14.2 DEMAND FORECAST

14.2.1 Estimation of Future Seaport Demand

The magnitude (type, site, location) of future port facilities in the target area should possibly and practically be governed by likely levels of demand (port throughput) expected in future years. Estimates of future demand were, correspondingly, demand based on reviews of two patterns:

- Historic evolution of port activity within Viet Nam; and,
- Relationship between unit national income (GDP per capita) and port activity exhibited by Southeast Asian nations with strong maritime histories (Thailand, Indonesia, Philippines) as well as Japan during earlier stages of economic development.

Findings are presented in the following pages.

1) Historic Evolution Methodology

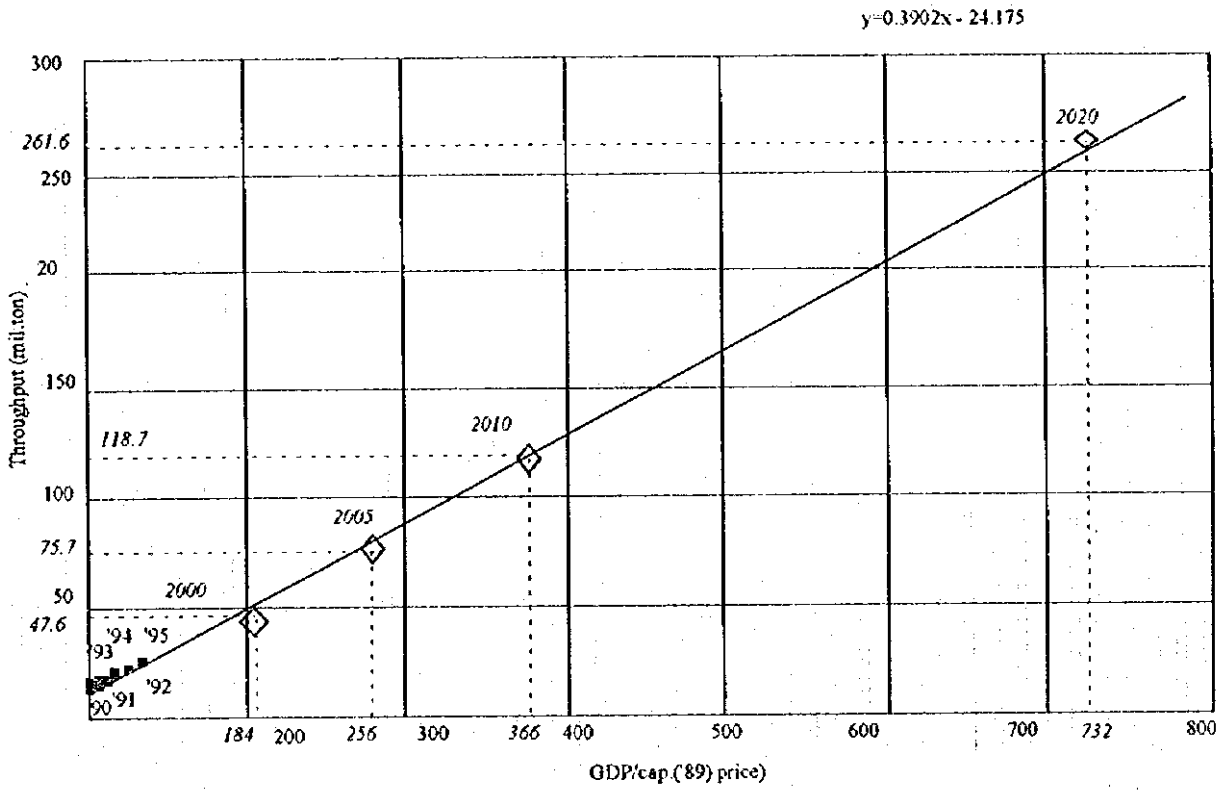
The national economy (GDP) has exhibited strong gains in recent years, exceeding (in real terms) 9% per annum in 1995. The macro-economic framework derived for current study suggests that strong future growth will be the norm with real GDP growth ranging between 8.5 and 9.3% over the next two decades. Thus, unit national income (GDP/capita) is expected to increase between 6.1 and 7.4% per annum over the same period (Table 14.2.1).

Table 14.2.1 Historic and Forecast Economic Evolution Republic of Viet Nam

Year	1989	1990	1991	1992	1993	1994	1995	*2000*	*2005*	*2010*	*2020*
GDP,'89 constant prices,A,(Dong bil.)	28,135	29,529	31,286	33,991	36,735	39,982	43,765	65,509	100,138	156,180	369,734
growth rate (%/year)	8.0	0.5	0.6	0.9	0.8	0.9	0.9	0.9	0.9	0.9	assuming 0.9
Exchange rate B,(Dong/US$)	applied '89 rate 4,300(Dong/US$)										
GDP,'89 price C=A/B,(US$ bil.)	0.7	0.7	0.7	0.8	0.9	0.9	1.0	1.5	2.3	3.6	8.6
growth rate (%/year)		0.5	0.6	0.9	0.8	0.9	0.9	0.8	0.9	0.9	0.9
Population D,(unit thousand)	64,774	66,233	67,774	69,405	70,983	71,456	74,199	82,773	91,010	99,200	117,414
growth rate (%/year)		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	assuming 0.2
GDP/cap.,'89 price E=C/D,(US$)	101	104	107	114	120	130	137	184	256	366	732
growth rate		0.3	0.4	0.6	0.6	0.8	0.5	0.6	0.7	0.7	0.7

Historic port throughput for the Republic has steadily grown from 16.8 million tons in 1990 to 30.4 million tons in 1995. Although such a short period of record must be treated with caution, the application of a linear regression technique suggests, in line with likely growth in unit national income, that national port throughput could exceed 260 million tons by year 2020 (Figure 14.2.1).

Figure 14.2.1 Historic and Forecast Port Throughput Republic of Viet Nam



Year	1990	1991	1992	1993	1994	1995	*2000*	*2005*	*2010*	*2020*
Throughput (mil.ton)	16.8	17.9	20.1	22 0	25.8	30.35	47.6	75.7	119	261.6
Throughput/cap. (kg)	253. 8	264 0	289. 6	309. 9	360. 9	410 1	576	831	1,196 5	2,227 81

Preliminary forecasts of population indicate that, by year 2020, the national population will exceed 117 million persons, the central region 33 million persons, and the target area (4 provinces) 7 million persons. The hinterland for target area ports will exceed the boundaries of the target area, and extend into the remainder of the central region. Thus, for calculation purposes, the port's hinterland is defined as 70% of the central region with a cargo captureratio of 70%. This means some 50% of the central area population or more than 16 million persons by year 2020 (Table 14.2.2).

Table 14.2.2 Historic and Forecast National, Regional and Catchment Population (Unit: Thousand People)

Year	1993	1994	1995	1996	2000	2005	2010	2020
National Total	70,983	71,465	74,199	75,927	82,773	91,010	99,200	117,414
North Central (6 provinces)	9,661	9,727	10,098	10,334	11,265	12,386	13,501	15,980
Central Coast (7 provinces)	7,506	7,557	7,846	8,028	8,752	9,623	10,489	12,415
Central Highland (4 provinces)	2,979	2,999	3,114	186	3,473	3,819	4,163	4,927
Central Region	20,145	20,283	21,058	21,548	23,491	25,829	28,153	33,322
	assumed that this population is 28.4% of National Total,besed on'93 result							
Target Area (4 provinces)	4,630	4,662	4,840	4,953	5,399	5,937	6,471	7,659
Hinterland	10,072	10,142	10,529	10,774	11,745	12,914	14,076	16,661
	assumed that this population is 50% of central region's.							

Application of unit throughput rates to hinterland population suggests that throughput for ports in the target area could reach 6.8 million tons by year 2000, and 37.1 million tons byyear 2020 (Table 14.2.3).

Table 14.2.3 Forecast Composite Throughput Target Area Seaports Trend Pattern

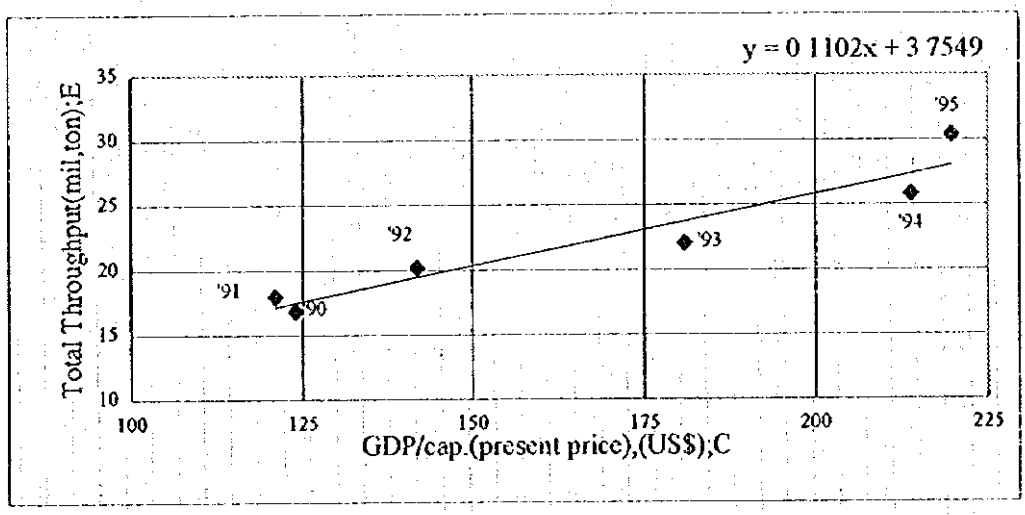
Year		2000	2005	2010	2020
Unit Throughput Rate	(kg/capita)	575.6	831.5	1,196 5	2,227 8
Hinterland Population	(thousand)	11,745	12,914	14,076	16,661
Target Area Port Throughput	(thousand)	6.8	10.7	16.8	37.1

2) Asian Precedence Methodology

Comparison of historic relationship between unit national income (GDP/capita), and unit port activity (kg /capita) for Viet Nam, Thailand, Philippines, Indonesia and Japan confirms that, in general, port throughput is correlated with unit national income (Figure 14.2.2).

Figure 14.2.2 Relationship of Unit National Income and Port Throughput Republic of Viet Nam

Year;A	GDP present price (US$ bill.);B	GDP/cap. present price (US$/prs.);C	Population;D (mil.prs.)	Throughput Total (mil.ton);E	Throughput MOTC managed (mil. ton) F=G+H+I	Im.;G	Ex;H	Domest.;I	J=E/D (kg/cap.)
1983									
1984					5 6				
1985					5 8				
1986				13 9	6 4	3 6	1 1	1 8	
1987				14 5	6 5	3 5	1 0	2 0	
1988				15 4	8 2	3 8	1 1	2 6	
1989			65		8 2	3 2	3 4	1 7	
1990	8 2	124	66	16 8	8 2	3 1	3 3	1 8	253 8
1991	8 2	121	68	17 9	7 9	2 7	2 8	2 3	264 0
1992	9 9	142	69	20 1	9 0	3 0	3 8	2 2	289 6
1993	12 9	181	71	22 0	10 0	4 2	3 9	2 0	309 9
1994	15 5	214	71	*25 8*	12 3				*360 9*
1995	16 3	220		*30 4*					*410 1*
				E'94,'95are estimated from F(E=F*2.1)					



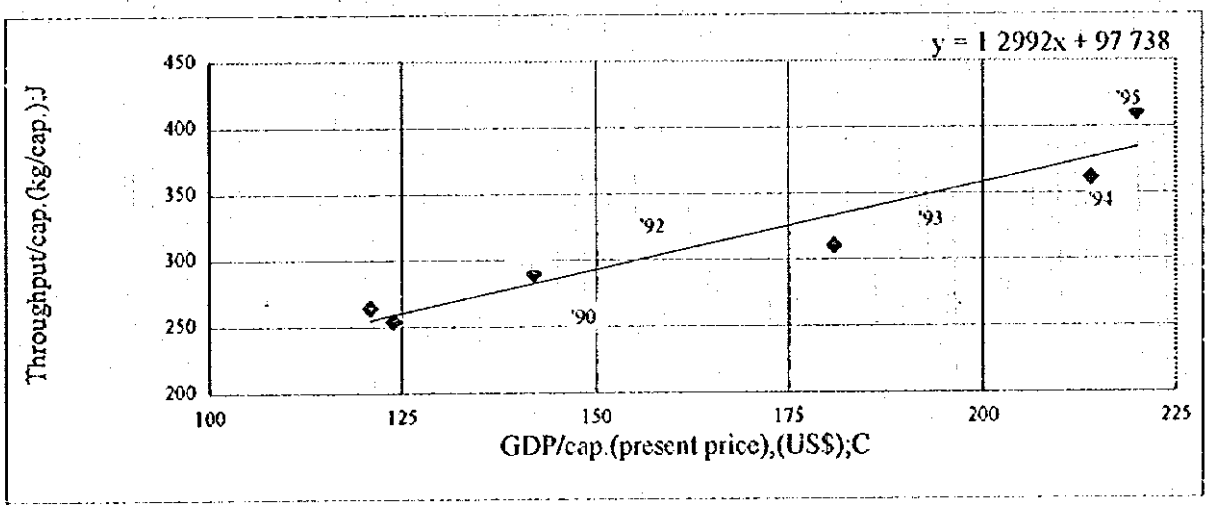
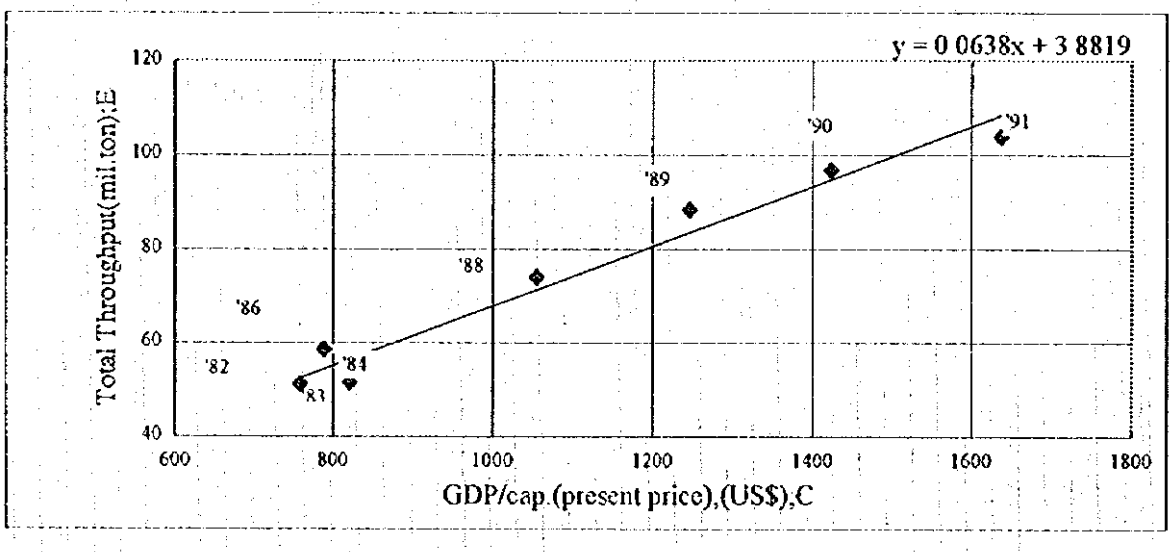


Figure 14.2.3 Relationship of Unit National Income and Port Throughput Kingdom of Thailand

Year;A	GDP present price (US$ bil.);B	GDP/cap. present price (US$/prs);C	Population;D (mil person)	Throughput(mil.ton) Total E=F+I	Foreign F=G+H	Im.;G	Ex;H	Domestic;I	J=E/D (kg/cap.)
1981	36 8	767	48						
1982	36 8	759	49	51 0	36 8	15 7	21 1	14 2	1052
1983	40 4	822	49	51 4	37 1	20 0	17 1	14 3	1045
1984	42 0	836	50	54 2	39 2	18 9	20 3	15 1	1080
1985				55 1	39 8	18 1	21 7	15 3	
1986	41 8	789	53	58 4	42 2	18 8	23 4	16 2	1103
1987			54	62 6	45 2	22 7	22 5	17 4	1162
1988	58 0	1054	55	73 9	53 3	26 1	27 2	20 5	1344
1989	69 7	1247	56	88 2	64 6	32 6	32 0	23 7	1579
1990	80 2	1424	56	96 7	69 4	39 9	29 6	27 3	1718
1991	93 3	1638	57	103 8	76 1	45 4	30 6	27 7	1822



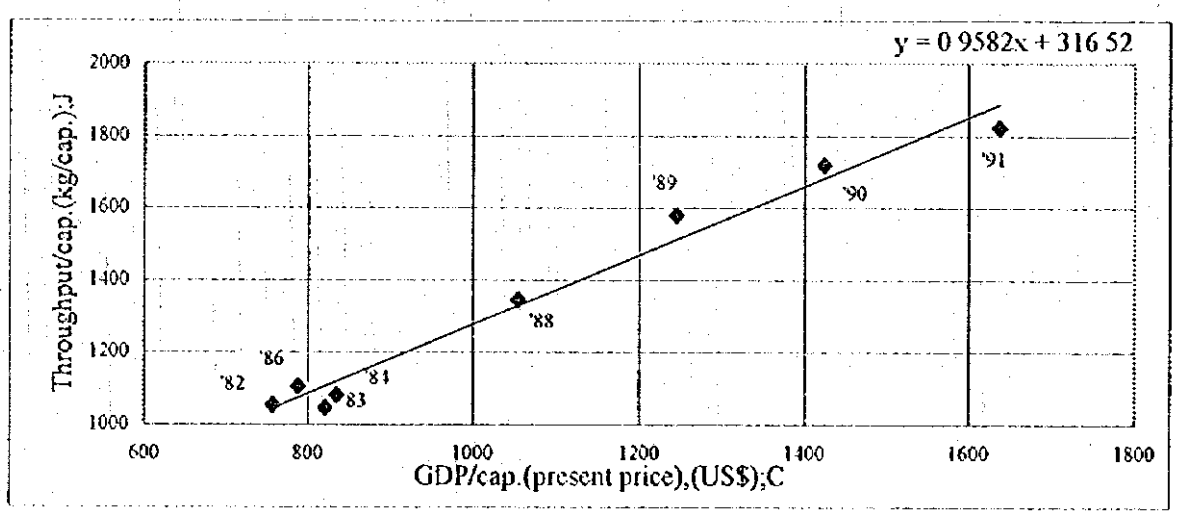
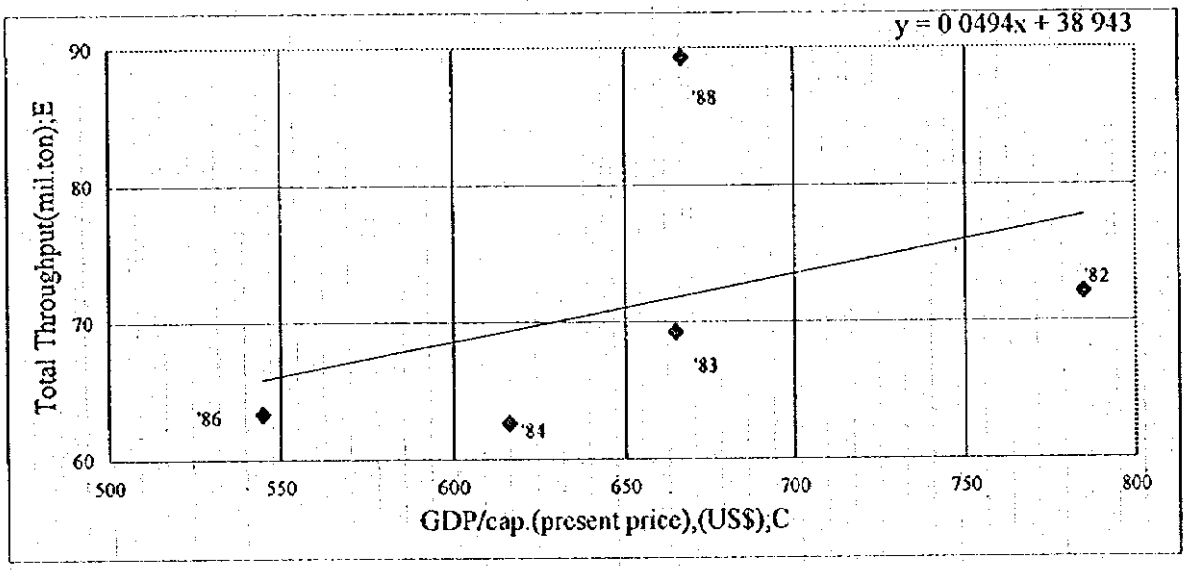


Figure 14.2.4 Relationship of Unit National Income and Port Throughput Republic of Philippines

Year;A	GDP present price (US$ bill.);B	GDP/cap. present price (US$/prs.);C	Population;D (mil person)	Throughput(mil. ton) Total E=F+I	Foreign F=G+H	Im.;G	Ex;H	Domest.;I	J=E/D (kg/cap.)
1977			45						
1978			45						
1979			47						
1980			48						
1981	38 9	785	50						
1982	39 9	785	51	72 1	35 2	20 5	15 2	36 4	1420
1983	34 6	665	52	69 2	32 6	20 1	12 5	36 6	1329
1984	32 8	616	53	62 6	28 2	17 5	10 7	34 4	1173
1985			55	61 8	27 4	17 6	9 8	34 4	1130
1986	30 5	545	56	63 3	28 1	15 7	12 4	35 2	1130
1987			57						
1988	39 2	667	59	89 3	38 5	26 0	12 6	50 8	1521
1989	44 4	739	60						
1990	43 9	713	62						
1991	44 9	714	63						



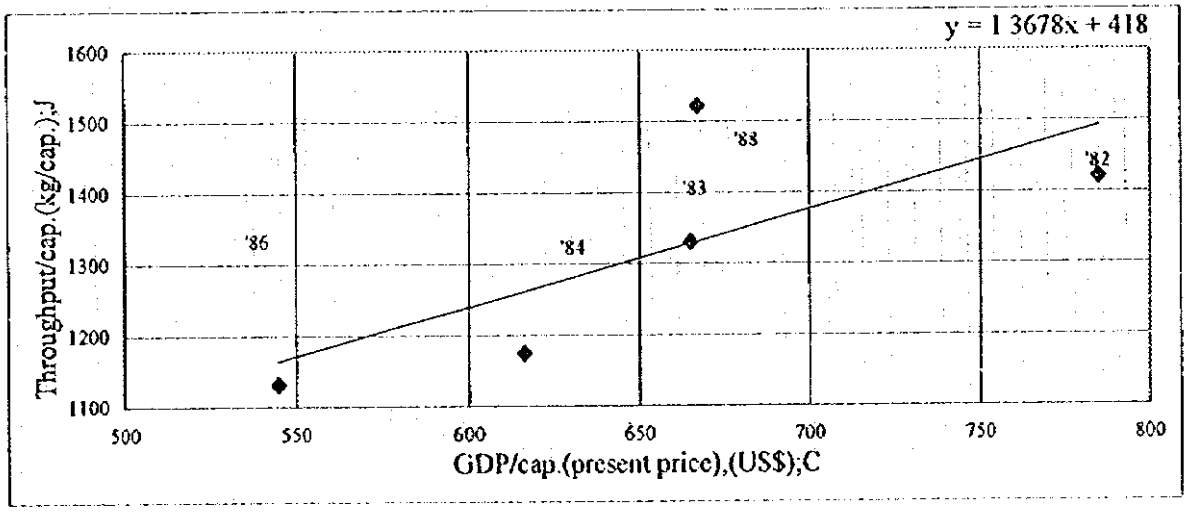
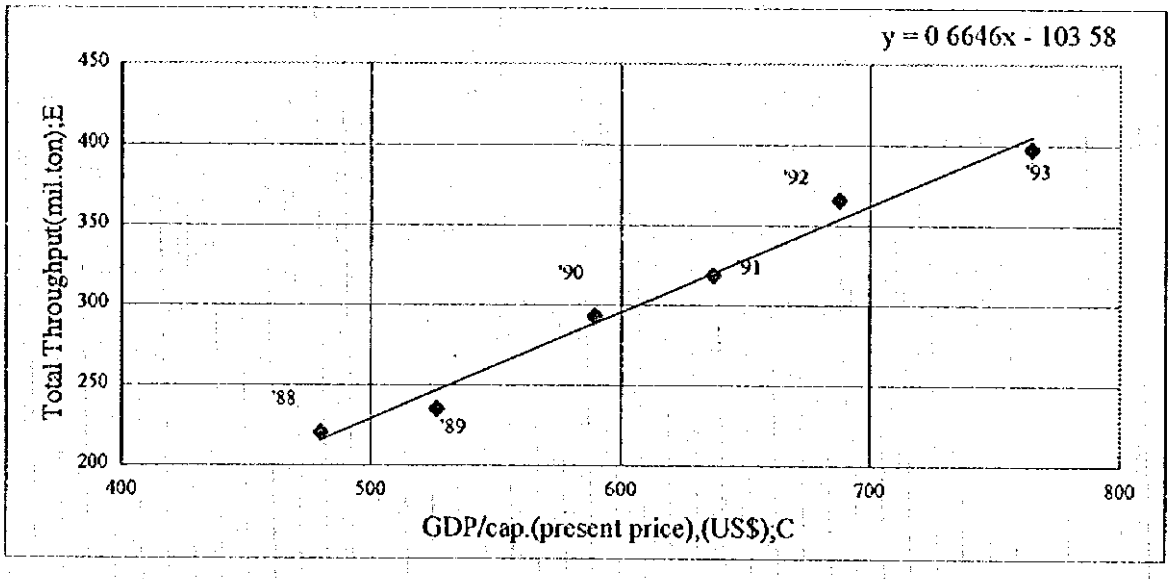


Figure 14.2.5 Relationship of Unit National Income and Port Throughput Republic of Indonesia

Year;A	GDP present price (US$ bil.);B	GDP/cap. present price US$;C	Population;D (mil.person)	Throughput(mil. ton) Total E=F+I	Foreign F=G+H	Im.;G	Ex.;H	Domestic;I	J=E/D (kg/cap.)
1985	87 6	531	165						
1986	80 0	476	168						
1987	75 9	441	172						
1988	84 5	480	176	220 0	103 7262			116 2	1250
1989	91 3	527	179	235 0	105 6445			129 3	1313
1990	106 2	590	180	292 9	135 5955			157 3	1627
1991	116 6	637	183	318 5	148 2835			170 2	1740
1992	128 0	688	186	365 5	166 7484			198 8	1965
1993	144 6	765	189	397 2	187 9272			209 3	2102
1994			192						



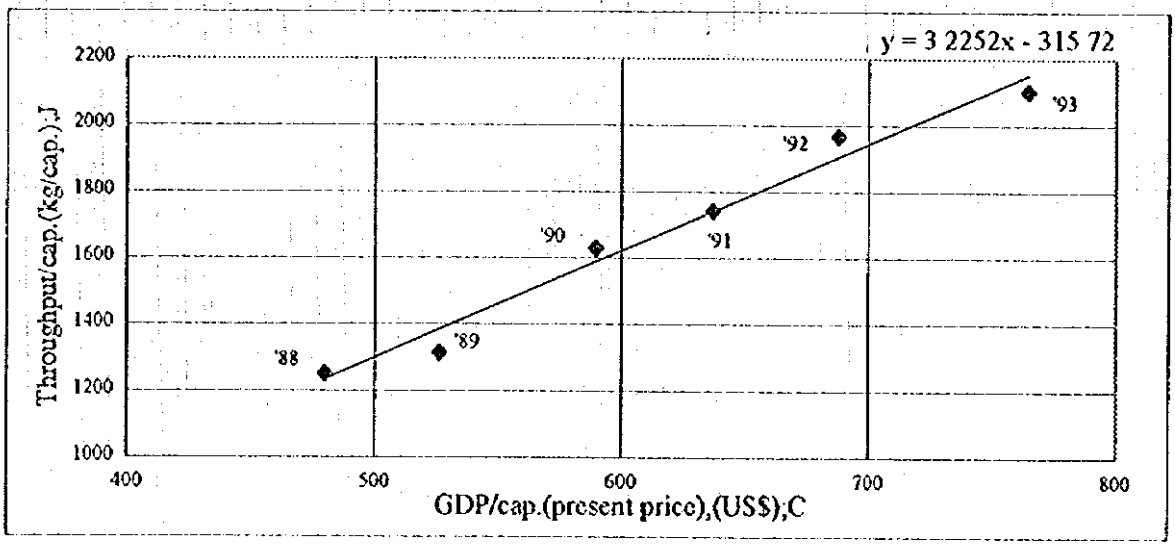
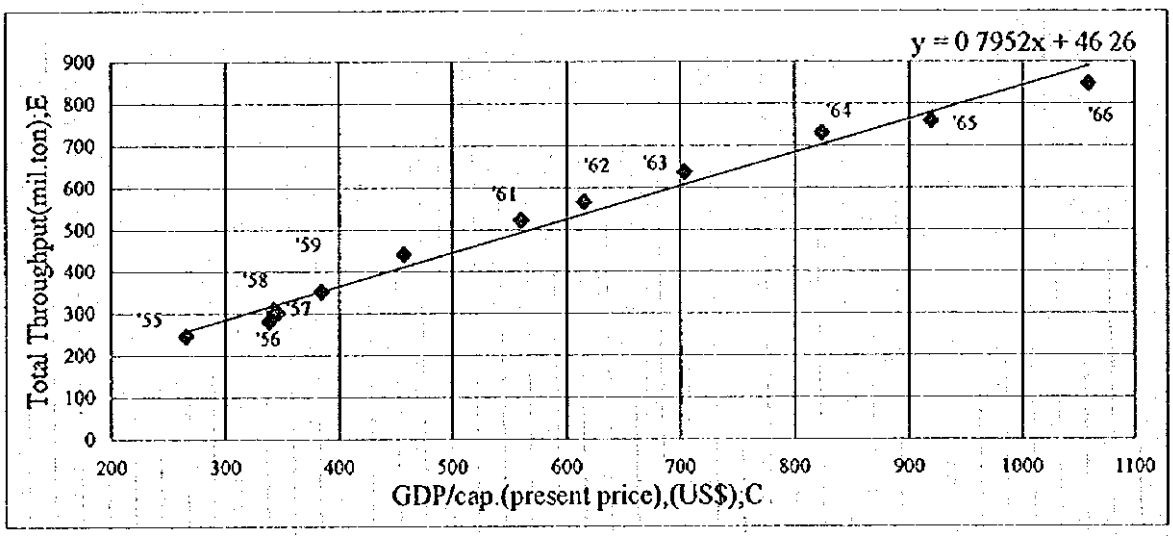
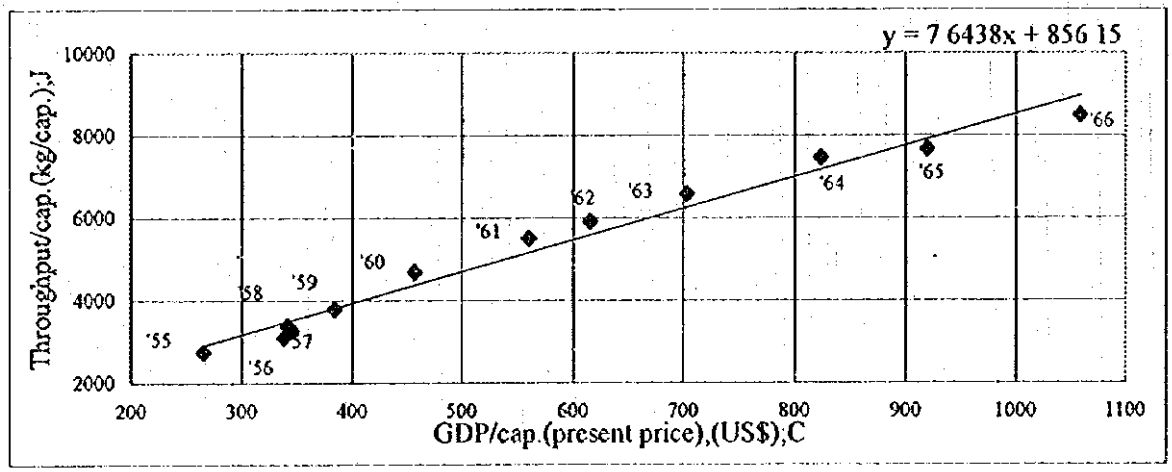


Figure 14.2.6 Relationship of Unit National Income and Port Throughput Japan

Year;A	GDP present price (US$ bil.);B	GDP/cap. present price (US$/prs.);C	Population;D (million)	Throughput(mil.ton) Total E=F+I	Foreign F=G+H	Im.;G	Ex.;H	Domest.;I	J=E/D (kg/cap.)
1955	23 9	266	90	245 6	50 0	40 7	9 3	195 6	2734
1956	30 8	339	91	280 4	60 8	50 4	10 4	219 6	3092
1957	31 4	343	92	308 2	71 8	61 6	10 2	236 4	3366
1958	32 0	346	92	300 0	63 4	52 6	10 8	236 6	3247
1959	35 9	385	93	351 6	75 8	62 8	13 0	275 8	3769
1960	43 1	458	94	439 9	107 0	92 2	14 8	332 9	4675
1961	53 2	561	95	520 9	138 2	123 4	14 8	382 7	5486
1962	59 0	616	96	564 5	144 3	125 8	18 5	420 2	5891
1963	68 2	704	97	635 6	175 0	153 9	21 1	460 6	6565
1964	80 6	824	98	728 0	210 0	185 6	24 4	518 0	7441
1965	91 0	920	99	757 4	241 7	211 8	29 9	515 7	7660
1966	105 6	1059	100	846 0	278 5	245 3	33 2	567 5	8478





When viewed on a comparative basis, unit throughput rates of Japan exceed, as Viet Nam lags, the Southeast Asian norm. That is: unit throughput rates for Indonesia, Thailand and Philippines converge to a common level, even though unit national incomes differ significantly between these three nations (Figures 14.2.7 and 14.2.8).

Figure 14.2.7 Unit National Income and Port Throughput Pattern Select East Asian Nations

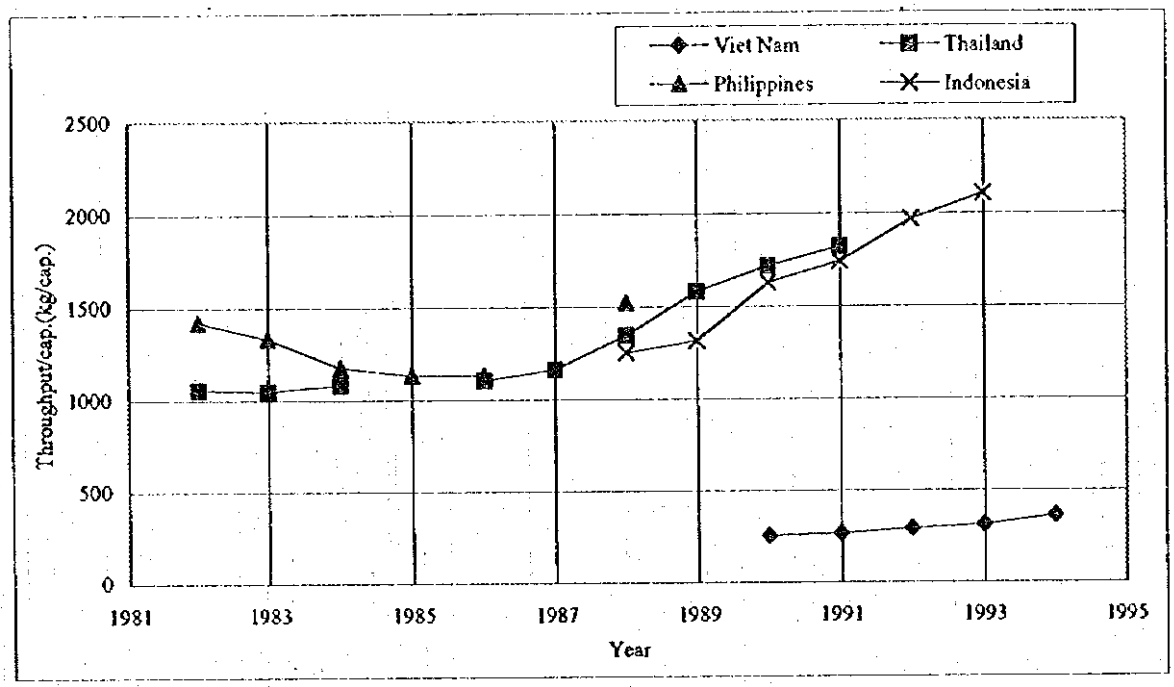
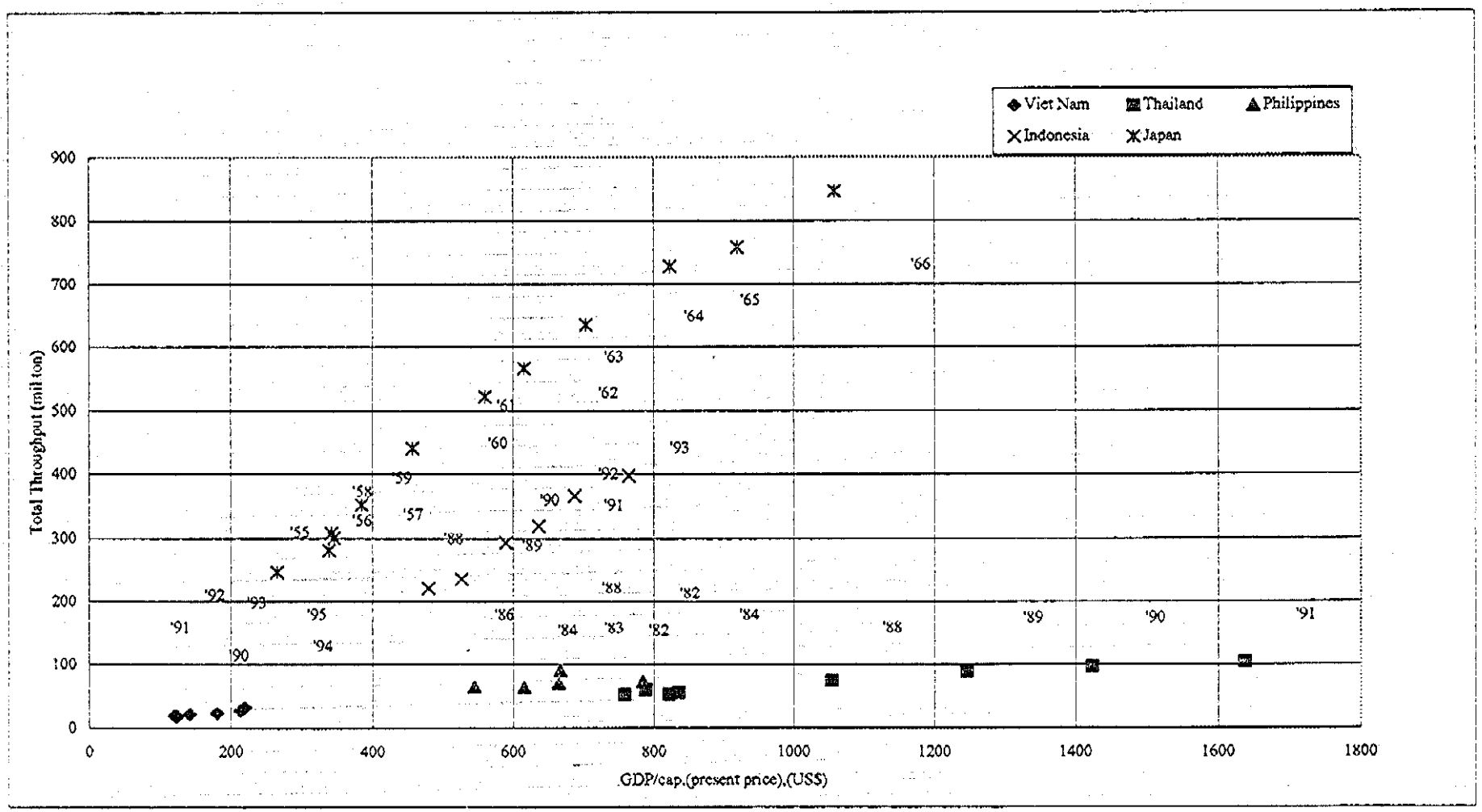


Figure 14.2.8 Unit National Income and Port Throughput Pattern
Select Southeast Asian Nations



Averaging the unit throughput rates achieved by Thailand, Philippines and Indonesia from 1986 (discounts the negative or stagnant pre-1986 economic growth catalyzed by the oil crisis of the early 1980's) yields average growth rates of 9.2% per annum (1986 -1989) and 10.8% per annum (1989 - 1992). Application of these growth rates (9.2 % to year 2005; 10.8 % thereafter) suggests that throughput for ports in the target area could reach 6.8 million tons by year 2000, and 69.6 million tons by year 2020 (Table 14.2.4).

Table 14.2.4 Forecast Composite Throughput Target Area Seaports Asian Precedence Pattern

Year	2000	2005	2010	2020
Unit Throughput (kg/capita)	575.6	892.6	1,493.3	4,179.4
Growth rate (%/year)	0.9		1.1	
Hinterland Population (thousand)	11,745	12,914	14,076	16,661
Target Area Port Throughput (mil. ton)	6.8	11.5	21.0	69.6

3) Adopted Demand Forecast

A comparison of forecasts derived by the historic evolution methodology (refer Table 14.2.3) and the Asian precedence methodology (refer Table 14.2.4) indicates that both approaches yield very similar results for the near term future (to year 2005). However, for the longer term future (year 2005 - 2020) rapid diversion takes place with the Asian precedence methodology yielding higher forecasts. This is not surprising, and entirely logical. Viet Nam will over the next few years, continue to evolve a maritime sector based on existing infrastructure, port practices and trading patterns. However, as new port facilities are implemented, the economy continues to advance to free-market status, promote globalization of trading patterns, and Viet Nam's maritime industry will increasingly change from historic practices toward Southeast Asian norms. Thus, the forecast derived the Asian precedence methodology is considered robust, and is adopted for port planning purposes by the study (Table 14.2.5).

Table 14.2.5 Forecast Composite Throughput Target Area Seaports

Year	Throughput (mil. ton)
2000	6.8
2005	11.5
2010	21.0
2020	69.6

Project Profile

No.:	TRANS-06	**Sector:**	Seaports	
Title:	Hue-Danang Port Development			
Implementing Agencies:	Central Region Development Committee			
Development Phasing:	~2000	2000~2005	2005~2010	2010~
	Urgent Phase	Phase - 1	Phase - 2	
Location:	The proposed new Hue-Danang port is located at Chan May bay about 50 kilometers south of Hue city and 30 kilometers north of Danang city.			
Estimated Cost:	US$ 164 million (up to Phase - 1)			

Outline of the Project:

Improvement Goal:

The port will function as a trans-shipment hub and processing trade port. The role of the port will be to (a) serve the study area as well as central Viet Nam , and (b) provide maritime services for neighboring countries to include Cambodia, Lao PDR and Thailand.

Background and Justification:

Existing port facilities as well as infrastructure in the study area are outdated and in urgent need of upgrading. Operations are further compromised by a lack of effective land-side transport systems, as well as sea-side problems which include, for all practical purposes, port closure during the peak monsoon months due to significant wave intrusion. Demand forecasts confirm that additional port capacity will be required already in the near-term future. However, expansion of existing ports to accommodate forecast throughput needs is neither practical or necessarily cost-effective. Thus, the construction of new port facilities, strategically sited and provided with up-to-date technology and infrastructure, is needed if the Republic's external trade pattern is to achieve its full potential.

Objectives

The Chan May area in the province of Thua Thien Hue is well endowed to accommodate a new deep-sea port which will serve as a major commercial port that functions as a transshipment hub for handling cargoes generated through the new East–West Trade Corridor linking to the Greater Mekong Subregion (GMS). Whilst at present, the Da Nang port is assuming the commercial and industrial port functions in the Central Region, the proposed Hue-Danang port should be well coordinated with the port of Da Nang by reasonably sharing port functions in the Central Region. It is envisaged that with the development of a new Hue - Da Nang Highway (refer Transport Project 03) and an improved crossing of Hai Van pass (refer Transport Project 02), the proposed port can effectively serve both Hue and Da Nang cities.

It is noted that the port development concept derived within the framework of the current study should be integrated with the forthcoming Central Region Port Study to be conducted under sponsorship of the Japan International Cooperation Agency.

Description:

Principal port elements include:

- Accommodate vessels up to 40,000 DWT class.
- Main cargoes are expected to be cement, construction materials and equipment, fuel, fertilizer, kaolin as well as light industry products.
- Total throughput is estimated at 3.0 million tons per annum by year 2005 and 8.1 million tons per annum by year 2010.
- The port is strategically sited in that Cape Chan May provides protection from wind and wave action prevailing during the NE monsoon season.
- Adequate vacant land is available in vicinity of the port to permit construction of the proposed Free Trade Zone.

Project Profile

No.: TRANS-07	**Sector:** Seaports			
Title:	Dung Quat Port Development			
Implementing Agencies:	Central Region Development Committee			
Development Phasing:	~2000	2000~2005	2005~2010	2010~
	Urgent Phase	Phases - 1	Phase - 2	
Location:	The proposed new Dung Quat port is located along the western flank of Cape Vi An Ka, some 95 kilometers south of Danang city and 38 kilometers north of Quang Ngai city.			
Estimated Cost:	US$ 466 million (up to Phase 2)			

Outline of the Project:

Improvement Goal:

The port will principally function as an industrial deep-water port with a focus toward oil refinery processes, petrochemical products, power generation, shipyard and steel milling. The port will also serve in a more limited general cargo role thus supporting regional manufacturing and agricultural functions.

Background and Justification:

- The Dung Quat project has been approved, in principle, by the Prime Minister's Office on 26 December, 1995 according to an interview with the Vice-Head of the "Managing Board of Dung Quat Industrial Zone".
- Feasibility studies for the oil refinery development plan are completed by Petrovietnam.

Objectives

Creation of a spearheading industrial development center in the Central Region is of strategic importance to harness overall socio-economic development of the Central Region, even though it might not be justified only on pure economic grounds. It is given to understand that the first refinery project in Dung Quat has been approved by the Government and negotiations with a prospective investor group is currently in progress. This de facto project should be realized to form the primary critical mass for a self-sufficient heavy industrial complex in the Central Region. The construction of the urgent phase breakwater and adjoining berthing jetty facilities is considered mandatory to facilitate unloading of massive construction equipment and materials for the refinery project. Therefore, the urgent phase port development should be advanced to enable subsequent construction of the refinery project.

Description:

Dung Quat Port will consist of three inter-related components:

(1) Refinery and petrochemical products wharf

(2) Shipyard and steel recycling mill

(3) Public wharf

Based on requirements of the first stage refinery plant, a wharf for construction material and equipment including a breakwater of 300 m and a causeway of 1.2 km, must be provided by year 2000. In addition, the first stage refinery wharf, including a breakwater of 900 m is scheduled for construction by year 2002 as part of the urgent phase.

Wharves for second stage refinery product and phase - 1 public wharves and shipyard are scheduled to be constructed by year 2005.

Responding to the increase of container activity after 2005, container cranes are provided to assist in converting two general cargo wharves to container wharves.

CHAPTER 15 AIR TRANSPORT

15.1 SUMMARY

1) Air transport plays a crucial role in international and long-distance domestic movements of people and goods. This also applies to Viet Nam and the study area. The modal share of air transport in long-distance travel markets will increase disproportionately as the levels of income rise.

2) Da Nang International Airport and Phu Bai (Hue) Airport in the study area have a sufficient capacity to handle the current levels of air traffic. However, significant developments and improvements are required to cope with future increases in air traffic. The number of air passengers at those airports will reach 6 to 7 times the present levels in 2010.

3) The two airports in Da Nang and Hue have large expandability which will provide a long-term capacity to cope with future air traffic increases. The development strategies of the two airports concern the increase of passenger and cargo handling capabilities while assuring aviation safety.

4) Da Nang Airport will function as one of the major gateways to Viet Nam, capable of handling up to B747 aircraft. Phu Bai Airport will continue to be developed as a domestic airport, where A320s (140-150 seats) will be the dominant aircraft. One international airport can cover Da Nang and Hue Cities, since the completion of the Hai Van Pass Tunnel will significantly shorten the time distance between the two cities.

5) The development of Da Nang and Phu Bai Airports will provide great opportunities to the Da Nang - Hue urban agglomeration through the improvement of urban productivity. It will not only facilitate movements of people and goods, but also promote the inflows of FDI and thus accelerate manufacturing locations. Needless to say that the airport development is essential for tourism development, in which the study area has a great potential.

6) The geographical distribution of airports in Viet Nam relative to GDP and population distribution will justify Chu Lai Airport to serve Quang Ngai City, which has no adequate access to an airport. The development strategy for Chu Lai Airport should be demand oriented as well as those of the other two airports. It will be started with minimum facilities for operations of ATR72s (66 seats). Sufficient expandability and flexibility should be accommodated in airport planning to prepare for unanticipated air traffic increases from Dung Quat related activities.

7) The recommended projects and rough construction cost requirements up to the year 2010 are as follows:

   - Da Nang International Airport Improvement Project: US$90 million
   - Phu Bai Airport Improvement Project: US$40 million, and
   - Chu Lai Airport Development Project: US$20 million.

8) The sustainable development of airports will require adequate institutional and financial frameworks. The issue is crucial, but cannot be solved in the regional context. The institutional and financial reform of the CAAV needs to be discussed at the national level.

15.2 AIR TRANSPORT SYSTEM IN VIET NAM

15.2.1 Administrative Authority

Civil aviation in Viet Nam is administered by the Civil Aviation Authority of Viet Nam (CAAV). It is a wholly state-owned and managed entity governed by the National Civil Aviation Law promulgated in 1992. The CAAV previously came under the Ministry of Transport and Communications, but is now under the direct authority of the Office of the Government[1].

The CAAV has three categories of organizations under its authority, i.e., administrative organizations, semi-administrative organizations and aviation enterprises. The Middle Airports Authority (MAA), which is one of the four semi-administrative organizations[2] under the CAAV, operates five airports in Central Viet Nam including Da Nang Airport and Phu Bai (Hue) Airport in the study area. Viet Nam Airlines (VNA) is one of the aviation enterprises under the CAAV, which exclusively serves the two airports in the study area at present.

15.2.2 Airport System

In Viet Nam 15 airports[3] are currently used for regular commercial flights as shown in Figure 15.1. Out of those, the three airports below are designated as international airports, having international passenger and cargo handling capability:

1) Noi Bai International Airport in Hanoi

2) Da Nang International Airport, and

3) Tan Son Nhut International Airport in HCMC.

Noi Bai Airport and Tan Son Nhut Airport are two major international airports in Viet Nam with regular international services, while Da Nang Airport so far has no regular international flights. Noi Bai Airport has a 3,200m long runway, while Tan Son Nhut has two runways of 3,048m and 3,036m long in close parallel configurations. Da Nang Airport has two 3,048m long close parallel runways. All three international airports can accommodate aircraft up to B747.[4]

Other domestic airports mainly serve administrative centers of Vietnamese Provinces although their coverage seems to be very limited. During the economic adjustment period in the late 1980s, air services to many of domestic airports were suspended. By the beginning of the 1990s, only Hai Phog and Nha Trang Airports in addition to the three international airports were available for domestic services. Until now, 15 airports have been made available for regular services as mentioned earlier. The length of the runway at domestic airports ranges from 1,200m to 3,050m. They are served by small aircraft such as TU134, ATR72 and YAK40.

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[1] The division of the CAAV into the CAAV and the Civil Aviation Cooperation is currently discussed by the Office of the Government.

[2] The other three include the North Airports Authority (NAA), the South Airports Authority (SAA), and Air Navigation Department of Vietnam (ANDV), which respectively operate 5 airports in Northern Vietnam (including Noi Bai Airport in Hanoi), 4 airports in Southern Vietnam (including Tan Son Nhut Airport in HCMC) and nation-wide air navigation systems.

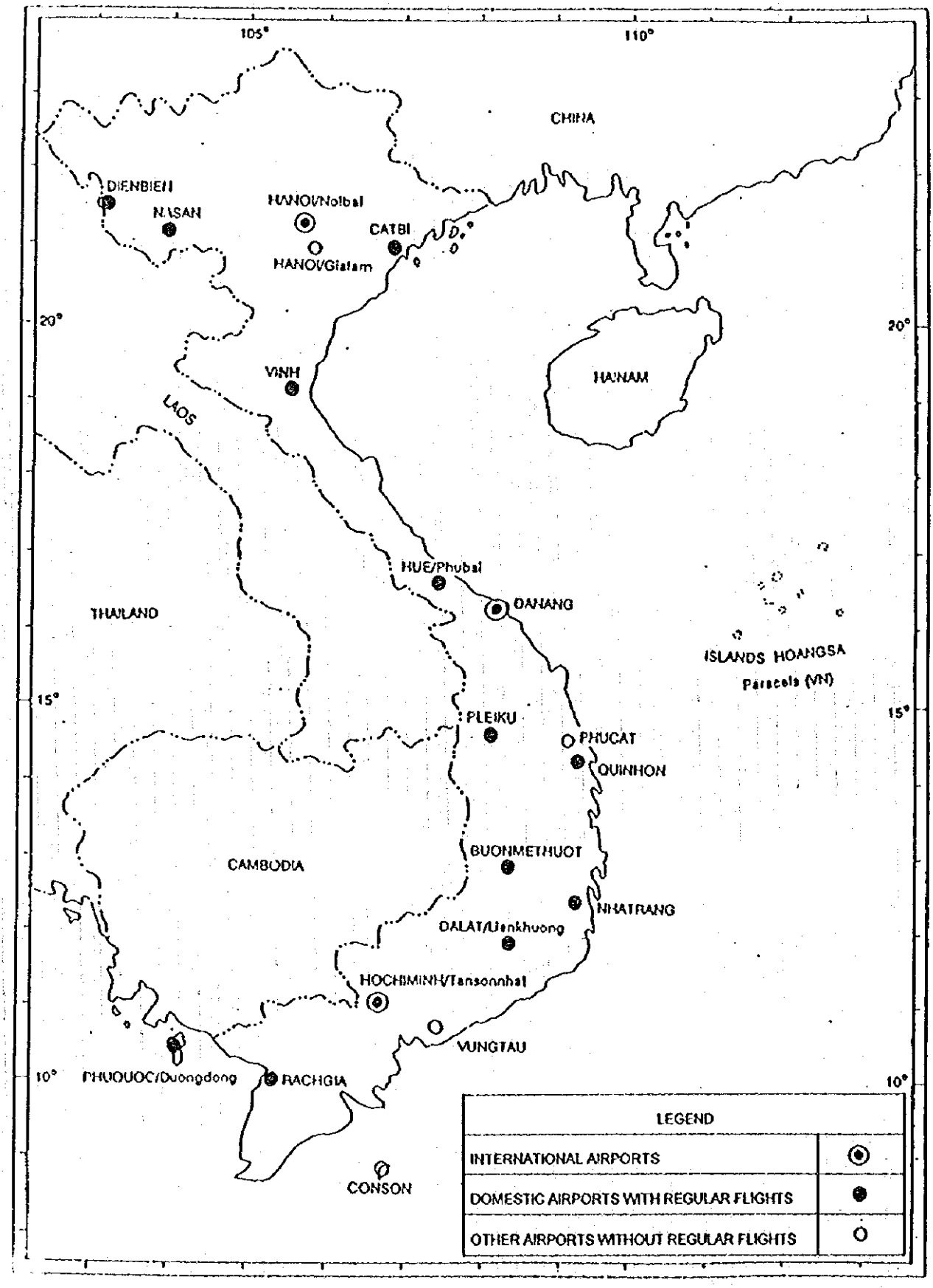
[3] Two airports in Dien Bien and Nassan are temporarily closed for development works as of March 1996. Singapore's Region Air uses Vung Tau Airport for non-scheduled flights from Singapore, but not regular flights.

[4] Payload restrictions would be required for takeoff operations of long-distance flights due to shortage of runway length at those airports. About 3,600m long runway is required for unrestricted takeoff operations of large aircraft such as B747, MD11, A340, DC10 and so on.

15.2.3 Air Route Structure

The existing international air routes connecting Viet Nam with the outside world are relatively concentrated in HCMC. This is reflected in the fact that the number of international air passengers at Tan Son Nhut Airport accounted for 78% of total passengers from/to Viet Nam in 1994, while that of Noi Bai Airport accounted for only 22%. A few foreign airlines showed interest in flying to Da Nang; however, so far not realized yet.

Figure 15.11 Airports in Viet Nam



Major international routes from/to Viet Nam at present are regional international routes connecting either HCMC or Hanoi with major cities of East and Southeast Asia. In contrast, the long-distance market has been relatively underdeveloped. Major European airlines serve Viet Nam as feeder route of high-demand destinations such as Bangkok, Singapore and Kuala Lumpur. Viet Nam Airlines is strengthening the European market by adding two more aircraft of long-range capability in February 1996.[5]

Domestic air routes in Viet Nam are structured around the three international airports in Hanoi, Da Nang and HCMC. Other domestic airports are feeder airports connected from Hanoi, Da Nang and/or HCMC.

Within the domestic network, Hanoi - HCMC is the busiest domestic route, which accounted for 48.3% of total air passenger traffic in 1994, followed by HCMC - Da Nang (12.7%) and Hanoi - Da Nang (11.4%), HCMC - Hai Phong (4.8%), HCMC - Nha Trang (3.7%), HCMC - Hue (3.5%) and Hanoi - Hue (2.9%).

15.2.4 Airlines

There are two national carriers, which provide regular commercial services in Viet Nam; one is the former monopolist, state-owned Viet Nam Airlines (VNA), and the other is Pacific Airlines, which is a joint venture of non-CAAV state-owned enterprises.

VNA has six B767s (204-248 seats), seven A320s (140-150 seats), 10 Tu134s (41-72 seats), four ATR72s (66 seats) and one YAK40 (32 seats). Its international services cover major cities in the East and Southeast Asia, some of European capitals and two Australian cities. VNA's share in international passenger traffic from/to Viet Nam accounts for about 40% of the total market, while it has an overwhelming share of more than 95% in the domestic market. Pacific Airlines connects HCMC with Taipei and Kaohsiung via Hanoi with two B737s (124 seats). Although it is the second airline in Viet Nam, the scale of services is not comparable with VNA.

VNA and Pacific Airlines adopt a two-tier airfare system on domestic routes. Lower rates apply to resident Vietnamese, while higher ones to foreigners and overseas Vietnamese. The differences between higher rates and lower ones are 2.5-3 times depending on sectors. The airfare is regulated by the Government and those for resident Vietnamese are kept below economic cost. Although this policy may be inevitable for the transit period to a market economy, it would require a review in the future in connection with the self-accounting and self-financing policy for state-owned enterprises by the same government.

[5] Vietnam Airlines added two B767-300ERs on 15 February 1996.

15.2.5 Modal Share with Other Transport Systems

An air transport system has quite different characteristics from other modes of transport, i.e., in Viet Nam those are road and railway systems. Its speed, punctuality and reliability are far higher than the others, while the levels of user charge are also high.

As described in the road and railway section of this annex report, the modal share of air transport for inter-provincial passengers is very low, at about 3.3% in 1994. However, those aggregate data might conceal the importance of the air transport system. Needless to say, air transport plays a dominant role in international passenger movements -- about 93% of international passengers from/to Viet Nam used air transport in 1994. In the case of the domestic travel market, the role of air transport is less pronounced. However, its advantages in long-distance passenger transport are obvious. The following Table 15.1 shows the passenger modal shares between air, road and rail transport between three major urban centers in Viet Nam.

Table 15.1 Passenger Modal Shares between Hanoi, Da Nang and HCMC in 1994

Sectors	Air		Rail		Road		Total
	Annual Passengers	Modal Share	Annual Passengers	Modal Share	Annual Passengers	Modal Share	Annual Passengers
Hanoi- HCMC	469,557	38.1%	339,330	27.5%	423,912	34.4%	1,232,799
Hanoi - Da Nang	110,569	17.6%	69,248	11.1%	446,714	71.3%	626,531
Da Nang - HCMC	123,290	15.5%	177,689	22.3%	494,691	62.2%	795,670

Source: Air transport from CAAV, others from JICA Study on National Rail Improvement, 1995.

Note 1: Road transport includes all types of passenger vehicles.

Note 2: Travel duration between the three cities is as follows (not including waiting time and access to airports/rail stations/bus terminals):

Hanoi - HCMC: 2 hours by air, 36 hours by fastest express train, 48 hours by bus

Hanoi - Da Nang: 70 minutes by air, 16 hours and 40 minutes by the fastest train, 24 hours by bus

Da Nang - HCMC: 70 minutes by air, 19 hours and 10 minutes by the fastest train, 24 hours by bus

Air transport already has the greatest shares between Hanoi and HCMC. For shorter distance sectors of Hanoi - Da Nang and Da Nang - HCMC, air transport was less competitive. However, it is expected that the share of air transport will increase as income levels rise, as experienced in many other countries.

15.3 EXISTING CONDITIONS OF AIRPORTS IN THE STUDY AREA

15.3.1 Da Nang International Airport

1) Airport Facilities

Da Nang Airport is the third busiest airport in Viet Nam. It is located at a distance of about 3km southwest from the center of Da Nang City. The airport was build during the 1960s by the U.S. army. After re-unification in 1975, it has been used as a joint civil-military airport. The CAAV designates this airport as the alternate international airport for Noi Bai and Tan Son Nhut International Airports.

It has two runways each 3,048m long each and in close parallel configuration. For civil flights, the eastern runway (17L/35R) is generally used, but the other parallel runway (17R/35L) is available on request. The runway length and strength is sufficient for operating aircraft up to B747. It can be extended by 600m within the existing airport property area when the future demand justifies the operation of long-distance nonstop flights to Europe or the United States.

The air navigation system at Da Nang Airport has recently been modernized and it meets international standards. The main runway is equipped with category-1 instrument landing system (ILS) and precision approach lighting system (PALS). A new control tower was completed in 1995 with new air traffic control and communication equipment. In addition, the airport also has primary surveillance radar (PSR) and secondary surveillance radar (SSR) for approach control and area control[6] services. The level of rescue and fire fighting services also meet international standards.

In contrast to those basic facilities, the terminal facilities are generally in poorer condition. The apron, passenger terminal building, cargo terminal building and carpark are located on a small area on the northeastern corner of the airport property area near the runway 17L threshold. The existing passenger terminal building (total floor area of 5,700 sq.m) has an estimated capacity of one million passenger per annum (mppa), against the present air traffic of 0.5 mppa. However, if the present very rapid growth of air traffic continues, the capacity will be reached in a few years. There are temporary international departure facilities in the terminal building, but they are only capable of handling occasional charter flights.

The airspace surrounding the airport is adequately reserved for safe aircraft operations. The airport is located on a fairly level ground and has sufficient space to accommodate future facility expansion, but only if unused part of military land is transferred to the CAAV. Since the airport is located very close to the city, aircraft noise problems will occur in future without proper land use management for airport surroundings.

The layout plan and outline of airport facilities at Da Nang Airport are shown in Attachment-1 and Attachment-2, respectively.

2) Air Traffic and Air Services

The number of aircraft movements, air passengers and cargo volume handled at Da Nang Airport from 1991 to 1995 are shown in Table 15.2.

Table 15.2 Air Traffic at Da Nang Airport: 1991-1995

Year	Annual Aircraft Movements	Annual Passengers	Annual Cargo (ton)
1991	1,468	51,100	269
1992	2,159	97,700	269
1993	3,518	172,000	524
1994	5,463	293,300	1,302
1995	6,232	424,100	2,064
Annual Growth Rate '91-'95	43.5%	67.9%	66.4%

Source: CAAV

As shown in the above table, air traffic at Da Nang Airport is increasing at very high growth rates. Air passenger demand elasticity with regard to national GDP normally ranges from 1.0 to 1.5 in other countries, while that of Da Nang Airport for the 1994-95 period was 4.7 (44.6%/9.5%). Approximately one-third of total passengers at Da Nang Airport were foreign passengers in 1994.

Air services provided at Da Nang Airport as of March 1996 are as follows:

[6] The radar station in Da Nang are used for substation of HCM Area Control Center.

Table 15.3 Air Services at Da Nang Airport: March 1996

Routes	Airlines	Aircraft Type	Movements/ Week (both ways)
Da Nang - HCMC	Viet Nam Airlines	A320	10
		Tu134	32
Da Nang - Hanoi	Viet Nam Airlines	A320	8
		Tu134	34
Da Nang - Pleiku	Viet Nam Airlines	ATR72	8
Da Nang - Hai Phong	Viet Nam Airlines	Tu134	6
Da Nang - Nha Trang	Viet Nam Airlines	ATR72	6
Da Nang - Ban Me Thuot	Viet Nam Airlines	ATR72	6
Da Nang - Vinh	Viet Nam Airlines	ATR72	6
Da Nang - Quy Nhon	Viet Nam Airlines	YAK40	6
		Total	122

Source: Viet Nam Airlines

Among the eight domestic routes mentioned above, Da Nang-HCMC and Da Nang-Hanoi accounted for 86% of total air passengers at Da Nang Airport in 1994. All other routes are of small traffic without daily operations.

3) Ongoing Projects

Several minor projects including the pavement repair of the secondary runway, taxiway, apron and access road, and the upgrading of meteorological system are ongoing funded from the state budget.

4) CAAV's Master Plan for Da Nang Airport

The CAAV has produced a master plan for Da Nang Airport up to the year 2020, which is now subject to government approval. Although details of the master plan were not released, its main objective is the expansion of terminal capacities by constructing international passenger terminal, cargo terminal, carpark, access road and so on For those facility developments, the CAAV is now discussing the transfer of unused military land on the south side of the existing terminal facilities with the Ministry of Defense. One of three terminal facility layout plans under consideration is shown in Attachment-3.

15.3.2 Phu Bai Airport

1) Airport Facilities

Phu Bai Airport is the fourth busiest airport in Viet Nam in terms of air passenger traffic. It is located at a distance of about 13km southeast from the center of Hue City. The airport was build in 1940 by the French army. It initially had three runways, of which the 1,240m long east-west runway was extended to 2,000m by the end of Viet Nam war. The other two runways were abandoned.

The existing runway is currently used by short-range aircraft such as ATR72 (66 seats) and YAK40 (32 seats). However, upon completion of the ongoing runway extension work to 2,700m, Phu Bai Airport will be able to accommodate large aircraft such as B767 (204-248 seats), A320 (140-150 seats) and Tu134s (41-72 seats).

The air navigation system at Phu Bai Airport is far below international standards. It has two non-directional beacons (NDB), control tower and some communication equipment. There is no lighting system at the airport. The fire fighting can only be done with hand-held fire extinguishers. Phu Bai Airport is subject to severe poor visibility, particularly in the mornings of fall and winter. The cancellation and delay of flights occur very often, and this seems to be discouraging people from using air transport. It is an immediate need for Phu Bai Airport to improve the air navigation system to ensure safety and reliability of air transport.

The apron, passenger terminal building, cargo and carpark are located on the southern side of the runway. There is a small passenger terminal building of 2,000 sq.m. It is adequate for the present level of air traffic. However, a larger terminal will be required when larger aircraft are introduced upon completion of the ongoing runway extension work.

The airspace surrounding the airport is adequately reserved for safe aircraft operations.[7] The airport has sufficient expandability for future development without a serious noise problem.[8]

The layout plan and outline of airport facilities at Phu Bai Airport are shown in Attachment-4 and Attachment-5 respectively.

2) Air Traffic and Air Services

The number of aircraft movements, air passengers and cargo volume handled at Phu Bai Airport from 1991 to 1995 are shown in Table 15.4.

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[7] Only exception is that the clearance for approach surface for the runway 09 over the national road No. 1 may be insufficient. This will require confirmation by topographic survey, and possibly the displacement of the runway 09 threshold.

[8] Although there is an aggregation of shops and houses along the national road No.1, its density is low. One school located 200m from the runway 09 threshold besides the national road No.1 may be required to be sound proofed or relocated when the operation of jet aircraft become frequent.

Table 15.4 Air Traffic at Phu Bai Airport: 1991-1995

Year	Annual Aircraft Movements	Annual Passengers	Annual Cargo (ton)
1991	n.a.	n.a.	n.a.
1992	419	9,600	3.9
1993	870	30,800	14.7
1994	1,410	66,100	38.5
1995	2,520	123,200	50.5
Annual Growth Rate '92-'95	81.9%	134.1%	134.8%

Source: CAAV

Air traffic at Phu Bai Airport is increasing at even higher growth rates than that of Da Nang Airport. This coincides with the rapid growth of foreign tourists to Hue, which recorded an average annual growth rate of 63% between 1992 and 1994. About 60% of total passengers at Phu Bai Airport were foreigners in 1994. This percentage of foreign passengers is the highest among Vietnamese airports.

Air services provided at Phu Bai Airport as of March 1996 were as follows:

Table 15.5 Air Services at Phu Bai Airport: March 1996

Routes	Airlines	Aircraft Type	Movements/ Week (both ways)
Hue - HCMC	Viet Nam Airlines	ATR72	26
Hue - Hanoi	Viet Nam Airlines	ATR72	26
Hue - Da Lat	Viet Nam Airlines	YAK40	6
		Total	58

Source: Viet Nam Airlines

3) Ongoing Projects

As mentioned earlier, the runway extension of 700m is in progress. The preparation of 150m wide runway strip is also being undertaken. These works are expected to be completed by the end of 1996.

4) CAAV's Master Plan for Phu Bai Airport

The CAAV has produced a master plan for Phu Bai Airport up to the year 2010. Phu Bai Airport will continue to be developed as a domestic airport within the planning horizon. The capacity increasing and the upgrading of air navigation system are main objective of the master plan. The CAAV's master plan for the year 2010 is shown in Attachment-6.

15.3.3 Chu Lai Airfield

Chu Lai Airfield is a unused airfield under the Ministry of Defense. It is located in the southeast corner of Quang Nam-Da Nang Province. The idea of converting this airfield for civil use appears in the Socio-economic Master Plan of Quang Ngai Province in 1996-2010 by the Quang Ngai Provincial People's Committee in relation to the development of deep seaport and industrial zone at Dung Quat site. The CAAV has no plan to develop Chu Lai Airfield.

The distance from Dung Quat site to Chu Lai Airfield is about 40km by the existing roads. That from Quang Ngai City, which will potentially served by Chu Lai Airport, is about 36km via the national road No.1.

The airfield has a runway of 2,800m[9] long and 45m wide with 14/32 designators. The condition of pavement surface looked good with short cracks sealed with asphaltic fillers. The pavement strength is not known, so that it should be technically evaluated before use. However, it is possibly able to accommodate A320 class aircraft without major strengthening. The runways has a full parallel taxiway and five exit taxiways.

There is no air navigation system such as radio navigation aids and lighting system. Two aircraft parking spaces are located along the parallel taxiway. They may be used for the terminal apron by removing shelters for fighter planes currently located there.

The airspace surrounding the airfield is adequate for safe aircraft operations. The airfield is located on a fairly level ground and sufficient space to accommodate future facility expansion. There would be no major environmental influence on the airport surroundings by developing the airfield for civil aviation.

15.4 DEVELOPMENT STRATEGIES

15.4.1 Improvement of Da Nang and Phu Bai Airports

Air transport development in the regional context should be addressed as a supporting sector of urban development. As the levels of economic development progresses, the cities tend to specialize, through trade, in production of narrower range of goods and services for greater efficiency. This is also a underlying objective of this Central Viet Nam Integrated Socio-economic Master Plan, in which different mix of resource endowments are exploited at each locality based on comparative advantages.

Da Nang and Hue are two largest cities in the study area, which are proposed to constitute an urban agglomeration center through a twin-city concept in this study. In general, they are

[9] According to officer at Chu Lai Airfield. However, our trip meter measured approximately 3,200m, which needs confirmation.

expected to form a mixed commerce, trade and industry area; however, they have great potentials particularly in the manufacturing, tourism and other related sectors. Airport development in the two cities has to be pursued so that those advantages are realized for higher urban productivity.

The only EPZ and most of industrial estate developments in the study area are located in and around Da Nang City. Our industrial development planner analyzed that the vicinities of Phu Bai Airport is a superior site for future high-technology industrial park. From the viewpoint of encouraging manufacturing locations, Da Nang and Phu Bai Airports are essential facilities for those EPZ and industrial estates. Air transport will not only facilitate movements of passengers and cargo, but promote foreign direct investment (FDI). FDI is a main ingredient for Viet Nam's industrialization in terms of capital formation and technology transfer. Since the study area has no large market in itself, the integration to external economies is certainly a high priority issue for its overall development strategy.

As is well known, the semi-conductor and electrical parts industries are always located where an airport is available. Market-sensitive industries such as apparels, footwear, sporting goods and so on need convenient access to air transport to quickly respond to constantly changing market conditions and consumers' preference. Exports of fresh vegetables, fruits, cut flowers and fish have made possible in many other countries by air transport together with adequate air cargo terminal facilities.

Hue, Da Nang and Hoi An altogether provide a set of different tourist attractions, which have a potential of mass tourism in the study area. As analyzed in the tourism section of this annex report, the area is abundant in historic, cultural, artistic, ethnic, scenic and recreational tourism resources, which are not been exploited effectively so far. However, without convenient air access, those resources would merely continue to attract tourists with special interest, which have marginal impact on the regional economies. Therefore, airport development should also be progressed in parallel with the development of tourism.

In those respects, Da Nang Airport can provide a great opportunity, since it has a long-term capability to serve as one of the major gateways of Viet Nam. The airport already has two 3,048m long runways equipped with the air navigation system and fire fighting facilities of international standards. They can be extended up to 3,600m when operations of long-distance nonstop flights are anticipated.

The major problems of the existing Da Nang Airport are poor levels of terminal facilities. Although there are temporary international passenger facilities in the terminal building, they are inadequate to handle regular flights which are likely to fly in Da Nang Airport in the near future. The domestic passenger facilities have sufficient capacity to cope with the present level of air traffic. However, given the current very rapid increases in air traffic at this airport, capacity expansion is an immediate need for domestic facilities, too. An efficient air cargo terminal will also be an essential facility for some sections of industries.

Phu Bai Airport, thought the fourth busiest airport in terms of air passenger traffic in Viet Nam, is a small airport with only 8-10 operations per day, mainly of ATR72 (66 seats), at present. However, it is the fastest growing airport (86% increase for 1994-1995) with the highest proportion of foreign passengers (57% in 1995) in Viet Nam. The CAAV plans to introduce larger aircraft, most likely A320 (140-150 seats), and now the runway extension to 2,700m is in progress.

Phu Bai Airport is located in the suburb of Hue City, where the airport has large expandability for future air traffic increases. It has a great potential to function as a catalyst for international tourism development. At the same time, "air front" type of industrial development may be contemplated by locating an industrial park besides the airport.

The most promising airport to have regular international flights in Viet Nam after Da Nang is Phu Bai Airport. However, when Hue and Da Nang Cities are more integrated with the completion of Hai Van Pass Tunnel, it is unlikely that both the two airports in one and a half hour separation distance will have international air traffic. Therefore, it is reasonable that Phu Bai Airport be continued to be developed as a domestic airport.

For developing Phu Bai Airport, improvements in many aspects will be required. The issue of air safety should be raised in the first priority. The air navigation system at Phu Bai Airport is far from satisfactory. This airport is subject to occasional poor visibility, but since there is neither lighting system nor precision radio navigation aids, flight cancellations and delays are very often, significantly discouraging the use of air transport. There is virtually no preparation for rescue and fire fighting, which may lead to a tragic accident. The substandard runway width, 5m less than the standard 45m, needs to be widened for operations of A320s.

The second priority is the development of terminal facilities such as apron, passenger terminal, cargo terminal, carpark and so on. It is a medium- to long-term objective, but taking into account the required period, a immediate action would be required.

15.4.2 Development of Chu Lai Airport

By the site investigation of Chu Lai Airfield, it was found that the airport can technically be developed with relatively small investment by use of existing facilities. However, the development of Chu Lai Airport seems to have generated from a simple idea that the airport is already there where the Dung Quat Industrial Zone is planned nearby. There is no study on expected air traffic demand and/or the size and kind of required airport facilities.

In considering the use of Chu Lai Airport, its development strategy may be chosen by the Government from two options. The first option is to use this airport as a pioneer facility for the Dung Quat project. The second is to develop this airport only if air traffic demand justifies it.

There are two groups of potential users for Chu Lai Airport. The first group will be business persons related to the Dung Quat project. The other will be passengers generated and attracted in Quang Ngai City, who have presently no convenient access to the air transport system -- it takes three hours from Quang Ngai City to Da Nang Airport via national road No.1.

Unfortunately the scale and timing of the development of the Dung Quat Industrial Zone are so far unclear. However, even if they are clarified, it is not conceivable that air traffic demand from the Dung Quat related activities will be large enough to commercially justify regular air services. Although Viet Nam Airlines is state-owned, it is against the self-accounting and self-financing policy for state-owned enterprises by the Government to force them to fly into Chu Lai Airport.

On the other hand, Quang Ngai City will generate air traffic great enough to commercially justify regular air services. When we look at the geographical distribution of airports in Viet Nam relative to GDP and population distributions, a new airport for Quang Ngai City would have potential passengers at least equivalent to Vinh Airport in Ha Tinh Province. At this stage of the study, it is recommended to develop Chu Lai Airport as an airport serving Quang Ngai City, with an option that the airport will be expanded when significant demand is expected from the Dung Quat related activities.

15.4.3 Financial and Institutional Aspects of Airport Development

The Middle Airports Authority (MAA) financially behaves like a governmental department, whose expenditures are allocated from the national treasury through the CAAV, while revenues are surrendered, vice versa, to the national treasury. Although the financial record of the MAA was not available, it is easily estimated that its revenues are much smaller than its current expenditures since the levels of airport charges for domestic flights and passengers are very low. The situation implies the difficulty of raising resources for investment, operation and maintenance of airports from user charges.

To enable sustainable development of the airports in the study area, the levels of airport charges, which are currently below economic costs, should be increased, and at the same time, the institutional framework of the MAA should be altered by providing financial autonomy. In fact, the MAA together with other two regional airport authorities in Viet Nam function as subsidizing agencies for Viet Nam Airlines, which is also forced by the Government to keep domestic airfares for resident Vietnamese lower than economic cost. Furthermore, the current

system tends to reduce the incentives of the MAA to develop new revenue sources, or increase income from existing sources since it cannot make use of revenues it generates to defray expenses for which it holds responsibility.

Since these issues are those which requires a substantial reform in institutional system of the CAAV at the national level, they are beyond the scope of this regional master plan study. However, it may be remembered that successful airport development always requires adequate institutional and financial frameworks.

15.5 RECOMMENDED PROJECTS IN THE AIR TRANSPORT SECTOR

The development strategies in the previous section are translated into the projects, which are recommended to be implemented within the planning horizon until the year 2010. Preliminary air traffic forecasts in Attachments-7 and -8 are used to provide implications on the scale of the projects.

15.5.1 Da Nang International Airport Improvement Project

1) Objective:

- The expansion of passenger and cargo handling capabilities.
- The required capacities are approximately 3.1 million passengers (0.7 million international passengers and 2.4 million domestic passengers) and 40,000 tons of cargo in 2010.

2) Scope of Work:

- The construction of an international passenger terminal building, domestic passenger terminal building, cargo terminal building, roads and car parks, and related utility systems.

3) Rough Cost Estimate:

- USD90 million.

15.5.2 Phu Bai Airport Improvement Project

1) Objective:

- The improvement in aviation safety and runway usability.
- The expansion of passenger and cargo handling capabilities.
- The required capacities are approximately 800,000 passengers and 9,000 tons of cargo in 2010.

2) Scope of Work:

- The installation of precision radio navigation aids and lighting system, and the improvement of air traffic control/communication system and meteorological system.
- The provision of rescue and fire fighting services.
- The widening of the runway.
- The construction of apron, passenger terminal building, cargo terminal building, roads and car parks, and related utility systems.

3) **Rough Cost Estimate:**

- USD40 million.

15.5.3 Chu Lai Airport Development Project

1) **Objective:**

- The conversion of the unused airfield for civil use.
- The required capacities are approximately 100,000 passengers and 2,000 tons of cargo in 2010.

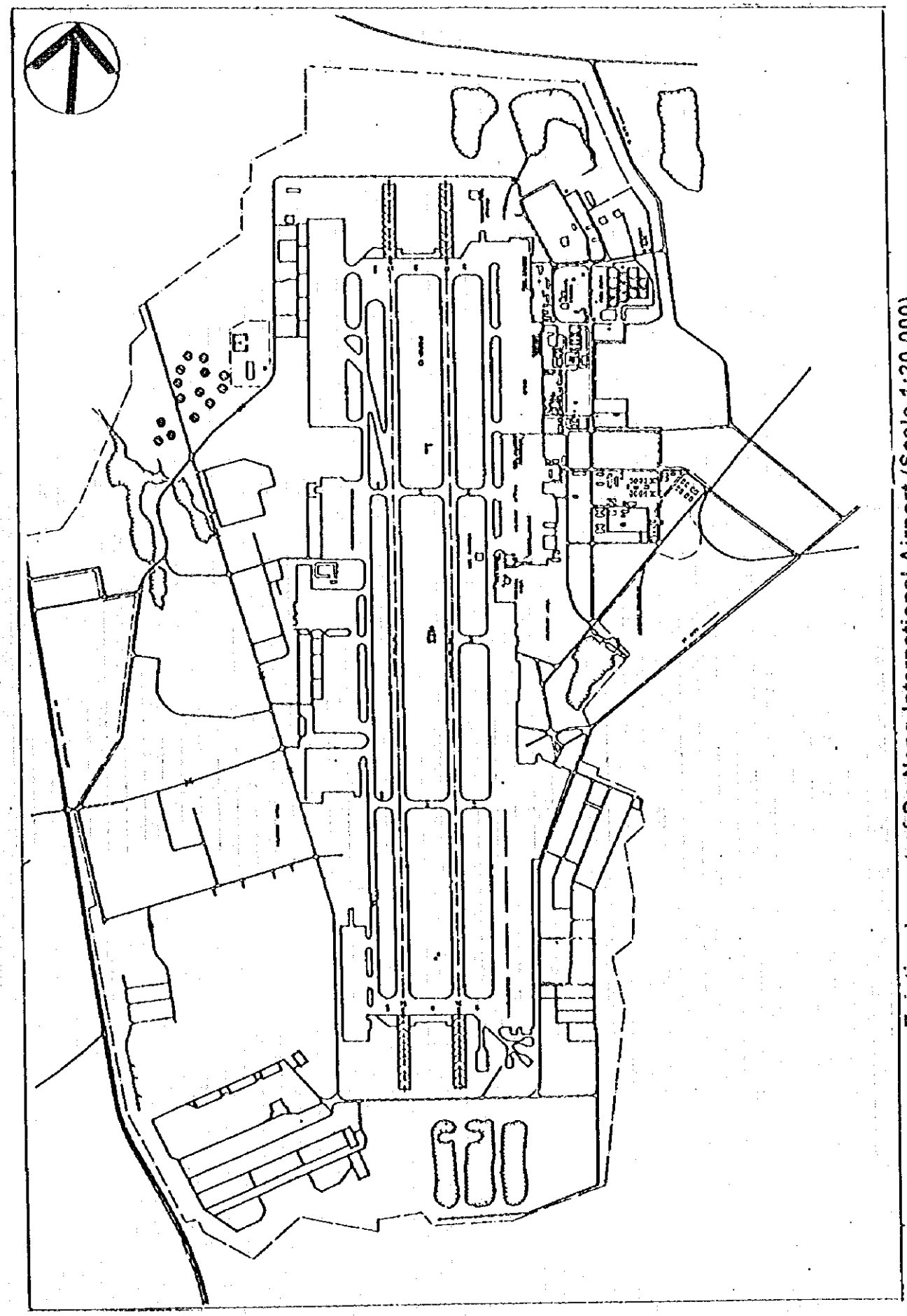
2) **Scope of Work:**

- The strengthening of existing runway, taxiway and apron pavements based on technical evaluation.
- The installation of the air navigation system (radio navigation aids, lighting system, air traffic control/communication system, meteorological system)
- The provision of rescue and fire fighting services.
- The construction of apron, passenger terminal building, roads and car parks, and related utility systems.

3) **Rough Cost Estimate:**

- USD20 million.

List of Attachments to Chapter 15



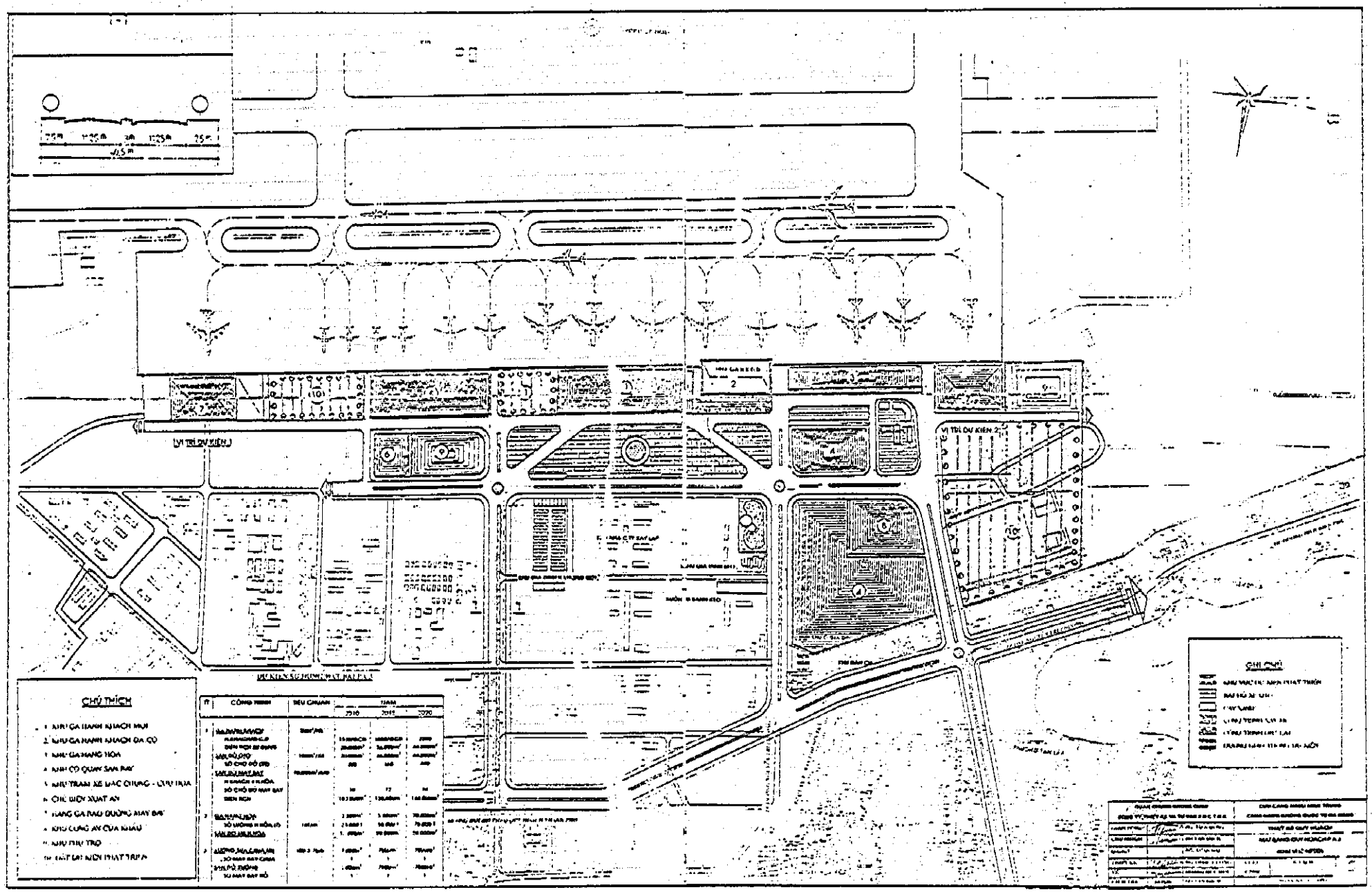
Existing Layout of Da Nang International Airport (Scale 1:20,000)

Source: Civil Aviation Master Plan, UNDP/ICAO, March 1992

OUTLINE OF AIRPORT FACILITIES AT DA NANG AIRPORT

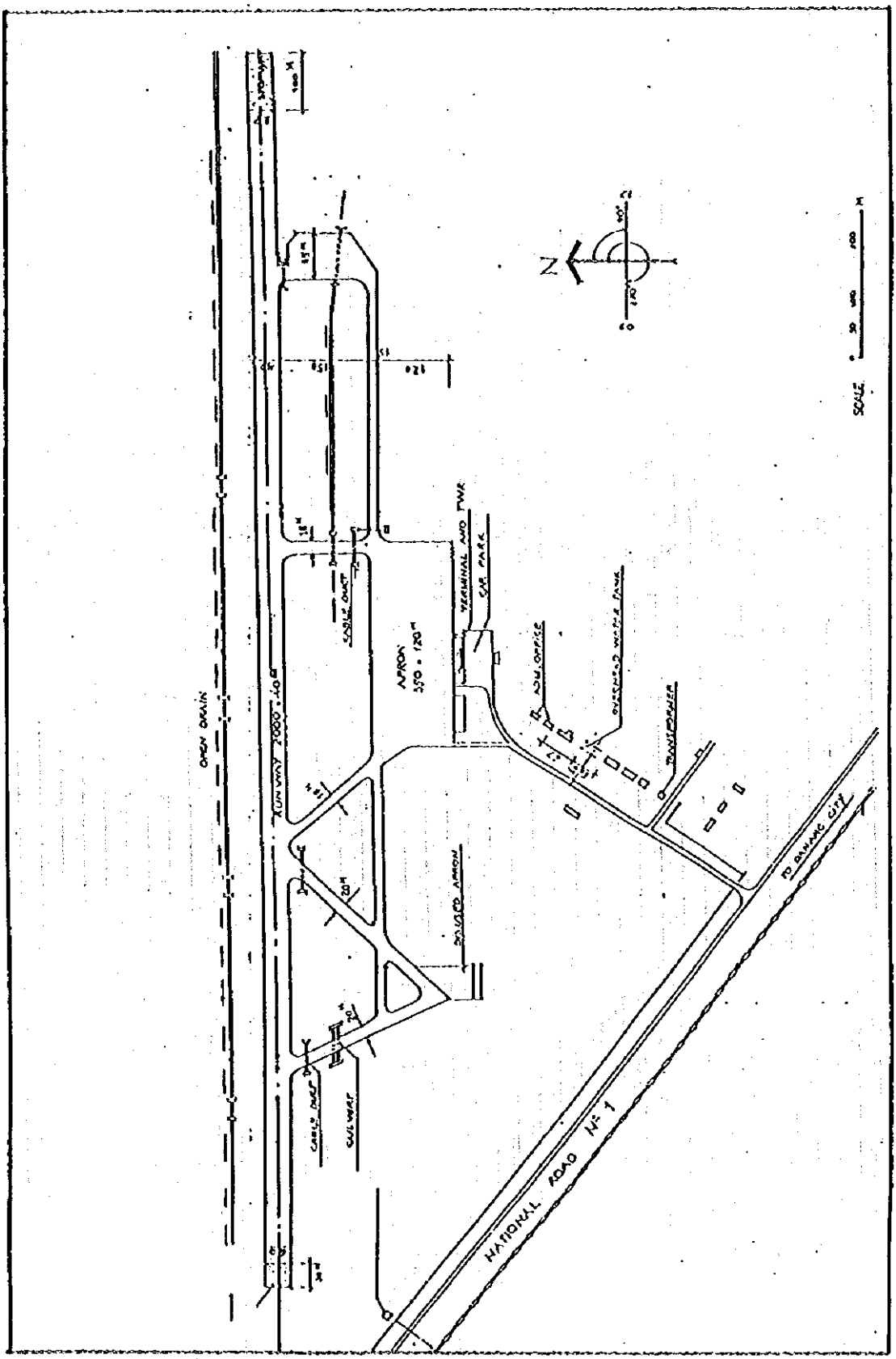
Aerodrome Data:	
Reference point:	N16°02'32", E108°12'22"
Elevation:	8m
Reference Temperature:	35°C
Operational hours:	24hrs
Distance from city:	3km (southwest)
Runway:	
Designator:	17L/35R, 17R/35L Civil aircraft usually use RWY17L/35R Main approach from RWY35R
Length and width:	3,048m x 45m x 2
Separation distance of 2 RWYs:	220m
Pavement:	17L/35R: Flexible pavement with 400 ton capacity 17R/35L: PCN30F/B/X/U
Runway Strip:	
Length and width:	3,658m x 150m x 2
Taxiways	
Taxiway system:	2 full parallel taxiway with 14 right-angle exits
Separation distence from RWY:	200m
Width:	25-30m
Pavement:	PCN30F/B/X/U
Apron:	
Size:	320m x 137m and 462m x 159m(117,298 sq.m) for civil aviation
Pavement:	PCN30R/B/X/U
Passenger Terminal Building:	
Structure:	Two story RC building
Total floor area:	5,666 sq.m (3,308 sq.m for departure, 2,158 sq.m for arrival and 200 sq.m for VIP)
Cargo Terminal Building:	
Structure:	One story steel structure building
Total floor area:	810 sq.m (storage area)
Car Park:	100 cars
Access Road:	
Number of lanes:	2 lane for each direction to connect city network
Air Navigation System:	
Radio navigation aids:	ILS Category-I (LLZ, GP, DME) for RWY35R, VOR/DME, NDB x 2
Air traffic control system:	Air traffic control tower, PSR, SSR
Aeronautical communications:	
Mobile service:	APP (125.3MHz), TWR (125.0MHz)
Fixed service:	INTERSAT, HF
Aeronautical ground lights:	Category-I PALS for RWY35R, PAPI and THRL for RWY35R/17L, runway edge lights, taxiway edge lights, apron flood lights
Rescue and Fire Fighting Facilities:	
Level of protection:	Category-7
Fire fighting vehicles:	8,000L x 1, 2,000L x 4, ambulance x 1
Number of trained staff:	14
Fire station:	Space for 5 fire vehicles, equipment and foam reserve

Aviation Fuel Supply System:	
Storage capacity:	6,200KL
Refueling system:	By fuel trucks
Aircraft Maintenance Hangar:	Nil
Ground Service Equipment:	Passenger step, passenger bus, baggage tractor, baggage cart, ground power unit, air starter, compressor vehicle, catering truck, fresh water truck, lavatory truck, follow-me-car
Public Utilities	
Power supply system:	City supply with 5 backup generator sets with a total capacity of 1,500KVA
Water supply system:	City supply with water tanks
Sewage disposal system:	Septic tanks for individual buildings
Airport Authority:	
Organization:	Middle Airports Authority (MAA), Civil Aviation Authority of Vietnam (CAAV)
Number of airport staff:	350 at Da Nang Airport (500 for total of MAA)



CAAV's Master Plan for Da Nang International Airport (Terminal Area Development Alternative)

Source: Middle Airports Region, CAAV

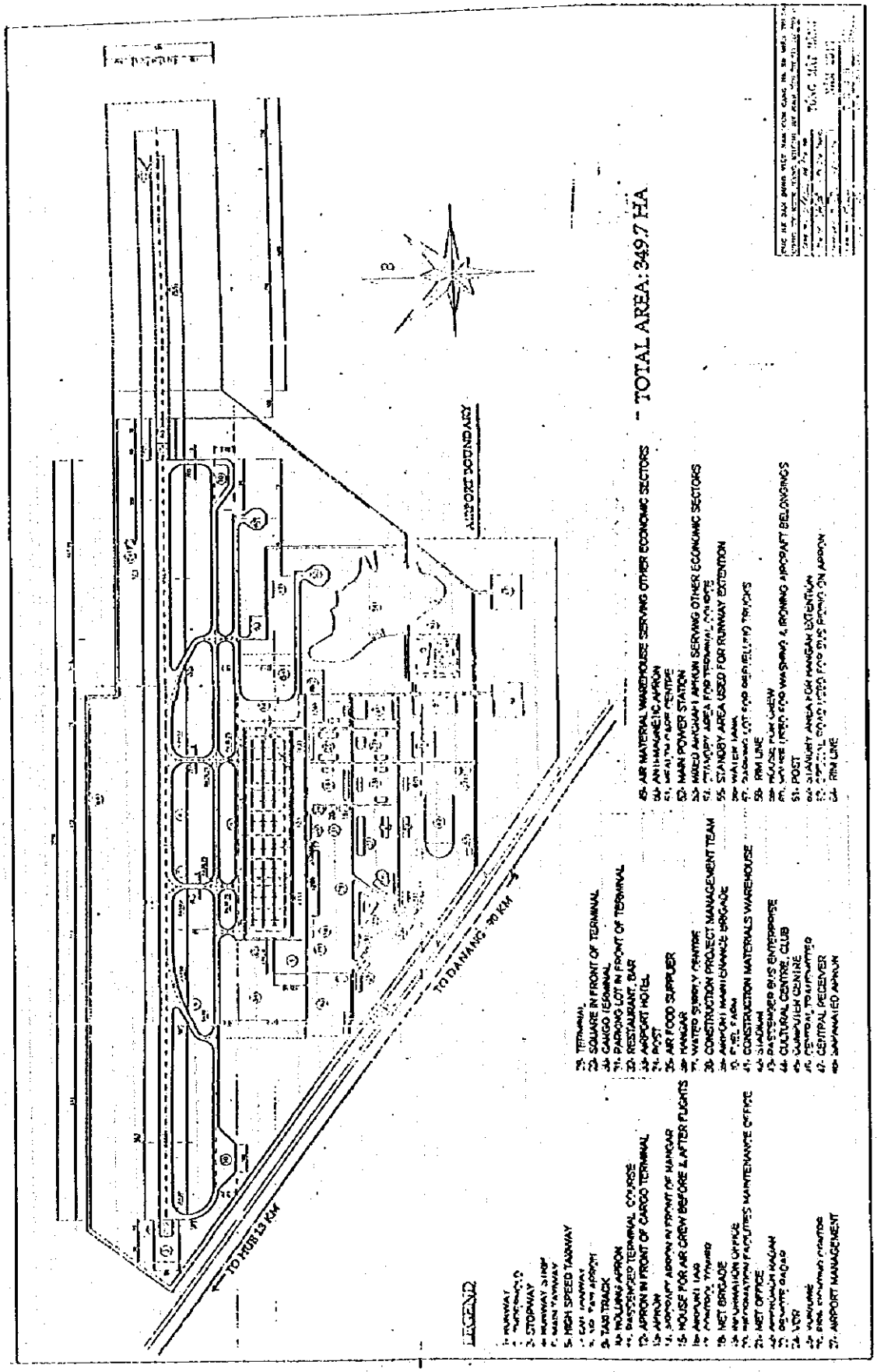


Existing Layout of Phu Bai (Hue) Airport (Scale 1:10,000)
Source: Civil Aviation Master Plan, UNDP/ICAO, March 1992

OUTLINE OF AIRPORT FACILITIES AT PHU BAI AIRPORT

Aerodrome Data:	
Reference point:	N16°23'58", E107°42'22"
Elevation:	13m
Reference Temperature:	34°C
Operational hours:	Sunrise to sunset
Distance from city:	13km (southeast)
Runway:	
Designator:	09/27 Main approach from RWY27
Length and width:	2,000m x 40m (Extention work to 2,700m is in progress and will complete in 1996.)
Pavement:	Flexible pavement with 59 tons capacity
Runway Strip:	
Length and width:	Not declared (Preparation of 150m wide strip is in progress and will be completed in 1996.)
Taxiways	
Taxiway system:	Partial parallel taxiway with 2 exits (Other 3 exits are closed.)
Width:	18-20m
Separation distance from RWY:	150m
Pavement:	Flexible pavement with 59 tons capacity
Apron:	
Size:	350m x 120m (42,000 sq.m)
Pavement:	Flexible pavement with 59 tons capacity
Passenger Terminal Building:	
Structure:	Two story RC building
Total floor area:	2,000 sq.m
Cargo Terminal Building:	Nil
Car Park:	60 cars.
Access Road:	
Number of lanes:	1 lane for each direction to connect
Air Navigation System:	
Radio navigation aids:	NDB x 2
Air traffic control system:	Air traffic control tower
Aeronautical communications:	
Mobile service:	TWR (118.8MHz)
Fixed service:	HF
Aeronautical ground lights:	Nil
Rescue and Fire Fighting Facilities:	Hand-held fire extinguishers only
Aviation Fuel Supply System:	
Storage capacity:	n.a.
Refueling system:	By fuel truck
Aircraft Maintenance Hangar:	Nil
Ground Service Equipment:	Pick-up truck, baggage cart

Public Utilities	
Power supply system:	City supply with backup generator set
Water supply system:	Tube well with water tanks
Sewage disposal system:	Septic tanks for individual buildings
Airport Authority:	
Organization:	Middle Airports Authority (MAA), Civil Aviation Authority of Vietnam (CAAV)
Number of airport staff:	48 at Phu Bai Airport (500 for total of MAA)



CAAV's Master Plan for Phu Bai (Hue) Airport for the Year 2010
Source: Middle Airports Region, CAAV

[PRELIMINARY INFORMATION]

FORECAST OF INTERNATIONAL AIR PASSENGERS

Airport Passengers	1995 (est.)	2000	2005	2010	Annual Average Growth Rate 1995-2010
HCMC	1,654,000	3,551,000	6,007,000	9,752,000	12.6%
Hanoi	473,000	1,104,000	2,002,000	3,483,000	14.2%
Da Nang	0	144,000	334,000	697,000	-
Total	2,127,000	4,799,000	8,343,000	13,932,000	13.3%

Airport Shares	1995 (est.)	2000	2005	2010
HCMC	77.8%	74.0%	72.0%	70.0%
Hanoi	22.2%	23.0%	24.0%	25.0%
Da Nang	0.0%	3.0%	4.0%	5.0%
Total	100.0%	100.0%	100.0%	100.0%

Assumed GDP Growth Rate	9.0%	(1995-2010)
Demand Elasticity w.r.t. GDP:	2.8 - 1.5 (variable)	(1995-2000)
	1.3	(2000-2005)
	1.2	(2005-2010)

Forecasting Methodology: The total international air passengers in and out of Vietnam are estimated with GDP growth rate and demand elasticity.
This total international passengers are then allocated to the three airports depending on the GDP size of the catchment areas, i.e., 70% for the Southern Triangle (HCMC), 25% for the Northern Triangle (Hanoi) and 5% for Central Vietn (Da Nang).

[PRELIMINARY INFORMATION]

FORECAST OF DOMESTIC AIR PASSENGERS

Sector Passengers		1995 (est.)	2000	2005	2010	Annual Average Growth Rate 1995-2010
Hanoi	- HCMC	625,000	1,150,000	1,818,000	2,915,000	10.8%
Hanoi	- Da Nang	168,000	368,000	581,000	931,000	12.1%
Hanoi	- Hue	56,000	169,000	267,000	428,000	14.5%
Hanoi	- Nha Trang	15,000	25,000	39,000	63,000	10.0%
Hanoi	- Dien Bien	8,000	18,000	28,000	45,000	12.2%
Hanoi	- Na San	7,000	12,000	17,000	27,000	9.4%
Hanoi	- Vinh	11,000	21,000	33,000	53,000	11.1%
Hanoi	- Chu Lai	0	0	33,000	53,000	-
HCMC	- Da Nang	191,000	433,000	685,000	1,099,000	12.4%
HCMC	- Hai Phong	57,000	92,000	145,000	232,000	9.8%
HCMC	- Nha Trang	81,000	278,000	440,000	707,000	15.5%
HCMC	- Hue	58,000	149,000	236,000	378,000	13.3%
HCMC	- Ban Me Thuot	38,000	82,000	130,000	209,000	12.0%
HCMC	- Pleiku	24,000	52,000	82,000	132,000	12.0%
HCMC	- Qui Nhon	28,000	79,000	126,000	202,000	14.1%
HCMC	- Phu Quoc	8,000	12,000	17,000	27,000	8.4%
HCMC	- Da Lat	6,000	11,000	16,000	26,000	10.3%
HCMC	- Rich Gia	6,000	11,000	16,000	26,000	10.3%
HCMC	- Chu Lai	0	0	41,000	65,000	-
Da Nang	- Pleiku	22,000	56,000	89,000	144,000	13.3%
Da Nang	- Nha Trang	11,000	24,000	38,000	62,000	12.2%
Da Nang	- Ban Me Thuot	9,000	19,000	29,000	46,000	11.5%
Da Nang	- Hai Phong	8,000	18,000	28,000	45,000	12.2%
Da Nang	- Qui Nhon	8,000	20,000	31,000	49,000	12.8%
Da Nang	- Vinh	12,000	26,000	41,000	65,000	11.9%
Hue	- Da Lat	6,000	11,000	16,000	26,000	10.3%
Phu Quoc	- Rach Gia	6,000	11,000	16,000	26,000	10.3%
Total Air Passenger Trips		1,469,000	3,147,000	5,038,000	8,081,000	12.0%

Airport Passengers	1995 (est.)	2000	2005	2010	Annual Average Growth Rate 1995-2010
HCMC	1,122,000	2,349,000	3,752,000	6,018,000	11.8%
Hanoi	690,000	1,763,000	2,816,000	4,515,000	11.4%
Da Nang	429,000	964,000	1,522,000	2,441,000	12.3%
Hue	120,000	329,000	519,000	832,000	13.8%
Nha Trang	107,000	327,000	517,000	832,000	14.7%
Hai Phong	65,000	110,000	173,000	277,000	10.1%
Ban Me Thuot	47,000	101,000	159,000	255,000	11.9%
Pleiku	46,000	108,000	171,000	276,000	12.7%
Qui Nhon	36,000	99,000	157,000	251,000	13.8%
Phu Quoc	14,000	23,000	33,000	53,000	9.3%
Da Lat	12,000	22,000	32,000	52,000	10.3%
Rach Gia	12,000	22,000	32,000	52,000	10.3%
Vinh	23,000	47,000	74,000	118,000	11.5%
Dien Bien	8,000	18,000	28,000	45,000	12.2%
Na San	7,000	12,000	17,000	27,000	9.4%
Chu Lai	0	0	74,000	118,000	-
Total Airport Passengers	2,938,000	6,294,000	10,076,000	16,162,000	12.0%

Assumed GDP Growth Rate:	9.0%	(1995-2010)
Demand Elasticity w.r.t. GDP:	3.5 - 1.1 (variable)	(1995-2000)
	1.1	(2000-2005)
	1.1	(2005-2010)

Forecasting Methodology: The extention of the past trend with a control of total domestic air trips given by GDP growth rate and demand elasticity until the year 2000. Thereafter all the sector will growth at the same rate given by GDP growth rate and the elasticity.

CHAPTER 16 ENVIRONMENTAL SANITATION

In this study, the environmental sanitation sector covers the fields of: (1) water supply, (2) sewerage (storm water drainage*1 and waste water disposal), and (3) solid waste disposal. They are deemed to be crucial infrastructure, which secures the preservation of human health/living circumstances and the natural environment so as to support sustainable social-economic activities. The outcomes derived from elaborate analysis on the current status of the study area are described, and major issues are extracted and examined in view of the development and mitigation strategies for each category. Together, a development plan and strategies as well as recommended development projects on this sector both, in the whole study area and in each Province are discussed and suggested hereinafter.

16.1 OVERVIEW OF SECTOR INSTITUTIONS AND FINANCES

16.1.1 Institutional Aspect

At the Central Government level, the main institutions in the environmental sanitation sector are the Ministry of Construction (MOC), the Ministry of Agriculture and Rural Development (MARD), which accommodates the former Ministry of Labor and Social Welfare's responsibilities, and the Ministry of Health (MOH). MOC is the main institution for designing and implementing urban water supply and sanitation systems and developing sector policies. It also supervises project implementation through its design company. The design and construction of projects have been traditionally carried out by various enterprises under the control of MOC, but recent developments aimed at giving increased responsibility to local governments have created competition between MOC's construction companies and construction units at the provincial level. Such decentralization trend of activities is also occurring in planning and design tasks.

MOH handles quality control and supervision of drinking water in urban and rural areas, and is also responsible for rural sanitation. MARD coordinates the implementation of rural water supply projects. The Development Strategy Institute (DSI), which is recently organized including the former State Planning Committee and which belongs to the Ministry of Planning and Investment (MPI), plays an important role by determining sector priorities and selecting investments to be funded. A number of other institutions plays more limited roles in the sector, concentrated mostly on research, data collection and general monitoring of the sector.

For planning and design activities, the local companies, such as water supply company, urban environment company, and so on and the design units of public works departments carry out distribution network design by themselves. They may be assisted in handling more complex aspects, such as treatment plants and pumping stations, by MOC, when necessary. The large cities also tend to carry out construction works for environmental sanitation, and even the smaller urban centers use local construction units for the construction of distribution networks and house connections.

Local Governments in each Province, City, Town and District are responsible for the management, operation and maintenance of water supply and sanitation systems. In general, the water supply companies of provincial capitals are relatively autonomous

*1 : While flood control in terms of river water control is in important relation with drainage, it is handled in other sector in this study. In this report, "drainage" covers just "inner storm water discharge or its facilities."

public companies responsible to the provincial Department of Construction in Local People's Committees. Drainage and sanitation activities are, in general, under the responsibility of the Provincial Department of Construction, acting under the authority of the Local People's Committee.

16.1.2 Finances

Traditionally, the Central Government funds in capital investments have played the major role in financing water supply and sewerage investment in Viet Nam. While the current allocation by the Central Government is not identified clearly, it is known that, in the past, some 75% of water supply investments were financed by the Central Government and the remaining 25% by local authorities. The contribution of water users to the construction costs in urban areas is limited to only fees for connection work.

The operating expenses of urban water supply are in general barely covered by revenues, and the charge for drainage, sewerage and solid waste collection/disposal have not even been introduced in the country. In the water supply sector, consumers are required to pay for water distributed through house and yard tap connections, while water is free of charge at public taps and tanks. The Central Government has given the Local Governments and their water companies an increasingly free hand in determining tariff levels to encourage the companies to limit their dependence on subsidies and become financially self-supporting. As a result, tariffs have been set at a level, which may facilitate the recovery of operation and maintenance costs.

The current water tariffs applied in the study area are shown in Table 16.1. While there are several categories depending on consumers, the tariff for private household is ranging from 800 VND to 1,000 VND per m³ and for industry and commerce from 2000 VND to 3500 VND. Water tariffs are set based on consumption levels, but in some cases based on estimated consumption, because the flow meters for assessing users' consumption is not always available.

Table 16.1 Water Tariffs in the Study Area

Urban centers	Water users	Tariffs (VND/cu-m)
Dong Ha Town	Household	1,000
	Industry	2,000
	Commercial, Hotel	3,500
Da Nang City	Household	800
	Governmental office	1,500
	Private service	3,500
	Foreign institute	5,000
Quang Ngai Town	Household	1,000
	Industry	2,000

Source : JICA Study Team

16.1.3 External Assistance

Because Viet Nam is badly in shortage of investment for development on environmental sanitation infrastructure, Viet Nam has received financing from external sources for the sector development as shown in Table 16.2. France, Japan and Finland Government are major donors mainly in the sector of water supply, such as Ha Noi City, Da Nang City and Hue City, and also UNICEF has played an important role to implement water supply programs in rural areas.

At present, almost all of external assistance have focused on the water supply sector. It is projected to extend to the sewerage sector and also solid waste disposal sector in the future.

Table 16.2 Ongoing External Assistance Project in the Environmental Sanitation Sector in Viet Nam

Project title	Duration	Country /Donor	Commitment in 1000 US$	Project objectives
1. Environmental sanitation	93-94	UNICEF	2,981	Disseminate appropriate sanitation techniques in rural communes.
2. Rural water supply	88-95	UNICEF	11,498	Build 17,000 wells, 25 gravity flow systems, 1,000 water sources in rural area.
3. Ha Noi water supply programme, Phase-III	91-95	Finland	38,000	Rehabilitate, upgrade and extend the water supply system of Ha Noi City.
4. Hai Phong water supply and sanitation programme	91-96	Finland	14,325	Provide Hai Phong with a water supply and sanitation programme.
5. HCMC water supply system	92-95	Italy	23,110	To supply HCMC with clean water.
6. Water project in Hue, Phase-II	92-94	France	1,773	Supply of equipment to rehabilitate and extend the Hue water supply system.
7. Water project in HCMC, Phase-I	92-95	France	1,064	Supply of equipment to renovate Thu Duc water treatment plant.
8. Water project in HCMC. Phase-II	93-95	France	1,233	Upgrade Thu Duc water treatment plant and water distribution networks survey in HCMC.
9. Water project in Can Tho, Phase-II	93-95	France	1,898	Construction of a new water treatment plant in Can Tho.
10. Water project in Hue, Phase-II	93-95	France	1,898	Prepare a master plan on water distribution network and provide emergency equipment.
11. Water project in Nam Dinh	93-95	France	1,898	Provide emergency equipment and conduct a survey of water pollution in Nam Dinh.
12. Water project in Da Nang	93-95	France	1,898	Upgrade the water distribution network in Da Nang.
13. Project support for WATSAN activities	91-95	UNICEF	2,729	Provide back-up technical staff for the implementation of WATSAN projects.
14. Rural water supply and sanitation	92-95	UNICEF	3,016	Rural water supply and sanitation programme for seventeen provinces.
15. Water supply project	92-99	Australia	15,372	Institutionalize provincial water enterprises including construction of water supply facilties.
16. Water project in Hue	94-95	France	2,310	Revamping of drinking water system.
17. Water supply in Nam Dinh	94	France	2,812	Audit and supply of equipment for water treatment plant.
18. Water project in Lao Cai	94-95	France	2,133	Revamping of Lao Cai water supply.
19. Water project in Hoa Binh	94-95	France	2,310	Revamping of Hoa Binh water supply system.
20. Water project in HCMC	94-95	France	1,511	Expansion of Thu Duc water plant and supply of filters.
21. Water project in Can Tho	94-95	France	4,087	Expansion of water treatment plant.
22. Water project in Da Nang	94-95	France	3,554	Upgrading of water distribution network.
23. Improvement of water supply facilities in Gia Lam	94-95	Japan	26,985	To lay pipelines and to construct water purification plant.
24. Study on urban drainage and waste water disposal system in Hanoi	93-94	Japan	2,792	To formulate a master plan with F/S on drainage and waste water disposal in Ha Noi.

Note: The information which shows projects beyond 1,000US$ is sourced from UNDP Report(1995).

16.2 PRESENT CONDITIONS

16.2.1 Water Supply

In Viet Nam, of the 436 urban centers with a population exceeding 5,000, only 100 centers have a piped-water supply system. These water supply systems serve some 6.0 million people or only 47 % of the urban population. Although the service coverage target of safe water supply in 2000 has been disclosed by the Central Government, as shown in Table 16.3, the remaining urban inhabitants and people in rural areas are still forced to use water for living from shallow wells (in most cases unprotected and polluted), rainwater collection tanks, streams and ponds at the present.

Table 16.3 Service Level Target of Water Supply in Viet Nam

Urban centers	Served population rate (%)	Per capita consumption (lit/cap.day)
Ha Noi	85	150
Hai Phong	85	150
HCMC	85	150
Large cities (beyond 90,000 population)	70	100-150
Medium-size cities (15,000 to 90,000 population)	50-60	70-80

Source : Compiled by JICA Study Team based on information brought by SPC.

Under such low developed situation on water supply in Viet Nam, it is reported that water-born diseases such as gastroenteritis, typhoid, cholera, malaria and viral hepatitis are possibly important sources of high morbidity, especially among children in this country.

In the study area, there are totally ten (10) piped-water systems in operation at present as shown in Table 16.4. The findings of the site survey on water supply in the study area are summarized as follows.

Table 16.4 Existing Piped-Water Supply Facilities in the Study Area

Provinces	Locations	Production and Distribution Capacity	Remarks
1. Quang Tri Province	Dong Ha Town	7,500 cu-m/d	Original capacity 15000cu-m/d
	Quang Tri Town	3,000 cu-m/d	
	Vinh Linh District	1,000 cu-m/d	
2. TT-Hue Province	Hue City	25,000 cu-m/d	
3. QN-Da Nang Province	Da Nang City	54,000 cu-m/d	
	Hoi An Town	500 cu-m/d	Original Capacity 6000 cu-m/d
	Tam Ky Town	6,000 cu-m/d	
	Dien Ban District	2,000 cu-m/d	
	Hiep Duc District	1,500 cu-m/d	
4. Quang Ngai Province	Quang Ngai Town	10,000 cu-m/d	Intake from deep well

Source : Compiled by JICA Study Team

(1) Quang Tri Province

Dong Ha Town has a piped-water supply system with an original capacity of 15,000 m³/d. At present, the system, which covers 45 % population in this town, is forced to supply only some 7,500 m³/d due to superannuation of facilities and shortage of maintenance investment. The Town is planning to restore the water purification facilities to the original capacity with the aid of foreign government's investment. Raw water for the water supply is taken from the rivers flowing inside the Town. In the dry season, the salinity of raw water comes to be high in some year, because of sea water intrusion.

Another piped-water supply system in Quang Tri Province is facilitated in Vinh Linh District with the capacity of 1,000 m³/d and in Quang Tri Town with the capacity of 3,000

m³/d. At present, people in the remaining areas of this Province are relying on wells, rainwater collection tank, stream nearby and so on for their living water. Plans of small-scale systems of water supply with the capacity of some 1,000 m³/d are under way for 6,000 to 10,000 people of served population in Gio Linh, Trieu Phong and Hai Lang District.

(2) TT-Hue Province

In the whole TT-Hue Province, there is only one piped-water supply system. The purification plant is located in Quang Te and Gia Vien. Although its original maximum capacity is 30,000 m³/d, 10,000 m³/d, respectively, actual water supply is limited to about 25,000 m³/d, due to superannuating of purification plant and water distribution networks. With the loss rate of as high as some 35 %, the water supply system is covering about 50 % of the population in Hue City.

This plant has two pumping stations getting raw water from the Huong River and one of those is located just next to Dzavien Bridge crossing the Huong River. This pumping station is only about 1 km far from the Hue City's center and about 18 km to the coastal gate. The second pumping station is located 4 km far away from the first one to the inland direction. Under such siting of water intake station, a major problem in the water supply system of Hue City is salinity intrusion in the dry season, especially from April till July.

Hue City has formulated and partly implemented the development plan of water supply works with assistance of the French Government. According to the plan, as shown in Table 16.5, the population coverage in Hue City is to be improved to 79 % with the per capita consumption of 150 lit/cap.day in 2010.

At present, people in the remaining areas of the Province other than Hue City are relying on wells, rainwater collection tank, stream nearby and so on for their living water.

Table 16.5 Water Supply Works Development Plan in Hue City

Items		Phase-I	Phase-II	Phase-III
Target year		1997	2002	2010
Served population number			415,800	487,900
Served population ratio	(%)		59	79
House connection number			15,200	51,600
Consumption rate	(lit/cap.d)		138	150
Total water supply capacity	(cu-m/d)	65,000	120,000	150,000
Distribution networks	(km)	180	206	222

Note : The data are sourced form the Development Plan formulated by the People's Committee of Thua Thien-Hue Province.

(3) Quang Nam-Da Nang Province

In the whole of Quang Nam-Da Nang Province, only 10 % of the population is served by piped-water supply. Da Nang City has a water supply system with total capacity of 54,000 m³/d, which was originally constructed by French in 1950s and later upgraded by the United States in 1960s. The main water user in Da Nang City are residential houses and governmental offices accounting for 80 % of 54,000 m³/d, manufacturing and service building accounting for 13 % and other parts including foreigner's residents accounting for 2 %.

Three (3) water purification plants are working in Da Nang City; 24,000 m³/d at Cau Do, 20,000 m³/d at San Bay and 10,000 m³/d at Son Tra. The water supply system, which covers some 40% of the population in Da Nang City utilizes river water as raw water and often suffers from salinity intrusion in the dry season similar to other regions in the study area. Although there are many wells for drinking water intake in the city, it is said that they cannot be used due to pollution by living waste water.

Da Nang City is implementing the water supply upgrade project with aid of the French Government, which includes the three (3)-phase capacity expansion to 80,000 m³/d

together with rehabilitation work of the distribution system until 1998. Besides this, the feasibility study assisted by the Australian Government has been finished, saying that another water supply plant of 120,000 m³/d should be constructed newly in 2000 to 2010.

Quang Nam-Da Nang Province has a plan to construct new water supply works in the north and in the south of Da Nang City as shown in Table 16.6. The water supply system in the north is 180,000 m³/d capacity and is correspondent to the development project for heavy industries, sea port at Lien Chieu, Nam O, Hoa Khanh and so on. While the water supply system in the south has a 150,000m³/d capacity and is correspondent to the development project for light industries, tourism, at the surroundings of Hoi An, Dien Nam, Dien Ngoc and so on.

Table 16.6 Water Supply Works Development Plan in the North and the South of Da Nang City

Items	The North Area	The South Area
Covered areas	Lien Chieu Nam O Hoa Khanh Thuy Tu	Hoi An Dien Nam Dien Ngoc Non Nuoc Hoa Hai
Major development sector	Industry Sea port	Tourism Light industry
Water source	Cau De River	Binh Dien River
Raw water conveyance pipe	1000mmDia x 2lines x 2.0km	900mmDia x 2lines x 1.0km
Purification plant	180,000m3/d	150,000m3/d
Distribution pipes	Total 161km	Total 211km

Note : The data are sourced from QN-Da Nang Province's materials.
Source : Compiled by JICA Study Team based on information brought by QN-Da Nang People's Committee.

Besides Da Nang City, there are four (4) piped-water supply systems working in the Province at present; 500 m³/d in Hoi An Town*1 , 6,000 m³/d in Tam Ky Town, 2,000 m³/d in Dien Van District and 1,500 m³/d in Hiep Duc District. In order to mitigate the present poor prevalence, the development plans for water supply system in local Towns and Districts are prepared with a series of piped-water supply systems, such as 2,000 m³/d in Thang Binh District, 1,500 m³/d in Que Son District, 3,000 m³/d in Dai Loc and 2,000 m³/d in Thien Phuoc District .

While the water supply situation in the urban center and local towns in the Province is being enhanced gradually as above mentioned, people in the remaining areas of the Province are still relying on wells, rainwater collection tank, stream nearby and so on for their living water.

(4) Quang Ngai Province

Quang Ngai Town has a water supply system of 10,000 m³/d capacity consisting of eight (8) wells, eight (8) distribution pumps and relevant distribution pipes. Out of 10,000 m³/d, 85 % accounts for the usage for households and other 15% accounts for industries, commercial activities and so on. Intake wells for underground water are located along the Tra Khuc River in the depth ranging from 28 m to 37 m. Quang Ngai Town has worked out an expansion plan to 20,000 m³/d using underground water in a few years and to 50,000 m³/d using river water in the future.

People in the remaining areas of the Province other than Quang Ngai Town are still relying on private well, rainwater collection tank, stream nearby and so on. for their living water. Some local communities are equipped with a small water supply system constructed under the safe water program with the aid of UNICEF.

*1 : While the water production capacity of Hoi An Town water supply system was originally 6,000 cu-m/day, it remains at some 500 cu-m/day due to unreliable raw water intake source.

In accordance with the Dung Quat regional development project, the Province has a conceptual plan that the required water is provided by the water supply system of 10,000 m³/d taking raw water from the Thac Nham irrigation system in the first phase and afterward by the water supply system of 20,000 m³/d taking raw water from the reservoir to be constructed in the Tra Bong River .

16.2.2 Sewerage

In Viet Nam, a sewerage*1 system equipped with waste water treatment facilities does not exist even in large urban centers like Ha Noi and HCMC at present. Only quite limited drainage pipes for rain water and sewer pipes are installed in old urban centers, and its population coverage is estimated to be only 23 % in urban areas. Consequently, many areas, especially in large urban centers, are periodically suffering from flood damage and natural and environment pollution.

Table 16.7 shows the status of the existing sewerage in the study area and the findings realized during site survey on sewerage are summarized below.

Table 16.7 Existing Sewerage in the Study Area

Provinces	Locations	Total Length of Sewer Drain Route	Remarks
1. Quang Tri Province	Dong Ha Town	2.0 km	
2. TT-Hue Province	Hue City	43.4 km	Equivalent to 23 % of road length
3. QN-Da Nang Province	Da Nang City	117 km	20 % length is not usable
	Tam Ky Town	2.3 km	
4. Quang Ngai Province	Quang Ngai Town	7.8 km	

Source : Compiled by JICA Study Team based on the results of interview survey.

(1) Quang Tri Province

Dong Ha Town is provided with only 2.0 km sewerage pipes in total length along with the National Road no.1 and no.9. The pipes, which cover the living area for 11,000 people, are used for rain water drainage and waste water collection from households, industries and others. Sewer is directly discharged into the stream and ponds nearby without any treatment.

Due to the shortage of drainage facilities, the urban centers in the Province often suffer from typhoons and inundation. The People's Committee of Quang Tri Province has pointed out such poor sewerage facilities as one of the major constraints for economic development of the Province.

(2) TT-Hue Province

In Hue City, there is a drainage system with a total length of 43.4 km consisting of canals and ditches . The existing drainage system, which is used mainly for rain water discharge, covers some 20 % of urban residents and the total length is equivalent to about 23% of total road length in the City center. Due to such shortage of drainage facilities and , in addition, blocking by mud and stones in ditches, Hue City has suffered periodically from severe damage by storms and floods from September to December. Because of this, historical vestiges designated as the World's Cultural Heritage are reported to have faced so many time submersion.

At present, there is no treatment system for waste water from households, industries and so on. Almost all waste water, therefore, is discharged directly into receiving bodies, which are tributary systems of the Huong River. Besides this, due to waste water being directly discharged from some 1,000 people living in boats on the river, it is reported that water of the Huong River, which is a major intake source of water supply, is seriously

*1 : The word "sewerage" is used in this report means both the waste water from urban living, industrial and other kinds of activities, and storm water drain.

polluted.

Hue City has formulated a sewerage development plan to alleviate such substandard situation. According to this plan, the service area is divided into two (2) zones by the Huong River and each area is equipped with a waste water treatment plant to purify waste water from households, industries and so on. When this development works are completed in the target year of 2010, some 50 % volume of living waste water, industrial waste water and so on. will be purified before discharged into water bodies.

Another development project plan to protect the Hue Citadel from floods has been formulated. This consists of two objectives; the short-term one for protection of the World's Cultural Heritage in the Citadel and the long-term one for improvement of the environment towards a clean and beautiful tourist center. The project contains dredging works of rivers/canals inside and nearby the Citadel, and construction and rehabilitation works of water control gates and pumping stations.

(3) Quang Nam-Da Nang Province

The drainage net works in Da Nang City were built in the early 1950s. The total length of drainage is 117 km, of which stone-made ditches account for 90 km and soil-made ditches account for 27 km. While the major purpose of drainage is to collect and discharge rain water, some 20 % length of the present drainage system is reported to be unusable, due to silting or damage. Consequently, Da Nang City has often suffered from flood in the rainy season. While Quan Nam-Da Nang Province has promulgated the environmental protection law recently including effluent regulation for waste water, industries, households and so on. are discharging waste water into water courses nearby without any kind of treatment. To mitigate such situation, Da Nan City is preparing some sewerage development plan at the moment.

Tam Ky Town is equipped with about 2.3 km drainage networks made from concrete along the National Road no.1. To alleviate the present poor network rate of only 39 m/ha, this town has formulated a sewerage development plan which includes waste water treatment facilities for purification from living waste water and industrial waste water. Besides, a drainage development plan, which contains some 20 km collection network has been worked out by Hoi An Town to support tourism promotion in the town.

(4) Quang Ngai Province

Quang Ngai Town has a drainage system with a total length of 7.8 km, of which some 30% length is reportedly unusable due to silting or damage. While rain water is lead to the Tra Khuc River through sewerage net works, the town has often suffered from flood damage, due to shortage of drainage capacity.

In terms of industrial waste water, a sugar factory is discharging as large as 600m³/h and a frozen products factory is discharging offensive waste water to public water course without any treatment. These are causing water pollution problems in the Tra Khuc River flowing in the town.

With respect to rural sanitation, the major concern common to the whole study area is the use of fresh human excreta as fertilizer for agriculture in rural area. Despite the Government's health education campaign, this practice is still continuing even in some of urban centers, resulting in a high infestation rate of intestinal parasites in this country.

16.2.3 Solid Waste Disposal

In Viet Nam, the volume of solid waste generated in urban areas is estimated to amount to 9,100 m³/day, of which only 4,000 m³/day (equivalent to 44 %) is collected. The remaining uncollected waste is either privately burned or illegally dumped into lakes, ponds and uncontrolled sites on the ground. There are no solid waste incineration plants for waste volume reduction or safe disposal of toxic substances in Viet Nam.

The type of land filling by simple open dumping without any protective measure has prevailed in Viet Nam. Because of this, many landfill risk to discharge leachate and offensive odor to the surroundings. While a pilot plant of composting plant for solid waste reuse as agricultural fertilizer is under way in Ha Noi City, this has not yet prevailed at present. In terms of recuperation and recycling of solid waste, only informal practice by scavenger at landfill sites is observed in the country.

Table 16.8 shows the present situation of solid waste disposal facilities in the study area and the findings identified through site survey are summarized below.

Table 16.8 Existing Solid Waste Disposal Facilities in the Study Area

Provinces/Locations	Collected Solid	Waste Disposal Facilities
1. Quang Tri Province	10 ton/d	
/Dong Ha Town	5 open dumping sites	
2. TT-Hue Province	60 ton/d	4 vehicles for collection and transportation
/Hue City	Open dumping site	
3. QN-Da Nang Province	290 ton/d	17 vehicles for collection and transportation
/Da Nang City	Open dumping site	
4. Quang Ngai Province	44 ton/d	3 vehicles for collection and transportation
/Quang Ngai Town	Open dumping sites	

Source : Compiled by JICA Study Team based on the results of interview survey.

(1) Quang Tri Province

Dong Ha Town is equipped with only one (1) truck and five (5) hand carts for collection and transportation of solid waste and 10 workers are engaged in solid waste disposal works. Consequently, only 10 ton/day*1 (equivalent to 50%) out of the total generated in the urban center of this town is collected and transported to the disposal site. The rest of solid waste is uncollected and illegally dumped in the town.

Other urban centers in Quang Tri Province are in a similar or worse situation as compared to Dong Ha Town. As such, Quang Tri Province is obviously suffering from serious shortage in equipment and manpower for collection and transportation of solid waste.

(2) TT-Hue Province

Like many urban centers of Viet Nam, solid waste, especially domestic garbage, becomes a serious problem for Hue City. Citizens and tourists in the city are estimated to release some 100 ton of garbage every day. The collection and transportation of about 60 ton garbage a day are carried out by a staff of 120 workers with four (4) trucks each of six (6) ton capacity. While City Government has permitted to arrange the locations of 17 places in the urban center for garbage concentration, in fact the garbage is piled up at more than 1,000 places inside the City.

The biggest landfill site of Hue City is a valley located in the upper section of Huong Thuy District, about 13 km from the City center. As this land fill site is a simple open dumping type without any further treatment, offensive odor is generated, especially in the hot summer season. It is also reported that, in the rainy seasons, rain water and leachate comes down from the landfill site to the Huong River which is a major drinking water source of Hue City.

In such situation, Hue City carried out a survey on the quantity and quality of solid waste generated in the City. As a results of this survey, the following necessary countermeasures are suggested against the projected increase of population for 10 years:

- Relocation, extension and upgrading of existing landfill sites to expand disposal capacity and prevent the harmful impact on the surroundings caused by offensive odor

*1 : While the collected data in the study area on solid waste are based on the volume unit(cu-m), the weight base (ton) is employed as the measuring unit of solid waste in general. In this report, the weight base unit is applied after converted with using bulk density.

and leachate.

- Introduction of solid waste incineration for toxic waste discharged from hospitals, medical research centers and so on to avoid a irreversible impact on the natural environment and human health.

(3) Quang Nam-Da Nang Province

In the study area, Da Nang City may be rather endowed with facilities and manpower compared to other urban centers. At present, 17 units of waste haulage vehicles and some 400 people are engaged in waste disposal works in the City. The total amount of solid waste collected every day is 250 to 300 ton, by mobilizing such facilities and manpower. This collected volume, however, is equivalent to only some 70 % of the 400 ton a day generated in Da Nang City.

For the present time, solid waste collected is transported to the landfill site located on the foot of the Khan Son Hill, about 20 km to the west from the City center. As the present type of landfill is just open dumping, it is causing environmental problems to the surroundings by offensive odor generation. It is said that this landfill site has to be relocated, when the City will be expanded.

According to the City official's estimation, generated volume of solid waste in Da Nang City will increase to 970 ton a day in 2000 and then 5000 ton a day in 2010. To mitigate such situation, Da Nang City has established a comprehensive solid waste disposal facility. In this solid waste disposal plan, the compost plant will work to produce fertilizer for agriculture from organic refuse accounting for some 60 % volume of total generated solid waste. The facilities will accommodate the incinerator to handle 10 % volume of total generated solid waste and the treatment plant to handle each some 10,000 ton sludge a year collected from drainage system and septic tanks in the city.

(4) Quang Ngai Province

Quang Ngai Town is equipped with only three (3) trucks for collection and transportation of solid waste and 57 workers are engaged in solid waste disposal works. While present generated volume of solid waste in the town is not clearly identified, only 45 ton everyday is collected and transported to disposal site. As the most part of solid waste is uncollected and illegally dumped, it is easily seen that rubbish is scattered on the streets and be piled up here and there in the town.

While there is only one disposal site, some 15 km far from the town center, accessibility to the site is observed to be quite bad due to wrong road condition. As such, Quang Ngai Province is obviously suffering from a serious shortage in both, equipment and manpower for collection and transportation of solid waste.

16.3 DEVELOPMENT ISSUES

As mentioned above, due to insufficient investment as well as a shortage of trained manpower and coordinated strategies/plans for development, the study area has remained at quite poor stage in all subsectors of environmental sanitation: water supply, sewerage and solid waste disposal. Major constraint factors for such present status are deemed to result from a shortage of public awareness on the environmental relationship with human health and a lack of well- coordinated health and environmental protection policy and planning at both, Central and Local Governmental levels.

Major constraints including some important issues identified through the field survey in the study area are analyzed and discussed hereinafter.

16.3.1 Water Supply

(1) Service Level of Safe Water

In the study area, residents are relying on diversified sources other than the piped-water supply system*1 to obtain water for their daily living: shallow wells, rainwater collection tanks and ponds. Individual use of shallow water and rainwater cannot be considered to be safe water, because of possible intrusion of pollutants through the ground surface and/or underground. Prevalence of safe water usage employing a piped-water supply system still remains very limited in the study area. Even in provincial centers, the target level has yet been attained as shown in Table 16.9.

Table 16.9 Present Per Capita Consumption in Provincial Centers

Area	Urban population (number)	Capacity of water supply (m3/d)	Per cap consumption (lit/d.cap)	Government target (lit/d.cap)
Quang Ngai Town	62,000	8,000	54	70 to 80
Da Nang City	437,000	54,000	52	100 to150
Hue City	223,000	28,000	53	100 to150
Dong Ha Town	50,800	7,500	62	70 to 80

Note : This table shows estimation based on the data in 1995 on the assumption of residential use 60%, leakage ratio 30% and full urban population coverage.

For the alleviation for such poor conditions, a couple of water supply projects assisted by foreign donors are ongoing or planned at the moment in the way of rehabilitation, expansion and/or construction of new plants in Da Nang City, Hue City, and other Towns/Districts. Besides the betterment of the water supply situation in urban areas, another exertions are directed to the provision of piped-water supply in rural small Towns and Districts in the region, and to the installation of micro-water supply apparatus equipped with well and hand pumps in some communes.

As seen above, the major theme in the study area on water supply is obviously how to expand service coverage of safe water with the provision of piped-water supply in terms of both, per capita consumption and population.

(2) Drinking Water Qualities

The Local Governments in the region have set the specification of the quality standards for raw water sources to be used for the purpose of water supply. In the study area, many urban centers are located in the vicinity of the coast at lower altitude. Because of this, raw water sources in the region tend to be often influenced by tidal fluctuation with the occurrence of sea water intrusion. As a typical case, the water supply system in Hue City periodically suffers from high salinity beyond the drinking water quality standard shown in Table 16.10, during dry season. Similar saline water intrusion, at more or lesser degree, takes place in Quang Tri Province and QN-Da Nang Province. In such urban centers, some proper mitigation should be worked out to secure steady and safe raw water intake with suitable quality, such as:

- Construction of anti-intrusion dike at the proper location of the river
- Relocation of water intake place to the upstream of the river, and/or
- Construction of a reservoir as a comprehensive countermeasure, including irrigation water in agriculture.

Apart from what is mentioned above, there are also concerns, which force to put raw water sources at risk. In Hue City, as a typical case, leachate generated from landfill sites can topographically reach the Huong River, which is used for raw water sources of water

*1 : The word " piped-water supply system" means a centralized water system with pipe distribution networks except for individual system using shallow well, stream, rain water pond and so on.

supply at present. This is caused by a wrong selection of the landfill location, and primitive open dumping, without careful consideration for leachate, as observed commonly in the region. In such connection, it is conceived that, in some area of this region, examination for security of safe raw water sources for water supply is a crucial matter. By the same token, careful attention ought to be paid for the selection of raw water source for the newly developed areas, such as industrial zone, tourism zone and so on.

Besides, another major concern identified through field survey is a lack of water quality data in terms of both, raw water and supplied water, and this may be caused by more intensive quantity-oriented exertion more than quality. In the study area, which is not endowed with steady qualified raw water and often suffers from malfunction in the water purification plant, the monitoring of water qualities is inevitable practice from the point of safe water supply.

In this respect, the following countermeasures are considerably urgent:

- Establishment of centralized laboratory facilities in the respective Provinces as well as on-site laboratory at each water purification plant, equipped with suitable measurement/analysis tools and devices, and
- Training of concerned staff for acquirement of measurement and analysis technologies.

Table 16.10 Drinking Water Quality Standard in Viet Nam

Items	Unit	Limitations	
		Urban area	Rural area
pH		6.5-8.5	6.5-8.5
Transparence	cm	30	25
Colour(Pt-Co scale)	degree	10	10
Suspended solids	mg/l	5	20 (MOSTE std 10)
Total dissolved solids(TDS)	mg/l	500	1000
Hardness(as calcium carbonate)	mg/l	500	500
Sodium chloride			
coastal zone	mg/l	400	500
inland	mg/l	250	250
Total organic carbon(TOC)	mg/l	0.5-2.0	2.0-4.0
Ammonia			
surface water	mg/l	0	0
ground water	mg/l	3.0	3.0
Nitrite	mg/l	0	0
Nitrate	mg/l	10	10
Aluminium	mg/l	0.2	0.2
Copper	mg/l	1.0	1.0
Iron	mg/l	0.3	0.5
Manganese	mg/l	0.1	0.1
Sodium	mg/l	200	200
Sulfate	mg/l	400	400
Zinc	mg/l	5.0	5.0

Notes :
(1) The above shows the standards specified in Da Nang Province.
(2) The following substances are also specified in the limitation beside the above listed items: - hydrogen sulfide, chlorobenzen, chlorophenol, Detergents, asenic, cadmium, chromium, cyanide, fluoride, lead, mercury, selenium, aldrin and diedrin, benzen, benzopyrene, carbon tetrachloride, chlordan, chloroform, DDT(total isomer), 1,2-dichloroethane, 1,1-dichloroethane, heptachlor and heptachlo epoxide, r-hexachlorohexane, hexachlorobenzene, methoxychlor, pentachloroethane, tetrachloroethane, Trichloroethane, 2,4,6-trichlorophenol, trihalomethanes, total alpha un of activity, total beta unit of activity.

(3) Maintenance of Water Supply System

One of the common practices prevailing in the existing systems is malfunction of the water supply system: purification plant, water distribution equipment/pipe network, water measuring meter and so on, due to superannuation of facilities and insufficient maintenance. In addition to capacity increase by expansion or new construction of a water supply plant, much more attention should be paid to the rehabilitation of the existing system in the study area and expectedly this may effectively result in:

- Abating of leakage ratio, which is reportedly as high as 30 to 40 % at present, by appropriate diagnosis and repairing distribution pipes
- Collection of financial source by adequate metering of respective user's water consumption with proper provision of water meters, and
- Encouragement of public consciousness for water saving through adequate imposition to water use by installation of water meter.

(4) Needs for Training and Sufficient Allocation of Operational Staff

Construction of water supply hardware facilities cannot completely meet the needs for access to safe water in the study area. It can be stated based on observation on the current substandard practices prevailing, that proper knowledge and operation technologies based on sufficient experience is also essential.

At present, the respective water supply company managed by the local Government is responsible for operation and maintenance of the water supply system. Proper allocation of trained and qualified operational staff comes to be important in order to keep efficient operation of the water supply system. Considering the present shortage of trained staff common to the study area, the following preparedness may be suggested:

- Establishment of an operator training program at the level of both Central and Local Government,
- Exchange of information and staff between central cities and rural Towns/Districts so as to foster and prevail operation and maintenance technologies in the whole study area.

16.3.2 Sewerage

(1) Function of Existing Sewerage

In the original purpose, sewerage is facilitated in order to: (1) inundation protection by draining storm water, (2) conservation of human living environment by collecting waste water from households, industries and so on and, (3) natural environment preservation around public water courses by purifying collected waste water. The existing sewerage in the study area, however, does not handle waste water, while it simply contributes to nothing but discharge of storm water.

At present, only drainage networks of quite limited length are equipped in major cities and towns in the study area. These mainly function as just drainage for storm water aside from waste water from households, commercial buildings, factories and others. Yet, their existing capacity hardly can drain even small amounts of storm water, since not a few of existing drainage are silting and damaged, due to superannuating and insufficient maintenance.

While some urban centers in the study areas are preparing some plans to develop sewerage accommodating some treatment of waste water, no immediate implementation project is identified. Besides, almost all factories, even hospitals and medical institutions handling toxic/hazardous chemicals, are discharging waste water to public water courses such as rivers, canals and lakes and so forth without any treatment.

(2) Flood and Inundation Control

In the study area, several urban centers, such as Quang Ngai Town, Hue City, Quang Tri Town and so on so often suffer from periodical flood. Inundation in these areas are destined easily to be caused by even quite small rainfall, due to the shortage of drainage capacity. Obviously, a crucial and urgent matter in such flood-prone regions is to expand drainage capacity by rehabilitation of silted ditches, repair of damaged canals/pipes, and construction of new drain routes and so on.

On the other hand, some flood control measures around rivers and moreover water basins, which will be detailed in other parts of the report, also are inevitable for flood control. As such, it is an important aspect that the mitigation for flood should take place as not simply construction works of water way inside the urban area, but comprehensive water sheds control planning in the respective water basin.

(3) Urban Waste Water Treatment

In TT-Hue Province, the Tamgiang Cauhai lagoon system, which the largest coastal one in the world with some 22,000 ha surface area and 70 km-length, is laid down at the down stream of all rivers in the Province. This lagoon is regarded as quite vulnerable environmentally, since it is an almost closed water zone, without large pass way to the sea. Thus, in Hue City, which is located with the Huong River and which is anticipated to discharge a large pollutant load, urgent and strict mitigation for the reduction of pollutant load by the introduction of sewerage system employing waste water treatment facilities is considerably significant.

In this connection, the following programs are suggested in order to preserve the Tamgiang Cauhai lagoon system, which is a quite promising resource as fishery and agriculture in the region:

- Establishment of a water qualities monitoring system for the lagoon and rivers flowing into lagoon, and
- Development of sewerage equipped with a waste water treatment plant in Hue City to prevent deterioration of the water environment in the lagoon system.

In other regions of the study area, the monitoring practice of water quality is also needed as a first step towards introduction of waste water purification.

Considering the sewerage system to be introduced in the study area, from the viewpoint of both, human living and natural environment conservation, a completely separated system as employed in developed countries is ideal. However, because flood and inundation proofing is the most urgent matter in some flood-prone areas of the study area, gradual transition from a combined system to a separated system through partially separated system may be realistic. Together, in the course of sewerage development, the introduction of some small-sized individual treatment package like septic tank with leaching zone or aerobic septic tank should also be considered for rather dispersed-population zones from the point of economically efficient implementation.

(4) Industrial Waste Water Treatment

At present, almost all industries in the study area discharge to public water courses their waste water without any treatment, in the same manner with living waste water. Unlike household waster, treatment of industrial waste water is very important, since some of them are toxic and hazardous, possibly exerting an irreversible influence on human health and the environment. Although the regulation together with the limitation of effluent waste water, as shown in Table 16.11, is promulgated under the environment protection law, any actual effects cannot be observed and expected at present, because of no investment in this field for the time being.

Such legislative measure may bring forth actual effect for water pollution control in terms of industrial waste water, after being accompanied by more actual and precise steps

mentioned below, based on comprehensive environment control management:

- Providing some loans or subsidies by the Government for the investment in water pollution control countermeasures
- Applying viable limitation standards, such as the ones classified limitations with different provision between existing firms to newly-constructed one, and
- Exempting very small-sized firms from their duty to observe strict environment protection limitation.

Table 16.11 Maximum Effluent Limit of Waste Water's Constituent in Viet Nam

Constituent	Unit	Limit specified by MOSTE		Limit specified by Da Nang	
		Class-I	Class-II	Class-I	Class-II
1. pH		5-8	4-9	5-8	4-9
2. Suspended solids	mg/l	50	100		40
3. Color after filtering (Pt-Co scale)		200	500	200	500
4. Biochemical oxygen demand	mg/l	80	100	50	80
5. Chemical oxygen demand	mg/l	160	200	80	140
6. Hydrocarbon (oil and grease)	mg/l	1	10	0.01	0
7. Phenol	mg/l	1	5	1	5
8. Cyanide	mg/l	0.2	1	0.2	1
9. Chromium	mg/l	0.5	2	0.5	3
10. Zinc	mg/l	1	5	1	5
11. Copper	mg/l	0.5	3	0.5	3
12. Cadmium	mg/l	0.02	0.1	0.02	0.1
13. Mercury	mg/l	0.01	0.05	0.01	0
14. Arsenic	mg/l	0.1	0.5	0.1	0.5
15. Lead	mg/l	0.2	1.0	0.2	1.0
16. Manganese	mg/l	2	10	0.5	1.0
17. Sulfide	mg/l	0.5	1.0	0.5	1.0
18. Chloride	mg/l	500	1000	500	1000
19. Chlorinated hydrocarbon	mg/l	0.01	0.02	0.01	0
20. Total Pesticides	mg/l	0.005	0.01	0.005	0
21. Total coliforms	Number/100ml	5,000	10,000		

Notes :
Class-I : applied to the water sources using for water supply, tourism, fishing.
Class-II: applied to the water sources not using for above purposes.

Industrial estates, to be regarded as a major pollutant source in the future, should essentially facilitate adequate waste water treatment system. In industrial waste water treatment, it is common that the waste water treatment system consists of centralized waste water treatment facilities and individual pretreatment facilities. From the viewpoints of economical investment and steady operation performance, application of such two-steps treatment employing pretreatment subsystem for special grade and kind waste water may be suggested for industrial estate.

16.3.3 Solid Waste Disposal

(1) Current Practice on Solid Waste Handling

Among the three (3) environmental sanitation subsectors in the study area, the solid waste disposal sector is recognized to be the most behind development for the time being. As identified through the field survey, all of urban centers are suffering from serious shortage of facilities/equipment to handle solid waste. It is commonly observed everywhere that solids waste, such as vegetables and fruits from markets, waste bricks from construction sites, and garbage from households, are littered and piled up here and there.

At present, the only way for final disposal in the study area is a landfill, even though garbage contains toxic or hazardous waste discharged from hospitals, medical institutes

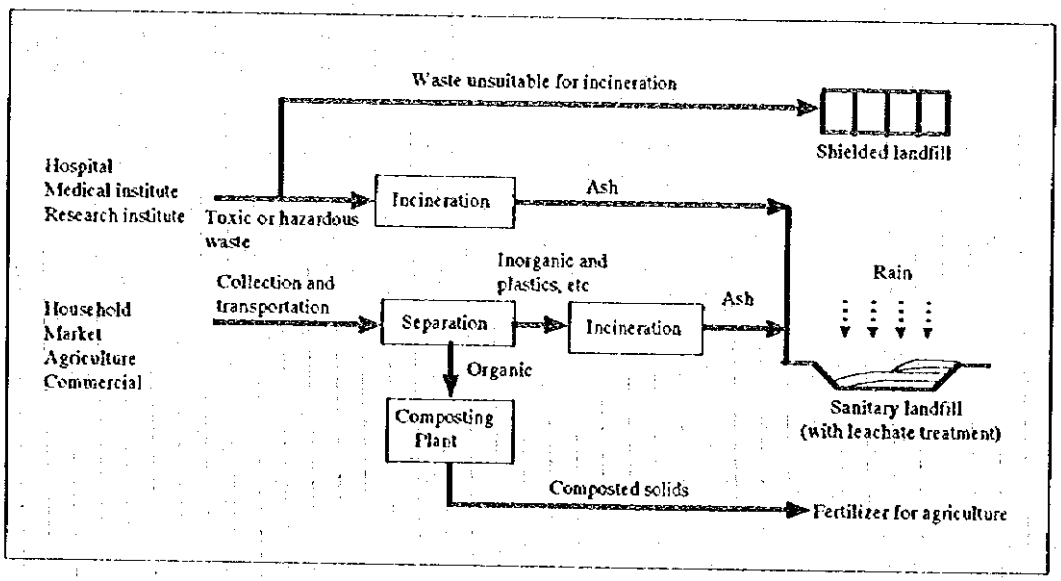
and so on. Some of the landfill sites in the study area exert serious danger to ground water by infiltration and surface water by runoff of leachate, since prevailing land fillings are simple open dumping sites without any adequate consideration for environmental impediment caused by the degradation of waste and rainfall. Proper and urgent mitigation of such unfavorable status on solid waste are called for in order to protect human living circumstances and, as well, to reserve safe water source for water supply.

(2) Composting of Organic Garbage

Figure 16.1 shows general disposal and utilization conception of solid waste generated in urban activities. The waste solids produced in the region have some favorable properties from viewpoint of recycling of resources. As shown in Figure 16.2, organic components originating from fruits, vegetables, foods, animals, etc. account for over 50% weight. They are easily composted and are useful for fertilizer of agriculture, the introduction of composting is strongly recommended.

In such, because the conception of composting of organic garbage, as observed in plans formulated by some communities, is endowed with quite reasonable basis and necessities in the central region backed by agriculture and its relevant industries.

Figure 16.1 Concept of Disposal and Utilization of Solid Waste

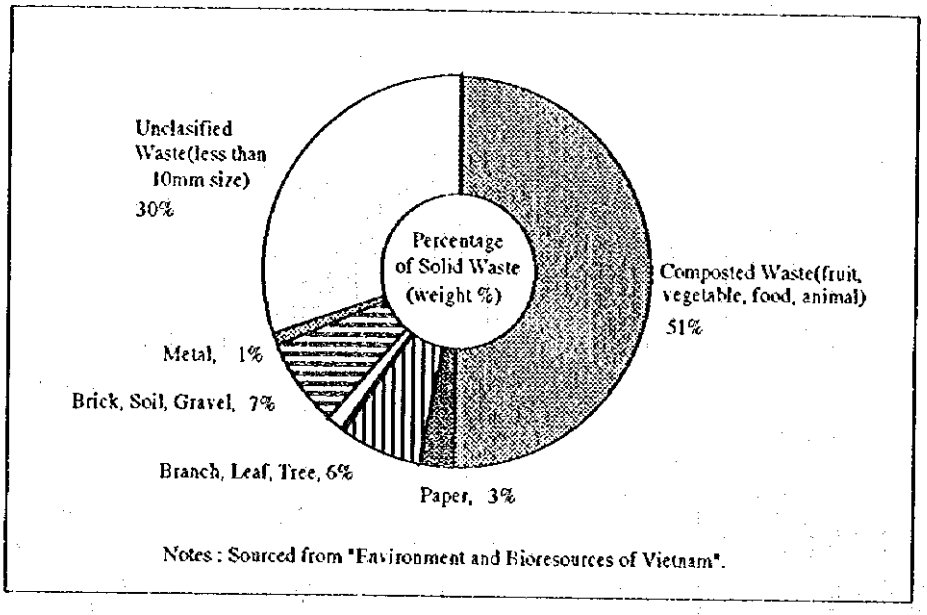


(3) Toxic or Hazardous Waste Disposal

In almost all of the urban centers in the study area, toxic/hazardous waste from hospitals, medical institutes and so on waste are collected together with other wastes without separation. Such practice may force human health to face at direct risk, through intermediate of recovered goods by illegal scavengers from waste, and by leachate intrusion into water sources. Some of the countermeasures listed below should be worked out to remedy such unsanitary and dangerous situation:

- Introduction of incineration for combustible toxic/hazardous wastes, and
- Introduction of completely shielded-type landfill to store permanently non-combustible toxic /hazardous waste.

Figure 16.2 Typical Composition of Solid Waste



(4) Landfill Practice

All landfill sites in the study area are giving off ill odor, because solid waste is simply filled or piled up in the shape of open dumping. Moreover, there is a serious concern that leachate generated by rain and biodegradation may cause heavy negative impacts to human hygiene and natural the environment.

Landfill will continue to be used predominately as a final disposal of solid wastes, even though other final disposal methods such as composition, incineration and so on. will be put to use. Thus, sanitary landfill equipped with such protection measures as mentioned below should essentially be introduced:

- Soil covers and gas extraction pipes to prevent from bad smell discharging
- Isolation membranes and water collection pipes to protect from the runoff of leachate, and
- Leachate purification facilities to treat waste water from the landfill site.

16.4 DEVELOPMENT PLAN

The number and variety of problems in the study area's environmental sanitation sector as well as the still limited financial and technical absorptive capacity indicate that development to substantially improve present service levels call for long-term action and need careful preparation and planning. At the same time, implementation of development projects in some places are urgently needed to avoid further deterioration of existing situation on environmental sanitation.

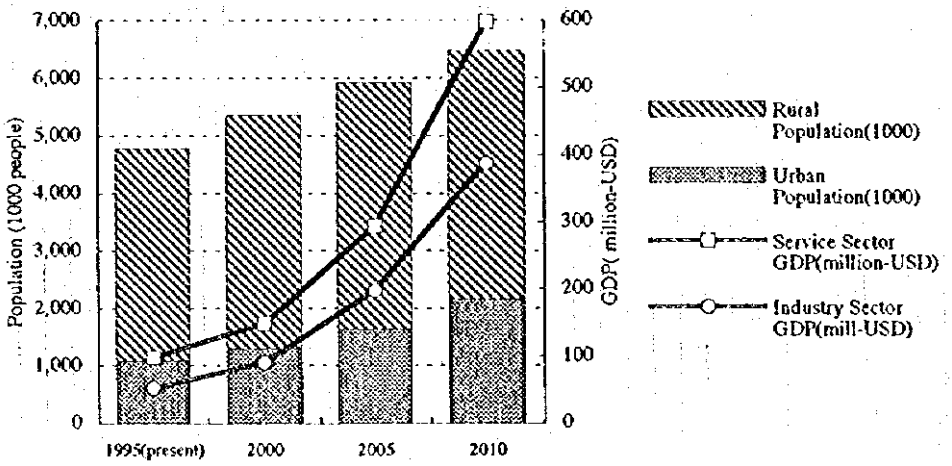
Together, it is very important that the environmental sanitation development should be established in harmony with other sector projects in urban, industry and tourism development, since environmental sanitation can be addressed as supporting utility sector for other sectors in some aspect. Based on such consideration, the development target and strategy of the environmental sanitation sector are discussed hereinafter.

16.4.1 Development Target and Strategy in the Whole Study Area

As shown in Figure 16.3 and described precisely in the section on the macro-economic sector, the whole study area is projected to attain in 2010: (1) some 6.5 million population with 1.8 to 2.5 % growth, (2) totally some 980 million USD of GDP in industry and service sector with 25 to 56 % growth. Such socio-economic growth will bring to the environmental sanitation sector of the study area:

- Water Supply : Rapid increase in water demand caused by: (1) population growth and urbanization, and enlargement of industry and service activities, (2) enhancement of urban living style.
- Sewerage : (1) Pollution load increase with the enlargement in the volume of waste water discharged from urban areas and industrial zones, (2) diversification in the quality categories of waste water to be discharged, (3) expansion of urban zones which need storm water drainage.
- Solid waste disposal : (1) Enlargement in the volume of solid waste discharged from urban, commercial and industrial activities, (2) diversification in the quality categories of solid waste to be discharged.

Figure 16.3 Socio-Economic Development Trend in the Study Area



Source : JICA Study Team

Consequently, the development plan toward 2010 in environmental sanitation of the study area must cope with : (1) the abatement for inferior situation standards at the present phase, and (2) the mitigation and betterment in line with the enlargement of population, urban area and industry activities to be caused by socio-economic growth in the future. The development plan for the environmental sanitation sector is formulated and proposed in this section, fundamentally based on the consideration that the service and utilization level of environmental sanitation in the study area is enhanced to that of countries in South East Asia until 2010 so as to support sound and sustainable socio-economic development in this region.

Though this section describes some investment cost required for the development, it should be noted that they are aimed at providing advanced information on the magnitude of required cost for reference only. The result from the examination of development plan as discussed later in detail forecasts the total magnitude of cumulative investment amount reach some 1,900 million-USD in 2010. Of this amount, some 1,300 million USD

equivalent to about 200 USD per capita is possibly to be financed by the public sector and some 600 million USD possibly to be self-financed by various industries.

It is clearly anticipated that a major issue on implementation will be how to arrange and allocate the required investment fund. It may be argued that the proposed development plan is too ambitious from the view point of budgetary affordability. Nevertheless, what should be strongly pointed out is that severe and large-scale deterioration of human and natural environment is foreseen in the study area, unless appropriate measures are undertaken against the negative impact to be caused by rapid socio-economic growth. At this point, the development plan will be subject to more precise argument and verification in the level of the whole study area and also on the level of each Province. In the respect, on is highly recommended that a comprehensive master plan study specialized in environmental sanitation infrastructure in the study area and in each Province is worked out at an early stage.

(1) Water Supply

In urban water supply, a major point of the study area is to increase coverage of safe water and to attain the standard per capita consumption with providing suitable quality water. It is necessary for industrial water supply that enough water in terms of both quantity and quality is provided to support industrial activity. The specific target in 2010 in water supply is summarized and proposed as follows:

Target of urban water supply in 2010:

- Unit consumption : 150 lit/cap.d in urban area (on daily average base)
- Population coverage : 90 % in urban area, 50 % in the whole study area, and
- Leak loss from pipe network : less than 15 %.

Target of industrial water supply in 2010:

- Water production : equivalent to the unit demand of 2.0 to 7.0 m³/d per GDP-1000 USD.

Table 16.12 shows numerical transition status on water supply by the phase toward 2010. It is projected that, in the whole study area, the production capacity of urban water supply and industrial water supply will increase to some 780,000 m³/day and some 1,000,000 m³/day in 2010, respectively. Figure 16.4 outlines that the rough estimation of cumulative investment amount*1 to be required for the project implementation for development reaches approximately 430 million USD*2 in 2010.

For the attainment of this goal, the necessary implementation direction in the study area is categorized as follows:

- Rehabilitation and expansion of existing water supply system in core urban centers in line with their urban development plans
- Promotion of community piped-water supply system in the urban areas, where individual water supply measures are dominant at present
- To cope with industry and tourism development projects, development of water supply system together with exploitation of raw water sources in industrial and tourism zones, and
- Relocation of raw water intake place or development of new raw water source by construction reservoir in order to avoid sea water intrusion to drinking water.

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*1 : Cumulative investment amount means the required total amount during the period from the present(1995) to the subject phase in this Report.

*2 : Investment amounts are estimated based on the unit cost of 450 USD/cu-m.day for urban water supply and 300 USD/cu-m.day for industrial water supply.

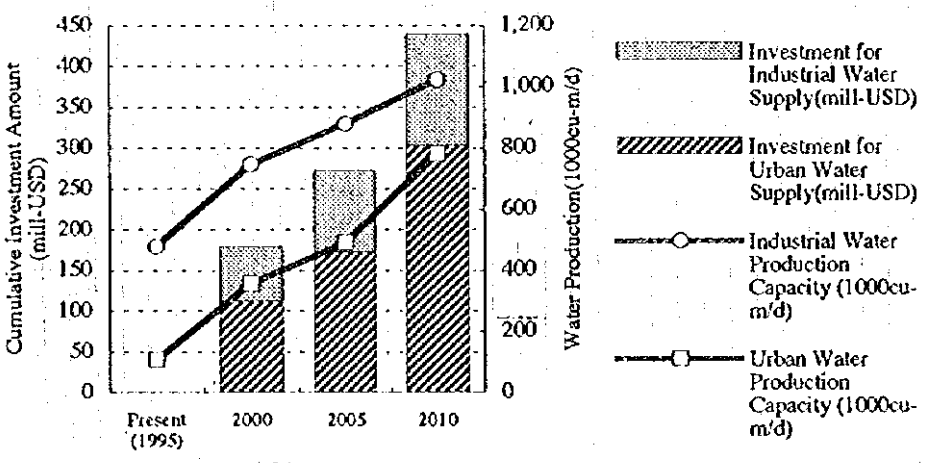
Together, for currently isolated local areas with no safe water supply in some mountain area, introduction of micro-scale safe water supply system consisting of wells equipped with hand-pump, mini-sized pump or packaged purification unit and so on are necessary.

Table 16.12 Development Plan for Water Supply in the Whole Study Area

Items	Phase			
	Present (1995)	2000	2005	2010
A. Urban Water Supply				
Population(x 1000)	4,774	5,355	5,922	6,480
Share of Urban Population(%)	22.6	24.0	27.6	33.1
Unit Consumption(lit/cap.d)	60-78	100	125	150
Population Coverage in Urban Area(%)	50-60	70	80	90
Population Coverage in the Whole Area(%)	4.8-22	24	37	50
Transmission Loss(%)	30-40	25	20	15
Non-living Consumption and Loss(cu-m/d)	61,500	196,300	245,371	350,934
Water Production Capacity(cu-m/d)	107,900	357,100	491,020	780,700
B. Industrial Water Supply				
Industry GDP(million USD)	52	90	198	387
Unit Demand(cu-m/d per GDP-1000USD)	8.0	6.9	3.7	2.2
Water Demand(cu-m/d)	414,000	621,690	731,738	851,840
Water Production(cu-m/d)	478,000	746,000	878,000	1,022,000

Note : The figures on the urban water supply are related to the piped-water supply facilities for living, commercial activities and others in urban areas including some parts of surrounding rural areas.
Source : JICA Study Team

Figure 16.4 Development and Investment Amount for Water Supply in the Study Area



Source : JICA Study Team

(2) Sewerage

In the original purpose, sewerage should work for both, flood prevention and human living/natural environment conservation by treatment for toilet and gray waste water discharged from households, and waste water from commerce and industries. As seen before, the existing sewerage in the study area, however, does not handle waste water, while it simply can contribute to discharge a part of storm water. Because periodical inundation occurring in the study area is a definite constraint for socio-economic development, one essential thing for sustainable development is to facilitate storm water drainage to protect flood incidents.

To be more important in sewerage sector, the huge pollution load*1 to be discharged from

*1 : The pollution load in terms of BOD is estimated based on: (1) 30 to 60 g/cap.day to be transited from 1995 to 2010 in urban waste water. (2) 200 to 600 mg/l to be transited from 1995 to 2010 in industrial waste water.

urban and industrial activities will make the introduction of waste water treatment to the study area a crucial matter.

It is anticipated that the volume of waste water to be discharged from urban areas and industrial zones in the study area come to be some 1,800,000 m³/day almost equal to supplied water volume in 2010. Therefore, the generated pollution load in the study area will extend from some 100 ton-BOD/day at present to 640 ton-BOD/day in 2010. It is obvious that the natural and human environment in the study area are destined to deteriorate without the introduction of waste water treatment.

Thus, the following development criteria for the sewerage sector together with expansion of storm water drainage are proposed based on the minimum requirement for the study area: The total pollution load to the environment in 2010 is controlled under the present level with the introduction of waste water treatment employing a biological process for urban and industrial waste.

Target of waste water disposal in 2010:

- Population coverage in urban waste : 93 % in urban area, and
- Treatment volume coverage in industrial waste : 95 %.

Target of storm water drainage in 2010:

- Drainage network density : 110 m/ha in urban area, and
- Drainage coverage : 100 % in urban area*1.

Table 16.13 shows the numerical transition status on sewerage by phase towards 2010. It is projected that ,in the whole study area, the generated pollution load of 640 ton-BOD/day from urban areas and industrial zones is reduced to some 95 ton-BOD/day in 2010 thanks to contribution of waste water treatment. As outlined in Figure 16.5, the rough estimation of cumulative investment amount*2 to be required for project implementation will be approximately 1,200 million USD in 2010.

Taking such present premature situation in sewerage into account, the development direction in the study area is categorized as follows:

- In flood-prone areas, rehabilitation and expansion of existing drainage for storm water, and provision of pump station, if necessary depending on topographical condition
- In core urban centers or urban centers and the areas located at the upstream of environmentally vulnerable public water course, development of sewerage accommodating waste water purification facilities as well as storm water drainage, and
- In newly constructed large-scale development zones supporting industrial and/or commercial activities, development of sewerage together with waste water purification facilities as well as storm water drainage.

(3) Solid Waste Disposal

The present collected volume ratio of solid waste in the study area is only some 60 % of generated waste and all of collected waste are simply dumped in disposal sites with no proper mitigation. To abate the growth of solid waste generation resulting from urbanization with socio-economic development, it is quite obvious, based on the results of the field survey, that the introduction and development of a series of suitable facilities over collection, transportation, intermediate disposal and final disposal system are essential in

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*1 : The increase of urbanized area is simply estimated based on the equation of;

(Urban Area in Standard Year) x [(Population in Subject Year)/(Population in Standard Year)]^0.8

*2 : The investment amounts of sewerage are estimated based on the unit cost of 800 USD/cu-m d for urban waste water disposal, 900 USD/cu-m.d for industrial waste water and 200 USD/m for storm water drainage.

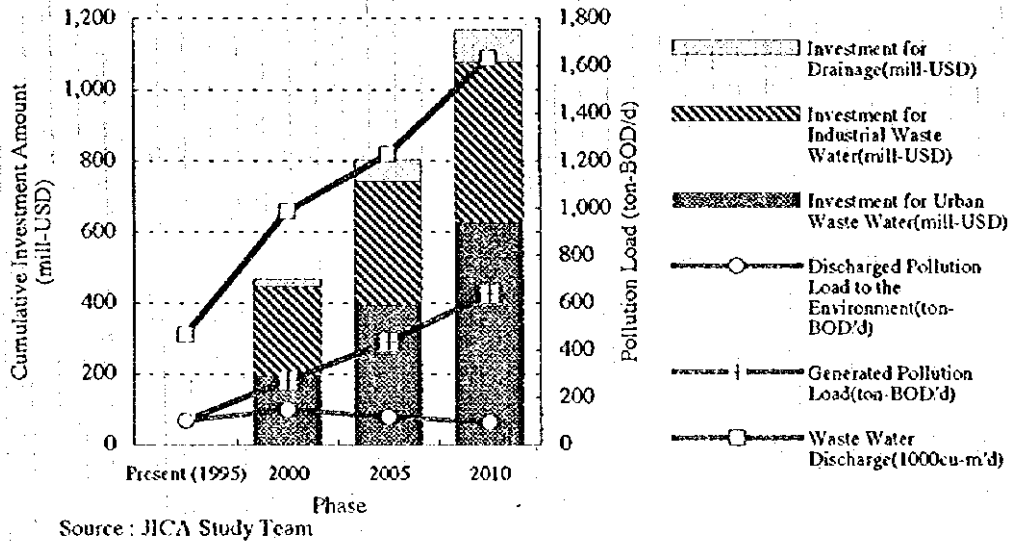
the study area.

Table 16.13 Development Plan for Sewerage in the Whole Study Area

Items	Phase			
	Present (1995)	2000	2005	2010
A. Urban Waste Water Disposal				
Population(x 1000)	4,774	5,355	5,922	6,480
Share of Urban Population(%)	22.6	24.0	27.6	33.1
Population Coverage(%)	0	50	85	93
Waste Water Discharge(cu-m/d)	116,000	357,100	491,020	780,700
Generated Pollution Load(ton-BOD/d)	32.4	51.4	81.8	129
Discharged Pollution Load to the environment(ton-BOD/d	32.4	28.3	19.2	21.0
B. Industrial Waste Water Disposal				
Industry GDP(million USD)	52	90	198	387
Unit Demand(cu-m/d per GDP-1000USD)	6.7	7.0	3.7	2.2
Treatment Coverage(%)	0	50	80	95
Waste Water Discharge(cu-m/d)	349,700	630,300	738,100	851,900
Generated Pollution Load(ton-BOD/d)	69.9	221	354	511
Discharged Pollution Load to the Environment(ton-BOD/d	69.9	121	99.2	74.1
(Urban Waste Water + Industrial Waste Water)				
Waste Water Discharge(cu-m/d)	465,700	987,400	1,229,120	1,632,600
Generated Pollution Load(ton-BOD/d)	102	272	436	640
Discharged Pollution Load to the environment(ton-BOD/d	102	149	118	95.1
C. Storm Water Drainage				
Urbanized Area(ha)	3,167	3,707	4,568	5,716
Area Coverage(%)	50	70	94	100
Drainage Density(m/ha)	55	77	103	110
Total Length of Drain Route(km)	172	286	472	629

Note : The figures on the urban waste water disposal are related to waste water living, commercial activiti in urban areas including some parts of surrounding rural areas.
Source : JICA Study Team

Figure 16.5 Development and Investment Amount for Sewerage in the Study Area



Source : JICA Study Team

The generation of urban solid waste*1 in the study area is projected to reach some 1,800 ton/day in 2010 except for industrial wastes and it can be anticipated that the obtainment of landfill sites will come difficult, since the cumulative required landfill site volume reaches about 4 million cubic-m in 2010. To mitigate such conditions, the introduction of the following reinforcement measures is essential for coordinated and safe disposal of solid waste in the study area:

Collection and transportation system	: Garbage collection vehicles, garbage relay station and haulage trucks
Intermediate disposal system	: Organic garbage composting facilities and incineration facilities, and
Final disposal system	: Sanitary landfill facilities equipped with leachate treatment system.

The major theme in solid waste disposal in the study area should focus on the expansion of collection service coverage and volume reduction of generated garbage, namely:

Target of solid waste disposal in 2010:

- Collection service coverage : 100 % population in urban area, and
- Waste volume reduction*2 : 50 % by introduction of composting and incineration.

Table 16.14 shows the numerical transition status on solid waste disposal by phase towards 2010. It is projected that, in the whole study area, the final disposed solid waste comes to some 950 ton/day in 2010, even though generated waste is reduced by some 50 % by introduction of composting and incineration. As outlined in Figure 16.6, the rough estimation of cumulative investment amount*3 to be required for the development implementation will reach approximately 290 million USD in 2010.

In the study area, where solid waste disposal still remains at a very premature stage, the development direction is categorized as follows:

- In core urban centers and in newly developed zone for industrial and commercial activities, expansion of waste collection/transportation facilities and improvement of final disposal manner, taking into account the introduction of: (1) sanitary landfill with leachate treatment, (2) incineration of combustible and toxic/hazardous waste, and (3) composting of organic garbage, and
- In large urban centers, expansion of facilities such as containers and vehicles necessary for waste collection services and waste haulage.

(4) Non-Structural Development Measures

In the development of the environmental sanitation sector of the study area, besides structural development measures mentioned above, a series of coordinated non-structural development programs as stated below should be undertaken to prevail the setup of environmental infrastructure and to foster proper utilization of facilities and relevant technologies.

- Intensification of environmental regulations to enforce environmental policy
- Formulation of a financial back-up system to encourage environmental protection measures in the private sectors

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*1 : Urban solid waste stands for the waste discharged from households, offices, markets and other service sectors.

*2 : The waste volume reduction is defined by : (Final disposed volume)/(Generated volume) x 100.

*3 : The investment amounts for solid waste disposal are estimated based on the unit costs; 5000 USD/ton.d for collection, 12000 USD/ton.d for relay and transportation, 15000 USD/ton.d for composting, 150000 USD/ton.d for incineration and 50 USD/cu-m except land cost.

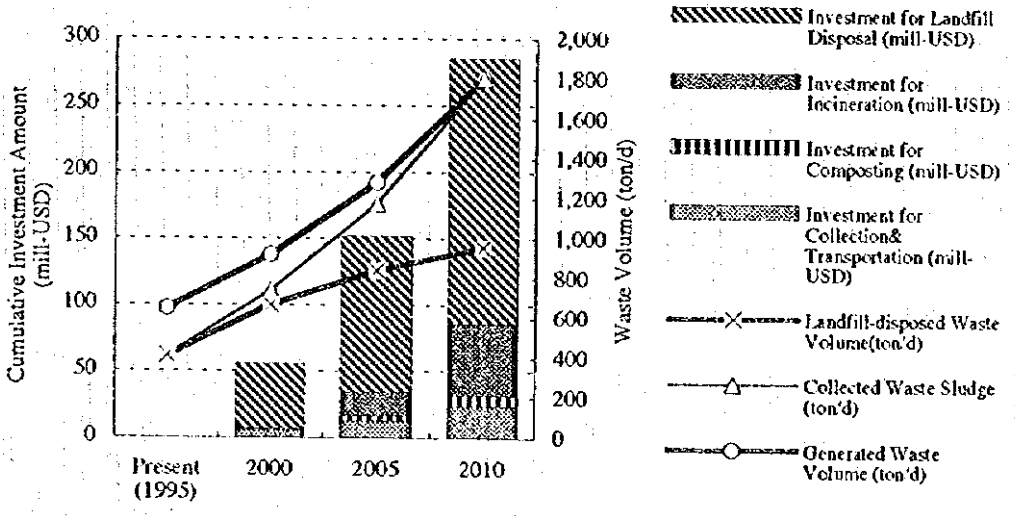
- Reinforcement of management and operation capacity in environmental sanitation facilities
- Establishment of water-saving practice in water utilization in all sectors, especially in manufacturing industries, and
- Enhancement of public awareness on environment and health care.

Table 16.14 Development Plan for Solid Waste Disposal in the Whole Study Area

Parameters	Phase			
	Present (1995)	2000	2005	2010
Urban Population(1000 people)	1,079	1,286	1,637	2,147
Unit Living Waste Discharge(g/cap.d)	500	550	580	600
Ratio of Commercial Waste(%)	20.0	30.0	35.0	40.0
Generated Solid Waste Volume(ton/d)	647	919	1,282	1,803
Population Service Coverage(%)	64	81	92	100
Collected Waste Volume(ton/d)	411	741	1,174	1,803
Composted Waste Volume(ton/d)	0	74.1	235	541
Ratio of Composting(%)	0	10	20	30
Incinerated Waste Volume(ton/d)	0	0	117	361
Ratio of Incineration(%)	0	0	10	20
Generated Ash Volume(ton/d)	0	0	17.6	54.1
Total Land-fill Disposed Waste Volume(ton/d)	411	667	839	956
Overall Waste Volume Reduction Ration(%)	0	10.0	28.5	47.0

Source : JICA Study Team

Figure 16.6 Development and Investment Amount for Solid Waste Disposal in the Study Area



Source : JICA Study Team

16.4.2 Provincial Development Plan

(1) Quang Tri Province

In Quang Tri Province, the total population and the GDP in both, industry and service sectors, are projected to reach some 800 thousand people and some 60 million USD in 2010, respectively. Such socio-economic enlargement will call for large scale expansion in all environmental sanitation subsectors as shown in Table 16.15 and the cumulative investment amount of a total of some 150 million USD until 2010 covering water supply facilities, sewerage and solid waste disposal facilities as shown in Figure 16.7.

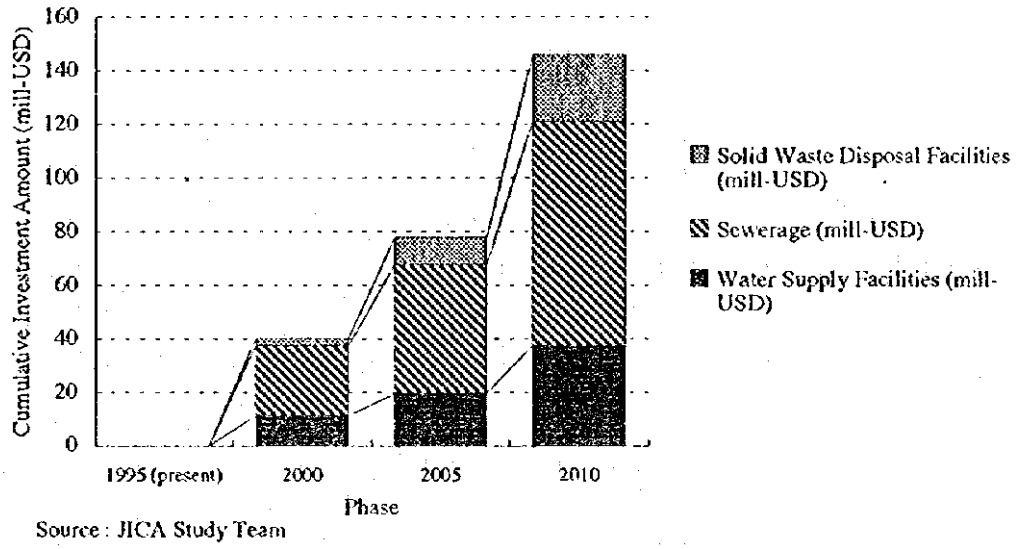
In light of effective and efficient investment in development, Dong Ha Town, Quang Tri Town, which accommodate large urban center and newly industrial zones to be constructed such as Road no.9 Estate and Nam Dong Ha-Ai Tu Estate will come to be important subject areas for the implementation of environmental sanitation infrastructure.

Table 16.15 Projection for Environmental Sanitation Infrastructure in Quang Tri Province

Parameters	Phase			
	1995 (present)	2000	2005	2010
1. Socio-Economic Development Frame				
Urban population(1000 people)	91	119	170	244
Rural Population(1000 people)	455	508	540	549
Industry Sector GDP(million-USD)	3.1	4.1	6.6	11.3
Service Sector GDP(million-USD)	11.2	22.9	35.6	51.6
2. Water Supply Facilities				
Produced Water in Urban Piped-Water Supply System(cu-m/d)	11,500	32,900	51,120	88,800
Produced Water in Industrial Water Supply System(cu-m/d)	27,700	33,400	33,400	35,800
3. Sewerage				
A. Waste Water Disposal Facilities				
Generated Pollution Load from Urban Waste Water(ton-BOD/d)	2.7	4.7	8.5	14.7
Generated Pollution Load from Industrial Waste Water(ton-BOD/d)	5.5	11.7	16.0	21.5
Discharged Pollution Load to the Environment(ton-BOD/d)	8.3	9.0	6.5	5.5
B. Storm Water Drainage				
Urbanized Area(ha)	524	646	864	1,153
Total Length of Drain Route(km)	2.0	38.8	86.4	126.8
4. Solid Waste Disposal Facilities				
Generated Waste Volume(ton/d)	54.7	84.7	133.4	205.2
Collected Waste Volume(ton/d)	8.2	42.4	100.1	205.2
Composted Waste Volume(ton/d)	0	4.1	19.3	61.6
Incinerated Waste Volume(ton/d)	0	0	9.6	41.0
Landfill-Disposed Waste Volume(ton/d)	8.2	38.1	71.5	108.7

Note : The figures in this table is computed using the socio-economic development indicators explained in this section.
Source : JICA Study Team

Figure 16.7 Projection of Investment Amount for Environmental Sanitation Infrastructure in Quang Tri Province



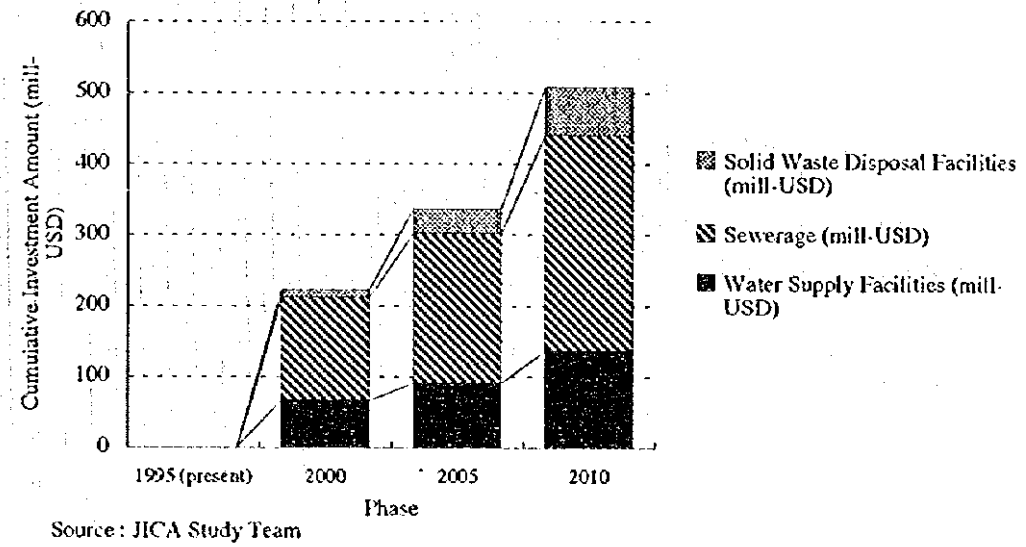
Source : JICA Study Team

(2) TT-Hue Province

In TT-Hue Province, the total population and the GDP in both, industry and service sectors, are projected to reach some 1.4 million people and some 400 million USD in 2010, respectively. Such socio-economic enlargement will call for large scale expansion in all environmental sanitation subsectors as shown in Table 16.16 and the cumulative investment amount of total some 500 million USD covering water supply facilities, sewerage and solid waste disposal facilities until 2010 as shown in Figure 16.8.

In light of effective and efficient investment in development, Hue City, which accommodates large urban center and is also promising center for tourism zone in the central region, and industrial zones such as Chan May Port Zone, Phu Bai Estate to be constructed newly will come to be important subject areas for the implementation of environmental sanitation infrastructure.

Figure 16.8 Projection of Investment Amount for Environmental Sanitation Infrastructure in TT-Hue Province



Source : JICA Study Team

Table 16.16 Projection for Environmental Sanitation Infrastructure in TT-Hue Province

Parameters	Phase			
	1995 (present)	2000	2005	2010
1. Socio-Economic Development Frame				
Urban population(1000 people)	270	336	429	548
Rural Population(1000 people)	767	834	872	878
Industry Sector GDP(million-USD)	16.1	31.1	57.5	111.2
Service Sector GDP(million-USD)	31.1	49.6	121.2	296.1
2. Water Supply Facilities				
Produced Water in Urban Piped-Water Supply System(cu-m/d)	25,000	93,300	128,800	199,100
Produced Water in Industrial Water Supply System(cu-m/d)	157,600	275,800	306,400	350,800
3. Sewerage				
A. Waste Water Disposal Facilities				
Generated Pollution Load from Urban Waste Water(ton-BOD/d)	8.1	13.4	21.5	32.9
Generated Pollution Load from Industrial Waste Water(ton-BOD/d)	26.3	80.4	122.5	175.4
Discharged Pollution Load to the Environment(ton-BOD/d)	34.4	51.6	39.4	30.8
B. Storm Water Drainage				
Urbanized Area(ha)	1,190	1,420	1,720	2,090
Total Length of Drain Route(km)	43.4	84.9	172.3	230.3
4. Solid Waste Disposal Facilities				
Generated Waste Volume(ton/d)	162	240	336	460
Collected Waste Volume(ton/d)	64.7	168	303	460
Composted Waste Volume(ton/d)	0	17.0	61.0	138
Incinerated Waste Volume(ton/d)	0	0	30.3	92.0
Landfill-Disposed Waste Volume(ton/d)	64.7	151	216	244

Note : The figures in this table is computed using the socio-economic development indicators explained in this section.
Source : JICA Study Team

(3) QN-Da Nang Province

In QN-Da Nang Province, the total population and the GDP in both, industry and service sectors, are projected to reach some 2.6 million people with high urbanization ratio of some 40% population, and some 270 million USD in 2010, respectively. Such socio-economic enlargement will call for large scale expansion in all environmental sanitation subsectors as shown in Table 16.17 and the cumulative investment amount of total some 800 million USD covering water supply facilities, sewerage and solid waste disposal facilities until 2010 as shown in Figure 16.9.

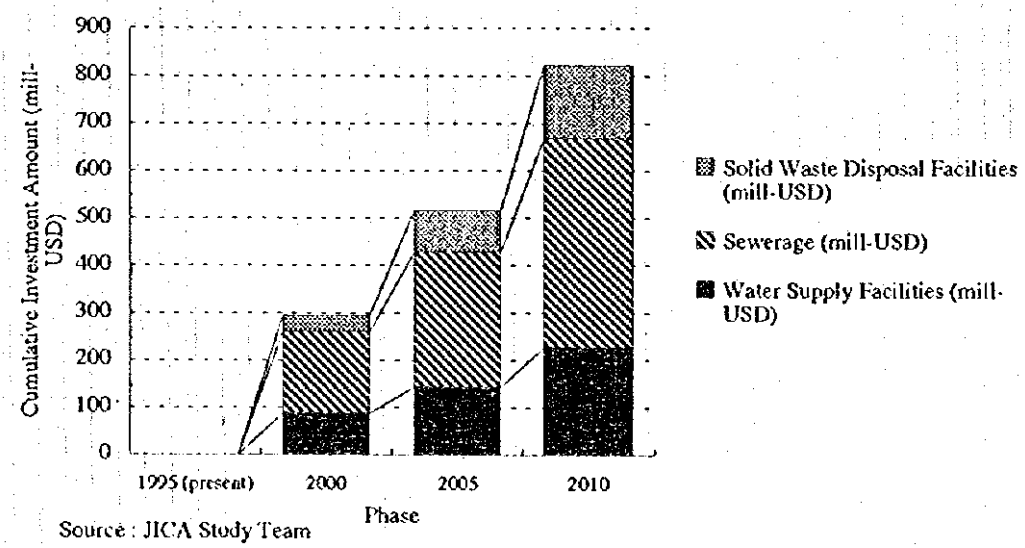
In light of effective and efficient investment in development, Da Nang City, Hoi An Town and Tam Ky which accommodate large urban center and also include promising center for tourism zone in the central region, and industrial zones such as Da Nang EPZ, Hoa Khanh Estate and Dien Ngoc-Dien Nam Estate to be constructed newly will come to be important subject areas for the implementation of environmental sanitation infrastructure.

Table 16.17 Projection for Environmental Sanitation Infrastructure in QN-Da Nang Province

Parameters	Phase			
	1995 (present)	2000	2005	2010
1. Socio-Economic Development Frame				
Urban population(1000 people)	613	700	852	1,089
Rural Population(1000 people)	1,370	1,500	1,555	1,528
Industry Sector GDP(million-USD)	22.5	30.5	52.1	90.2
Service Sector GDP(million-USD)	44.0	58.9	103.9	183.0
2. Water Supply Facilities				
Produced Water in Urban Piped-Water Supply System(cu-m/d)	69,500	194,300	255,600	395,900
Produced Water in Industrial Water Supply System(cu-m/d)	133,500	241,400	330,500	399,900
3. Sewerage				
A. Waste Water Disposal Facilities				
Generated Pollution Load from Urban Waste Water(ton-BOD/d)	18.4	28.0	42.6	65.3
Generated Pollution Load from Industrial Waste Water(ton-BOD/d)	22.3	70.4	132.2	200.0
Discharged Pollution Load to the Environment(ton-BOD/d)	40.6	54.1	47.0	39.6
B. Storm Water Drainage				
Urbanized Area(ha)	1,140	1,270	1,480	1,800
Total Length of Drain Route(km)	119.3	139.3	163.1	198.4
4. Solid Waste Disposal Facilities				
Generated Waste Volume(ton/d)	368	500	667	915
Collected Waste Volume(ton/d)	294	450	634	915
Composted Waste Volume(ton/d)	0	45	127	274
Incinerated Waste Volume(ton/d)	0	0	63.4	183
Landfill-Disposed Waste Volume(ton/d)	294	405	453	485

Note : The figures in this table is computed using the socio-economic development indicators explained in this section.
Source : JICA Study Team

Figure 16.9 Projection of Investment Amount for Environmental Sanitation Infrastructure in QN-Da Nang Province



Source : JICA Study Team

(4) Quang Ngai Province

In Quang Ngai Province, the total population and the GDP in both, industry and service sectors, are projected to reach some 1.6 million people, and some 240 million USD as high as about 17 times growth in 2010, respectively. Such socio-economic enlargement will call for large scale expansion in all environmental sanitation subsectors as shown in Table 16.18 and the cumulative investment amount of a total of some 280 million USD covering water supply facilities, sewerage and solid waste disposal facilities until 2010 as shown in Figure 16.10.

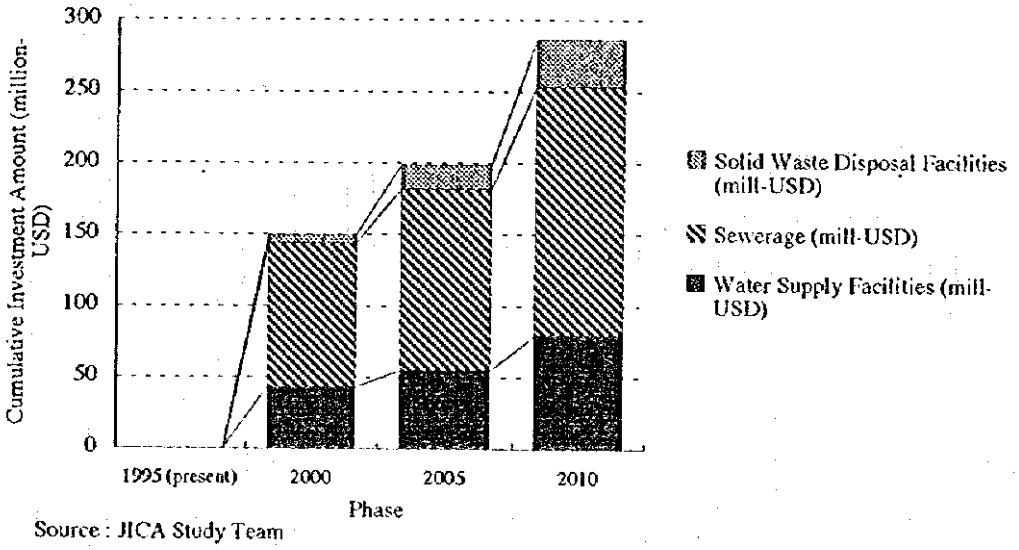
In light of effective and efficient investment in development, Quang Ngai Town which accommodates large urban center and Dung Quat industrial town to be constructed newly at mega-scale will come to be important subject areas for the implementation for environmental sanitation infrastructure.

Table 16.18 Projection for Environmental Sanitation Infrastructure in Quang Ngai Province

Parameters	Phase			
	1995 (present)	2000	2005	2010
1. Socio-Economic Development Frame				
Urban population(1000 people)	105	132	185	266
Rural Population(1000 people)	1,103	1,226	1,319	1,378
Industry Sector GDP(million-USD)	10.2	24.4	81.3	174.5
Service Sector GDP(million-USD)	11.4	16.5	33.1	66.6
2. Water Supply Facilities				
Produced Water in Urban Piped-Water Supply System(cu-m/d)	10,000	36,600	55,500	96,900
Produced Water in Industrial Water Supply System(cu-m/d)	95,400	199,200	209,900	228,700
3. Sewerage				
A. Waste Water Disposal Facilities				
Generated Pollution Load from Urban Waste Water(ton-BOD/d)	3.2	5.3	9.3	16.0
Generated Pollution Load from Industrial Waste Water(ton-BOD/d)	16.0	58.1	83.6	114.3
Discharged Pollution Load to the Environment(ton-BOD/d)	19.1	34.9	25.6	19.2
B. Storm Water Drainage				
Urbanized Area(ha)	316	379	498	666
Total Length of Drain Route(km)	7.8	22.8	49.8	73.3
4. Solid Waste Disposal Facilities				
Generated Waste Volume(ton/d)	63.1	94.2	145	224
Collected Waste Volume(ton/d)	44.1	80.1	138	224
Composted Waste Volume(ton/d)	0	8	28	67
Incinerated Waste Volume(ton/d)	0	0	14	45
Landfill-Disposed Waste Volume(ton/d)	44.1	72.1	98.4	119

Note : The figures in this table is computed using the Socio-economic development indicators explained in this section.
Source : JICA Study Team

Figure 16.10 Projection of Investment Amount for Environmental Sanitation Infrastructure in Quang Ngai Province



Source : JICA Study Team

16.5 DEVELOPMENT PROJECTS

The development projects shown in Table 16.19 are candidate ones for the environmental sanitation sector, including water supply, sewerage and solid waste disposal. Though these candidate projects have emerged based on the results of the development plan discussed before, it should be understood that these projects and their objectives described here is subject to more precise examinations from the view points of implementation priority both, in the study area and in each Province. It also should be noted that some projects or a part of project's objectives and scopes are accommodated in the development plan in other sectors through the course of project/programs compile in this study.

The projects marked by asterisk in the priority level column of Table 16.19 are regarded as highest priority ones to call for urgent implementation from the view point of necessity and viability like:

Necessity:

(1) Extremely inadequate situation at present that crucially hampers human health/living conditions, natural environment and constrains socio-economic development

(2) Certain possibilities in severe negative impacts in future, which are resulting from socio-economic growth or constrains socio-economic development, and

(3) Existence of huge and strong demand, which will greatly contribute to other sector development.

Viability:

(1) High probability of mobilizing necessary funds for project financing including ODA,

(2) Existence of people's awareness of the development with their support for implementation.

The projects marked by double asterisk(**) in the priority level column are described in the Pre-Feasibility study Report and the one marked by single asterisk(*) in the priority level column are described in detail in the Appendix of the Main Report .

Table 16.19 (1/2) Candidate Development Projects for Environmental Sanitation

Code No	Name of Project	Priority Level	Subsector Field			Description
			Water Supply	Sewerage	Solid Waste Disposal	
1. Quang Tri Province						
SANI-01	Expansion of piped-water supply system in Dong Ha, Quang Tri		*			The existing system, which is suffering from superannuating, will be rehabilitated and expanded to meet the water demand.
SANI-02	Expansion of storm water drainage in Dong Ha, Quang Tri			*		The existing drainage, which cover quite limited area of urban area, will be expanded to increase storm water discharge capacity.
SANI-03	Reinforcement of solid waste disposal facilities in Dong Ha, Quang Tri				*	The existing system, which is too poor to handle generated garbage, will be reinforced by provision of adequate vehicles and other facilities necessary for garbage disposal.
SANI-04	Development of water supply facilities and sewerage and solid waste disposal facilities in newly constructed industrial zones such as Road no.9 industrial estate and Nam Dong-Ai Tu industrial estate		*	*	*	The construction for water supply facilities and sewerage(waste water disposal facilities and storm water drainage) and solid waste disposal facilities will take place to support industrial activities including some surrounding parts of industrial zones, if any.
2. TT-Hue Province						
SANI-05	Sewerage improvement project in the Hue Citadel	*		*		While Hue is a promising tourism center in the Central Region, the world vestiges is facing at the risk of deterioration due to periodical flooding, especially inside the Citadel. The rehabilitation of existing drainage and new construction of waste water disposal facilities will improve such environment within the Citadel.
SANI-06	Development of piped-water supply Facilities in Huong Thuy and Phu Loc		*			The present individual water supply apparatus will be replaced by piped-water supply system to secure safe water provision.
SANI-07	Development of water supply facilities, sewerage and solid waste disposal facilities in Lang Co	**	*	*	*	The Construction of piped-water supply facilities, sewerage(waste water disposal facilities and storm water drainage) and solid waste disposal facilities will take place in Lang Co and relevant areas in line with tourism development.
SANI-08	Expansion and rehabilitation of water supply facilities in Hue		*			The existing water supply facilities, which are still remaining at low service level, will be expanded and rehabilitated, including examination for raw water intake place where does not suffer from sea water intrusion.
SANI-09	Expansion of sewerage in Hue			*		The existing storm water drainage, which is insufficient capacity due to shortage of networks and superannuating, will be rehabilitated and be accompanied by waste water treatment facilities.
SANI-10	Reinforcement of solid waste in Hue				*	The existing solid waste disposal facilities will be reinforced by provision of waste collection and transportation equipment. Sanitary landfill to replace present open dumping and incineration for toxic waste will be introduced.
SANI-11	Development of water supply facilities, sewerage and solid waste disposal facilities in newly constructed industrial zones such as Chen May and Phu Bai		*	*	*	Water supply facilities, sewerage and solid waste disposal facilities will be developed as utility facilities for industrial zones, including a part of surrounding area, if any.

Table 16.19(2/2) Candidate Development Projects for Environmental Sanitation

Code No.	Name of Project	Priority Level	Subsector Field			Description
			Water Supply	Sewerage	Solid Waste Disposal	
3. QN-Da Nang Province						
SANI-12	Rehabilitation of water supply facilities in Da Nang		*			The existing water supply facilities are suffering from periodical sea water intrusion due to improper intake place of raw water. Some reliable water source will be examined and provided to secure safe raw water source.
SANI-13	Development of piped-water supply facilities in Hoa Vang, Duy Xuyen and Tra My		*			The present individual water supply apparatus will be replaced by piped-water supply system to secure safe water provision.
SANI-14	Development of sewerage in Da Nang			*		The existing storm water drainage, which is insufficient capacity due to superannuating, will be rehabilitated and be accompanied by waste water treatment facilities.
SANI-15	Reinforcement of solid waste disposal facilities in Da Nang				*	The existing solid waste disposal facilities will be reinforced by provision of waste collection and transportation equipment. Sanitary landfill to replace present open dumping and incineration for toxic waste will be introduced.
SANI-16	Development of water supply facilities, sewerage and solid waste disposal facilities in the south new town of Da Nang		*	*	*	Water supply facilities which is estimated to be some 150,000 cu-m/day, sewerage and solid waste disposal facilities will be developed as utility facilities for industrial town, including a part of surrounding area, if any.
SANI-17	Improvement of water supply facilities and Sewerage in Hoi An	**	*	*		The existing water supply system will be expanded to meet the water demand. And the existing sewerage, which cover quite limited area out of urban area, will be expanded to increase storm water discharge capacity to be equipped with waste water treatment plant.
SANI-18	Development of water supply facilities, sewerage and solid waste disposal facilities in the north new town of Da Nang		*	*	*	Water supply facilities, sewerage and solid waste disposal facilities will be developed as utility facilities for industrial zones, including a part of surrounding area, if any.
4. Quang Ngai Province						
SANI-19	Expansion of piped-water supply system in Quang Ngai		*			The existing system, which is suffering from superannuating will be rehabilitated and expanded to meet the water demand.
SANI-20	Development of piped-water supply Facilities in Son Tin, Tu Nghia		*			The present individual water supply apparatus will be replaced by piped-water supply system to secure safe water provision.
SANI-21	Expansion of storm water drainage in Quang Ngai			*		The existing drainage, which covers quite limited area out of urban area, will be expanded to increase storm water discharge capacity.
SANI-22	Reinforcement of solid waste disposal facilities in Quang Ngai				*	The existing system, which is too poor to handle generated garbage, will be reinforced by provision of adequate vehicles and other facilities necessary for garbage disposal.
SANI-23	Development of water supply facilities, sewerage and solid waste disposal facilities in Dung Quat Industrial Port Town	**	*	*	*	Water supply facilities, sewerage and solid waste disposal facilities will be developed as utility facility for industrial zones, including a part of surrounding area, if any.

Notes : The projects marked by (**) in the column of Priority Level are the subject for Pre-Feasibility Study and the project marked by (*) is detailed in the Appendix of Main Report.
Source : JICA Study Team

CHAPTER 17 SOCIAL DEVELOPMENT

17.1 PRESENT CONDITION

The social development component of this study shall basically cover "basic human needs," social infrastructure and social services, such as "health care" and "education," with particular attention to the socioeconomic situation of the people living in the remote mountainous regions, who compose the majority of the poorest strata of the society in Viet Nam. Other fields of social aspects such as water supply, sewerage, electricity, and roads shall be covered by each specialist who is assigned for the task, but the conditions at the District and commune levels of the study area are included in this section.

17.1.1 General Overview

General overview of the Vietnamese social situation in one word is still poor, but socially stable. However, after initiation of the "doi moi" policy, the socioeconomic conditions have been and are rapidly changing.

Economic activities in large cities are extremely brisk, but the situation in small towns and the rural area is quite different. The disparity between some of the prosperous regions and the other regions, the disparity between the urban and the rural area, are substantial. And, poverty of the people in the mountainous regions needs special attention.

Because the government of Viet Nam is particularly concerned about the development of rural areas and the mountainous regions, the focus of this study has been also placed on them.

1) Population

The population of Viet Nam in 1994 is estimated as 72 million. (See attached tables for population). The ratio between male and female is approximately 51.2%:48.8%.

Of 72 million, the four target provinces have 4.66 million, accounting for 6.4%. The Province of Quang Tri has 535 thousand, Thua Thien-Hue has 995 thousand, Quang Nam-Da Nang has 1,953 thousand and Quang Ngai Province has 1,179 thousand of population.

Concentration of population in urban areas is high in the Provinces that have large cities, but still low in other Provinces. While national average of the concentration in 1994 is about 19.8%, the ratio in Quang Tri Province is 16.7%, Thua Thien-Hue 25.8%, Quang Nam-Da Nang 30.9% and in Quang Ngai Province it is 8.7%.

Of the above population, 9 million of ethnic minorities are dispersed in the land of Viet Nam.

2) Ethnic Composition

Available data indicate that there are 53 ethnic minorities in Viet Nam including very small groups of only a few hundred population. The major ethnic group is the Kinh or Viet who composes approximately 87% of the entire population. Ethnic minorities are called by various different names and are divided into small local groups of different names, but they are officially grouped by language families and groups. There are 3 major language families and 8 major groups.

The Kinh generally live in the urban and lowland areas of the entire country. The largest number and groups of ethnic minorities can be seen in the northern highlands followed by the central and southern highlands. The ethnic minorities that live in the study area are the Xo-dang (the total population 97,000), the Hre (94,000), the Bru-Van Kieu (40,000), the Co-tu (37,000), the Gie-trieng (27,000), the Ta-oi (26,000), and Co (23,000) people of the Mon-

Khmer Group belonging to the Austro-Asian language family.

A large number of Bru-Van kieu people and Pa Ko-Ta Oi people are in the mountainous regions of Quang Tri Province and Thua Thien-Hue Province, Co-Tu people inhabit the western mountains and southwestern region of Thua Thien-Hue Province. Co-Tu people are also in the northwestern mountainous region of the Quang Nam-Da Nang Province. Gie-trieng and Hre people are in Quang Nam-Da Nang and Quang Ngai Provinces.

They used to maintain their own cultures, traditions and social systems, but many of such traditions have been and are being absorbed or assimilated into Kinh's culture. Some rituals and festivities are still carried out and traditional attires are maintained by many groups.

In the past, those people had been living very much independently practicing shifting agriculture, separated from the Kinh, the people of lowland areas. Even now, it is said that, the relation between the Kinh and ethnic minorities is not necessarily of an equal respect, but ethnic conflicts are unheard of.

3) Language

Many ethnic minorities have their own languages. Although presently education in Viet Nam from primary level is given in Vietnamese, there are a number of older people among ethnic minorities, who do not speak Vietnamese, but speak only their own language. Those people had no opportunities of receiving any formal education for various reasons.

4) Rural Communities

As explained in Chapter 3, Development Administration, the smallest administrative unit in Viet Nam is a commune. There are more than 10,000 communes in the whole country. Of which 706 communes exist in the study area as of June 1996.

The communes consist of a few to a number of villages or hamlets depending on the size of the commune. Each village is led by a chief elected by its people and the chief is supported by one assistant and one secretary.

The three communes in the mountainous region of the District of Huong Hoa, Quang Tri Province that were visited by the study team comprise roughly ten villages. The communes have 1,300 to 2,100 population, and each commune has approximately 300 to 480 households. Each village has 30 to 50 households. The female population of the three communes are considerably lower than the male population.

The communes and villages in Huong Hoa District are largely scattered occupying about half of the surface area of the Quang Tri Province. Villagers in Viet Nam generally live in clusters, sometimes in rows or at random.

The land for cultivation is already extremely scarce in Viet Name, and thus the allocation of farm land for each household in average is less than one hectare. However, because of the scattered population and difficult natural environment, large areas of cultivable land are still available in the mountainous regions. Some of the so called "mountainous villages" are not necessarily in mountains in our sense like in Japan or Nepal. Often they are in gentle hills or in open areas of mountainous regions.

At household level, each farm household decides its own farm production after the enforcement of the "doi moi" policy and disbandment of cooperatives. At the village level, each village prepares its development master plan each year based on the people's production plan and development requests. Then, the Commune People's Committee shall prepare a master plan for the commune each year and submit it to the District People's Committee. The final decision of an overall development plan of the District and each Commune shall be made by the District People's Committee.

Each Commune has various mass organizations such as "women's union," "farmers' union," "youth union," or "veterans' union," which are basically formed by the government. The chairman of each organization is thus paid by the government. These mass organizations play an important role in the development of rural households and villages. They shall directly

assist households by contributing necessary labor to needy households or they shall carry out some projects leading villagers.

Table 17.1 Present Number Of Communes In Four Provinces (As of December 1995)

Province/District	No. of Commune	Province/District	No. of Commune	Province/District	No. of Commune
Quang Tri Province	**126**	**Quang Nam-Da Nang Province**	**245**	**Quang Ngai Province**	**157**
Dong Ha Town	2	Hoi An Town	7	Quang Ngai Town	4
Vinh Linh District	22	Tam Ky Town	12	Ly Son District	2
Gio Linh District	19	Hoa Vang District	19	Binh Son District	23
Cam Lo District	9	Hien District	15	Tra Bong District	19
Trieu Phong District	22	Dai Loc District	17	Son Tinh District	12
Hai Lang District	21	Dien Ban District	16	Son Tay District	4
Huong Hoa District	31	Duy Xuyen District	14	Son Ha District	16
Thua Thien-Hue	**14**	Giang District	9	Tu Nghia District	16
Hue City	5	Que Son District	17	Nghia Hanh District	10
Phong Dien District	15	Thang Binh District	21	Minh Long District	5
Quang Dien District	10	Phuoc Son District	9	Mo Duc District	12
Huong Tra District	15	Hiep Duc District	11	Duc Pho District	13
Phu Vang District	21	Tien Phuoc District	15	Ba To District	17
Huong Thuy District	11	Nui Thanh District	15		
Phu Loc District	17	Tra My District	20		
Nam Dong District	9	Hoang Sa District	-		
A Luoi District	21				

Source: Taken from the State Planning Committee of each Province.

5) Women's Status (WID)

Women's legal status in Viet Nam is very much equal to that of men. There is no law to systematically discriminate women from the rights that men can enjoy.

However, when it comes to real life, the picture looks different. Although the society of Viet Nam appears to be free of traditional and rigid social customs that bind women in some ways, especially in urban areas, a strong influence of the traditional Chinese culture, Confucianism, can be seen in everyday life. The effect seems to be particularly strong in the northern regions, where historically China had often invaded.

Regardless of the fact that Vietnamese women fought the wars along with their men, regardless of the fact that women do almost any kind of heavy labor and often work much harder engaged in such as road construction, irrigation construction, and carrying heavy load that in other countries mostly men shall do, still in many cases women are often placed below men socially, or they are paid less for the same work as men do. The low status of women seems to be more notable and rigid in the rural area.

The differences of ratios in school enrollment and literacy rate can be some evidence of the lower status of women. Further, all rural Communes visited by the study team, had no women representatives for their board members or People's Committee members, except for the Women's Union. The reason for this under-representation is that the qualification for the members is "literacy", but there are only very few literate women in poor communes or communes of minority groups. No other available statistics to tell the discrimination were obtained, but evidence can be easily found in everyday life. Even so, many women are energetically participating in social and economic activities of all fields.

The Women's Union of Viet Nam is working hard to improve women's status and to eliminate such social injustice by assisting women for their development and improvement of their life.