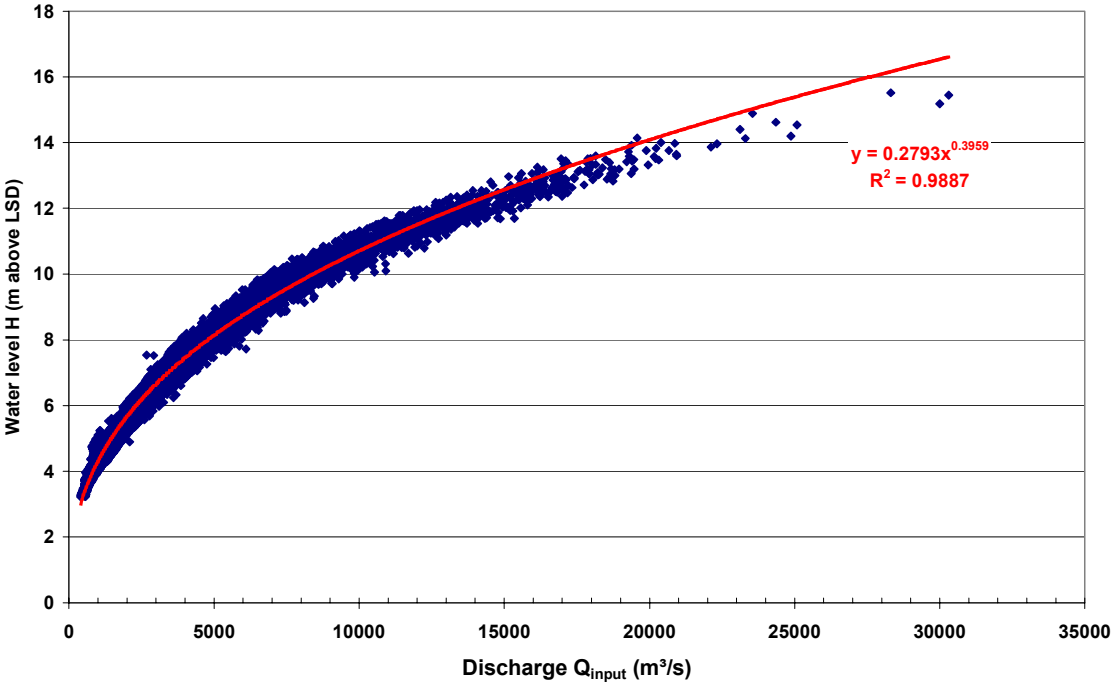


This discharge in cross-section 1 can be seen as the upstream boundary condition, driving the flow in the studied Hanoi Red River reach.



**Figure 14.5.12 Extrapolated Rating Curve at Cross-Section 1
On the Red River (data from 1956 till 2000)**

In all intermediate sections of this upstream reach, as well as in the sections downstream of the Hanoi measuring location (= section 5), an identical inter-/extrapolation technique is applied to obtain the associated water level. So, starting from a given discharge in cross-section 1 as the upstream boundary condition, a rough theoretical reconstruction of both water level and flow along the river reach can be calculated.

14.6 Hydraulics at the Day River estuary

14.6.1 General features

The navigation corridor No. 3 (ref: ADB-Haskoning classification, Jan '98) ensures the link between the Ninh Phuc Port, the two other Ninh Binh Ports (power Plant berth and Ninh Binh port), the port of But Son (But Son Cement Plant) and the Gulf of Bac Bo and is using the down- stream part of the Day River. Total length of this navigation corridor between Ninh Binh and Cua Day Estuary mouth is 78 km with a LAD of 3.6m, and average channel widths between 80m and 120m.

The navigation route is used by both IWT-means and by Sea-River vessels. Total number of shipcalls in the three Ninh Binh Ports (vessels and barge-trains) in 2001 was 899 calls, with average sizes of approx. 650 DWT.

In January 1999, the official approval of the decision to improve the waterway from Ninh Phuc Port to the Day River mouth was given (92/CDS-XDCB dated 25th of January 1999).

Between Do Muoi area (km 40) – the area where the Day River and the Ninh Co River (Mouth = Cua Lach Giang) are running almost parallel to each other and only 250m distant from each other – and the Day River Mouth (km 68) there is a river-stretch of 28 km with available depths in excess of 5m. Because of the morphological and sedimentological instability of the Lach Giang Mouth and its important exposure to NE-winds and E-typhoons, the ADB-Haskoning's Study on the Red River Waterway Improvement (ref TA No.2615-VIE, Jan '98) proposed to consider the dredging of a canal connecting the Day River and the Ninh Co River in the Do Muoi area (DNC canal): the canal would have a width of 100m, and would affect some 13 ha of paddy fields (rice with 2 crops/year), 70 households and 20 tombs, and would allow maritime navigation on the Ninh Co River reaches via the Day River Mouth.

The Day River Mouth is connected with the open-sea in the Gulf of Bac Bo via a 14 km long maritime access-channel, crossing an offshore bar (approx 1 km long) in which the LAD varies between CD- 3.2m (after dredging) and CD -1.0 m to -1.4m (after siltation).

Before 1997, only small coasters with less than 500 DWT could take advantage of the maritime access via the Day River Mouth; however, since 1999, traffic is increasing by approximately 10%/year and nowadays Sea-cum-River Vessels of 1,000 DWT (LOA = 73.7m; B=10.8m; Tst= 3.0m) are regularly calling at Ninh Binh.

The most significant bottleneck for the improvement of maritime traffic in this corridor is the siltation of the maritime access-channel in the offshore-bar crossing.

14.6.2 Hydro-Sedimentology of the Day River estuary

The hydro-sedimentological regime of the Day River Estuary is mainly linked to the following components:

(1) Hydro-meteorology

- The river discharge and its seasonal variations (see further sub 'Climate') in discharge, current velocities and water-levels;
- The tidal regime with a diurnal character and with a tidal amplitude of $T_r=3.0\text{m}$ at Spring Tide and $T_r=1.8\text{m}$ at Neap Tide; minimum tidal water level are typically $H_{95\%} = CD + 0.4\text{m}$ and $H_{70\%} = CD + 1.4\text{m}$;
- Currents in the Day River Mouth are reported to be quite high, and oriented along the axis of the main ebb-gulley; according to the December 1996 survey (WECO TEDI), DS surface currents in the Day River Mouth are typically (higher velocities during ebb can be explained by reduced hydraulic sections and summing of river discharge):
 - $V_{fl} = 0.78 \text{ m/sec}$ at High Water (HW; flood);
 - $V_{eb} = 0.82 \text{ to } 1.05 \text{ m/sec}$ at Low Water (LW; ebb)
- The tidal penetration , including salt-wedge penetration into the estuaries and rivers: tide is penetrating up to Hung Yen in the Flood Season (FS), and up to Hanoi in the Dry Season (DS);
- The tropical/subtropical monsoon climate, for both wind,waves and rainfall:
 - North-East Monsoon (NEm), from October to April, with lower rainfall, colder temperatures (less than 20 C);
 - South-West Monsoon (SWm), from May to September, with high rainfalls, higher temperatures (between 20 C and 29 C);
 - Typhoons (NE to E), occurring at a frequency of approx. 8/year generally between June and September, and associated with strong winds, heavy rainfall, storm surges and high waves

(2) Sedimentology

- The Day River Estuary is located in the Lower Part of the Red River Delta, of which the subsoil is mainly consisting of mud deposits, fine sand and alluvium;
- In the South-East area of the Delta, a geological subsidence of ca. 0.005m/year is reported;
- The hydro-sedimentology of the Red River System is mainly governed by the

seasonal fluctuations, whereby maximum river discharge is occurring between July and September and minimum discharge in February/March: this is valid for all tributaries, the Da River (ca 51 % of total), the Lo River (26 %) and the Thao River (20%); overall sediment-transport in the Red River Basin is generally considered to be proportionally very high - reports mention 120 Mtons of dry solids/year - of which the following contribution is made by the various tributaries: 54 % by the Da River, 8 % by the Lo River and 35 % by the Thao River;

- The Day River Mouth foredelta is reported to be prograding (accretion of foredelta by subaquatic sedimentation) in Southern directions with rates of up to 150m to 200m/year (WCCC-VIWA, 2001);

- The river is forming a natural ebb-gulley system, with 3 ebb-gulleys; since 1999, however, one ebb-gulley developed as the main one, used for navigation, and extends sinusoidally (wavelength, $wL = 8\text{km}$; amplitude, $A = 2\text{km}$) into the sea up to a distance of approx. 13 km, where an offshore bar is formed, at the equilibrium between wave action, river discharge current action and tidal current action;

- It is deduced from recent observations (ref VIWA VCCC, 2001), that the main ebb-gulley is relatively stable since 1997; however, no ascertainment of a long-term stability can be given yet, without a detailed analysis;

- The offshore bar is identified as a shoal with 'natural' waterdepths of CD-0.4m to CD-1.0m and is reported to consist out of medium sand (VIWA VCCC, 2001);

- The reduced nautical depth available on the offshore bar, necessitates regular dredging and offshore aquatic disposal (distance dredging/disposal site: approx 3 km) of the dredged material; dredging is done by various means (Trailer Suction Hopper Dredger, Grab Dredger, Cutter Suction Dredger, Manually Stirring and Pumping,..) and accounts for 80,000 to 100,000 m^3/year on average between 1997 and 2000 for nominal dredged levels $D_{rn} = \text{CD}-1,7\text{m}$; complete siltation of the dredged channel is reported to occur within 6 months after dredging, with average siltation rates of approx 1.00m/year;

- Siltation rates are also reported to be maximal at the end of the Flood Season (FS) and during the following Dry Season (DS), i.e. from September to March: hence, one may conclude that the NE Monsoon - with higher wave activity - is predominating the remobilization of sediments and the sedimentation on the shoal of the offshore bar;

- The mudflats along the Day River Estuary are considered as a National Nature Sanctuary (under Bio-Diversity Action Plan for Viet Nam, and must be protected.

14.6.3 Navigation in the Day River mouth

Because of the shoal at the offshore bar and the rapid siltation rates, navigation in the Day River access-channel is not without risks. Considerable efforts were made by MOT in order to improve the Aids-to-Navigation (AtN). Between 1995 and 1997, appropriated buoyage (buoys and posts at T1, T2, T3, DV3, DV4, Pier N2) and control stations (at Cua Day and Kim Dai) were implemented. Moreover, a survey-vessel was equipped to facilitate survey of the maritime access-channel and a buoy-laying vessel was mobilized to the site in order to (re)locate the buoys according to the survey results and the position of the main ebb-gulley or dredged channel.

Navigation of larger vessels occur within 'tidal windows' and depending upon the static draft (Tst) of the vessels and the Tidal Coefficient (Tcf): actually, 600 DWT to 1.000 DWT vessels use typical tidal windows with water levels of CD + 2.0m to CD +2.5m.

Maritime navigation is mainly linked to :

- Supply of Coal (ca 1.2 Mt coal/year) from Quang Ninh/Hong Gai to Power Plants and Cement Plants in Ninh Binh area:
 - But Son Cement Plant, near Phu Ly (cap= 1.4 Mt/year)
 - Tam Diep Cement Plant (I, cap = 1.4 Mt/year; imp=180,000 ton coal/year);
 - Bim Son Plant (cap = 2.4 Mt/year);
 - Nguoi Thuong Cement Plant (cap= 0.3 Mt/year);
 - X77 Qun Doi Plant (cap = 0.4 Mt/year);
 - Ninh Binh Power Plant (cap=100 MW; imp = 400,000 t coal/year);
- Export of Cement, raw materials and Fertilizer:
 - Fertilizers from Cau Yen Fertilizer Plant (cap = 50,000 tons/year);
 - Rock from He Duong Rock quarry (cap = 1 Mt/year);
 - Rocks from Gia Thanh Rock Quarry (cap = 0.3 Mt/year);
 - Cement from above-mentioned Cement Plants;

Although the maritime navigation route with coasters and Sea-cum-River vessels is more attractive from the economic point of view - shorter sailing distance (ca 60km shorter than via IWT) and cheaper freight rates/smaller transport times (approx 25% cheaper w.r.t IWT) - maritime traffic is still not strongly developed; main reasons are linked to the shoal and draft-restrictions at the Day River Mouth

and to the nautical accessibility of larger vessels to the berths close to the coal mines in the Quang Ninh/Hong Gai area.

14.6.4 Plans for the new access-channel in Day River estuary

According to the Pre-F/S (WECO-TEDI, 1994), the new access-channel in the Day River Mouth, as proposed to MOT, has the following characteristics:

- bottom-width , $w = 60\text{m}$;
- slopes : 1/10;
- minimum radius of curvature $R_{\text{curv}} = 250\text{m}$;
- design tonnage 1,000 DWT

Nowadays, a trend towards larger vessels of 3,000 DWT can be observed and should be considered for the improvement of the maritime transport route to/from Ninh Binh.

However, the design of the improved access-channel, should rely on a thorough investigation of the hydro-sedimentological conditions governing the dynamics of this estuary.

14.7 Stranding of ships and dredging

In the Red River Basin there are many difficult places for inland waterway ships to navigate due to sharp bends and shoals. **Figure 14.7.1** shows distribution of stranded ships in January 2002. There are 11 places where the stranded ships were confirmed.

(2) Dredging activities in the Red River

There are many places where dredging are carried out, which in general, affects navigational conditions and river morphology. Dredging is also carried out to take sand as construction material. **Figure 14.7.2** shows locations of dredging works and sand exploitation currently executed at Hanoi segment in January 2002.

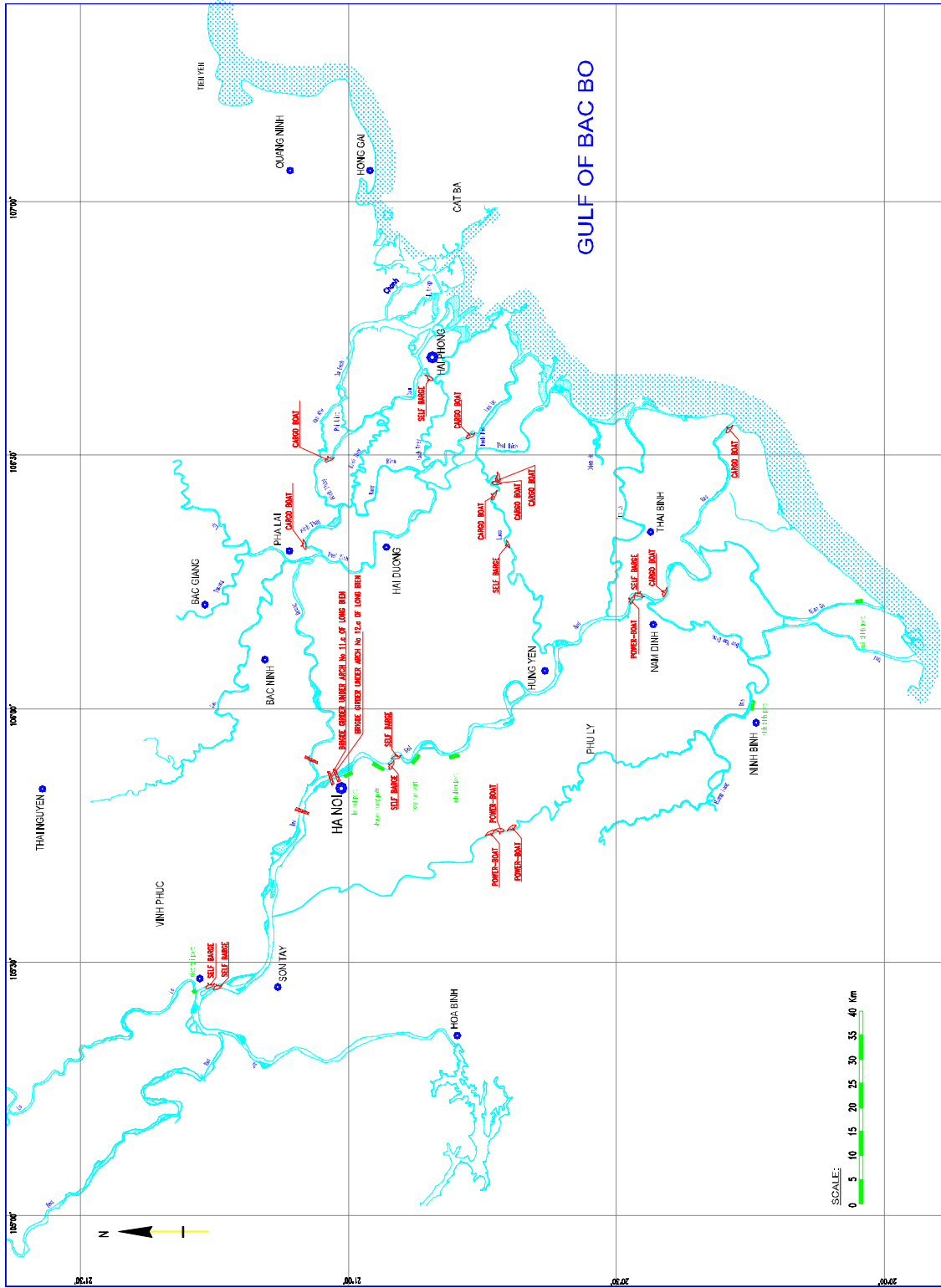


Figure 14.7.1 Locations of Stranded Ships and Proposed bend Cutting in the Red River Delta (January 2002)

Source) JICA Study Team

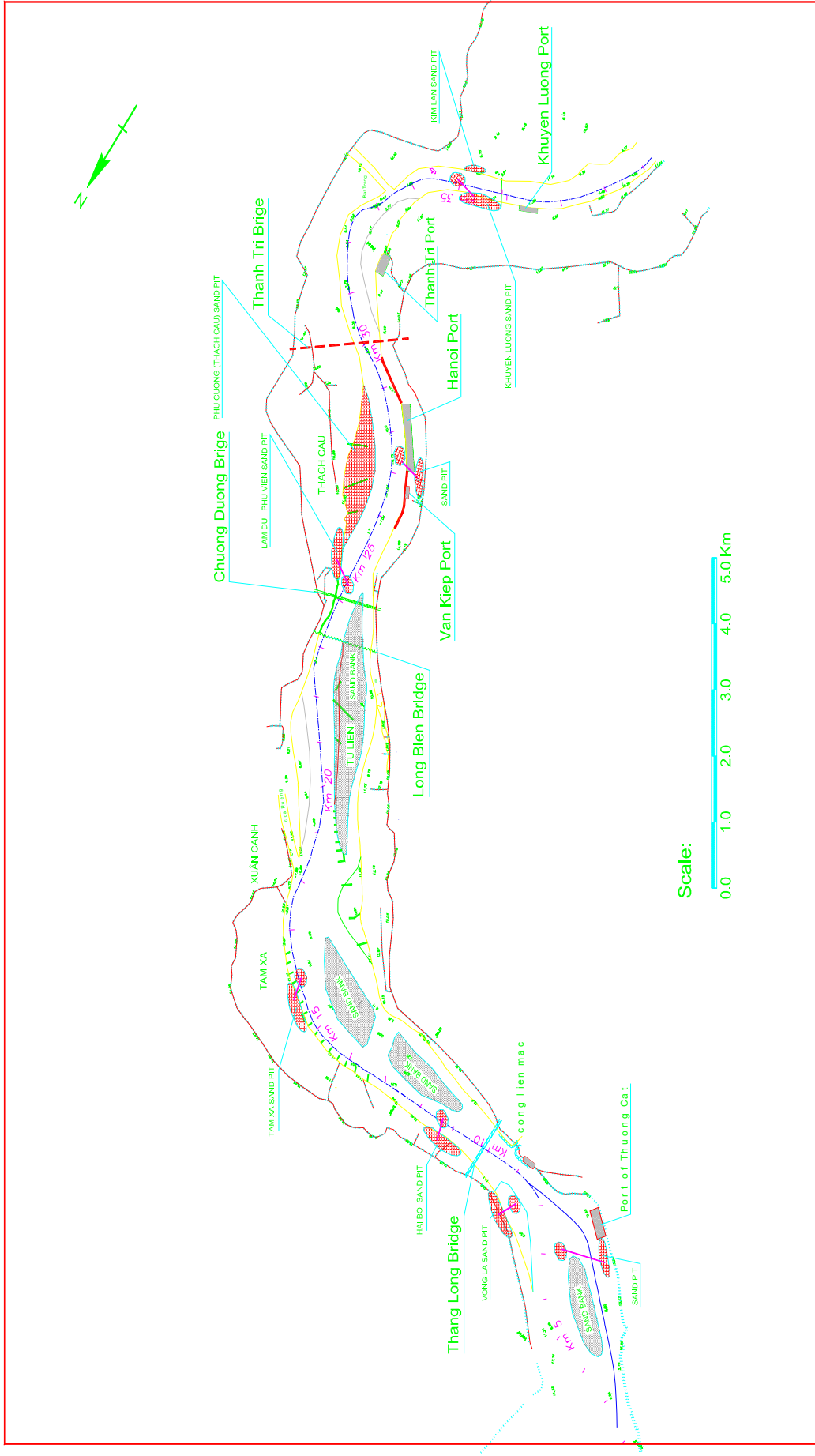


Figure 14.7.2 Locations of Sand Pits where Dredging are Carried out (January 2002)

Source) JICA Study Team

Chapter 15 Environmental Conditions in the Red River Delta

15.1 Environmental quality and public hazards in the Red River basin

15.1.1 General

The environment in the Red River basin has already been affected to a large extent by human interventions, the Red River delta being one of the most densely populated regions in the world. Outside the urban areas, land use is mainly for agriculture. Along major part of the river system and the sea coast, dykes have been constructed to protect the land from flooding. For years, dredging of the rivers has been common practice. Almost everywhere along the waterways, the natural vegetation has disappeared and crops are cultivated on the river banks. Overexploitation of natural resources as a result of population pressure and industrialization form a major threat to the environment of the project area. Urbanization is progressing rapidly and sewage and industrial effluents are discharged, mostly untreated, in the inland and coastal waters.

15.1.2 Environmental issues related to the agriculture activities

In 1993, the Ministry of Agriculture and Food Industries (MAFI) (now it is renamed as the Ministry of Agriculture and Rural Development (MARD)) has issued the 'Regulation for Pesticide Registration' together with a list of pesticides permitted, of restricted use and banned from use in Vietnam. Pesticides, prohibited to be used in Vietnam are, amongst others, the highly persistent insecticides Aldrin, Dieldrin, Endrin, Lindane and DDT, furthermore, Hexachlorobenzene, a fungicide, and herbicides such as 2,4,5T.

As reflected by the water quality monitoring results, the overall impact of drainage water from agricultural lands, containing pesticide residues on the water quality of the rivers seems to be minor. However, the agriculture activities cause increasing in the SS and nutrient's concentrations. The Vietnam Research Forestry Institute shows that in the raining season, one hectare of the uncovered basalt land with 18-20° slope loose 173 tons of soil, 442 kg of total Nitrogen (N), 123 kg of total Phosphorus (P), 2,088 kg Kali, while one hectare of forest loose only 1 ton of soil, 3 kg of total N, 9 kg of total P. Therefore, conservation of the forests is effective measure for prevention of soil erosion and lake or river sedimentation.

The results of the pollutant's analysis of sediment samples, taken from the Red River and Thai Binh River systems show that the sediment quality in the different waterways of the project area complies with the Japanese environmental quality standards established for river sediments. However, according to the Proceedings on National Wetland Conservation and Management (1996), sediment samples from the tidal marshes of the Red River contained residues of DDT and Lindane exceeding the permissible levels.

15.1.3 Environmental issues related to the industrial and mining activities

(1) Environmental issue related to industrial activities

Industrial activities are expanding rapidly in the Red river basin. Presently, main sources of environmental pollution are constituted by old factories, which, located near the Red River, discharge about 35 millions cubic meters of untreated wastewater yearly in the river. Amongst others, these wastewaters contain about 100 tons of H_2SO_4 , 4,000 tons of HCl, 1300 tons of NaOH, 300 tons of benzene and 25 tons of pesticides. Hanoi city suffers from serious air pollution problems and noise impacts. In Haiphong, the cement factory constitutes the most important source of air pollution. Also, the thermal power station of Thuong Ly, the mechanical factory Duyen Hai and the shipyard of Bach Dang are important pollution sources.

Leachate from the coal piles of the thermal power station at Pha Lai is collected in canals, which empty directly in the river system. Also, cooling water, 10 to 15°C warmer of Ninh Binh presents a major source of air pollution for the town, especially affecting the residential areas located at a distance of 300 to 1500 m from the thermal power plant. Moreover, the air pollution caused by the thermal power station adversely affects the nearby agricultural lands.

In the Cau River basin there are about 400 state owned and province owned industries. Beside those, there are thousands small- and medium- scale enterprises, including 200 traditional handicraft villages.

The main industrial pollution sources in the Cau River basin are as follows :

- The waste water from the metallurgical plant contains high concentrations of heavy metals (i.e. Pb, Mn etc.).
- The waste water from the Hoang Van Thu Paper Mill contains high concentrations of Lignine, Alkaline and organic matters.

- The waste water with daily flow rate of 3,000 m³ contains high concentrations of Lignine, Alkaline and organic matters discharging from 120 paper mill enterprises concentrated in two paper production villages located in Phong Khe commune, Yen Phong District and Phu Lam Commune, Tien Son District, Bac Ninh Province.

The survey data obtained by 6 Departments of Science Technology and Environment, Center for Environmental Research Training and Consultancy within the Institute of Applied Mechanics, Center for Air and Water Research within the General Department of Meteorology and Hydrology etc. show that the Cau river water quality is getting worse, especially, in the river segments passing through the urban, industrial parks and traditional handicraft villages.

The water quality in the segment from Buoi Waterfall upward is still clean. The water in the river segment from the Du river to Phu Loi (Soc Son District) is heavily contaminated by 300 millions m³ waste waters, discharging yearly from the industrial, agricultural, domestic and trade activities.

The water quality of the Cau river is presented in **Table 15.1.1**.

Table 15.1.1 Water Quality of the Cau River

No	Parameter	Unit	Results				
			RW-1	RW-2	RW-3	RW-4	RW-5
1	pH	-	7.6	7.5	7.5	7.1	7.2
2	SS	mg/l	174	64	70	55	50
3	DO	mg/l	7.2	4.0	5.2	5.5	6.0
4	BOD ₅	mg/l	25	32	14	13	14
5	COD	mg/l	36	45	21	64	18
6	N-NH ₄	mg/l	0.19	0.25	0.25	0.19	0.20
7	Pesticide	mg/l	-	0.10	0.06	0.05	0.06
8	Detergent	mg/l	-	0.40	0.27	0.15	0.11
9	Total Coliform	MPN/100 ml	50,000	33,000	14,300	10,500	10,100

Note) Sampling locations
 RW-1 : Thai Nguyen
 RW-2 : Tam Da
 RW-3 : Bac Ninh (1)
 RW-4 : Bac Ninh (2)
 RW-5 : Chau Phong

Source) Environmental Protection, NEA/MOSTE, No 11, 2001

The river segment passing through Bac Ninh and Bac Giang provinces is contaminated by the waste waters discharging from the traditional handicraft villages.

(2) Environmental issue related to mining

So far, there were 200 million tons of coal exploited in Hon Gai-Uong Bi and 1.6 billion of the waste soil were discharged. About 700 million tons of the waste soil will be discharged into the environment by the year of 2010. Beside that, about 3 million tons of sediment are resulted every year. The waste water with the annual flow rate of 1.3 million m³ from the coal processing plant contains high concentrations of Phenols and Cyanide.

After the coal is mined, it is screened, washed and hand sorted at the mine. Water, which has been used for washing the coal, is conducted towards unlined setting ponds. Water from the setting ponds of the Uong Bi coal area is discharged into the Dien Co river, a tributary of the Bach Dang River; wastewaters from the Hong Gai coal area are deposits in the upstream catchment area of the Red River enter the river system. Sand mining takes place in the Lo and Da rivers, increasing the turbidity of the river water.

The mine exploitation and processing industries are mainly concentrated in Bac Kan and Thai Nguyen provinces. The number of the exploited mines is 259, including Cadimium, Mercury, Iron, Manganese etc. The solid wastes originated from the Coal, Iron and Thin mines are about 1.5; 2.5 and 0.8 million tons per a year, respectively. The waste waters from the mine processing contain the SS concentration of 400 mg/l and other hazardous matters.

The Hoa Binh hydropower station (damp), operational since 1989, causes an increased river flow downstream, resulting in changes in estuarine salinities during the dry season and in a decreased sediment input from the upper Da River. As a result of these changes in physical conditions, biological production in the estuarine environment has been reduced.

Now the National Assembly of Vietnam is being considered the project of construction of the Son La Hydropower Station on the Da river, that will strongly affect on the water levels as well as water quality in the downstream of the Red river system in the future.

15.1.4 Environmental issues related to the transport activities

(1) Environmental issues related to port activities

Field investigations have shown that, in the present situation, environmental issues are not being paid proper attention by the ship and port owners. The ports have regulations, which prohibit ships to dump waste in the port area, but no facilities exist in the ports for reception of sewage, waste oil and solid waste from ships. From interviews with ship owners and port staff it became clear that, because disposal of ship wastes is not allowed within port area, the ships dispose of their waste illegally along the shipping corridors, either in river or at sea.

A major source of water pollution in the port areas is constituted by contaminated surface runoff water. Mostly, the piles of coal, stored in the port areas, are not covered so that leachate from the coal piles may be discharged into the river, during the rainy season. Wastewater and drainage systems are poorly developed in the ports and storm water and untreated wastewater are directly discharged into the river or marine environment.

Air pollution in the port areas is mainly from dust, originating from different sources : uncovered sand and coal piles, scattering and spilling of sand and coal, during cargo handling, and dust emission from vehicular traffic as a result of bad road conditions within the port areas. Dust emissions from port activities not only affect the port areas, but also the nearby located residential areas. The surveyed ports have water trucks for dust reduction, but both the number and the storage capacity (only 4m³) of the trucks is not sufficient for efficient dust reduction.

Noise and vibrations present another environmental problem in the ports. Most of the port facilities and equipment are outdated and produce considerable noise and vibrations when operating. Truck traffic also contributes to noise impact in the port areas.

The storehouses of the surveyed ports are well equipped to prevent fires. Over the past decade, no record was made of fires or explosions in the surveyed ports. It should be noted, though, that generally the types of cargo presently handled in the river ports do not present an unacceptable risk of fires or explosions.

(2) Environmental issues related to water transport

Currently, apart from the state - owned and province- owned shipping companies and inland waterway fleets, many small privately owned fleets operate along the Red River waterway system. These fleets, mainly consisting of barges and tug-boats, transport coal sand and wood. All vessels belonging to these fleets are in need of repair and, therefore are not expected to have safety and environmental protection facilities installed. Commodities transported by these barges and boats are usually landed, wherever these goods are needed. These uncontrolled unloading activities present an additional environmental problem.

Presently, the shipping route for coal supply, from the mining areas in Quang Ninh province (exported through the ports of Hon Gai and Cam Pha) to the project area, follows the coast line of Ha Long Bay; this shipping corridor is intensively used. In view of the proximity of the route to the Cat Ba archipelago, adverse impacts on this important wetland area can not be excluded.

(3) Environmental issues related to waterway improvements

Transport by ship requires river training works and/or dredging of shallows to obtain a navigation channel of sufficient depth. In some places of the Red River waterway system, river training works, constructed along one bank of the river for navigation purposes, have resulted in erosion of the opposite river bank. Maintenance dredging to deepen the navigation channels in the project area has been applied already for years.

(4) Environmental issues related to road transport

Although information on air quality in the study area is limited, the present volumes of road traffic do not seem to cause a major air pollution problem. Presently, more than 80% of the total tonnage of commodities transported by ship on the Red River waterways consist of coal (and peat) and construction materials. Transport of these bulk cargoes by road would have a serious impact on human health due to the dust produced in the densely populated areas crossed by the roads. Also it would increase the number of traffic accidents.

15.1.5 Environmental issues related to the domestic activities

Urban population in the Northern Focal Zone and Red River Delta :

- Present : 2.880.100 inhabitants
- Year of 2020 : 8.750.000 inhabitants

Urban distribution in the Northern Focal Zone and Red River Delta is presented in **Table 15.1.2.**

Table 15.1.2 Urban Distribution in the Northern Focal Zone and Red River Delta

No	Urban class	Present	2020	Note
1	State towns	2	2	Hanoi, Hai Phong
2	Regional towns	0	2	Ha Long City, Nam Dinh City
3	Provincial towns	8	6	Hai Duong, Hung Yen, Ha Dong, Thai Binh, Ninh Binh, Phu Ly, Vinh Yen, Bac Ninh
4	District's towns	74	273	-

Source) JICA Study Team, Jan., 2002.

Urban domestic water demand in the delta, currently being 100 million m³/year, is assumed to attain 300 million m³/year in 2005. The domestic waste waters from Ha Long city, Cam Pha and Uong Bi towns are about 31,000; 10,000; 72,000 m³/day, containing high concentrations of BOD/COD and nutrients (N, P), discharging directly into the Cau river. At the present only minimal amounts of urban wastewater are treated. Most of the sewage is discharged without any treatment in urban lakes, in the local river systems or, in case of Haiphong, directly in the marine environment.

Besides that, every day there are 1,500 tons of domestic wastes and hazardous wastes from 35 hospitals are discharged directly into the Cau river .

Turbidity and sediment loads of the Red River waterways are high. If considering the concentrations of inorganic compounds, the water quality in the urban areas seriously degraded by the discharge of untreated domestic and industrial wastewaters.

15.2 Environmental issues in Hanoi

15.2.1 Rapid growth of the population in Hanoi

Population in the inner Hanoi city is presented in **Table 15.2.1**:

Table 15.2.1 Population in the Inner Hanoi

Year	Population in the inner city (person)
1945	250,000
1954	300,000
1983	800,000
1995	1,000,000
1999	1,538,900

Source) JICA Study Team, Jan., 2002

The population in the inner city is increased 5 times for 45 years.

The population in the inner city is occupied 53.3% of total population, that is distributed on the 84 sq.km area, equivalent to 9.1% of total natural area of Hanoi city. The population density in the inner city is very high (17,207 persons/km²).

The population in Hanoi City by the year of 2020 will be as follows.

Table 15.2.2 Population in Hanoi City by the Year of 2020

Environmental zone	Description	Area (km ²)	Population (2020)
Zone 1	Old center of the city	35.0	800,000
Zone 2	West-Northern Right Bank of the Red River	55.9	383,000
Zone 3	Southern Right Bank of the Red River	27.0	285,500
Zone 4	Dong Anh Townlet	85.3	672,000
Zone 5	Gia Lam Townlet	43.0	328,000
Zone 6	Sub-urban area	657.6	1,007,900
Zone 7	Area surrounding the West Lake	4.1	32,000
Zone 8	Area within the Red river dams	-	0
Total		907.7	3,507,900

Source) Hanoi City's Environmental Improvement Project. JICA, Feb., 2000

The rapid population growth causes the negative impacts on the environments, such as:

- Poor technical infrastructure
- Flooding in the raining seasons.
- Traffic jams.

- Deficits in the water supply in the Summer (about 30% of population in the Vinh Tuy ward is supplied by the tape water).
- Uncontrolled solid waste disposal.

15.2.2. River and canal water pollution

The waste water volume and loads of the organic matter (BOD) discharged into the water bodies of Hanoi City are summarized the **Table 15.2.3.**

Table 15.2.3 Waste Water Volume and Loads of the Organic Matter (Bod)

Zone	BOD loads		Waste water volume	
	kg/day	kg/ha/day	m ³ /day	m ³ /ha/day
Zone 1	47,946	13.70	143,839	41.11
Zone 2	14,391	2.57	42,837	7.66
Zone 3	17,062	6.33	49,355	18.31
Zone 4	7,044	0.83	20,571	2.41
Zone 5	9,272	2.16	26,545	6.18
Zone 6	40,756	0.65	52,341	0.83
Zone 7	1,067	2.60	3,200	7.80
Zone 8	0	0	0	0

Source) Hanoi City's Environmental Improvement Project. JICA, Feb., 2000

The pollution levels measured in second haft of 1997 year in the To Lich and Kim Nguu rivers are presented in the **Table 15.2.4.**

Comparing the analytical data with the Vietnam Standards (TCVN 5942-95, grade B) shows that the rivers are polluted by organic matters i.e. high BOD/COD and low DO.

Besides that, there are 23 canals with total length of 38 km and width of 2-10 m.

The rivers and canals are heavily polluted by the municipal, industrial and hospital's wastes.

Table 15.2.4 Pollution Levels in the To Lich and Kim Nguu Rivers

No	Parameter	The To Lich river				The Kim Nguu river			
		RW-6	RW-7	RW-8	RW-9	RW-10	RW-11	RW-12	RW-13
1	pH	7.6	7.1	7.6	7.4	8.1	8.2	7.0	6.7
2	DO	0.1	1.5	2.3	2.8	1.0	1.2	1.5	1.8
3	SS	45	118	87	10	250	200	150	75
4	BOD ₅	4	700	59	6	90	60	27	8
5	COD	12	950	240	9	120	80	80	40
6	Oil and grease	1.6	-	-	0.9	-	-	-	-

Note) Water sampling locations :

RW-6 : The downstream of the Detergent Production Plant.

RW-7 : The downstream of the Institute of Food Processing Industries

RW-8 : The Dinh Vong Pit.

RW-9 : The Thinh Liet damp

RW-10 : The Lo Duc Pit

RW-11 : The Mai Dong bridge

RW-12 : The Yen So Pit

RW-13 : The Phap Van bridge

Source) Magazine " Clean Water and Environmental Sanitation", 1/2002.

15.2.3 Lake water pollution

The survey results carried out by the Center for Marine Environment and Institute of Chemistry within the National Center for Natural Sciences and Technologies in the West lake on June, 2001 show that the lake water near to the discharging points is polluted by COD, oil and grease and E. Coli.

15.2.4 Ground water pollution

In general, the quality of the groundwater resources is good and suitable for drinking water and domestic use. However, in the Hanoi ground water is polluted, in particular by domestic wastewater. The iron content of the ground water is rather high, especially in the Quaternary aquifers.

15.2.5 Land shifting in Hanoi

Shifting rate is about 20 mm per a year (In the South of the city including Ha Dinh, Van Dien, Cau Bieu, Cau Moi, Nga Tu Vong, Phap Van and center of the city from Thanh Cong to Ngo Si Lien).

15.2.6 Industrial pollution

At the present time, there are 318 large scale industries and 12,000 small and medium scale enterprises in Hanoi. Industrial wastes cause the air and water pollution.

The pollution situation in the traditional handicraft villages is serious, especially, in Bat Trang Ceramic village and Phu Do Noodle village.

15.2.7 Air pollution

The air pollution in Hanoi city caused mainly by motor vehicles and industrial emissions. The air quality in Hanoi city can be presented in **Table 15.2.5**.

Table 15.2.5 Air Quality in Hanoi City

Zone	CO	NO ₂	SO ₂	TSP	PM ₁₀	Pb	Overall
Zone 1	NP	NP	NP	SP	SP-HP-NP	NP	HP
Zone 2	NP	NP	NP	NP-HP-SP	NP-SP	NP	NP-HP-SP
Zone 3	NP	NP	NP	NP	NP-SP-HP	NP	HP-NP-SP
Zone 4	NP	NP	NP	NP	NP	NP	NP
Zone 5	NP	NP	NP	NP-SP	NP-SP	NP	NP-SP
Zone 6	NP	NP	NP	NP-HP-SP	NP-SP-HP	NP	NP-SP-HP
Zone 7	NP	NP	NP	NP-HP	NP-HP	NP	NP-HP

Note) NP – Unpolluted; SP- Slightly polluted; HP- Heavily polluted

Source) Hanoi City's Environmental Improvement Project. JICA, Feb., 2000

15.2.8 Solid wastes

At the present time, total load of the solid wastes in Hanoi city is about 3,000 m³, including about 80% of the municipal solid wastes and 20% of industrial wastes. Hanoi Urban Environmental Company (URENCO) can collect only 80% of solid wastes in the inner city.

15.2.9 Historical relics

In Hanoi city, there are about 2,000 historical relics with average density of 2 relics/km².

15.3 Measures for the sustainable development in the Red River basin

15.3.1 Environmental issues

- Uncontrolled deforestation in the upstream.
- Rapid development of industries, discharging untreated waste waters into the river.
- Unplanned mine exploitation.
- Rapid urbanization in the basin, discharging untreated municipal wastes into the river.
- Lack of legal framework related to management of the natural resources.
- Low public awareness.

15.3.2 Measures

(1) Setting up regional environmental planning for sustainable development in the Red River basin

(2) Developing environmental action plans for development of individual provinces and sectors in the basin

(3) Prevention of natural disasters and flooding control

- Integrated management of the Red River basin's master development plan including hydro- power stations, water reservoirs, production, resettlement etc.
- Development of the weather forecast system, especially flooding forecast in the Red River basin.
- Implementation of the baseline survey projects in the Red River basin, including the natural conditions.

(4) Conservation of water resource

- Minimization of the waste waters discharging into the Red River.
- Planning the land use.

(5) Management and conservation of the forests and natural ecosystems to avoid erosion and sedimentation

(6) Information exchange between the countries located in the Red River, especially, natural conditions in the Nguyen River basin, located in China territory

The International Workshop on Socio-economic Development and Environmental Protection in the Red River and Nguyen River was held by the Research Center for Regional Development within MOSTE, Vietnam and the Van Nam Institute of Geography, China in Haiphong City from October 21 to November 1, 2001.

50 papers related to geological conditions, conservation of water, soil and biological resources, environmental quality, tourism and economic development etc were presented in the Workshop.

Four main aspects were discussed among the Vietnamese and Chinese scientists including :

- Conservation and rational use of the water resources.
- Development and conservation of the forestry resources and soil erosion control.
- Natural disasters and geological tectonics .
- Cooperation in the culture, tourism and trade development.

The joint cooperation programme was proposed in the workshop as follows:

- Development of the Master plan for the development in the Red- Nguyen River basin.
- Research of the natural disasters and measures for prevention and control.
- Integrated management of the water resources and flooding control.
- Development of the land and waterway transport.
- Cooperation in the ecological tourism, culture, rising the environmental awareness for minorities, technology transfer etc.

(7) Developing regional environmental management board and policy

(8) Developing appropriated technologies and economic incentives for pollution control

15.4 Environmental laws, legislation on Environmental Impact Assessment (EIA) and quality standards in Vietnam

15.4.1 Environmental protection law

The Vietnamese Government promulgated in 1985 the Decree No. 246/HDBT in order to provide the requirement of implementation of EIA for ongoing projects. However, it has been applied only a few projects and has not been propagated.

On December 27th, 1993, the Environmental Protection Law has passed National Assembly and the President's Decision No. 29L/CTN has put it into effect on January 10th, 1994. It consists of 7 chapters and 55 articles enacting the policy and general aspect on Environmental Protection.

According to the article Nos. 17 and 18 of the law, all of organizations and individuals who manage the economic, scientific, technological, public health, cultural, social, security and national defense establishments in Vietnam have to prepare the EIA report of their establishments and submit it to the national environmental management agencies to receive the EIA Appraisal Decision.

15.4.2 Government decrees

The Government Decree No. 175/CP was issued on October 18th, 1994 aiming at provision of the guidance for the implementation of the Environmental Protection Law.

The Decree specifies the following items.

Chapter I: General Provision

Chapter II: Distribution of Responsibility of State Management on Environmental Protection; Responsibility of Organizations and Individuals for Environment Protection

Chapter III: Assessment of Environmental Impact

Chapter IV: Preventing, Resisting and Overcoming Environmental Deterioration, Pollution and Incidents

Chapter V: The Financial Sources for the Task of Environment Protection

Chapter VI: Inspection of Environmental Protection

Chapter VII: Provision for Implementation

Appendices: The Contents of EIA Report

In addition, the specifications of the projects that require EIA and its appraisal organizations are specified as tabulated in **Table 15.4.1.**

Table 15.4.1 Specifications of Projects Requiring EIA and Appraisal Organizations

	Specifications	by MOSTE	by DOSTE
1	Mining	Big and medium mine	Small
2	Oil exploring and refinery, oil chemicals and gas oil	All	
3	Chemical plant	All	
4	Steel plant	All	
5	Non-ferrous metal plant	All	
6	Leather plant	Over 1,000 T/year	Rest
7	Textile plant	Over 30 mil. m/year	Rest
8	Plant protection chemical plant	All	
9	Rubber and paint plant	All	
10	Plastic plant	Over 1,000 T/year	Rest
11	Radiation plant	All	
12	Airport	All	
13	Export processing zone	All	
14	Hydropower dam water reservation	Over 100 mil. m ³ /year	Rest
15	Irrigation system	Above limitation	
16	Thermal and other kinds of power plant	Over 30MV	Rest
17	Cement plant	Over 500,000 T/year	Rest
18	Paper and paper pulp mill	Over 40,000 T/year	Rest
29	Pharmaceutical plant	Central	Rest
20	Fertilizer plant	Over 100,000 T/year	Rest
21	Food processing plant	Over 1,000 T/year	Rest
22	Sugar plant	Over 100,000 T/year	Rest
23	Hospital	Over 500 beds	Rest
24	Railway, Motorway of grades 1,2 and 3	Over 50 km	Rest
25	Power transmission station	Over 110 kV	Rest
26	Tourism and entertainment resort	Over 100 ha	Rest
27	Oil and gasoline store	Over 3,000 m ³	Rest
28	Poisonous chemicals store	All	
29	Plantation	Over 2,000 ha	Rest
30	Wood exploiting farm	Over 3,000 ha	Rest
31	Industrial forestation farm	Over 2,000 ha	Rest
32	Aqua cultural farm	Over 200 ha	Rest
33	Port	Over 100,000 T/year	Rest
34	Ply-wood factory	Over 500,000 m ² /year	Rest
35	Migration area	Over 500 households	Rest
36	Alluvial plain	Over 500 ha	Rest
37	Engineering factory	Over 50,000 T/year	Rest
38	Telecommunication station	Radar station and central broadcasting station	Rest
39	Freezing plant	Large and medium scale	Small
40	Construction materials factory	Large and medium scale	Small
41	Hotel and business sector	Large and medium scale	Small

Source) Government Decree No. 175/CP

Note) MOSTE: The Ministry of Science, Technology and Environment

DOSTE: The Provincial Departments of Science, Technology and Environment

15.4.3 Circulars on guidelines and decisions issued by MOSTE

Following the enforcement of the Environmental Protection Law, MOSTE issued several legal documents on EIA for new projects and existing facilities in Vietnam.

Those Circulars and Decision are summarized in **Table 15.4.2**.

Table 15.4.2 Circulars and Decisions effected

Date of issue	Number of documents	Summary of content
November 26 th , 1994	Circular No.1420/MTg	Circular on guiding the environmental impact assessment of existing facilities
December 31 st , 1994	Decision No 1806-QD/MTg and Regulation No1807/MTg	Regulations on organizations and activities of EIA Appraisal Committee.
April 3 rd , 1995	Circular No.714-MTg	Circular on issuing the EIA Appraisal Letter
April 17 th , 1996	Circular No. 812-MTg	Circular on issuing the application form and form of EIA Appraisal Decision (Forms: I-B, II-B, III, IV)
December 3 rd , 1996	Circular No.2781/TT-KCM	Circular on guiding the formalities on providing, expanding time-limit and withdrawing the environmental license for existing industrial facilities after receiving the Appraisal Decision of EIA report or report on environmental impact activities.
March 6 th , 1997	Circular No.276/TT-MTg	Circular on guiding controlling pollution to enterprises after receiving the Appraisal Decision of EIA report or report on environmental impact activities.
April 29 th , 1998	Circular No 490/1998/TT-BKHCMNT	Circular on making and evaluating environmental impact assessment report with regard to investment projects

Source) JICA Study Team

On February 3rd, 2000, Prime Minister issued the Decision No. 19 to abolish 84 kinds of certificate, which contrasted with the regulations in the Trade Law, including the Certificate for pollution control (as mentioned in the Circular No. 276/TT-MTg issued by MOSTE on 6th March 1997).

15.4.4 Environmental standards

(1) Principle

All facilities in the territory of Vietnam after receiving the EIA Appraisal Decision or Certificate for securing the environmental standards must apply the pollution control measures in order to meet the environmental standards issued by MOSTE or other ones issued by the Provincial People's Committees and the Ministry of Health which must be stricter than the environmental standards issued by the MOSTE.

(2) International standard

In case, environmental standards need to apply but they have not issued by the MOSTE, the Ministry of Health and Provincial People's Committees, facilities owners may apply environmental standards, which are issued by other countries or international organizations, after getting the approval letter of the Provincial People's Committee, where the existing facility is being operated. The Provincial People's Committee must report to MOSTE the agreement concerning with applying the foreign standards in the province. MOSTE intervenes the decision of the People's Committee only, if necessary.

(3) Vietnamese standard to be applied

The Vietnamese Environmental Standards relevant to port development are presented in the Appendix III.

15.5 Biological resources

15.5.1 Legal documents on protection of rare fauna and flora

Following legal documents are released and effective:

- Red Book of Vietnam, 1992, providing the status of treated animals
- Government Decree No. 18/HDBT, January 17th 1992, providing the lists of rare fauna and flora, and regulations on management and protection
- Introduction No. 359/TTg, May 9th 1996, providing urgent measures for protection and development of wildlife animals

15.5.2 Status of flora and fauna in the survey areas

(1) General

As for the living natural resources of the project area, especially those being part of wetland ecosystems are of interest to the project. Wetlands of special value, located in the area of influence of the project.

Along major part of the river system and the sea coast of the project area, dykes have been constructed to protect the land from flooding. Beyond the sea wall only a narrow zone of intertidal sand or mud flats is left, except near the river mouths, where new mud flats and sandy islands are being formed continuously. In the mouth of the Red River, the islands Con Ngan and Con Lu have developed as a result of coastal accretion; nowadays, they constitute the core area of the Xuan Thuy Nature Reserve. The mangrove vegetation, met near the coast along the tidal stretch of the rivers, is represented by small shrub-like trees. With respect to the stunted growth of the trees, it should be noted that most trees derive from plantations. Moreover, climate and other physical conditions in Northern Vietnam are limiting optimal mangrove development.

Along the coast of the Red River delta, about 7,400 ha of mangroves derive from afforestation. *Kandelia candel* has been planted in the intertidal areas and *Casuarina equisetifolia*, an exotic species, has been planted on sandy beaches and in dunes.

(2) Coastal wetlands

From Do Son Cape to the Northern bank of the Van Uc River, the presence of many sandy (submerged) islands protects the shore from strong wave action, thus creating a suitable habitat for mangrove development. A large portion of fresh water and alluvium from the Thai Binh river system flows through the Cam and Bach Dang rivers into the coastal area, north of Do Son Cape. The mangrove communities consist of *Sonneratia caseolaris* and the shrubs *Aegiceras corniculatum* and *Acanthus ilicifolius*. In recent years, due to shrimp pond construction, the area covered with *Sonneratia* forest has been strongly reduced.

The coastal strip from Van Uc estuary to Lach Truong consists of land accreted as a result of deposition of alluvium from the Red River system. The area is open and flat and comprises large swamps, no mangrove vegetation is met along

this stretch of coast, except inside the estuaries of Ninh Co and Tra Ly rivers. Stands of *Aegiceras corniculatum* and *Acanthus ilicifolius* alternate with *Kandelia kandel* and *Sonneratia caseolaris*.

Cold air, brought in suddenly by the North - East monsoon, adversely affects the development of mangrove vegetation. Along the coast of Northern Vietnam, tropical depressions, accompanied by storms or typhoons, often occur during the wet season. Generally, mangroves do not grow naturally in areas strongly affected by storms. If compared with environmental conditions prevailing in the South of the country, the lower average temperatures in the North and the larger daily and annual fluctuations in temperature result in lower species diversity and in a reduction in height and diameter of the trees. Moreover, the large tidal amplitude (3-4m) and high velocities of tidal currents widening the channels cause erosion of mangrove areas and hamper settlement of mangrove propagules. An additional limiting factor for mangrove development in the project area is constituted by the character of the alluvium contained in the mud flats, being of laterite origin.

(3) Coastal fauna

Seagrass beds offer valuable feeding grounds and nursery areas for many marine animal species, among which several species of commercial value. Seagrass species reported to occur in the shallow waters along the coast of the Red River delta are *Ruppia maritima* and *Halophila ovalis*. Seaweeds, recorded from the coastal waters are, amongst others, the Chlorophyta *Chaetomorpha linum* and *C. capillaris* and the Rhodophyta *Gracilaria asiatica* and *G. tenuistipitata*. *Gracilaria* is grown in brackish water ponds in Hai Phong province.

No coral reefs are met along the coast of the Red River delta. Among the invertebrate fauna, occurring in the coastal waters of the Red River delta, several species of shrimps of commercial value are met, which belong to the family of Penaeidae. Penaeid shrimps reproduce in coastal waters, but after completion of the larval development, the postlarvae migrate into the brackish waters of estuaries and lagoons. The juvenile shrimp remain 2 to 4 months in the brackish water environment, where they find food and shelter from predators. Towards sexual maturity, the shrimp migrate back to the sea. Also freshwater prawns, *Macrobrachium spp.*, depend on the brackish water environment for the completion of their life cycle.

(4) River fauna

Almost everywhere along the waterways of the project area the natural vegetation has disappeared and crops are cultivated on the river banks. Dykes have been constructed all along the rivers to control flooding, so that no riverine wetlands exists any more. Little is known about the composition of the riverine fauna, except for the fish species used for freshwater aquaculture (carps, snakehead fish, carfish species). Freshwater plants like lotus, *Nelumbo nucifera*, and water chest-nut, *Trapa naturans*, are grown throughout the Red River delta for consumption by man.

(5) Protected areas and endangered species

The Bio-diversity Action Plan for Viet Nam considers the conservation of the Red River delta wetlands and the management of Cat Ba National Park to be priority projects, that is, projects of importance to the overall conservation of biodiversity in Vietnam. Also, the Cua Day mudflats have been identified as area of highest priority with respect to biodiversity conservation.

A nature conservation area consists of a strictly protected 'core area' and a surrounding 'buffer zone', which has been defined as 'an area that surrounds a wild land management area and serves to mitigate adverse effects from human activities outside the area'. The concept of sustainability serves as a guiding principle to determine the scope for the socio-economic activities, which are allowed within the buffer zones.

The Red River estuary represents the most important staging and wintering area for migratory waterfowl in Northern Vietnam. It plays an important role as stopover site on one of the major Asian bird migration routes. In 1987, an area of 12,000 ha in the Red River estuary has been given a protected status by the Vietnamese Government. The protected area is located along the coast of the Xuan Thuy District. Bird hunting, mangrove cutting and intensive shrimp farming are prohibited in the Xuan Thuy Wildlife Reserve. The site is state-owned and was added to the Ramsar list of 'wetlands of international importance' in 1989, when Vietnam became a signatory party of the Ramsar Convention. The main part of the reserve consists of the islands of Con Lu and Con Ngan. Furthermore, the reserve comprises the marine waters between the islands and the mainland, and the reserve comprises the marine waters between the islands and the mainland, and the strip of land located seaward of the dyke system. Along the

coast of Tien Hai district, a second protected area located near the Red River mouth is met, the Tien Hai Nature Reserve.

The Cat Ba archipelago is located in Ha Long Bay at about 30 km from Hai Phong city and port. The archipelago, consisting of one main island and 366 smaller islands, presents a beautiful scenery and a large diversity of ecosystems, including offshore coral reefs, mangrove swamps and sandy beaches. The islands are located on a major bird migration route; their beaches and mangrove swamps offer feeding and roosting sites for large numbers of birds, during the migration seasons. In 1986, a large area of the main island and the adjacent waters have been declared National Park.

The aquatic fauna of the Red River delta and coastal waters comprises a number of rare or endangered species, mentioned in the 'Red Data Book' of Vietnam. Also, among the birds, observed in the Red River estuary, several species have been identified as rare or endangered, for example the Black-faced spoonbill, *Platalea minor*, the Asian dowitcher, *Limnodromus semipalmatus*, and Saunder's gull, *Larus saundersi*.

(6) Depletion of living natural resources

The riverine and coastal fishery resources are permanently threatened by excessive exploitation of stocks, use of non-selective and destructive fishing methods and habitat destruction. In particular the shrimp stocks are declining as a result of overexploitation.

In addition to the loss of mangrove forest due to cutting of the trees, also many trees die when they are cut off from tidal flushing by the dykes constructed for shrimp farming. Moreover, the construction of dykes for flood protection along the sea coast has had a negative impact on the extension of the mangrove vegetation. In the Red River estuary, the mangrove forest not only declined as a result of impoundment for shrimp farming and cutting for fuel wood, but also due to forest clearing for the cultivation of rushes, *Cyperus malaccensis*, grown as a crop for industrial purposes.

Seaweeds have been and are still nowadays heavily exploited as food or as raw material to extract alginates for the production of agar-agar. Seagrass is used in some areas as a fertilizer for rice fields. Also, certain fishing methods destroy seaweed and seagrass habitats by seriously disturbing the bottom substrate. Moreover, increased turbidity, sedimentation and clearance for

shrimp pond construction have adversely affected the seagrass vegetation met in the shallow waters along the coast of the Red River delta. Birds are harvested in the coastal areas, either for consumption by the local population or for export to other parts of Vietnam and to China.

15.6 Socio-economic conditions

15.6.1 Social conditions in the Red River Delta

(1) Population and labor

The Northern Focal Zone and Red River Delta with total natural area of 1,844.8 million of hectares, including Hanoi capital, Hai Phong city, Quang Ninh, Hai Duong, Hung Yen, Ha Tay, Ha Nam, Nam Dinh, Thai Binh, Ninh Binh provinces and part of Vinh Phuc, Bac Ninh provinces.

The total area, population and population density of the Study area are presented in **Table 15.6.1**.

Table 15.6.1 Total Area, Population and Population Density of the Study Area

No	Province/city	Total area (Sq. km)	Population (persons) (year of 2000)	Population density (person/sq.km)
01	Hanoi	921	2,736,400	2,971
02	Hai Phong	1,519	1,690,800	1,113
03	Vinh Phuc	1,371	1,103,000	805
04	Ha Tay	2,192	2,410,800	1,100
05	Bac Ninh	804	948,800	1,180
06	Hai Duong	1,648	1,657,500	1,006
07	Hung Yen	923	1,081,900	1,172
08	Ha Nam	849	797,600	939
09	Nam Dinh	1,637	1,905,300	1,164
10	Thai Binh	1,542	1,797,200	1,165
11	Ninh Binh	1,382	888,400	643
	Total	14,788	17,017,700	1,151
12	Quang Ninh (*)	5,899	1,017,700	173

Note : (*) Quang Ninh belong to the North East region.

Source :Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

The Red River Delta is often regarded as the heartland of the Vietnamese people and its culture. Its population is overwhelmingly ethnic Kinh or Viet, with 90% or more. Within its natural boundary the RRD has a total area of 14,788 km²

or 4.5% of Vietnam's land and 17.0 million people or 21.9% of Vietnam's population (in 2000). In Vietnam as a whole 76.0% of its population still resides in rural areas whereas the rest is classified as urban, of living in towns or cities with 2000 or more people.

The urban and rural populations in the RRD (in 2000) are presented in **Table 15.6.2**.

Table 15.6.2 Urban and Rural Populations in the RRD (in 2000)

No	Province/city	Urban		Rural	
		1000 x Persons	%	1000 x Persons	%
01	Hanoi	1,581.3	57.8	1,155.1	42.2
02	Hai Phong	576.3	34.1	1,114.5	65.9
03	Vinh Phuc	118.1	10.7	984.9	89.3
04	Ha Tay	197.4	8.2	2,213.4	91.8
05	Bac Ninh	89.7	9.5	859.1	90.5
06	Hai Duong	229.5	13.8	1,428.0	86.2
07	Hung Yen	103.1	9.4	980.6	90.6
08	Ha Nam	63.0	7.9	734.6	92.1
09	Nam Dinh	245.9	12.9	1,659.4	87.1
10	Thai Binh	103.8	5.8	1,693.4	94.2
11	Ninh Binh	120.4	13.6	768.0	86.4
	Total	3,419.5	20.1	13,588.0	79.9

Source) Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

The RRD's population is 20.1% urban and 79.9% rural. Within the Red River Delta, two major cities are counted: Hanoi with a population density of the RRD is the highest in Vietnam, with 2,971 persons per km² as compared with Vietnam's average density of 236 people per km² in 2000.

The Red River Delta population is very young, with nearly 40% under the age of 15 years. The median age of 20.2 years (1989 figure) and the population age structure point to a large potential growth of population in the future due to a large number of women of childbearing age. War and migration have influenced the age and sex structure of the Red River Delta population. Although figures vary by age group, it reflects male losses. The average sex ratio of the Delta increased to 90.7% in 1989 and in 1995 it was 92.3% and in 2000 it was 95.4%. While the ratio for the whole Vietnam was 94.7 and 95.3% and 96.7% respectively. The low sex ratio may also contribute to lower birth rates in recent

years due to large cohort of women who were widowed or separated from their husbands in war periods.

Throughout Vietnam, the birth rate has declined from 5.1 children per woman in 1980 to 3.8 children in 1989, and 3.1 in 1993 with higher rates experienced in rural areas. During the period 1980 - 1989, life expectancy for males rose from 55 to 59.4 years and for females from 60 to 67.5 years, nationally. These figures reflect the success that Vietnam has had in its efforts to improve health, reduce infant mortality, and promote its family planning program. The densely populated Red River Delta provinces have among the lowest fertility rate in the nation. The annual average birth rate in provinces of the RRD varied from 29,4 to 34, 85 in period the 1980 - 1984. Its overall rate continued to drop from 26.5 per thousand in 1988 - 1989 to 19.5 in 1993 – 1994 and to 13.09 in 1997-1998. The even decline in fertility from an average of 6 children to 3 children per family is another indication of the success of the family planning program, particularly in the North where a government commitment began early in 1963. In the RRD the birth of third child in a family is becoming a rare event, particularly during the last 5 years. The main reasons for such decline in the crude birth rate in the Delta are economic difficulties and lack of employment opportunities.

The statistical data in 1998 show that the RRD has a rate of unemployed people is 1.85% of total population, including 2.13% of men and 1.59% of women. The rates of unemployed people in the urban and rural areas are 7.92 and 0.57 respectively. The rate in the urban areas of the RRD increases to 9.34% in 1999 and drops to 7.34% in 2000.

According to the socio-economic statistical data, the average monthly income per capita in Vietnam was 295,000 VND in 1999, that in rural areas was VND 225,000 and VND 832,500 in urban areas. The monthly average income per capita in the RRD was 280,300 VND in 1999. The main causes of poverty were found to be lack of capital, lack of cultivated land, many children, shortage of labour and illness. The rich households in the RRD got monthly incomes of VND 696,300 per capita, while the poor households got VND 99,500 per capita. One consequence of being poor is the inability to take advantage of new opportunities opened by the market economy due to low levels of education, lack of skills, ill health and poor nutrition. Women are particularly at a disadvantage.

(2) Resettlement of residents

1) Legal framework

(a) Vietnam policy

The Socialist Republic of Vietnam has been revising and strengthening its legal framework during the last 10 years to respond to economic and social changes. A new Constitution was approved in 1992, and since that time a number of laws and codes dealing with civil rights and obligations have been prepared to bring Vietnam closer to international standards. The laws/codes have related decrees, which provide more detailed policies and regulation for implementation. The legal system in Vietnam is very new but is still not independent from the Government. The laws and decrees have been developed by the Government and administered by local government. There is recourse available through the Courts but in practice, people rarely initiate such action.

The constitution is the basis for all laws and civil rights in Vietnam. A fourth revision was approved in 1992 which was in response to a strategy endorsed by Government in the late 1980s for socio-economic stability and development up to the year 2000/ The new Constitution guarantees the democratic rights of citizens, the State ownership of land and resources, the rights of organizations and individuals to use land, the rights of property ownership, and other civil rights and obligation of citizens. Significant changes made in 1992 include the recognition and protection of land use rights and private ownership rights for property and production. The most important aspect of the Constitution in terms of involuntary resettlements is Article 23, which enables the state to recover land for purposes of national defense and security and national interest.

(b) ADB resettlement policy

Principles of ADB regarding involuntary Resettlement Policy have been formulated in documents R. 179-95 dated 12 September 1995. Previously ADB followed World Bank's Operational Directive 4.30. The ADB policy documents observe the principles from OD.

A summary of objectives and principles reads as follows:

- Involuntary resettlement should be avoided where feasible;

- Where population displacement is unavoidable, it should be minimized by exploring all viable project options;
- Unavoidably displaced people should be compensated and assisted, so that their economic and social future would be generally as favourable as it would have been in the absence of the project;
- Existing social and cultural institutions of resettled families and their hosts should not be a constraint to compensation, particular attention should be paid to female headed households and other vulnerable groups, such as indigenous people and ethnic minorities and appropriate assistance provided to help them improve their status;
- As far as possible, involuntary resettlement should be conceived and executed as a part of the project;
- The full costs of resettlement and compensation should be included in the presentation of project costs and benefit;
- Costs of resettlement and compensation may be considered for inclusion in the Bank loan financing the project.

(c) MOT resettlement policy

The Ministry of Transport (MOT) is responsible for construction, maintenance and operation of roads, inland waterways, ports, railways and airports. In the course of its mandate MOT is involved with the recovery of land, clearance of land, compensation for land and users and resettlement of affected people to new sites. For projects with ODA, MOT has set up project management units. For example, PMU-1 for Highway No.1 and PMU-5 for Highway No.5 project. Of all institutions and agencies in Vietnam MOT has acquired most experience with involuntary resettlement and with the policies and implementation requirements of foreign multilateral and bilateral donors as World Bank, ADB, Japan, Great Britain, etc. The rehabilitation of Highway I and implementation of the associated resettlement component has been a valuable learning process for Donors as well as for MOT. At present the experience of the Highway I resettlement programme provides most of the case material from which the Government is formulating a National Resettlement Policy.

Adverse effects of the Inland Waterways Improvement Project per farmer are limited and in view of the large number of farmers involved in eight different locations the drafting of a comprehensive resettlement plan was deemed warranted. It is believed that Annex 6 as presented contains all elements for a RAP as required by GOV and ADB.

2) Land requirements

According to the results of the ADB TA No. 2615-VIE on the Red River Waterways Project, land acquisition and resettlement activities are foreseen for 8 locations. In addition, as stated in the introduction, land requirements and locations for spoil soil deposit remain to be defined in the final design phase of the project. An overview of the number of affected families per location is shown below (see **Table 15.6.3**).

Table 15.6.3 Families and Holdings affected per Location

Location	Number of families	Agricultural land (m ²)	Houses
Mom Ro	47	18,000	
Hung Long	8	4,000	
Doc Bo	20	25,000	2
Keo	60	30,000	
Trai Son	15	10,000	
Luoc Loop	271	115,000	
Lach tray	100	18,000	
Day/Ninh Co River	70	120,000	8
Total	591	340,000	10

Source) The ADB TA No. 2615-VIE on the Red River Waterways Project, 1998

3) Socio-economic survey

According to the results of the ADB TA No. 2615-VIE on the Red River Waterways Project, the total number of families affected by the implementation of the Red River Waterways Project is 591. Most of these households, however, will have very marginal losses. A socio-economic survey has been undertaken and its outcome is complemented by data obtained from desk research, focused discussions with authorities and individuals and data from District Land Registration Offices.

In order to obtain a comprehensive sample which would include the various segments of population affected their landholdings and the degree of project impact groups of PAF from all 8 locations were included in the survey. Ha Thanh Commune in Tu Ky district and Nghia Lac Commune in Nghia Hung district represent all types of land loss and all types of soil. Farmers practicing sericulture in Truc Chinh Commune were included as well as families which will have to be relocated. Total number of families included in the survey is 103 among which

all families with more than marginal losses. The remainder of the households surveyed is complemented by random sampling of households with marginal losses.

Average age of the heads of households interviewed is 43. Average family size is with 5.2 persons higher than the delta's overall average of 4.3 persons. Per family 2.9 persons are economically active. Of the total sample of 103 families, 101 gave secondary source of income. Other secondary occupations include fishing, transport and trade. In 8 families the income was supplemented by government-salaries and pensions. All families, but two, have electricity.

Average monthly per capita income (1996) is 129,000VND or 11US\$ and varies from 98,000 VND or 8.4US\$ in Nghia Lac to 188,000VND or 16US\$ Truck Chinh. This compares reasonably well with the poverty line for the RRD which has been fixed at 70-80.000VND or 6.5US\$. Working as hired labourer or rearing livestock brings more revenues than rice cultivation. Sericulture provides a relatively good income. Almost half of all persons interviewed expressed concerns regarding impact and changes in living conditions as a result of project implementation. The relative living standard for various district can be illustrated by the extent to which families manage to save or are forced to borrow.

15.6.2 Economic conditions

(1) Agriculture

The agriculture gross outputs at current prices (in 2000) and at constant 1994 prices are presented in **Table 15.6.4.**

Table 15.6.4 Agriculture Gross Outputs

(Unit : Billions VND)

No	Province/city	The gross outputs at current prices (in 2000)	The gross outputs at constant 1994 prices
01	Hanoi	1,583.7	1,239.6
02	Hai Phong	2,310.4	1,600.0
03	Vinh Phuc	1,395.2	1,194.9
04	Ha Tay	3,944.7	2,932.2
05	Bac Ninh	1,560.0	1,306.3
06	Hai Duong	3,058.4	2,504.2
07	Hung Yen	2,434.4	1,875.4
08	Ha Nam	1,350.7	1,134.4
09	Nam Dinh	2,878.1	2,310.1
10	Thai Binh	4,303.7	3,326.1
11	Ninh Binh	1,444.2	1,122.2
	Total	26,263.5	20,545.4

Source) Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

Agriculture represents the most important economic subsector in the Red River delta. The agriculture gross outputs in 2000 at the current prices and at constant 1994 prices are 26,263.5 and 20,545.4 billions VND. Almost 90% of the agricultural land is used for annual crops, 6.6% is used for aquaculture and fisheries, 3.1% for perennial crops, and only 0.6% as pasture land. Paddy is the main crop. Some 62,000 ha of land outside the dykes and prone to flooding by the river are used for subsidiary crops such as soybean, maize and vegetables. That amount of pesticides used in Vietnam is still relatively low, usually being in the range 0.5 - 2 kg of active ingredient per hectare; also the amount of fertilizer used is low.

About 70% of the agricultural land consists of old and young alluvial soils; some 13% of soils are saline or acid sulphate soils, about 10% are degraded sandy loam soils deposited flats along the coast. Saline soils are found along the coast of Hai Phong, Hai Hung, Nam Ha, Ninh Binh, Thai Binh and Quang Ninh provinces. Acid sulphate soils, altogether 45,000 ha of actual and potential acid sulphate soils, are distributed over the Hai Phong, Quang Binh and Thai Binh provinces. Flooded soils are mainly found in Nam Ha, Ninh Binh, Ha Tay and Hai Hung provinces and cover as much as 85,000 ha. Over the years, 'problem soils' have been turned into very productive soils by means of proper management and development of irrigation and drainage systems.

(2) Fisheries

The fishery gross outputs at current prices (in 2000) and at constant 1994 prices are presented in **Table 15.6.5**.

Table 15.6.5 Fishery Gross Outputs

No	Province/city	The gross output at current prices (Bill. VND)	The gross output at constant 1994 prices (Bill. VND)	The gross output of aquatic products (tons)	The gross output of breeding fish (tons)
01	Hanoi	75.6	62.3	8,188	7,271
02	Hai Phong	371.4	294.5	37,879	12,146
03	Vinh Phuc	39.7	38.1	5,548	3,725
04	Ha Tay	115.7	95.8	12,498	8,614
05	Bac Ninh	66.3	53.3	6,773	5,210
06	Hai Duong	121.9	103.1	12,960	11,200
07	Hung Yen	65.6	59.7	7,450	5,330
08	Ha Nam	37.3	35.7	4,509	3,900
09	Nam Dinh	300.4	315.5	42,194	11,413
10	Thai Binh	269.3	274.8	33,339	10,478
11	Ninh Binh	53.5	58.2	7,000	3,499
	Total	1,516.7	1,391.0	178,338	82,786

Source) Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

Both capture fisheries and aquaculture constitute important sources of income for the population of the project area. Main fishing ports are located in Hai Phong and Hong Gai.

However, when compared with the marine fishery production in the south of the country, the production of the Gulf of Tonkin is rather low due to its relatively small area of continental shelf. Moreover, fish and shrimp stocks in the Gulf of Tonkin are intensively exploited by vessels from China and Hong Kong. Riverine fish catches have declined over the past decades and nowadays productivity is low. Shrimps constitute important fishery resources both for capture fisheries and aquaculture. Freshwater aquaculture in the project area focuses on carp species (common carp, grass carp, bighead carp, mud carp, Indian carp), but also snakehead is grown.

People living in the coastal districts within Thai Binh, Nam Dinh, Ninh Binh, Hai Phong provinces changed their production activities from agriculture to fishery.

The fish and shrimp gross outputs and breeding areas in some provinces are presented in **Table 15.6.6**.

Table 15.6.6 Fish and Shrimp Gross Outputs and Breeding Areas in 2000 Year

No	Province/ city	Area of water surface for production of aquatic products (ha)	Gross output of breeding fishes (tons)	Gross output of breeding shrimp (tons)
01	Hanoi	3,091.2	7,271	2.0
02	Hai Phong	13,342.1	12,146	1,229.0
03	Vinh Phuc	3,447.9	3,725	0
04	Ha Tay	7,199.0	8,614	0
05	Bac Ninh	2,582.0	5,210	310.0
06	Hai Duong	6,500.0	11,200	0
07	Hung Yen	3,018.0	5,330	20.0
08	Ha Nam	3,756.0	3,900	18.0
09	Nam Dinh	11,017.0	11,413	856.0
10	Thai Binh	9,500.0	10,478	707.0
11	Ninh Binh	3,720.0	3,499	140.0
	Total	67,173.6	82,786	3,282.0

Source) Statistic Yearbook 2000, Statistical Publishing House

Benefit gained from shrimp farming is 5 times higher than that from rice or salt production. Other fishery products are shell, fish, crap etc. Besides, that the salt production is quite developed in the coastal area of the RRD. The salt production area in Nam Dinh province is 1,164 ha.

(3) Mining

Coal, mainly high grade anthracite, occurs in large quantities in Quang Ninh province, in the district of Hong Gai. The main coal mines are located very close to the coast, near the ports of Hong Gai and Cam Pha. For this reason, coal can be readily transported by barge to other locations in the Red River delta and also can be loaded almost directly into ships for export overseas. Coal is a typical commodity for inland water transport.

Coal exploitation in Hon Gai- Uong Bi (Quang Ninh Province) in the past and future is the following :

1998	3.878 million tons
2000	7.291 million tons
2005	9.410 million tons

2010

9.310 million tons

As for construction materials, limestone, clay, silica, sand, gravel, andesite and sandstone are mined, limestone and clay being the most important. Many limestone deposits are being exploited to obtain rock material for construction and to supply the cement factories.

(4) Industry

The number of establishments and industrial gross outputs in 2000 year in the RRD are presented in **Table 15.6.7**.

Table 15.6.7 Number of Establishments and Industrial Gross Outputs

No	Province/city	Number of establishments		Gross outputs at constant 1994 prices (Bill. VND)	
		Domestic	Foreign	Domestic	Foreign
01	Hanoi	15,654	101	9,856.4	5,362.2
02	Hai Phong	10,187	44	4,179.3	3,848.5
03	Vinh Phuc	11,458	9	346.6	2,488.9
04	Ha Tay	59,341	17	1,986.2	682.0
05	Bac Ninh	9,904	3	1,035.3	506.9
06	Hai Duong	21,176	14	2,711.5	247.4
07	Hung Yen	15,185	4	531.2	1,261.1
08	Ha Nam	16,455	-	980.7	-
09	Nam Dinh	26,662	2	1,477.3	4.6
10	Thai Binh	44,580	-	1,378.0	-
11	Ninh Binh	14,352	2	477.0	1.0
	Total	244,954	196	24,959.5	14,402.6

Source) Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

The list of existing industrial parks in the Red river basin is presented in **Table 15.6.8**.

Table 15.6.8 List of Existing Industrial Parks in the Red River Basin

(by December, 1998)

Name of IP	Year	Planned area (ha)	Number of enterprises	Occupied area (ha)	Labor
		Phase I/ Total area		Total	
Total					
HANOI		445/562	16	32.33	3,700
1. Sai Dong B IP	1996	30 (phase 1)	8	24/24	3,000
	1997	54.38 (phase 2)	4	1.83	
2. Noi Bai IP (J/V with Malaysia)	1994	50/100	4	6.5/33.2	700
3. Hanoi IP (100% Investment of Taiwan)	1995	40			
4. DAEWOO – HANEL IP (J/V with Korea)	1996	197	-		
5. North Thang Long IP (J/v with Japan)	1997	128	-		
HAIPHONG		467	9	5.4	1,000
1. Haiphong - NOMURA (J/v with Japan)	1994	153	8	5.4/108	1,000
2. Ding Vu IP (J/v with Thailand, Belgium, USA)	1997	164	1		
3. Haiphong ESZ 96 (J/v with Hongkong)	1993 1997	150	-		
BAC NINH		134.76			
1. Tien Son	1998	134.76	-		
VINH PHUC					
1. Kim Hoa IP	1998	264.41			
PHUTHO		70			
1. Thuy Van IP	1997	70	-		
QUANG NINH		78			
1. Cai Lan IP	1997	78	-		

Source) JICA Study Team

Detailed plan for development of industrial parks in the Red River delta is presented in **Table 15.6.9**.

**Table 15.6.9 Detailed Plan for Development of Industrial Parks
in the Red River Delta**

No	Name of Industrial Park	Area planned up to year of 2020	Year of final approval of the plan	Remark
01	Hanoi			
	East – North Hanoi	430	1997	
	Northern Thang Long	350	1997	
	Southern Thang Long	220		
	Soc Son EPZ	100		
	Da Phuc	900		
	Dong Anh	80		
02	Hai Phong			
	Do Son EPZ	1,000		
	Nomura	150	1994	
	Dinh Vu	800	1997	
	Minh Duc	1,200		
03	Vinh Phuc			
	Kim Hoa	180	1998	
	Me Linh	60		
04	Ha Tay			
	Hoa Lac 1	1,000		
	Hoa Lac 2	600		
	Xuan Mai	400		
05	Bac Ninh			
	Tien Son	300		
06	Hai Duong			
	Pha Lai	500		
	Chi Linh	1,000		
	Nam Sach	100		
07	Hung Yen			
08	Ha Nam			
09	Nam Dinh			
10	Thai Binh			
11	Ninh Binh			
	Nui Dinh	1,000		
12	Quang Ninh (*)			
	Dong Trieu	800		
	Mao Khe	400		
	Uong Bi	500		
	Chap Khe	350		
	Dong Dang	150		
	Cai Lan	90	1987	
	Hoanh Bo	170		

Source) JICA Study Team

Industry is concentrated in the cities of Hanoi and Haiphong, but some heavy industry also can be found in Viet Tri and at various locations in the Quang Ninh province. In the Haiphong industrial zone chemical, seafood, paper, cement, and steel factories are met, as well as shipyards.

Some main industries in the RRD are as follows :

1) Cement industries

- Hoang Thach Cement Plant (Hai Duong Province) : ~2,400,000 tons/year.
- Phuc Son Cement Factory (Hai Duong Province) : ~ 1,300,000 tons/year.
- But Son Cement Factory (Ha Nam Province) : 1,400,000 tons/year
- Ching Fong Cement Factory (Hai Phong City) : ~ 2,000,000 tons/year
- Hai Phong Cement Factory (Hai Phong City) : ~ 400,000 tons/year
- Tam Diep Cement Factory (Ninh Binh Province) : ~ 1,200,000 tons/year.

2) Steel industries

- Thai Nguyen Steel Company (Thai Nguyen Province) : ~ 200,000 tons/year
- Viet Steel Factory (Binh Duong province) : 300,000 tons/year
- Hoa Phat Steel factory (Hung Yen Province) : 250,000 tons/year
- Steel factory of Song Da Construction Company (Hung Yen Province) : 120,000 tons/year.
- Hai Phong Steel Factory (Hai Phong City) : 250,000 tons/year
- Ninh Binh Steel Factory (Ninh Binh Province): 250,000 tons/year

(5) Infrastructure

Important destinations for the anthracite coal, mined in the Quang Binh Province, are constituted by the thermal power stations located in or near the Red River Delta. The thermal power station at Pha Lai uses 600,000 tonnes of coal/year. The Ninh Binh thermal power station consumes a 200,000 tonnes of coal/year. The Hoa Binh hydroelectric dam, constructed on the Da River is the largest hydropower dam in Vietnam.

Regarding urban water supply, Hanoi, Ha Dong, Hung Yen and Vinh Yen rely on groundwater resources, whereas the city of Haiphong obtains water both from surface and groundwater resources. Rural water supply is from deep and shallow wells (dugwells) and from surface waters (rivers, canals, lakes and ponds) and rainwater (roof catchments). The main aquifer exploited for waters

(rivers, canals, lakes and ponds) and rainwater (roof catchments). The main aquifer exploited for water supply in the project area is the Vinh Phuc - Hanoi aquifer.

Only small amounts of urban wastewater are treated presently. Most of the sewage is discharged without any treatment in urban lakes, in the local river systems or, in case of Haiphong, directly in the marine environment.

(6) Transportation

The main channel giving access to the Red River system from the sea is constituted by the mouth of the Ninh Co River at Lach Giang. The Red River system is connected with the Thai Binh River system by the Duong and Luoc rivers. Presently, the shipping route for coal supply, from the mining areas in Quang Ninh province to the project area, follows the coastline of Ha Long Bay. The inland continuation of the sea corridor from Quang Ninh is by means of the north-south inland waterway corridor, between Haiphong and Ninh Binh, and through the Haiphong - Hanoi - Viet Tri corridor; both corridors are intensively used.

The largest consumers of coal in the delta are the power stations at Pha Lai, Uong Bi and Ninh Binh, and the cement factories. Also transport of coal by barge takes place to Viet Tri in order to supply the steel works at Thai Nguyen. Furthermore, coal is unloaded at various other locations along the waterways to supply the numerous brick kilns, near Thai Binh for example. Most of the river fleet consists of steel barges, tow/push boats and self-propelled barges. The condition of the fleet is poor due to lack of maintenance.

The local transport in the RRD in 2000 year is summarized in **Table 15.6.10**.

Table 15.6.10 Local Transport in the RRD in 2000 Year

No	Province/ city	Volume of freight (Thous.tons)	Volume of freight traffic (mill.tons.km)	Number of passenger (Mill.persons)	Passenger traffic (Mill.person.km)
01	Hanoi	9,176.0	605.7	31.8	485.6
02	Hai Phong	1,800.0	450.0	11.0	236.9
03	Vinh Phuc	1,120.0	42.0	0.9	60.7
04	Ha Tay	3,300.0	150.0	9.5	260.0
05	Bac Ninh	1,371.0	35.9	2.5	121.5
06	Hai Duong	2,650.0	179.6	1.3	73.1
07	Hung Yen	1,881.4	119.9	0.8	64.2
08	Ha Nam	1,333.0	55.1	0.9	106.4
09	Nam Dinh	1,650.0	163.6	4.1	250.4
10	Thai Binh	2,310.0	131.2	2.5	-
11	Ninh Binh	2,890.4	59.4	1.5	81.3
	Total	29,481.8	1,992.4	66.8	1,740.1

Source) Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

15.6.3 Land utilization

The present land use in the RRD is summarized in **Table 15.6.11**.

Table 15.6.11 Present Land Use in the RRD

No	Province/ city	Area of unused land (x 1000 ha)	Area of used land (in 2000), x 1,000 ha			
			Agriculture	Forestry	Special use	Residential
01	Hanoi	10.2	43.6	6.1	20.5	11.7
02	Hai Phong	30.1	72.6	21.7	20.9	6.6
03	Vinh Phuc	16.0	66.8	30.4	18.7	5.2
04	Ha Tay	27.0	123.4	16.7	39.5	12.6
05	Bac Ninh	8.8	52.0	0.6	13.8	5.2
06	Hai Duong	12.4	105.7	9.1	26.5	11.1
07	Hung Yen	6.1	64.2	-	14.7	7.3
08	Ha Nam	7.8	51.8	9.4	11.6	4.3
09	Nam Dinh	17.6	106.7	4.7	25.3	9.4
10	Thai Binh	9.6	103.2	2.6	25.9	12.9
11	Ninh Binh	32.3	67.6	17.7	15.6	5.0
	Total	177.9	857.6	119.0	233.0	91.3

Source) Socio-economic statistical data of 61 provinces and cities in Vietnam, Statistical Publishing House, 2001

Total natural area of the RRD is 1,478,800 ha.

According to the data in the table, in the RRD there is about 12% of total area unused; about 60% of total area is used for the agriculture development, 8% of total land is used for forestry plantation, 15.8% of total land is specially used and 6.2% of total area is residential.

Explanation of Cover Design

Future images of the Inland Waterway Transport System in the Red River Delta, the projects on channel stabilization and the major ports in the segment through Hanoi in particular, are drawn in this Study. This project is expected to contribute to the 1000 year anniversary of Thang Long - Hanoi - in 2010. In the cover page of this final report, pink band and light blue band express the Red River and the blue sky above Hanoi respectively. Both Dao (peach flowers) and Quat (a kind of citrus fruits) in the colored bands are cultivated along the river bank and adorned at the entrance of each house to celebrate Tet (a new year) in Hanoi. The JICA Study Team and relevant organizations of Vietnam hope the project will be carried out as early as possible.

A satellite image of the Red River system, showing a wide, winding river with a reddish-brown hue, flowing through a landscape of green vegetation and brownish soil. The river meanders across the frame, with several smaller tributaries and channels visible. In the upper left, there is a rectangular structure, possibly a dam or a bridge. The overall scene is a mix of natural and human-made elements.

THE STUDY ON THE RED RIVER IWT SYSTEM

LANDSAT-7 16th November 2001

MOT (PMU-Waterways)

JICA Study Team (OCDI & JPC)