constituted / will constitute your environmental management policy/plan?

Solid waste management	YES ☐	NO ☐
Wastewater management	YES ☐	NO ☐
Solutions to air pollution	YES ☐	NO ☐
Solutions to water pollution	YES ☐	NO ☐
Solutions to soil pollution	YES ☐	NO ☐
Preparedness for small oil spills	YES ☐	NO ☐
Preparedness for large oil spills	YES ☐	NO ☐
Habitat rehabilitation	YES ☐	NO ☐
Occupational health and safety	YES ☐	NO ☐
Financial aspects	YES ☐	NO ☐
Human resource aspects	YES ☐	NO ☐
Other:		
Other:		
Other:		
Other:		

8d. Does/will the policy/plan for environmental management foresee investment in monitoring/measuring environmental indicators?

YES ☐ NO ☐

8e. Do you have policy/plan to send your staff to environmental management training courses?

YES ☐ NO ☐

If 'Yes', when will it happen? ..... And how many people are expected to be trained? .....

9a. Does your port have designated personnel responsible for following activities?

Handling solid waste issues	YES ☐	NO ☐
Handling wastewater issues	YES ☐	NO ☐
Collecting environmental performance information	YES ☐	NO ☐
Collecting environmental legislations and standards	YES ☐	NO ☐
Checking environmental compliance	YES ☐	NO ☐
Reporting environmental incidents	YES ☐	NO ☐
Responding to environmental hazards (i.e. oil spill)	YES ☐	NO ☐
Contacting relevant authorities about environmental problems	YES ☐	NO ☐

9b. Is there anyone in the port who is responsible for environmental management? If Yes, tick the list beneath. If No, who would you plan or who do you prefer to become responsible for the environment in your port?

	YES	No
Port Manager	☐	☐
Environmental Manager	☐	☐
Harbour Master	☐	☐
Port Engineer	☐	☐
Safety Manager	☐	☐
Other, please state:	.....	.....

10. Is environmental monitoring carried out in your port:

YES ☐ NO ☐

If 'No', do you plan to do it?

YES ☐ NO ☐

If 'Yes', when will it happen? ..... and proceed with question 11.

11a. Who is doing/will do the environmental monitoring in your port?

a. the Port Authority? ☐

b. an external organisation? ☐

Name and address of the external organisation: .....

11b. What is/will be monitored and how frequent?

			Frequency
Air	YES ☐	NO ☐	.....
Seawater	YES ☐	NO ☐	.....
River water	YES ☐	NO ☐	.....
Level of pollutants in wastewater	YES ☐	NO ☐	.....
Amount of solid waste	YES ☐	NO ☐	.....
Amount of liquid waste	YES ☐	NO ☐	.....
Soil	YES ☐	NO ☐	.....
Number of accidents	YES ☐	NO ☐	.....
Number of oil spills	YES ☐	NO ☐	.....
Risk	YES ☐	NO ☐	.....

12. Which environmental indicators are important in your port?

Examples could include:	Please provide some examples of the indicators used by your port:
Water Quality *(e.g. chemical variables in water samples: BOD, COD, pH, etc)*	What is measured? ..... What is important to be measured?.....
Soil / Sediment Quality *(e.g. heavy metal levels in samples)*	What is measured? ..... What is important to be measured?.....
Air Quality *(e.g. number of incidents of odour complaints)*	What is measured? ..... What is important to be measured?.....
Ecology *(e.g. extent and condition of habitats)*	What is measured? ..... What is important to be measured?.....
Management Performance *(e.g. number of environmental infringements)*	What is measured? ..... What is important to be measured?.....
Other	What is measured? ..... What is important to be measured?.....

13. Is maintenance dredging carried out in your port?
YES ☐ NO ☐

14. Does your port aim to improve environmental standards BEYOND those required under legislation?
YES ☐ NO ☐

15a. Does your port aim to promote environmental awareness by all port users?
YES ☐ NO ☐

15b. Does your port aim to promote environmental awareness by all port employees?
YES ☐ NO ☐

15c. Is there a defined procedure for consulting with the local community on its environmental programme?
YES ☐ NO ☐
If 'No', does your port aim to do so?
YES ☐NO ☐

PART 4: PORT PLANNING AND DEVELOPMENT

16a. Has your port undergone an environmental impact assessment in connection with a new development during the last 5 years?

YES ☐ NO ☐

16b. Has your port designed an environmental compliance declaration in the framework of a planned project during last 5 years?

YES ☐ NO ☐

16c. If yes, what were the main topics of the declaration?

- ☐ Air quality
- ☐ Water quality
- ☐ Soil quality
- ☐ Waste
- ☐ Noise impact
- ☐ Others: .....
- ☐ Others: .....

16d. Is your port involved with other organisations in a coastal or estuary management plan?

YES ☐ NO ☐

16e. Is your port located within, or does it contain a site with special conservation designations?

YES ☐ NO ☐

16f. Has your Port Authority experienced, or does it anticipate any restrictions on development due to environmental planning controls?

YES ☐ NO ☐

PART 5: AN EXAMPLE OF YOUR PORT ENVIRONMENTAL MANAGEMENT

Using the following format, please provide some details of a successful environmental solution that has been applied in your port.

SOLUTION FORM

Port of.....
Contact person.....

1. Concern and Issue

Briefly describe the nature of the environmental problem. Identify the major issue(s) (see examples in Question 6), list the related port activities, and the reasons why you took action.

For example, (1) the port development was restricted by proximity of designated conservation area, the need for dredging, spoil disposal and associated engineering works. (2) the port wished to improve its local public relations image and organised a port 'open day' for local community and other stakeholders.

.....

2. Solution

Identify the category of solution by ticking the keyword(s) that applies and give detailed descriptions of the chosen solution.

☐ Managerial ☐ Regulatory
☐ Technical ☐ Financial
☐ Procedural ☐ Other

For Example: Technical Solution for Energy Consumption. Shore electricity supply established. Single cable high voltage connection installed on two terminals. Visiting ships require electrical switch or connector. Reductions in emissions and noise produced by vessels in port.

.....

3. Costs and benefits

Costs

Provide a general description of the costs and resources that were required to implement the solution in terms of time, training, finance, administrative effort, interruption to commercial activity etc. Mention any specific problems encountered during implementation

.....

Benefits

Describe the main benefits of implementing the solutions in terms of improvement of environmental quality, reduction in resource consumption, financial savings, improved public relations, increased efficiency of operations, protection of fauna, flora and habitat etc.
Is the situation currently monitored?

.....

The EU Pro Eco project VN/ASIA Pro Eco/01 (91168) would appreciate the opportunity to share your experience with other port professionals through its link with the ECOPORTS project.

Do you allow adding this solution form to the database? YES ☐ NO ☐

Using the following format, please provide and environmental problem on which you would like to have a solution or on which you would like to have assistance.
Briefly describe the nature of the environmental problem.

QUESTION FORM

1. Identification of the problem

Please name the issue.

.....

2. Why it is a problem?

Please give details of the reason(s) why it is a problem

- ☐ Legislation
- ☐ Port/City Development
- ☐ Costs
- ☐ Complaints
- ☐ Other

.....

3. Costs

Please estimate the budget that you can foresee to solve this problem?

.....

PART 6: GLOSSARY

Monitoring
Activity involving repeated observation, according to a pre-determined schedule of one or more elements of the environment to detect their characteristics (status and trends).

Hazardous/dangerous cargo
Storage of this kind of cargo may result in an environmental risk, depending on the chemical/physical characteristics of the cargo.

Habitat
Place where an organism lives: plant forms, forests, mangrove area, etc, where species or communities are living in.

Environmental policy
Statement containing an organisation's intentions and principles in relation to its overall environmental performance. The policy provides a framework for action and for setting environmental objectives and targets.

Environmental management
Management that enables an organisation to establish and environmental policy and objectives, comply with them and demonstrate them to the outside world. The policy must be relevant to the organisation's activities, products, services and their environmental effects. It should be understood, implemented and maintained at all staff level.

Environmental impact
Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.