

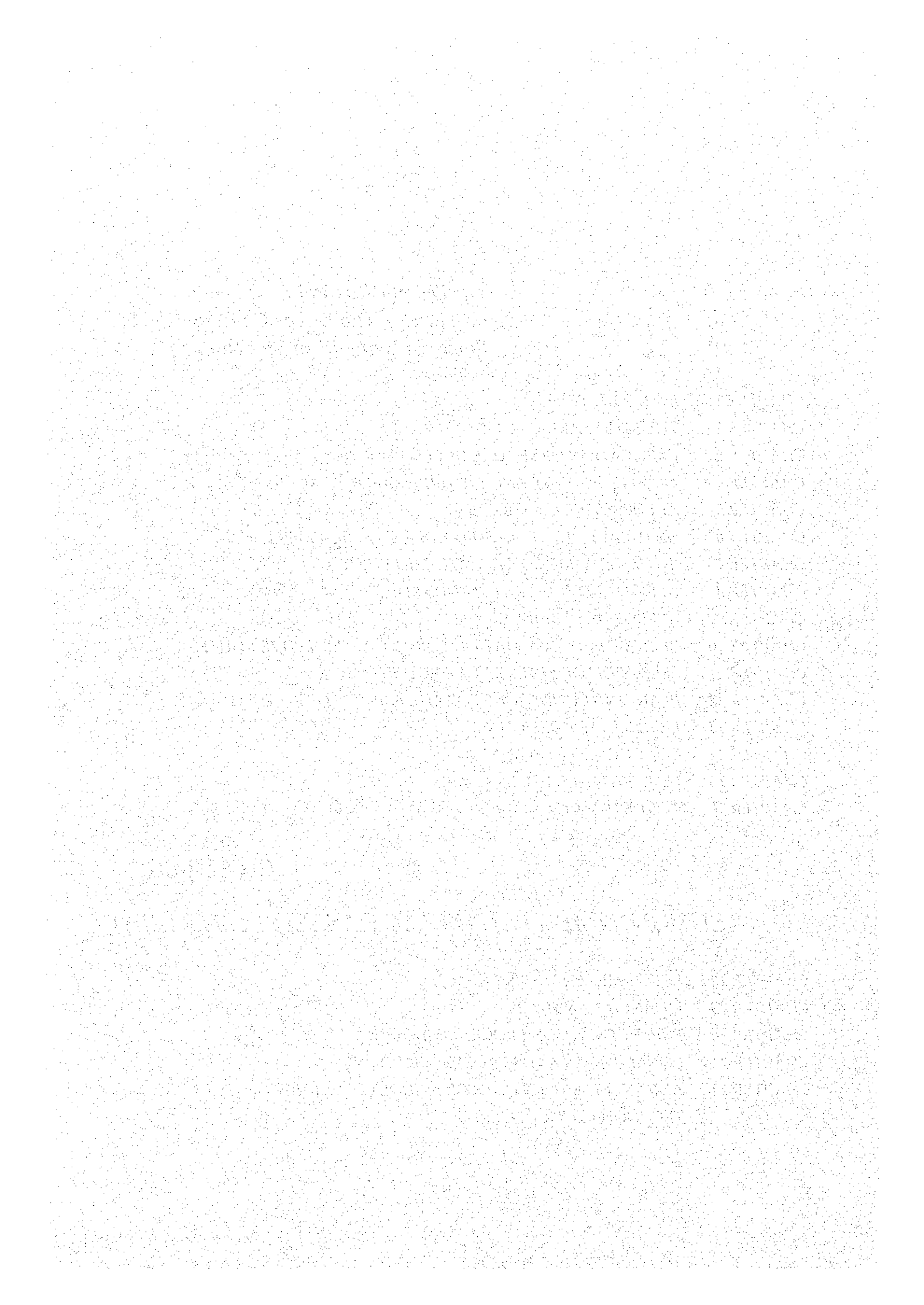
***The Feasibility Study
on The Can Tho Bridge Construction in
Socialist Republic of Viet Nam***

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CHAPTER 17 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

17.1. Existing Natural Environment

17.1.1 Physical Environment

The proposed Can Tho Bridge is located in the central part of the Mekong Delta, on the Hau Giang (Hau River) tributary channel, close to the existing Can Tho Ferry. The ferry is the main river crossing infrastructure connecting Can Tho City (Can Tho Province) on the south bank of the Hau River and Binh Minh District (Vinh Long Province) on the north bank of the river.

(1) Climate

The study area is a part of the Mekong Delta which is influenced by a monsoon climate with heavy rainfall occurring in the rainy season lasting from May to November. During this season, waterways are subjected to bank erosion and siltation. In the dry season (lasting from December to April when the river discharge is at its lowest, water levels in several channels are lower making navigation impossible and at several places vessels have to wait for high tides.

There are many storms occurring annually in the Mekong Delta region. The number of stormy days is estimated at 100-140 every year. The storm season lasts from June to October, but typhoons generally do not reach the southern part of the Mekong Delta. As shown by the meteorological statistical data, there were only 8 typhoons that reached the southern coast in the last 55 years. The typhoon in June 1981 was a large one that attacked the area with a wind velocity of 30m/s, or 108 km/h. Usually, the typhoons lose almost of their power before they reach the coast of the Mekong Delta region.

(2) Physical characteristics

The Mekong Delta is an extensive fan-like area of floodplain alluvial deposits built up at the mouth of the Mekong River, and covers an area of almost 39,000 sq.km.

The channels of the Mekong River form a highly braided system with eight main tributary channels across the delta, migrating slowly

upstream. The flat terrain is only relieved by the natural levee banks and is generally lower than 1 m above mean sea level.

The sediment load is high and consist of Holocene sandy silts and clays, more than 50 meter deep, overlying approximately 1,700 meters of Pleistocene sands and gravels. The lowermost recent (finer) sediments are almost certainly initially of marine and near shore origin, laid as the delta advanced following the Holocene postglacial rise in sea level. Mangrove forests would have built up and later diminished as the delta shoreline advanced, making these lower Holocene sediments rich in organic sulfides.

The alluvial soils of the delta area give rise to two potential environmental problems: 1) soil salinity, and 2) acid sulfate effluence.

Nearly a half of Mekong Delta in the eastern region (especially the provinces of Minh Hai, Ben Tre, Tra Vinh, Kien Giang) is affected by salinity intrusion with the water salinity $S \geq 4\text{g/l}$ during at least 3 months each year (Fig. 16.1).

The Mekong River discharge varies greatly for different months of the year. The mean annual flow of the Mekong is 437 billion m^3 , or about 14,000 m^3/s . However, in the dry season in March and April, it is only about 2,000 m^3/s , while in December, about 6,000 m^3/s . During September in the flood season, it can reach over 40,000 m^3/s .

Maximum discharges occur during the southwest monsoon period (September to October) and during this period, major flooding of the Mekong Delta occurs between Phnom Penh to just upstream of My Thuan. Below My Thuan, only minor rises of up to 250mm (1 in 500 year return period) occur above the tidal variation.

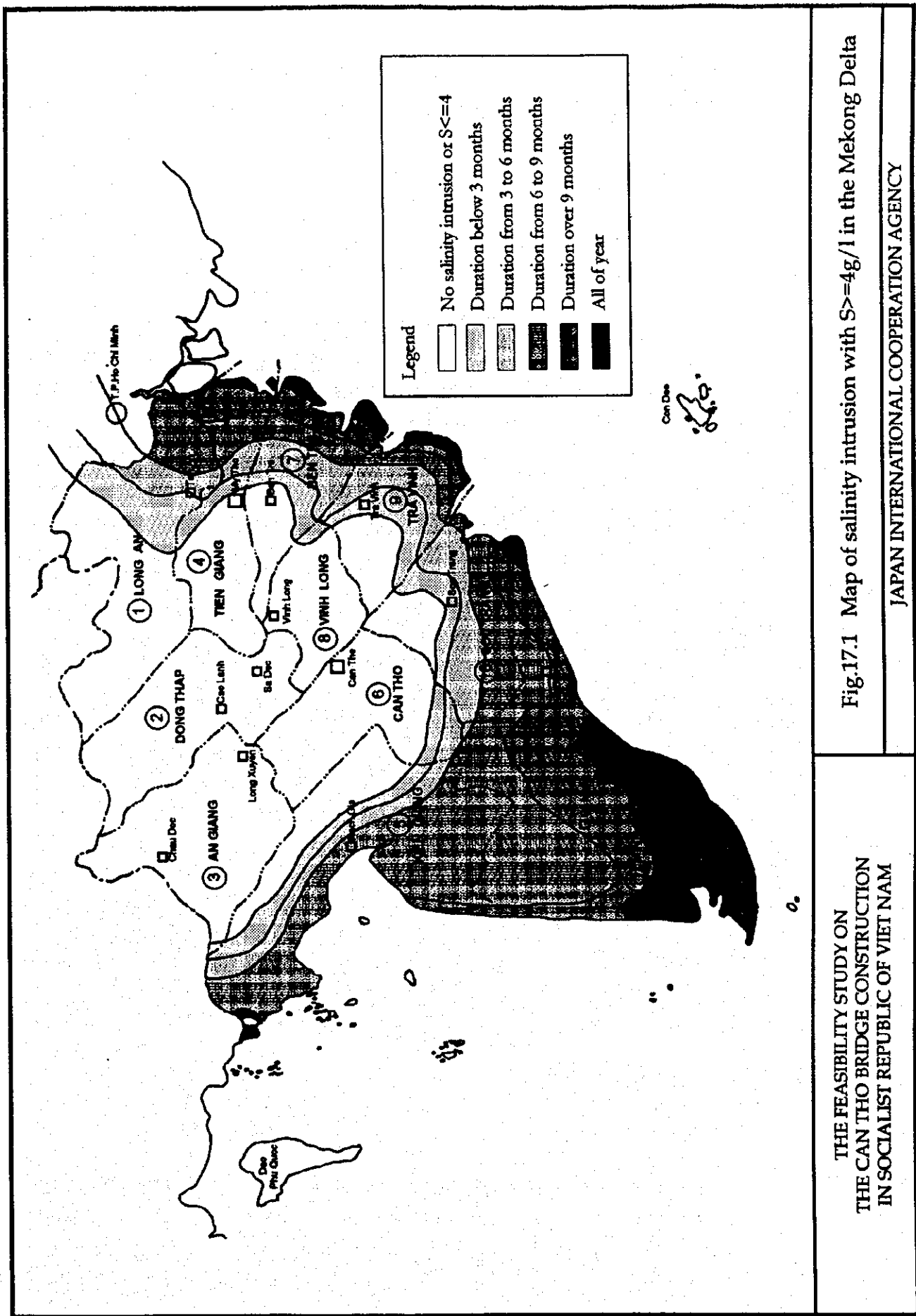


Fig.17.1 Map of salinity intrusion with $S \geq 4g/l$ in the Mekong Delta

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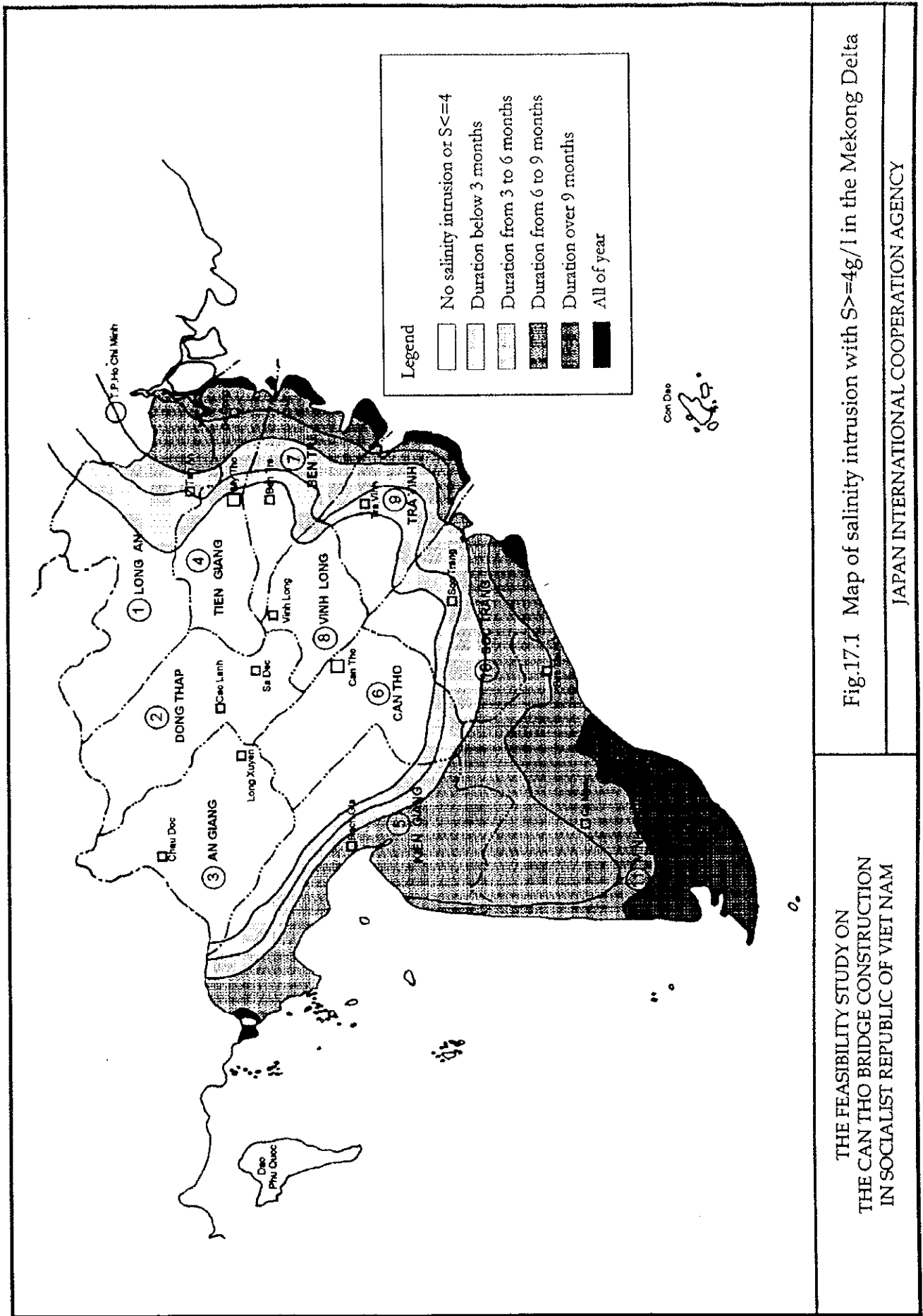


Fig.17.1 Map of salinity intrusion with $S > 4g/l$ in the Mekong Delta

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The Mekong Delta is also affected by tides. Two tidal regimes occur in the region: The semi-diurnal (twice daily) tides in the South China Sea with an high amplitude of 2.00 - 3.75 m and the diurnal (daily) tides in the Gulf of Thailand with a small amplitude of 0.4 - 1.2 m. During the dry season, when the river discharge is low, reversal of the direction of river flow is wide spread in the river system. There are associated seasonal changes in the sediment load, salinity and pH.

As shown by Table 17.1, a very high siltation rates occur in the area subject to regular and prolonged salinity intrusion. Lower siltation rates (but still rather high) are recorded in the fresh water zones. Consequently, major maintenance dredging operations will need to be carried out annually in the brackish water zone, where fishery activities take place. This may cause local disturbance to aquatic habitats and could also have an impact on aquatic production in the downstream areas.

Table 17.1 Current velocity and annual siltation rates in some main waterways of Mekong Delta.

Corridor	Current velocity (m/s)	Siltation/rate (cm/y)
* HCMC-Can Tho	1.5 -2.0 (ebb tide) 0.8 - 1.2 (high tide)	11
* Can Tho - Ca Mau - via Dai Ngai - Bac Lieu - via Xa No canal	1.5 - 2.0 (ebb tide) 0.8 - 1.2 (high tide)	29 (at Phu Huu-Bai Xau) 17 (at Ba Xuyen-Dua Tho) 76 (at Khuc Treo-Tac Van) 20 (at Xa No) 31 (at Tac Cay Tram)
* Can Tho-Kien Luong - via Rach Soi - Hau Giang - via Xa No	2.0 -2.5 (ebb tide) 1.0 - 1.5 (high tide) 1.5 -2.0 (ebb tide) 1.0 - 1.5 (high tide)	12 (at Rach Soi-Hau Giang) 61 (at Ong Tien-Ta Nien) 20 (at Xa No) 26 at Rach Gia-Ha Tien
* HCM-Kien Luong		13 (at Lap Vo-Sa Dec)

17.1.2 Biological Environment

(1) Terrestrial ecosystems

The natural environment of the Mekong Delta has been extensively modified. Throughout most of the central area, the natural marshlands have been drained, and in-filled, and the smaller drainage channels straightened and harnessed as canals. The material used for in-filling

being obtained from excavation for drainage channels and ponds. Some remnants of the former native flora still exist, and in the central area these include *Melaleuca* swamps, peaty wetlands, and backswamps with sedges, reeds and rushes. In the central part of the Delta, the vegetation now comprises mainly rice paddy-fields, dryland garden crops, tree crops, and planted bamboo and *Eucalyptus* trees.

Near the coast there are extensive mangrove forests which are important resource areas, providing timber, fuel-wood, and acting as nursery areas for fish and crustaceans. The loss of mangrove forests is reported to be continuing at a high rate.

In the Mekong Delta provinces of Dong Thap and Minh Hai there are eight areas reserved for nature conservation, including small areas for bird breeding colonies and larger areas of wetlands supporting reeds and rushes, or *Melaleuca* and mangrove forests (Fig. 17.2).

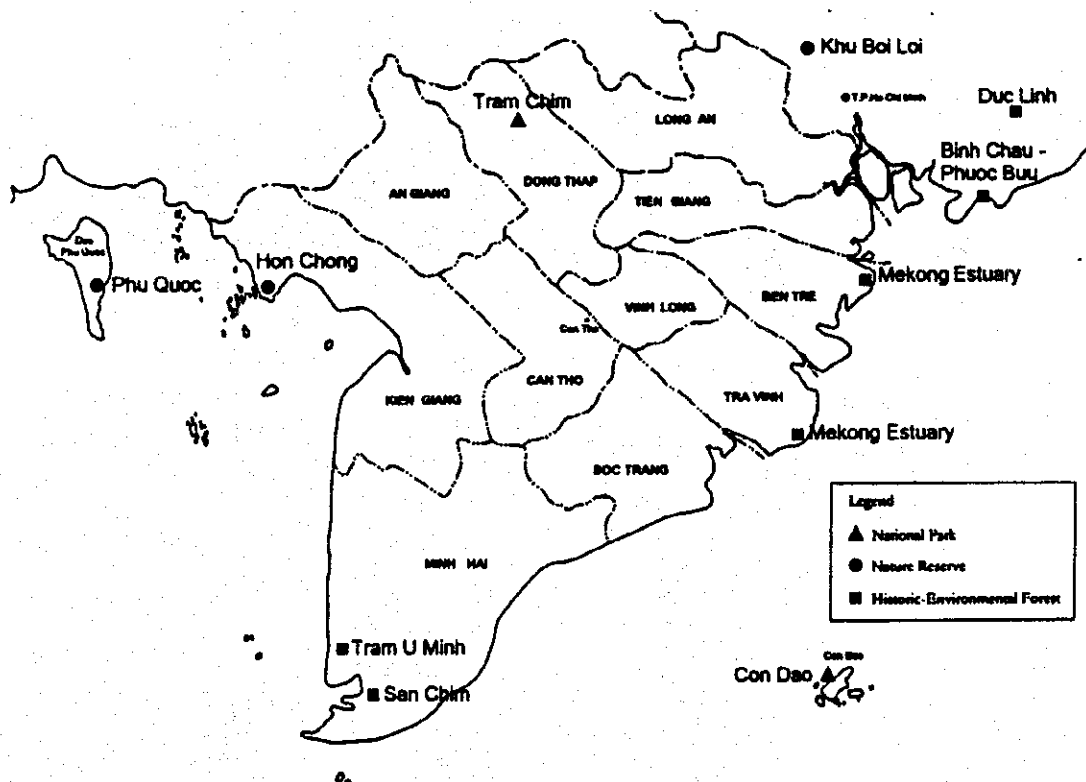


Fig. 17.2 National Park, Nature Reserve, Historic-Environmental Forest around Mekong Delta

A recent report indicates that a variety of natural fauna survive within these reserved areas, including about 20 species of mammals, about

200 bird species (including migratory waders), more than 30 species of reptiles and 11 species of amphibian.

The delta is of particular importance as a wintering and breeding area for migratory birds. Ducks, heron, pelican, cormorants, darters, egrets, storks (including the uncommon painted stork), ibis and crane (including the rare Saurus crane) have been found in the mangrove and *Melaleuca* (Cay Tram, back mangrove tree, one kind of mangrove tree growing on peat soils or acid sulfate soils) forests, and reedy wetlands (Fig. 17.3).

Biodiversity is diminishing in the Mekong Delta as population growth causes forest and other previously unused areas to be cleared. Enforcement of provincial and national environmental protection legislation is lacking. There are no official statistics on the loss of wild fauna.

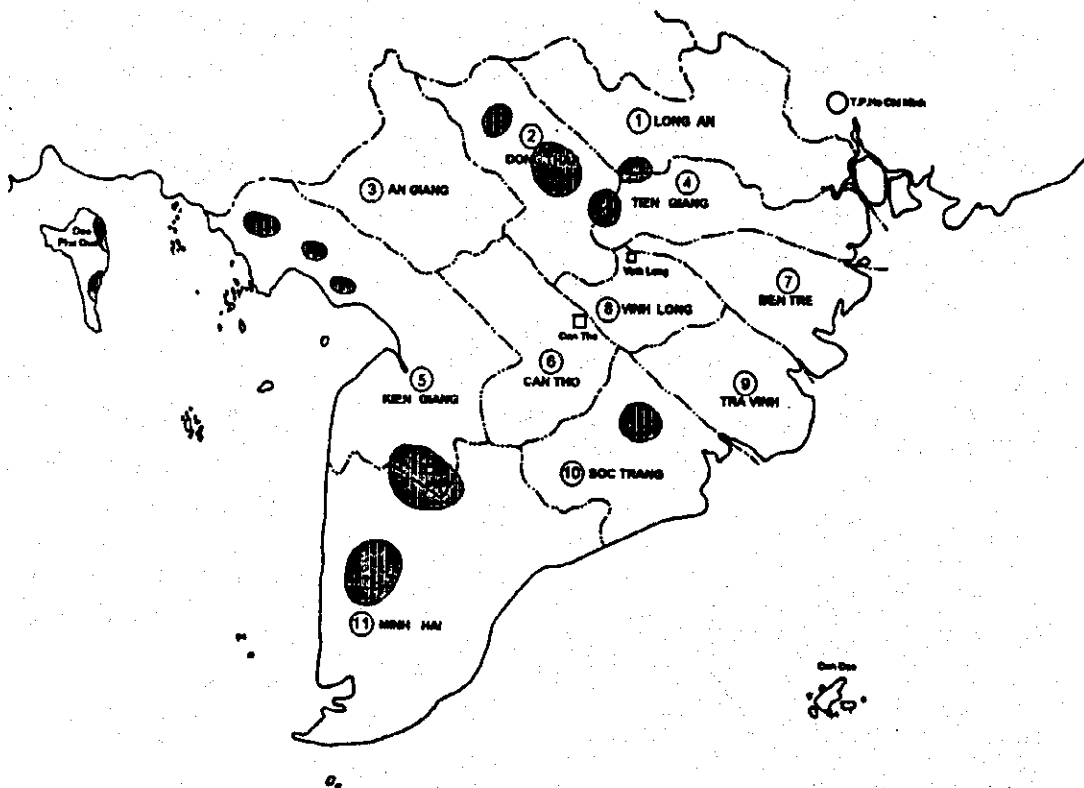


Fig. 17.3 Distribution of *Melaleuca* forest in Mekong Delta

However, the topic of rapidly decreasing biodiversity is such a national concern that Vietnamese scientists have published the *Sach Do Viet*

Nam (Vietnamese Red Book) summarizing the status of threatened fauna and flora in the country. Fig. 17.4 shows the specified floras described in this book which were found existing in Mekong Delta region.

(2) Aquatic ecosystems

The diversity of aquatic organisms throughout the delta is high. Species diversity and densities are at their maximum nearer the coast. Both the numbers and diversity of planktonic and benthic organisms diminish steadily further inland from the coast. The shell boring mytilid mussel, *Limnosperma siamense*, which is able to bore into concrete, is found in the delta.

The Mekong Rivers create favorable conditions for fish habitats, with more than 250 species of fish, of which about half are of economic importance. Fish plays a central role in human nutrition, with the average annual per capita consumption of fresh fish products at 21 kg, with an additional 4.9 kg per capita of processed fish products. Most families whose land fronts the Delta's waterways are in daily contact with the water, operating fish traps and undertaking bank stabilization. Freshwater culture accounts for 24 percent of the regional fishery production.

Sustainability of this fishery depends on maintaining suitable water quality, by avoiding excessive inputs of fine sediment, or appreciably altering the pH or salinity of the water.

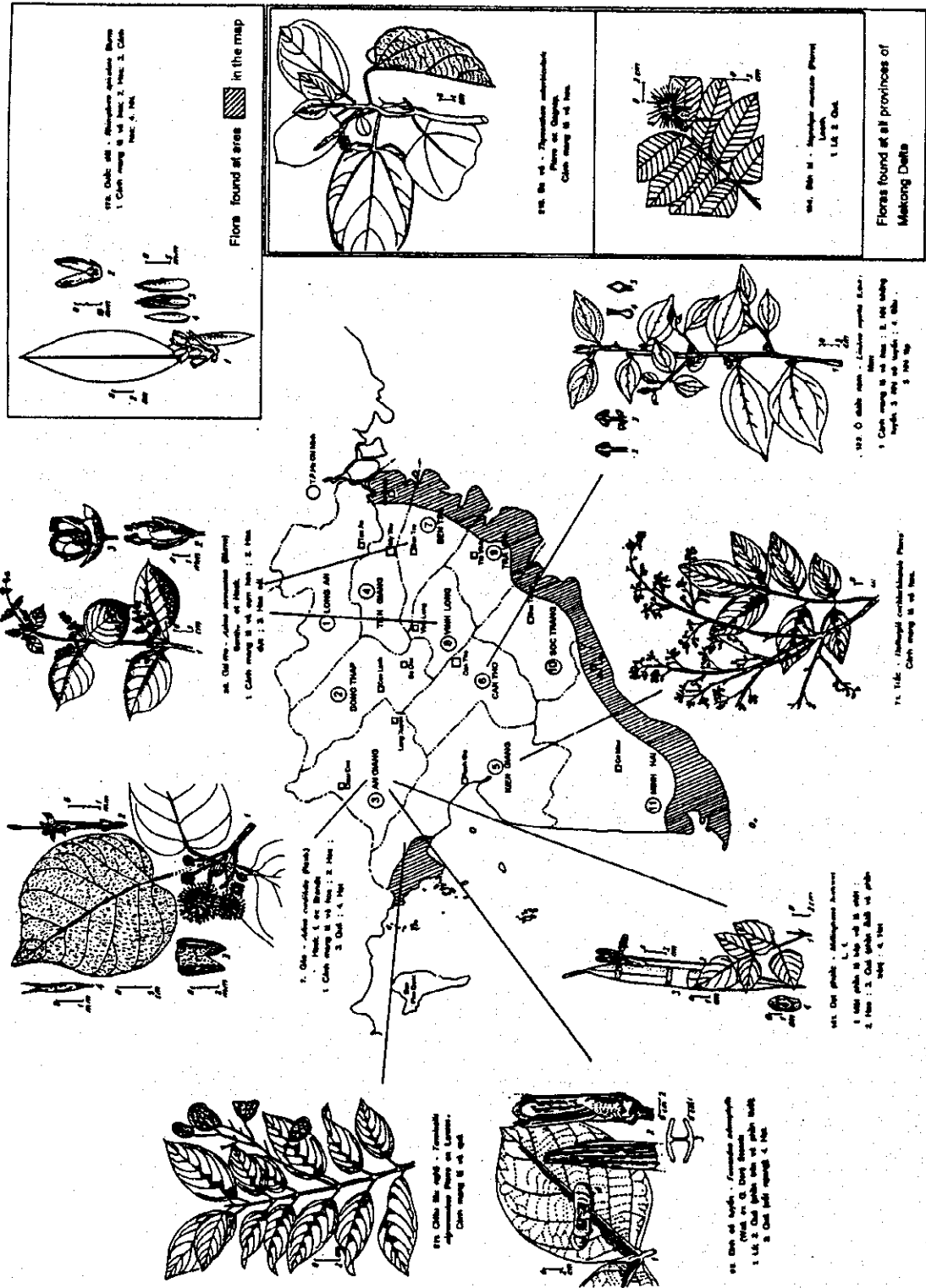


Fig.17.4 Distribution on specified florae in the Mekong Delta (Data from Red Data Book of Viet Nam, Hanoi, 1996)

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17.1.3 Land and Water Resource Use

(1) Land use pattern

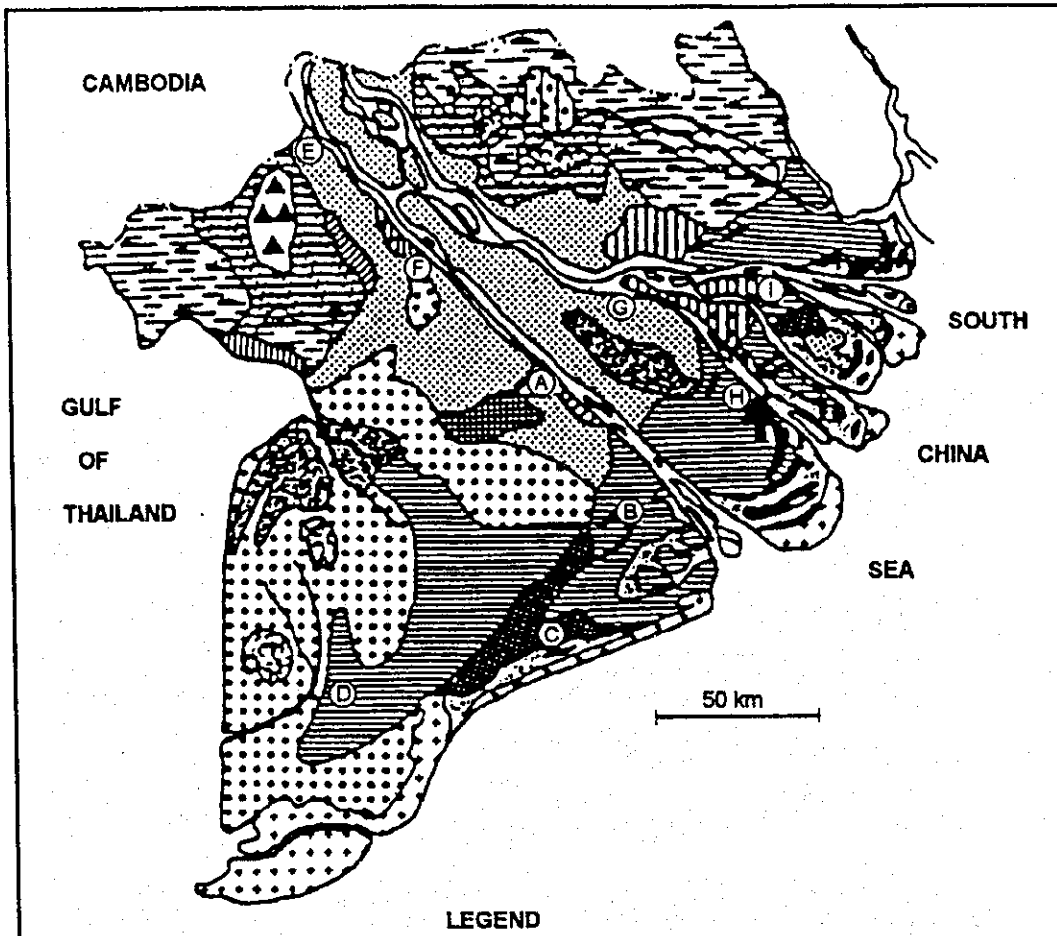
During the long period of cultivation exploitation in the past, almost all of primitive vegetation in the Mekong Delta had been exterminated and replaced by rice paddy, tree-crops and other agricultural ecological systems (Fig. 17.5).

The ecological system of the area adjacent to Binh Minh District is affected by the specific geomorphological, and pedological characteristics of the Hau River's region. 58% of the districts surface is in a high level area where flood water is easy to drain away. The main vegetation in the districts are *lac qui*, *lac hen*. Besides, 14% of the districts surface is in the mud-sand soil, suffering shallow flood during a short period in the rainy season, where the vegetation such as *lac chiec*, *ngat*, *water hyacinth*, etc. are growing.

Table 17.2 shows some natural characteristics of the Binh Minh District

Table 17.2 Some natural characteristics of the Binh Minh District

Area (%)	Physical characteristic	Meteorological characteristic	Specific vegetation and animals
58.0	Non-saline soil	Shallow flood water, easy to drain off, abundant water source	<i>Lac qui</i> , <i>lac hen</i> , freshwater fishes, shrimps
14.0	Freshwater, shallow flood, muddy with sand	Shallow flood in the Monsoon, easy to drain off.	<i>Lac chiec</i> , <i>ngat</i> , <i>water hyacinth</i> .
12.5	Freshwater, Non-flood area, wet sandy mud soil	Not influenced by flood, irrigation by gravity flow or with supplementary pumps.	Reeds, corks, <i>ngat</i>
6.6	Low lands, or river estuary areas, saline soil	Suffering shallow or medium-high flood, difficult to drain off, hard irrigation	<i>Nang</i> , sedges.
2.9	Low lands, muddy with clay, often flooded, high salinity.	River branches, where the riverbed is easily deposited consisting of fine sand and silt.	<i>Nang</i> , sedges, black fishes, shrimps.



LEGEND

Uncultivated area	Hills & mountains
Mangrove forest	House garden
Winter-spring rice + summer-autumn rice	Floating rice
Winter-spring rice + summer-autumn jute	Winter-spring rice
Upland crop + summer-autumn rice	Local rice
High-yielding rainy season rice + shrimp	Coconut + fish + shrimp
Summer-autumn rice + local rice	Yam + local rice
Local rice mixed with high-yielding rice	Summer-autumn rice
High-yielding rainy season rice	Local rice + upland crop
Melaleuca + bee + fish	Pineapple
Floating rice + upland crop	Sand ridge
Sweet potatoes + high-yielding rainy season rice	
Winter-spring rice + spring-summer rice + summer-autumn rice	

(A) CAN THO (B) SOC TRANG (C) BAC LIEU (D) CA MAU (E) CHAU DOC
 (F) LONG XUYEN (G) VINH LONG (H) TRA VINH (I) BEN TRE

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Fig. 17.5 Land Use Pattern in the Mekong Delta since 1990 (by Nguyen Huu Chiem, 1994, Tohnam Asia Kenkyu, Sep.1995)
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(2) Water resources

The Mekong River and its tributaries are used extensively for transport and irrigation. Transport of both people and cargo, including construction materials, rice and other agricultural produce, fuel, agricultural chemicals, and timber from Cambodia, is significant. Small wooden boats are frequently used, for transport and accommodation, and are either paddled or driven by outboard motors. The entire Mekong Delta is covered with a network of irrigation and navigation canals in which flows reverse with seasonal runoff and tidal effects. These canals form the extensive transport system of the delta.

The Tien Giang and Hau Giang channels are used by large international vessels in transit to the port at Phnom Penh in Cambodia, and coastal vessels also service ports along both channels.

The Mekong River carries a high load of suspended solids, and a bedload of predominantly fine sand and silt. The sand tends to be deposited in locations where there is a marked decrease in flow velocity, especially where the river branches. These areas are frequently dredged to obtain sand for land filling or for concrete.

(3) Aquatic resources

Since Binh Minh District and Can Tho City are located in the same location along the Hau River, their aquatic resources are almost the same. However, in the low land of Tra On in Binh Minh District, where the *Co Chien River* joins the Hau River, there exists a special nursery area for fresh water fish and crustaceans.

17.1.4 Water Quality

(1) General issues on Mekong River's water quality

The water in the Mekong River is highly polluted and the sediment load restricts light penetration in the water column to just several centimeters during the wet season. Untreated sewage enters the river from towns, river bank dwellings and boats, and pesticides and industrial pollutants also enter the rivers without any treatment. Diseases caused by water-borne or water-related organisms are common in the delta.

Water is drawn from the river for domestic use, particularly for clothes washing, after the settlement of suspended sediment in large earthenware jars. River water is not normally used for drinking, and if this is necessary the water is boiled for several minutes. In some areas, away from the channels, water is taken from shallow boxed wells which intercept sand lenses.

About half of the delta is affected by permanent or seasonal saline intrusion, and 80 percent of the groundwater bores have salinity levels above the World Health Organization recommended standard for drinking water. River water salinity is a particular problem along the south-eastern part of the delta, in Minh Hai Province.

During flood flows there is little visible oil and grease in the river owing to the low levels of both industry and power boats relative to the size of the river, however, in low flow periods, oil film patches are visible.

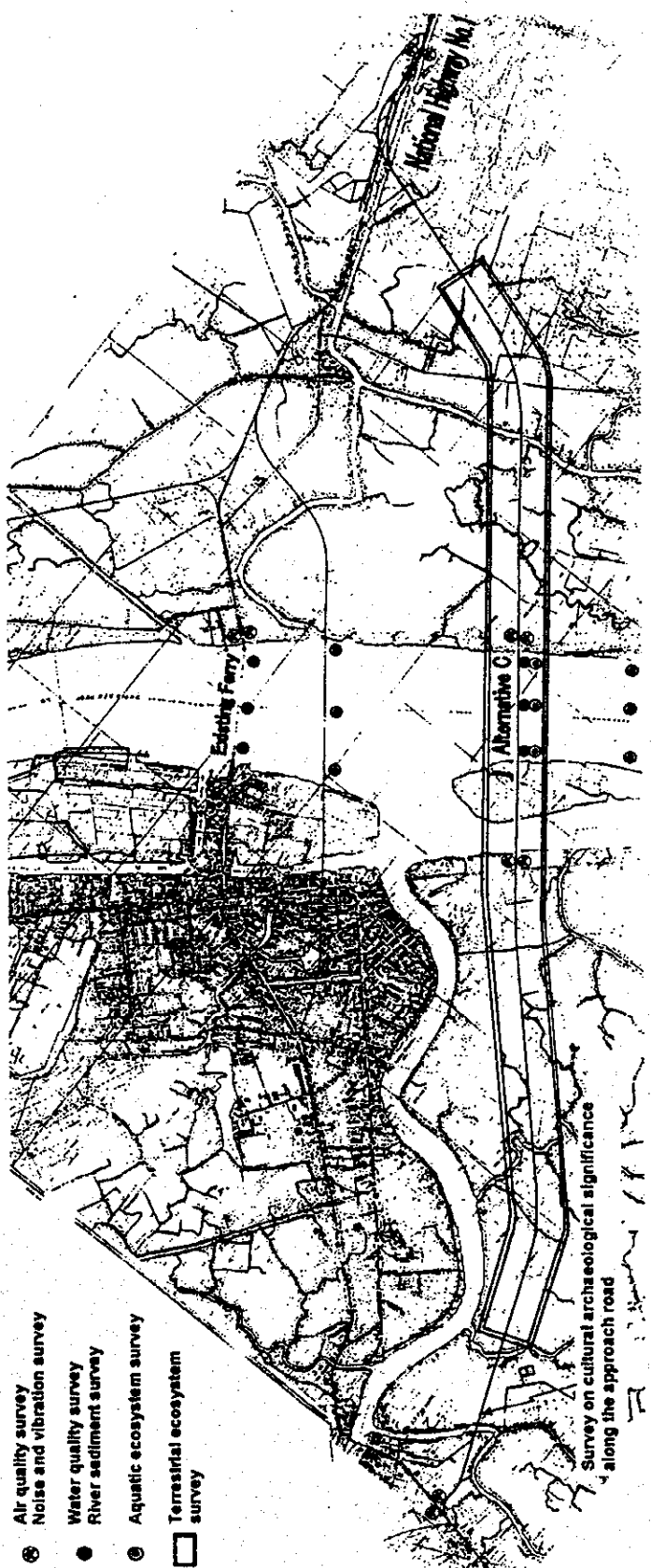
Acidification of water owing to the exposure of acid sulphate soils has occurred in the provinces of Long An, Dong Thap (Plain of Reeds), Minh Hai, Kien Giang and the northern parts of Tien Giang. River water acidity is highest in the early wet season when accumulated soil acids are flushed from the Delta sediments.

(2) Water quality at the proposed bridge construction site

A survey on water quality at the location close to the existing ferry crossing and at the proposed bridge construction site have been conducted by RITST during 3 days (February 5 ~7, 1998). Fig. 17.6 shows the locations where the water quality surveys were conducted.

The survey result is attached in the Annexure 9.1.

These results show that water of the Hau Giang River in the dry season is relatively clean. Suspended solids vary in the range of 50 to 80mg/l. BOD level varies from 2.6 to 3.2 mg/l.



- ⊙ Air quality survey
- Noise and vibration survey
- Water quality survey
- River sediment survey
- ⊖ Aquatic ecosystem survey
- Terrestrial ecosystem survey

Survey on cultural archaeological significance along the approach road

Fig.17.6 Location of surveys on water quality, river sediment, aquatic ecosystem, and terrestrial ecosystem

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17.1.5 Air Quality and Noise

(1) General issues on air quality and noise in the Mekong Delta region

Exhaust emissions from leaded petrol, inadequately cleaned diesel injectors, two-stroke motorcycle engines and minor industrial activities contribute to localized airborne particulate matter and gaseous pollution in the area.

Traffic noise in the study area, including the constant sounding of horns by overtaking vehicles, is confined to the road corridors and boat wharves.

(2) Surveys on air quality and noise

The surveys on air quality and noise environment at the study area has been carried out by RITST during 6 days in February 1998. The survey locations are shown in Fig. 18.3.

These results are attached in Annexure 9.1.

17.1.6 Scenic Value/Visual Amenity

The study area is a part of the flat alluvial terrain of the Mekong Delta, where the common seen landscape is mainly large spreading rice paddy-fields back from the rivers or canals' levees, dryland garden crop trees, and 10~20 meter-high trees such as bamboo, coconut trees (*dua trai*), *nypa palm* (*dua nuoc*), *sonneratia caseolaris* (*ban chua*), etc. Scattered on the ground beside is low vegetation such as grasses, water hyacinth, etc. (See photographs in Annexure 9.3).

One can find some beautiful landscape with various kinds of vegetation in the green crop tree gardens at Xa Tan Quoi of Binh Minh District, 2 to 3 km distance upstream from the study area. But in the area adjacent to the proposed bridge, there is no remarkable beautiful landscape or any significantly high structures.

17.1.7 Conservation Areas and Nature Conservation Status

The natural ecosystems of the study area have been extensively modified by agriculture over many centuries. Only rats and domesticated animals such

as pig, duck, swan, chicken, goose, etc. are found near the proposed bridge construction site.

However, there are six reserved areas in the provinces of Minh Hai, Dong Thap, Kien Giang, and in the islands of Con Dao, Phu Quoc (Fig. 17.2). But they are at considerable distances from the study area.

17.2. Assessment on Natural Environmental Impacts

17.2.1 Prediction of Environmental Impacts in Case of Without the Project

The Mekong Delta in general, and the study area in particular, is under a continuously growing pressure caused by the growing economic conditions and the increasing population. This pressure is unchanged either in case of "without" the Project or "with" the Project.

However, in case of "without" the Project, the three existing ferry facilities crossing Hau Giang River should be upgraded to meet the increasing traffic demand in the region. A small number of residents living close to these ferry crossing points would earn more benefits with more viable business activities on the ferries or at the ferry terminals. On the other hand, however, the physical environment at the areas adjacent to the ferry terminals and along the access roads would suffer the significant adverse impacts of a growing number of moving machines and a higher level of traffic congestion, etc. The risks of accident on the river and on land would escalate, and large scale soil erosion at the river banks close to the ferry terminals would be unavoidable.

17.2.2 Prediction and Evaluation of Impacts on Natural Environment

(1) Impacts on land and soil

The construction of the approach roads with total length of nearly 15 km on the soft ground of the Mekong Delta would raise significant impacts on the land and soil of the local area.

The excavation of land would lead to the exposure of potentially acid soils to air, and would generate large quantities of soluble acid substances in the surface water. This would affect the ecosystem of a large area along the approach roads. Dust generated from alluvial sediments and soils which are poorly structured and easily eroded,

would be exposed to the air and give significant damage to the physical environment, residents, livestock and vegetation existing at the areas adjacent to the construction sites.

During the rainy season a part of the materials utilized for the road embankment and the road surface would be eroded and run off to pollute the water in the existing drainage system.

(2) Impacts on water resources and hydrological system

During the construction phase, the earth works, the stock piling of construction materials, the construction of new drainage facilities, etc. would lead to the change of water flows in the canals along the approach roads, and pollute these water sources.

(3) Impacts on water quality

Although the river water in the Mekong Delta is highly polluted (as they are used to dispose of sewage from villages, dwellings along the river banks, and boats, etc.) it is still used as the main source of water for washing, irrigation, etc, in the daily life of the local people.

During the construction phase, eroded materials, acidic and turbid water containing suspended solids generated by the construction earth works, and liquid or solid wastes originating from the construction camps, etc. would contaminate the river water, and make adverse impacts to the life of the local people.

Gasoline, engine oil, etc. used by heavy machines and dump trucks during the construction phase may permeate underground or flow into rivers, and contaminate the groundwater and river water.

(4) Impacts on terrestrial and aquatic ecology

In consequence of the exacerbation of water quality and air quality along the approach roads during the construction phase, the faunas and floras in the study area would temporarily suffer significant adverse impacts.

Although there are no specified natural vegetation or habitat within the study area that may be affected by the project, caution should be paid to ensure that no excessive amounts of sediment, acidic soil or

acidic water or toxic pollutants are released into the river, as they could damage the existing riveline ecosystems and give rise to adverse effects on the existing subsistence and commercial fisheries.

(5) Impacts of noise

There would be temporary noise impacts during construction, especially at the areas where the pile driving works are done. The noise levels at such areas during the construction period may exceed Vietnamese standards.

Two elementary schools located close to the approach road on the Vinh Long side (one close to the river bank, and one close to the existing National Highway No.1) would be significantly affected by noise during the construction phase. However, the number of residents who are living along the proposed approach roads and would be affected by excessive noise during the construction phase is small and limited. With the careful choice of working methods, construction equipment, etc. the impacts of excessive noise may be mitigated.

(6) Impacts of vibration

There is a small number of residents living in the areas close to the construction sites that may be significantly affected by vibration generated from the construction works such as piling, moving of heavy machines, etc.

(7) Impacts on air quality

Residents living along the existing National Highway No.1 close to the proposed intersection with the approach road on the Vinh Long side, would suffer significant impacts of air pollution during the construction period. Heavy machinery which is powered by diesel engines would exhaust a significant volume of NO₂, CO and SO₂ and cause an impact on the air quality of the areas adjacent to the construction sites and along the approach roads. Earthworks conducted on embankment, concrete batching, and construction vehicles would stir up dust from exposed soils and construction materials, especially during the dry season.

Dust control methods should be implemented, and further caution should be paid to mitigate adverse impacts on air quality to residents and pupils of the two elementary schools located close to the approach road on the Vinh Long side. The concrete batching plants should be constructed and operated in such manner to minimize potential air pollution problems.

(8) Impacts of excavation and transportation of construction materials

As described in section 14.6, a considerable volume of coarse aggregate, sand, cement, etc. are required for the construction of the approach roads, bridge structure and other facilities. Four sources of aggregate (Bien Hoa, Nui Sap, Vung Tau, An Giang) and three sources of sand (Dong Nai, Long Xuyen, Soc Trang) have been surveyed in selecting the most appropriate sources for procurement of these construction materials (Fig. 14.9).

Barges are assumed to be the most appropriate means of transport of these materials from the sources to the sites.

However, dust and scattered construction materials generated in the process of excavation and transportation would contaminate and disturb the physical environment on land and in the water at the quarry sites and along the transport routes.

(9) Impacts of wastes

During the construction phase, numerous kinds of waste such as scattered construction materials, waste water, solid wastes, machine oils, etc. may be generated from the construction sites and from the worker camps. Appropriate planning to control wastes from these sites should be implemented to avoid negative environmental impacts due to the construction.

(10) Impacts on environmental health and safety

Human health and safety, both within the construction workforce and among the local residents should be specifically considered during the construction phase.

At the present time, residents living in the study area are relatively well nourished by a stable farming system which is able to produce various sources of food for subsistence use and for sale. The existing farming system with extensive use of swamps and ponds for fisheries does not provide favorable places for the propagation of mosquitoes or other disease-transmitted insects.

This stable farming system should be maintained, and all potential toxic substances produced or exposed during the construction phase should be treated by the appropriate methods to ensure that the existing ecosystem will not be damaged.

17.3. Existing Socio-economic Environment

17.3.1 Existing Social Environment

(1) General

The Mekong Delta's population in 1995 was 16.2 million, and the overall population growth rate during the 1991~1995 period was 2.1%. The majority of the Mekong Delta population is Kinh with about 8 percent consisting of minority groups, including Khmer, Chinese, and Cham.

Income levels for the delta are relatively high compared with other regions of Vietnam, as a result of high male earnings.

The main local administrative unit in Vietnam is the People's Committee, which exists at provincial, district and village levels. In addition to the Communist Party, a number of other mass organizations do exist, grouped under the Vietnam Fatherland Front. The most important include the Ho Chi Minh Communist Youth Union, the Vietnamese Women's Union and the Confederation of Trade Unions.

As a result of economic reform, some stratification of society based on wealth has been occurring and, whilst exceptional progress has been made in improving living standards, the gap between urban and rural areas is likely to widen.

(2) Vinh Long Province and Binh Minh District

Vinh Long Province is located at the center of Mekong Delta, between Tien Giang and Hau Giang in the Mekong River's downstream. The area of the province is 1,487.37 km², and its population is 1,102,821, including 6 districts and 1 town.

Binh Minh District where the approach route in the north of the proposed bridge is to be constructed, is a large district of Vinh Long Province. The district covers all the appropriate short routes for the trips from Ho Chi Minh City to the southern part of the Mekong Delta through National Road 1A. As a part of the Mekong Delta, it is rich in natural resource, suitable for agricultural development, and particularly for fruit-trees. It consists of 15 villages and 1 town as listed below:

Town : Cai Von

Village: (1) Tan Luoc, (2) Tan An Thanh, (3) Tan Hung, (4) Tan Quoi, (5) Tan Binh, (6) Thanh Loi, (7) Thanh Dong, (8) Trung Thanh, (9) Dong Binh, (10) Dong Thanh, (11) Dong Thanh, (12) Thuan An, (13) My Thuan, (14) Nguyen Van Thanh and (15) My Hoa.

(3) Can Tho Province and Can Tho City

Can Tho Province is known as the economic center of the Mekong River with its rich economic resources relative to the other provinces in the region. The Province's area is 2,962.54 km² with the population count at 1,892,027 in 1996.

Can Tho Province has one city and 6 districts. Can Tho City (where the southern access point of the proposed bridge is planned to take place), is the Can Tho provincial capital. The other 6 districts in the Can Tho Province are: (1) Thot Not, (2) O Mon, (3) Chau Thanh, (4) Phung Hiep, (5) Vi Thanh, and (6) Long My.

Can Tho City is continuing to develop as a regional center, having both a major university and the provincial hospital.

Current developments in Can Tho City are concentrated on processing agricultural, forestry and fishing products, and light industrial goods.

Table 17.3 shows some major social indexes of the Binh Minh District and Can Tho City.

Table 17.3 Major Social Indexes of Binh Minh District and Can Tho City

Items	Binh Minh District (in 1996)	Can Tho City (in 1994)
Area (km ²)	246.93	141
Population (people)	187,386	332,972
Women ratio (%)	52.34	52.11
Population density (people/km ²)	759	2,399
Population growth rate (%)	1.88	2.03
- Education		
+ Kindergarten (pupils)	1,834	3,885
+ Primary school (pupils)	23,960	34,036
+ Secondary school (pupils)	8,175	16,842
+ High school (pupils)	2,213	7,136
- Medical services		
+ District/City Hospital	1	6
+ Local surgery	1	7
+ Medical stations	16	17
+ Medical officers (people)	153	1086
+ Doctors (people)	84	313

(4) Cultural heritage

The Mekong Delta was the center of a major civilization named after its central city Oc Eo. This civilization existed for about 500 years from the 1st century AD and extended to the east, beyond the Tien Giang, and to the south into the present Minh Hai Province. Dong Thap Province, north of My Thuan, is rich in archaeological sites from this period. During the subsequent 1000 years (until about 1700 AD) the area was inhabited primarily by the Phu Nam and Chen Lap civilizations.

Most of the Mekong Delta came under the control of the Vietnamese (Nguyen) colonizers in the 16th and 17th centuries AD, and they reclaimed extensive areas of land for agriculture and began to construct a sound network of canals.

Rock outcrops are rare in the Mekong Delta and these are frequently used as a source of building material. However, as many of these

outcrops are the sites of ancient Khmer temples, the Vietnamese Government has restricted the quarrying of material from these outcrops. Most outcrops are likely to have been occupied by inhabitants in the past.

(5) The role of women

In general, there are two or more generations living in each household in the Mekong Delta region. According to a survey on farming households conducted by the Institute of Social Sciences in 1991, 2% of households in Mekong Delta consist only of one generation, while 74% consist of two generations, 23% consist of three generations, and other 1% consist of four generations.

Women in Vietnam play a significant role in all aspects of farming and farm management. However, according to an Institute of Social Sciences survey^{*)}, for those farming households in the delta in which the husband is the head of household, major decisions are made, in most cases, by the husband, although usually after discussing such decisions with his wife. Only in a small proportion of households was the wife responsible for actually making major economic decisions.

Note: *) My Thuan Bridge Project, Feasibility Study - Environmental and Social Impact, Final Report.

17.3.2 Existing Economic Environment

(1) Settlement patterns

In general, the settlement pattern in the Mekong Delta is a dispersed one, with ribbon development along roads and rivers sometimes stretching over tens of kilometers. The urban population is concentrated in a small number of cities and towns. The larger towns (50,000 to 100,000 population) are generally located at the crossings of the major roads with canals or river branches. Smaller towns are located at less important transport junctions. Markets, construction material plants and trans-shipment facilities have grown up around the approaches to most bridge crossings on the main highway linking Ho Chi Minh City with the delta.

In general, however, urbanization in the delta is relatively low. In 1990, of a total population of 14.6 million people, 12.3 million were classified as 'rural' and 2.3 million as 'urban'. In 1995, the population density for the Mekong Delta as a whole was 406 people per square kilometer, some two times that of the national average. In Vinh Long Province, the density was 723 people per square kilometer, and in Can Tho Province, 623 per square kilometer^{*)}.

Note: **) Impetus and present situation of Vietnam Society and Economy after ten years of Doi Moi.

Economic pressure to move out of the rural areas has been strong in Vietnam although, until recently, this has been counteracted both by tight controls on population movement and by the relatively low income differentials between town and country. However, the delta's population is projected to increase to 17.9 million and 23.7 million by the years 2000 and 2015, respectively. As the capacity of the primary sector to absorb more labor declines, the non-primary sectors will have to compensate, and activities in these sectors generally require an urban environment. Thus, urbanization in the Mekong Delta is expected to increase in the near future.

(2) Economic development

The delta has responded exceptionally fast to deregulation and economic liberalization. Between 1986 and 1989, economic growth exceeded 10% per annum, and while slowing down to 6-9% later on, it is still vigorous. However, to a large extent, growth so far has been "easy", coming along almost naturally in the wake of Doi Moi and tapping latent resources. Future growth will need more effort and increasing technological and managerial sophistication.

Within the delta, growth has not been even. In the last few years, most foreign investment in the Mekong Delta has gone to Long An and Tien Giang Provinces to the north of My Thuan. Joint ventures have been set up with local companies in these areas because there are no transport barriers such as ferry crossings, and because they are closer to Ho Chi Minh City, compared with the southern provinces. Investors are said to hesitate in setting up further south, because of the cargo flow problems

Table 17.4 Major Economic Indexes of Binh Minh District and Can Tho City

Items	Binh Minh District (in 1996)	Can Tho City (in 1994)
Total agricultural output (millions VND)	412,827	148,430
Total Industrial output (millions VND)	27,045	153,607
- Some main products		
+ Rice output (tons)	161,456	46,466
+ Sweet potato (tons)	42,938	-
+ Green bean (tons)	889	451
+ Sauce (1000 litters)	3,320	-

The construction of the bridge offers an opportunity to direct development away from the major urban complex around Ho Chi Minh City, towards the regional development of the provinces in the southern area of the Mekong River.

(3) Agricultural sector

In general, economic growth in the Delta has been the result of increased primary sector output accelerated by sharply increased international trade. Most of the population of the Mekong Delta is still concentrated in the agricultural sector. In 1990 the delta produced about 50 percent of Vietnam's rice output and contributed 85 percent of its rice exports. Agricultural development in the delta is based on private small-holdings with an average size of one hectare and horticultural use is concentrated along levees and canals.

Rice cultivation represents the predominant agricultural activity in the Mekong Delta. In 1994, the delta produced 12.8 million tons of rice, an amount equivalent to a half of the whole country's production. Can Tho is one of the biggest rice paddies of the delta. In 1994, Can Tho Province produced 1.7 million tons of rice, ranking next to An Giang Province (1.9 million tons) as the highest rice producing province in the delta.

The main problem for rice production in the Mekong Delta is competition in the export market. Even with moderate development, the delta would be able to supply the demand for rice and at the same time diversify into higher value crops, the more so if rice export volumes were to drop.

(4) Industrial sector

The main industrial activity in the Mekong Delta is the processing of agricultural and fishery output. Recent growth rates are somewhat higher than that of the primary sector output. In both provinces, food processing is responsible for over 50% of the value of all products in the industrial sector and its value is increasing in absolute terms.

A considerable proportion of the delta's agricultural output is currently processed in Ho Chi Minh City. However, in the next few years, the processing industry will likely be the major carrier of secondary sector growth. Processing is directly connected with the diversification of the primary sector. Joint primary sector/processing operations will be the most efficient way of enhancing both the diversification and increased value added in the primary sector, and the accelerated transformation of the delta into a truly diversified and mature economy. A crop diversification-cum-processing study has been recommended.

In contrast to developments in Tien Giang Province, in Vinh Long Province and Can Tho Province in relative terms, the value of food processing is decreasing. There has been little response to calls for investment in industries in the provinces on the southern bank of the Mekong River. It is believed that congestion at the two rivers discourages foreign investment, and that the construction of the bridge will make the province more attractive for foreign investors.

There are other forms of light industry in the two provinces, some of which are predominantly cottage industries. Garment manufacture, repair of machinery, weaving of mats from vegetable fibre, and carpentry are all local economic activities.

(5) Tourism

After the government introduced its new travel policy in 1993, 40,000 tourists came to the delta and in the first six months of 1994, 60,000 visited the region.

In Vinh Long Province and Can Tho Province, longer package tours of gardens and farms are being organized, and it is planned to create an orange garden for tourists to visit, and spend the night. Although Vinh Long Province has some interesting pagodas, it has few other historical

sites, but tourists can visit islands in the Mekong River. Tourism income is shared between the farmers, the local community, the transport providers, and the State Planning Committee.

(6) Water usage

A part of the residents living in Cai Von Town is served by a sole existing water supply system with a capacity of 300 m³/day. Water is treated by using alum to settle the suspended sediment.

The majority of the residents of Binh Minh District use rainwater or surface water as drinking water for daily life, after settling suspended sediment with alum. Recently, UNICEF has contributed substantially in improving the sanitary conditions in the rural areas of Binh Minh District by providing finance to a project to set up many hand water-pumps in the district. As well some of the rural residents have been provided finance aid from UNICEF to buy large earthenware jars to store rainwater for daily water use.

The people in Can Tho City have almost the same water usage as the people in Binh Minh District. However, there are about 70% of the Can Tho City residents who are served by the public water supply system.

(7) Energy use

The current level of energy use in rural Vietnam is low by the standards of more developed countries. Most farmers use manual methods of farming and agricultural machinery is rarely used.

The Vietnam electrical power grid extends into the Mekong Delta and many of the villages are connected to this supply. Most of the households have electric lights and television, however cooking is mainly carried out using wood or charcoal fires.

17.3.3 Current Settlements at The Ferry Crossing and Proposed Bridge Site

Results of the hearing survey to 400 households living along the proposed approach roads, carried out by the local survey company (RITST) in February 1998 show that a household in this study area generally consists of 5.83 members, of which, 3.7 members are of labor

age, and 2.14 members are dependent persons who are pupils or elderly.

During this survey, 62% of the total interviewed residents said that they have lived in their dwellings for more than 20 years. Most of the dwellings are made by themselves (42%), or inherited from their ancestors (31.5%). A remarkable number of the interviewed residents said that his/her dwelling land area was larger than 1000m².

Among residents interviewed, a majority (54% of total answers on the Vinh Long side, and 58% on the Can Tho side) said that their main source of income was gardening or rice cultivation. Interviewed residents in Binh Minh District seem to have a higher income than the interviewed residents in Can Tho City (Table 17.5).

Table 17.5 Interviewed Residents' Household Annual Income

Annual income (VND/year)	Vinh Long side	Can Tho side	Total
Less than 3,000,000	1 (0.8%)	11 (14.7%)	12 (6.0%)
3,000,000~5,000,000	7 (5.6%)	37 (49.3%)	44 (22.0%)
5,000,000~7,000,000	41 (32.8%)	3 (4.0%)	44 (22.0%)
7,000,000~9,000,000	28 (22.4%)	15 (20.0%)	43 (21.5%)
More than 9,000,000	48 (38.4%)	9 (12.0%)	57 (28.5%)
Total	125 (100%)	75 (100%)	200 (100%)

17.3.4 General Issues on Land Use Right, Land Acquisition and Resettlement

(1) Legislative Background on Compensation of Lands and Dwellings

Viet Nam has experienced major legislative change since the late 1980's when the country began social and economic reforms based on the partial transfer of rights from the State to the individual.

a) Law on Land

Technically, in Viet Nam, no private individual can own land. Land belongs to the government, although individuals have '*land use right*'.

Previously, those with land use rights could not sell the land. Thus, the government had the power to control and manage all the land. However, since land was not privatized, people did not

accept responsibility for developing and preserving it, especially in rural areas. Accordingly, the household contract system was introduced in 1988, enabling land to be contracted for fifteen years or longer to households acting as self-managing economic units.

The principal document that triggered significant social change in Viet Nam is the Land on Law (promulgated on 15 October 1993). In short, this Law gives the land users five rights:

- i) The land user can transfer the land use right to someone else under the current market mechanism: this represents one way of 'selling' land, although it is not recorded as such on the relevant documentation;
- ii) Land use rights are invested in the user for a considerable period of time;
- iii) Subsequent generations can inherit land use rights;
- iv) Land use rights can be used like real estate as a form of collateral for borrowing from state banks; and
- v) Land use rights can be exchanged legally.

Thus, since the end of 1993, individual land use policies had become very open, even though in legal terms, the land still belongs to the government, and when land use rights are sold, the people concerned must get the permission of the local authorities. The ultimate decision on transfers depends on the compatibility of the proposed land use with the master plan for the area.

Land is classified into 6 categories according to its usage (Article 11): (1) agricultural land, (2) forestry land, (3) rural residential land, (4) urban land, (5) special use land and, (6) waste land. Access to land planted under annual crops or devoted to aquaculture is limited to 20 years, while usage of perennial crop land is limited to 50 years. On expiry, the user may apply to continue using the land and such right is granted providing the land has been used appropriately. Time limits do not apply to residential land, which is granted in perpetuity (Article 20).

Certificates verifying rights to use land must be issued to the rightful user by the appropriate government agency (Article 36) and land can only be re-assigned from the current to the prospective user after the proper procedures have been carried out (Article 21), this requires the sanction of the appropriate People's committees, who are responsible for managing land issues within their jurisdiction (Article 8).

b) Compulsory land acquisition

Where absolutely necessary, the State shall regain the land which is under use from land users for the purpose of national defense, security, and national or public interest. In these cases, the State shall be obliged to compensate the land users for the losses incurred (Article 27).

The State bodies which are authorized to determine the allocation of specified land shall also be authorized to regain possession of that land from its user. Prior to regaining the land, the land user shall be notified of the reasons for which the land is regained, the time, the plan for moving and the solutions for recovering the losses (Article 28).

Thus, the Law on Land guarantees the land user's right to be compensated for loss of land whenever land is resumed or taken back.

c) Residential property

The Law on Residence promulgated by the State Council on 26 March 1991 recognized three categories of property: (1) State-owned, (2) collectively-owned, and (3) privately owned. The law acknowledges and protects the citizen's right to own their residences (Article 2) and that people have a right to dwellings which they have legally constructed themselves or rented from another individual (Article 1). Decree 60-CP of 5th July 1994 strengthens this law by guaranteeing the right to own residential buildings and to use residential land.

d) Agricultural land allocation

Decree No. 64-CP of 15th September 1993 guarantees the allocation of agricultural land to the private sector. The Decree ratifies the duration of land use as set out in the Law on Land and the responsibilities of the People's Committees in determining correct land use and issuing land use certificates. In reality, land allocation is largely the continued usage of existing owners, with little redistribution occurring.

e) Land valuation and compensation

Land values are calculated according to Decree No.87/CP of 17th August 1994, which stipulates that the value of agricultural land and forest land shall be derived from taxation rates levied for land use in plains, foothill and mountain communes. The State sets minimum and maximum prices for different categories of land, and the Provincial Peoples' Committees determine the price of land according to local costs and conditions.

Compensation payments are based on Decree No.90/CP. All individuals or bodies which are using the land legally are entitled to compensation if the State claims their rights of land use. They must have either been using the land prior to the date of the enactment of Law on Land in 1993, or have been allocated land according to this Law.

Claimants must have a land use rights certificate or a paper validated by the local Peoples' Committee validating their claim to land usage. Business users, whether State, co-operative or private will be entitled to compensation if they have paid the land-using-fees by moneys extracted from non-State budgets.

The value of all classes of land is determined by the Provincial Peoples' Committees. They are charged under Decree No.87/CP with deciding land values as the basis for calculating land allocation fees, taxes on the transfer of land use right, determining property values and setting compensation payments. The Peoples' Committees must set values within national limits determined by the Government. However, the Peoples'

Committees may adjust these values periodically to reflect changing economic conditions.

Compensation for annual plants and aquaculture is based on the value of the next harvest as determined by local prices for the previous three seasons' harvests, while perennial plants are compensated according to the value of the harvest and the amount of work involved in tending the particular species of plant.

In reality, in the urban areas, commercial areas, or other economically important areas, the land prices are likely to be determined by its accessibility to the city center or to other potential areas. The land price is higher if the land is located closer to the most important street or commercial area. The land price is also high if it faces to a street front, a canal or other means of accessible transportation.

f) House valuation and compensation

Circular No.5 - BXD/DT of 9th February 1993 of the Ministry of Construction sets out the system of building classification, which sets up the basis of tax assessment, sale of property and compensation. This identifies four classes of buildings based on the quality of construction and durability, fire resistance and comfort level (principally sanitary facilities), with category I being the best quality and category IV the least prestigious.

17.4. Assessment on Socio-economic Environmental Impacts

17.4.1 Prediction of Socio-economic Impacts in Case of Without the Project

In the case of "without the Project" or "do nothing", there would be no remarkable change in the socio-economic situation of the study area. However, the Can Tho Ferry's services and its accompanying facilities would be upgraded to meet the growing traffic demand, and the pressure on the physical and socio-economic environment of the areas adjacent to the ferry terminals would grow continuously. The Hau Giang River would continue to be a big barrier hindering the economic development of Mekong Delta region.

17.4.2 Prediction and Evaluation of Socio-economic Impacts During the Construction Phase

Fig. 17.7 summarizes the key impacts caused by the construction of the Can Tho Bridge on the socio-economic environment status of the study area.

During the construction phase, these impacts may be described as follows:

- A number of residents would lose their dwellings or cultivated lands and would be forced to resettle (hereinafter refer to as the Project-Affected People, or PAP).
- The local community would be distressed by rumors relating to land price issues, and would be affected by the escalation in the price of land and construction materials,
- A conflict between local residents and the out of station of construction workers would be unavoidable,
- There would be a widespread increase of infectious diseases in the local community.
- Two elementary schools and two or more shrines/temples would need to be relocated or would suffer the significant impacts of noise, air pollution, and accident risks, etc.

(1) Impacts on land acquisition and resettlement

a) Number of likely affected dwellings

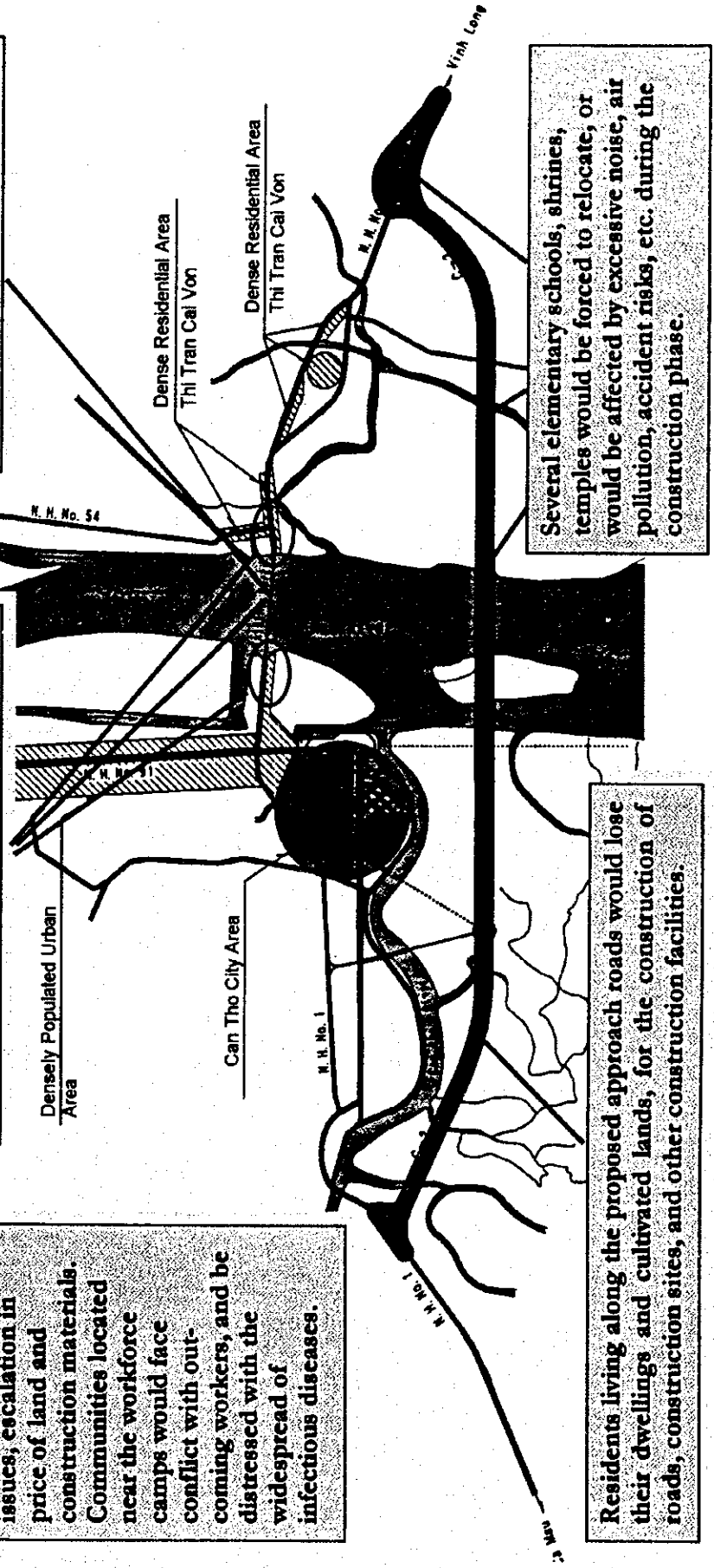
Although the proposed approach roads are planned to be located at the areas which consist of mainly rice paddy and crop lands, there are a number of residents whose dwellings or lands may be acquired to make space for the construction of approach roads, service areas, construction sites, resettlement zones, and other relevant facilities (See photographs in Annexure 9.3).

Fig. 17.8 shows the distribution of dwellings at 13 sites where a significant number of residents may lose their dwellings or lands for the project. These sites are almost all located on the levees of the canals or rivers, or along the existing roads, where the proposed approach roads are planned to pass through.

Local community would be distressed by uncertainty and rumors relating to land price issues, escalation in price of land and construction materials. Communities located near the workforce camps would face conflict with out-coming workers, and be distressed with the widespread of infectious diseases.

Business shops, peddlers, mini-local transporters, etc. would lose means of livelihood or main sources of income due to the reduction of Can Tho Ferry services.

The Can Tho Ferry Company would be removed or reduced, and a part of its management staff would be forced to be re-employed.



Residents living along the proposed approach roads would lose their dwellings and cultivated lands, for the construction of roads, construction sites, and other construction facilities.

Several elementary schools, shrines, or temples would be forced to relocate, or would be affected by excessive noise, air pollution, accident risks, etc. during the construction phase.

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Fig. 17.7 Major Negative Impacts on the Socio-Economic Environment

JAPAN INTERNATIONAL COOPERATION AGENCY

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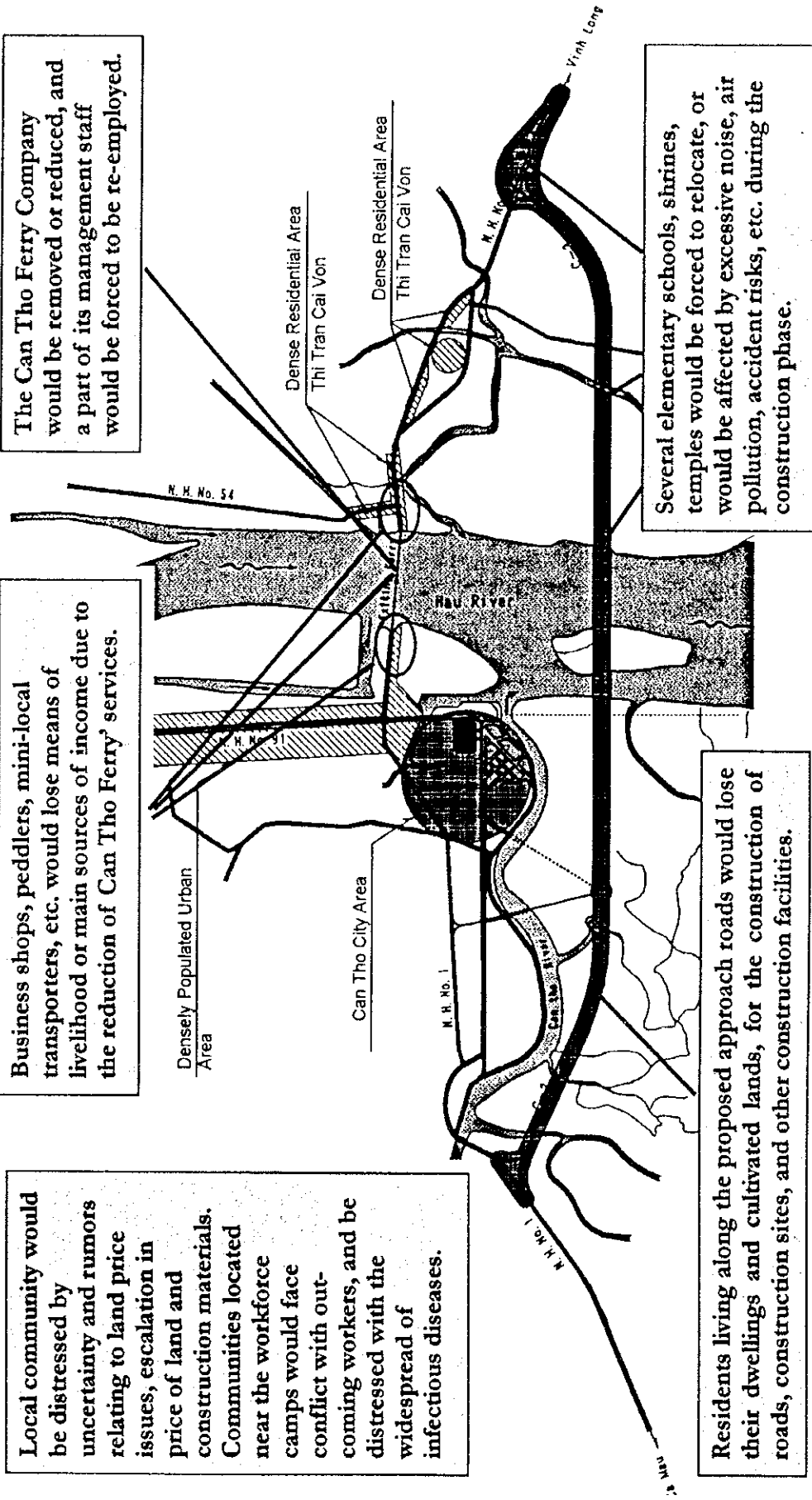
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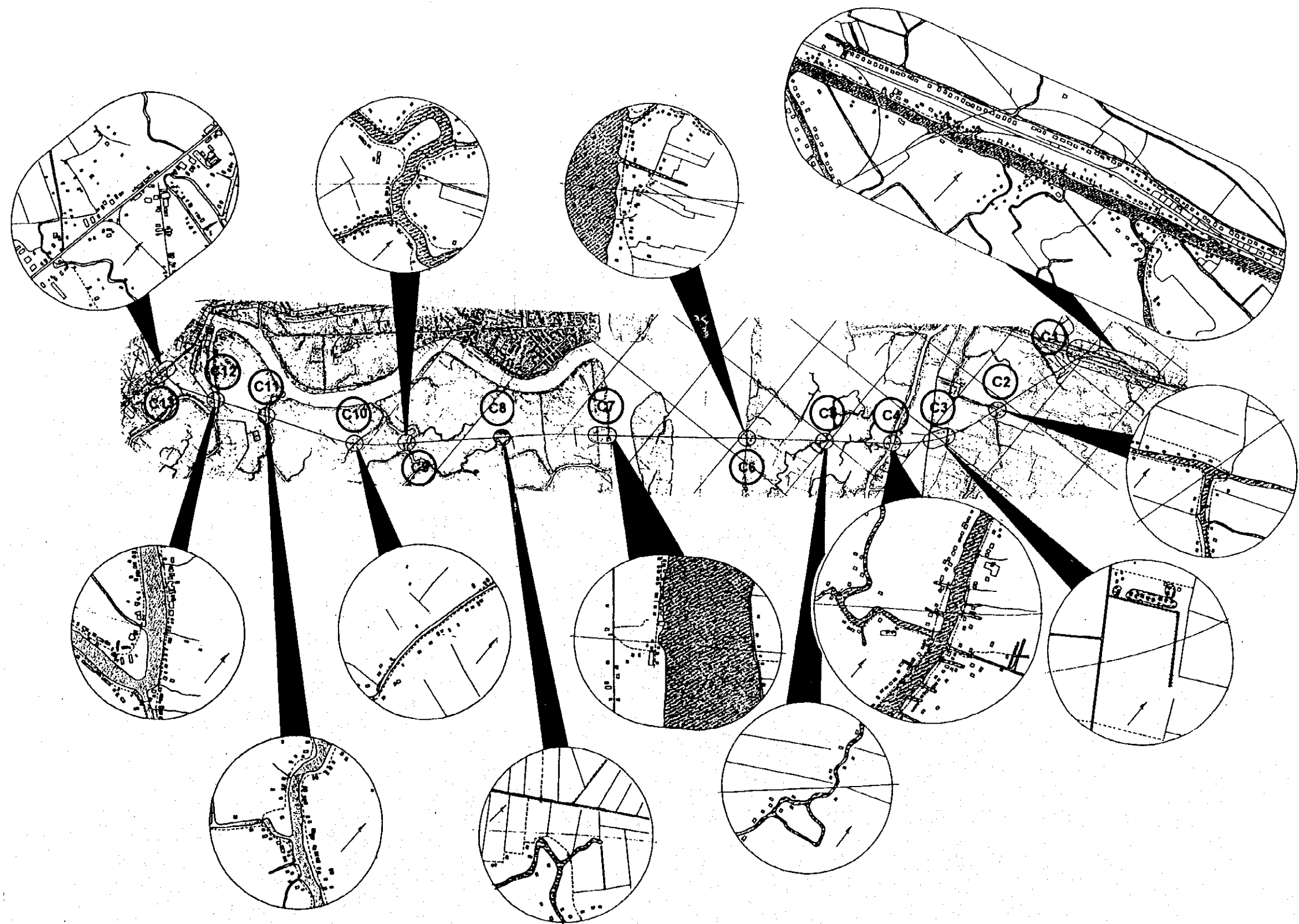


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Fig.17.7 Major Negative Impacts on the Socio-Economic Environment
JAPAN INTERNATIONAL COOPERATION AGENCY



THE FEASIBILITY STUDY ON
 THE CAN THO BRIDGE CONSTRUCTION
 IN SOCIALIST REPUBLIC OF VIET NAM

Fig.17.8 Distribution of Dwellings
 Along the Proposed Approach Roads
 JAPAN INTERNATIONAL COOPERATION AGENCY

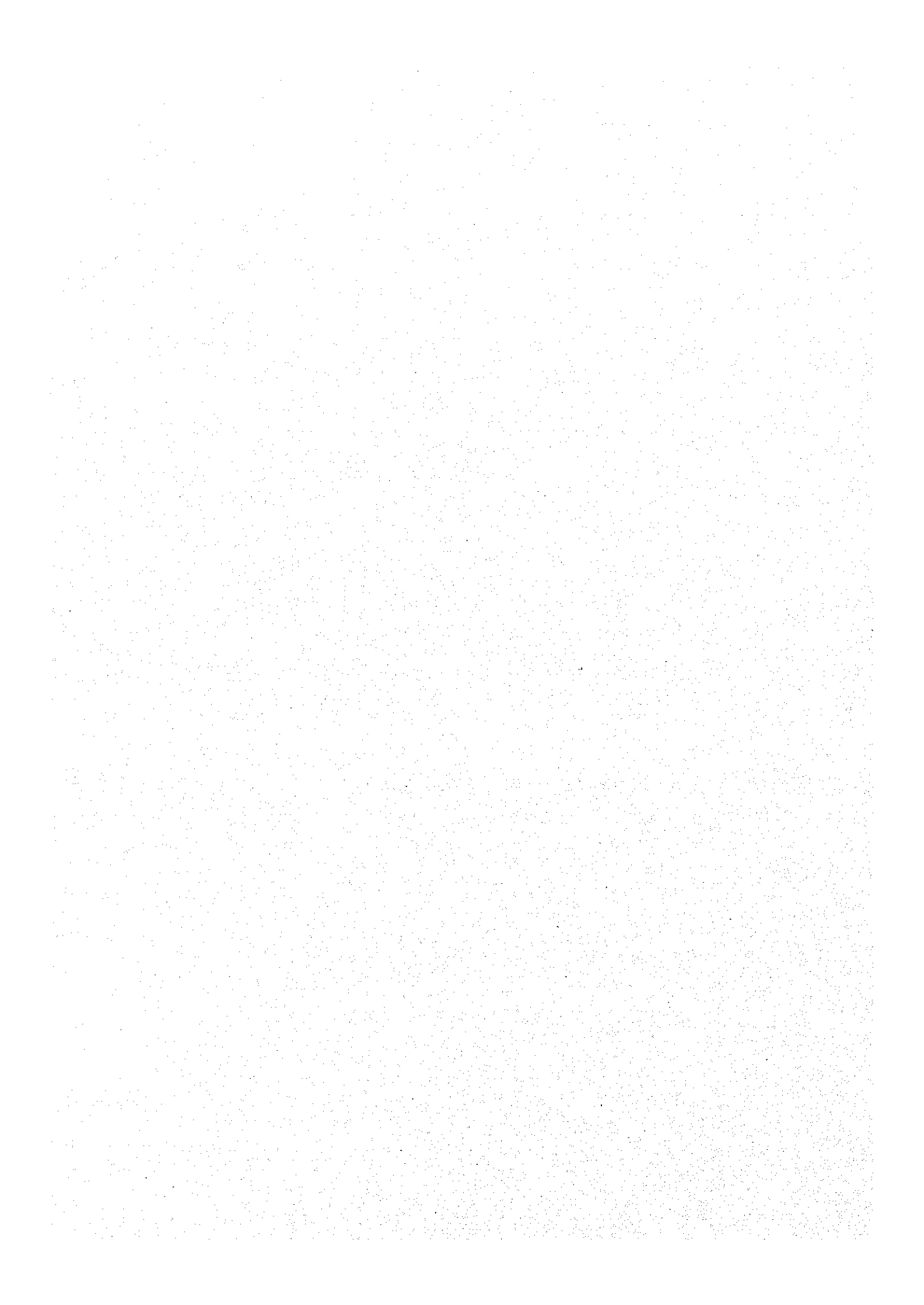


Table 17.6 summarizes the result of an initial survey on the dwelling and temple/shrine sites that are assumed to be affected by the project.

Based on this survey, the total number of dwelling likely to be affected is 210, of which 10 dwellings are of house category 1, 30 dwellings of category 2, and 170 dwellings of category 3.

As described in Section 17.3.3, a majority of the likely affected residents are dependent on gardening or rice cultivation as the main source of income, and according to the results of the hearing survey conducted by RITST in February 1998, almost all of them have the official right to use these lands (Fig. 17.9).

Table 17.6 Number of Likely Affected Dwellings and Other Specified Facilities

Site No.	Number of Likely Affected Dwellings				Other specified facilities
	Category 1	Category 2	Category 3	Total	
1			60	60	1 elementary school
2			2	2	
3			2	2	
4		2	8	10	1 temple
5			5	5	
6			8	8	1 school, 2 temple/shrine
7			18	18	
8			4	4	
9			8	8	
10			5	5	
11			10	10	
12		8	20	26	
13	10	20	20	50	
Total	10	30	170	210	

Note: Classification of dwelling was referred to Circular No.05/BXD/TT.

(See Annexure 5, 5.2)

The issues which are the major concern among most of the residents living along the proposed approach roads are: (1) the discontinuation of schooling for children, (2) the unfair compensation for loss of land and dwellings, and (3) the relocation of dwellings and crop land.

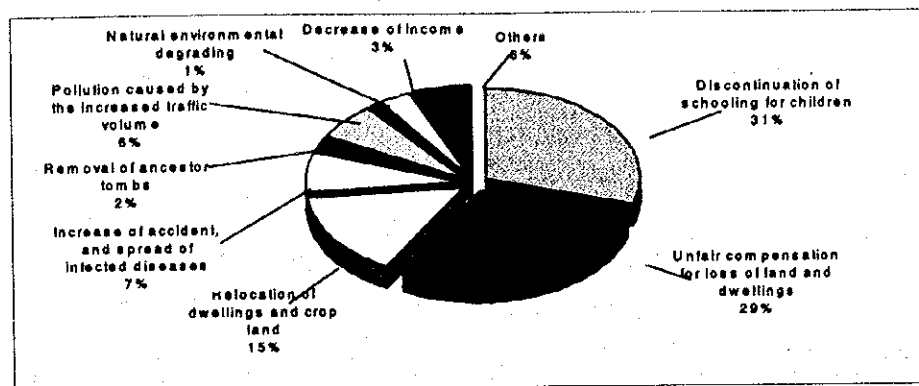


Fig. 17.9 Issues of concern among the local residents on the bridge construction project (from result of the Hearing Survey on February 1998)

b) Quantity of likely affected lands

Table 17.7 shows the quantities of land classified by its usage, which is likely to be affected by the project.

Table 17.7 Quantities of Likely Affected Lands

(Unit: meter)

Site No.	Rural residential land		Annual crop land and aquacultural land		Perennial crop land	
	City	District	City	District	City	District
1		300		1500	700	
2		100		800	200	
3		50		600	100	
4		200		700	500	
5		100		700	100	
6		150		0	300	
7	200		900	500	200	
8	200		500	300	200	
9	200		400	200	250	
10	200		500	300	250	
11	200		400	200	300	
12	300		200	100	300	
13	600		50	0	200	
Total	1,900	900	2,950	5,900	3,600	0

The study to estimate these quantities of likely affected lands was based mainly on 1/10000 scale maps. This should be revised in the near future with more detailed maps, to determine the exact amount of land affected by the project.

(2) Impacts on the economic activities of regional residents

News about the plan to implement the Can Tho Bridge Construction Project has been widespread nationwide, and the residents in Vinh Long and Can Tho Province are being distressed by the uncertainty caused by the rumors about the construction of the Can Tho Bridge. The land price at the areas surrounding the proposed bridge site seems to be increasing, and this phenomenon would continue to occur in the future.

The price of construction materials would escalate if it appears the need to provide houses to workers who come from other provinces.

(3) Impacts on public health and others

If significant numbers of construction workers come from other regions, it would appear that the threat to public health and hygiene caused by the spread of AIDS/HIV and other sexually transmitted diseases as a result of an increase in prostitution will become a reality. The conflict between local residents and outside workers would also be another threat to the stability of the local communities.

Water pollution, air pollution, excessive noise, vibration caused by the construction works would disturb the physical environment and create adverse affects to the health of residents living close to the construction sites. Pupils of the two elementary schools located close to the proposed approach roads would suffer significant impacts on their health if their schools are not relocated.

17.4.3 Prediction and Evaluation of Socio-economic Impacts During the Service Phase

(1) Adverse impacts on economic activities of regional residents

Residents who are operating the business shops at the existing ferry terminals, and peddlers, local transporters, etc. who have some sources of income depending on the business activities on the ferries or at the ferry terminals, would lose their means of livelihood or main sources of income due to the reduction of the Can Tho Ferry's services after the construction of the Can Tho Bridge (Photographs in Annexure 9.3).

Almost all of interviewed persons who are running some kind of business shops at the ferry terminals said that their business is their main source of income. Therefore a decrease in the number of ferry passengers caused by the reduction of the Can Tho Ferry service after the completion of the bridge would significantly affect their livelihoods.

A part of the Can Tho Ferry Company's management staff would be forced to re-employ or move to another region due to the restructuring of the company after the construction of the bridge. After the completion of the bridge, depending on the number of local people employed on the construction site, there would be a sudden increase in unemployment in the local communities.

(2) Hazards and risk

The risks of traffic accidents along the approach roads would grow higher, as a result of the increase in traffic volume and vehicle velocity.

17.5 Recommended Mitigatory Measures

17.5.1 Mitigatory Measures on Natural Environment Impacts

(1) General issues

All of the adverse impacts on the natural environment should be mitigated by the appropriate management methods.

During the construction phase, a local residents' organization should be established or strengthened to facilitate the implementation of mitigatory measures on adverse environmental impacts. On-site meetings should be held frequently to inform and help the affected residents on all issues relating to the construction progress, compensation, resettlement, health, and safety, etc.

(2) Erosion and sediment control

An erosion and sediment control plan should be prepared in advance of the construction.

All construction sites, and facilities should be located as far as possible behind the levee. The road embankment, the disturbed areas, etc, should be revegetated as soon as possible.

(3) Control of water pollution

All waste water or contaminated rainwater runoff from construction areas, worker camps, etc. should be treated by the appropriate methods before discharging into canals or rivers.

The concrete batching sites should be located at appropriate areas where the runoff water can be treated easily. Contaminated water should be channeled into a settling pit, so as to collect fine sediment and sediment slurry.

In order to minimize the adverse impact of sewage and waste disposed from construction camps, the sewage should be channeled into hygienic pit latrines or into a septic tank system, and all solid wastes should be disposed of in a sanitary landfill area.

(4) Control of air pollution

Appropriate measures which aim to mitigate adverse impacts on air environment should be implemented at the concrete batching sites, construction areas, and other places where there is a generation of dusts, contaminant gas, etc.

17.5.2 Mitigatory Measures on the Adverse Socio-Economic Impacts

(1) General issues

As was mentioned in Section 17.4, it is anticipated that a number of residents, and communities in Binh Minh District and Can Tho City would directly suffer many adverse impacts caused by the proposed bridge construction project. Among them, the most affected people may be (1) the residents who have lost their dwellings and cultivated lands to the project, (2) the shopkeepers, the peddlers, the local transporters, etc. who have lost their main sources of income due to the reduction of the existing ferry service.

The issues which are of major concern among these PAPs are likely to be: (1) the compensation for loss of dwellings and lands, (2) the

relocation of dwellings and croplands, and other issues such as: (3) the discontinuation of schooling for children, (4) the relocation of ancestor tombs, etc.

To prevent any delay of the project implementation caused by local residents' opposition, it is recommended that these issues mentioned above (especially the issues on compensation and relocation of dwellings and croplands), should be discussed carefully during the detailed design period and as soon as possible after the project approval.

(2) Compensation Policy

During the hearing surveys on PAPs in February 1998, almost all of interviewed residents said that they agreed with the project implementation, and are ready to relocate their dwellings and croplands if they are to be lost to the project. Since the Vietnam Law on Land guarantees the land user's right to be compensated for the loss of land use, whenever land is consumed or taken back for public interests, the most concerned issue from the PAPs' viewpoint is whether the compensation is reasonable and acceptable or not.

According to Decree No.87/CP, the Provincial Peoples' Committees are charged with deciding land values as the basis for calculating land allocation fees, taxes on the transfer of land use right, determining property values and setting compensation payments. The initial cost estimation for compensation of lands in this study, has been done with the land values decided by the Peoples' Committee of Can Tho Province (Decision No.2504/QD.UBT.97 of October 2nd, 1997).

However, the experience learned from other construction projects elsewhere in Vietnam, and especially from the My Thuan Bridge Construction Project shows that the land values decided by the provincial authorities are usually difficult to be accepted by the dislocated residents. To avoid undesirable disputes on the compensation issue, it is recommended first that the current methods for deciding land values be revised.

As well, the compensation policy should be carefully prepared as soon as possible after the project approval, and should take into account the following matters:

- Compensation should be adequate for dislocated families to re-establish and survive until the acquired new land becomes fully productive.
- Compensation should be given for all affected structures or lands to all families registered in the census of a fixed day (such as the project approval day). No differentiation should be made according to the legal status of the families registered.
- Compensation should include all additional works carried out by PAPs, such as household electrification, compound walls, and all additional items such as trees, graves, wells, etc.
- For families losing their house and with remaining land which is insufficient to rebuild a new house, compensation should be paid for the loss of their house and the total land, even if not all the acreage is required for project purposes. These families should be entitled to receive a lot of 100m² in a resettlement zone prepared by the authorities.
- For families wanting to acquire lots and houses in a location other than the resettlement zone prepared by the authorities, compensation can be paid in cash at replacement cost.
- All families of which part of the house is affected are entitled to a subsistence allowance for a fixed period needed to rebuild the new house or relocate to another place.
All dislocated families should be provided a transport allowance for the move from the original homestead to the new settlement area.

(3) Resettlement Plan

According to the results of the hearing survey on project-affected people conducted in February 1998, the issue on relocation of dwelling and crop land is one of the major issues of concern among residents who are likely to be affected by the project.

There appears to be a remarkable difference between the intention of the residents in Binh Minh District and in Can Tho City, on the location

where they want to be resettled (Fig. 17.10). 53% of the interviewed residents in Binh Minh District expressed the intention to move to a resettlement zone planned by the authority, while only 7% of the interviewed residents in Can Tho City had the same view. A majority of the interviewed residents in Can Tho (84%) answered that they wanted to resettle somewhere near to their existing dwelling and land.

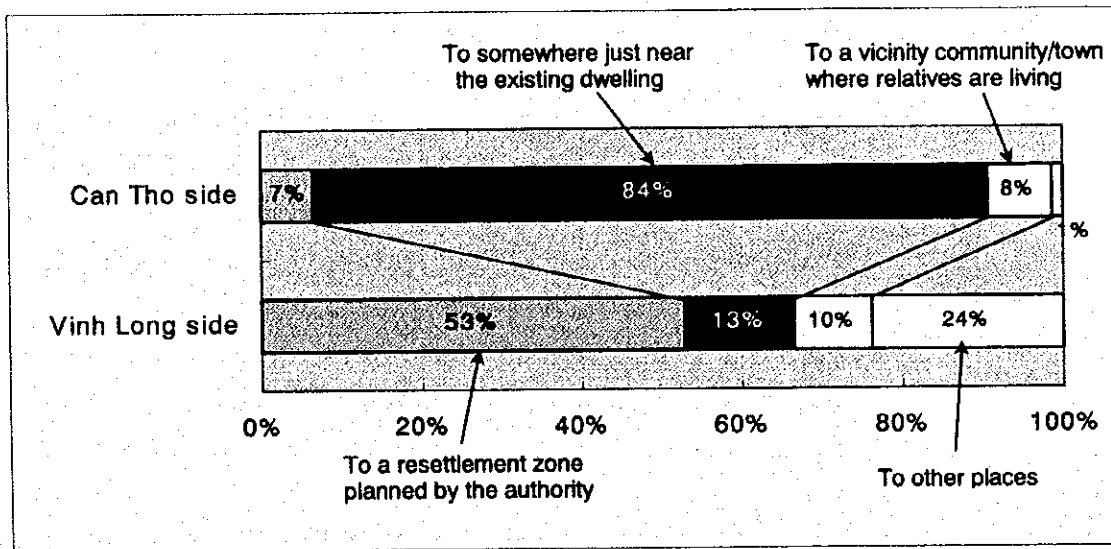


Fig. 17.10 Interviewed residents' intention on the site to resettle if their dwelling is acquired by the project.

However, to mitigate the impacts on residents who will lose their dwellings to the project, a resettlement plan should be prepared at the detailed design stage prior to construction. To ensure that the project is acceptable to all PAPs and to avoid any undesirable disputes during the project implementation, adequate preparations such as the following should be implemented in the process of making the resettlement plan:

- Conducting detailed surveys on the PAPs' intentions, to collect the necessary detailed information for the setting up of compensation policy, resettlement plan, etc.
- Setting up the policy on compensation, land acquisition, and resettlement which is preferable to a majority of PAPs.
- Setting up the principles on the formulation and the activities of the 'Resettlement Committee' responsible for the implementation of the resettlement plan, taking into account the participation of PAPs in this organization,

- Setting up the principles on the providing of subsistence allowances, and other subsidiary policies.
- Setting up the appeal mechanism, to allow any aggrieved resident to express his/her opinions to the 'Resettlement Committee', and to ensure that these appeals are appropriately considered.

In this study, based on the results of the hearing survey on PAPs conducted by RITST in February 1998, it is assumed that two resettlement zones (one in Binh Minh District, and one in Can Tho District) should be constructed to allow the relocation of 100 dwellings (or about a half number of total affected dwellings).

Fig. 17.11 shows the recommended sites for these two resettlement zones. The following factors have been considered in selecting the sites for the resettlement zones:

- The land use plans of Binh Minh District and Can Tho City should be taken into consideration while selecting the sites for the resettlement zones.
- The resettlement zone should be located near the community where there is a substantial number of residents to be relocated.
- The resettlement zone should be located near a waterway or a road to allow easy access to the adjacent city/district urban centers.
- The resettlement zone should be located close to the existing ferry, or the newly constructed service areas, to provide the dislocated PAPs with opportunities to continue his/her business, or to start new ones.
- The site should be of sufficient land area and be easy to construct the basic infrastructure such as water supply system, electric power supply system, community facilities, dispensaries, educational facilities, etc

Wherever possible, a resettlement zone needed to relocate 50 dwellings should have a land area of at least 8,800 m² (100m × 88 m), and should consist of:

- House lots: (100 m² /lot × 50 house =) 5,000 m² (57%)
- Roads: 2,200 m² (25%)
- Open area for open drainage ditches: 450 m² (5%)
- Green zone and public facilities: 1,150 m² (13%)

Outline of one Resettlement Zone

Land area at least required for one Resettlement Zone available for relocation of 50 dwellings.

Total land area: 8,800m² (100m×88m)

For houses: (100m²/101×50 house) 5,000 m² (57%)

For roads: 2,200 m² (25%)

For sewage, drainage, etc.: 450 m² (5%)

For green space, community facility, etc.: 1,150 m² (13%)

Required infrastructure: Water Supply (piped supply or well for each house), sewage, electric power supply, etc.

Required community facility: meeting hall, clinic, elementary school, etc.

Proposed location of Service Area on the Can Tho side

Proposed location of Resettlement Zone on the Can Tho side

Outline of one Service Area

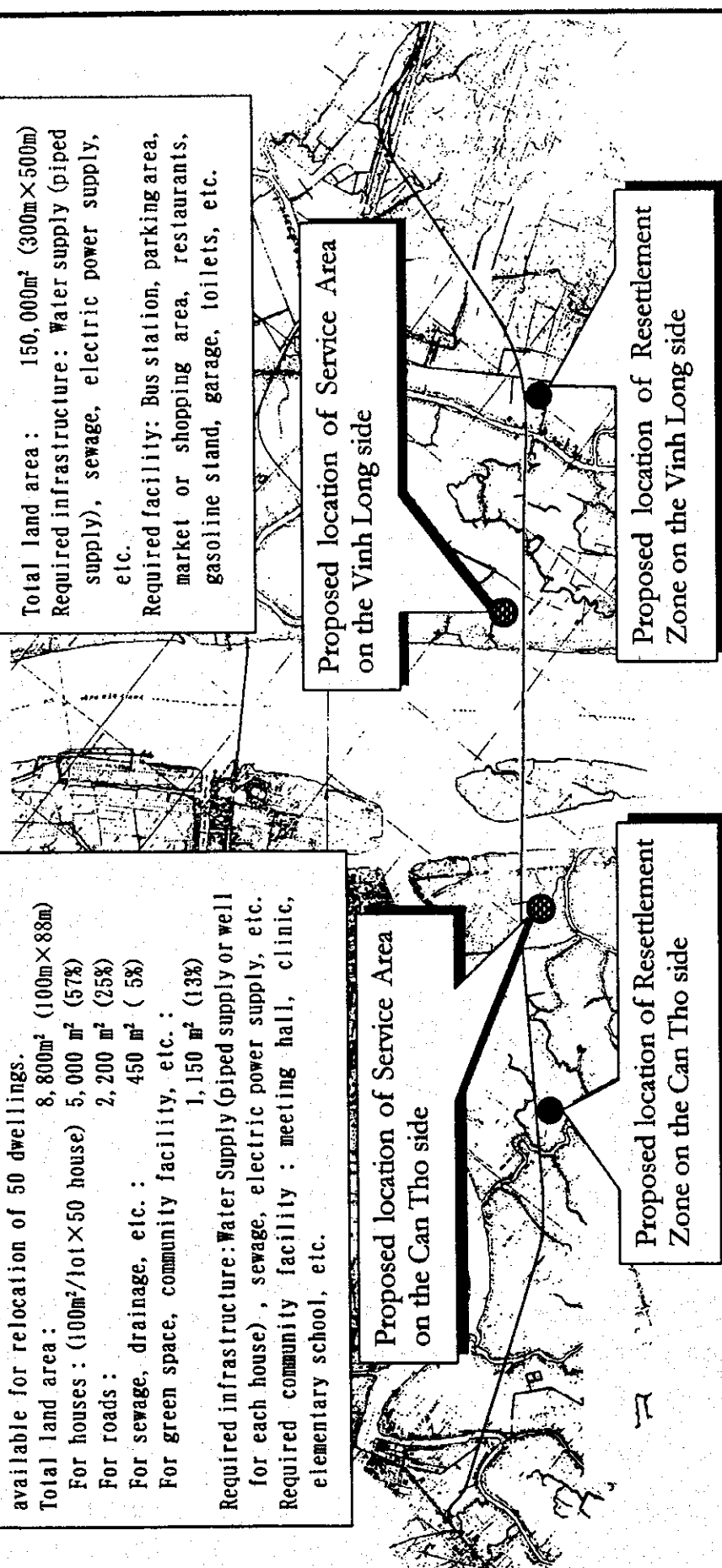
Total land area: 150,000m² (300m×500m)

Required infrastructure: Water supply (piped supply), sewage, electric power supply, etc.

Required facility: Bus station, parking area, market or shopping area, restaurants, gasoline stand, garage, toilets, etc.

Proposed location of Service Area on the Vinh Long side

Proposed location of Resettlement Zone on the Vinh Long side



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Fig.17.11 Recommended sites for resettlement zones and service areas

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The estimated cost for the construction of infrastructure for two resettlement zones is described in Section 17.7.2.

(4) Assistance to Those Losing Means of Livelihood at the Ferry Crossing

There is a plan to maintain the Can Tho Ferry as a river crossing serving the residents living in Cai Von Town (Binh Minh District) and Can Tho City. Therefore the shopkeepers, the peddlers, and the local transporters, etc. at the ferry terminals may be able to continue their businesses even after the completion of the bridge. It is, however, anticipated that these PAPs will lose a part of their income, due to the decrease in the number of ferry passengers. Some of these shopkeepers may lose their means of livelihood, and would have to be assisted to find some substitute sources of income. Appropriate measures should be implemented to help these PAPs, whose livelihoods are dependent on the business or service activities on the existing ferries or at the ferry terminals.

A further detailed study should be carried out in advance of the bridge construction, to determine the exact number of shopkeepers who need to be assisted, their economic circumstances, and their intentions on changing businesses, etc.

In this study, the construction of two service areas at both sides of the proposed bridge is recommended. Cars, buses, trucks, passengers, tourists, etc. can take a rest at these service areas, taking meals, buying foods, gifts, gasoline, etc. and may enjoy a view of the large-scale new bridge after its completion. The project-affected shopkeepers and the peddlers at the existing ferry terminals should be given priority to move into one of these two service areas and carry out substitute businesses to maintain their livelihood.

One service area may have a land area of about 150,000 m² (300m × 500m), and should consist of bus terminals, markets, business shops, restaurants, gasoline stands, repair shops, sanitary toilets, etc. Shortly after the completion of the bridge, the two construction sites at both sides of the bridge may be used in constructing these two service areas. By doing so, the basic infrastructure constructed for the worker encampments, such as electric power supply facilities, water supply facilities, drainage system, health care facilities, etc. may be utilized

appropriately to serve as the basic infrastructure required for the service areas.

The physical design and the construction plan of these service areas should be done, at the early stage of the detailed design immediately after the project approval.

Beside the construction of these two service areas, other measures such as the following should be implemented to mitigate the adverse impacts caused by the project to the residents whose livelihood is depending on the existing ferry:

- Training on some viable forms of food processing which could be undertaken at the household level.
- Establishment of some form of soft loans, to help the affected residents, especially the peddlers, who intend to carry out new business ventures, but do not have sufficient finance.

(5) Other mitigatory measures on socio-economic adverse impacts

- The Binh Minh District People's Committee and the Can Tho City People's Committee should organize one specified staff unit (namely 'Compensation and Resettlement Unit for Can Tho Bridge Project', for instance), and assign efficient experienced experts, finance and equipment, to take charge of property evaluation, compensation, resettlement plan implementation, etc. Also, the unit should solve all problems, disputes, etc. relating to the above-mentioned issues, as well as resolving all conflicts between the local residents and out-coming workers, etc.
- PMU-My Thuan, the People's Committee of Vinh Long Province, and the People's Committee of Can Tho Province should work together closely to support and supervise the 'Compensation and Resettlement Units', to ensure the participation of representatives of PAPs through all processes of planning and implementing of the compensation and resettlement plans.
- The provincial Departments of Labor, Disabled Soldiers and Social Welfare, and/or the local branches of the Labor Union should be entrusted to establish an employment register of local people with relevant skills interested in obtaining work on the bridge construction project.

- The staff members of the Can Tho Ferry Company, who would lose their current jobs due to the reduction of their company after the completion of the bridge, should be given priority to be employed at the companies to be entrusted to undertake the bridge operation/maintenance works.
- The plan to establish the gardening-tourism areas in the southern part of Binh Minh District and in Con Au Island should be pushed forward, to create new jobs for local residents, especially for the peddlers, and the local transporters who would lose their main source of income due to the reduction of the Can Tho Ferry services. Such tourism areas may also serve as places to absorb unemployed workers after the completion of the bridge.
- The relocation of the elementary schools and shrines affected by the project in Binh Minh District should be carefully examined, if all proposed reasonable mitigatory measures are thought to be unable to mitigate all of potential adverse affects caused by the project.
- Assistance should be provided for the establishment and upgrading of the local clinics on either sides of the river, to help construction workers and local residents in medical examining and treating of minor illnesses. Some of these local clinics may be entrusted to monitor the socio-economic impacts (by collecting data on residents' health condition), with reasonable financial support.
- Consideration should be given to help dislocated families who need to remove their ancestor tombs. Usually, the removal of these tombs would have to be done by a professional on a determined day and at time set by an astrologist.

17.6 Recommended Monitoring Program

The monitoring program is necessary to understand the environmental conditions and to examine the environmental conservation measures. The components of the monitoring plan are shown in Table 17.8.

Table 17.8 Components of the Monitoring Program

Items	Monitoring	Time *
1. Topography, geology, soil	Periodical inspection of soil erosion, slope failure, etc.	1 and 2
2. Water quality	Periodical inspection of the conditions of the water and drainage systems. Periodical measurement of pH, SS, COD, BOD, DO, P, Al, Fe	1 and 2
3. Air quality	Periodical inspection of the conditions of air environment. Periodical measurement of TSPM, SO ₂ , NO _x , HC, CO, Pb	1 and 2
4. Noise and vibrations	Periodical measurement of noise levels and vibration levels	1 and 2
5. Aquatic ecosystem	Periodical inspection of the conditions of aquatic ecosystem Periodical survey on phytoplankton, zooplankton, benthic organism.	1 and 2
6. Community	Periodical investigation of social indicators	2
7. Economic activities	Periodical investigation of economic development, community health.	2

Note 1: During the construction phase
2: After the construction

17.7. Estimation of Environmental Costs

17.7.1 Compensation Costs for the Loss of Dwellings and Lands

Table 17.9 and Table 17.10 show the draft estimated compensation costs for the loss of dwellings and lands, respectively.

Table 17.9 Compensation for loss of land

(Unit: 1000VND&1000USD)

	Unit	Quantity		Cost	
	VND/m ²	m	m ²	1000VND	1000USD
Rural residential land					
City	38,000	1,900	155,420	5,905,960	456.06
District	19,000	900	73,620	1,398,780	108.01
Urban land					
Street type 1	3,500,000	0	0	0	0
Street type 2	2,000,000	0	0	0	0
Street type 3	800,000	0	0	0	0
Annual crop land and aquacultural land					
City	19,000	2,950	241,310	4,584,890	354.05
District	5,500	5,900	482,620	2,654,410	204.97
Perennial crop land					
City	14,000	3,600	294,480	4,122,720	318.36
District	4,200	0	0	0	0
Total		15,250	1,247,450	18,666,760	1,441.45

Note: Right of Way = 20m Road width + Right of Way = 81.8m
Demarcation = 7m Road width + Right of Way = 55.8m
At urban areas of Can Tho City: loss of land = road length * 55.8m
At other areas: loss of land = road length * 81.8m
1USD = 12,950VND

Table 17.10 Compensation for Loss of Dwellings

(Unit: 1000VND&1000USD)

	Unit price	Dwelling		Cost	
	VND/m ²	Quantity	m ²	1000VND	1000USD
House category 1	1,000,000	10	1,000	1,000,000	77.22
House category 2	900,000	30	1,800	1,620,000	125.10
House category 3	450,000	170	6,800	3,060,000	236.29
House category 4	300,000	0	0	0	0
Total		210	9,600	5,680,000	438.61

Note: 1USD = 12,950VND

17.7.2 Costs for Implementation of Environmental Mitigatory Measures and the Monitoring Program

Table 17.11 ~ Table 17.13 show the draft estimated costs for the implementation of mitigatory measures and the monitoring program.

Table 17.11 Cost for Implementation of Mitigatory Measures

(Unit: 1000VND&1000USD)

	1000VND	1000USD
Cost for construction of infrastructure of resettlement zones		
Land reform (17,600 m ² @ 30,000VND)	528,000	40.77
Water supply system (100 dwellings @ 2,000,000VND)	200,000	15.44
Power supply (2 zones @ 450,000,000VND)	900,000	69.50
Road (2000m @ 250,000VND)	500,000	38.61
School (2 schools @ 165,000,000VND)	330,000	25.48
Dispensary (2 stations @ 150,000,000VND)	300,000	23.17
Sewage system, garbage dispose station, etc.	300,000	23.17
Sub total	3,058,000	236.14
Cost for construction of infrastructure of service areas		
Cost for reform of land for service areas (2 sites @ 150,000 m ² @ 30,000VND)	9,000,000	694.98
Sub total	9,000,000	694.98
Grand total cost for implementation of mitigatory measures	12,058,000	931.12

Note: The estimation of total surface area needed for resettlement zones was based on following assumption:

- Surface area needed for one dwelling = 100m²
- Land for housing = 57% of total surface area
- Land for roads = 25% of total surface area
- Land for sewage = 5% of total surface area
- Land for greenzone, public facilities = 13% of total surface area
- 1USD = 12,950VND

Table 17.12 Cost for Implementation of the Environmental Monitoring Program

Item	Cost	
	(Unit: US\$)	
During the construction phase		
Water quality monitoring (72US\$/time, 2 times per week, every week during 4 year period)	29,952	
Air quality monitoring (90US\$/time, 8 times per month, every month during 4 year-period)	34,560	
Noise monitoring (70US\$/time, 1 time per month, every month during 4 year period)	3,360	
Monitoring on aquatic ecosystem (400US\$/time, 2 times per month, every month during 4 year period)	38,400	
Monitoring on socio-economic conditions (Financial support to local healthcare stations for data collection, 400US\$ per month, every month during 4 years)	19,200	
Sub total	125,472	
During the operation phase after the construction		
Water quality monitoring (72US\$/time, 2 times per month, every month during the first 2 year period, and 2 times per 6-month, during the latter 3 year period)	4,320	
Air quality monitoring (90US\$/time, 8 times per 6-month, during 5 year-period)	7,200	
Noise monitoring (70US\$/time, 1 time per 6-month, during 5 year period)	700	
Monitoring on the aquatic ecosystem (400US\$/time, 1 times per 6-month, during 5 year period)	48,000	
Monitoring on socio-economic conditions (Financial support to local healthcare stations for data collection, 400US\$ per month, every month during 5 years)	24,000	
Sub total	84,220	
Grand total cost for environmental monitoring program	209,692	

Table 17.13 Total Environmental Costs

Item	Cost	
	1000VND	1000USD
Compensation cost for loss of dwellings	18,666,760	1,441.45
Compensation cost for loss of lands	5,680,000	438.61
Cost for implementation of environmental mitigatory measures	12,058,000	931.12
Cost for implementation of environmental monitoring program	2,715,511	209.69
Total	39,120,271	3,020.87

Note: Cost for implementation of environmental monitoring program = 209,692US\$ or 2,715,511,000VND (1US\$=12,950VND)