MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT (MARD)

PROJECT PREPARATION UNIT (PPU)

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ENVIRONMENTAL IMPACT ASSESSMENT

FOR NATURAL DISASTER MITIGATION PROJECT (WB4)

WORLD BANK PROJECT

VOLUME 3

BA TRI SEA-DYKE SUB-PROJECT

(Final report)

PREPARED BY

ENVIRONMENTAL RESEARCH CENTER

June 01, 2005

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Project Preparation Unit

EIA Consulting Agency
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Director

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June 01, 2005

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CHAPTER 1. **INTRODUCTION**

1.1. OBJECTIVES OF ENVIRONMENT IMPACTS ASSESSMENT (EIA)

The objectives of Environment Impacts Assessment are to determine the potential impacts of project on environment in the area and to prôpe mitigation measures. Thus, it is possible to limit or exclude the negative impacts on environment during construction and operation to secure the harmonious and sustainable development of environment and economy of the country.

The process of EIA is as follows:

- To assess the present status of environment through field investigation, reference to project area available environmental research documents on project area, to evaluate present situation and the trend of natural environment development in case of no project implementation. Based on that, to assess positive as well as negative changes of ecological environment in project area.
- To summarize the comments from the People's Committee, Department of Agriculture and Rural Development, and Department of Culture and Information of Ben Tre province.
- From the above-mentioned researches, to propose scientific and practical solutions and actions to minimize the negative effects, pay attention to the management of ecology and environment, to indicate direction for sustainable development of project area and its vicinity.

1.2. DATABASE FOR EIA

1.2.1. Documents for EIA

The EIA is made on the basis of reference to EIA available in Ben Tre province and some concerned agencies that were made for researches and for invested projects in the province.

- Report on present status of Ben Tre province environment in 2003, made by provincial Department of Science and Technology;
- Report on "The level of water pollution in the coastal and estuary areas of Ben Tre province" made by the Environment Research Center - EPC in 1998;
- Hydrology Projects of Sap bridge, Binh Dai Sea dyke, Project for 872 ha of industrial shrimp culture in Bao Thuan Commune, Project 773 at Tan Xuan, An Thuy, Tan Thuy villages, etc.
- The national documents and guidelines for making EIA, the regulations and procedures.
- The data of preliminary investigation and survey on environment in project area made by the Environment Research Center, Institute of Meteorology and Hydrology.
- Data on situation of people's living, economy, society and diseases in communes of project area, the types of production affected by environment and natural disasters.
- The assessment methods are based on the analysis and synthesis of available and survey data, then analysing the benefits and expenses which project may bring about, its potential negative and positive impacts on ecology and environment.

1.2.2. Strategy and regulation of EIA

EIA of this project is made in the complying with the regulations of Vietnam

Government on environment protection and the environment policy of the World Bank (WB). The legal documents include:

- The Environment Protection Law of Vietnam approved by the National Assembly of Vietnam on 27-12-1993
- Decree 175/CP1994. Guidelines on the implementation of the Environment Protection Law.
- Decree 12/CP dated February/1997 on detailed regulations of the implementation of the Law on Foreign Investment in Vietnam ;
- Decree 490/1988/TT- BKHCN&MT, guidelines on making and verification of EIA for investment projects;
- Decree 12/CT - TTg of March/1998 on Flood and Typhoon prevention and preparedness and natural disaster mitigation;
- Decree 581 - TTg to promulgate regulations on flood warning (1997);
- Ordinance on Dyke (in 1995, amended in 2000);
- Vietnam National Environment Standards;
- Project on Resettlement policy of Vietnam, final report. Decree on compensation and resettlement, Ministry of Planning and Investment, June1998.
- The National Strategy on Environment protection from 2001 to 2010
- The National Ecology Action Plan (1995)

In the operation policy OP - 4.01 WB has specified the requirements to environment impacts assessment of projects with financial support. In this relation, EIA shoud be complied with the technical document No. 139 of WB from volume I to III.

1.3. SELECTION OF RESEARCH METHODS

The WB project, part 1 is of class B (Ba Tri sea dyke - Ben Tre province), belonging to Subproject of natural disaster mitigation WB4; the consideration, assessment of concerned factors impacts should be based on the past, present and future conditions. Therefore, the method used in making EIA is a systematic one. It considers the relationships between the environment components, the objects affected during construction and operation of project.

The methods used for EIA are:

+ Method of selected use of past experiencies
+ Checklist method
+ Comparison method
+ Expert method
+ Field investigation and survey method
+ Using GIS method

1.4. ORGANIZATION AND PREPARATION FOR EIA

Steps made in EIA are as follows:

- Collection of related documents
- Community opinions gathering
- Consultation of experts (in state and profession management...)
- Additional measurement and survey
- Site survey in projected area
- Making EIA
- Expert consultation

Taking part in this connection are:

Dr. Duong Hong Son.
Dr. Nguyen Kien Dung.
Ms. Tran Thanh Thuy.
Ms Phan Ban Mai.
Ms. Tran Dieu Hang

1.5. THE AFFECTED AREA OF SUBPROJECT

The affected area of subproject is as follows:

- 6 communes in subproject are: Tan Xuan; Bao Thanh; Bao Thuan; Tan Thuy; An Thuy; An Hoa Tay of Ba Tri District, Ben Tre province.
- Other components affected by subproject operation may be surface and ground water resources; air quality, living environment, infrastructure....

1.6. THE MAIN CONTENT OF EIA.

EIA includes 5 main parts listed below. Its maps and tables are attached in references

Chapter I. Introduction

The objectives and research and assessment methods for the propose are presented.

Chapter II. Subproject description

Location, tasks and objectives of project; proposals for socio-economic development

Chapter III. Present condition of natural resources socio-econimy

To assess present situation, natural environment, ecology, people's living and socio-economy in projected area. This is one of important items of the report serving as the basis for EIA and considerations of changes after implementation of project

Chapter IV. Environment impact assessment

To forecast the natural environment evolution in project area without project. To indicate possible impacts from project operation such as building of sea dyke, canals, culverts, dams in construction and management phase on environment: natural environment, ecology, people's living and socio-economy. Concentration be made on some main issues such as ground environment, water quality.... as the basis for comparison and assessment of possible environment impacts of project.

Chapter V. Conderation of alternatives

To compare and select the most suilable alternative.

Chapter VI. Mitigation measures and environment management plan

To make the environment action plan in project area to avoid negative effects on environment, mitigate the adverse impacts and exploit the positive impacts. Then to make scientific and practical conclusion and recommendations to mitigate negative effects on environment. Pay due attention to the management of ecological environment and the direction for sustainable development of the area.

Conclusions and recommendations

CHAPTER 2. **SUBPROJECT DESCRIPTION**

2.1. PROJECT'S NAME: BA TRI SEA DYKE

(WB4 Natural disaster mitigation Project)

2.2. PROJECT MANAGEMENT AGENCY : MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

Representative investor: WB4 Natural Disaster Mitigation Project PPU

2.3. EIA COMPILING AGENCY CENTER FOR ENVIRONMENTAL RESEARCH, INSTITUTE OF HYDROLOGY AND METEOROLOGY

Project sites: Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay villages in Ba Tri district - Ben Tre Province

2.4. GEOGRAPHICAL LOCATION

Ben Tre province is situated in the downstream of the Mekong River, divided by a great number of big rivers in the form of a handly fan, with 4 river mouths in Ben Tre province: Cua Dai, Cua Ba Lai, Cua Ham Luong and Cua Co Chien), creating three islands.

- An Hoa Island including: Chau Thanh and Binh Dai District
- Bao Island including: Ben Tre Province and Giong Trom; Ba Tri Districts
- Minh Island including: Cho Lach, Mo Cay and Thach Phu Districts

Ben Tre province lies between $9^0$48' -:-$10^0$20' North latitude and $105^0$51' -:-$106^0$8' East longitude on the Southern Vietnam seacoast of 65 km in length.

+ In the North it borders with Tien Giang Province.
+ In the South and East it border with Tra Vinh Province.
+ In the West it border with Vinh Long Province.
+ In the East with East Sea.

Ben Tre is one of the provinces located in the lower Mekong river delta and crossed by Tien river towards East Sea through four main branches namely Dai, Ham Luong, Co Chien, Ba Lai (with Ba Lai dam and culvert built in 2001). Ba Tri sea dyke sub-project area is located between Ba Lai and Ham Luong estuaries with the seacoast length of 25 kilometers. It belongs to Ba Tri district in the Southeast of Ben Tre province bordering with East Sea thatis often indirectly affected by typhoons and tropical low pressure in the East sea.

Such coastal communes as Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, West An Hoa in Ba Tri district directly benefit from Ba Tri sea dyke sub-project. The total natural land area within the project zone is about 14,529 ha (40.88% of district area) with the population of 68,043 people.

The project zone is 60 kilometers away from Ben Tre town. Geographical features are as follows:

+ Southeastern part borders with East Sea.
+ Southwestern part is adjacent to Ham Luong river.
+ Northeastern part borders with Ba Lai river.
+ Northern and Northwestern part is adjacent to Vinh Hoa – Tan Xuan road.

2.5. PROJECT OBJECTIVES AND TASKS

Ba Tri Sea Dyke Project will bring great socio-economic benefits to population in Ben Tre province, especially for Ba Tri district. It has some major targets as follows :

- The project aims at preventing and mitigating natural disasters due to frequent occurrence of sea storm, spring tide which directly affect 26,886 people / 4,801 ha from district road 16 to sea and indirectly affect 41,157 people / 10,728 ha inside district road 16 and adversely affect such different industries in the project zone as : rice growing, salt producing, aquatic farming,... The project also helps to reduce damage by natural disasters in such communes as: Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, and An Hoa Tay .
- To meet the demands in water for production in 14,529ha of project area; for domestic uses, improvement of soil/water environment, protection and improvement of the environment for sustainable development. It helps the population in self protection their living.
- To protect population zones, their life and properties from the flood and storm; to retain fresh water for 2 – 3 crops of agricultural production of 2340 ha, and 1250ha of one crop. To bring saline water for salt production and fishery. to drain rain water for 14,135ha agricultural land, to wash acid sulphate and dirty, waste materials released during production and domestic waste into the sea.
- To combine the sea of dyke as communication road, especially for evacuation in flood/ rainy season. To combine the rural, naval communication and create safe protection site for boats/ships with fast and convenient entry/exit. To establish the line national defense and security.
- Active provision of fresh water for shrimp raising areas to dilute salinity adequate for aquiculture.
- To create favorable conditions for population zones in building infrastructures and technical material bases, public benefits structures to heighten cultural and spirit living conditions of the population.
- To replan the supply/drainage zones for water control adequate for various landfarms.

2.6. MAIN TECHNICAL COMPONENTS AND GRADES OF THE CONSTRUCTION

2.6.1. Major components of construction system include:

- Sea dyke system
-Dike culverts

2.6.2. Main technical norms

- The total natural land area of the 6 project communes is about 14,529 ha with 68,043 inhabitants in which 4,801 ha/26,886 inhabitants (from district road 16 to sea) are directly affected by annual natural disasters, the remaining areas and habitants are also indirectly influenced.
  Selected design constructions grade is III grade construction (basing on the official document No 489/PCLB dated 25th December 2002 by MARD).

2.6.3. Design frequency:

- Design frequency P=5%
- Cyclone of grade 9 V=24m/s

Height and size of the dyke:

Calculation of dyke crest level:

Hdd= Htk + Hnd + Hsl + a

Dyke crest height is designed on the basis of this following formula:

Hdd = Htk + Hnd + Hsl + a

Including:

- Htk = +1.90m (Designed water level following the frequency P=5% at Ben Trai Hydro-Meo Station)

- Hnd = 0.5m (run-up surge height following the zone of surge by tide within the Southern Vietnam.

- a= 0.9 m (safety height following QPTL A.6.77 δ1=0.2m, with sea dyke category III + construction settlement height and management δ2= 0.5m)

- Hsl = 0,39m (run-up height) – refer to relevant calculation annex

Thereof: H_{dd} = 1.90 + 0.5 + 0.39 + 0.7 = +3.49m

- Based on the official document No 3197/BNN.PCLB dated 3rd September1999 by MARD, the sea dyke crest height in Ben Tre region is at H_{dd} = +3.50m.

Selection of dike crest height **H_{dd} = +3.50m** (See details at annex for calculation of the dike size).

Selection of dike crest height (Joined with Ba Hien canal) **H_{dd} = +3.00m**

* Length of the sea dyke L=31,581km

* Size of the dyke network:

- Design section:

Design dike crest level +3,5m

Width of sea dyke Bdd = 5m

Sea-oriented dike slope : m = 3,0m; field -oriented m = 2,0m

Gallery of dike Blk ≥ 10m

The protection forest is outside the sea dike R = 150 - 300m

The dike is 3.5m in height that would protect the project area when the maximum height of the tide is 1m75 (observed data at An Thuan station in 2001).

- Treatment of sea dyke slope

From K0 - K12+500 and K20 +000 – Kf the sea dykes are treated as follows :

- Grass is grown on all the dike slope in the upper and lower reaches

From K26+300 – K30+100 (Ba Hien canal)the sea dyke section is as follows:

Design dyke crest level +3,0m

Width of sea dyke Bdd = 4m

Seaside oriented dike slope m = 2,0m; Field oriented dike slope m = 2,0m

Gallery of dike Blk ≥ 5m

Dyke box culverts

Functions:

- Local water logging drainage
- Supply water to production
- Prevent flood tide when cyclone occurs

The culverts are made of ferro-concrete with anticorrosion steel valve, two direction automatic valves opening according to Vietnam construction standard TCXDVN 285-2002, the grade of the construction is IV.

Proposed locations of construction

Opening dyke culverts

Functions: Major functions of these constructions are as follows:

- Prevent surge by flood tide and/or cyclone in order to avoid losses caused by natural disasters to production inside the sea dyke.
- Sewage and storage of water, salinity regulation, supply of water needed for aquaculture, salt production,... as well as for transport.
- Discharge flood for cultivated area inside the sea dyke when needed.
- Facilitate road and sea transportation conditions under traffic bridge over H13-XB60 culvert design standards.

2.7. SELECTED ALTERNATIVE

2.7.1. Work volume of the alternatives

2.7.1.1. Work bulk

1. *Sea-dyke*

Table 2-1. Work bulk in first alternative

No	Items	Unit	Alternative 1					
			measure 1a	measure 1b	measure 1c	measure 1d	measure 1e	measure 1f
1.	Soil for embankment	m^3	696,506	827,807	937,947	937,947	908,583	908,583
2.	Gravel	m^3	160,869	160,869	160,869	160,869	169,051	169,051
3.	Clay cover	m^3		77,155				
4.	Sticky soil	m^3	246,441					30,862
5.	coco-nut carpet	m^3			139,091			
6.	coco-nut net	m^3				139,091		
7.	Ashlar carpet	m^3					126,000	75,600
8.	filter cloth	m^3				139,091	183,682	86,799
9.	Pile ϕ 41 = 40 cm	kg			22,032	22,032		
10.	grass cover	m^2	481,961	336,461	336,461	336,461	336,461	412,661

(Source: FS of Ba Tri Sea-dyke)

Table 2-2. Work bulk in alternative 2

No	Cases	Unit	Alternative 2					
			measure 2a	measure 2b	measure 2c	measure 2d	measure 2e	measure 2f
1.	Soil for embankment	m^3	854,937	1,041,152	1,126,022	1,126,022	1,084,422	908,583
2.	Gravel	m^3	181,542	181,542	181,542	181,542	190,542	190,542
3.	Clay cover	m^3		84,870				
4.	sticky soil	m^3	271,085					33,948

5.	coco-nut carpet	m^3			153,000			
6.	coco-nut net	m^3				153,000		
7.	Ashlar carpet	m^3					138,600	
8.	filter cloth	m^3		2,511		153,000	202,050	183,160
9.	Pin ϕ 41 = 40 cm	kg			24,235	24,235		121,230
10.	Growing grass	m^2	544,456	417,406	417,406	417,406	417,406	468,226

(Source: FS of Ba Tri sea-dyke)

2. Box-shaped Culvert

Table 2-3 Work bulk in alternatives

No	Items	Unit	Alternative	
			Alternative 1	Alternative 2
1.	Excavation ground	m^3	191,970.4	116,364.8
2.	Backfill ground	m^3	95,225.95	58,608.10
3.	Gravel	m^3	4,500	3,400
4.	Various reinforced concrete	m^3	5,718	3,656.26
5.	Ashlar carpet	m^2	8,307	5,791.16
6.	Stone case	m^2	998.4	712
7.	Geo-technical cloth	m^2	28,442.24	18,641.38
8.	Stones	m^3	4,247.22	2,827.72
9.	Cajuput stake	m	419,545.65	255,410
10.	reinforced steel	Kg	409,952.55	252,279.3

(Source: FS of Ba Tri sea-dyke)

3. Open dike culvert

Table 2-4. General quantity of the plans

No	Items	Unit	Alternative	
			Alternative 1	Alternative 1
1.	Excavation ground	m^3	485,180.2	569,433.7
2.	Backfill ground	m^3	236,839.74	261,433.77
3.	Gravel	m^3	9,090.8	9,931.6
4.	Various reinforced concrete	m^3	15,305.43	23,010.69
5.	Ashlar carpet	m^2	10,752	12,704
6.	Stone case	m^2	2,256	2,704
7.	Geo-technical cloth	m^2	45,801.22	63,557.98
8.	Stones	m^3	5,153.37	7,232.01
9.	Cajuput stake	m	696,537	800,413.5
10.	reinforced steel	Kg	1,137,562.19	1,763,610

(Source: FS of Ba Tri sea-dyke)

4. HL 16 road crossing culvert

Table 2-5. Work volumes

No	Items	Unit	Quantity	
			Box-shape Culvert	Bridge

1.	Excavation ground	m^3	129,012.2	6,000
2.	Backfill ground	m^3	53,451.84	6,000
3.	Gravel	m^3	3,800	800
4.	Various reinforced concrete	m^3	4,456.13	780.51
5.	Ashlar carpet	m^2	4,821.1	
6.	Stone case	m^2	1,416	
7.	Geotechnics cloth	m^2	15,243.67	
8.	Various stone	m^3	1,988.37	362
9.	Cajuput stake	m	351,736.5	14,555
10.	Steel reinforcement	Kg	334,797.45	192,631.4

(Source: FS of Ba Tri sea-dyke)

2.7.1.2. Cost of the alternatives

1. Sea dyke and sea dyke culvert

Table 2-6. Total cost of alternatives

	Total investment (VND)	Of which		
		construction	Other cost	Spare
Measure 1a	163,278,283,000	125,121,763,419	23,313,039,316	14,843,480,273
Measure 1b	161,970,266,000	124,234,619,547	23,011,077,120	14,724,569,667
Measure 1c	158,973,960,000	121,853,825,533	22,667,956,520	14,452,178,205
Measure 1d	160,085,353,000	122,818,384,724	22,713,754,745	14,553,213,947
Measure 1e	202,864,709,000	159,998,761,289	24,423,701,188	18,442,246,248
Measure 1f	184,806,240,000	144,232,490,457	23,773,182,580	16,800,567,304
Measure 2a	184,087,810,000	143,197,942,386	24,154,612,293	16,735,255,468
Measure 2b	182,351,901,000	141,937,690,585	23,836,764,674	16,577,445,526
Measure 2c	179,412,513,000	139,603,210,666	23,499,074,328	16,310,228,499
Measure 2d	180,633,423,000	140,664,226,384	23,547,976,741	16,421,220,313
Measure 2e	228,245,179,000	182,106,386,782	25,389,230,040	20,749,461,682
Measure 2f	164,865,904,000	128,506,697,742	21,371,126,409	14,987,809,415

(Source: FS of Ba Tri sea-dyke)

2. Fresh water conducting culvert and HL 16 road crossing bridge

Table 2-7. Total cost of the works

Total investment (VND)		**28,055,550,000**
Of which:	- Construction cost	24,889,595,019
	- other cost	615,450,137
	- Spare	2,550,504,516

(Source: FS of Ba Tri sea-dyke)

The selected alternative for dyke construction is alternative 2 and measure f.

a) Sea dyke :

Length of the sea dyke L = 31.581 Km

The sea dike network (Figure 2.1).

The whole sea dyke is embanked with ground (excavated in the inner part of the dyke, 10 meters away from dike foot).

The section of the dyke (about 1,000 meters away from the fishing port) is embanked with the ground from elsewhere. This portion of dyke joined with Ba Hien canal into Cau Di culvert must have a smaller section as compared with the size of river dike's to reduce the area occupied by the construction

To protect against sea dyke slope erosion cohesive soil is used to cover the slope d=40-:-60 cm and grass cover is implanted.

From K12+500 ÷ K20+000 the dyke goes across the sandy area. The dyke slope will be treated as follows:

The dyke is covered with red gravel of 20 cm thickness and 4m width. The dyke slope side is covered with grass; the seaside dyke slope is reforested over 20m from dyke foot with 150 – 300m width to protect the dyke and enhance the ecology in project area

Figure 2-1. The Batri sea dyke and project area

b. Dyke culverts

+ Dyke box shaped culverts

Functions of culverts:

- Local water logging drainage
- Supply water to production
- Prevent flood tide in cyclones

The culverts are made of reinforced-concrete with stainless steel valve, automatic two way valves according to Vietnam construction standard TCXDVN 285-2002, for the IV grade construction.

Proposed locations of construction:

Table 2-8. Proposed locations , aperture and project size

Number	Name of the construction	Location	Functions				Size	
			Tide prevention	Saline draw	Drainage	Transportation	Area (m^2)	Z® (m)
1	Ong Tai canal	K1+230	X	X	X		1.5x1.5	-2.0
2	Xeo La canal	K4+671	X	X	X		1.5x1.5	-2.0
3	Xeo Rao canal	K4 +970	X	X	X		1.5x1.5	-2.0
4	Cua canal	K5 + 582	X	X	X		1.5x1.5	-2.0
5	Ong Chau canal	K7 + 362	X	X	X		1.5x1.5	-2.0
6	Muong Dao canal	K10+384	X	X	X		1.5x1.5	-2.0
7	Duong Xuong canal	K13+028	X	X	X		2.0x2.0	-2.0
8	An Thanh canal	K21+556	X	X	X		2.0x2.0	-2.0
9	An Loi 1	K27+120	X	X	X		1.5x1.5	-2.0
10	An Loi 2	K28+925	X	X	X		1.5x1.5	-2.0

(Source: FS of Ba Tri sea-dyke)

+ Open dyke culverts

Functions: Major functions of these constructions are as follows:

- Prevent from flood tide and/or cyclone surger to avoid losses caused by natural disasters for production inside the sea dyke.
- Withdrawal and storage of water, salinity regulation, supply of water for aquaculture, salt production,... as well as for transport.
- Discharge flood water for cultivated area inside the sea dyke.
- Facilitate land and sea transportation conditions with traffic bridge over H13-XB60 culvert design standards.

The culverts are made of reinforced-concrete; with stainless steel, two way automatic valves according to Vietnam construction standard TCXDVN 285-2002, for the III grade construction.

Table 2-9. Proposed locations , aperture and project size

Number	Name of the construction	Location	Functions				Size	
			Tide prevention	Saline draw	Drainage	Transportation	Width (m)	Z® (m)
1	Gia ditch	K2 +285	X	X	X	X	B=3.0m	-2.5
2	No ditch	K3+573	X	X	X	X	B=5.0m	-2.5
3	Trai ditch	K5+971	X	X	X	X	Bc=5.0m	-3.0
4	Ruong Muoi	K8+333	X	X	X	X	Bc=10m	-3.0
5	Duong Khai	K12+553	X	X	X	X	Bc=5.0m	-3.0
6	Trang Nuoc culvert	K15+100	X	X	X	X	Bc=10m	-3.0
7	Duong Tac	K17+528	X	X	X	X	Bc=10m	-3.0
8	Cay Keo	K18+859	X	X	X	X	Bc=5.0m	-3.0
9	Chau Ngao	K24+114	X	X	X	X	Bc=7.5m	-3.0

(Source: FS of Ba Tri sea-dyke)

c. Culvert across district road N16

Functions:

- Local water logging drainage for agricultural production zone inside district road No 16 if possible.
- Supply fresh water for regulating salinity in aquatic farming zone from District road No 16 to the sea.

The culverts are made of reinforced-concrete with stainless steel, two way automatic valves according to Vietnam construction standards TCXDVN 285-2002, for the IV grade construction.

Proposed locations for construction

Table 2-10. Summarized table of dike box culverts across district road No 16

No	Name of the construction	Location	Functions				Size	
			Fresh water supply	Saline sewage	Drainage	Transportation	1^{st} projection 2^{nd} projection	Z base (m)
01	Gia ditch	K2+285	X		X		2x(2x2)	-1,5
02	No ditch	K3+573	X		X		2x(2x2)	Existing
03	Ruong Muoi	K8+333	X		X		4x(2x2)	-1,5
04	Coc forest	K12+533	X		X		2x(1,5x1,5)	-1,5
05	Chua road	K14+447	X		X		4x(2x2)	-1,5
06	Tac road	K17+528	X		X		4x(2x2)	-1,5

(Source: FS of Ba Tri sea-dyke)

Proposed locations for construction of traffic bridges (P = 8 tons) on dyke road ont the locations of fresh water canals leading to aquatic farming area across dyke road).

Table 2-11. Summarized table of bridge location across Dyke Road

(H8 bridge)

No	Name of the construction	Location	Size			
			Designed width (m)	Used width (m)	Length (m)	Span(s)
01	Bridge over Ruong Muoi canal	K8+333	4.0	3.5	24	3
02	Bridge over Rung Coc canal	K12+533	4.0	3.5	27	3
03	Bridge over Duong Chua canal	K14+447	4.0	3.5	24	3
04	Bridge over Duong Tac canal	K17+528	4.0	3.5	30	3
05	Bridge over Cay Keo canal	K18+859	4.0	3.5	24	3

(Source: FS of Ba Tri sea-dyke)

Selecting investment alternative

Selecting the alternative line:

The economic calculations show that: both alternatives are feasible. The cost of the works in the alternative 2 is larger than that of alternative 1, however, it was selected under the FS for following reasons:

- The protective area is larger than that of alternative 1 about 1,302 ha of prawn growing area in Bao Thuan, Tan Thuy, An Thuy communes. In the development planing of Ben Tre as well as of Ba Tri, by the year 2001, growing prawn at the coastal area will be one of the key industries. Therefore, the growing prawn area of 1,302 ha outside the national defense seadyke is very necessary to meet the set-forth target of the works.
- In addition, according to the alternative 1, the seadyke section from Km12+000 to Km18+250 about 1000 – 1500m from the water edge will cause disadvantages for resettlement works afterward.

Selecting measure for embankment

The embankment at the sections K0- K12+500 and K20+000 – Kf will be implemented with sticky soil at site. For the section K12+500 - K20+000, with sandy clay, there are 6 measures for consolidating the surface and sides of the seadyke. Advantages and disadvantages of measures are primarily evaluated as follows:

Measure a: Embankment with sticky soil from other sites

In this case, body of seadyke embanked by sticky soi will be more stable uniform and meet the technical requirements. But it is difficult to get a a large quantity of sticky soil and to transport them. Expenditures for the purpose will be large. This measure is classified as the third priority.

Measure b: Clay cover of dike slopes

The clay coverof dike slopes is the most effective for erosion prevention, which have been executed and tested for many similar constructions in Ben Tre and nearby. But the cost is very high and clay source is rare in the zone.

Measure c: Treatment by coconut fiber mat

This measure is feasible with local material and cheap manpower, simple execution but of low safety level and undurable. The measure has not been experienced in the saline water area.

Measure d: Treatment by scouring protection filter cloth– coconut fiber – thin coconut net (mesh of 2.5cm)

Scouring protection cloth is made of 3 layers: filter cloth – coconut fiber and sparse coconut net. The measure could make use of local material and manpower, but the cost is higher and more complicated. Though the safety level and durability is higher than that of measure C, but it has not been experienced in saline water area and fire safety.

Measure e: Use of scouring protection filter cloth and stone cover.

30cm thick ashlar carpet for scouring prevention is used. The materials are available and easy to be supplied with large quantity by waterway. Through cost is high in comparison with that of measure C and D but construction is simple and fast, high safety level and durability, sustainable in storm and saltwater, good fire-prevention has been experienced well for many works nationwide.

Measure f: Seaside of dyke is covered with sticky soil (cover thickness d = 40-60cm and grass). Sticky soil could be supplied at site (within the project area) with large quantity and easily transported by waterway. Although the cost is higher than that of measure C & D, the construction is simple and quick with high safety level and durability, sustainable in rainy windy weather, in saline water and good. This measure has been analyzed at the dyke and fire protection. It was used in many works in the country. However, during the time of exploitation, it needs to implement additional embankment, especially at the sea side due to the tidal impact

Hence, we prefer the measure 2f for the dike slopes by using sticky soil exploited at site (cover thickness d = 40-60cm). It is more feasible in technical and economic aspects in the works.

2.8. DIRECTION FOR SOCIO-ECONOMIC DEVELOPMENT

2.8.1. Agricultural production

Gross Domestic Product (GDP) oF Ben Tre at the prices of 1994 has increased from 2,248 billion VND in 1990 up to 3,018 billion VND in 1995 and 4,076 billion VND in 2000, with the average growth rate of 6.07%/year during 1990 - 1995 and 6.18%/year during 1996 – 2000 ; this is equivalent to GDP/person from 1,820,000 VND (165 USD) in 1990 up to 2,360,000 VND (210 USD) in 1995: 2,700,000 VND (254 USD) in 1998: 3,100,000 VND (281 USD) in 2000. Per capita income of Ben Tre province equals to 70% percapita income of the whole country and this gap may be come bigger and bigger.

The food meets local requirements, may guarantee food safety for project area in general and Ba Tri district in particular. Food production in project area is at hopefully to reach 20,436 tons, with food per capita from 300kg/person/year, and per capita income from 300 USD/person/year at present to attain 600USD/person/year in 2010.

2.8.2. Cultivation

After provincial annual report of province, the main crops are fruit trees (309,000 tons), rice (357,3000 tons), coconut (231 million fruits), sugar cane (799,000 tons). In cultivation sector, there has been important production restructuring. The rice production ratio value has decreased from 43.7% in 1990 to 24.9% in 2000; fruits have increased correspondingly from 6.9% up to 29.1%. The restructuring rate in 10 years is about 30% and becomes one of the main factors of the crop pattern changes in the province as well as in maintaining rather high growth rate in cultivation.

2.8.3. Husbandry

Husbandry is the second important sector after cultivation, with small scale and scattered and separated, limited in family economy to make use of land, labor, agricultural auxiliary products, to increase family income, provide living foodstuff and drive force for cultivation. Total number of buffaloes and cows herd in project area are 8,346, pigs and goats: 28,050, poultry: 145,478.

After annual report, the provincial main animals are pigs (280,600), poultry (5 million). In production structure, the main product is meat (51,000 tons, or 68% - 70%), eggs and other raw products are about 10% - 12% (about 124 million eggs in 2000). The growth rate of husbandry is at average level (1.9%/year).

The agricultural production of province increased from 1,237 billion VND in 1990 up to 1,768 billion VND in 2000 (at the price of 1994), the average growth rate is 3.6%/year, or 22.3% of GDP. Fruit tree is always the principal development sector of area I in particular and for the whole provincial economy, in general, which has high effectiveness and great contribution to create beautiful landscape and good living environment for the people.

2.8.4. Forestry

Although forestry makes small proportion (1%) in economic structure, it has an important role in the protection of ecological environment in the coastal area and river mouth. The program of reforestation has good effect; during (1996 - 2000) it attained 1,460 ha of protecting forest, protect 2,482 ha. The forest cover has increased from 27.6% in 1995 up to 42% in 2000 (including concentrated forest, perennial and scattering trees).

2.8.5. Aquatic products

The aquaculture and fishing continue to develop and play an important role in economy, make 35.7% of the production value of area I, and 33.4% export value of the whole province. In 2000, total aquatic products attained 107,150 tons, increased nearly 20,000 tons over 1998, amount makes 40 - 41%. The area for aquaculture increased from 24,730 ha in 1995 to 33,900 ha in 2000, in which the area for shrimp culture is 28,900 ha. The product of aquaculture of 10,500 tons in 1995 has increased to 20,000 tons in 2000 (not including astarte, clam and crab), in which shrimp output amounted to 10,300 tons. Many boats and ships were restored, upgraded or newly built . Their number increased from 1,756 to 1,900, in which 330 were offshore fishing ships. The fishing has developed rather well; due to the decrease of coastal resources, it was concentrated in offshore fishing. The yield rose up from 45,000 tons/ in 1995 to 63,500 tons/ in 2000.

The aquaculture and fishing are developed in both fresh and saline water. It is planned to attain total fishing and aquaculture output of 35,027 tons of shrimp and fish in 2010 for

whole district, with the value of 1,751 billion VND. The area of industrial shrimp culture is 4.101 ha.

The area for salt production is 650 ha, with average output 39,000 tons/year and value of 12.87 billion VND. The area of protection forest lies from the sea dyke to the sea, which combines the cultivation of astarte, clam and reservation of the coastal mangrove ecosystem, serves as the shield to protect the inland area from strong effects of the sea, contributes to food supply for people and the balance of marine ecosystem in coastal area.

2.8.6. Water supply issues.

It is projected by the year 2010, the agricultural area of communes in project area inside the district road 16 will have 2 - 3 rice crops/year, that mainly uses the fresh water from drainage systems such as Cay Da, Cau Sap and Ba Lai; in this area, at present the drainage has difficulties due to lowland, and the drainage ways are very few and far away, for instance the drainage of Cau Vy and Giong Qui culverts, 10 water gates, Rach No, Ba Lai..... Therefore, it is necessary to build some culverts on district road 6 to drain dirty and stagnant water of the area to the sea; that is very reasonable and will contribute to the improvement of the soil, the environment and living conditions of the area.

The remaining area which lies outside the district road 16 will be used for the industrial and semi-industrial, extensive and improved extensive shrimp culture; the specialized salt production area will be 650 ha of Bao Thanh commune. Because of sea dyke construction, it is necessary to fill p some small ditches directly connecting to the sea and to the two rivers of Ba Lai and Ham Luong. Therefore, it needs to plan a reasonable canal system inside the field, build the tide prevention culverts to serve the supply and drainage of saline water for areas specialized in shrimp culture and salt production.

2.8.7. Direction for multi-purpose development

To improve and develop water and land transport, build the coastal rescue route to evacuate the people and their property into main land quickly when there is typhoon. The area inside the dyke and tide prevention culverts is also the safe shelter for boats and ships in typhoon, high tide, storm .... The routes connecting the populated area along the district road 16 and the bordering roads to the sea will create an integrated transport network, contribute to the exploitation of marine economy, particularly the raising of astarte and clam output at the coastal sedimented grounds

CHAPTER 3. **PRESENT CONDITION OF NATURAL RESOURCES AND SOCIO-ECONOMY**

3.1. NATURAL RESOURCES

3.1.1. Topography and geology

- *Topography*: The project area is located within relatively even topography where sand dunes have the highest altitude and are parallel with the seacoast. Natural ground elevation is 0.8 – 1.2 meter. It is hard to actively prevent sea water penetration and store fresh water in both dry and rainy season due to the ground altitude. It is also difficult to discharge flood because the depression area lies deeply inside local interior field (with the altitude of 0.6 – 0.8 meter). The region is badly affected by East Sea tides, together with Ham Luong and Ba Lai river surges through the interior canal network.

The project area is covered with fairly plenty of natural canals and divided into small sections by scores of sand dykes. The local salinity prevention from outer sea dyke in the project zone is built from Truong Dang (near the end of provincial road 885), along side coast, and across such communes as An Thuy, Tan Thuy, Bao Thuan to Bao Thanh (Ruong Muoi canal), and named as National Defense sea dykes. This small-scale sea dyke is deeply inside local interior fields; the canals coming from East Sea acrossing the dyke to the interior areas are not in use, which results in low efficiency. Hydraulic constructions within project areas have been being invested to implement as: Muoi Cua Culvert; Rach No sewer; Rach La irrigation system; technical infrastructure investment projects for prawns farming of aquatic sector in Bao Thuan, West An Hoa, Tan Xuan,... together with outer sea dyke and canals network are built locally following scores of constructions. Road and sea transport are quite convenient, which offers favorable conditions to process of planning and investing in hydraulic constructions implementation.

- *Mineral resources:* some mineral resources have been investigated such as metals (mineral sand Inmenit, and no metal (sand for construction, clay for brick and tile) which were formed in the process of sedimentation under the effects of combined conducting flows of river and sea that bring alluvial.

Mineral sand: Immenit mineral sand concentrates much in Con Bung (Thach Phu) and Con Ho (Batri) and distributes along the sea coast, has the dark color, and thickness of about 0.5m, lying among yellow sand areas, and has the content of sand mineral: Inmenit 207 – 113.680 g/m^3 sand with ore, Zvicon 44 – 95.818 g/m^3 sand with ore, few Rutin - 141g/m^3 sand with ore.

River bed sand: in the main rivers of Ben Tre, investigations found many sand quarries which can be used for ground leveling and improvement of poor quality gardens.

+ In the upstream of main rivers:

. Sand quality: in general, river sand is clean, contains few mica and plant humus. The contents of mineral ore in sand are low, impossible to create industrial mineral sand. The sand in upstream is mainly fine one, which can be used for ground leveling. Particularly in Co Chien River (especially in the mine of Phung Chau) the proportion of sand > 0.5 mm attains 85%, and can be used as construction mortar of mark 25-75.

. Sand reserves: total reserves are 116.5 million m^3 including C_2 grade reserves of 20548 thousand m^3, P_1 grade: 96134 thousand m^3.

Table 3-1. Reserves of C_2 level.

River	Mine	Reserves (1000m^3)
Ba Lai	Phuoc Thanh	391
Ham Luong	Son Phu	4466
Ham Luong	Tan Thanh Binh	2852
Co Chien	Phung Chau	6370
My Tho	Phu Tuc	5040
My Tho	Phu tuc	1466
Total		20548

(Source: The current environment report of Ben Tre province)

Table 3-2. Reserves of P_1 level

River	Reserves of P_1 level(1000m^3)
Co Chien	27560
Ham Luong	32598
My Tho	35976
Total	96134

(Source: The current environment report of Ben Tre province)

Total of reserves of $C_2 + P_1$ level is 116.5 million m^3.

+ Downstream of the major rivers:

. Sand quality: Sand on downstream of these rivers is fine, contaminated with salinity and can use for ground levelling.

. Sand reserves:

Table 3-3. Reverves of P_1 level

River	Mine	Reserves (1000m^3)
My Tho	Quoi Son-Long Thanh	33196
My Tho	Phu Thuan-Loc Thuan	62619
Ham Luong	An Hiep-Tan Thuy	68178
Ham Luong	Binh Khanh-An Thanh	42153
Co Chien	Khanh Thanh Tan	3182
Co Chien	§ai Phuoc-Cam Son	14387
Co Chien	Long Hoa	12266
Total		235981

(Source: The current environment report of Ben Tre province)

Table 3-4. Reverves of P_2 level

River	Reserves (1000m^3)
Co Chien	30480
Ham Luong	51057
My Tho	56271
Total	137808

(Source: The current environment report of Ben Tre province)

Total of reserves of $P_2 + P_1$ level is 373,789,000m^3

- Clay has reserve capable for exploitation to making brick, tileand distributes along the rivers in the fresh water area.

3.1.2. Meteorology

3.1.2.1. General characteristics

The project zone is in tropic and monsoon affected area with hot and humid climate all year round. There are two major wind directions corresponding to two clear cut seasons. Winter monsoon, that is hot and dry, is major wind direction in dry season (from November to May). Southwest monsoon is full of steam in rainy season from May to November. Mid-rainy season often has drought prolonging about 15 days.

3.1.2.2. Major meteorological elements

a. Air temperature

The project zone falls within tropical and monsoon affected area with hot and humid climate. Monthly and annual average temperature lightly changes in space but it is quite stable during the year (Table 3.5). Average temperature is 27^0C. The hottest month is April or May with average temperature Tbq = 28.8^0C -:- 32^0C. The coldest month is January with average temperature Tbq= 22^oC -:- 25.7^0C. Amplitude $\Delta T \approx 6^0$C -:-7^0C.

Table 3-5. Monthly average temperature

Unit: ^{o}C

Station	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Year*
Ben Tre	*25.4*	*26.3*	*27.5*	*28.6*	*26.6*	*27.9*	*27.6*	*27.2*	*27.2*	*27.1*	*26.6*	*25.5*	*27.1*
Ba Tri	*25.2*	*25.9*	*27.1*	*28.6*	*28.5*	*27.6*	*27.2*	*27*	*26.9*	*26.8*	*26.4*	*25.5*	*26.8*
My Tho	*25.3*	*25.7*	*27.1*	*28.6*	*28.4*	*27.5*	*27*	*26.8*	*26.7*	*26.5*	*26*	*25.2*	*26.7*

(Source: South Center of Hydrology and Meteorology)

b. Humidity

Average humidity during months in rainy season is 82.0% and in dry season is 79.2%. The wettest month is August with average humidity Ubq = 82.5%. The driest months are March and April with average humidity Ubq = 74.1%.

Table 3-6. Monthly average humidity

Unit: %

Station	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Year*
Ba Tri	*81*	*81*	*80*	*80*	*83*	*85*	*86*	*87*	*88*	*88*	*86*	*82*	*84*
My Tho	*79*	*79*	*79*	*79*	*83*	*85*	*85*	*86*	*86*	*87*	*85*	*82*	*83*

(Source: South Center of Hydrology and Meteorology)

c. Evaporation

During dry season from December to April, average evaporation is at 3.3 mm/24 hours. In other months during rainy season, when the humidity is high, average evaporation is only at 2.3 mm/24 hours. Average annual evaporation is at 2.8 mm/24 hours.

Table 3-7. Monthly average evaporation

Unit: mm/month

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Ba Tri	114.7	117.6	124	123	93	90	83.7	77.5	69	68.2	78	96.1	113.5
My Tho	111.6	120.4	145.7	129	96.1	90	93	93	78	68.2	72	89.9	118.7

(Source: South Center of Hydrology and Meteorology)

d. Sunlight and cloud

Located near the equator, the project area gains quite a lot of sunlight which accounts for 2660 hours/year (around 30% hours in a year). The number of average sun hours during a day is 7 hours/day. In dry season, it is about 8 - 9 hours/day. In rainy season, it is about 6 - 7 hours/day.

Table 3-8. Monthly sunshine

Unit: hour

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Ba Tri	277	273	312	283	233	189	212	178	180	179	218	251	232
My Tho	270	272	313	229	229	192	208	196	186	183	210	243	232

(Source: South Center of Hydrology and Meteorology)

e. Wind and storm

There are two major monsoons during the year:

- The Eastern Northeastern monsoon corresponds to dry season from December to April. Average wind velocity ranges from 2.4 m/s to 4.5 m/s. Sea water accompanied with tide penetratse deeply into inner fields, threatens production and water supply for local people.

- The West - Southwestern monsoon corresponds to rainy season from May to November. Average wind velocity ranges only from 2.2 m/s to 4.2 m/s (Table 3.9) in normal days. During days with typhoons or cyclones, wind velocity is about 15 m/s.

However, there are a few storms occurring in the area. Strong whirlwind often occurrs in early rainy season when tropic convergence is very active (July, August).

The statistics (over the period from 1929 to 1985) show that the area have suffered weak and medium typhoons. The hundred years a typhoon takes place with the wind speed at 30 m/s. This might be the reson the Linda typhoon which occurred in November 1997 with not so high wind speed (force 10 offshore and more than force 5 on the mainland) could cause serious damages to the region : aquatic farms's embankments and surrounding drains collapsed, fishing boats sunk; many losses in properties and human lives, cereal and infrastructure due to typhoon wind combined with spring waters and due to no adequate preparations to face up to this mishap.

Table 3-9. Monthly characteristies of wind

Unit: m/s

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Ba Tri	3.1	3.6	3.2	2.5	1.6	1.8	1.6	1.9	1.3	1.3	1.9	2.1	2.2
My Tho	2.1	2.9	2.5	2	1.6	1.32	1.8	2.3	1.6	1.3	1.3	1.2	1.9

(Source: South Center of Hydrology and Meteorology)

Table 3-10. Wind speed of various frequencies

Unit: m/s

v_{tb}	Wind speed corresponding to frequency			
	1%	3%	5%	10%
13.0	23.0	19.8	18.4	16.4

(Source: South Center of Hydrology and Meteorology)

f. Rainfall

Like the whole Mekong river delta, rain is attributed to air convection within the project zone. Humidity is higher up on the occurrence of Southwestern monsoon every year. At noon, humid air evaporates from the hot land, generates small-scale thunder-rains in the afternoon.

Perennial average rainfall is at 1,493 mm (CV=0,24, Cs=2Cv). Rainfall in the rainy season (from May to October) accounts for 86% of total amount. In dry season (from November to April), it makes only 14%. It rains heavily in such months as July, August, September, and October. While it rains very little or even has no rain in January, February, and March. High evaporation, strong radication intensity, and increased oxidation result in a rise of Al^{+3} and Fe^{+3} concentration, sea water intrusion deeply into the inner fields adversely affect plant development but create favorable conditions for aquaculture farming, salt production, as well as coastal forest a forestation.

Table 3-11. Monthly average rainfall

Unit: mm

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Ben Tre	3	0	5	25	169	190	180	198	206	299	90	26	1389
Max	25	0	58	129	390	398	375	355	460	511	243	289	2094
Ba Tri	1	1	5	34	139	215	195	186	227	255	73	5	1411
Max	12	11	50	205	303	517	354	271	434	499	262	41	1949
My Tho	5	2	5	38	149	192	184	172	234	263	101	34	1371
Max	63	36	72	360	338	430	398	409	473	550	324	193	2046

(Source: South Center of Hydrology and Meteorology)

Table 3-12. Rainfall corresponding to frequency

Unit: mm

Station	Amount of year	X_{tb}	C_v	Rainfall corresponding to frequency			
				$X_{50\%}$	$X_{75\%}$	$X_{85\%}$	$X_{95\%}$
Ben Tre	20	1448	0.26	1434	1187	1057	985
My Tho	58	11382	0.20	1365	1195	1105	965
Ba Tri	16	1411	0.19	1376	1221	1149	1048

(Source: South Center of Hydrology and Meteorology)

Table 3-13. Rainfall distribution in seasons

Unit: mm

Station	Amount of years	X_{tb}	Rainy season		Dry season	
			X	%	X	%
Ben Tre	20	1448	1387	96	61	4
My Tho	58	11382	1297	94	86	6
Ba Tri	16	1411	1375	97	46	3

X_{tb}: many year average rainfall.

(Source: South Center of Hydrology and Meteorology)

Table 3-14. Maximum rainfall for various time periods

Period of time	Amount of observed years	$\overline{X}$	C_v	C_s	X_p (mm)			
					1%	5%	10%	25%
1 day	33	91	0.28	$4C_v$	206	158	137	106
3 day	33	128	0.37	$4C_v$	285	220	191	151
5 day	33	160	0.32	$3C_v$	317	256	229	202
7 day	33	184	0.31	$3C_v$	353	291	261	217

(Source: South Center of Hydrology and Meteorology)

g. Flood and drought

* Possibilities of rainfall which causes flood

The rainfall which causes flooding varies anually. On the average, in all months of rainy season, there may happer 50mm rainfalls , 3 day rainfall of more than 75 mm and 5 day rainfall of over 100 mm. In October, there may occur rains causing flooding.

* Drought in the rainy season

During rainy season (from May to November), there are 16 - 20 rainy days per month on average. Also, there are no rain days when it is extremely hot and sunny. This case is called "Ba Chan" drought or drought in rainy season. The period of no rain lasts from 7 to 10 days, sometimes even for the whole month. However, a 15-day period of no rain hardly occurs. "Ba Chan" drought which usually appears in late July and early August exerts terrible influences on plant and domestic animal productivity, and local people's daily life. Plants are withered and even dead when water is lost and evaporated, leading to the shortage of water supply. Less serious droughts may occur in September, October, and November. It is necessary to store fresh water to supply for plants due to droughts in rainy season.

Table 3-15. Average number of 7th – 10th – 15th day drought in a month

Unit : stage(s)

Station	May			Jun			July			August			October			November		
	7	10	15	7	10	15	7	10	15	7	10	15	7	10	15	7	10	15
My Tho	1	1	0	1	1	0	1	1	0.2	1	0	0	1	0	0	1	1	0.2
Ben Tre	1	1	0	1	0	0	1	1	0.2	1	0	0	1	0	0	1	1	0.3
Ba Tri	0	0	0	1	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0.2

(Source: South Center of Hydrology and Meteorology)

3.1.3. Hydrology

3.1.3.1. General characteristics

Hydrological regime of the project area is closely related to tidal regime of East Sea, hydrological regime of Tien River and rainy regime in the area. The main streams such as Cua Lai, Ba Lai, Ham Luong and Co Chien river, have large and deep river-bed, low slope, large river-mouth favorable to the penetration of tide. After penetrating to inner field from main canal-mouth, amplitude of tide reduces little as compared with that at large canal-mouth.

Hydrological characteristics in the project area: The project area lies within the end part of Mekong River Delta close to the sea and estuary area and is surrounded by two big

tributaries of Ham Luong and Ba Lai. That facilitates strong tide intrusion into the local canals. During flood season, the maximum tide amplitude is about 3.18 –3.24 m at Tan Thuy, 3.37 – 3.54m at Ben Trai and 3.04 – 3.23m at Binh Dai. Maximum water level occur at Tan Thuy, Ben Trai and Binh Dai in November. The project area is flooded mainly due to rainfall and flood-tide in flood season.

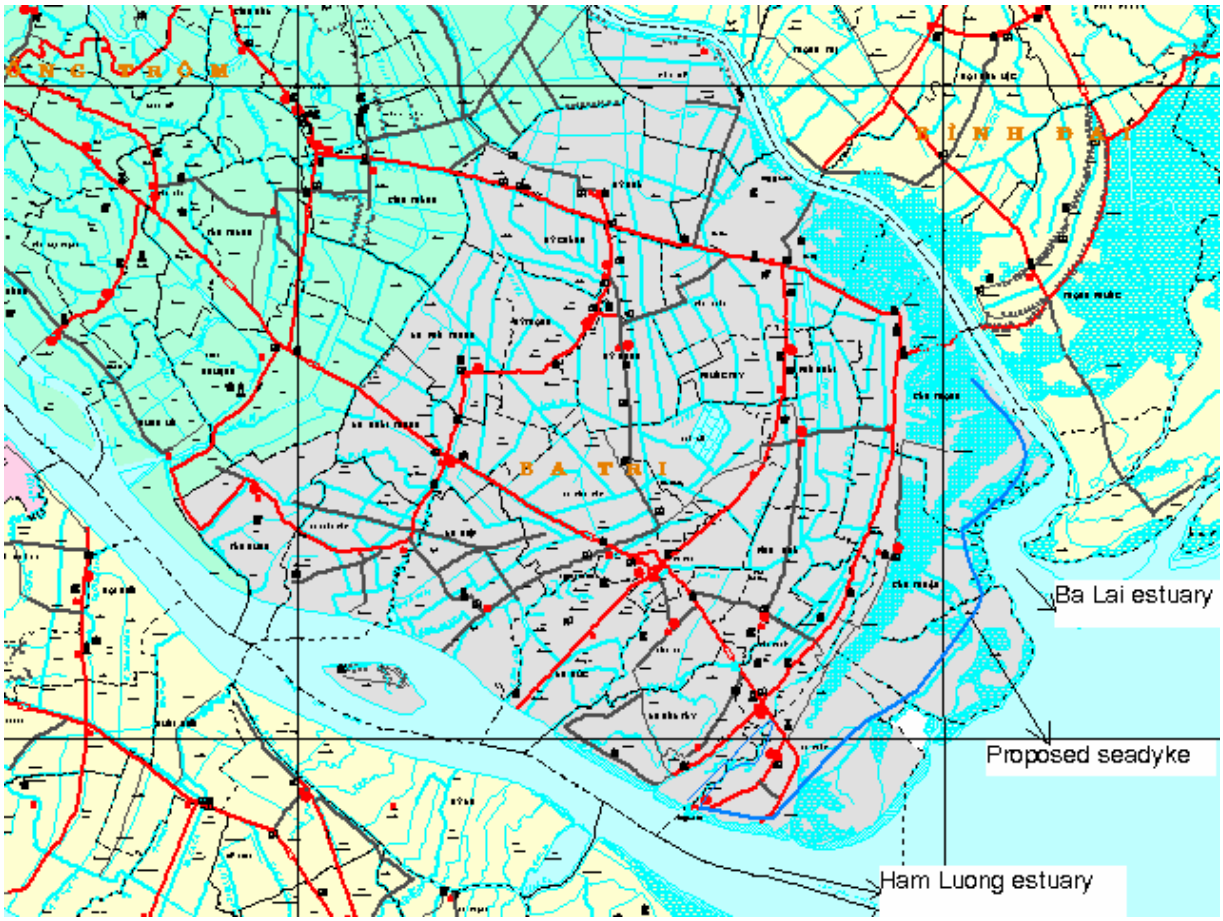

Figure 3-1. Map of two estuaries

3.1.3.2. Specific characteristics

a. Canal network

The project zone shares some common characteristics with the Mekong river delta. It is located within a plenty of canals area. The relatively even topography, natural and artifical canals, linked each to other, create a complicated canal network. Northern boundary of the project area is Ba Lai river with average width of 700m, depth of 6 -:- 10m. The Eastern part borders with East Sea and the Southern part is adjacent to Ham Luong river with the average width of over 1000m, depth of 8 -:- 14m. Within the project area, major canals are follows:

Canals and ditches within fresh water area (in the inner side of district road system No 16 from Provincial road 885 to Tan Xuan) which support agricultural production such as :

Ba Tri – Giong Trom canal, Dong Xuan canal, Xa Dieu ditch, Ba Hien ditch, Moi canal, Muong Lo canal, and Tan Thuy canal.

Canals and ditches within coastal saline water area come from East Sea and mainly support aquaculture farming and salt production such as: Gia, No, Trai, Ong Chau, Ba Di, Ruong Muoi, Duong Khai, Duong Mieu, Hai Ha, Khem, Duong Tac, Cay Keo, Chau Ngao and others.

Table 3-16 Basic characteristics of canals within the project area

Number	Name of canal	L (m)	B (m)	H (m)	Crossed sites
I	***Fresh water areas***				
1	Ba Hien ditch	8500	12-:-18	-2.2	Tan Thuy – An Thuy – Bao Thuan – Bao Thanh
2	Xa Dieu ditch – Tan Thuy canal	10200	12-:-20	-2.5	Tan Thuy – An Hoa Tay – Bao Thuan – Bao Thanh
3	Ba Tri – Giong Trom canal	6500	20-:-30	-1.7-:--2.5	Tan Thuy
4	Dong Xuan canal	7500	30-:-40	-2.5	Bao Thuan – Bao Thanh – Tan Xuan
5	Moi canal	2000	15	-1.7	Bao Thuan
5	Muong Lo canal	7000	12-:-15	-1.7-:-2.0	Bao Thuan – Bao Thanh – Tan Xuan
II	***Saline water areas***				
1	Gia ditch	2500	12-:-20	-1.7	Tan Xuan – Bao Thanh
2	No ditch	2000	15-:-30	-1.7-:-2.5	Bao Thanh
3	Trai ditch	3472	12-:-20	-2.5-:--3.5	Bao Thanh
4	Ba Di ditch	1600	10-:-15	-1.8-:--2.5	Bao Thanh
5	Ong Chau ditch	1200	10-:-15	-1.8-:--2.5	Bao Thanh
6	Xeo Doi ditch	1500	10-:-15	-1.8-:--2.5	Bao Thanh
7	Ruong Muoi ditch	2833	15-:-30	-2.5-:-3.5	Bao Thanh
8	Duong Khai ditch	2600	15-:-40	-2.0-:-3.5	Bao Thanh – Bao Thuan
9	Duong Xuong ditch	2000	12-:-20	-1.7-:-2.5	Bao Thuan
10	Ong Tam ditch	2100	12-:-20	-1.7-:-2.5	Bao Thuan
11	Duong Mieu ditch	2200	15-:-30	-1.7-:-2.5	Bao Thuan
12	Duong Chua ditch	2200	12-:-25	-1.7-:-2.5	Bao Thuan
13	Hai Ha ditch	1890	12-:-25	-1.7-:-2.5	Bao Thuan
14	Cay Bang ditch	1900	12-:-25	-1.5-:-2.5	Bao Thuan
15	Trang Nuoc ditch	2500	20-:-35	-2.0-:-3.5	Bao Thuan

Number	Name of canal	L (m)	B (m)	H (m)	Crossed sites
16	Duong Tiam ditch	1500	15-:-20	-1.5-:-2.5	Bao Thuan
17	Ong Sinh ditch	2300	12-:-25	-1.5-:-2.5	Bao Thuan
18	Ong Kim ditch	3100	12-:-20	-1.7-:-2.0	Bao Thuan
19	Duong Tac ditch	3250	20-:-40	-1.7-:-3.5	Bao Thuan – Tan Thuy
20	Khem ditch	4000	30-:-50	-2.5-:-3.5	An Thuy – Tan Thuy
21	Lap ditch	2000	12-:-20	-1.5-:-3.0	An Thuy
22	Cay Keo ditch	2300	12-:-25	-1.5-:--3.0	An Thuy
23	Cay Bang ditch	2100	12-:-25	-1.5-:--3.0	An Thuy
24	Cay Mam ditch	2500	15-:-30	-1.8-:--3.5	An Thuy
25	An Thanh ditch	1500	12-:-20	-1.5-:--2.5	An Thuy
26	Chau Ngao ditch	3000	20-:-30	-2.0-:--3.5	An Thuy
27	Ba Hien ditch	4500	25-:-50	-2.5-:--3.5	An Thuy – An Hoa Tay – Tan Thuy
28	Ben ditch (Ba Beo)	3000	12-:-25	-1-:--2.0	An Hoa Tay

(Source: FS of Ba Tri sea-dyke)

b. Amplitude and regime of tide

Due to the irregular semi-diurnal tide, there are two tide risings and two tide fallings day. The daily cycle of tide is 24 hours 50 minutes. Two peaks of tide is not significant (from 0.20 – 0.30m) but difference between two bottoms of tide is large (from 1.00 – 2.50).

Within a month there are two spring-tides on the 1st and the 15th of the lunar calendar or shifted for 1 – 2 days. Two neap tides occur on the 7th and 23th of the lunar calendar or shifted for 1 – 2 day. Within a month there are two cycles of tide lasting for about 13 – 14 days.

Comparing higher and lower levels of tide with the ground's natural elevation we may find good possibilities for water sewage and drainage by slope.

Table 3-17. Tidal range at some positions on Tien river

Unit: cm

Position	*Dry season*	*Flood season*	*Remark*
Binh Dai	*241*	*229*	*River-mouth*
My Tho	*222*	*214*	*56 km*
Cho Lach	*199*	*182*	*105 km*

(Source: South Center of Hydrology and Meteorology)

c. Tidal level

Due to the influences of irregular semi-diurnal tide regime water level in canals goes up and down twice a day with two different higher and lower levels. The two tides last from 24 to 25 hours. Within a month there are two cycles of tides: one spring tide and one neap

tide. The spring tide period lasts from 5 to 6 days . The peak water level falls on 16th; 17th; and the 1st, the 2nd of the lunar calendar.

Highest water level of tide peak in the year at coastal stations (Binh Dai, Tan Thuy, Ben Trai) often occurs in November.

Lowest water level of lower tide in the year at coastal stations (Binh Dai, Tan Thuy, Ben Trai) often occurs in July.

In a year, the stations mean higher water level of tide reaches highest values in June, lowest values in November.

At Binh Dai, Tan Thuy, Ben Trai stations, there are 6 months when average water level of tide peaks is higher than 1.00m (from September to March of the next year) and 6 month when average water level of tide peaks is lower than 1.00m (from April to August).

In a year, at the stations, lower water level of tide is small (lowest in July, highest in March).

Monthly average water level always exceeds ± 0.00m from September to May, about 0.00 – 40cm.

d. Salinity intrusion

Salinity is closely linked to upstream flow regime. When large water discharge comes from upstream, salinity decreases and vice versa .On the other hand, salinity depends on tide mode and wind surges. When wind surge is strong, salinity will icrease.

Every year, the salinity intrusion occurs from November to January when upstream water discharge in Ham Luong and Co Chien rivers goes down and tidal affects are sinificant. The salinity increases and reaches maximum values from March to May. The salinity gradually decreases by June, July and from the river mouth upstream; it decreases fast once flows of upper reaches are considerable for salt dilution and pushes down it to the river mounth.

On Ba Lai river next to Ba Lai bridge (about 50km from the sea) when no dam on Ba Lai river; the 4g/l salinity limit may surpass My Hoa (Ham Luong river), Son Ma canal (50km from the sea), Vam Thom-Mo Cay (Co Chien river).

On Cua Dai river water supply may be successful for 8 moths in a year; about 5 – 7km upper Rach Mieu ferry on Tien river people may make water supply all year round.

On Ham Luong river upper Phu Khanh (Thanh Phu) some km, water supply may be implemented during 8 months in a year; some km above My Hoa (at Son Ma canal, Son Dong water supply factory of Ben Tre township) water supply may be successful all year round. In 1998 saline water might intrude up to Phu Son (Cho Lach) and Thanh Tan (Mo Cay) about 10km upper Son Ma canal.

At Vam Thom (Co Chien river) water supply is done all year round except in 1998 when saline water penetrates up to Tan Thieng (Cho Lach) about 15km upper Vam Thom.

Studies show that the salinity on Ham Luong and Co Chien rivers tends to raise in concentration and in duration. Water may be withdrawn to supply for production and domestic purposes that facilitates salinity to intrude deeper , its concentration tends to increase and prolongs the intrusion time. So, besides the flood protection, tide prevention, storm and surge safeguarnding, water logging drainage, water storage to supply for production and domestic purposes, the seadyke and culvert constructionshould serve prevention from salinity intrusion from two estuaries. In March, Apirl 2004 at the project site salinity reached 40‰(while the requirement for shrimp raising lies within 15 - 20‰, that made mass dead of prawn, great damages.

3.1.4. Air quality

In general, the air quality in the project area is rather good. There is only local pollution in small scale industries. The pollutants are mainly dust, CO, NOx, SOx

3.1.5. Water quality

3.1.5.1. Surface water quality

- In dry season: The water environment tends to look like seawater environment. The saline water at the estuaries prevails and is not affected by alum. The chemical and physical composition of the water changes little. But salinity alone may have large variation up to 22‰ ÷ 30‰ (40‰ in some specific years). Littoral alluvium ground is not only fertile and rich of organic content and is frequently fostered by upstream water that increases organic content in water, makes it favorable for shrimp and aquatic plants.,
- In rainy season: Fresh upstream water in Ham Luong river flows downstream in big amount, which pushes down saline water and helps dilution process in the project area, in flood season that reduces salinity to S=3 - 16‰, but still favors the second shrimp breeding crop. Moreover, the flow through Ba Lai drain is limited, so salinity intrusion will be prolonged.
- Being at the end of the source, the river water quality in Ben Tre province is affected by activities in upstream. Surface water supply is polluted by microorganism and amonium.

The results of chemical, physical and microbiological analysis at 80 points (178 samples) for surface water during 1998 – 2001 of Vietnamese EPA, in Ben Tre current environment assessment project, show ed the following pollution level:

- Microbiological pollution: microbiological factors (coliform: 75 – 24,000 MNP/ml) exceed 5 times the allowed criteria.

- Organic pollution: The average BOD5 content is 6.7 mg/l, exceeds 1.7 time the allowed criteria for source of type A. Some canals have BOD5 up to 20 mg/l.

- Average acid sulphate and ferrous pollution is 0.08 mg/l, aluminum - 0.05 mg/l, which are lower than the allowed criteria.

- Pollution due to nutrients: The concentrations of NO_3^-, NO_2^- are 2.76 and 0.9mg/l correspondingly, which are light to medium pollution.

Every year, surface water is affected by salinity intrusion during 6 months.

The results of analyzing the contents of micro-elements (μg/l) in 4 big rivers: Ba Lai, Ham Luong, Tien, and Ben Tre show that they are smaller than the allowed limits:

- Cu (μg/l): 10 - 19.3, average 12.8.
- Pb (μg/l): 1.63 - 4.11, average 2.4.
- Zn (μg/l): 2.89 – 7.53, average 5.05.
- Hg (μg/l): 1.11 – 3.86, average 2.32.
- Cd (μg/l): 1.12 – 2.68, average 1.92.
- As (μg/l): 1.65 - 3.08, average 2.24.
- Cr (μg/l): < 20.

The analysis of radioactive nuclides in surface water of lakes, rivers and canals shows that they are lower than the allowed limits:

- Ra (Pci/l): 0.5 – 0.9, average 0.39.
- U (Pci/l): 1.3 – 1.5, average 1.3.

- Th (Pci/l): 0.44 – 0.88, average 0.66
- K (Pci/l): 0.2 – 0.8, average 0.43 x 10^{-2}%.

The results of recent surface water quality survey in Ba Tri District in October, 2004 is showed in Table 3.18:

Table 3-18. The surface water quality survey result in Ba Tri District in October, 2004

STT	Parameter	Unit	Station			
			K1	K2	K3	K4
1	pH		7.13	7.48	7.57	7.08
2	Salinity	‰	0	4.8	3.9	0.8
3	Turbudity	NTU	204	79	161	84
4	DO	mg/L	6.7	6.4	6.6	6.8
5	COD	mg/L	20.2	35.9	17.3	14.4
6	BOD_5	mg/L	15	24	13	11
7	Ca^{++}	mg/L	3.3	46.1	28.1	20.0
8	Mg^{++}	mg/L	4.9	166.6	153.2	41.3
9	$N\text{-}NO_2^-$	mg/L	0.03	0.02	0.04	0.05
10	$N\text{-}NO_3^-$	mg/L	0.16	0.18	0.15	0.08
11	$N\text{-}NH_4^+$	mg/L	0.22	0.36	0.20	0.17
12	Cr	mg/L	< 0.0003	< 0.0003	< 0.0003	< 0.0003
13	Cu	mg/L	0.00251	0.00312	0.00216	0.0027
14	Ni	mg/L	0.00025	0.00035	0.00023	0.00031
15	Ag	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005
16	Zn	mg/L	0.00561	0.00505	0.00631	0.00612
19	CN	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
17	Total oil	mg/L	4.0	-	-	-
18	Coli	MPN/100mL	900	2300	900	900

K1: Khem arroyo, nearby Fish Port;
K2: Trang Nuoc Culvert, Frontier Post No 598;
K3: Đuong Xuong Arroyo;
K4: Ten doors Culvert.

- Comparing with *Water quality standards for irrigation* TCVN 6773/2000 and *Fresh water quality standards for protection of aquatic lifes* TCVN 6774/2000, the mentioned values at 4 positions are under or lightly larger norms such as BOD_5 ($\leq$ 10 mg/l in TCVN 6774/2000). The results show that the water source is not polluted by organic matter or insinificantly polluted.
- Along proposed sea-dyke, there are no industrial or ships reparing factories so surface water is not polluted by heavy metals. Measured heavy metal contents (Cu, Cr, Ni, Ag, Zn) are smaller or close to allowable limits.
- In surveying process, we did not observed oily film along the route so water quality has met the standard in TCVN 6774/2000 for aquatic farming and other agricultural

activities in the project area. Total oil of 4.0mg/l is 10 times the standard in TCVN 5942/1995 due to sampling site just near to fish port.

- In the project area, there are no area for growing fresh vegetable since the surface water quality with measured Coliform value that is assessed not polluted by Coliform. If camparing with Surface water quality Standard 5974/1995, measured Coliform value are smaller many times (in TCVN 5947/1995, Coliform = 10 000MPN/100ml).

3.1.5.2. Underground water

The underground saline water in the upper layers is abundant for prawn farming in the project area. The water level is found at 0.50 m under the natural ground surface. The underground fresh water is rare or brackish of small amount and bad quality with rather high content of iron which can not be used for domestic use and agricultural production. According to the study results of program No 60-02, there is no deep-level fresh underground water for socio-economic development within the project area. People's running water source is rain rain and shallow-level underground water at the depth of 2m -:- 8m in sand dunes.

According to data source of Viet Nam EPA , Water quality in sand bars changes with season, place and depth of the well:

- Microbiological pollution: All E. coli indexes exceed from dozen to hundred times the allowed criteria.

- Ferrous and acid pollution varies from 0.05 – 16.5 mg/l, which exceeds 2 – 50 times the allowed criteria. The high level of ferrous pollution is mainly in dry season.

- Nutrient pollution: The indexes of NH_4^+, NO_3^-, PO_4^{3-} are 1.49, 1.95, 1.15 mg/l correspondingly. They belong to medium and rather strong pollution.

- Salinity intrusion is widespread in coastal sand bars. It is more and more frequent and of large scale due to technically incorrect exploitation (too deep digging), exploitation to exhaustion (due to lack of water) and due to the aquaculture, the salt fields are close to the sand bars. Sometimes, the concentration of Cl^- goes up to 2,500 mg/l.

The above-mentioned Pleistocene water lens has a wide spread distribution, but the distribution of water with weak salinity is limited. The weak salinity water concentrates in the North of Chau Thanh, South Thanh Phu and in An Thuy commune, Ba Tri district. This area has two water lenses: the first one at the depth from 30 – 50m; the second at 60 – 90m. Underground water in this area has high content of ion Cl (454 -925 mg/l); acid sulphate (Fe^{++}: 0.4 – 36 mg/l), high hardness (300 – 1,212 mg $CaCO_3$/l). This water source can be temporary used for living when water is scarce.

- The lower Pleistocene water lens in Ben Tre is deeper than in the vicinity as My Tho and Tan An. The bottom of this lens is 160 – 175m deep. The water quality of the lower Pleistocene water lens is low, totally saline, with total mineral M =1.14 – 7.07g/l.

- The upper Pleistocene water lens in Ben Tre is found at the depth 160 – 197m. This is a water rich layer Q=6.65 – 16.6l/s. The light saline water mainly concentrates in the North of Chau Thanh with mineral concentration of M=0.55 – 0.61g/l; pH=8 and without microorganism. The contents of microelements Cu, Pb, Zn, Hg, Cl, Mn, Mo, As, Fe, Li, Se are lower than the allowed limits.

- The lower Pleistocene water lens is under the upper one, and distributes at the depth 346 – 446m. Its average discharge is Q < 5l/s, with total mineral M=0.89 – 2.58g/l, without microorganism. The contents of microelements Cu, Pb, Zn, Hg, Cd, Mn, Mo, Cr, and As, as well as radioactive nuclides U, Th are smaller than the allowed limits.

In the Miocene water lens at the urban area of Ben Tre, the light saline water is only found in

the center of the town and at the North of Chau Thanh.

Table 3-19. Physical and chemical characteristics of underground water

Ion components				*Other components*	
Name of ion	*Me/l*	*Mg/l*	*Me%*		
Ca^{2+}	*1.933*	*38.741*	*18.2*	*pH*	*7.4*
Mg^{2+}	*1.179*	*14.337*	*11.1*	*Total hardness (me/l)*	*3.112*
$K^{+}+Na^{+}$	*7.525*	*188.125*	*70.7*	*Temporary hardness*	*0.4*
HCO_3^{-}	*1.200*	*73.224*	*11.3*	*Permanent hardness*	*2.71*
Cl^{-}	*8.800*	*312.048*	*82.7*	*Free CO_2 (mg/l)*	*13.2*
SO_4^{2-}	*8.637*	*30.605*	*6.0*	*Corroded CO_2 (mg/l)*	*26.4*

(Source: The current environment report of Ben Tre province)

3.1.5.3. Sea water

Reference to the "State of Environment in Viet Nam 2001" of the National Environmental Agency (http://www.rrcap.unep.org/reports/soe/vietnam/), in recent years because of rapid urbanization, modernisation and a rapid increase in navigation in coastal areas, there has been a corresponding increase in the quantity and categories of pollutants in the marine environment, thus, degrading marine resources, particulary in the coastal areas of North and South Vietnam. The concentration of pollutants is increasingly being detected in the sea. There has also been a perceptible decline in the fishery yields in coastal areas. Util now, there is no laboratory-analysis on seawater quality in the project area. However, main pollution sources, generally, originates from the inland discharge and release from navigation and fishery activities in offshore area. The unpolluted water quality in the project command area analyzed in October 2004 (Table 3.18), which is presented for the discharge from inland area, may lead to the conclusion that the seawater in the coastal area along the dyke might not polluted yet. Additionally, the abundant mangrove forest along this area could contribute a great role in treating and absorbing pollutants if any. The other reason for the above deduction is the obtained results from the "Status of marine water pollution" publication (http://www.rrcap.unep.org/reports/soe/vietnam/), which indicates that almost seawater in the project area is not polluted yet. Inaccording with the publication, the status of marine water pollution is assessed on the basis of analysis and monitoring results of the national Monitoring System for marine region in Viet nam from 1995 onwards. The assessment is alo based on many other surveys, studies and EIA reports for many coastal projects. the main results are presented in Box 1.

Box1-Seawater quality

Temperature, salinity, pH,

Temperature, salinity, pH, DO, BOD all meet the permitted standards in Vietnam.

Total Suspended Solid (TSS)

Similar to salinity, suspended solids in the Southern and North marine areas are strongly influenced by the river flows. In the open sea, the water is not polluted b SS.

Nitrogen- nitrite (NO_2^{-} - N)

Nitrite concentration in marine water ranges from traces to 345 μg/l. In the Southern coast, it recorded highest levels in two years (1996-1997) and is always over the permitted level. In the offshore areas, the nitrite content is low and stable.

Nitrogen- nitrate (NO_3^- - N)

In the coastal waters the average value of NO_3^- - *N* ranges from 44.0 to 375.53 μg/l. The measured maximum value at Rach Gia is 1,080 μg/l (the standard value is 500 μg/l for swimming and aquaculture). In general in the areas influenced by river flows, NO_3^- - *N* is higher than in other areas. In the open sea it is rather high. The average value is 651 μg/l and 365 μg/l respectively.

Phosphorous - phosphate (PO_4^{3-} - P)

- In the coastal waters

The average values from man years of observation of PO_4^{3-} - *P* ranges from 4.03 to 53.63 μg/l. It is noted that from Vung Tau to Rach Gia average value of PO_4^{3-} - *P* during flood season is higher than in dry season.

***- In the open sea*: PO_4^{3-} - P** concentration is rather small and maximum value does not exceed 30 μg/l.

SiO_2 - Si

The yearly average values of SiO_2-Si are in the range of 206.6-2606.9 μg/l.

In general, the maximum and average values of SiO_2-Si at all coastal stations in flood season are higher than in the dry season. It is caused by river flows with high concentration of SiO_2-Si.

Heav metals

The concentration of As, Cd, Hg, Pb measured at all stations is within the permissible range for all kinds of uses and there is no clear increasing or decreasing trend.

Oil content

In the open sea, oil content is in the 0.038-0.536 mg/l range. Only in the oil exploitationarea the oil content is higher than 0.500 mg/l. The other regions have lower oil content.

The maximum and yearly average values do not follow a clear trend; they increase with time at several stations and decrease with time at others.

3.1.6. Soil quality

Apart from the alluvial area of fresh and brackish water which is cultivated with fruit trees, coconut, sugarcane,… following canal model, the land is rather stable due to annual deposition of mud and the nutrition of soil is recovered through fertilizer, falling leaves…, other areas are more or less degraded and polluted due to different reasons.

The wetland under saline water: due to deforestation for shrimp farming, the falling leaves decrease, and their decomposition into humus enriching the zoobenthos also decreases, the bottom floor gradually becomes poorly nourishing for aquaculture development, at the same time, pollutants are accumulated due to the decomposition of surplus shrimp feed and their waste, that create favorable conditions for easy diseases appearance and development. The digging of ponds for shrimp farming facilitates the acid layer to the surface; make the potential alum into active one. This alum will be washed after 1 – 2 rainy seasons, and the soil alum will decrease but the water will be acid. Moreover, due to human activities, wind, runoff…. At some places of riverside and sea coast, the land is eroded every year (in compensation for some other deposited areas and the current common tendency of land expanding to the sea).

According to the study of National Institute of Agriculture – planning and projection published in 2003, the soil status in the project area is demonstrated in Figure 3.1.

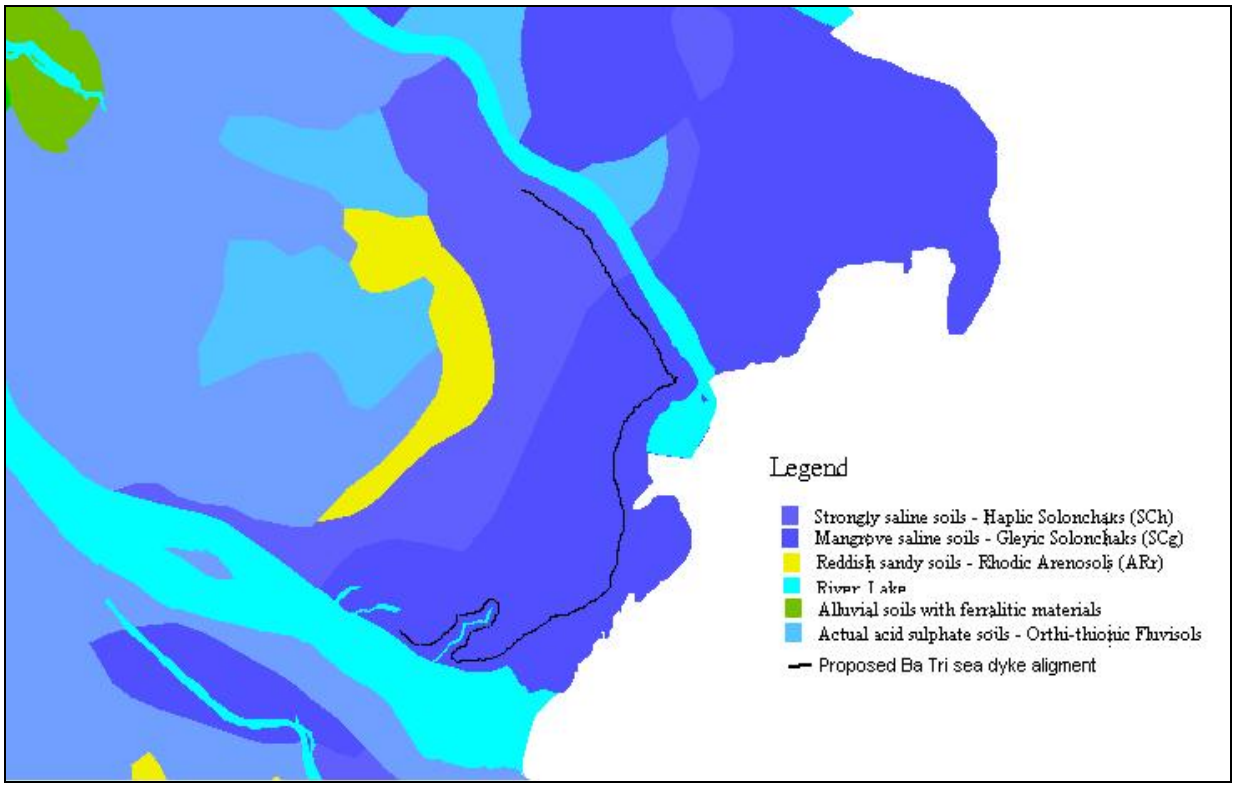

Figure 3-2. Soil status in the project area

Sand stretches: the soil is degraded due to continuous crop rotation, the removed soil nutrition can not be recovered timely (the sand soil is poor in organic substances).

Field areas: soil is degraded due to defertilizing process after 2-3 rice crops, irrigational and unbalanced use of fertilizers, soil improveishment (due to non application of organic fertilizers) and due to pollution by fertilizers and pesticides/insecticides.

According to the results of pesticide residual analysis in soil of some rice growing areas in Ba Tri district in May, 1998:

- Methamidophos: 4.36 x 10^{-5} mg/kg of soil;
- Methylparathion: 3.24 x 10^{-5} mg/kg of soil;
- Dimethroat: 1.65 x 10^{-5} mg/kg of soil;
- Parndan: 2.68 x 10^{-5} mg/kg of soil.

These substances are lower allowable limit but residual of pesticides in soil is some dozen times higher than in water. Results of soil environment analysis in 2001 are shown in table 3.20.

Table 3-20. Result of soil quality analysis

Position	P_2O_5 (%)	N (%)	DDT (µg//kg of soil)	Methylparathion (µg/kg of soil)	Cu (mg//kg of soil)	Pb (mg//kg of soil)
Hamlet No 2, Bao Thanh			KPH	KPH	20.2	28.7
An Nh¬n					14.6	22.4
K22					13.9	21.5
Vinh Thanh	0.02	0.006			8.72	14.02
Hamlet No 2, An Hiep	0.13	0.008	0.26097	KPH		
TCVN 5944/1995			0.1 mg/kg of soil	0.1 mg/kg of soil		

KPH: undiscovered

(Source: The current environment report of Ben Tre province)

- P_2O_5: in rice growing land, the measured values of P_2O_5 and N are corresponding to 0.13%, 0.008% and higher than in fruit-tree growing land (1.1% and 0.002%).
- Residual of pecticide such as DDT and Methylparathion in sugar-cane and fruit-tree growing soil and in land of aquatic farming is not found but residual of DDT is 2.6 times higher than allowable standard.
- Heavy metal contents such as Cu is from 8.72 to 20.2 mg/kg of soil, Pb from 402 to 28.7 mg/kg of soil. Cu content in the aquatic farming area is higher than in the fruit-tree growing area.

3.1.7. Soil

The project area has 5 main soil groups namely: hilly sandy soil, salinity polluted alluvial soil, alum soil, saline alum soil and coastal alluvial soil.

The group of soils in sand dunes:

+ Cf: sand soil of flat sea which was differentiated in profile.
+ C: sand soil of flat sea which has not been differentiated in profile.

This group of soils distributes along the sea coast, with unclear differentiated profile, malnutrition, loose, without structure or fake structure, pH from 6 - 7, Cl from 0.1 – 0.3%, SO_4^{2-} 0.01%. These sand stretches are the populated areas, with infrastructure, public works, and crops, especially subsidiary crops and livestock.

Group of saline alluvial soil:

+ PfMn: heavy saline soil with patched layer.
+ PhMn: heavy saline soil with rich organic substances.
+ Mn: frequent saline soil and undeveloped.

They are scattered in the medium and low areas between sand stretches, their mechanic components include argillanceous soil and clay, high nutrition, in which there are plenty of plant roots, and decomposed organism, average pH from 5 – 6.5, Cl 0.05%, SO_4^{2-} 0.01%. This land is used for extensive or industrial shrimp farming, or mainly salt production.

Acid soil group:

+ P(f): grey brown alluvial which is developing and has rusty spots.

It is partially distributed in deep inland communes due to long time mineralization

decomposition and sulfatization of sea vegetation. The main mechanic compositions are clay (few), argillanceous soil or argillanceous soil mixed with clay, the content of ferrous sulfate is high, with grey blue, and grey yellow in lower layer, and yellow or brown yellow colors at the surface.

Group of acid sulphate and saline soils:

+ P(f)b: grey brown alluvial soil which was developed and patched with saline layer now and then.
+ P(f)(b)m: alluvial soil which is developing, has rusty spots and is salinity polluted now and then.

The soils concentrated in the coastal areas or in the South of river mouths are newly deposited alluvial, young, with strongly developed plants are mangrove and cork trees. The soils have obvious smell of H_2S, CH_4, and high content of chloride. That is mainly in the protection forest.

Group of mud soil deposited in the sea coast:

In project area of Ba Tri there are about 2,500 ha of low land which are submerged by saline water all the year round; when the water withdraws, there remains a long stretch of mud and sand along the coast, the vegetation is not yet developed. At present, this place is partly used for clam and oyster farming.

3.2. BIO-DIVERSITY

3.2.1. Terrestrial area and aquatic life in fresh water

Terrestrial ecosystem in the project area is mainly cultivation field including rice, vegetables, various types of fruit tree and perennial trees. The majority of flora in this area therefore, is all planted plants such as agricultural plants, vegetables, various kinds of fruit tree, shade and perennial trees. The fauna is also simple with presence of small animal such as mouse, lizard, amphibians, insects and domestic animal such as dog, cat, poultry and livestock.

In the fresh water bodies, 106 species of algae belong to 5 groups of alge have been recorded, of which, silicate algae contributes more than half , 51.86% (55 species), Cyanophytes accounts for 22.64%, Chlorophytes, Euglenophytes, Pyrrophyta 13.20%, 11.32%, 0.9%, respectively. There is only 20.75% of the total number of encountered species are marine original. The density of phytoplankton in the natural water bodies quite low compared with this in aquaculture ponds: 25,000-403,000 individual/l and 260,000-41,400,000 individual/l, in that order.

Diversity of zooplankton is quite low with presence of only 28 species belong to 6 major groups of rotifer trochophora(31.14%), copepoda (21.43%), protozoa (4.28%), Cladocera (14.28%), mollusca (7.14%), Annelida and crustacean Ostropoda (3,8%). In addition to that, many larvae of crustaceans, fish are also observed in freshwater bodies. Abundance and density of zooplankton are observed higher in dry season than in rainy season and higher in aquaculture ponds than in natural water bodies, attributed to more nutrient availability in farming ponds.

Benthos are diverse, too with community composition of 51 species belong to 5 major groups including crustacean (dominant group with 21 species), gastropoda (14 species), bivalvia (5 species), aquatic insecta (5 species), polychaeta and annelida (3 species each). It is noticed that several brackish water originated species also go

further to freshwater bodies including 3 species known as marine: *Nemalycastialongenris, Dandronerois destuarina, Nephthys polybranchia.*

70 species of fish belong to 39 families has been observed in freshwater bodies, of which many are economically important to fisheries economy. Fishes are grouped into 4 main groups based on their ecological characteristics:

- Group 1: fishes are living in running-water bodies including *Cyprinidae, Schilbeidae, Siluridae,Cobitidae, Bagridae, Sisoridae, Mautocombetidae*
- Group 2 : fishes are living in still-water bodies including *Fluta aba, Ophiocephalida, Anabantidae.*
- Group 3 (anadromous): fishes are migrating from marine and brackish water into freshwater including *Clupeidae, Engraulidae, Plotovidae, Ariidae, Scisenidae, Polynemidae, Mugilidae*
- Group 4: Fishes are living in both brackish and fresh water including *Fleotridae, Gobiidae, Periophthalamidae, Apocryteidae.*

Common fishes in this area are snakehead (*Ophiocephalus striatus*), *Flutu alba*, *Ophiocephalus micropotles*, *Anabas testudineus*, *Trichogaster pectoralis*, *Notopterus notopterus*, *Puntius altus*, *Leptobarbus hoevenii*, *Pangasius spp,* and several species migrating from sea water like *Lycothrissa croccodylus*, *Coilia macrognathus*, croakers, (*Polynemus longipcotorulis*), *Oxyoleotris siamensis*, *Clossogobius giuris*, *Pseudapoxytes lancelolatus*...

A major habitat type found in the coastal zone of Ba Tri District is aquacultural pond that consists of c. 4.000 ha. There are two types of aquacultural practice were recorded. The intensive aquaculture activities were concentrated at the area inside proposed dyke - option 1. This type of aquaculture, which for shrimp production, consists of ponds bound by the solid dykes and support no vegetation inside. In fact, that type of landuse contents a little biodiversity value. Outside the proposed dyke - option 1 and also scattered in the southern bank of the Ba Lai estuary, there are areas for extensive aquaculture activities. The main products of those areas are shellfish, shrimp, crab and fish species. This type consists of the sallower ponds with emerged vegetation inside and provides an important roosting and feeding habitat for a number species of shorebirds.

Several other fish species have been introduced to aquaculture such as tilapia, giant gourami, silver carp, bighead carp, grass carp, common carp, mrigal, rohu, and catla.

3.2.2. Littoral area and inshore water

There is a big change from mainly planted plants in the terrestrial area to more natural and wild flora in the littoral area. There were natural mangroves in this area long time ago but they were all destroyed during the American war so at present the mangrove forest in the project area is secondary forests and it has been heavily exploited by local people for timber. Living in this mangroves are both true mangroves as well as associated mangroves. The project area is in between two estuaries with very much different flow regimes affecting to the composition of mangrove. Diversity of mangrove here is relatively good with *Sonneratia spp*, *Avicenia*, *Kandelia*, *Ceriops*, *Acanthus*, *Cryptocoryne*, *Nypa,*. This is about 20 year old-mangroves, with an average canopy's height of 2-2.5m.

Mangroves associated fauna are relatively diverse with presence of crabs, pistol shrimp (*Alphaeus*), mud lobster (*Uphogebia*) and larvae of many aquatic species such as mud crab (*Scylla sp*.), marine shrimps (*Penaeus* and *Metapenaeus*) and some fishes.

There are large areas of intertidal mud- and sandy flats were found along the coastal line of Ba Tri District. Although the accurate area of this habitat was impossible to be measured, the mud- and sandy flats are the most important feeding habitat for almost shorebird species. In the high tide, exposed parts of sandy flats provide the important roosting grounds for bird congregations.

In total, there are 36 species were recorded during the survey. Combine with the results from Moores and Bao Hoa (2001), the total number of species recorded at the site is 55 species. Two bird species recorded are species of global concern: Chinese Egret *Egretta eulophotes* (VU), and Malaysian Plover *Pluvialis squatarola* (NT) (BirdLife International 2004). The most abundant species counted in early March 2005 were Greater Sand Plover *Charadrius leschenaultii* (248), Black-tailed Godwit *Limosa limosa* (212), and Common Tern *Sterna hirundo* (193). However, this number was much lower than the number recorded by Moores and Bao Hoa (2001), this fact may be reflected the less effort for ornithological work of this survey and/or the seasonal characteristic of bird fauna of the site. Number of each waterbird species recorded is presented below:

Table 3-21. Number of waterbirds recorded

No.	Common name	Latin name	Number
1	Black-tailed Godwit	*Limosa limosa*	212
2	Whimbrel	*Numenius phaeopus*	6
3	Eurasian Curlew	*Numenius arquata*	25
4	Common Greenshank	*Tringa nebularia*	13
5	Common Sandpiper	*Actitis hypoleucos*	62
6	Sanderling	*Calidris alba*	6
7	Pacific Golden Plover	*Pluvialis fulva*	18
8	Grey Plover	*Pluvialis squatarola*	24
9	Little Ringed Plover	*Charadrius dubius*	18
10	Malaysian Plover	*Charadrius peronii*	3
11	Lesser Sand Plover	*Charadrius mongolus*	5
12	Greater Sand Plover	*Charadrius leschenaultii*	248
13	Black-headed Gull	*Larus ridibundus*	1
14	Gull-billed Tern	*Gelochelidon nilotica*	1
15	Caspian Tern	*Sterna caspia*	40
16	Common Tern	*Sterna hirundo*	193
17	Little Cormorant	*Phalacrocorax niger*	6
18	Little Egret	*Egretta garzetta*	7
19	Chinese Egret	*Egretta eulophotes*	1
20	Grey Heron	*Ardea cinerea*	6
21	Great Egret	*Casmerodius albus*	2
22	Cattle Egret	*Bubulcus ibis*	55
23	Chinese Pond Heron	*Ardeola bacchus*	11

An annotated checklist of key bird species

Chinese Egret *Egretta eulophotes* (Globally Vulnerable)
A single bird was identified on the afternoon of 4 March 2005. The bird was very active when feeding in the edge of sandy flat of Hang Duong Island, and displayed green legs and yellow basal part of the lower mandible. Also recorded by Moores and Bao Hoa (2001).

Malaysian Plover *Pluvialis squatarola* (Globally Near-threatened)
Three adult Malaysian Plover were seen at the intertidal sand flat in the Hang Duong Island on 4 March 2005. They were feeding on the southern tip of the island, together with one flock of Greater Sand Plover *Charadrius leschenaultii*, some Little Ringed Plovers *Charadrius dubius*, Sanderlings *Calidris alba* and close to a roost of Caspian Terns *Hydroprogne caspia* and Common Terns *Sterna hirundo*. The birds were clearly observed through a spotting scope. Also recorded by Moores and Bao Hoa (2001).

Spoon-billed Sandpiper *Eurynorhynchus pygmaeus* (Globally Vulnerable)
Not recorded during this survey. Up to five individuals were observed at the site in December 2000 (Moores and Bao Hoa 2001).

Painted Stork *Mycteria leucocephala* (Globally Near-threatened)
Not recorded during this survey. Nine individuals were observed in mangrove areas in the Ba Lai river mouth in December 2000 (Moores and Bao Hoa 2001).

Greater Sand Plover *Charadrius leschenaulti*

248 birds were counted during the survey. Counts of 140 and 1,425 individuals were made in April and December 2000 respectively (Moores and Bao Hoa 2001). This number is over 1% (1,000 birds) of the Asian biogeographic population of Greater Sand Plover *Charadrius leschenaultii* (Wetlands International 2002).

Based on the results of this survey and a previous survey taken in 2000 by Moores and Bao Hoa (2001), the Ba Tri is eligible to be defined as an Important Bird Area. Together with the Binh Dai IBA in the north, the two sites form a large habitat area that used as wintering and passive grounds for migratory shorebirds. The intertidal mud- and sandy flats, and the mangroves of this area are not only important for bird but also provide an important breeding habitat for many aquatic faunal species that provides a fundamental factor for the economic development in the district.

Phytoplankton

133 species belong to 5 families of algae have been recorded in the project area. More than half of them (63.16%) is Silicate algae, cyanophytes (29%), chlorophyte green algae(10.53%), euglenophyta (7.5%), Pyrrophyta (1.5%). Among them, many are feed for shrimp and fish such as *Nitzschia, Melosira, Gyrosima, Pleurosigma...* Especially, there are some nitrogen-fixing algae namely *Anabaena sp., Anabaena variabilisy, Anabaena viguierig...*

Zooplankton

In brackish and sea water, 36 species of zooplankton have been observed with dominant group of copepoda (72.3%) followed by Anthropoda, Protozoan. Most of

them (60%) are marine originated and have been very good food for many economically important fisheries species. The common zooplanktons encountered in this area are *Titinnopsis cylindong, Tin. Morteseni, Codenellopsis orthocerns,* larvae of Polychaeta, gastropoda, decapoda and pelecypoda (mollusca); *Calanus sp, Cithona sp,Cyclop sp.* The abundance of plankton in project's area has been dramatically decreasing recently.

Benthos in brackish water in Batri is very diverse with presence of 61 species belong to 8 major families including Crustacea (26 species), Gastropoda (17 species), Bivalvia (6 species), Polychaeta (6 species), Oligocheata and Insecta (3 species each), Sagitoidea and Sipunculoidea (1 species each)

Community of aquatic fauna in inshore water is relatively rich with 102 fish species belong to 43 families and 5 orders, of which, *Peroiformos* is dominant with 54 species observed in this area. Fishes are grouped into 5 main groups as follows based on their habitat:

- Group 1: True brackish water: involves many stenohaline species, who spend almost their life in brackish water. Some of them are very important target of fisheries. Representative of this group are: *Septipina tati, Pbetesus anguillaris, Scatophagu argus, Oxyurichthys etersenii, Acentrogobius caninus...*
- Group 2: Marine fishes that migrate to brackishwater: composed of many fishes belong to *Clupeidae*, *Engraulidae* and many predators. They are also economic important to fisheries sector.
- Group 3 (Catadromous): Freshwater fishes that migrate to brackishwater: only 1 species is observed in this group: *Hamibarbus*
- Group 4: Migratory fishes (diadromous): brackish water fishes that migrate to marine water or fresh water for spawning. Representatives of this group are: *Coilia rendabiti, Septipinaty, Thrilocoles setirostris, Thri hamitoni, Mugil nepalensia, Polynemus sextarius...*

Fishes can be also categorized into 5 groups based on their feeding mechanisms. Those groups are: herbivorers, planktivorers, benthos feeders, nectobenthos-feeders, and predator. Additionally, this area is very rich in shrimp resources in term of abundance and number of species. More than 20 species of brackish and marine water have been found including some important species such as: *Penaeus indicus, P. merguiensis, P. semisulcatus, P. monodon, Metapenaus ensis, M. lysianassa, M. mutatus,* and *Parapenaeopsis hardvikii.* Moreover, bivalves and crustaceans are also important source of food as well as livelihood of people in this area. The representatives of these two groups are: *Acetes indicus, A. japonicus, Meretrix spp., Scyllar serrata, Myomenippe hondviokii, Searma sp, Grapsus grapsus, Searma mederi*.

Rate: 1:110 000

Figure 3-3. Ecology map of project area

Currently, the major threat to biodiversity in the coastal zone of Ba Tri District is habitat loss, particularly conversion of mangrove and sandy flats into aquacultural ponds. Better planning is required at all levels in order to develop aquaculture in a more sustainable manner.

The second major threat to biodiversity in the coastal zone of Ba Tri District might be hunting, in the form of mist-netting, often using whistles or taped calls. Even this activity was reported as prohibition in the district by the local authorities. However, mist-netting should be still existed following information gained from local people. This hunting technique is indiscriminate, and particularly serious during migration periods. It is necessary to introduce measures to control hunting throughout the entire coastal zone. These measures should include development of anti-hunting regulations; strengthened law enforcement, involving District FPD, and local authorities; and awareness-raising activities among local communities and decision makers at all levels.

Another threat to the biodiversity in Ba Tri District is human disturbance, especially concerning to the boat transportation in the Ham Luong and Ba Lai estuaries. The boat transportation not only causes disturbance on the wildlife population, especially birds, but also be a source of fuel discharged pollutants.

3.3. SOCIO-ECONOMIC SITUATION

3.3.1. Population and labor

The natural land of the area: 14,529ha, the population: 68,043 inhabitants; average density: 468 persons per square km of them 55% are female; the main workforce is 48% . Most are farmers (70%) ; the rest are fishmen, aquatic farmers , salt makers and servicing people (Statistics on economic and welfare situation of the 06 communes in the year 2003 within the Ba Tri sub-project area).

The Majority of the population are settled on the dry sandy dunes with availability of fresh water, alongside with the road lines and existing canals . Some of them earn their living at seaside dunes namely Ho, Tron in An Thuy commune , Nhan , Ngoai in Bao Thuan commune …). Their lives depend on fishing, afforestation and subsidiary crops on dunes banks. Besides the village centers and aquatic products purchasing sites where houses are solid may resist against storms like Tiem Tom fishing port in An Thuy commune) most of the population live in thatched houses or makeshift residences and therefore face the danger of strong tide and cyclone.

In the last few years the population tends to rise thanks to the region' s great economic potentials. The communes are planned for economic development with the main objective as: developing agriculture – forestry - sea economies. The most typical model of production is extensive and industrial prawn farming in coastal areas.

Most of the inhabitants are somehow experienced in production. Because of the lack of production conditions like, water resources, saline soils, capital and unfavorable weather conditions the productivity still remains low.

The most remarkable point in the area is the population varies seasonally. Their lives remain unstable. The labor force has not been fully used. This requires such sectors as Agriculture, Forestry, Fishery to be intensively invested to each zone for adequately exploitation of the land and plant resources.

3.3.2. Historical relic

In the project area, there are two historical relics including Phan Thanh Gian grave in Bao Thanh commune and Cay Da Doi in Tan Xuan commune.

3.3.3. Health and water for domestic uses

Local villagers are still suffering of a hard life. Drinking and running water's quality does not meet Vietnamese standard (almost villagers use canal and rain water for their daily lives). Funded UNICEF handpump wells are very few. Such diseases as petichial fever, malaria, diarrhea, cutanious diseases, trachoma is far beyond the local authority's control. In addition, facilities and health-care equipment are inadequately provided; there is only one healthcare post in each commune; the number of nurse or doctor is one for 2,835 residents. In recent years, there has some improvement for the local public healthcare; periodic health examination and disease treatment for villagers are made annually in village healthcare center. Apart from those, there are charitable medical examination and treatment programs made by provincial and Ho Chi Minh City hospitals.

Water sources for local people's daily lives: There are almost no hand-pump wells in the project area due to salinized underground water sources in the project area. Only some water from few deep wells and funded UNICEF hand-pump wells are available in limited small areas within the sandy dunes. Thus, most water used for local residents' daily lives should be brought from outside. Rain-water is ideal source for use among communities. Big size ceramic vases and jars are used to store rain-water during the rainy season for family use in the dry season. However, the actual needs for local people's are much greater than stored rain-water mentioned above. The severe lack of clean water and the use of polluted water in inner field rivers and canals of local people have resulted in intestinal, respiratory diseases and trachoma. This issue should be paid a due attention for improvement of living condition for local community.

3.3.4. Occupation

The local people practice the three main jobs : agriculture (rice and subsidiary growing) , salt making and aquatic farming . Farming is specialized in such communes as Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Hoa Tay , salt production in Bao Thanh, Bao Thuan, aquatic farming in An Thuy, Bao Thuan, Tan Thuy , Tan Xuan. Results of the survey on employment status of the local people in 2003 are presented in Table 3.8

Table 3-22. Labor force allocation in the area

Number	Commune	Agricultural production rate (% of population)	Salt production rate (%)	Aquaculture farming rate (%)	Other occupations (%)
1	Tan Xuan	67%	0%	30%	3%
2	Bao Thanh	21%	60.5%	15%	3.5%
3	Bao Thuan	20%	20%	50%	10%
4	Tan Thuy	60%	1%	20%	19%
5	An Thuy	20%	0.5%	74.5%	5%
6	An Hoa Tay	65%	0%	15	20%

(Source: Statistical yearbook of Ben Tre province)

3.3.5. Education

In general the Communist Party and the local authorities pay attention on education and training in the area (as one of the key tasks). For developing human resources, in all villages both primary and secondary schools are available and attended by large number of

pupils. However the number of attendants considerably varry due to family economic difficulties many pupils should drop out the class. The number of schools and attendants is presented in table 3.22 (2003 figures)

Table 3-23. Education status in project area

Number	Commune	School-attending students					
		Number of schools and classes		Primary-school students		Secondary-school students	
		Schools	Classes	Number of students	of % total children	Number of students	of % total children
1	Tan Xuan	3	69	1570	98%	913	95%
2	Bao Thanh	3	45	1750	100%	603	98%
3	Bao Thuan	3	33	1290	100%	592	72%
4	Tan Thuy	4	45	1482	95%	617	98%
5	An Thuy	4	41	1990	100%	798	73%
6	An Hoa Tay	3	37	1447	99%	1010	85%

(Source: Statistical yearbook of Ben Tre province)

The school atteding number varies with the male and the female. Women while doing housework also take part in the work done by men to increase family income. The school-girls are paid less care than boys. The low income and the family burden are the main reasons forcing children to drop school and make difficulties for education work.

3.3.6. Family income

The official statistics show that average income of local people is still very low and unstable. Local people face many difficulties in their life. Per capita income is VND 250,000 per month. The economic household groups incomes are as follows :

- Rich household group : 10.02%
- Fair household group (>250.000 VND/month) : 36.60%
- Medium household group (250.000 VND/month) : 44,30%
- Poor household group (<250.000 VND/month) : 8,10%
- Household group needing food aid : 0,98%

Table 3-24. Investigated income of farming households

Number	Commune	Rich household group	Fair household group	Medium household group	Poor household group	Food aid needed household group	Total households
1	Tan Xuan	998	996	447	114	90	2645
2	Bao Thanh	372	656	962	196	0	2186
3	Bao Thuan	328	434	951	167	26	1906
4	Tan Thuy	212	814	912	224	0	2162
5	An Thuy	296	1255	1334	332	0	3217
6	An Hoa Tay	621	508	673	244	42	2046

(Source: Statistical yearbook of Ben Tre province)

The grassroot reason for local people's low-income is natural disasters affact such as severe salinity intrusion (in dry season), spring tide (in rainy season), unpredictable weather variations in recent years (drought, flood, storm, low tropical pressure….). Further more, cultivated areas allocated for agriculture, forestry, and aquaculture developments are not utilized effectively; crop productivity is still low and depends mostly on natural conditions.

Especially in recent years, the movement of prawn raising has been much developed. However, local villagers are facing such high risks as high salinity, long lasting rains which reduce salinity causing mass death to shrimps, or tide surges which destroy pond dykes and make many people bankcrupt.

3.3.7. Culture – Information – Sports and social issues

In each commune there is a network of loudspeakers . Annually there make 760 hours of broadcasting and retransmission. Information state policy is broadcasted. Post office, cultural centers .... are available

According to statistics of Ba Tri district, there are as many as 500 telephone sets, 13,000 Radios, Cassettes, Television sets (1,08 household/set)

The commune usually promotes sports and games programs for youth. The games are: football, volleyball. Meetings are held to exchange information and cultural festivals are organized. However, material bases and methods are still limited.

Social issues: Life of inhabitant bases mainly up on aquatic product fishing and farming so it depends on weather very much. In the years of favorable weather conditions with few natural disasters crops are of high productivity and making good income and vice versa . Unemployment and low income also negatively affect communities' living condition, health and education and future manpower.

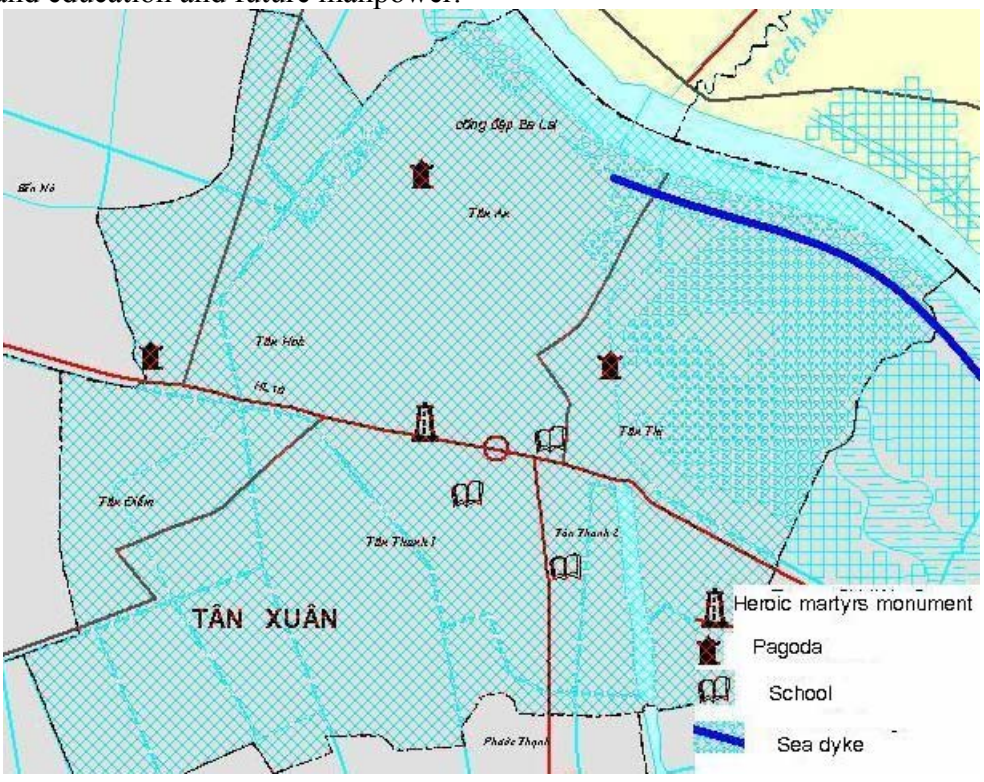

Figure 3-4. Cultural-hitorical relic in Tan Xuan Commune

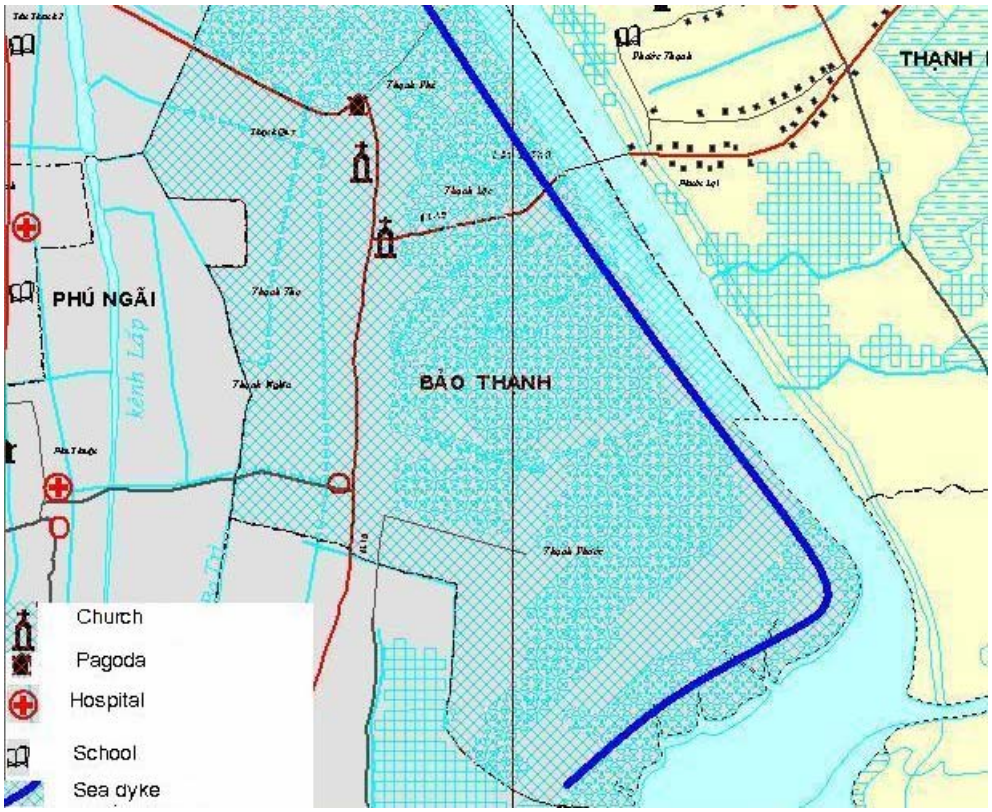

Figure 3-5. Cultural-Historical relic in Bao Thanh Commune

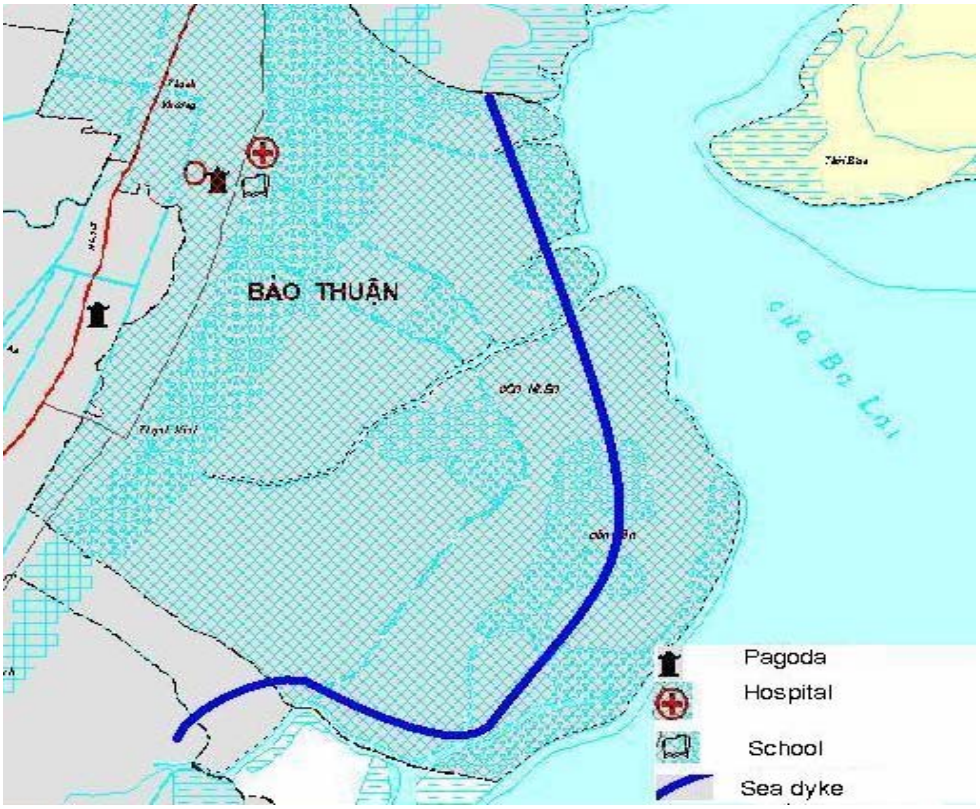

Figure 3-6. Cultural- hospital relic in Bao Thuan Commune

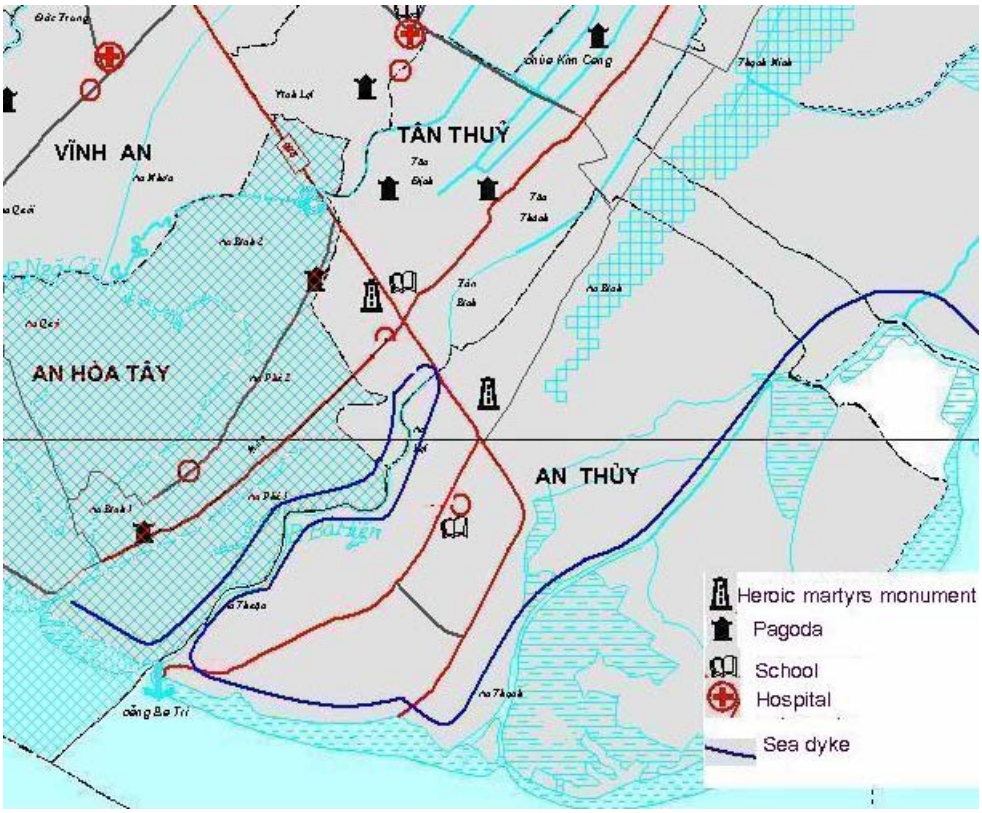

Figure 3-7. Cultural-hospital relic in An Thuy, Tan Thuy, An Hoa Tay Communes

3.3.8. Infrastructure condition

In general the infrastructure intended for livelihood and production are not comprehensive in terms of agricultural machinery, communication, education especially housing for the population (thatched houses account for 80%). To highten productivity it is necessary to increase agricultural mechanicalization together with development of local rural industries on the basis of rational use of available materials, thus creating more jobs, income and swifter rotation of capital for local people.

Table 3-25. Status of local infrastructure in the project area.

No	Infrastructure	Unit	Quantity	Capacity	Remarks
1	Clean water	Well	one unit/3,000 households		Hand Pump funded by (UNICEF)
2	Communication				
	- Telephone	Set	01 set /28 households		
	- TV set, radio set	Set	1.08 set/household		
3	Electricity network		86 % of households use electricity		Electricity network available

No	Infrastructure	Unit	Quantity	Capacity	Remarks
4	Big Tractor	Set	0		Not yet used
5	Small Tractor	Set	1..2 set/household		
6	Fishing boat	set	1 set/16 households		In coastal communes
7	Offshore fishing boat	Set	1 set/67 households		in coastal communes
8	Carrying vessel	Set	4 set/100 households		
9	Pumping machine	set	8 households/set		
10	Paddy processing machine	Set	1 set/120 households		
11	Housing				
	- Bricks house (ceramic / corrugated iron roof)	%	25		
	- Thatched house	%	75		
12	- Salt field upgrading project				in Bao Thach commune
	- Dredging sewage and drainage canals (grade II, III)	km	34.5	650ha	
	- Dyke road	km	4.0	Red gravel cover	
	- Canal bridge		4.0	Pedestrian	
13	Extensive and industrial prawn farming				Bao Thuan, An Thuy, An Hoa Tay, Tan Xuan
	- Dredging canals	km	30	1406	
	- Dyke Road	km	3.5	Red gravel cover	Bao Thuan
	- Canal bridge	unit	3	H8	Bao Thuan
	- Canal bridge	unit	4	H3	Tan Xuan, An Thuy
	- Sewer	m	2.0	164	An Hoa Tay
	- Water supply culvert	m	2.0	164	An Hoa Tay

(Source: Statistical yearbook of Ben Tre province)

3.3.9. Status of irrigation works

3.3.9.1. Status of existing irrigation works in the area

a. Status of canal system

Due attention has not been paid to periodic dredging of the region's canals. Flooding and water lugging drainage have not been comprehensively implemented.

Only some canals in the region are made for fresh water supply, which lie inside district road 16 from Provincial Road 885 to Tan Xuan. Such canals as No, Cong 10 Cua,

Rach La and some inner field Chin A and Dong Xuan canals are being dredged in Tan Xuan, Bao Thuan, Bao Thanh, An Thuy communes. However the main canals for water drainage have not been dredged. So the spring tide and rain water drainage is still tan urgent problem to the region.

Such coastal canals as Gia, No, Trai, Ong Chau, Ba Di, Ruong Muoi, Duong Khai, Duong Mieu, Hai Ha, Khem, Duong Tac, Khem, Cay Keo, Chau Ngao and others originate from the East Sea and are used for salt making and aquatic farming. Some items of the system have been dredged for the above purposes. Most of the remaining canals are dried up due to sedimentation by coastal alluvial.

b. Status of cofferdams

In the project area the salinity clocking coffer dams were built by embankment of the new portions of dikes and linked to the dike roads. This system assured close salinity protection and started from Rach La irrigation works, went -along the Ham Luong river -An Hoa Tay dike road –across Provincial Road 885-An Thuy - Bao Thuan - Bao Thanh – Tan Xuan then joined with the sea dike along B a Lai river to reach Ba Lai culvert with the length of 28.500 m.

Table 3-26.Location of Sea dyke and Dyke Road in the project area

No	Name of constructions	Location and length
1	Salinity protection sea dyke (District Road No 16- Tan Xuan)	From An Hoa Tay to Ba Lai culvert, L=16.500 m
2	National defense sea dyke	From Ruong Muoi canal to An Thuy's Truong Dang, L = 12.000m
3	Rach La sea dyke	From Ba tri to road of Ba Beo dune, L=5.000m
4	Sea Dyke –Muoi Cua Culvert and Ba Lai Culvert	From Ba Lai Culvert to Muoi Cua Culvert, L=2.000m
5	From Dyke Road to Thu Ba Lai wharf (Section at District Road No 16)	From District Road 16 to Ba Lai river L= 1.625 m
6	Dyke Road and Coc forest	From District Road 16 -Duong Khai dune road to Ruong Muoi L=1.200 m
7	D1 Road (Construction for prawn farm on 872 ha in Bao Thuan)	From District Road 16 -Nhan dune L=4.100 m
8	Provincial Road 885 section to Tiem Tom	Provincial Road 885 to Tiem Tom L=3.600 m
9	Provincial Road 885 to Bai Ngao	Provincial Road 885 to Bai Ngao L=1.750 m
10	Rach Khem Road	Provincial Road 885 to Rach Khem, L=1.500m

(Source: Statistical yearbook of Ben Tre province)

In project area, a number of other irrigation works in the areas outside the agricultural zone there have been constructing some water works like the infrastructure works of

aquaculture branch at Bao Thuan, An Hoa Tay, Tan Xuan for prawn farming together with a number surrounding dykes or conducting canals built in various protects..

Apart from the above salinity prevention sea dikes another local salinity protection sea dike going from Truong Dang (at the end of Provincial Road 885)-along the East Sea - An Thuy, Tan Thuy, Bao Thuan to Bao Thanh. It is named as National Defense Dyke. This small-scale inner field Dyke and the crossing canals originating from the East Sea remain open have not been effectively used.

The sea dykes are confined in the inner part but have some sections of low level. The natural area outside the sea dykes still is large. Such canals as Gia, Trai, Ruong Muoi, Duong Tac, Chau Ngao… remain open. Therefore salt water penetrated by strong tide and flood water intrude from the sea and Ba Lai, Ham Luong rivers into the project area. Attention should be paid to the model of production in each area prior to the building of the headworks.

3.3.9.2. Limitations of irrigation works in producing process in the project area

a. Fresh watert

The supply of fresh water to agricultural production is very limited. Fresh water resources are taken only from Chau Binh and Vam Ho irrigation system, from Cay Da irrigation works through Giong Tom, Chin A canals and the Cay Da canal of slope flow. This amount of water is supplied only for an insignificant area. Other areas depend on rain-water.

The sea dikes and the headworks are uncompleted can not help store /and drain fresh water when needed. For this reason the cultivation is not productive. Some small irrigation works have been invested. These are Culvert 10 in Tan Xuan, a recently built irrigation system in Rach La (An Hoa Tay), Rach No works in Bao Thach, Cau Di construction, Dong Xuan Culvert, Chin A canal, Cay Da canal, Dong Xuan canal. The dyke system, complete water sewage and salinity protection system are able to supply of fresh water to 02 rice crops per year. In remaining areas people can make only 1 or 2 crops so the living conditions are not stable.

The introduction of Ba Lai culvert uncompleted but may supply fresh water to the project area in dry season. It is necessary to exploit the source of fresh water from Ba Lai reservoir to serve agricultural production in addition to dredging inner field irrigation works in an integrated way. Ba Lai reservoir must effectively tapped to serve agricultural and aquatic production.

b. Salinity intrusion

On the one hand salinity is closely linked to up stream flow regime of Tien River. Once much water comes from Mekong river salinity decreases and vice versa .On the other hand salinity depends on tide regime and climate conditions in the project areal.

Daily rising and falling tide regime and salinity intrusion influence subsidiary crops growing on sandy dunes. Productivity is therefore low and in many cases crops are totally lost. In flood season, dunes crops are damaged by strong tide from the East Sea.

The agricultural production zones are mostly inside Distric Road 16 (linking communes of Tan Thuy, Bao Thuan – Bao Thanh – Tan Xuan. Only a few areas like Ba Thach forest, the coastal sandy dunes in Bao Thuan, Bao Thanh, Tan Thuy, An Thuy, Con Nhan, Con Ho lie outside this district road. Salinity mainly intrudes from the sea and through Ham Luong and Ba Lai rivers and the regional canals namely Rach Gia, rach No, rach Trai, Ruong Muoi, Duong Xuong, Duong Tac, Ba Hien….

c. Flooding in rainy season

The area' s natural ground level in the project area is lower than the average ground level of the Mekong river delta. The enclosing dams are 0.9-1.2 m elevation on the average. The reasons for flooding of the agricultural land are as below:

- The areas outside the dyke are generally higher than the lower ones inside the dyke
- Water drainage is limited because of great fluctuation mode of the tides with their peak water level higher than the natural ground
- The salinity locking sea dike remains unintegrated
- The large waves and spring tide protection sea dikes surrounding the project area have not been built
- The salinity protection dykes have not been invested in an integrated way. Spring tide prevention, water sewage and drainage have not been controlled as required
- Main and inner fields canals have not systematically dredged for sedimentation.

d. *Flood impacts on Bai Lai and Ham Luong rivers*

Flood in Ba Lai and Ham Luong rivers usually occurs from the end of August to November (Flood in combination with tide in the East Sea). Great damages are caused in the absence of the flooding prevention works. Agricultural output is often decreased or even totally lost (especially in Cau Di alluvial area to Coc forest).

Large flodd may reduce spring tide salinity unsuitable for shrimp farming. Shrimp pond embankments collapse, which leads to low productivity of shrimp raising, great losses.

Salt making is affected by spring tide: Salt warehouses and salt fields are flooded so producing cost affecting.

Ba Tri district's statistics show that losses worth 15% of the total agricultural production are caused. The locals who are living hard lives will face more serious hardships.

3.3.10. Economic situation

3.3.10.1. Land use status

Most of The project area's land has been fully used. No fallow is available except the alluvial land and coastal protection forest. Investments are being made by the sectors of Agriculture-Forestry-Fisheries namely. Technical and material infrastructures of Rach La irrigation works, Ba Hien culvert, Quy dune, Muoi Cua culverts, surrounding dams going from Rach La irrigation sytem to Ruong Muoi serving, prawn farming center in Bao Thuan and salt production at Bao Thanh, canals and dams to serve aquatic farming in the communes : Tan Xuan, Bao Thanh, An Thuy, Tan Thuy under Program 773 have been implemented in service of agriculture-forestry-aquatic farming-salt making..

The land for rice, subsidiary crops growing and aquatic farming is on the constant rise. However, the cultivated lands are increased in some sub-projects and the productivity is unsteady in the absence of the srtuctural measures to protect abnormal changes of climate, spring tides natural calamities.

Table 3-27. Current land use in 2003

Number	Item	Area (ha)	Percentage (%)	Remarks
	Natural land area	**14,529**		
A	**Agricultural land**	**5527.18**	38.04%	Compared to natural land area
1	Rice land	3405.79	61.6%	Compared with to natural lands
	- 3 crop land	1066.5		
	- 2 crop land	1645		
	- 1 crop land	1111		
2	Land for vegetable and secondary crops	716.37		
3	Land for perennial plants	1406.6		
B	**Land for aquaculture – Salt production**	**5137.6**		
1	Land for aquaculture farming	4250.6		Including the water surface area
2	Land for salt production	887		
C	**Specialized use land**	**560.92**		
D	**Dwelling land**	**266.5**		
E	**Sand dunes**	**438**		
F	**Forestry land**	**629.23**		
G	**Waterway land**	**1969.57**		

(Source: Statistical yearbook of Ben Tre province)

3.3.10.2 Production status

In the project area there are diversified economic structural components. The main activities include agricultural production (rice, subsidiary crops, fruit trees growing, poultry and cattle raising) fisheries (prawn, fish, seashore M.lusoria, Arca subcrenata farming) forestry (protection afforestation, wood and water coconut palm exploitation), salt making, industries (aquatic products trading and processing, fishing port), small industries (small trading, prawn and fish fry nursery, prawn food). Last years prawn industrial farming has been much developing in the communes of the project area. However the productivity remains low due to climate conditions (salinity, spring tide, flooding). Epidemics often cause shrimp mass death.

a. Subsidiary crops

The areas for vegetables and subsidiary crops belong to the agricultural land (2 rice crops + one subsidiary crop or one rice crop + 2 subsidiary crops per year) . The subsidiary crops include soya beans, corn, potatoes, wheat, chilly, onion.... and most other vegetables are grown on sandy dunes. Now gardening is effectively developing with intensive cultivation of diversified plants and trees.

A weakness of the area is salinity intrusion so productivity of subsidiary crops is not high, area under cultivation is only about 80% of agricultural area.

b. Rice growing

Rice cultivated area: The area for rice growing is within the confines of the salinity locking sea dike (District Road joining Tan Thuy with Tan Xuan). This rice productivity is dependable on rainfall. Rice crops areas are large in the years of good weather, well distributed rainfall and little salinity intrusion. Most 1-2 crop areas are feasible, 3 crop areas are rare (under Cha Binh - Vam Ho and Thuy Cay Da projects and in the inner part of dike of Chin A, Dong Xuan irrigation systems. For a year to now fresh water supply has been made under Ba Lai project. Since the irrigation system still needs improvement (Ba Lai reservoir is unfilled, limitations of inner field canals) the rice productivity is low and unstable only accounts for 50-60 % of the average output in the Mekong delta.

Area for rice growing : 3405.79 ha
- Winter -Spring crop : 903.7ha
- Summer Autumn crop: 2370ha
- Spring crop : 2819ha

Productivity
- One crop area : 2,9 - 3,5 T/ha
- Two crop area : 3,5 - 4 T/ha
- Three crop area : 5 - 6 T/ha

The rice productivity in the area depends much on the weather variation. The statistics on the population' s economic and welfare conditions show that in 2003 the 06 beneficiary project communes have cultivated rice area accounting for 94.50% of the total area; as compared with 80% in early 2004 because of salinity intrusion, shortage of fresh water and spring tide

c. Domestic animal breeding

In the project are, domestic animal breeding ranks after cultivation here and is of small family scale to make full use of workforce, agricultural by products and to increase income for households and provide food for their own use. In addition this creates traction power for cultivation. The region's total number of cattles is 8,346, pigs and goats: 28,050; poultry: 145.478.

d. Salt making

Salt making dates back long ago in coastal areas of Binh Dai and Ba Tri districts. The local people make salt in the coastal and estuary areas of Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy communes. The total area for salt production is 887 ha, 650 ha of which is in Bao Thach. The productivity reaches 450-:-500 kg/ha/crop.

However the salt prices fluctuate and the output mostly depends on climate conditions. The salt makers suffer hardships once there is spring tide. Some households have to do other jobs. The land for salt production is left fallow very often. The Ministry of Agriculture and rural development invested capital in technical infrastructure to help salt production on 650 ha of Bao Thach commune (Canals have been dredged for water supply and drainage, ponds edges strengthened, electric pumping stations established, communication network improved). These are necessary and urgent works to stabilize the lives of salt makers.

For the last few years prawn farming has been rapidly developed in coastal districts. This work is more efficient than others despite of high risks. The local people have shifted from salt production to prawn industrial / extensive farming. The restructured areas are mostly in Bao Thuan, Tan Thuy, An Thuy communes where little salt is made.

e. Aquatic farming

In Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy , An Thuy , An Hoa Tay villages under the projects of Program 773 for prawn industrial , farming at 872 ha and another 164 ha in An Hoa Tay specialized in industrial, semi-industrial , extensive prawn farming and improvement of extensive models in Bao Thanh, Tan Thuy, An Thuy. However , it is due to the lack of capital and high risks that the industrial farming area only reaches 639.6ha of the total 4250.6ha.

Due to the incomplete sewers and ponds. The households who apply extensive farming get an out put of 0.3 ton of /ha. The others who follow industrial farming model get 5-7 ton/ha output as a result of high salinity, rainfall, spring tide, cyclones; some of them may suffer total loss in case of epidemics.

Some households make use of the coastal alluvial land to raise M.lusoria , Arca subcrenata with high productivity but the prices are unstable.

However the aquatic farming brings about high income in the area as compared with other sectors. Therefore the local people and authorities wish for State support to complete natural disaster prevention and mitigation constructions for risk management and sustainable development of aquatic farming and other branches.

3.3.11. Traffic network

Current local traffic Network consists of both waterway and landroute. There was Ba Lai culvert connecting Ba Tri district with Binh Dai district so it is convenient for .travelling. In the project area, the inter-district road No 16 connects inter-province road No 885, up to Tan Xuan, Ba Lai culvert directs, towards Binh Dai. This route has been covered with asphalt on about 4km and with red-gravel on remaining part. Inter-province route No 885 cross, over the project area for about 6500m, was asphalted about 4000m and red-gravel on rest road part from Truong Dang to Bai Ngao. Besides, almost remaining landroutes are pathway and red-gravel path with 3-5m in width. The tracffic is difficult, especially in months of rainy season, so the traffic is mainly waterway.

The waterway is convenient due to two large rivers: Ba Lai and Ham Luong that run around the project area and the arroyos connecting with the sea. Local people often use junks, boats with load of 5-100 tons to transport agricultural products and other agricultural materials such as the pesticides, breed-rice, shrimp, etc as well as the construction materials such as cement, iron, steel, etc.

At present, most of the canals, arroyos in the salt-marsh area have not yet irrigation works so the traffict by boats, ships is still convenient. However, this canals are being deposited. Some canals in the area was dredged but they have not yet satisfied with demands as well as requirements of waterway.

When the project is completed the waterway will be more convenient in inner area of the project because the canals are dredged and widened. However, the waterway in exterior zone is limited due to the dependence on operation regime of the works on the dyke. When sea dyke system is completed the landroute will be better because this is inter-commune road and rescue route when there are storms.

CHAPTER 4. **ENVIRONMENT IMPACT ASSESSMENT**

The project impacts on the environment occur mainly in the construction phase, but there are also the impacts in the pre-construction and operation phase. The impact of each phase is different from type and level. The impacts in the construction phase are short-term impacts and potential impacts in the pre-construction phase by appropriating land, relocation and resettlement. In the operation phase, although not serious, the impacts are long-term impacts.

4.1. THE PROJECT IMPACTS IN PRE-CONSTRUCTION PHASE

4.1.1. Impact on the status of land use and resettlement

Building dyke culverts is a proposed technical solution to prevent and relieve natural calamities for residents in the project zone .The implementation of this plan will extract part of region area used for aquatic farming and salt making aqua cultural, alkaline, tenure, some forest land, crop plants and housing area (compensation for relocation) in six coastal communes of Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay (upon receipt of request for premises clearance due to construction).

Table 4-1 .Material damages due to sea dyke construction at Ba Tri district

No	Items	Unit	Area
1	**Everlasting deprivation of area**	Ha	195.405
	- 20 meters of dyke body	Ha	63.162
	- 10 meters of gallery of dike	Ha	31.581
	-20 meters of excavated and drilled ground land	Ha	63.162
	- Positions of dike culverts	Ha	37.5
2	**Number of houses to be demolished**	m2	12,300
	- Thatched houses	m2	11,600
	- Bricked houses	m2	50
	- Tiled houses	m2	450
	- Corrugated iron houses	m2	200
3	**Number of households to be relocated**	household	70
4	**Fruits trees and others**	tree	8,230
5	**Graves to be relocated**	pce	6.0

(Source: FS of Ba Tri sea-dyke)

Tiem Tom , Bai Ngao in An Thuy commune , Thu Ba Lai wharf (From Lo Trai to District Road 16) will suffer the most of damages for relocation. Less damages will be reported to the area along the riverside and seaside from An Thuy to Tan Xuan where households are scattered with thatched sheds for watching shrimp pond. These households live in An Thuy- Bao Thuan-Bao Thanh (beltway) and along District Road 16. Damages are also caused to settlers from other district, other communes. They came here to rent land for shrimp raising.

As many as 70 households need relocation accounting for 1.56 percent of the total directly hit by natural calamities in the project zone (these households live along District Road 16 to sea).

The households subject to relocation are living within the confines of the project. Only 30 households who own their houses in Tiem Tom will have to move out. Since the remaining households have only makeshift shrimp pond watching sheds there will be no problem about. Since most of the households who are completely deprived of their land but own houses on the dunes in Bao Thuan, Bao Thanh will need not to be relocated except being reallocated of land at the site or elsewhere in the project area .

4.1.2. Impact on family income

In the project zone residents are of King community who have settled here for years, work for traditional rice growing, fishing, aquatic farming, salt making, afforestation etc. Most of them are steadily settled on sandy soils in deeper mainland. At the seaside are scattered other settlers coming from the district's other communes. The settlers rented land for prawn farming and now live in makeshift thatched houses. Once any natural disaster occurs the local authorities alert them to evacuate to the upper dunes for their safety.

Households who are completely deprived of land will have to resettle elsewhere and as a result of this will encounter lots of hardships in the process of relocation: temporal unemployment, change of jobs. Especially the households in Tiem Tom fishing port will suffer with income deprivation. The households who are deprived of production land will have to bear the cost of rebuilding farming ponds. It needs therefore to financially support them for production rehabilitation.

4.1.3. Impact on the psychology of people

According to table 4.1, there are only 6 households that have to move graves. This fact will also cause negative responses from these households since the graves moving is taboo according to Vietnamese custom. Moreover, to move graves as well as to look for land for building the new cemetery is very difficult.

Although in the designed area no historical relics are to be moved or destroyed, some impacts on quiescence, belief, etc. may hane due to project implementation and operation.

4.1.4. Impact on biological resource and bio-diversity

There will be no impact on biological resources and biodiversity during pre-construction phase.

4.2. THE PROJECT IMPACTS IN CONSTRUCTION PHASE

4.2.1. Impact on air quality

The Ba Tri sea-dyke construction with 31.581km in length will need 908,583m^3 of soil. Most soils are exploited at the site along the dyke and about 10m from the foundation of dyke. There are only 1000m of dyke embanked by soil from another place. Ther use excavator with bucket >1.25m^3 for total line of dyke and digging-machine to move soil to the selected location. These exploiting activities will not cause much dust because embanked soil is wet soil.

There are about 40 vehicles and machines used for constructing the proposed sea-dyke route in 1,830 days so the quantity of emitted gas will not be significant.

4.2.2. Impact on the noise and vibration

The residential area is far from the proposed seadyke so the activity of the machines, constructing equipment and vehicles will not cause sinificant impacts.

4.2.3. Impact on water quality

a. Surface water

- Salinity: the canals will be dredged to construct culverts and the earth excavation will create a canal parallel with the proposed dyke , these activities may ease the saline water intruding deeply into the rice field, especially, when the process is combined with tide and easterly wind in dry season. The salinity higher than the threshold will be harmful for some aquatic products such as shrimp. Moreover, the building of bridges (driving the pile) and culverts crossing district-road No 16 also block the flow from upstream to dilute salinity: the saline water, which is retained for long time in the field will eject out and have adverse impacts on people's life as well as for domestic water supply, and for underground water. During dry season from December to April of the next year, the big volume of evaporating water and strong radiation intensity increase the salinity of surface water. Big amount of fresh water should be reserved in Ba Lai reservoir to dilute high salinity.
- Acidity: The digging of earth for banking up the dyke and building the beam blocking salt water: the digging of ditches and building of bridges and culverts affect the drainage of acid water and acid earth layer, create conditions for oxidizing the pyrite layer of earth, leading to acidification of earth and water. Especially the digging, banking up, pile driving and treatment of foundation have the effect of acid escape, making the water more acid. However, along the proposed dyke route, there is only a little area at A Thuy commune, near Ham Luong river, with alum earth so this impact is not significant.
- Pollution of surface water: the waste discharge from the sheds of construction workers as well as local people into surface water will make it polluted. Suppose that in average, every people uses 100-300 liter/day in an area of 100 people, the corresponding waste water loading for developing countries proposed by S.J. Arceivala and Marcel Dekede is:

-	BOD_5	: 450 – 540	mg/l
-	COD	: 720 – 1.020	mg/l
-	SS	: 700 – 1.450	mg/l
-	Oil	: 100 – 300	mg/l
-	Total N	: 60 – 120	mg/l
-	Total Coliform	: 10^9 - 10^{10}	MNP/100ml
-	Ecoli	: 10^5 - 10^6	MNP/100ml
-	Eggs of parasitic worms	: > 10^3	MNP/100ml
-	Bacterium	: 10^2 - 10^4	MNP/100ml
-	Cl^-	: 40 – 80	mg/l
-	Total P	: 8 – 40	mg/l
-	TSS	: 1700 – 2200	mg/l

Nearly 300 workers are divided into small groups (each about 50 workers) implementing small work volume, the impact of waste water from workers on water quality will not be considerable .

The main profession in the area is agriculture and aquaculture and fishing, so many chemicals are used such as pesticides, fertilizers,...in agriculture, or antibiotics, medicines,... in aqua-culture. During rainfall or drainage of water in ponds, these chemicals will come into surface water. Due to impact of construction, the poor drainage causes stagnation and pollution of surface water. Then the polluted water will permeate into underground water, make it polluted. Arranging time for constructing reasonably to drain waste water off quickly (defining time when local people release water in ponds to stop constructing nearby culverts, this is not affect on construction process since time for release is not long) .

Table 4-2. The analysis result of some parameters of water sample in shrimp breeding pond

Parameter	*Unit*	*Result*	*TCVN 6986:2001*
pH		*7.72*	*5-9*
BOD_5	*mg/l*	*94*	*10*
NH_4^+	*mg/l*	*0.47*	*1*
SS	*mg/l*	*56.6*	*50*
Coliform	*MNP/1000ml*	*97*	*5000*
NO_3^-	*mg/l*	*2.16*	*-*
Oil	*mg/l*	*Trace*	*5*

Driving of piles for building bridges and culverts will effect on surface runoff, cause erosion and collapse, suddenly increase the turbidity of water current. The exploitation, gathering, and transportation of materials will also effect surface water quality, increase turbidity due to their spilling and scattering. Moreover, that also increases the sedimentation in canals. The contractor should carry out bank consolidation and cover vegetable plant to reduce the erosion on two banks. The gathering place should be equipped with cover canvas to avoid strewing material in canals.

Underground water quality

When surface water is polluted by these sources, it will lead to pollution of underground water, because surface water is the main water supply for underground water. The digging of bridge foundation and pile driving make holes in surface layer, creating direct exchange between surface and underground water, causing pollution. Moreover, that also expose the underground water of shallow layer, increase the possibility of natural intrusion of pollutants and decrease the reserve of underground water. If implementing surface water pollution mitigation measures, ground water source will not be polluted.

Underground water is also exploited intensively for aquatic farming of local people especially in dry season, that leads to the danger of lower underground water table, and possible salinity intrusion, especially at sand stretches, salt fields close to these stretches, and underground light brackish water in shallow layer that is used very frequently now. There should plan to manage the exploitation of underground water, supplementing with surface fresh water to limit the possible exhaustion in quality and quantity of underground water.

b. Impact on the flooding

The project area by itself is a depression of the Mekong River Delta, and the building of dyke and culverts will affect the hydrological regime in the area, change it, the exchange of input and output flows is limited. When upstream water flow increases and limits the drainage that causes inundation in the area, polluting water source, especially for shrimp farming area and affects the people's life.

Flood season of this area often appears from the end of August to November every year. Upstream flow in combination with high tide make the water in the field rise, causing inundation. The execution of construction will be able to prevent high tide, but also limit the drainage. In addition, the activities of construction, digging of foundation will obstruct the flow, make the riverbed narrower, and cause sedimentation in riverbed, leading to poor drainage. The Contractor should construct a half of total of culverts in dry season to ensure the drainage of water in the rainy season.

4.2.4. Impact on soil environment and sediment

The exploitation of earth for banking up the dyke, as well as the transportation and gathering of materials also have negative effects on soil environment, breaking earth structure. To reduce these impacts the Contractor needs to choose hard ground to gather materials.

Land needs and soil for dike construction will be exploited along the proposed seadyke line. The location of the source of that soil is in the inner part of the dyke, about 10meters away from dyke foot. The exploitation will impact on alum soil layer and create the condition for pyrite oxidation. As a result of that, soil will be acidified.

Wastes from inhabitants, worker, construction activities, oil and grease from machines and equipment discharged directly into the earth cause soil pollution. The polluted surface water permeates into the earth also lead to pollution. The plant species cannot develop, leading to the loss of vegetation cover, and degradation of soil. It needs to arrange waste tanks near construction place, tents for workers and forbid to release waste in canals.

During earth excavation, there will be the embankment that retains saline water, and makes underground water lower, leading to salinity intrusion. All these will make the soil saline.

As mentioned above, the dyke embankment, building of bridge and culverts will limit the water drainage, retain the waste water from shrimp farming ponds, containing many antibiotics to treat shrimp, that will permeates into the earth and pollutes it. Moreover, the chemicals used in agriculture such as fertilizers, plant protection, … also have direct effects on soil environment. All these effects can be mitigated by appropriate management and mitigation measures.

4.2.5. Impact on biological resource

Construction phase will have significant impacts on biological resources. The main impact elements are:

- Many workers in construction site;
- Equipment and machines;
- Transportation means;
- Construction materials;

The above elements will give rise to many additional elements such as: building of sheds, gathering of materials, and increase of day and night activities causing pollution of air,

noise, vibration, and pollution of water and soil. All of these elements have direct or indirect effects on biological resources in the area:

- Losing a part of mangrove forest;
- Losing vegetation coverage at locations of material exploitation, dyke banking, material gathering, and culvert building...
- Affecting habitats of some animals;
- Pollution of habitat of some species.

a. Terrestrial ecosystem and aquatic life in fresh water body

195 ha will be converted permanently from farmland to the sea dyke and its canal. The farmland consists of rice fields, fruit trees and shade trees. The wild life found in this area consists of species that are commonly occurring in farmland and in and around human settlement as mentioned in chapter 3. There are not valuable and rare plants and animals which requires the protection or special concern. This impact is assessed as not significant.

During construction, there will also be temporary loss of farmland as a result of storage sites for construction material and new roads for construction. But as mentioned in Chapter 3, the ecosystem in projected area has poor biodiversity, so these impacts are assessed as not significant.

b. Littoral area and adjacent water

The sea dyke construction will have impact on the biodiversity of littoral area and adjacent sea water.

Permanently, dyke will result in loss of up to 12ha, approximately, of mangroves along a 3.1 km section. The sea dyke will be built right at the landward rear of mangroves and this construction itself will take away a band of 10 to 20 m (maximum 50m depend on how much cares taken during construction period) wide of mangrove, that is an area of 3.1 to 6.2 ha (up to maximum 15.5 ha) of mangroves will be lost. In addition to that, the nursery area of larvae and habitat of many economically and ecologically important species such as marine and brackish water shrimp, mud crab, pistol shrimp, mud lobster and gobies and some fish will be destroyed or heavily disturbed causing a decline of fisheries resources and fisheries production in the adjacent sea water.

Given that the ratio between aquaculture area and area of mangroves, which are already recognized as vital to sustainable aquaculture and durability of any shore constructions, at present is more than 1, any further loss of mangrove forest will severely affect to the survival of the remaining mangroves due to the decreased resistance of mangroves forest against the wave and tide strength, especially in the natural calamities such as typhoon. Consequently, threat to biodiversity and abundance of aquatic species in the project area and its surrounding will rise.

Even the impact of the sea dyke during construction phase is assessed to be significant to the community in the littoral area and sea water adjacent project area, it is considered as of possible mitigation by rehabilitation of mangrove in seaward side of the dyke

To manage and stabilize the biodiversity in this area, the project should mitigate the above mentioned impacts by allocating a budget to restore and plant mangrove along a seaward side of the dyke and in mud flat areas where technical and natural conditions for mangrove plantation are met (preliminary research might needed). The estimated cost for

plantation of mangrove is about 100-150 USD/ha depending on types of the sediment and further cost for protection of newly planted mangroves in the 1st two years after mangroves have been planted is 500.000-700.000 VND/ha/year, approximately. The planting cost should include 30% resource for replanting areas where mangrove seedlings do not survive the first time they are planted. By doing this, it is not only the loss of mangrove ecosystem and its supporting habitat of many important species will be restored but the dyke's base itself will also be better protected.

Apart from disturbances to sediment, digging up of earth and ground leveling during construction period will increase water's turbidity in project area, which, in turn, will have significant impact on growing or even on mortality of filter feeder species such as shrimp and mollusk by blocking their gills, some fishes will also be affected by the same way. Turbidity will have direct disturbance on settlement of mollusk's larvae resulting in decline of recruitment of these species in the project area. In addition to that, acid leaching from excavated earth will degrade water quality; thereby threaten life and growth of aquatic communities. However, the increasing turbidity and decreasing pH of water will not last for long time since the suspended solids will settle down few months (maximum 6 months) after construction is completed and acid will be buffered partly by saline water and the remaining will be washed out to the sea. Hence, the temporary impacts are assessed as not significant.

Other factors such as noise, earth vibration will also scare away shore birds and other mobile animal. A new population (300 people in 3 years) will be established by the new workers will come with the dyke construction. Noise (and vibrations) from the operation of the heavy machinery and traffic: The noise of a large-scale construction work causes stress to wildlife populations that can translate avoidance of disturbed area (even if they are important breeding, feeding or roosting areas). This threat will affect not only the Ba Tri IBA, but also the wildlife populations of the Binh Dai IBA nearby.

The coastal ecosystem will be also affected by oil and grease from ships transporting earth for dyke embankment and from other ships as well as domestic wastes from workers sheds and inland field. Besides, the water ecosystem of mangrove forest will more or less fluctuate when being newly planted after destruction for dyke building. The built of sea dyke, bridge and culverts in raining season (from May to October) can cause local inundation that makes aquaculture environment polluted, leading to diseases and may be mass death of cultured species. In addition to that, the digging of foundation for building bridge and culverts, and dredging of river bed lead to temporary changes of bottom structure, decreasing of zoobenthos and changing of community structure and species composition in a way that more tolerant species will survive while less tolerant species will be disadvantaged. Again, they will cause only temporary impacts to the biodiversity of project area; therefore, they are assessed of no special concern.

During the construction period, the new population will be published by the workers that come to work in the area would create a new demand on the natural resources of the site and will cause:

- Direct mortality of wildlife and vegetation loss: Increased hunting to provide bushmeat, increased fire wood collection, increased logging, and over-fishing.

4.2.6. Impact on socio-economy

a. Infrastructure

The process of construction of culverts across the dyke will affect water transport in the area due to obstruction. But this impact is only temporary.

b. Water supply and quality

To serve the construction and workers' living, a big amount of surface and underground water will be used that may decrease the reserve of water supplied for production and living of inhabitants in the area; at the same time, water quality is also affected. However, these impacts can be mitigated by improving current fresh water system (this activity is proposedin the Water Resource Development Plan of Ba Tri district).

Because the salt amplitude becomes more and more complicated, can not be forecasted and controlled, its concentration has increasing tendency. High salinity will directly affect the productivity and cost of production which may have many potential risks; so the control of the intrusion of spring tide by culverts on sea dyke and the supply of fresh water to dilute the salinity, through culvert system on district road 16 to decrease the salinity in fresh water area are sustainable solution of long-term strategy for Ba Tri district in particular, and Ben Tre province in general.

c. Historical relic and social works

In projected area, it is found that there are not any historical sites or schools, hospitals, tourist areas…, which may be under direct or indirect impacts such as noise, vibration, dust, and exhaust gases on environment that requires tranquility and clean of this area, especially for the pagoda area of Bao Thanh commune, the hospital, school area of An Thuy, Tan Thuy communes.

d. Socio-economy

The building of Ba Tri Sea-dyke will have certain impacts on current life of local people. Firstly they will affect aquaculture households, because salinity of shrimp ponds will be directly affected because the sea water supplied is limited by the dyke that prevent salinity intrusion. When there is not appropriate salinity, many species will be damaged. Other impacts on water sources and soil acidifying them will also affect the habitat of aquatic species. Leading local people to reserve enough water in standby ponds. About 15 – 20days, people will renew water in shrimp ponds so the Contractor shoud stop constructing culvert in that day for local people to release waste water take new salt water.

Waste water from agricultural activities, inhabitant areas, workers area, and livestock, containing many chemicals, organic substances and disease microbes that has poor drainage due to the construction, causing stagnation and will intrude into farming ponds, killing many aquatic animals.

During construction process, there will be a big number of workers. Thus, there will be some services that improve some how people's life and contribute to the development of some local handicrafts and small industries. Beside these positive effects, there appear some negative ones.

Because at construction sites there are no sanitary facilities (such as system to collect waste water), the waste water from workers sheds containing high contents of microbes and organic substances will pollute surface water, underground water and soil This is adverse effect for the area, especially inhabitant area, historical and tourist sites. If workers are divided into small groups, the impact will not be significant.

The appearance of some people from other places coming here to live and work temporarily will also lead to many contradictions with local people due to differences in way of life, income, and violation of local traditions; increase of dissemination of diseases such as diarrhea, typhoid, fever epidemic, … especially strange diseases from other localities. The development of some services can also lead to many social evils. However, these impacts can be mitigated by management and education measures..

The construction process also leads to possibility of accidents due to wrong technical operation, not compliance to labor safety regulation … So, there should be measure to manage the execution of construction.

e. Solid waste

The waste from building and living activities of workers as well as from the residential area will affect on water, soil. These impacts can be reduced by management measures.

In general, the main impacts of the project have been above mentioned. This is the phase that cause the strongest impacts on environment. The mitigation measures will be presented at Chapter 5.

4.3. THE PROJECT IMPACTS IN OPERATION PHASE

After all the dyke and culverts come into operation, the number of transport means will increase, including water and land ones, because the transport system would have been upgraded and improved, but that also brings about the increase of toxic gases emission, dust and noise, increasing possibility of vehicle accidents. Although impacts in this phase are not obvious and vigorous as in construction phase, they have latent effects on environment during the entire operation duration of the structures.

4.3.1. Impact on natural resource

a. Air

The Ba Tri sea dyke is merely a natural disaster mitigation project against spring waters , typhoon , flood , saline intrusion ... Once the works are available the rotated use of land and the area of green trees will become much larger .The flooded zones inside District road 16 (the artificial fresh water zone) would benefit from swifter drainage . The well washed land would produce little alum evaporation that causes air pollution in the dry season. In addition, the ever changing clean fresh water which is stored so much in channels and trenches for irrigation would increase water evaporation in the dry season. This would lead to more clement weather and restricts epidemics caused to human beings and animals.

When the dyke is in use, the density of transport means will rise up, especially on top of dyke (4 – 5m in width). This transport can affect the dyke body if there is not careful management, and may cause the exhaust of gases, dust and noise increase

b. Hydrological conditions

Once the network of dykes and sewers is put in use the hydrological regime flow, water level inside the dyke will change according to the culvert operation; the outer dykes seashore will be more deposited and the inner dykes area is not affected by typhoon and spring waters.

The building of culverts for drainage of saline water, conducting fresh water as well as activities of dredging canals, regulating water level and discharge will have positive effects on surface water hydrology

c. Surface water quality

The earth is not affected any more and is gradually stable, the acid layer is in latent form, in addition to that with the supplementation for fresh water source, the acidity and salinity of water are washed away frequently. Water is not acidified or salinized any more. In dry season, there is no more lack of water because of supplementary fresh water provided through conducting canals, making fresh water amount stable.

The water will considerably be improved in terms of quality in the fresh water area and most of the inner areas alongside with District Road No 16 thanks to more direct and swift drainage. Fresh water in bigger amount is taken in from the upper area and Ba Lai reservoir to decrease pollution.

However, the surface water pollution in shrimps farm due to epidemics or wastes will have a negative impact on the artificial fresh water area. Pollution of this zone' s surface water is the result of the process of washing alum, salt, toxical elements stuck to earth, toxical substance from chemical fertilizer and insecticide. It needs to guide local people of hygienic shrimp farming techniques to reduce diseases.

The surface water pollution also results from the increasing production brought about by the project in addition to the local backward practice and model of production, the failure of application of scientific progress, the use of chemical and insecticide products

The favourable natural conditions, the natural disaster mitigation, the higher productivity, the project zone economic development will lead to more surface water pollution (Petrol and gasoline wastes caused by navigation vessels, repair and oil stations, and increasing bacteria due to wastes, natural and mechamical population boom.

d. Underground water quality

Upon completion of the project the underground water quality will be worse so the population growth will cause full exploition of water wells; the development of the agriculture will cause the increasing use of pesticide, chemical fertilizer, etc. Negatively influenced will be mostly the underground wells in the areas close to shrimp farms; the polluted water will find their way into the wells together with microbiological and chemical substance. However, these impacts is not clearly.

e. Pedologic condition

The soil in the project zone area is merely salted. This soil is improved by the project and make the productivity higher due to sufficient supply of water for salt washing, that meets the requirements for plant growing.

Another kind is the sandy soil. Once there is sufficient supply of fresh water to this region the requirements for intensive vegetables cultivation will be met.

4.3.2. Impact on biological resource

a. Terrestrial and freshwater ecosystem

When the sea dyke functions, there will be considerable changes to the terrestrial and freshwater ecosystems. First of all, more freshwater will be kept within the area than before resulting in better growth and development of cultivated crops. It is likely that the 2-3 crops/year for an existing area of agricultural field of one crop per year are possible with better supply of freshwater thanks to presence of the dyke, especially in dry season. Secondly, poultry, livestock as well as wild animals would also be benefited from more availability of freshwater.

However, there will also be a risk of local flood from river due to inappropriate drainage of the existing system. Bearing in mind that more sedimentation is consequence of higher volume of freshwater in the project area, improvement of drainage system and frequent dredging are vital to optimize advantages of new dyke to cultivation area. Higher rate of sedimentation in water bodies will affect to the lives of benthos, especially filter feeders.

Though, this area is not important regarding its biodiversity of fauna and flora and this area is heavily anthropogenic so the effects mentioned above is of no special concern.

Generally, impact of the dyke in terrestrial ecosystem and aquatic life in fresh water body is assessed as not significant provided that drainage system will be improved and dredged frequently and dredged material will be dumped properly.

b. Littroral area

Impacts of the new sea dyke will not be identical in areas along its two sides. The landward side of the sea dyke will have more freshwater and less saline water, especially during the neap tides. The band of nippa trees will be slightly impacted but not for so long, since this band has already been isolated from the sea by aquaculture area and this species can easily adapt to low salinity conditions, even in freshwater.

Sea dyke will protect aquaculture area from negative impact of wave and saline water intrusion. Aquatic species in ponds will also be benefited from more fresh water in the project area since freshwater can dilute and reduce water's salinity which has been limiting factor of shrimp growth, especially in spring tide. However, insecticide, chemical fertilizers and organic material in fresh water will have longer time in the area to affect to living things; they might be good to some but harmful to the others. Providing that BOD of surface water has been monitored of up to 20mg/l, cultured shrimp can be influenced by algae bloom locally. Thus, freshwater quality should be monitored and only when water's quality is met standards for aquaculture then it can be used to dilute sea water.

When sea dyke is under operation, because of better water supply, suitable water salinity to shrimp culture and more safety of the farming ponds, total area for aquaculture and scale of aquaculture will tend to rise (possibly more intensive) producing more waste and more sewage discharge from the farming area. Consequently, draining canals will be filled up soon. Therefore, frequent dredging and good management of waste and sewage from aquaculture is necessary to sustain good environment.

Along seaward side of sea dyke, mangrove with its associated fauna and fauna in tidal flat will suffer from changes of volume and pattern of freshwater flow from land; i.e. less and regulated freshwater coming out from land. Less volume of freshwater from the land will carry fewer amounts of nutrient to mangroves, tidal flat and inshore water resulting in a decline of productivity of these three types of habitat. However, this impact is considered not significant in the south of Duong Tac canal since relatively high discharge of fresh water from Hamluong estuary will gradually give back. But northern part of this canal will have moderate impact because small discharge from Balai estuary might not compensate sufficiently. So, some shore birds, which usually feed in tidal flat, might go further to the aquaculture area for feeding because of more food availability and might have more risks of being caught there.

On the one hand, mangroves area along sea dyke will not be altered more into aquaculture pond as farmers tend to stay behind the dyke to have their pond protected so, to some extent, mangroves left in this area can have some better protection from cutting. On the other hand, there will also be further loss of mangrove due to erosion along Hamluong estuary and tidal flat because of presence of the sea dyke and mangroves in the project area will be more vulnerable to the negative impact of wave, wind and tide after the dyke's construction has removed an area of 4-10 ha of mangrove, approximately. It is almost impossible to predict a pattern of land erosion and accretion without any scientific evidences. Hence, it is suggested that Duong Tac canal should be draining canal of fresh water from land to sea and more mangrove should be planted to mitigate impact of possibility of soil erosions and loss of mangroves in this area.

Apart from all impacts mentioned earlier, in the design of project, waste and sewage from aquaculture area, which are very rich in organic material, will be regularly washed out to the sea. If they are dumped only in several sites, there will be significant impact to mangroves and tidal flat ecosystem because of a pile up of nutrients at those sites. A good management and wise strategy of dumping waste and sewage from shrimp farming areas should be in place to mitigate those impacts.

However, as mentioned earlier, when the dyke implement, some area which has been used for rice culture can be altered into aquaculture area resulting in less environmental problems to the dumping area of the sewage since rice farming has been heavily chemical dependent.

Aquatic species in inshore water, especially migratory species or those who need more than one habitat to complete their life cycles, will suffer from loss of habitat availability due to a fact that the dyke will partly block their migration way further in to land. Those who try to pass through gates will tend to be caught more by barrier nets, which are common fishing practices in this area. Therefore, fishing mortality of seeds of those species will increase; as consequence, fishing production of inshore water will decrease while production from aquaculture will rise. Life cycles of migratory species such as shrimp, mud crab and some fishes might by interrupted. Salinity's fluctuation in inshore water together with other changes of living environment due to the change of freshwater regime will influence aquatic life and community structure in a way that they favour tolerant species (e.g. euryhaline ones)

and disadvantage less tolerant species (e.g. stenohaline ones). Those impacts can reduce very much in 5 years when newly planted mangroves will be stable.

The total area of direct habitat loss caused by the dike construction will be a small proportion of total important habitat area of the site. However, the main impacts that the new sea-dike will create on wildlife would be habitat change and fragmentation. The new sea-dike will:

- Cause the habitat loss, change and fragmentation due to the future new roads accompanied with the dykes. In addition, any planned and/or spontaneous new settlements associated with the dyke will also cause the direct habitat loss.
- Create up a barrier preventing the movement of the wild animal, especially the aquatic species (fish, shrimp, etc.) and also bird species.

When completed, the dyke will lead to expand the area of intensive aquacultural ponds and reduce the area of suitable habitat for a number of bird species such as saltpans, extensive aquacultural ponds etc.

For the first option, almost the important habitat area for shorebird population will be situated outside the dyke, only c. 800 ha of saltpans and extensive aquacultural ponds in the north-west of Ba Tri IBA will be enclosed inside the dyke. While for the second option, the dyke will enclose more 660 ha of one of most important habitats, that includes almost the extensive aquacultural ponds and mature mangrove plantations of the Ba Tri IBA.

In the long term, the sea dyke will pose a number of impacts to the wildlife populations of the Ba Tri IBA. Those impacts come from:

- Increased accessibility (roads and channels): The new dyke accompanied with new roads and dredged channels will give an open access to the most biodiversity sensitive areas, e.g. mangroves and tidal flats, for illegal activities.
- Create up new settlements close to the IBA: the new transport infrastructures developed and more land availability by the dyke will become an attraction for establishment of new settlements along the new roads. The new settlements will put a pressure on the IBA in term of habitat loss and fragmentation, disturbance to wildlife populations and illegal exploitation of natural resources.

For the second option, the sea dyke will go very close to the centre of the IBA, Hang Duong Island, and will cause direct effects to the high tide roosts in this island.

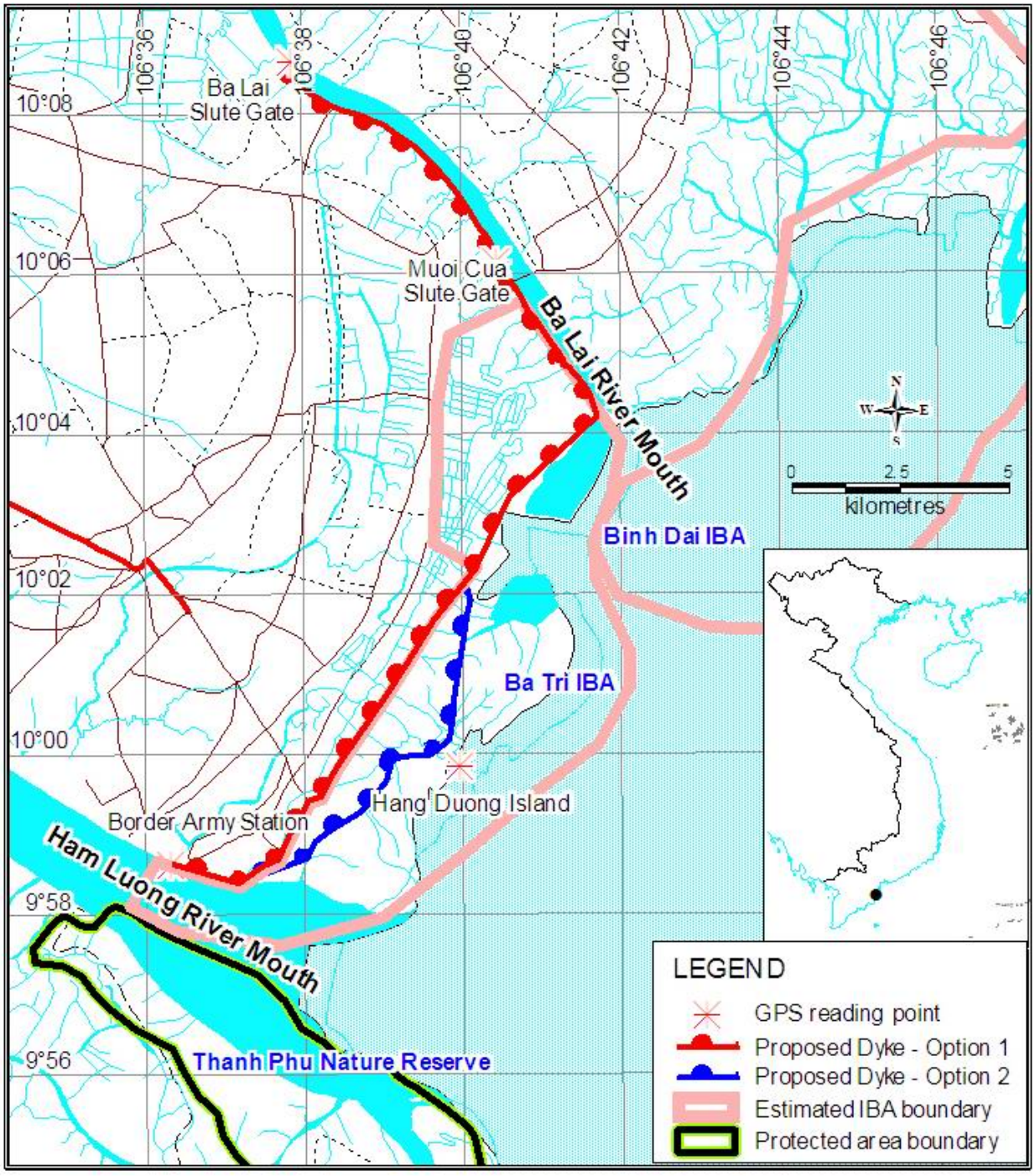

Figure 4-1. Map showing the location of Ba Tri and Binh Dai IBAs and Thanh Phu Nature Reserve

4.3.3. Impact on socio-economy

a. The project impacts on the population community health care

The natural disaster mitigation has much to do with the community health care and the quality of life. On the project completion worries will be overcome about affects of high tide and typhoon. The living houses will be kept clean and dry. No worries about the lack of clean water for human use for salt water will be prevented from getting into the artificial fresh water area and that fresh water will be supplied from Ba Lai reservoir. The clean water supply programs are being implemented by the competent authorities. The economic growth and the better quality of life will help the population to pay attention to the environmental protection and to hygienical conditions. This will improve the community health, maintain and develop the manpower for the project zone area.

Once the project is completed the negative impacts caused but nature will be restricted and alleviated. The increasing output of high quality aquatic products will help boost the region economic growth. This will generate the population boom and the services intended for fishing, industries and small industries. After all there will be widening demand for clean water while underground and surface waters are likely to be polluted and used up and that the rainwater is too insignificant. Therefore ther is an urgent need for the capital allocation to the clean water supply programs.

Possible transmission of infections diseases from workers to local population and versa
In the construction areas, communicable diseases such as water-born diseases (diarrhoea, dysentery, cholera, typhoid fever...), vector-born diseases (malaria..) are still common. In the conditions of low sanitary conditions and daily contract between local people and construction workers, infections diseases may be transmitted from workers to local people and vice versa. This phenomena was occurred in various construction sites in developing countries. Therefore, it is expected that transmission of infections diseases will occur in the construction sites if no effective measures will be adopted. This will affect health of workers and local peoples.

b. The economy

The artificial fresh water area will be stabilized thanks to clean water supplemented from Ba Lai reservoir via the sewers alongside with the Ba Lai River. Ba Lai reservoir has the possibility of supplying enough irrigation – water for 115,000ha of agricultual area since. Water in the reservoir was formerly used to supply for 80% of agricultural area and desalt. When the seadyke is built, the salt intrusion will be controlled. In addition, irrigation-work system will be dredged and completed so there will be enough freshwater for additional rice crops.

Saline intrusion , spring tide waters and drainage will be discharged through the sewers and the culverts attached to Sap, Rach Ra and Giong Qui bridges project alongside with the Ham Luong River .The flooded area alongside with District Road No 16 will be treated to the best by use of the drainage and sewage system on District Road No 16. Attention should be paid to the change in the production structure initiated by the population in this artificial fresh water supply region. This initiative results from the use of resources brought about by aquaculture for the salty flooded area.

In dry season from November to May, limited upstream water flow along with strong Northeastern monsoon results in sea water intrusion deep into interior field ($4^0/_{00}$ seawater line is 40-:-50 km away the estuary). Interior field lacks production and running water because culverts are closed to prevent seawater in this season. Due to the absence of supplemented water, stored water becomes unused and is intruded by alum. Canals without seawater prevention system are intruded by seawater. Therefore, there are a lot of difficulties in cultivation sector and domestic animal raising. Land is almost decertified. Some sand dunes are used to plant fruits on small scale thanks to taking advantage of well drainage water.

Land and water environment (in agricultural production area) is polluted due to the expansion of 6-8 month seawater intrusion period. Wells are dry, seawater intruded, and unable to exploit or use. Locals lack fresh running water (normally, in this season, local people have to carry or buy fresh water 60-:-70 km away from their place with grossly excessive price of 50.000VND/m^3-:-80.000VND/m^3).

Aquaculture farming area in project communes (from District road No 16 to the sea) which is directly affected by sea water during the year with grossly excessive salinity of more than $30^0/_{00}$ is inappropriate to raise prawns. Shrimp farming area can not be expanded due to the inactive regulation of salinity

The prawn farms and the salt fields will no longer totally depend on nature. It is easier to restrict and mitigate natural disaster. Damages will be alleviated thanks to the network of sea dykes and the rationally built sewers and culverts that prevent high tide. If the saline degree is too high in the dry season the sewers on District Road No 16 will be shut for prevention of saline intrusion and supply of water from the artificial fresh water zone for saline dilution. In case shrimps get shocked due to late harvest under hard rains, the salt water will be kept in canals for water treatment in ponds.

The water -level, the saline intrusion, the supply of fresh water and the drainage of dirty water in both salt and fresh water areas would be controlled by the coastal sewers and the culverts on District Road No 16.

In both cases : either the storage of sea water for the canals' appropriate saline concentration or the supply of fresh water originating from the artificial fresh water zone for the requested dilution require the closure of the coastal sewers for a period of time , that hinders the transport into and out of the project area.

The sea dykes top level designed at (+3.5 m) and the sewer gate level at +2.5 m) are criteria for designing the embankment height of shrimp ponds. Therefore if the tidal water level is likely to exceed the banks height of shrimp ponds due to typhoon it is compulsory to keep the water level by shutting all sewers. This will lay an impact on the sea transport.

There are not any more the threatening of natural disasters, so the fast increase of area and scale of farming is indispensable. The risks in production are limited that makes the people feel safe in production investment. The yield and economic values will quickly grow up, contributing to poverty alleviation, giving more jobs

The surface water will be alum contaminated as a result of oxydized alum leaking from the top ponds edges under ponds construction and canals renovation. This negatively affects the water quality for farming.

In order to avoid pollution for shrimps farm, the drainage of waste for the artificial fresh water area must depend on that of the shrimps farm.

The area of one-crop rice will be transferred into shrimp farming with combination with stable productivity – rice: 4 tons/ha, commercial shrimp: 0.7 – 1.0 ton/ha. With supplementary fresh water, the productivity of 2 rice crops is stably developed at average of: 7 tons/ha; 3 rice crops: 10 tons/ha; productivity of salt production: 60 tons/ha.

c. Transportation

After the sea dyke is completed, some new roads will be built that cause establishment of new settlements along the new roads.

The sea dykes, sewers and culverts, bridges, dams and on- dykes gravel paths will create a smooth network of land route communication for economic growth. This route will help swiftly rescue and relocate people into the inner area from the outer surroundings in case of emergency. This constitutes a border from which forest will be protected. This will be deemed as the ecological lungs of the region and a means for national defense.

What will restrict the water communication is the on and off sewers across the canals so the aperture of canals is smaller than the natural cross-section of canals. Even when they are opened the communication will still depend on their operations for agricultural production. The fact is that vessels of great tonnages and naval pile heights are not suitable to the current status of communication in the project area.

In the operation phase, boat traffic may be increased in the project area. The main reasons are:

- Increase of traffic density
- Increase of boat's velocity
- Traffic regulation is not strictly followed by drivers as well as local people
- Inadequate transport inspection by police.

d. Society

A considerable number of cultivated areas will be lost in the presence of the network of sea dykes, sewers and culverts, dams. Relocation will be obvious for a number of households. They will suffer damages resulting from this project. This considerable impact is an objective reality within the framework of this project. Serious measures must be taken to deal with their relocation, allocation of cultivated land for them, change of jobs, job training and support for them in all aspects.

The natural landscape in the area will be lost by constructing the project. The completed sea dyke and crossing dyke works will be ideal road and water transport system, which facilitates living conditions for local people to settle in this coastal areas, together with coastal national defense. Thanks to the sea dyke, protection and scruinization of coastal prevention forests are simple. It is also convenient to promote eco-tourism models from Provincial Road 885 to coastal protection forests, as well as oyster raising expansion in Bao Thuan, Tan Thuy, An Thuy coastline.

When structures come into operation, the number of local workers taking part in construction will have no jobs any more. Therefore, it requireds to arrange jobs for them to

avoid social evils due to unemployment.

When the project is completed, all socio-economic aspects will develop, attracting people in the vicinity to come to live and settle here. This will lead to the mix up in the area: loss of social security, population growth ... which is followed by many social evils and other diseases. There should be administrative management measures to control the population growth.

CHAPTER 5. **CONSIDERATION OF ALTERNATIVES**

Table 5-1.Summary of key impacts for three alternatives

Impacts	No project	Alternative 1	Alternative 2
Air quality	The communes in project area at present only concentrate in small scale industrial production, so air pollution is still very few, and mainly due to acid and saline vapor strongly evaporated in dry season.	Air quality at shrimp farming area will be polluted due to increasing the number of shrimp crops.	
Water quality	-Underground water is found in depth of 2 - 8 meters within the sandy dunes. This water which has wantonly been exploited, will dry up and be contaminated, especially it is the case in areas next to salt fields and shrimp ponds. The salt water is in high content of iron. - In the area outside District Road No 16 affected by high salinity in the dry season. The canals in the artificial fresh water areas are contaminated with light organic substances. The area which is affected by salinity due to the connection of river and canals with the sea and 2 big river mouths has very high density of water transport, the stations of the oil and grease, as well as ship and boat repair.....also cause oil and grease pollution.	- Since the proposed sea-dyke is inside the mainland (some points are 1500 -:- 2000m away seaside), sea water intrudes deeply into interior field. Ground and surface water will have high salinity. The development of farming pond and dredge of canal system on the alum soil will cause oxidization of alum soil on the surface of pond top edges. The alum will drop into the water and disqualify the water. A superfluous amount of shrimp meals together with their wastes pollute the water environment, which leads to growth of alga. The water becomes worse in the presence of rotten alga. - Openings of dyke culverts are not in	- Upon completion of the project the underground water quality will be worse so the population growth will cause full exploition of water wells; the development of the agriculture will cause the increasing use of pesticide, chemical fertilizer, etc. Negatively influenced will be mostly the underground wells in the areas close to shrimp farms; the polluted water will find their way into the wells together with microbiological and chemical substance. - The earth is not affected any more and is gradually stable, the acid layer is in latent form, in addition to that with the supplementation for fresh water source, the acidity and salinity of water are washed away frequently. However, the surface water pollution in shrimps farm due to epidemics or wastes will

		full use because they are selected in accordance with water transportation that result in the limitation of drainage.	have a negative impact on the artificial fresh water area. Pollution of this zone' s surface water is the result of the process of washing alum, salt, toxical elements stuck to earth, toxical substance from chemical fertilizer and insecticide. The surface water pollution also results from the increasing production brought about by the project in addition to the local backward practice and model of production, the failure of application of scientific progress, the use of chemical and insecticide products
Soil quality	The development of industrial farming model in aquaproduct will make the soil degraded quickly, the substances and wastes in the farming will pollute the soil heavily. The increasing cultivation leads to the soil degradation. Without irrigation works and structural measures, soil nutritive will be taken away to decrease cultivation productivity. The growing utilization of chemical fertilizers, pesticides contribute to polluting soil environment. The chemical elements which have been over stored in soil will tell on quality and productivity of crops. The permanently flooded soil also results in pollution.	The outside dyke area is quite large (1,302 ha) since soil of this area will completely be infected with salinity.	The soil in the project zone area is merely salted. This soil is improved by the project and make the productivity higher due to sufficient supply of water for salt washing, that meets the requirements for plant growing. Another kind is the sandy soil. Once there is sufficient supply of fresh water to this region the requirements for intensive vegetables cultivation will be met.
Biodiversity	- Terrestrial ecosystem consists of fresh water plants and vegetal. The rice growing area is likely to decrease and replaced by subsidiary crops and perennial trees (coconut palm, fruit tree) which tend to increase in cultivation area thanks to soaring prices. - Littorial ecosystem is not diversified. Main plants are mangrove, cypress, aegiceras, water coconut palm, *Kandelia candel, Avicennia marina* and other typical local plants. (detailed in **3.2**).	- Since the dyke is located inside the mainland (from Duong Khai canal to Provincial 885 and 1 -:- 1.5km away coastal flood prevention forests), the lost area of mangrove forest will not large. - For the first option, almost the important habitat area for shorebird population will be situated outside the	- Generally, impact of the dyke in terrestrial ecosystem and aquatic life in fresh water body is assessed as not significant provided that drainage system will be improved and dredged frequently and dredged material will be dumped properly. - Impacts of the new sea dyke will not be identical in areas along its two sides. Sea dyke will protect aquaculture area

	At present, this system degrades due to the expansion of area for shrimp farming and fish raising in the industrial and semi industrial farming models. The mangrove forest has been heavily exploited by local people. The reduction in the area of protection forest and the absence of safety zones of the farming center at the river bank will cause erosion, riverside slash by typhoon, flood tide, surge and cyclone. - Aquatic ecosystem is facing the serious decline which is impossible to recover due to the over fishing and exploitation by annihilation forms, particularly shrimp and fish species in rivers, canals and coastal region, because the people individually organize by themselves the near shore fishing due to without enough investment for offshore fishing. The use of finished chemicals for wild fish killing may lead to total extinction.	dyke, only c. 800 ha of saltpans and extensive aquacultural ponds in the north-west of Ba Tri IBA will be enclosed inside the dyke. While for the second option, the dyke will enclose more 660 ha of one of most important habitats, that includes almost the extensive aquacultural ponds and mature mangrove plantations of the Ba Tri IBA.	from negative impact of wave and saline water intrusion. Aquatic species in ponds will also be benefited from more fresh water in the project area since freshwater can dilute and reduce water's salinity which has been limiting factor of shrimp growth, especially in spring tide. Along seaward side of sea dyke, mangrove with its associated fauna and fauna in tidal flat will suffer from changes of volume and pattern of freshwater flow from land; i.e. less and regulated freshwater coming out from land. Less volume of freshwater from the land will carry fewer amounts of nutrient to mangroves, tidal flat and inshore water resulting in a decline of productivity of these three types of habitat. Some shore birds, which usually feed in tidal flat, might go further to the aquaculture area for feeding because of more food availability and might have more risks of being caught there. On the one hand, mangroves area along sea dyke will not be altered more into aquaculture pond as farmers tend to stay behind the dyke to have their pond protected so, to some extent, mangroves left in this area can have some better protection from cutting. On the other hand, there will also be further loss of mangrove due to erosion. - Aquatic species in inshore water, especially migratory species or those who need more

			than one habitat to complete their life cycles, will suffer from loss of habitat availability due to a fact that the dyke will partly block their migration way further in to land. Therefore, fishing mortality of seeds of those species will increase; as consequence, fishing production of inshore water will decrease while production from aquaculture will rise. Salinity's fluctuation in inshore water together with other changes of living environment due to the change of freshwater regime will influence aquatic life and community structure in a way that they favour tolerant species (e.g. euryhaline ones) and disadvantage less tolerant species (e.g. stenohaline ones). Those impacts can reduce very much in 5 years when newly planted mangroves will be stable.
Socio-economy	- The population growth rate of about 2 % will bring about 76,000 people in the project area until the year 2010 in the density of 500 persons per km^2. This density may increase due to the physical population growth. The population boom ceates a high pressure on management of the environment. - Along with the population boom and the being into existence of the services needed for fishing, industries and small industries, the need for running water is widening whereas the under ground water faces the danger of exhaustion and the surface water is seriously polluted. - Salinity and flood tide prevention and drainage remains unsettled for the area inside dyke road and district road No 16. The saline flooding area is mainly for aqua-culture and	According to this alternative, outside dyke area of aquaculture raising and salt production in Bao Thuan, Tan Thuy, An Thuy commune is quite large (it is necessary to protect the area of 1,302 ha out of 4,801 ha which is directly affected by natural disasters). Therefore, the objective of natural disaster prevention and mitigation for the project zone has not been completely fulfilled. According to the directions for socio-economic development and aquatic farming planning in Ba Tri	- Once the project is completed the negative impacts caused but nature will be restricted and alleviated. The increasing output of high quality aquatic products will help boost the region economic growth. This will generate the population boom and the services intended for fishing, industries and small industries. After all there will be widening demand for clean water while underground and surface waters are likely to be polluted and used up and that the rainwater is too insignificant. Therefore ther is an urgent need for the capital allocation to the clean water supply programs. - The prawn farms and the salt fields will no

	salt field, which still totally depend on the nature, without one's own initiative in natural disaster prevention and mitigation. Dry season is the main crop, but if salinity is too high and there is not fresh water to dilute to decrease the salinity or without appropriate technique, causing shock to shrimp, leading to not high productivity. In the second crop, that is spring tide, flood and typhoon make water overflow the bank of pond and culverts, leading to escape of shrimp ... which causes remarkable economic losses for villagers. Vegetables and subsidiary crop on the dunes are also in flood. Consequences are clear: erosion of organic substance, soil degradation, compulsory use of fertilizers and pesticides . Therefore, there should be structures for both salinity prevention and drainage for fresh as well as saline flooding areas.	(Ben Tre province) by 2010, total land area inside the project zone except Bao Thanh 650-ha salt production area (from District Road 16 to the sea) planned by Ministry of Agriculture and Rural Development will become specialized shrimp raising areas (industrial, semi-industrial, and newly extensive methods). Therefore, if building following this alternative – the section across Bao Thuan, Tan Thuy, An Thuy commune and deeply inside the mainland, the sea dyke will fail to meet the requirement of ensuring local people's aquatic raising within the project area in accordance with provincial planning directions.	longer totally depend on nature. It is easier to restrict and mitigate natural disaster. Damages will be alleviated thanks to the network of sea dykes and the rationally built sewers and culverts that prevent high tide. If the saline degree is too high in the dry season the sewers on District Road No 16 will be shut for prevention of saline intrusion and supply of water from the artificial fresh water zone for saline dilution. In case shrimps get shocked due to late harvest under hard rains, the salt water will be kept in canals for water treatment in ponds. The water -level, the saline intrusion, the supply of fresh water and the drainage of dirty water in both salt and fresh water areas would be controlled by the coastal sewers and the culverts on District Road No 16. There are not any more the threatening of natural disasters, so the fast increase of area and scale of farming is indispensable. The risks in production are limited that makes the people feel safe in production investment. The yield and economic values will quickly grow up, contributing to poverty alleviation, giving more jobs.

5.1. ENVIRONMENT IMPACT ASSESSMENT IN THE ABSENCE OF THE PROJECT

Forecast of environment impact assessment when project is not implemented is based on changes due to production activities following socio-economic development plan of province. The environmental issues of main concern are: air environment, water quality, land resources, and environmental problems caused by natural disasters

5.1.1. Natural Resources

5.1.1.1. Air resources

The communes in project area at present only concentrate in small scale industrial production, so air pollution is still very few, and mainly due to acid and saline vapor strongly evaporated in dry season due to the lack of irrigation water to retain acidity on the field, and the heat of sunshine that makes salinity evaporate**.**

5.1.1.2. Water resources

Underground water: Underground water is found in depth of 2 - 8 meters within the sandy dunes. This water which has wantonly been exploited, will dry up and be contaminated, especially it is the case in areas next to salt fields and shrimp ponds. The salt water is in high content of iron. It is not acceptable to use it for daily life but local people have no choice. Danger of diseases and epidemics caused to man and animals is high.

- Canal and river water:

In the area outside District Road No 16 affected by high salinity in the dry season, it is not effective to raise prawn at the salinity rate of 20 ‰. The sudden decrease in salinity will cause prawn to die. According to researches, prawn will die in case of salinity fluctuation of 5‰.

The canals in the artificial fresh water areas are contaminated with light organic substances. COD at above 9 – 11 mg/l , oxigen (DO) rather high at 6,1 – 6,2 mg/l is suitable to running water. (standard TCVN 5942-95).

The level of organic pollution is average depending on the two criteria: N- NO3- and total P. Organic pollution is high here except for the canals outside District Road No 16. where high content of nitrogen and phosphorus is reported . However these conditions are favorable for prawn raising and aquatic lives. (Natural meal for shimps and fish is abundant)

Oil and gasoline pollution: In the artificial freshwater areas, oil and gasoline pollution is not too high due to low waterway traffic (underground culverts restrict vessels and boats' traveling). However measures should be taken to intensify drainage, especially for flooded areas. The concentration of oil and gasoline wastes will be a danger.

Micro-bacteria pollution: The test results of T.Coli and F.Coli show that all the canals in the project areas have sign of pollution as results of the above two indicative micro-bacteria. This common phenomenon is due to the release of running water waste and other wastes by the people living on the canals. This water should be treated (purification) before use.

Plant protection chemicals: Local people have the habit to use these products for rice growing subsidiary crops and others . Some of these chemicals are strictly forbidden. It is the point of interest in the process of sustainable economic development and in the development of culverts to take into account the suitable chemicals for use.

Oil and grease pollution: in fresh area, because the culverts are built underground,

which limit the navigation of boats, leading to low water transport, thus oil and grease pollution does not surpass the allowed limit. Attention should be paid to hollow areas that have not drainage possibility, and accumulate oil and grease during operation process, affecting the environment for a long time. The area which is affected by salinity due to the connection of river and canals with the sea and 2 big river mouths has very high density of water transport, the stations of the oil and grease, as well as ship and boat repair.....also cause oil and grease pollution. Measurement shows that oil and grease content is 0,16-0,50mg/l, which cannot meet the criteria of water for living (category A), even cannot be used for aquaculture (surpass even category B – 0,4mg/l)

Plant protection chemicals: at present, people still have the habit of using plenty of fertilizers and plant protection chemicals, even some listed in prohibited ones, when cultivating rice, other crops and fruit trees. However, the pollution level is not yet high, but when building culverts supplying fresh water from fresh area to saline one in dry season, and draining for fresh area in flood season, there should be attention to reasonable period of chemical use.

Table 5-2. The results of water analyzing at Ba Lai river

No	Standard	Unit	Result	TCVN 5942-95 Level A	Estimation
1	pH		7.2	6 - 8.5	Standard
2	NO_3^-	mg/l	0.43	10	Standard
3	Fe	mg/l	0.47	1	Standard
4	Cu	mg/l	<0.01	0.1	Standard
5	Pb	mg/l	<0.01	0.05	Standard
6	BOD_5	mg/l	6	<4	Over fulfill norm
7	oil	mg/l	<0.01	No	No
8	SS	mg/l	20	20	Standard
9	Coliform	MPN/100ml	120.000	5000	Over 24 times

(Source: Report on present status of environment of Ben Tre province of 2003)

Table 5-3. The results of surface water analyzing in the project area

No	Standard	Unit	Result of Ba Lai river (12/1999)
1	T^o	^oC	29.5-34
2	Salt	‰	8-25
3	§é trong	cm	5-60
4	PH		6.9-8
5	HCO_3^-	mg/l	72.3-134
6	Ca^{2+}	mg/l	28-138
7	Mg^{2+}	mg/l	65.3-1133
8	Total Fe	mg/l	0.1-0.55
9	NH_4^+	mg/l	0.1-0.3
10	CO_2	mg/l	2.64-19.3
11	DO	mg/l	3.5-8.0
12	COD	mg/l	3.84-27

(Resouce: BaLai project)

Table 5-4. The results of water analyzing at canal (Tan Xuan - district - Ba Tri)

No	Standard	Unit	Result	TCVN 5942-95 Level A	Estimation
1	pH		7.2	6 - 8.5	Standard
2	NO_3^-	mg/l	0.36	10	Standard
3	Fe	mg/l	1.03	1	Standard
4	BOD_5	mg/l	5	<4	Over fulfill norm
5	SS	mg/l	56	10	Over 2,5 times
6	Coliform	MPN/100ml	93.000	5000	Over 18 times

Well water: all well water in sand stretches in project area is acid and saline. With very high content of Fe, turbidity, many algae and suspended substances, the water there is not suitable for general criteria of water supply. The water is heavily polluted, especially bacteria Coli at high level, so it can be only used for irrigation of other crop. Some drilling wells in saline flooding area have stable and rather high salinity, so they are used by shrimp farming households to add to ponds and swamps when their salinity decreases.

Results of analyzing well water at some points around project area (source EPC).

Water of shrimp ponds and swamps: Shrimp swamps often have salinity higher than the one of water source at about 20% due to evaporation of a part. The content of nourishing substances in the water is high through indices of total P and Nitrogen that are a little higher than water in canals. The wastes and decomposed products from shrimp, residue of fresh food, and wild fish biocides have had effects on water quality.

Table 5-5. Analysis results of quality of waste water from industrial shrimp farming pond in An Thuy, area of 50 ha of Ben Tre Forest and Aquatic Products Import and Export Company

No	Standard	Unit	Result	TCVN 5942-95 Level A	Estimation
1	pH		8.2	6 - 8.5	Standard
2	NO_3^-	mg/l	2.87	-	Standard
3	NH^+_4	mg/l	0.12	0.5	Standard
4	BOD_5	mg/l	155	<10	over 15.5 times
5	oil	mg/l	0.05	no	no
6	SS	mg/l	77.8	50	over 15.5 times
7	Coliform	MPN/100ml	134	1000	Standard

Table 5-6. Analysis results of water in shrimp ponds and swamps at some points around project area (source EPC)

Standard	Units	Results			
		I stage on 9/1996		II stage 1996	
PH		7.95	7.54	7.6	7.8
EC	µS/cm	21.200	15.300	16.800	23.100
T^0	^0C				
Salinity	‰	-	-	7.4	14.2

Standard	Units	Results			
		I stage on 9/1996		II stage 1996	
Turbudity	NTU	-	-	19	21
SS	mg/l	38	72	-	-
SO_4^{2-}	mg/l	100	10	600	600
$N\text{-}NO_3$	mg/l	<0.01	<0.01	-	-
Total P	mg/l	0.04	0.13	0.04	0.03
$N\text{-}NH_4$	mg/l				
Cl^-	mg/l	8467	6096	-	-
Cu	mg/l	0.12	0.24	-	-
DO	mg/l	4.8	5.1	5.31	-
COD	mg/l	16	16	-	55
T.Coliform	MNP/100ml	1500	24.000	930	-
F.Coliform	MNP/100ml	1500	24.000	430	-

5.1.1.3. Soil resources

The development of industrial farming model in aquaproduct will make the soil degraded quickly, the substances and wastes in the farming will pollute the soil heavily. This is one of the causes that lead to decrease of productivity and value of shrimp. The spontaneous development of farming area, without planning will decrease mangrove forest, breaking ecological balance.

The increasing cultivation leads to the soil degradation. Without irrigation works and structural measures, soil nutritive will be taken away to decrease cultivation productivity. The growing utilization of chemical fertilizers, pesticides contribute to polluting soil environment. The chemical elements which have been over stored in soil will tell on quality and productivity of crops, domestic animals and poultry as well as human health.

The growing aquatic farming, the best of which is the industrial prawn farming will degrade the soil quickly. The finished products used in the farming and wastes will be the main causes for serious pollution. This is one of the main reasons for reduction of shrimp productivity and values. Development of spontaneous prawn farming regardless of plan will narrow the salt flooded area and destroy the local ecosystem.

The reduction in the area of protection forest and the absence of safety zones of the farming center at the river bank will cause erosion, riverside slash by typhoon, flood tide, surge and cyclone. This danger is realistic. The permanently flooded soil also results in pollution.

5.1.2. Biodiversity

5.1.2.1. Geo-ecological system

The project area has the salt and fresh water geo-ecological system in which one is adjacent to another and one is separated from another by dyke road and District Road No 16. This system consists of fresh water plants and vegetal. The rice growing area is likely to decrease and replaced by subsidiary crops and perennial trees (coconut palm, fruit tree) which tend to increase in cultivation area thanks to soaring prices.

This salt geo-ecological system is not diversified. Main plants are mangrove, cypress, aegiceras, water coconut palm, *Kandelia candel, Avicennia marina* and other typical local plants.

Currently, the local authority have rearranged prawn farming sections by categories so as to avoid the adverse impact on the environment. More effective measures are to be taken to stabilize cultivation and the life of population. By so doing can deforestation be avoided in the protection forest area (Forest clearing prevention for prawn farming).

5.1.2.2. Aquatic ecosystem

In general, the decrease of geological ecosystem is similar to the one of aquatic ecosystem, added by the over fishing and exploitation by annihilation forms. Aquatic ecosystem is facing the extinction which is impossible to recover, particularly shrimp and fish species in rivers, canals and coastal region, because the people individually organize by themselves the near shore fishing due to without enough investment for offshore fishing.

The above said environment degradation and the uncontrollable catch has caused destruction of the aquatic ecosystem which will never be recovered. The use of finished chemicals for wild fish killing may lead to total extinction.

5.1.3. Social and economic issues

5.1.3.1. Rise in population

The population growth rate of about 2 % will bring about 76,000 people in the project area until the year 2010 in the density of 500 persons per km^2. This density may increase due to the physical population growth. The population boom ceates a high pressure on management of the environment.

5.1.3.2 Supply of running water

Along with the population boom and the being into existence of the services needed for fishing, industries and small industries, the need for running water is widening whereas the under ground water faces the danger of exhaustion and the surface water is seriously polluted. Therefore, it is a matter of urgency to supply the population with running water on other funded programs. This aims at taking care of the human resources' heath and providing the hand power to farming centers, fishing boats and other production /servicing units

5.1.3.3. Agricultural production

Salinity and flood tide prevention and drainage remains unsettled for the area inside dyke road and district road No 16. The saline flooding area is mainly for aqua-culture and salt field, which still totally depend on the nature, without one's own initiative in natural disaster prevention and mitigation. Dry season is the main crop, but if salinity is too high and there is not fresh water to dilute to decrease the salinity or without appropriate technique, causing shock to shrimp, leading to not high productivity. In the second crop, that is spring tide, flood and typhoon make water overflow the bank of pond and culverts, leading to escape of shrimp ... which causes remarkable economic losses for villagers.

Vegetables and subsidiary crop on the dunes are also in flood. Consequences are clear: erosion of organic substance, soil degradation, compulsory use of fertilizers and pesticides .

Therefore, there should be structures for both salinity prevention and drainage for fresh as well as saline flooding areas.

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5.2. ENVIRONMENTAL CONDITIONS WITH THE PROJECT IMPLEMENTATION

The impacts on the hydrology, air, noise, vibration, water quality, and biological ecosystem, socio-economic development of localities and daily living activities of the local people with the project implementation are reported in chapter 4.

5.2.1. Economic development

With the economic development potentials as mentioned in the above part of "Without Project", the economic development of Ba Tri district will be largely improved in case of "With Project".

The details in socio-economic development of these localities are notified in Chapter 4 (Section 4.3.3. Impact on Socio-Economy) along with other impacts on hydrology, air, noise, vibration, water quality, natural resources, bio-diversification as well as living activities of the local inhabitants in the area in condition of "With Project".

In case of not having project is considered as a control plan to define the investment effect of the scheme plan that have been proposed and selected. In case of not having project set upon the estimated hypothesis of the invested level, it develops under the natural trend combining with experience acquired from the past. The comprehensive analysis and evaluation is concentrated in some main issues as follows:

Agricultural production tends to increase in comparison to the present but not worth mentioning due to not overcome completely the restriction of the natural conditions, objective factors. it also depends entirely to the subject factors (qualification and ability to access scientific technology, the situation of using bread and varieties as well as chemicals and fertilizers).

In case of having project

- Profit of of the Project is defined on the basis of the estimated development of agriculture and aquaculture with the reference to the growth rate of the invested areas. These are the obtainable minimum conditions on the theoretical calculation.
- Productive development is implemented via the quality improvement of the soil and water so as to stabilize and increase the productivity and reduce investment cost due to the favorable watering that show in some following aspects:
- Changing entire area of one-crop rice field to prawn growing combining with rice cultivation: 4T/ha for rice, 0.7-1.0 ton/ha/year for prawn.
- Productivity of two-crop rice cultivation is 7 ton/ha on average
- Productivity of three-crop rice cultivation is 10 ton/ha on average

5.2.2. Alternatives of Ba Tri seadyke

5.2.2.1. Route alternatives

As reported in chapter 1, the feasibility study clarified that the project 2 is the better alternative. In order to choose the most rational project plan to construct the new expressway these alternatives will be considered hereafter.

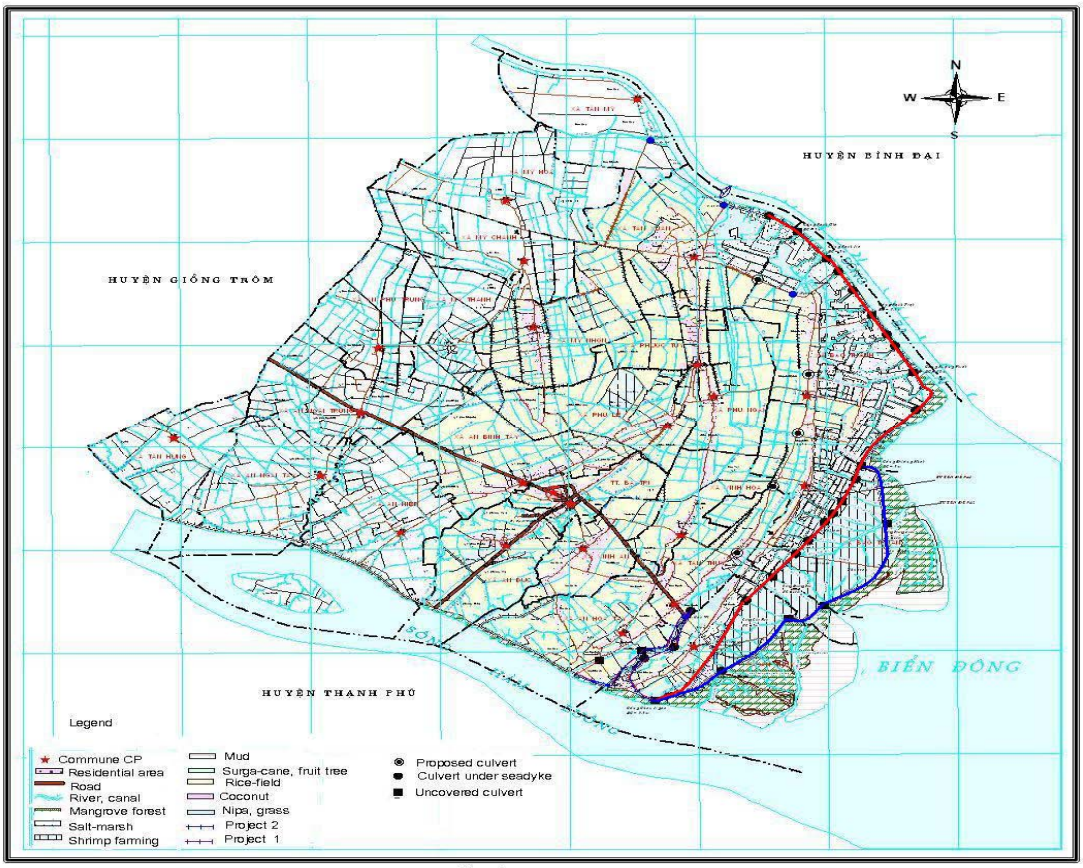

Figure 5-1. Route location of alternatives 1 and 2

- Alternative 1 is presented by the red line in figure 5.1 commencing from 10 doors culvert and finishing at Rach La irrigation works. This alternative is about 27.956 km in lengh.
- Alternative 2 is presented by the blue line in figure 5.1 commencing from 10 doors culvert and finishing at Rach La irrigation works. The length is about 31.581 km.

5.2.2.2. Salient features of each alternative

Good points: ***Alternative 1: (L = 27,100 km)*** - Length is shorter than that of Alternative 2 - The sea dyke is the existing national defense sea dyke and Provincial Road 885. Volume of the construction is smaller than that of Alternative 2. - Simple and swift implementation thanks to horizontal topography - Small compensated area - High stability of the construction - Small digging and embankment	***Alternative 2: (L = 31,581 km)*** - Defended area includes additional 1,302 ha of Bao Thuan, Tan Thuy, An Thuy as compared with the area of Alternative 1 - The completed sea dyke will be served as ideal waterway communication to serve + Resettlement to the coastal area to use the land for shrimps farming combined with security and national defense + Development of coastal ecological tourism + Favourable watching of protection forest - Once there is extension of the land towards the sea this projection still meets the set criteria - A number of culverts with selected aperture will meet the needs for waterway transport, water sewage and drainage - The best use of natural conditions for environmental improvement - It is not needed to build culverts at the openings of Duong Mieu, Duong Chua, Duonng Tiem, Cay Mam, Cay Bang. Only one culvert needs to be built at the beginning of Trang Nuoc canal - Concentrated culverts will enable their management and operation
Bad points: ***Alternative 1:*** - Once the project is in use as many as 1,320 ha of Bao Thuan, An Thuy will be left open to flood tide, Measures will be taken to cope with cyclone and flood tide - A number of culverts with selected openings will not fulfill the work of water drainage - Natural conditions are not fully use to improve the environment - Building culverts at the openings of Duong Mieu. Duong Chua, Duong Tiem, Cay Mam, Cay Bang. - Scattered small culverts will not help their operation in case of any mishap	***Alternative 2:*** - Ground area is larger than that of Alternative 1 - High volume of the construction will incur the costs higher that those of Alternative 1 - Much attention is paid to rational implementation measures -It takes more time for boats and vessels to wait before passing culverts

5.2.3. Environmental Conditions and Evaluation of Alternatives

5.2.3.1. Environmental conditions

The impacts on air, noise, vibration, water quality, natural resources, eco-system, bio-diversification are notified in details in Chapter 4.

5.2.3.2. Evaluation of Alternatives

The acquired profits in case of having project is synthetized in the following table.

Table 5-7. Acquired profits in case of having project

No.	Item	Annual profit (million VND)		Increased profit (million VND)	
		Alternative1	Alternative2	Alternative1	Alternative2
By the year 2010 (5 years)					
1.	Current production situation	233.79	290.38		
2.	Area expansion			24.65	21.80
By the year 2035 (25 years)					
1.	Stable production	365.07	405.41		
2.	Area expansion			6.68	10.99
Average profit during 30 years					
1.	Stable production	343.52	368.24		
2.	Area expansion			9.68	12.79

Effect of the resource works investment is calculated by 25% productivity between the cases of having project and not having project. Time for executing project is 4 years with the accumulate economic criteria of 25% per year.

Table 5-8. Effect of investment of alternatives

No	Cases	Annual profit (million VND)		Increased profit (million VND)	
		Alternative 1	Alternative 2	Alternative 1	Alternative 2
1	Without project	133.55	166.99	9.56	11.65
2	With project	343.52	368.24	9.68	12.79
3	Profit	209.97	219.25	0.12	1.14
4	Effect of investment	52.49	54.81	0.03	0.285

Volume of the construction of alternatives is presented in following tables:

Table 5-9. General quantity of embankment of the Alternative 1

No	Cases	Unit	Alternative1					
			measure 1a	measure 1b	measure 1c	measure 1d	measure 1e	measure 1f
11.	Soil for embankment	m^3	696.506	827.807	937.947	937.947	9.8.583	9.8.583
12.	Gravel	m^3	160.869	160.869	160.869	160.869	169.051	169.051
13.	Clay for covering	m^3		77.155				
14.	Sticky soil	m^2	246.44					30.862

			1					
15.	coco-nut carpet	m^2			139.091			
16.	coco-nut net	m^2				139.091		
17.	Ashiar carpet	m^2					126.000	75.600
18.	filter cloth	kg				139.091	183.682	86.799
19.	Pin ϕ 41 = 40 cm	m^2			22.032	22.032		
20.	Growing grass		481.961	336.461	336.461	336.461	336.461	412.661

Table 5-10. General quantity of embankment of the Alternative 2

No	Cases	Unit	Alternative 2					
			measure 1a	measure 1b	measure 1c	measure 1d	measure 1e	measure 1f
11.	Soil for embankment	m^3	696.506	827.807	937.947	937.947	9.8.583	9.8.583
12.	Gravel	m^3	160.869	160.869	160.869	160.869	169.051	169.051
13.	Clay	m^3		77.155				
14.	sticky soil	m^2	246.441					30.862
15.	coco-nut carpet	m^2			139.091			
16.	coco-nut net	m^2				139.091		
17.	Ashiar carpet	m^2					126.000	75.600
18.	filter cloth	kg				139.091	183.682	86.799
19.	Pin ϕ 41 = 40 cm	m^2			22.032	22.032		
20.	Growing grass		481.961	336.461	336.461	336.461	336.461	412.661

Table 5-11. General quantity of box-shaped culvert construction of the Alternatives

No	Items	Unit	Alternative	
			Alternative 1	Alternative 2
11.	Excavation of the work	M^3	191,970.4	116,364.8
12.	Backfil of the work	M^3	95,225.95	58,608.10
13.	Gravel	M^3	4,500	3,400
14.	Various reinforced concrete	M^3	5,718	3,656.26
15.	Ashiar carpet	M^2	8,307	5,791.16
16.	Stone case	M^2	998.4	712
17.	Geotechnics cloth	M^2	28,442.24	18,641.38
18.	Various stone	M^3	4,247.22	2,827.72
19.	Cajuput stake	M	419,545.65	255,410
• 10	Steel reinforcement	Kg	409,952.55	252,279.3

Table 5-12. General quantity of opening culvert construction of the Alternatives

No	Items	Unit	Alternative	
			Alternative 1	Alternative 1
11.	Excavation of the work	M^3	485,180.2	569,433.7
12.	Backfill of the work	M^3	236,839.74	261,433.77
13.	Gravel	M^3	9,090.8	9,931.6
14.	Various reinforced concrete	M^3	15,305.43	23,010.69
15.	Ashiar carpet	M^2	10,752	12,704
16.	Stone case	M^2	2,256	2,704
17.	Geotechnics cloth	M^2	45,801.22	63,557.98
18.	Various stone	M^3	5,153.37	7,232.01
19.	Cajuput stake	M	696,537	800,413.5
• 10	Steel reinforcement	Kg	1,137,562.19	1,763,610

Table 5-13. Total cost of alternatives

Alternatives	Total investment level (VND)			
		Construction	Other cost	Preventive
Alternative 1a	163.278.283.000	125.121.763.419	23.313.039.316	14.843.480.273
Alternative 1b	161.970.266.000	124.234.619.547	23.011.077.120	14.724.569.667
Alternative 1c	158.973.960.000	121.853.825.533	22.667.956.520	14.452.178.205
Alternative 1d	160.085.353.000	122.818.384.724	22.713.754.745	14.553.213.947
Alternative 1e	202.864.709.000	159.998.761.289	24.423.701.188	18.442.246.248
Alternative 1f	184.806.240.000	144.232.490.457	23.773.182.580	16.800.567.304
Alternative 2a	184.087.810.000	143.197.942.386	24.154.612.293	16.735.255.468
Alternative 2b	182.351.901.000	141.937.690.585	23.836.764.674	16.577.445.526
Alternative 2c	179.412.513.000	139.603.210.666	23.499.074.328	16.310.228.499
Alternative 2d	180.633.423.000	140.664.226.384	23.547.976.741	16.421.220.313
Alternative 2e	228.245.179.000	182.106.386.782	25.389.230.040	20.749.461.682
Alternative 2f	164.865.904.000	128.506.697.742	21.371.126.409	14.987.809.415

CHAPTER 6. MITIGATION MEASURES AND ENVIRONMENT MANAGEMENT PLAN

6.1. MITIGATION MEASURES

To minimize negative impacts of project on environment, at the same time create the adaptation with environment in the appearance of project, the mitigation measures are considered of primary importance. Mitigation measures will promote the positive aspects of project and minimize unexpected negative ones.

To attain the effectiveness of mitigation measures in all phases, the Construction Contractor should have a cadre specialized in environment to supervise and guide the integration of mitigation measures in all process of construction. At the same time, there should be also the activities of dissemination, education and raising awareness for workers in environment protection.

Table 6-1. The summary of mitigation measures

The construction phase

a. Air quality:

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Do not operate the machines concomitantly - The material transportation vehicles should have canvas to cover tightly. - Make material wet to a certain limit so that dust will not be whirled up and scattered during transportation. - Near the construction areas, there are waterspouts to make materials wet in dry season (making wet once a day), and material should be covered at the gathering places. - Use the vehicles follow the criteria in gas emission, noise, vibration and indices of transport safety according to Decree 175/ND-CP dated 28 October 1994 on detailed regulations on the emission standard of transport means. - Equipping protection hat, clothes, muffler and ear protection against noise. - Arranging tanks to collect and burying wastes (once a week) following TCVN 6696/2000 or TCXDVN 261/2001. The location of waste pits should be in the end of wind direction, at least 300m from the sheds and 500m from water sources. The best way is to choose the burying place with water impermeable structure. If this place is easy for water infiltration, it is necessary to compact the pit bottom by hand compactors to create the steadiness and use shovel to hit on its sides to close the porous holes, preventing the leakage of waste water, or use technical fabric or polymer to cover the bottom. On the top of pit, there must be a technical fabric cover to	PMU, DARD of Ben Tre, The Contractor, Ba Tri Commune People's committee, Environmental Supervisor,	- Observation 03 months/01 time at 06 communes; (detailed in Table 6.10)	Detailed in Table 6.10

avoid rainwater coming into the pit and leakage of waste gas that cause pollution. Around it there should be grass to create beautiful landscape.			

b. Water quality:

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Arranging sensible time to construct culverts (eg. a half of amount of culverts to be constructed in the dry season and the other culverts in the wet season). Ensuring aperture of culverts (Bc = 7.5 - 10m) to drain off water in time. - Arranging tanks to collect wastes and burying following the TCVN 6696/2000 or TCXDVN 261/2001. - Building high bank to enclose the breeding ponds but shorter than proposed dyke height (3.5m). - Dredging the current drainage system to drain off waste water rapidly. - Carrying out salinity monitoring frequently to open the door of Ba Lai culvert when salinity exceeding the standard applied for aquicultural area (10 - 15‰).	PMU, The Contractor, DARD of Ben Tre province, Aquaculture Department of Ba Tri Commune, Environmental Supervisor	Observation 03 months/01 time at 06 communes; (detailed in Table 6.10)	Detailed in Table 6.10

c. Soil quality:

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Collecting and burying wastes following the regulation. Concentrating equipments, machines at the location with hard floor, avoiding assemblage of so many equipments, vehicles of heavy loads, etc at a place that can destroy the soil structure. - Replanting tree after moving equipments, machines.	PMU, The Contractor, DARD of Ben Tre province, Aquaculture Department of Ba Tri Commune, Environmental Supervisor	- Observation of soil quality 03 months/01 time at 06 communes; (detailed in Table 6.10) Observation oferosion and landslide once a month at land exploiting and culvert building places.	Detailed in Table 6.10

d. Biodiversity

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Shorten the construction duration. Most intensive period should be designed to avoid the wintering season (September to April). - Agreement with the construction company on the forest protection. The Company have to prove their source of timber and fuel (no fuel wood collection in the construction area). Increase control by District FPD, strictly fine to any violation. - Awareness arising for the decision-makers and the company's workers on wildlife protection.	PMU, The Contractor, PC of Ba Tri Commune, Ba Tri District FPD	Mid-term Evaluations to assess the level of this impact.	Detailed in Table 6.10

e. Socio-economy:

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Arranging suitable time to construct culverts (eg. a half of amount of culverts to be constructed in the dry season and the other culverts in the wet season). - Always reserve salt water in the water supply system for ponds (the system is still existing). - Carrying out salinity monitoring frequently to open the door of Ba Lai culvert for diluting salinity. - Work closely with local authorities to employ local labour force, create	PMU, The Contractor, PC of Ba Tri Commune.	- Monitoring of socio-economy 03 times/ 01year at 6 communes; - Monitoring of health, labour of constructing workers and local people 02	Detailed in Table 6.10

new jobs and reduce the pressure to resources due to concentration of too many workers from other areas. - Improve health service for initial health care of workers as well as for local people, especially in emergency case. - Coordination and cooperation the Contractor with local government and security force to check frequently the quantity and native village of worker (checking once a month) .		times during construction phase when beginning and finishing this phase.	

The operation phase

a. Water quality:

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Managing closely the supply sources of pesticides, products used in aquatic farming (checking once a month). - Periodic monitoring water quality. - Ensure operation regime of culverts crossing the dyke(taking and keeping salt water, draining off waste water) and crossing HL 16 (supplying fresh water for external area and draining off waste water for interior area). - Once upstream water flowing down largely, the culverts crossing HL16 should be closed. - Periodic dredging the arroyos system (once two months). - Improve irrigation system and add several canals to drain off quickly in the rainy season. It is advisable to encourage farmers to apply some following methods: ***) Biological method***	PMU, The Contractor, DARD of Ben Tre province, Water Reource Work Investment Unit of Ben Tre province, Irrigation Department of Ba Tri Commune,	Observation 06 months/01 time at 06 communes; (detailed in Table 6.10)	Detailed in Table 6.10

The waste water from pawn raising pond is discharged through each pond Culvert. This withdrawn water then comes into the waste treatment pond via canal system. Finally, the water after treated will be disposed via irrigation canal system. The cycle for dismissing waste water is a of 10 days ***) The biological chemical method*** This method can be used at the end of harvest gathering period due to the limited storage capcity of the waste water storage system. By this way, water is eliminated not only once but 4 times. Waste water is stored within 24 hours before being dismissed. During a waste water storage period, it is advisable to use $Al_2(So_4)_3$ or $Fe_2(So_4)$ with concentration of (1- 5 g / m_3) waste water. It is also better to use $CaOCl_2$ with concentration of 500 - 800mg/m^3 for waste water effective treatmemt ***) Some suggested temporal methods*** - In case of serious epidemics, it is prohibited to release water into canals. It is reccommended to treat pond by pond. The ultilization of $CaOCl_2$ with concentration of (20 – 30 mg/ l) will be the best choice. Also, some above-mentioned chemicals of the appropriate doses could be used for water treatment before the disposal of water into canals	Environmental Supervisor		

b. Biodiversity

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Increase control by District FPD. Awareness and environmental education activities for the local communities on wildlife protection. If possible, establish some kind of community-based protected area at the IBA	PC of Ba Tri Commune, Ba Tri District FPD		Detailed in Table 6.10

b. Socio-economy

Mitigation measure	Agency to implement	Monitoring and frequency	Cost
- Compensation for people damage be followed regulation. - Arranging jobs for local workers. - In fact, leaving about 20% natural arroyos, canals open so that ships can run through in emergency case. - Propose moving the open culvert from Rach Gia canal to Rach Giong Trom because of hight traffic density.	PMU, The Contractor, PC of Ba Tri Commune.		Detailed in Table 6.10

Preventing the breakdown

Phenomenon	Mitigation measure	Agency to implement	Monitoring and frequency	Cost
Water overflowing	To prevent and repair this breakdown, the height of farming ponds should be enough to prevent the average max tide level, the pond bank should be designed with 1,5-1,75m in height to avoid bank collapse due to wind wave. Use net surrounding the pond during rainy season, to avoid losses and prevent insects getting into the pond. When the pond is not yet repaired, it is prohibited to take water from canal into the pond, and water in pond should be drained out entirely. After treatment to prevent diseases and water quality observations show that it	PMU, PC of Ba Tri district, PC of 6 communes, Aquiculture Department of Ba Tri.	- Observation 03 months/01time in the dry season (November to April) and 02 months/01time in the rainy season (May to October).	

	meets the standards, it is possible to charge water into the pond.			
Over increasing or decreasing of salinity	In dry season, there are periods with long sunny and hot spells, when strong evaporation makes salinity in the pond increase over the limit permissible for the development of shrimp, leading to the death of some shrimps or their massive death. Pay attention to daily weather forecast to have plan of storing saline water with low salinity in canals, or choose appropriate time to open fresh water culverts. The big aquaculture areas should reserve suitable area for fresh water pond, preventing this breakdown. In rainy season, salinity often decreases suddenly, leading to shocking and killing shrimp. So, it is necessary to have preventive measures such as storing of asaline water (salinity 100‰) or extracting underground water wells with low and stable salinity into shrimp pond to dilute the solution up to suiable salinity .	PMU, PC of Ba Tri district, PC of 6 communes, Aquiculture Department of Ba Tri.		
Subsidence, fissure on the body of dyke	Setting up maintenance work. Reporting to higher level and carry out the consolidating, supplementary embankment measures for dyke.	PMU, DARD of Ben Tre province, Irrigating Work Construction and Exploitation Company of Ben Tre province (the contractor), PC of Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay communes.	Monitoring once a week at 2 heads of bridges and concrete building component.	Annual cost of NDM Project
Sea water level is	Immediate report to higher level and release emergency buoy.	PMU, DARD of Ben Tre province, Irrigating Work	Monitoring water level daily at	

higher than the height of culvert door.		Construction and Exploitation Company of Ben Tre province (the contractor), PC of Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay communes.	culvert doors	

6.1.1. Measures to reduce the project's negative impacts during the pre-construction phase

a. Policy and compensation unit price

- Organizing the work of inventory for compensation and premises clearance

It is time consuming, complicated and painstaking works for inventory, compensation and premise clearance, mostly in sea dike sites. This task must conform to the current stipulations in combination of works for defining boundaries, the use of land, purpose of use, households land classification community considerations and agreement with the affected households.

For that reason, it is neccessary to set up a compensation and clearance settlement committee or a joint committee in charge of many constructions in the same provincial area. This committee consists of the following key elements:

- Provincial People's Committee and branches concerned;
- District People's Committee;
- Commune People's Committee.

- Policy and principles

The work of inventory, compensation, retrieval and premise clearance must meet the targets as follows:

- Assurance of project plan
- Objectively making accurate and adequate inventory of houses. Making definition and assessment of land and land type, and fruit gardens on the local guidance law and on the basis of agreement between the committee and the affected households
- Compensating the people rationally and adequately .Allocating the people with the dwelling places, cultivated land to stabilize their lives within the neighboring areas of their old areas so that their lives will not be disturbed.

- Unit price for compensation: this done on the basis of the following documents:
  - The Government's Decree 87/CP dated July 18th 1004 regarding price structure of various lands.
  - The Government's Decree 22/1998/CP regarding State's compensation for damages of deprived land for security, national defence and in the public interests
  - Circular 145/1998/TT-BTC of Ministry of Finance guiding the application of the Government's Decree 22/1998/ND-CP.
  - Decree 185/QD-UB dated February 10th 1998 of People's Committee of Ben Tre Province regarding issuance of price list for various lands

Table 6-2. Unit price for compensation

Type of land	Land class	Unit price (VND/m2)
Agricultural land for annual plant growing	1	7,500
Aquaculture land		7,500
Land for salt making	1	5,000
Annual forest land	1	2,000
Rural dwelling land		20,000

Table 6-3. Unit price for structure compensation

Type of house	Unit (VND)	Unit price (VND)
Thatched house, outhouse, wooden house	m2	50,000
Main house: wooden frame, thatched or iron roof, wooden partition, thatched, ground floor	m2	100,000
Main house: wooden frame, tiled roof, wooden partition, thatched, ground floor	pcs	120,000
Graves	pcs	2,000,000

Table 6-4. Compensation rate for relocation

Form of relocation	Unit	Unit price (VND)
Within the area of province (for less 50m^2 houses)	VND	2,000,000
Within the area of province (for above 50m^2 houses)	VND	3,000,000

The estimated cost is about 14,141,518,000 Vietnamdong.

b. Plan of relocation and resettlement

- Plan of non-resettlement

Once Ba Tri Sea Dike Project is accomplished, apart from the positive impacts to the natural disasters mitigation and prevention, the project will lay negative impacts on the population livehood as a result of relocation and land deprivation. According to the field topographical survey documents conducted in the line area of selected cross works since most routes from An Thuy to Tan Xuan are close to the seashore the local people are not steadily settled but only settled on crops of aquaculture and salt making seasons. Their houses are mainly makeshift thatched ones (scattered in the project line) designed for watching aquacultural pond or lagoon. These households own houses in Bao Thuan and Bao Thanh dunes. There are other residents coming from the district or provincial communes for shrimp hatching. Most houses are located in Tiem Tom area.

Therefore, upon compensation of houses, tenure land, production land and financial support for relocation, the hit residents can agree with the local people as well as the local authorities for the new
resettlement close to their residences to facilitate their livelihood .

Regarding cultivated land, besides possible re-selling to the local households it is possible to revert that land fund for sale to the stand-by land fund (5 percent of the commune's natural area land fund within project zone).

The fact is that the local people are accustomed to living in scattered areas atttached to the fields to earn their living and unfamiliar with concentrated settlement center. Moreover the households affected in the area are not of great in number (in average 12

households per commune). Thus, it's not necessary to build concentrated resettlement areas.

As matter of fact, following the experience of Binh Dai Sea Dike Project (completed and put in use in 2002) by which the above resettlement method was applied and won unanimous approval of the locals . At present, the resettlement of project has been implemented. Lesson from the project's success may be applicable to the remaining sea dike projects in Ba Tri and Thanh Phu districts.

- Plan of resettlement

The plan of non-resettlement is simple but complicated in terms of social security assurance in the absence of the local authorities support to sort out the problem of residences and cultivated land for households affected.

The plan of resettlement is to relocate inhabitants on spot by providing concentration grounds in the area. Every household is supplied with a landarea of 100m2 and allowances for relocation and settlement . This plan in fact is not suitable to their living and working practices of the households affected. There may be possibilities that some households will be unable to repractice their jobs and susceptible to unemployment. For that reason, it's most appropriate measure to provide people to reorganize their own lives with legal support from the local authorities.

Let the selection of plan for either compensation and resettlement or non- resettlement follow the willing of affected households.

6.1.2. Measures to reduce the project's negative impacts during the construction phase

a. Technical solution

According to option 2, the sea dyke will be built with technical specifications including:

- The whole sea dyke is embanked by ground (excavated in the inner part of the dyke, 10m away from dike foot). The section of the dyke (about 1,000m away from the fishing port) is embanked with the ground from elsewhere.
- To protect against sea dyke slope erosion cohesive soil is used to cover the slope d=40-60cm and grass cover is implanted.
- From K12+500 – K20+000 the dyke goes across the sandy area. The dyke slope will be treated as follows: The dyke is covered with red grave of 20cm thickness and 4m width. The dyke slope side is covered with grass; the seaside dyke slope is reforested over 20m from dyke foot with 150-300m width to protect the dyke and enhance the ecology in project area.
- The dike culverts are made of reinforced – concrete with stainless steel valve, automatic two way valves according to Vietnam construction standard TCXDVN 285-2002, with the IV and III grade construction for the box culverts and open culverts, respectively.
- Traffic bridges on dyke road are built by reinforced – concrete with P=8tons, 4.0m in designed width (3.5m in used width), 3 spans.

b. Measures to reduce air pollution

To reduce the impacts in the construction phase need implmenting the following measures:

- Choosing the proper time to construct (concerning time and weather);
- Arrange colleting tanks and bury waste. The location of waste pits should be in the end of wind direction, at least 300m from the sheds and 500m from water souses. The best

way is to choose the burying place with structure difficult for water to permeate. IF this place is easy for water to it is necessary to compact the pit bottom by hand compactors to create the steadiness and use shovel to hit on its sides to close the porous holes, preventing the leakage of waste water, or use technical fabric or polymer to cover the bottom. On the top of pit, there must be a technical fabric cover to avoid rainwater coming into the pit and leakage of waste gas that cause pollution. Around it there should be grass to create beautiful landscape.

- The project Management unit (PMU) and contractor should establish a team to do regular environment supervision and punish those who violate the regulation. The above-mentioned measures are applied to mitigate the pollution from workers' activities. About the pollution caused by operation of equipment and machines at the construction site, there should be following measures;

The above measures are applied for reducing pollution from the activities of works. For the pollution from the activities of equipments, constructing machines need be applied following measures:

- Select the machines which guarantee technical specification, especially waste gas indices. There should be regular inspection, maintenance and monitoring the situation of machines. Comply with regulations on inspection of communication means. Guarantee that the machines and equipments meet the criteria in gas emission, noise, vibration and indices of transport safety according to Decree 175/ND-CP dated 28 Octobers 1994 on detailed regulations about the emission standard of transport means.
- Ministry of transport (MOT) and Ministry of Natural Resources and Environment (MONRE) have promulgated the regulation on vehicles. The units taking part in construction are required to use construction machines that meet Vietnam Criteria on gas emission.
- Make material wet enough so that dust, especially sand, will not be whirled up and scattered during transportation.
- Near the construction areas, there arrange waterspouts to make materials wet in dry season, and materials should be covered at the gathering places.
- Alternating construction of each portion of seadyke case by case to limit smoke and dust, waste and noise.
- Establishing buffer zones between construction sites and living areas. For that trees must be maintained in the buffer zone. This will only minimize noise; purify the air but also rehabilitate the biological environment for the construction sites.

c. Measures to reduce the noise and vibrantion

For locations of concrete mixing and construction, it is necessary to:

- Guarantee the loading down of materials is carried out in day time; the mixing and pumping are done in working time or far from inhabitant area, especially the pile driving.
- Replace equipment that causes vibration with hammer in inhabitant area.
- Select equipment causing smallest noise and vibration.
- Create green belt, which also decrease noise and vibration.
- Only use heavy equipment in day time, don't use them at night and there should be notification in advance for people.
- Equip the workers who are affected by equipment with ear protection against noise.

d. Measures to reduce water pollution

- The ground of concrete mixing points must be built on a sand platform to guarantee all escaping water is separated from underground water of the area.

- Protect the vulnerable land by coverage of bush trees and grass to avoid erosion that cause pollution.
- Gather thoroughly grease and oil to avoid spilling that course pollution.
- Always maintain the fastest drainage system during construction of Ba Tri sea dyke by dredging the current drainge system.
- Dredge and improvethe canal system in the project area; extend the present canals supplying freshwater.
- The freshwater culverts are built late so taking freshwater will not be effected. Contruct the culverts crossing the seadyke will belong to the time when local people replaces water.
- Store a necessary amount of salt water in the spare ponds to replace the water in shrimp farming ponds when it comes to due period, avoiding stagnation of water in ponds that pollutes surface water
- Strictly monitoring the implementation and environment of each construction in case of partial implementation ; spontaneously reporting unfavorable environmental developments with a view to finding out timely appropriate solutions.
- The box dike and open culverts must be contructed on the right size which is proposed in technical design.
- The other canals that is still open should be built the box culverts according to natural aperture of these canals.
- Establishing a network for monitoring the quality of the surface and underground water within and without the project area in order to evaluate pollution resulting from construction and operation. Monitoring the water sewage and drainage as well as the water quality within the project area.

e. Measures to reduce the soil and sedimend pollution

Arrange the tanks to collect and bury following regulation.

- There should be a common waste canal meeting standards to avoid not only land pollution but also water source pollution.
- To collect material at those locations with hard floors, avoid assemblage of too many equipment, machines and vehicles of heavy loads at a place that can destroy the earth structure.
- Protect surface layer by planting of grass and trees.

f. Measures to reduce the impacts on bio-diversity and biological resource

- To plant and restore mangroves wherever technical and natural conditions for mangrove plantation are met. Total area (not including perished newly planted mangroves) of mangrove plantation should be at least as equal as area of mangroves lost due to construction and operation of the new dyke. Details of the plantation budget were mentioned in the part of pre-construction impact assessment. However, to ensure the success of plantation and restoration as well as high survival rate and good development of newly planted mangroves, preliminary study and collection of secondary information about species composition of mangroves, history of ecological progess in the project area should be conducted then Decree of which species of mangroves should be planted and where to plant can be made.
- To apply good aquaculture practices (GAP) in aquaculture farms to help prevent environmental degradation and environmental and ecological impacts to the surrounding areas. Training courses for farmers on GAP introduction and application should be orgarnised in coopeartion with local extension center. Raising awareness for farmers on risks of

environmental pollution from farming ponds and on higher value of aquaculture products produced from farms where GAP is applied should also be conducted.

- To improve irrigation and drainage system including frequent dredge to optimize benefits of the new dyke to project area. In other words, the existing irriagtion and drainage systems have been designed merely for rice farming should be improved to serve better for aquaculture and should be dreged more frequently to avoid accumulation of sediment.
- To have good management of wastes and sewage and wise dumping strategy, i.e. waste and sewage should not be loaded into limited number of sites to avoid environmental and ecological problems to the mangroves and adjacent sea water.
- To let freshwater flow to sea through Duong Tac canal to help prevent mangrove from more erosion of the tidal flat at the mouth of this canal.
- To monitor pattern of soil erosion and accretion to have appropriate interventions.

Shorten the construction duration. Most intensive period should be designed to avoid the wintering season (September to April).

- Agreement with the construction company on the forest protection. The Company have to prove their source of timber and fuel (no fuel wood collection in the construction area). Increase control by District FPD, strictly fine to any violation.
- Awareness arising for the decision-makers and the company's workers on wildlife protection.

g. Measures to reduce landslide and erosion

- Limit the clearance of vegetation, replant and quickly restore vegetation at the place where it has been cleared. Plant trees at the exposed earth and slopes to mitigate collapse and stabilize slopes.
- An important factor which limits erosion, collapse and decreases sedimentation in water source is the controlling of discharge, location and speed of water.

h. Measures to reduce the impacts on socio-economy

- Unexpected social impacts can appear during construction such as conflicts, constructions between local people and construction workers, especially the youth, or local people appropriate working facilities, materials and technical equipment of construction units. Therefore, there should be close cooperation with local authority, awareness raising for the people support project implementation. To educate people about objectives of project and possible changes of water and soil quality.
- Work closely with local authorities to employ local labour force thus creating new jobs for the region. In this sense the local workfoce will be improved
- The Principal Contractor should be responsible for all workers of different levels can participate in fundamental training courses on profession safety relevant to their responsibility.
- Define some options for local healthcare service agency, those who are responsible for community health protection, to deploy campaigns to construction workers on health, sanitary in general and prevention of HIV/AIDS in particular
- Provide with preliminary medical care and equipments for workers which is also useful to local people in case of emergency.
- Some services as providing food and other necessary goods may be carried out for for constructing process. Howver, enclosing with the service types is social evils such as theft, harlotry, drugs, etc so there should be the combination of with local goverment and security force to solve.
- Equipping labour safety equipments for workers. To take care of hygiene of food and of labour.

6.1.3. The mitigation measures in operation phase

In the operation phase, there are sill the impacts that are not clear but highly dangerous level. Since must apply many mitigation measures to ensure that the project will be effective:

- Check and take over all the items of the constructions and get them on trial before operation in order to minimize breakdowns. Great attention is paid to verification of the process of raming down the body of dyke; strengthening dyke's revetment; covering red gravel on dyke surface.... Check carefully all the possible changes such as crack, landslide, leak… in order to find out solutions in time.
- Restore the primitive environmental status if possible by planting trees (glass growing on dyke's revetments and on free space at the dyke feet) for their protection.
- Set up a reasonable procedure of operation of the overall system to get better effectiveness, frequently check the operation

Obey the regulation on changing the work regime of the culverts. In everycase of changing the work regime of the culverts, only operate the valve of sluices when the water level at downstream is stable.

a. Measures to reduce the impacts on the air quality

- Propagandizing, educating for means owners to alway maintain vehicles.
- Checking periodically the traffic means, rejecting deteriorated vehicles.
- Limiting heavy trucks, lorries join the traffic during the rush-hour. Defining the permissible load of vehicles (≤8tons) running on dyke. This is the method enhancing life-span of the dyke.

b. Measures to reduce the noise and vibrantion

- Installing the speed regulation post, forbidding hoorter sounding from 22h to 5h next morning.
- Building the wall for the noise protection and having buffer zone to reduce the impact of noise on the sensitive areas such as schools, hospitals, historical relics, hotels, etc.

c. Measures to reduce the impacts on water quality

- Applyingthe industrial, semi industrial, intensive farming at ponds after new method that uses the water cycling with little water change, with water treatment pond sedimentation pond, waste treatment pond so as to limit the direct discharge of water to the farming ponds and from ponds to rivers to prevent water pollution.
- Managing strictly the pesticides, pollutions from aquatic farming industry production and others so that all waste waters should be treated into the natural environment.
- Strictly managing the insecticides, pesticides, products used in aquaculture as well as their distribution system. To guide the use mentioned chemicals and list of prohobited chemicals. Regular checking all these activities to reduce negative impacts.
- Setting up plans for monitoring and minimizing the negative impacts on water quality inside and outside the project area resulted from the increasing use of pesticide and fertilizers.
- Researching operation process and supervising the implementation. Ensuring water resource in the area is always cleaned out and the water quality is better.
- The shrimp raising areas might cause cause water pollution. It is advisable to encourage farmers to apply some methods to control pollution. The suggested methods are as follows:

) Biological method

The waste water from pawn raising pond is discharged through each pond Culvert. This eliminated water then comes into the waste treatment pond via canal system. Finally, the

water after treated will be disposed via irrigation canal system. The cycle for dismissing waste water is a period of 10 days

) The biological chemical method

This method can be used at the end of harvest gathering period due to the limited storage capcity of the waste water storage system. By this way, water is eliminated not once only but 4 times. Waste water is stored within 24 hours before being dismissed. During a waste water storage period, it is advisable to use $Al_2 (So_4)_3$ or $Fe_2 (So_4)$ with concentration of (1- 5 g / m_3) waste water. It is also better to use $CaOCl_2$ with concentration of 500 - 800mg/m^3 for waste water effective treatmemt

) Some suggested temporal methods

In case of serious epidemics, it is prohibited to release water into canals. It is reccommended to treat pond by pond. The ultilization of $CaOCl_2$ with concentration of (20 – 30 mg/ l) will be the best choice. Also, some above- mentioned chemicals of the appropriate doses could be used for water treatment before the disposal of water into canals

- Investing appropriately for the infrastructure of the farming areas and managing the environment with technical requirements in pond side, secondary treating pond; pond treating sewage, mud; drain and canal level I, II, III. Monitoring periodically BOD, COD, NH3-N, NO2-N; monitoring daily pH, DO, t^o, turbidity, etc. Check daily pond border, canal, etc to discover and treat timely the damage and leakage, etc.

d. Measures to reduce the impacts on Bio-diversity

- Increase control by District FPD. Awareness and environmental education activities for the local communities on wildlife protection.

If possible, establish some kind of community-based protected area at the IBA

To ensure the long term conservation of the Ba Tri IBA, it is necessary to designate the site as a protected area, either at the national or provincial level. The best option would be a nature reserve consists of Ba Tri and Binh Dai IBAs. However, in the short term, establishment of a community-based conservation unit for the site would be more feasible. To do so, the following actions were recommended:

1. Hold a series of meetings with local community representatives to discuss the management of the site.
2. Create a management board or other body, containing members of the local community, with responsibility for environment management at the site.
3. Conduct further surveys to exactly identify the key areas for wildlife conservation in the coastal zone of Ba Tri Disttrict, and to better understand the threats to the wildlife populations of the site.
4. Raise awareness among all stakeholders of the biodiversity and socio-economic values of the site, and generate a sense of responsibility for the conservation of the site among the local community.
5. By means of provincial, district or commune-level regulations, combined with training and appropriate incentives, empower the local community to prevent the illegal activities in the IBA.
6. Introduce measures to ensure that aquacultural ponds are developed and managed sustainably, to prevent further die-back of mangrove.
7. Establish a monitoring programme for key bird species, involving local people.
8. In the long term, consider the options for designating the site as a protected area, either at the national or local level.

e. Measures to reduce the impacts on socio-economy

- Organizing and implementing the plan of loan and deposit money for local people to help them restore their production.
- Training career and arranging reasonable works for local workers to stabilize their life, social security quickly.
- Supporting the wholesome development of travelling services, hotels, restaurants,etc
- Promoting agricultural encouragement services; giving farmers technologies and methods to prevent and get rid of destructive insects during the time of planting (practicing IPM) as well as to ensure the safety for farmers. The application of IPM technique will help decrease the use of the amount of pesticide by 20 to 30 percents. This reduction is nealy equivalent to the additional use of pesticide because of the extention of cultivation area and new plants growing. Therefore, if the project is made a success, it is possible to reduce the project‘s negative effects.
- Planning the wharves to facility for daily activities of local people. Planning and managing closely the berthages, reparing workshop, petrol supplying stations, etc.
- The internal infrastructure will be invested with reasonable and more economical scale due to the smaller design frequencies such as the height of the orks, the boder, the background of civil work,etc.

6.2. Environment management plan

The objectives of environment protection of project are specified on the basis of following requirements:

- Comply with commitments on environment protection which have been signed
- Management of project to maintain technical parameters suitable for requirement on environment, health safety as well as requirements on finance, production and commerce of project
- Prevent pollution and maintain environment improvement
- Continue to search for the best technological solutions to gain high effects in environment protection and finance

The environment management program will ensure to:

- Provide information related to organization, regulations, and guidance, which are required to implement the environment protection and improvement
- Establish and execute a program of environment control and monitoring and waste auditory to secure a suitable environment control plan
- Comply with all the laws, which can be applied to create firm basis during negotiation with the environment management agencies and the partners

6.2.1. The Vietnam legal and administrative framework for environment management

The framework of environment management of Viet Nam is still being developed with new policies put forward every year. This part introduces environment policies of Viet Nam

Law on Environment protection (LEP) was promulgated in 1993. LEP includes:

- Specify responsibilities of the central and provincial governments, organizations and individuals on the prevention and repair of damages and pollution to environment and execution responsible functions of environment protection
- Support to build environment criteria and submit reports on environment impact assessment of new and existing foundations

- Support responsible sides in payment of compensation for environment damages
- Establish the rights of individuals and organization to have recommendations on the implementation of regulation on environment
- Require the civil and criminal punishment to the violations; and
- Promote international cooperation in environment

Decree 175/CP promulgated in 1994 on guidelines to implement Law of Environment Protection and designation of responsibility of environment protection between Ministries, environment impact assessment; prevention against pollution and natural disaster control; financial sources; inspection and determination of environment standards.

Circular Letter No 490 promulgated in 1998, guidelines on making and validating EIA of investment project. The letter specifies the requirement on laws following phases of project implementation and classification of project; determinates project content for EIA; and points out the management and approval of EIA

To supplement the above mentioned main policies, a series of Decree, regulations and standards to can be considered:

Decree 24/2000/ND - CP stipulates the implementation of Law on Foreign Investment in Viet Nam (Art. 82) concerning environment protection as follows: 1) enterprises which have Foreign Investment capital and joint venture companies must comply with regulations and criteria on environment protection, and Vietnam laws on environment protection; 2) if the investors apply the international advanced environment criteria, they have to register these criteria to MONRE.

Decree No 5/1997/QH10 specifies projects of national importance which the National Assembly approves and issues Decrees (Clause 2, Art.2) such as " Projects causing potential big or serious impacts on environment". For these projects, one of the contents submitted to the National Assembly for approval and issuance of Decree for investment is "the fundamental problems which need to be silved during project implementation: environment protection, move the population/resettlement...."

Decree 52/1999/ND-CP stipulates the environmental considerations in the management of construction as follows: 1) For PFS, clause 3 of AFT.23 stipulates the requirements on environment research concerning " selection of construction location and projection of required area of land use on the basis of minimizing the land use and impacts in environment, society and resettlement". 2) Clause 2 and 7 of Art.24 stipulate that FS should propose "options of specific locations (or areas of locations, routes) suitable for construction planning (including documents on location selection, in which there is proposal options, solutions on management and protection of environment". 30 For technical designs: Clause 1.b of Art. 37 and clause 2.a of Art.38, include regulations on validation and approval of "techniques to protect environment and ecology; prevention of fire and explosion, labor safety and industrial sanitary".

Decree 26/1996/CP stipulations on administrative violation punishment under LEP. Chapter 1 describes general provisions on punishment to those who violate the law against environment pollution

Viet nam Standard are national standards established by MONRE and applied to all government agencies, include all criteria in technique, construction, sciences and environment. Environment criteria include the limits of indices which are acceptable in air, noise and water quality. In general, the list of biological indices is enough for all observation programs that can use Viet Nam Standards as measures to assess. There are some exceptions

– the most important criteria for Ba Tri project such as sedimentation, soil and vibration are not available. Almost all Viet Nam standards are direct translation from ISO standards.

6.2.2. Administrative framework for environment management

Ministry of Natural Resources and Environment (MONRE) was established according to Decree of the Prime Minister dated 11/11/2002. This new Ministry has 4 Vice Ministers and 16 Departments. MONRE has just established some new department from some national agencies. Decree 91/2002/ND – CP stipulates functions, tasks, rights and organization structure of MONRE.

Department for Validation and Assessment on Environment Impacts. This Department belongs to MONRE. Following Decree 91/2002/ND-CP, the functions of Department include: validate EIAs of projects, production foundations and business centers, promulgate environment criteria; and unified management of the issuance and confiscation of permit to certify environment criteria following the laws. This Department will be regulated by the framework of laws of Viet Nam

Department of science, technology and environment (DOSTE). The environment management Department (EMD) of DOSTE of every province is responsible for management and protection of environment at this province following LEP, Decree 175 and Circular letter 490. Decree to reorganize DOSTE can be issued in 2003, after there is the Decree to restructure MONE at central level. It is expected that although EMD belongs to which agency, its function of environment protection will not be affected. Therefore, EDM can be still the principal member to successfully realize the observation and conduct project.

6.2.3. Agencies responsible for EIA

The agencies responsible for successful implementation of plan of environment responsible management of Ba Tri sea dyke include: NDM PPU – responsible for management of all the implementation of NDM and will have cadres for Agencies responsible protection

DARD of Ben Tre province, Ben Tre enterprise for Water resources survey and Design and PMU of subproject Ba Tri sea dyke – designate cadres responsible for implementation of day activities of Subproject. They will inspect the construction quality and implementation of EMP of subproject.

MONRE and DONRE of Ben Tre – will be responsible for all of consideration and approval following the national of law framework on environment responsible management and protection.

Other agencies of Ben Tre province (Ben Tre Departments of Fisheries, Forestry, etc) will have important responsibilities such as implementation of specific components to guarantee that the protection will be well executed and supply additional and secondary data to help implementing EMP Ba Tri

Contractor on environment protection – operates as general contractor to investigate and collect basic data for preparation and submission of EIA, observations report and inspection of the compliance. He will be also responsible for conducting some mitigation measures specifically in subproject of Ba Tri sea dyke

Environment consultants – include International environment consultants seconded from a national environment management agency.

6.2.4. Requirements of EMP report

Table 5.4 summarizes requirements of report to subject of Ba Tri sea dyke and responsibilities on regime for preparation of report. All annual reports are apart of V management plan of sub-project of Ba Tri sea dyke will include.

To evaluate clearly whether present EMP framework is enough; and to evaluate the success of mitigation activities (in case of observing the operation process of subproject) or evaluate actual impacts of the implementation of subproject Ba tri sea dyke, in comparison with predictions in EIA (in case of observing environment impacts)

If the conclusion is EMP framework is not enough explain the reasons why not enough and give detailed recommendations on re – design of EMP framework, reconsideration of the collected data and information, data analysis, report and budget estimation

Table 6-5. Requirements of EMP report of subproject Ba Tri sea dyke

Report	Preparation responsibility	Time	Agency to consider and approve
Regular reports in the framework of EMP implementation			
Annual report on EMP of coastal aquaculture	Select provincial agency responsible for EMP for coastal aquaculture	Implementation EMP every year for coastal aquaculture	PMU of subproject Ba Tri, NDM PPV, MARD, MONRE, Ben Tre DONRE, Ben Tre Department of Fisheries
Annual report on reforestation in project forest of Ba Tri coastal area	FPD of Ba Tri district is supported by DARD Ben Tre	Every year of reforestation program	PMU of subproject Ba Tri,
Report on progress of implementing mitigation in subproject Ba Tri sea dyke	Contractor of environment protection is supported by Environment consultants	Monthly	PMU of subproject Ba Tri
Report on observation of implementing mitigation in subproject Ba Tri sea dyke	Contractor of environment protection is supported by Environment consultants in the first 3 years, and by PMU of subproject Ba Tri during its implementation	Every year of construction phase	PMU of subproject Ba Tri,NDM PPV, MARD, MONRE, Ben Tre DONRE
Report on progress of observation of environment impacts of subproject Ba Tri	Contractor of environment protection is supported by	6 months	PMU of subproject Ba Tri,NDM PPV, MARD, MONRE, Ben Tre DONRE

sea dyke	Environment consultants		
Report on environment of subproject Ba Tri sea dyke, collecting results from EMP of Subproject Ba Tri sea dyke (mitigation, observation of environment impacts) in an independent report	Environment consultants are supported by Contractor environment protection in the first 3 years, and the Contractor ofenvironment Environment protection supports in the remaining phase of project implementation	Every year starts before construction in phase I	PMU of subproject Ba Tri, NDM PPV, MARD, MONRE, Ben Tre DONRE
Required phase report			
Technical design of Environment management plan of subproject Ba Tri sea dyke has been reconsidered.	Environment Consultants supported by Environment consultants and PMU of subproject Ba Tri depending on the nature of the required re- design during its implementation	Require the changes of EMP every time needed	PMU of subproject Ba Tri, NDM PPV, MARD, MONRE, Ben Tre DONRE

6.3. Actual environment Management Plan

6.3.1. Program observing the implementation of environment mitigation

The program observing the compliance with environment mitigation is designed to determinate whether measures of environment mitigation for subproject (Table 5.2) are best carried out and their effects have the tendency of preventing, limiting or correcting the negative environment impacts. If the observation of compliance with mitigation shows that the mitigation measures are not effective or are not carried out effectively, the responsible organizations must have corresponding adjustment actions.

Table 6-6. Observation Program of environment mitigation implementation

Preconstruction phase

Mitigation of resettlement and land appropriation	
Carrying out observation	• RAP of Subproject Ba Tri is responsible for detail implementation, observation, expenses and requirements of observation
Responsibility to carry out observation	

Estimated total budget	

Construction phase

Impact mitigation through construction contracts : digging earth for dyke embankment ; ground levelling of construction site, making foundation hole of culvert, building culvert through dyke; driving pile, building brige over-belt road ; disturbing the community by construction activities	
Carrying out observation acvtivities	• Inspect construction contractors in construction activities and report on the forms and conditions of environment which they comply in their contracts • Summary report will be prepared for each inspection of construction contractor (about 10 times of inspections/ month). Will be summarized in monthly summary report submitted to PMU of Subproject Ba Tri Sea-dyke • Report on inspection of carrying out Subproject Ba Tri Sea-dyke 2 times/year, prepare summary report on carrying out construction contract in previous 6 months and submit to SIU Subproject Ba Tri Sea-dyke. • All reports of the month and 6 months on inspection of Subproject Ba Tri Sea-dyke will be also submitted to NDM-PPU • All results of annual compulsory environment observation will be assembled into annual report on environment observation of Subproject Ba Tri Sea-dyke • Design the form of report and procedure of inspection will be fullfil in Preconstruction phase (Phase of technical design)
Responsibility to carry out observation	• The appropriate Contractor of environment protection will commit to carry out inspecting the environment compliance of construction locations, and prepare report on mitigation due to implementing of the above-mentioned observation. The observation experts will carry out with technical inspecting staff of SIU of Subproject Ba Tri Sea-dyke to train them on inspection of construction environment through the job. The Environment Consultants will help to design the form of report and inspection procedures in Preconstruction Phase (Detail Design).
Total estimated budget	See Table 6.10. for details
Mitigation of the loss of protection forest in the sea coast of Ba Tri due to dyke construction	
Carrying out observation activities	• DARD Ben Tre and FPD Ba Tri prepare annual report on progress to carry out reforestation activities in protection forest in the sea coast of Ba Tri and submit to SIU of Subproject Ba Tri Sea-dyke and PPU NDM for consideration and approval
Responsibility to carry out observation	
Total estimated budget	• Budget is in the implementation of NDM

Operation phase

Mitigation owing to application of increasing pesticides and fertilizers due to extension and intensive farming in agriculture	
Carrying out observation activities	• Annual Report on carrying out IPM which DARD Ben Tre supply to cho SIU of Subproject Ba Tri Sea-dyke • SIU of Subproject Ba Tri Sea-dyke will be responsible for consideration and approval of progress reports and final completion report of program IPM for irrigation area of Subproject Ba Tri
Responsibility to carry out observation	
Total estimated budget	• Budget is in the implementation of NDM
Mitigation of impacts of extending aquaculture in Ba Tri coastal area	
Carrying out observation activities	• Report on progress of carrying out environment management plan for aquaculture in coastal area of Ba Tri district prepared by implementation agency and submitted to SIU of Subproject Ba Tri Sea-dyke and PPU NDM, Ben Tre DOFi for consideration and approval
Responsibility to carry out observation	
Total estimated budget	Budget is in the implementation of NDM

6.3.2. Environment Impact observation program

Establish environment monitoring plan with the aim to mitigate negative impacts and promote at maximum the positive ones. Since then, propose suitable solutions to overcome adverse effects on environment. The environment monitoring program includes:

- Inspecting the construction process of contractors
- Monitoring of water quality
- Monitoring of soil quality and the use of chemical fertilizers
- Monitoring of sedimentation and erosion
- Monitoring of aquatic ecosystem and water-born diseases
- Monitoring of public health
- Monitoring of population growth, settlement of agriculture and residential area, changes of land use
- Monitoring of the compliance in aquaculture
- Monitoring of raising public awareness on environment protection

Program of environment observation will be carried out by the investor to monitor the environmental elements which have been predicted during execution of construction as well as in operation. From environment observation during construction and operation, there will be assessment of pollution level and detection of environment elements over the allowed limits. This will allow the investor and contractors to adjust or limit the impacts of construction and operation activities on natural and social environments.

The contents of environment observation include:

- Observation of air quality (03 months/01 time during construction and 06 months/ 01 time during operation at 6 communes)
- Observation of water quality (03 months/01 time during construction and 06 months/ 01 time during operation at 6 communes)
- Observation of noise, vibration (03 months/01 time during construction and 06 months/ 01 time during operation at 6 communes)

- Monitoring of the progress and the carrying out of measures mitigating pollution of water and air quality, noise and vibration during construction of Sea-dyke

- Observation of the changes of ecosystem and biological resources (02 times during construction and 01 time during operation at 6 communes)

- Observation of erosion and landslide, danger of inundation (02 times during construction and 01 time during operation at locations with danger of erosion, landslide and inundation along the dyke through 6 communes).

- Monitoring of socio-economy ((02 times during construction and 01 time during operation at the affected area of subproject).

- Monitoring of health, labor safety of construction cadres and workers (06 months/01time during construction).

Every year, Department of Natural Resources and Environment of Ben Tre province will make report on the results of environment monitoring to submit to the government environment management agencies at central and local levels to assess objectively the impacts of project on environment during construction and operation.

Table 6-7. Summary of environment management plan of Subproject Ba Tri Sea-dyke

Observation of environment impacts on water quality in terms of sedimentation, erosion due to Subproject activities and application of fertilizers and pesticides because of agricultural extension and extensive farming	
Observation objectives	• Increase of the network monitoring quality of surface and underground water, assessment of quality of water from the source, quality and reserve of water from discharging area, the capability of washing and exchange of water volume in the field, quality of water from intensive farming area. • Monitoring the quality of water from the wells that supply the water for living in rural area • Monitoring the quality of water reserved in fresh-making area in different growth periods of plant and at fresh water supply gates on district road 16 through shrimp farming area • Monitoring of water quality in farming ponds in some sensitive locations • Define which impacts of extension and intensive farming of agricultural land use and production of goods on the potential of surface and ground water in Subproject: - Meet the criteria of surrounding surface and ground water - Meet the criteria of irrigation water - Meet the criteria of water for drinking and living
The measured environment indices	•For surrounding surface and ground water; the following indices need be measured: pH, electric conductivity (EC), total suspended solid (TSS), BOD_5, COD, Fe, Al, nitrate-nitrite (NO_{2-3}), phosphate (PO_4-P), DO, Total pesticides and weed clearing chemicals • For criteria of water irrigation, the following surface water indices should be measured: Na, Mg, Ca (it is possible to calculate the sodium absorbing ratio [SAR]), fecal coliform (pH, TSS, Al, and DO will be used to assess the impacts of Subproject on surface water capacity to meet the criteria of irrigation water)

	• The following environment indices, as collected above, will be used to assess the impacts of Subproject on quality of water for drinking and living: pH, electric conductivity (EC), total suspended solid (TSS), BOD_5, COD, Fe, Al, nitrate-nitrite (NO_{2-3}), phosphate (PO_4-P), DO, fecal coliform
Sampling location, the first phase	– • The sampling of surface water quality will be made at 12 locations (all stations are arranged in space so that they can be put into map for space analysis of water quality results): specifically after culvert of Ba Lai dam, Ba Hien canal in the East of Ham Luong (fish port area), the mouths of canal Trang Nuoc, Tac canal, and Khem canal toward the sea • The sampling of underground water quality will be made at 12 locations in communes lying in affected area
Sampling location, the second phase	• The sampling of surface water quality will be made at 12 locations (all stations are arranged in space so that they can be put into map for space analysis of water quality results) The sampling of underground water will be made at 12 locations
Sampling time, phase 1 and 2	• For surface water quality: Preconstruction (for each phase of investment, establish database before Subproject): observation 3 times each year in each location (once in rainy season and twice in dry season) Construction phase : 3 times each year in each location (once in rainy season and twice in dry season) Operation phase : 3 times each year in each location (once in rainy season and twice in dry season) • For underground water quality: Preconstruction (for each phase of investment, establishing database before Subproject): observation 1 time each year in each location (dry season) Construction phase : 1 time each year in each location (dry season) Operation phase: 1 time each year in each location (dry season) • For residue of plant protecting chemicals, for both surface and underground water quality, observation 1 time each year, in the highest point of dry season (April) in each of 3 investment phases
The required supplementary data and information	Update the information timely and exactly in: Construction and operation phases of Subproject, Land use every year or following season and goods production in irrigation area; Meteorological data from hydro-meteorological stations; Information on underground water from Hydrology and Geology Agency
Requirements of report	– For the first 3 years of Subproject implementation, Environment Consultants, with the support of Environment Protection Contractor, will prepare annual report of Environment Management Plan of Subproject Ba Tri Sea-dyke. After that, Environment Protection Contractor will be responsible for making report. Environment Protection Contractor will has to prepare the report on progress of observation 6 months/time.
	- It is required to guarantee that the observed pesticides and weed clearing chemicals are representative in Subproject - The regime of sampling for phase 2 should be considered in the phase of detail

	design (preconstruction) of phase 2. - 15% budget should be invested for QA/QC; It is required to comply with Circular Letter on QA/QC of MoNRE on environment observation.
Environment Management Plan (EMP) in the process of sedimentation and erosion	
Objectives	- The process of system operation can cause local erosion or collapse, especially the operation of culvert system below the Sea-dyke, therefore, it is necessary to monitor to guarantee that the structure system operate well and safely - Monitoring of the changes of channel downstream of culverts under the dyke and district road 16, the sedimentation and erosion at the bank of Ham Luong River, Ba Lai River, sea coast and big canals in the fresh-making area and shrimp farming that are the decisive factors for periodical dredge. - Carefully consider the erosion and collapse of river bank, and sea coast outside the protection forest, particularly the scarcely or thin one and there should be plan for restoration, reinforcement or moving the dyke to inland
The required supplementary data and information	- Update information timely and exactly every year for Subproject on: Land use and goods production Building and operating of Subproject
Implementing responsibility	Environment Protection Contractor (EPC) will commit (select CQ as recommended) to carry out this component of Program on Environment Impact Observation. The detailed reference provisions for Contractor will be prepared by Environment Consultants (ECs) in the Phase of Detail Design. ECs will supervise and guide the EPC in the first 3 years of implementation.
Requirements of report	For the first 3 years of Subproject implementation, ECs assist EPC to make annual report on EMP to Subproject Ba Tri Sea-dyke. Then, EPC will be responsible for the report. EPC will be required to prepare report on observation progress 6 months/time.
– **Environment Management Plan for soil quality and production**	
Objectives	• Monitoring of soil environment changes, the situation of degradation, changes of acid soil environment….including the stations and work of observation on the residue of pesticides and substances for shrimp farming in cultivated land and farming ponds • Monitoring of the increasing use of pesticides, fertilizers and substances for aquaculture so that there will be recommendations about the use • Monitoring of water supply and drainage to guarantee that good supply and drainage will create conditions for better soil quality, monitoring of the drainage capability for long-standing flooded areas of fresh-made region. If the requirements are not met, there should be recommendations for treatment • Monitoring of sedimentation of wastes due to aquaculture in the ponds, assess the level of impacts, components of pollutants of wastes at the pond bottoms. Then propose the time and measures of treatment before release into environment
The measured environment indices	• pH, particle, SO_4^{2-}, PO_4^{3-}, EC, Fe^{3+}, Al^{3+}, insecticides, microelement
Sampling	• 12 places (6 ones inside the dyke, 6 ones outside the dyke) at 6 communes

location, the first phase	
Sampling location, the second phase	• 6 places at 6 communes
Implementing responsibility	• EPC will commit (to select CQ as recommended) to carry out this component of Program on Environment Impact Observation. The detailed reference provisions for Contractor will be prepared by Environment Consultants (ECs) in the Phase of Detail Design. ECs will supervise and guide the EPC in the first 3 years of implementation.
Requirements of report	• For the first 3 years of Subproject implementation, ECs assist EPC to make annual report on EMP to Subproject Ba Tri Sea-dyke. Then, EPC will be responsible for the report. EPC will be required to prepare report on observation progress 6 months/time.
Environment Management Plan during construction of the Contractor	
Objectives	- Monitoring of waste disposal in compliance with stipulated location, the leaking water from landfills will not affect the surrounding water environment - Monitoring the discard of soil from acid environment, there should be the embankment around the area to prevent waste water spreading all system, the embankment will direct waste water toward one way and draining into appropriate location - Monitoring the returning of construction execution ground to restore landscape - Monitoring of smoke, dust, noise, labor safety and domestic waste - Monitoring of waste from construction equipment and safety of water transport
The required supplementary data and information	Update information timely and exactly every year for Subproject on: - Land use and goods production - Building and operating of Subproject
Implementing responsibility	• EPC will commit (to select CQ as recommended) to carry out this component of Program on Environment Impact Observation. The detailed reference provisions for Contractor will be prepared by Environment Consultants (ECs) in the Phase of Detail Design. ECs will supervise and guide the EPC in the first 3 years of implementation.
Requirements of report	• For the first 3 years of Subproject implementation, ECs assist EPC to make annual report on EMP to Subproject Ba Tri Sea-dyke. Then, EPC will be responsible for the report. EPC will be required to prepare report on observation progress 6 months/time.
Environment Management Plan for aquatic ecosystem	
Objectives	The building system of dyke, culverts and dam for projected area may create conditions for stagnation of water in some local areas, which can make the aquatic ecosystem change. In this environment, algae will strongly develop, leading to blocking water source, decreasing of DO in water that makes stagnation water dangerous for aquatic animals and human.
The required supplementary data and	Update information timely and exactly every year for Subproject on: - Building and operating of Subproject - Frequent monitoring of waste volume discharged into drainage sewer

information	
Implementing responsibility	• EPC will commit (to select CQ as recommended) to carry out this component of Program on Environment Impact Observation. The detailed reference provisions for Contractor will be prepared by Environment Consultants (ECs) in the Phase of Detail Design. ECs will supervise and guide the EPC in the first 3 years of implementation.
Requirements of report	• For the first 3 years of Subproject implementation, ECs assist EPC to make annual report on EMP to Subproject Ba Tri Sea-dyke. Then, EPC will be responsible for the report. EPC will be required to prepare report on observation progress 6 months/time.

6.3.3. Plan for prevention and repair of breakdowns

This plan aims at preventing and repairing environmental unexpected breakdowns due to rainfall, flood, wind and typhoon, which cause collapse of the banks of river, canal, farming pond, make salinity increase or decrease too much, leakage, salinity intrusion into fresh area and diseases,.... seriously affecting ecological environment, people's life and production in the area.

Table 6-8. Summary on prevention and repair of breakdowns

No.	Prevention	Cause	Repair measures
1	Prevention and repair of overflowing	Breakdown of culverts through dyke	The farming ponds have banks higher than lín max water level
2	Prevention against the spread of shrimp diseases	Disease germ from shrimp breed	- Close the pond culvert, do not discharge water, report to responsible agencies for consideration and treatment - Exterminate by chemicals - Monitoring water quality of pond, limit over nutrition - Measure for checking and monitoring the schedule of closing and opening of culvert gate Ba Lai - Store fresh or saline water to change salinity
3	Prevention against toxic algae	Appear in shrimp farming pool	
4	Prevention against salinity fluctuation	- Tide (rainy season, dry season) - Operation of culvert Ba Lai	

6.3.3.1. Repair and prevention of water overflowing

Spring tide or flood, typhoon landing in this area will make water overflow the banks, leading to the loss of shrimp, or spreading of waste and waste water into river and canals. To prevent and repair this breakdown, the height of farming ponds should be enough to prevent the average max tide level, the pond slope should be designed with m = 1,5-1,75 to avoid bank collapse due to wind wave. Use net surrounding the pond during rainy season, to avoid losses and prevent insects get into the pond. When the pond is not yet repaired, it is impossible to take water from canal into the pond, and water in pond should be drained out

entirely. After treatment to prevent diseases and observation shows that water quality meets the criteria, it is possible to charge water into the pond.

6.3.3.2. Repair and prevention of the spreading of diseases

When discover diseases in the pond or in canal, immediately close culvert gates that supply water in the pond, absolutely do not continue to change water, report to responsible agencies for consideration and treatment, and avoid the spreading of diseases.

- Use Clorin of high dose (concentration of 30ppm), maintain in 7 days
- Fish out the shrimp to incinerate
- Clean, sterilize tools, feet and hands before contact with other ponds. Sterilize polluted water before discard

When diseases happen on large scale, there should be additional prevention measures as follows:

- Close culverts on Sea-dyke, totally isolate with outside environment
- Fish out all the dead shrimps, bury with lime or incinerate them. Thoroughly discard weak shrimps, limit birds or other livestock to eat sick shrimp
- Mix medicines in food, and give shrimp 10 days/time under the form of pill food such as Furazon: 0,25 g/kg food; oxy tetracylin: 1,8g/kg food.

6.3.3.3. Repair and prevention of the burst of toxic algae

Frequent monitor quality of waste water from shrimp farming pond and limit overnutrition of water source to prevent the development of toxic algae. Monitor, detect and timely eliminate their appearance and spreading.

6.3.3.4. Repair and prevention of over increase or decrease of salinity

In dry season, there are times with long sunny and hot spells, when strong evaporation makes salinity in the pond increase over the limit that allow the development of shrimp, leading to the death of some shrimps or their massive death. Pay attention to daily weather forecast to have plan of storing saline water with low salinity in canals, or choose appropriate time to open fresh water culverts. The big aquaculture areas should reserve suitable area for fresh water pond, preventing this breakdown.

In rainy season, salinity often decreases suddenly, leading to shocking and killing shrimp. So, it is necessary to have preventive measures such as storing of saturated water (salinity 100‰) or drilling of underground water wells with low and stable salinity to dissolve into shrimp pond when needed.

6.3.4. Plan of training to strengthen capacity to implement EMP

6.3.4.1. Assessment of environment management capacity

Subproject Ba Tri Sea-dyke will include representatives of DARD BÕn Tre and IMC Ba Tri, both of these agencies seldom receive the training on environment mitigation and observation to carry out project to protect environment. Particularly, IMC Ba Tri has not any environment cadres and no people trained in mitigation to comply with environment protection measures which have been designed. It is required to extend the training to these units for strengthening capacity in environment management.

EPC will be selected following recruitment requirements of WB. Some national consultancy agencies in Vietnam have demonstrated that they have adequate capacity in sampling and collection of fundamental environment infornation. Based on experience of national consultancy agencies in natural disaster mitigation projects financed by WB formerly, the capacity of these organizations is weak in terms of analysis and annotation of collected data, making conclusion on based on results of analysis, and recommendations on

environment impacts of Subproject Ba Tri Sea-dyke for observation of future impacts, and that will be the requirements in report on EMP of Subproject Ba Tri Sea-dyke

Governmental environment managers MoNRE has been trained and raised much in capacity through projects which were financed during many years by CWB, SWB on EIA, environment management, environment protection, and environment observation. Owing to many financed projects, MoNRE has been able to organize extensive training courses for provincial DoNREs, including DoNRE BÕn Tre. It is not necessary to train and raise capacity and there are not any recommendations for these agencies.

6.3.4.2. Recommendations on training and raing capacity

Subproject Ba Tri Sea-dyke will receive training and raising capacity in following issues:

- Prepare and work with various conditions and time limits in construction contracts. These conditions and time limits will include requirements on responsibilities of mitigation and compensation if not compliance with the designed mitigation measures;
- Training of monitoring cadres to carry out observation and monitoring the works of construction to guarantee that the environment mitigation measures are carried out completely (frequent observation, categories of works under observation, assessmenbt and report); and
- Prepare reports on observation in compliance with the above-mentioned requirements on report.

It is also possible to require the training of construction contractors to implement completely the environment mitigation measures to meet the time limits and conditions in their contracts and in preparation of position for Environment Management Plan. This training should be carried out at some field locations where there are requirements on mitigation measures. The training will be designed so that the technical supervision cadres can train the sub-contractors which are expected to do the construction.

Environment Protection Contractor: The training and raising capacity will serve the environment observation. This training will concentrate on detailed designing of environment observation system, including:

Specify environment impacts;

Clarify the set of indices or criteria such as criteria of water quality, or list out the diversity level of species, for example, these indices will be used to evaluate changes in environment conditions;

Prepare environment data base for environment conditions of Subproject Ba Tri Sea-dyke based on changes of environment conditions which have been evaluated;

Monitoring in space and time for environment observation so that is is possible to attribute the changes of environment conditions are due to impacts of Subproject rather than changes of elements not related to Subproject;

Design the data collection or data analysis;

QA/QC (Quality Assessment/Quality Control)

Analyze and present data and results;

Develop system of data base; and

Structure and form of report are suitable for the above-mentioned report requirements.

6.3.5. Budget for carrying out EMP

Total budget for carrying out EPM of Subproject Ba Tri Sea-dyke is US$ 281,237 including US$ 31,493 for carrying out environment mitigation measures and US$ 249,744 for

program of supervising the compliance with environment mitigation plan and environment impact observation. Details of budget are presented in Table 6.9 to 6.10. Measures to mitigate environment and Environemtn Observation Program (supervising the compliance with environment mitigation measures and observation of environment impacts) respectively.

Table 6-9 The cost of mitigation measures

Content	Unit	Price (USD)	Amount	Total (USD)
Total cost of mitigation measure implementation				**31,493**
A . Pre-construction phase				**4,493**
A.1. Coastal aquiculture environment consideration				**4,493**
A.1. 1. Salary for domestic consultant	day	60	30	1800
A.1.2. Subsistencie expenses for domestic consultant	day	50	30	1500
A.1.3. Travelling expenses	sub-project	500	1	500
A.1.4. Report, other cost (20% of salary)				360
A.1.5. Administrative cos (8% of A.1.1+A.1.2+A.1.3+A.1.4)				333
A.2. Compensation and resettlement	in cost of RAP			
B. Construction phase				
C. Operation phase				**27,000**
C.1. Carry out pesticide, herbicide using control plan (6 communes and implementation in 3 years)	**year**	1,500	18	27,000

Table 6-10. Cost and the detail schedule of environment observation program of Ba Tri sea-dyke sub-project, Ben Tre province

Cost article of environment observation	Unit	Price (US$)	Implementing year							Total (US$)
			Construction phase					Operation phase		
Environment mitigation observation			**1**	**2**	**3**	**4**	**5**	**6**	**7**	
Environment mitigation observation of construction contract										
Cost – Innerior environment protecting Contractor	Day	60	4	8	8	8	8	8	4	2,880
DSA - Innerior environment protecting Contractor	Day	50	4	8	8	8	8	8	4	2,400
Moving	Designted amount	500	1	1	1	1	1	1	1	3,500
Report, other cost	20% work		48	96	96	96	96	96	48	576
Sub-total			986	1,471	1,471	1,471	1,471	1,471	986	9,327
Administrative cost (8% of Sub-total)			79	118	118	118	118	118	79	746
Total 1			**1,122**	**1,702**	**1,702**	**1,702**	**1,702**	**1,702**	**1,122**	**19,429**
Environment impact observation										
1. Surface water quality observation										
Analysing cost										
pH	Sample	2	12	12	16	16	16	36	16	248
Conductivity	Sample	1	12	12	16	16	16	36	16	124
TSS	Sample	6	12	12	16	16	16	36	16	744
BOD_5	Sample	6	12	12	16	16	16	36	16	744
COD	Sample	8	12	12	16	16	16	36	16	992
Fe	Sample	8	12	12	16	16	16	36	16	992
Al	Sample	6	12	12	16	16	16	36	16	744
NO_3^-	Sample	5	12	12	16	16	16	36	16	620
PO_4-P	Sample	5	12	12	16	16	16	36	16	620
DO	Sample	5	12	12	16	16	16	36	16	620

Cost article of environment observation	Unit	Price (US$)	Implementing year							Total (US$)
			Construction phase					Operation phase		
Na	Sample	5	12	12	16	16	16	36	16	620
Mg	Sample	5	12	12	16	16	16	36	16	620
Ca	Sample	5	12	12	16	16	16	36	16	620
Biocides	Sample	100	10	10	13	13	13	18	13	9,000
Fecal Coliform	Sample	9	12	12	12	12	12	24	12	864
Sum 1			178	178	233	233	233	510	233	18,172
2. Ground water quality observation										
Analysing cost										
pH	Sample	2	6	6	8	8	8	8	8	104
Conductivity	Sample	1	6	6	8	8	8	8	8	52
TSS	Sample	6	6	6	8	8	8	8	8	312
BOD_5	Sample	6	6	6	8	8	8	8	8	312
COD	Sample	8	6	6	8	8	8	8	8	416
Fe	Sample	8	6	6	8	8	8	8	8	416
Al	Sample	6	6	6	8	8	8	8	8	312
NO_3^-	Sample	**5**	6	6	8	8	8	8	8	260
PO_4-P	Sample	5	6	6	8	8	8	8	8	260
DO	Sample	5	6	6	8	8	8	8	8	260
Fecal Coliform	Sample	9	6	6	8	8	8	8	8	468
Biocides	Sample	100	6	6	8	8	8	8	8	5,200
Sum 2			72	72	96	96	96	96	96	8,372
Sub-total 1 = Sum 1 + Sum 2			*250*	*250*	*329*	*329*	*329*	*606*	*329*	*26,544*
Sampling cost (20% of analysing cost)			50	50	66	66	66	121	66	5,309
Working and reporting cost (20% of sampling and analysing cost)			60	60	79	79	79	145	79	6,371

Cost article of environment observation	Unit	Price (US$)	Implementing year							Total (US$)
			Construction phase					Operation phase		
Collecting additional data (20% of working and reporting cost)			12	12	16	16	16	29	16	1,274
Sub-total 2			*372*	*372*	*490*	*490*	*490*	*902*	*490*	*39,497*
Administrative cost (8% of Sub-total 2)			30	30	39	39	39	72	39	3,160
Total 2			**402**	**402**	**529**	**529**	**529**	**974**	**529**	**42,657**
4. Air quality observation										
Analysing cost										
CO	Sample	5	12	12	16	16	16	36	16	620
NO_2	Sample	5	12	12	16	16	16	36	16	620
SO_2	Sample	5	12	12	16	16	16	36	16	620
TSP	Sample	5	12	12	16	16	16	36	16	620
VOC	Sample	5	12	12	12	12	12	24	12	480
Sum 4			60	60	76	76	76	168	76	2960
5. Noise and vibration observation										
Analysing cost										
Leq	Sample	1	12	12	16	16	16	36	16	124
L50	Sample	1	12	12	16	16	16	36	16	124
L90	Sample	1	12	12	16	16	16	36	16	124
Vibration frequency	Sample	3	12	12	16	16	16	36	16	372
Vibration acceleration	Sample	1	12	12	12	12	12	24	12	96
Sum 5			60	60	76	76	76	168	76	840
6. Soil quality observation										
pH dry	Sample	1	6	6	6	6	6	6	6	42
pH wet	Sample	1	6	6	6	6	6	6	6	42
EC	Sample	1	6	6	6	6	6	6	6	42

Cost article of environment observation	Unit	Price (US$)	Implementing year							Total (US$)
			Construction phase					Operation phase		
Total N	Sample	2	6	6	6	6	6	6	6	84
Total P	Sample	2	6	6	6	6	6	6	6	84
Total Fe	Sample	2	6	6	6	6	6	6	6	84
Al^{3+}	Sample	2	6	6	6	6	6	6	6	84
Sum 6			42	42	42	42	42	42	42	462
7. Ecosystem survey along the dyke										
Terrestrial bio-system survey	Sample	4	30	-	-	30	-	-	6	264
Alteration survey of vegetative cover	Sample	4	30	-	-	30	-	-	6	264
Aquatic bio-system survey	Sample	4	30	-	-	30	-	-	6	264
Fishery survey	Sample	4	30	-	-	30	-	-	6	264
Sum 7			120			120			24	1056
8. Socio-economic survey										
Possibly affected households survey	household	20	70	-	-	70	-	-	70	4,200
Other socio-economic indicators survey	work	3	60	-	-	60	-	-	60	540
Sum 8			1,580			1,580			130	4740
9. Erosion- deposition and landslide survey										
Erosion-deposeiion	cross-section	60	270	-	-	270	-	-	270	48,600
Landslide	km	100	30	-	-	30	-	-	30	9,000
Sum 9			19,200			19,200			19,200	57600
Total 3			21,062	162	194	21,094	194	378	19,548	67,658
Community-based for ptrotection section in IBA Ba Tri for Ba Tri Sea-dyke sub- project										120,000
Total cost of environment observation program			**22,586**	**2,265**	**2,424**	**23,324**	**2,424**	**3,054**	**21,199**	**249,744**

CONCLUSION AND RECOMMENDATIONS

Conclusion

Subproject Ba Tri Sea-dyke is invested to create favorable conditions for ecological environment and production development, increase of product values of projected area.

When the project comes into operation, it will increase the possibility of prevention and mitigation of natural disasters, high tide, flood, typhoon,... protection of production, life and property of the people, meet the requirements in development of agriculture-aquaculture-salt production and improve the life and economy of projected area.

Create foundation for resettlement, contribute to stabilize and raise the living standard of people in project area in particular, and Ba Tri district in general.

Recommendations

Subproject Ba Tri Sea-dyke is a big project, with big investment capital, and project effects on a large area (more than 14,000ha) and big number of beneficiaries (more than 68,000). The successful project will change production structure, form the models of specialized production, concentration and mutual interaction in environment.

Although production structure is assessed as more stable and ecological environment is assessed as being improved by different items of project investment that can solve the problems of natural disaster mitigation, take initiative in production, there should be adequate concerns because the environmental dangers are latent, and can be generated from process of production and people's life, as well as due to the vagaries of weather that can lead to diseases.

It is necessary to continue the regular research, survey, observation and monitoring of environmental changes in projected area, monitoring of quality of soil, surface and underground water, aquatic ecosystem,... updating of documents on environment impact assessment as well as effectiveness of project structures in operation. These are very important documents to serve the orientation, and adjustment of planning and proposal on environment action plan and serve the coming projects.

It is required to carry out well the issues mentioned in Environment Management Plan, pay attention to the supervision of construction execution and environment monitoring, arrangement of many environment monitoring points to timely recommend measure to overcome and mitigate the impacts. The requirements on environment protection should receive attention and consideration and be considered as an important component in the bidding for contract and execution of construction.

Appendix 1 – Vietnameses standard

Table. 1. The surface water quality standard - TCVN 5942-1995

No	Paramater	Unit	Limited value	
			A	B
1	pH	-	6-8,5	5,5-9
2	BOD5	mg/l	<4	<25
3	COD	mg/l	<10	<25
4	DO	mg/l	≥ 6	≥ 2
5	Suspended solids	mg/l	20	80
6	Asen	mg/l	0,05	0,1
7	Bari	mg/l	1	4
8	Cadimi	mg/l	– 0,01	0,02
9	Lead	mg/l	0,05	0,1
10	Cr (VI)	mg/l	0,05	0,05
11	Cr (III)	mg/l	0,1	1
12	Cu	mg/l	0,1	1
13	Zn	mg/l	1	2
14	Mn	mg/l	0,1	0,8
15	Ni	mg/l	0,1	1
16	Fe	mg/l	1	2
17	Hg	mg/l	0,001	0,002
18	Tin	mg/l	1	2
19	Amoniac (N)	mg/l	0,05	1
20	Flo	mg/l	1	1,5
21	Nitrat (N)	mg/l	10	15
22	Nitrit (N)	mg/l	0,01	0,05
23	Xianua	mg/l	0,01	0,05
24	Phenola (total)	mg/l	0,001	0,02
25	Oil	mg/l	nil	0,3
26	Detergent	mg/l	0,5	0,5
27	Coliform	MPN/100ml	5000	10000
28	Pesticide (except DDT)	mg/l	0,15	0,15
29	DDT	mg/l	0,01	0,01
30	Total of radioactivity α	Bq/l	0,1	0,1
31	Total of radioactivity β	Bq/l	1,0	1,0

Note : *- A column applies for surface water possibly using to be fresh water supply (but have to treat according to the regulation)*

- B column applies for surface water possibly using for other purposes. Water uses for agriculture, aqutic farming according to the specific regulation.

Hygienic standard for drinking and living water on physical and chemical aspects, Decree *No 505BYT/Q§, 3/4/1992*

No	Parameter	Unit	Urban	Rural
(1)	*(2)*	*(3)*	*(4)*	*(5)*
1	Clear level	cm	>30	>25
2	Colour	degree	<10	<10
3	Taste (cover tightly after boiling at 50-60^{o}C)	point	0	0
4	Content of undissolved dregs	mg/l	5	20
5	Content of desiccated dregs	mg/l	500	1000
6	pH	mg/l	6,5-8,5	6,5-8,5
7	Hardness (CaCO3)	mg/l	500	500
8	Salinity : - coastal zone	mg/l	400	500
	- innerior zone	mg/l	250	250
9	DO (organic)	mg/l	0,5 –2,0	2,0 – 4,0
10	Amoniac – surface water	mg/l	0	0
	- underground water	mg/l	3,0	3,0
11	Nitrit	mg/l	0	0
12	Nitrat (N)	mg/l	10,0	10,0
13	Alumium	mg/l	0,2	0,2
14	Copper	mg/l	1,0	1,0
15	Iron	mg/l	0,3	0,5
16	Mangan	mg/l	0,1	0,1
17	Natri	mg/l	- 200	200
18	Sunphate	mg/l	400	400
19	Zinc	mg/l	5,0	5,0
20	Hydrogen sulfide	mg/l	0	0
21	Chlorobenzen vµ Cholorophenol	mg/l	0	0
22	Detergents	mg/l	0	0
23	A sen	mg/l	0,05	0,05
24	Cadimi	mg/l	0,005	0,005
25	Crom	mg/l	0,05	0,05
26	Xyanua	mg/l	0,1	0,1
27	Florua	mg/l	1,5	1,5
28	Ch×	mg/l	0,05	0,05
29	Thuû ng©n	mg/l	0,001	0,001
30	Selen	mg/l	0,01	0,01
31	Aldrin vµ Dieidrin	mg/l	0,03	0,03
32	Benzene	mg/l	10	10
33	Benzo (a) pyrene	mg/l	0,01	0,01
34	Carbon tetrachloride	mg/l	3,0	3,0

No	Parameter	Unit	Urban	Rural
35	Chordane	mg/l	0,3	0,3
36	Chloroform	mg/l	30	30
37	2,4D	mg/l	100	100
38	DDT	mg/l	1,0	1,0
39	1,2 –dichlorethan	mg/l	10	10
40	1,1 –dichlorethan	mg/l	0,3	0,3
41	Heptachlor vμ heptachlor epoxide	mg/l	0,1	0,1
42	Gamme – HCH (lindane)	mg/l	3,0	3,0
43	Hexachlorobenzene	mg/l	0,01	0,01
44	Methoxychlor	mg/l	30	30
45	Pentachloro phenol	mg/l	10	10
46	Tetrachloroethene	mg/l	10	10
47	Trichloroethene	mg/l	30	30
48	2,4,6 Trichlorophenol	mg/l	10	10
49	Trihalomethenes	mg/l	30	30
50	Total of radioactivity α	Bq/l	0,1	0,1
51	Total of radioactivity β	Bq/l	1,0	1,0

Hygienic standard for drinking and living water on bacterium and biological aspects

No	Parameter	Unit	Standard	Remark
I	Bacterium standard A, Supplying water by drain A1, Cleaned water at distribution system			
	-Faecal coliform	Amount/100ml	0	- Turbidity 1 NTU
	-Coliform organisms	Amount/100ml	0	- Exterminating baterium by clor, pH 8,0, during 30 minutes , residential Clor 0,2-0,5 mg/l
	A2, Not yet cleaned water at distribution system			
	-Faecal coliform	Amount/100ml	0	- Ensuring 95% of samples achieving standard per year
	-Coliform organisms	Amount/100ml	≤ 3	- Sometimes
	A3, Water in distributing drainway	Amount/100ml		
	-Faecal coliform	Amount/100ml	0	- Ensuring 95% of samples achieving

No	Parameter	Unit	Standard	Remark
				standard per year
	-Coliform organisms	Amount/100ml	≤ 3	- Sometimes
	B, Do not supply water by drain	Amount/100ml		
	-Faecal coliform	Amount/100ml	0	
	-Coliform organisms	Amount/100ml	10	- Unusual - If usually, there need be the examination, repair, protect water supply.
	C, Bottled water			
	-Faecal coliform	Amount/100ml	0	
	-Coliform organisms	Amount/100ml	0	
	D, Emergency water supply	Amount/100ml		
	-Faecal coliform	Amount/100ml	0	- need boiling water In emergency case
	-Coliform organisms	Amount/100ml	0	
II	Biological standard			
	- Protozoa		0	
	- Helminths		0	
	- Free organisms (alga,,,)		0	

Water quality standard for irrigating - TCVN 6773 : 2000

Parameter	Unit	Standard
1. Total of dissolved particles	mg/l	< 400 using for bad irrigation system, saline soil (EC ≤ 0.75 μS/cm, 25oC) <1000, using for better irrigation system(EC ≤ 1.75 μS/cm, 25oC) < 2000 vμ ratio SAR (A appendix) in little irrigating water using to plant salinity standing trees, for the better irrigation area and initiative in the irrigation(EC ≤ 2.25 μS/cm, 25oC)
2. Ratio SAR in irrigation water		≤ 10, using for bad irrigation system . ≤ 18, using for better irrigation system > 18 using for exhausted soil
- 3. Bo (B)	mg/l	≤ 1, using to plant sensitive trees by Bo - ≤ 2, using to plant sensitive trees at medium level by Bo ≤ 4, using to plant other trees
4. Disloved Oxygen	mg/l	≥ 2
5. pH		5,5 –8,5
6. Clorua (Cl-)	mg/l	≤ 350

7. Herbicide (for each type of herbicide seperately)	mg/l	≤ 0,001
8. Mercury (Hg)	mg/l	≤ 0,001
9. Cadmi (Cd)	mg/l	0,005 – 0,01
10. Asen (As)	mg/l	0,05 – 0,1
11. Lead (Pb)	mg/l	≤ 0,1
12. Crom (Cr)	mg/l	≤ 0,1
13. Zin (Zn)	mg/l	Kh«ng qu¸, 1, nÕu pH soil ≤ 6,5 Kh«ng qu¸, 5, nÕu pH > 6,5
14. Fecal coliform	MPN/100ml	Not exceed 200 (for fresh vegetabel and other trees)

TCVN 6774: 2000

Fresh water quality guideline for protection of aquatic lifes.

Parameter	Unit	Standard	Remark
1. DO	mg/l	5	Daily average
2. Temp	^oC	natural temprature	according to season
3. BOD_5 20^oC	mg/l	< 10	
4. Pesticide (organic Clo): Aldrin/Dieldrin Eldrin B.H.C DDT Endosulfan Lindan Clordan Heptaclo	 µg/l µg/l µg/l µg/l µg/l µg/l µg/l µg/l	 < 0.008 < 0.014 < 0.13 < 0.004 < 0.01 0.38 0.02 0.06	
5. Pesticide (organic Phospho): Paration Malation	 µg/l µg/l	 ≤ 0.40 ≤ 0.32	
6. Herbicide 2,4 D 2,4,5 T Paraquat	 mg/l mg/l mg/l	 ≤ 0.45 ≤ 0.16 ≤ 1,80	
7. CO_2	mg/l	< 12	
8. pH		6.5 – 8.5	
9. NH_3	mg/l	≤ 2,20 ≤ 1,33 ≤ 1,49 ≤ 0,93	pH = 6,5; t^oC = 15 pH = 8,0; t^oC = 15 pH = 6,5; t^oC = 20 pH = 8,0; t^oC = 20
10. CN^-	mg/l	≤ 0,005	
11. Cu	mg/l	0.002 – 0.004	depending on the hardness of

			water ($CaCO_3$)
12. As	mg/l	≤ 0,02	
13. Cr	mg/l	≤ 0,02	
14. Cd	mg/l	0,80 – 1,80	depending on the hardness of water ($CaCO_3$)
15. Pb	mg/l	0,002 – 0,007	depending on the hardness of water ($CaCO_3$)
16. Se	mg/l	≤ 0,001	
17. Hg (total)	mg/l	≤ 0,10	
18. Oil (total)	mg/l	Unobservable oily film	
19. Phenol (total)	mg/l	≤ 0,02	
20. Dissolved solid	mg/l	≤ 1000	
21. Suspended solid	mg/l	≤ 100	
22. Surface activiting matter	mg/l	≤ 0,5	

TCVN 6980: 2001

Table 1.Allowable standard of industrial sewage discharging into the basin using for living water

Th«ng sè	Q> 200m ^{3}/s			Q= 50÷200m^3/s			Q < 50m^3/s		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Colour, Co-Pt ë pH=7	20	20	20	20	20	20	20	20	20
2. Smell, perceptobility	No bad smel l	No bad smel l	No bad smell	No bad smell	No bad smel l	No bad smell	No bad smell	No bad smel l	No bad smell
3. BOD_5 (20^o C), mg/l	40	35	35	30	25	25	20	20	20
4. COD, mg/l	70	60	60	60	50	50	50	40	40
5. TSP mg/l	50	45	45	45	40	40	40	30	30
6. Arsenic, As, mg/l	0,2	0,2	0,2	0,15	0,15	0,15	0,1	0,05	0,05
7. Pb, mg/l	0,1	0,1	0,1	0,08	0,08	0,08	0,06	0,06	0,06
8. Oil and grease, mg/l	5	5	5	5	5	5	5	5	5
9. Oil and fat, mg/l	20	20	20	10	10	10	5	5	5
10. Cu, mg/l	0,4	0,4	0,4	0,3	0,3	0,3	0,2	0,2	0,2
11. Zn, mg/l	1	1	1	0,7	0,7	0,7	0,5	0,5	0,5
12. Total of phospho, mg/l	10	10	10	6	6	6	4	4	4
13. Chlorua, Cl-, mg/l	600	600	600	600	600	600	600	600	600
14. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Note *: Q - discharge, m3/s* *F – Emited capacity, m3/day (24h)*

F1 – from 50 m3 to 500 m3/day *F2 – 500 m3 - 5000 m3/day*

F3 – ≥ 5000 m3/day

TCVN 6981: 2001

Table 2.Allowable standard of industrial sewage discharging into the basin using for living water

Th«ng sè	V> 100 x 10^6 m^3			V= (10 ÷ 100) x 10^6 m^3			V< 10 x 10^6 m^3		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Colour, Co-Pt ë pH=7	20	20	20	20	20	20	20	20	20
2. Smell, perceptobility	No bad smel l	No bad smel l	No bad smell	No bad smell	No bad smel l	No bad smell	No bad smell	No bad smel l	No bad smell
3. BOD_5 (20^o C), mg/l	30	30	30	20	20	20	15	15	15
4. COD, mg/l	60	60	60	40	40	40	30	30	30
5. TSP mg/l	50	50	50	40	40	40	30	20	15
6. Arsen, As, mg/l	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,02	0,02
7, Pb, mg/l	0,2	0,2	0,2	0,1	0,1	0,1	0,1	0,1	0,1
8, Crom (Cr) III, mg/l	0,2	0,2	0,2	0,15	0,15	0,15	0,10	0,10	0,10
8. Oil and grease, mg/l	5	5	5	5	5	5	5	5	5
9. Oil and fat, mg/l	20	20	20	20	20	20	20	20	20
10. Cu, mg/l	0,4	0,4	0,4	0,3	0,3	0,3	0,2	0,2	0,2
11. Zn, mg/l	1	0,8	0,8	0,7	0,7	0,7	0,5	0,5	0,5
12. Total of phospho, mg/l	10	8	8	8	6	6	6	4	4
14, Chlorua, Cl-, mg/l	500	500	500	500	500	500	500	500	500
15, Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Note *V - volumn of resevoir, m3/s* *F – Emited flow, m3/day (24h)*
F1 – from 50 m3 to 500 m3/day *F2 – 500 m3 - 5000 m3/day*
F3 – ≥5000 m3/day

TCVN 6983: 2001

Table 1.Allowable standard of industrial sewage discharging into the basin using for sport and entertainment under water.

Parameter	Q> 200m^3/s			Q= 50÷200m^3/s			Q < 50m^3/s		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Colour, Co-Pt ë pH=7	50	50	50	50	50	50	50	50	50
2. Smell, perceptobility	No bad smel l	No bad smel l	No bad smell	No bad smell	No bad smel l	No bad smell	No bad smell	No bad smel l	No bad smell
3. BOD_5 (20^o C), mg/l	50	40	40	40	30	30	30	30	30
4. COD, mg/l	100	80	80	80	60	60	60	60	60
5. TSP, mg/l	100	90	90	90	80	80	80	70	70

6. Arsen, As, mg/l	0,1	0,08	0,08	0,08	0,07	0,07	0,06	0,06	0,06
7, Pb, mg/l	0,5	0,5	0,5	0,5	0,5	0,4	0,4	0,4	0,4
8, Crom (Cr) III, mg/l	0,1	0,08	0,08	0,08	0,08	0,08	0,06	0,06	0,06
9. Total of phospho, mg/l	10	8	8	8	6	6	6	5	5
10. Chlorua, Cl-, mg/l	600	600	600	600	600	600	600	600	600
11. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Note *Q - discharge, m3/s* *F – Emited capacity, m3/day (24h)*
F1 – from 50 m3 to 500 m3/day *F2 – 500 m3 - 5000 m3/day*
F3 – ≥ 5000 m3/day

TCVN 6983: 2001

Table 2.Allowable standard of industrial sewage discharging into the basin using for sport and entertainment under water.

Parameter	V> 100 x 10^6 m^3			V= (10 ÷ 100) x 10^6 m^3			V< 10 x 10^6 m^3		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Colour, Co-Pt ë pH=7	50	50	50	50	50	50	50	50	50
2. Smell, perceptobility	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell	No bad smell
3. BOD_5 (20^o C), mg/l	50	40	40	30	30	30	30	20	20
4. COD, mg/l	100	80	80	70	60	60	60	40	40
5. TSP, mg/l	80	80	80	70	70	60	60	50	50
6. Arsen, As, mg/l	0,1	0,08	0,08	0,08	0,07	0,07	0,06	0,06	0,06
7, Pb, mg/l	0,5	0,5	0,5	0,5	0,4	0,4	0,4	0,4	0,4
8, Crom (Cr) III, mg/l	0,1	0,08	0,08	0,08	0,08	0,08	0,06	0,06	0,06
9. Total of phospho, mg/l	8	6	6	6	5	5	5	4	4
10.Hg, mg/l	0,005	0,005	0,005	0,005	0,004	0,004	0,004	0,004	0,004
11. Clorua , Cl-, mg/l	500	500	500	500	500	500	500	500	500
12. Coliform, MPN/100 ml	3000	3000	3000	3000	3000	3000	3000	3000	3000

Note *V - volumn of resevoir, m3/s* *F – Emited flow, m3/day (24h)*
F1 – from 50 m3 to 500 m3/day *F2 – 500 m3 - 5000 m3/day*
F3 – ≥ 5000 m3/day

TCVN 6984: 2001

Table 1.Allowable standard of industrial sewage discharging into the basin using to protect aquatic eco-system

Parameter	Q> 200m ^{3}/s			Q= 50÷200m^3/s			Q < 50m^3/s		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Colour, Co-Pt ë pH=7	50	50	50	50	50	50	50	50	50
2. Smell, perceptobility	Light	Light	Light	Light	Light	Light	Light	Light	Light
3. pH	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5
4. BOD_5 (20^o C), mg/l	50	45	40	40	35	30	30	20	20
5. COD, mg/l	100	90	80	80	70	60	60	50	50
6. TSP, mg/l	100	100	100	90	80	80	80	80	80
7 Arsen, As, mg/l	0,1	0,1	0,1	0,08	0,08	0,08	0,05	0,05	0,05
8. Cadmi, Cd, mg/l	0,02	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01
9. Pb, mg/l	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
10. Fe , mg/l	5	5	5	4	4	4	3	3	3
11. Cyanua, CN-, mg/l	0,1	0,1	0,1	0,05	0,05	0,05	0,05	0,05	0,05
12. Oil and grease, mg/l	10	5	5	10	5	5	5	5	5
13. Oil and fat, mg/l	20	20	20	20	10	10	10	10	10
14. Organic Phospho , mg/l	1	1	0,8	0,8	0,5	0,5	0,5	0,5	0,5
15. Total of Phospho, mg/l	10	8	8	6	6	6	5	5	4
16. Chlorua, Cl-, mg/l	1000	1000	1000	800	800	800	750	750	750
17. Surface activity substance, mg/l	10	10	10	5	5	5	5	5	5
18. Coliform, MPN/100 ml	5000	5000	5000	5000	5000	5000	5000	5000	5000
19. PCB, mg/l	0,02	0,02	0,02	0,01	0,01	0,01	0,01	0,01	0,01

***Note**:* *Q - discharge, m3/s* *F – Emited capacity, m3/day (24h)*

F1 – from 50 m3 to 500 m3/day *F2 – 500 m3 - 5000 m3/day*

F3 – ≥5000 m3/day

TCVN 6985: 2001

Table 2.Allowable standard of industrial sewage discharging into the basin using to protect aquatic eco-system

Parameter	V> 100 x 10^6 m ^{3}			V= (10 ÷ 100) x 10^6 m ^{3}			V< 10 x 10^6 m ^{3}		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Colour, Co-Pt ë pH=7	50	50	50	50	50	50	50	50	50
2. Smell, perceptobility	Light	Light	Light	Light	Light	Light	Light	Light	Light
3. pH	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5	6-8,5
4. BOD_5 (20^o C), mg/l	50	40	40	40	30	30	30	20	20
5. COD, mg/l	90	80	80	70	60	60	50	50	50
6. TSP, mg/l	100	90	90	80	70	70	70	70	70
7 Arsen, As, mg/l	0,1	0,07	0,07	0,05	0,05	0,04	0,04	0,03	0,03
8. Cadmi, Cd, mg/l	0,02	0,015	0,015	0,01	0,01	0,01	0,005	0,01	0,01

9. Pb, mg/l	0,5	0,4	0,4	0,3	0,3	0,3	0,2	0,1	0,1
10. Fe , mg/l	5	5	5	4	4	4	3	3	3
11. Cyanua, CN-, mg/l	0,1	0,1	0,1	0,05	0,05	0,05	0,05	0,05	0,05
12. Oil and grease, mg/l	10	10	10	5	5	5	5	5	5
13. Oil and fat, mg/l	10	10	10	7	7	7	5	5	5
14. Organic Phospho , mg/l	0,5	0,5	0,5	0,5	0,5	0,5	0,3	0,3	0,3
15. Total of Phospho, mg/l	6	6	6	5	5	5	4	4	4
16. Chlorua, Cl-, mg/l	750	750	700	650	600	600	500	500	500
17. Chlorua free, mg/l	1	1	1	1	1	1	1	1	1
18. Surface activity substance, mg/l	5	5	5	5	5	5	5	5	5
19. Coliform, MPN/100 ml	5000	5000	5000	5000	5000	5000	5000	5000	5000
20. PCB, mg/l	0,05	0,04	0,04	0,04	0,03	0,03	0,01	0,01	0,01

Note *V - volumn of resevoir, m3/s* *F – Emited flow, m3/day (24h)*
F1 – from 50 m3 to 500 m3/day *F2 – 500 m3 - 5000 m3/day*
F3 – ≥5000 m3/day

TCVN 6986: 2001

Table 1.Allowable standard of industrial sewage discharging into the coastal water using to protect aquatic eco-system

Parameter	Allowable standard		
	F1	F2	F3
1. Colour, Co-Pt ë pH=7	50	50	50
2. Smell, perceptobility	No bad smell	No bad smell	No bad smell
3. pH	5 - 9	5 - 9	5 - 9
4. BOD_5 (20^o C), mg/l	50	20	10
5. COD, mg/l	100	80	50
6. TSP, mg/l	100	80	50
7 Arsen, As, mg/l	1	0,5	0,1
8. Pb, mg/l	1	0,5	0,5
9. Crom VI, Cr, mg/l	1	0,5	0,1
10. Cu, mg/l	1	0,5	0,1
11. Zn, mg/l	2	1	1
12. Mangan, Mn, mg/l	5	5	1
13. Hg, mg/l	0,005	0,001	0,001
14. Total nitrogen (by N), mg/l	20	15	10
15. Oil and grease, mg/l	10	5	5
16. Oil and fat, mg/l	30	20	10
17. Organic Phospho , mg/l	0,5	0,2	0,2
18. Surface activity substance, mg/l	10	5	5
19. Coliform, MPN/100 ml	5000	5000	5000

Note *F – Emited flow, m3/day (24h)* *F1 – from 50 m3 to 500 m3/day*
F2 – 500 m3 - 5000 m3/day *F3 – ≥5000 m3/day*

TCVN 6987: 2001

Table 1.Allowable standard of industrial sewage discharging into the coastal water using for sport and entertainment under water

Parameter	Allowable standard		
	F1	F2	F3
1. Temp , ^oC	50	50	50
2. Colour, Co-Pt ë pH=7	30	30	30
3. Smell, perceptobility	No bad smell	No bad smell	No bad smell
4. pH	5,5 – 8,5	5,5 – 8,5	5,5 – 8,5
5. BOD_5 (20^o C), mg/l	50	40	30
6. COD, mg/l	100	80	50
7. TSP, mg/l	100	80	60
8. Arsen, As, mg/l	1	0,5	0,1
9. Pb, mg/l	0,5	0,4	0,4
10. Crom VI, Cr, mg/l	1	0,5	0,1
11. Fluor, F-, mg/l	25	25	15
12. Hg, mg/l	0,005	0,004	0,004
13. Sulfide, mg/l	1	0,5	0,5

14. Total nitrogen (by N), mg/l	20	15	10
15. Total phospho, mg/l	6	5	4
16. Oil and grease, mg/l	5	5	5
17. Oil and fat, mg/l	10	10	10
18. Surface activity substance, mg/l	10	5	5
19. Coliform, MPN/100 ml	3000	3000	3000

Note *F – Emited flow, m3/day (24h)* *F1 – from 50 m3 to 500 m3/day*
F2 – 500 m3 - 5000 m3/day *F3 – ≥ 5000 m3/day*

TCVN 5943:1995

Table 1. Water quality – Coastal water quality standard.

No	Parameter	Unit	Aquiculture
1	Temp	^oC	-
2	Smell		-
3	pH		6.5-8.5
4	DO	mg/l	≥5
5	BOD_5 (20^oC)	mg/l	<10
6	SS	mg/l	50
7	As	mg/l	0.01
8	Amoniac (N)	mg/l	0.5
9	Cd	mg/l	0.005
10	Pb	mg/l	0.05
11	Cr(VI)	mg/l	0.05
12	Cr(III)	mg/l	0.1
13	Clo	mg/l	0.01
14	Cu	mg/l	0.01
15	Fl	mg/l	1.5
16	Zn	mg/l	0.01
17	Mn	mg/l	0.1
18	Fe	mg/l	0.1
19	Hg	mg/l	0.005
20	Sulfua	mg/l	0.005
21	CN^-	mg/l	0.01
22	Total Phenol	mg/l	0.001
23	Oil film	mg/l	0
24	Oil emulsion	mg/l	1
25	Total of pesticide	mg/l	0.01
26	Coliform	MNP/100ml	1000

Appendix 2 - the summary of species in the surveying area of ben tre province

Table 1. The list of aquatic natural organisms

No	List	Unit	Fishery	Mangrove	Bank	River	Remark
I	**(Phytoplanton)**	individual/ lit	59.8	220	79.9	55	52 species; 3 branchs
1	Cyanophyta	individual/ lit	11.7	-	6.6	-	
2	Chlophyta	individual/ lit	11.7	-	-	10	
3	Bacillariophyta	individual/ lit	36.4	220	73.3	45	
II	**(Zooplankton)**	individual/ m^3	3774	1875	6000	2652	14 species; 2 branchs
1	Protozoa	individual/ m^3	30	-	6.6	-	
2	Ratatoria	individual/ m^3	558	-	-	-	
3	Mollóca larva	individual/ m^3	-	-	83	83	
4	Copepoda	individual/ m^3	3022	1875	4750	2542	
5	Decapoda larva	individual/ m^3	164	-	1667	-	
III	**(Zoobenthos)**						22 species; 3 classes
	Quantity	individual/ m^3	66.658	-	41.66	58.3	
	Mass	gram/m^2	4.152	-	2.13	6.84	
1	Bicalvia						
	Quantity	individual/ m^3	1388	-	-	-	
	Mass	gram/m^2	0.072	-	-	-	
2	polycheata						
	Quantity	individual/ m^3	-	-	16.66	8.3	
	Mass	gram/m^2	-	-			
3	Crustacea						
	Quantity	individual/ m^3	65.27	-	25	50	
	Mass	gram/m^2	4.08	-	1.78	6.72	

(Source: Institute of Aquatic farming research No II)

Table2. The list of coastal zooplankton of Ben Tre

No	Name of species	No	Name of species	No	Name of species
1	**MeDUSA**	34	C. gracillis (Dana)	67	Enterpina acutifrons Dana
2	Liriope fctraphylla Chamissco & Eysenhard	35	Schmackeria Dubia (Kiefcr)	68	**Vibilia gibbosa Bovillus Cummscea (Tom sen)**
3	Agalma okeri Eschscholtzi	36	Schmackeri sp	69	**Diastillis sp(Tom Cam)**
4	Halistemma rubra Vogt	37	Metacalanus aurivillii Cleve	70	Sirralla clausi sars
5	Agalma Halistemma peron & Lesuaur	38	Tcmors discandata (Gicsb)	71	Ncomysis Longicomis Sars
6	Bongainvillea bitentaculata Uchida	39	T. Turbinata (Dana)	72	Mesopodopsis slabben Bened
7	plenbranchia pileus	40	Pscudodiaptomus msrinus Dano	73	**Decapoda (Muoi Chan)**
8	Boroe cucumis Polychaeta (giun nhieu to)	41	P. incinus Shen & Lee	74	Lucifer hanseni Nobili
9	Polydora ciliata	42	Pscudodiaptomus SP	75	**Acetus vulgaris Hanse Isopoda (Chan Den)**
10	Sabalania alveolata	43	Allodiaptomus gladiolus Shen & Lee	76	Tachea chincnsis thiclemann
11	Nereispelagica	44	A. calcarus Shen ct tai	77	Tachea SP Pteropoda & heteropoda
12	Rhynchonerella fulgena Grccff	45	Labidocera enchacta Giesh	78	Atlanta fusca Sonleyet
13	**Cladocera (Rau nhanh)**	46	L.Pavi Giesb	79	Creseisacicula Rang
14	Penillia avirstris Dana	47	Calanopia clliti Dana	80	**C Virgular Escheholzi Chaetognatha (Ham To)**
15	Ceriodaphnia quadranguta Muller	48	C.Minor A.Scott	81	Sagita entlata
16	C. Recticalat Jurine	49	C. Thompsoni A. Scott	82	S. Bcdotiminor tokioka
17	Ceriodaphnia Sp	50	Pontella securifet Brady	83	S. Minima Grassi
18	Moinadubia Richard	51	P.sinica Sgen & Lee	84	S. Ncglecta aida
19	**Sida crystallina Muller Rotatotia(Trung banh xe)**	52	Acartia crythraca Giesb	85	S. delecata Tokioka
20	Brachionus plicatilis Muller	53	A. Paclicica Stener	86	**Krohnitta pacilica (Aida) Tunicata (Co Bao)**
21	B.quadridentata Herman	54	A.clasi Giesb	87	Oikoplenra rufeseens Fol
22	**Copepoda (chay mai**	55	A. Spinicanda Giesb	88	Rncylops SP

No	Name of species	No	Name of species	No	Name of species
	cheo)				
23	Canthocalanus Minor (claus)	56	A. negligens Dana	89	Corycaeus Speciosus Dana
24	Encalanus subcrassus Giesb	57	Acartiella Sincnsis Shen & Lee	90	C. Dahli Tanaka
25	Paracalanus acnlecatus Giesb	58	Torttanus Focipatus (Giesb)	91	Canthorocamlus staphylinus furinc
26	P.parvus (clans)	59	Oithona plumifera Braird	92	Limnoncaca genunica kokubo
27	P. gracilis Chen and Zhang	60	O. Brevicomis Giesb	93	Macrosetekka Gracillis Dana
28	P, crassirostrics Dahl	61	O.simillis (claus)	94	**Ostracoda (co vo)**
29	Acrocalanus Graciolis Giesb	62	Oncaca conifera Geisb	95	Heteroccyru\is anomala klie
30	A. Gibber Gicsb	63	Mescocyciops lencarti (Claus)	96	Physcopris crenilata (sats)
31	Clansocalanus arcniconis (Dana)	64	Encyclops serrudafus	97	**Ampipoda (Boi Nghieng)**
32	C.furcatus (Brady)	65	Microsetella norvegica Bocck	98	Hypera schzogencios Stcbing
33	Centropages furcatus (Dana)	66	M.rosca Dana	99	H. Latissma Bocatius

(Source: Nha Trang Oceanography Institute)

Table3. The list of coastal zooplankton of Ben Tre

Animal groups	Station										
	1	2	3	4	5	6	7	8	9	10	11
Copepoda	517.6	2859.1	4122.0	1038.2	2305.7	388.5	180.7	2442.9	7683.0	841.6	7950.0
Chaetognatha	29.11	170.33	138.44	2.378	0.16	0.25	0.37	4.48	120.96	170.53	16.25
Cladocera	0.62			12.71	59.96	4.16	33.3	3.14		2.08	15.00
Lucifet	5.03	34.63	18.53	70.26	173.31	0.26		1.96		1.18	3.75
AT polochaeta	0.62		1.83	3.63	4.77		1.11	4.33		15.47	0.62
ATCrustancean	56.25	92.99	166.13	15.50	374.95	3.38		32.28	221.77		90.00
AT Abdominal leg							0.37	0.39			
AT						1.04	0.74		7.25		

Animal groups	Station										
	1	2	3	4	5	6	7	8	9	10	11
equivalve											
Tunicata	10.14	45.67	17.50	1.81			0.37	4.27	30.64		
Isopada		0.45			1.31				6.45		
Mysidacca			1.83			8.07	5.92	48.03	7.25		
Acctes			6.17					5.11			
Amphipoda					1.48	3.12	1.48	1.18			
Hetero & ptetopoda					62.27				12.90	1.19	
Ostracoda						1.04	0.37				
Cumacea							0.37	3.39			
Total	619.4	3202.8	4472.5	1413.5	2985.5	409.6	195.1	2592.9	8090.3	1033.9	8076.2
Amount	18.88	52.2	263.15	154.37	172.98	28.64	3.70	251.96	201.61	17.85	67.76

(Source: Nha Trang Oceanography Institute)

Table 4. The zooplatonk species in shrim breeding ponds

No	Groups	Shrim breeding pond		
		1	2	3
1	Copepoda	4404	144	770
2	Chaetognatha			2
3	Crustacean larva	2868	548	1640
4	Mýidacea		4	4
5	Polochaete larva	12		112
6	Equivalve larva			14
7	Abdominal leg larva		2	
8	Brachionó		442	
	Total	**7284**		**2542**

(Source: Nha Trang Oceanography Institute)

Table 5. The list of zooplatonk species

No	Class-Breed- Species	Binh Dai	Thach Phu	Ba Tri
	Cyanophyceae			
1	Anbeana sp		+	
2	Microcysis sp			+
	Bacillariophyceae			
1	Bacillaria paradoxa	+	+	
2	Bacteriastrum commosum vhispida		+	
3	Bacteriastrum varians		+	
4	Bellerosxhea malleus	+	+	
5	Cerataulina bergonii		+	+
6	Chaetoceros laevis		+	

No	Class-Breed- Species	Binh Dai	Thach Phu	Ba Tri
7	Chaetoceros sp		+	
8	Clinacosdiun Biconcavum	+	+	+
9	Coscinndiscus centrales		+	
10	Coscinndiscus censinus		+	
11	Coscinndiscus curvsencs	+	+	
12	Coscinndiscus diversus		+	
13	Coscinndiscus exentricus	+		
14	Coscinndiscus gigas v.praetexte	+	+	
15	Coscinndiscusjcnestanus	+	+	+
16	Coscinndiscus lacustric	+	+	+
17	Coscinndiscus lineatus		+	
18	Coscinndiscus magrinatus	+	+	
19	Coscinndiscus perforatus	+	+	
20	Coscinndiscus radiatus	+	+	+
21	Coscinndiscus sp	+	+	+
22	Ditylum brighwvellii	+	+	+
23	Ditylum sol		+	+
24	Ethmodisus sp		+	
25	Guinardia flaccida		+	
26	Hemiaukus membranaceus		+	
27	Hemiaukus sinensis			+
28	Auderia brrelis		+	
29	Leptocylinarus danicus	+	+	
30	Melosira granulata	+	+	
31	Melosira granulata v. angustissima	+	+	+
32	Nitzschia lorenziana	+	+	+
33	Nitzschia sigma v. intercedens	+	+	
34	odontalla mobiliensis	+	+	+
35	Odontella regia		+	
36	Planktoniella sol		+	+
37	Pleurisigma normannil		+	
38	Plerosigma Sp	+		+
39	Proboscioa alata F.indica	+	+	
40	Pseudonitzschia sp		+	+
41	Pseudonitzschia calcar – avis		+	
42	Rhizosolenia bergonii		+	
43	Rhizosolenia cylindrus		+	
44	Rhizosolenia frgilissitna		+	
45	Rhizosolenia imbricata		+	
46	Rhizosolenia robusta		+	
47	Rhizosolenia stolterfothii		+	
48	Skeketonema costatum	+	+	
49	Sriella terera		+	+
50	Thalassionema nitzschiodes	+		

No	Class-Breed- Species	Binh Dai	Thach Phu	Ba Tri
51	Thalassiora decipiens	+	+	+
52	Thalassiora subtilis		+	+
53	Thalassiora frauenfeldii	+	+	
54	Triceratium favus	+	+	+
55	Triceratium revale		+	
56	Cf. planktoniellas	+	+	
	Chlorophyceae			
1	Pediartum biradiatum			
	Zygenemattophyceae			+
1	Spirogyra protecta	+	+	
	Dinophyceae			
1	Ceratium breve		+	
2	Ceratium furca	+	+	
3	Ceratium fusus		+	+
4	Ceratium horridiun		+	+
5	Ceratium macroceros		+	
6	Ceratium trichoceros	+	+	
7	Ceratium tripos			+
8	Ceratium vulture			+
9	Dinophysis cacdata		+	+
10	Dinophysis mikes	+	+	+
11	Dinothrix cf.paradoxa			
12	Dinothrix sp	+		+
13	Ornithocercus magnifacus		+	+
14	Protoperidinium depressum		+	+
15	Protoperidinium oceanicum			+
16	Protoperidinium sp	+		
17	Pyroccystis robusta		+	
	Total		66	32

Table 6. Inventory of zoobenthos mass according to the station and survey area of Ben Tre province

The area/station	Unit	Polochaete	Molluse	Crustacean	Echinoderm Species	Total
Ba Tri						
1	g/m^2	0.13	0.93			1.06
2	g/m^2	0.07	0.27			0.34
3	g/m^2		0.33			0.33
4	g/m^2	0.06	1.07		106.66	107.79
5	g/m^2	0.06		0.07		0.13
Average	***g/m^2***	***0.06***	***0.52***	***0.07***	***21.33***	***21.93***
Binh Dai						
6	g/m^2		0.40	2.20		2.60
7	g/m^2	0.02	0.40	0.20		0.80
8	g/m^2	2.80	1.20	0.40		4.40

9B	g/m^2	0.60				0.60
Average	***g/m^2***	***0.90***	***0.50***	***0.7***		***2.10***
Thach Phu						
10	g/m^2	0.13	0.87			1.00
11	g/m^2	0.20	0.40			0.60
Average	***g/m^2***	***0.16***	***0.63***			***0.80***
Average of all area	g/m^2	**0.39**	**0.53**	**0.26**	**9.70**	**10.88**

Table 7. The list of coastal zoobenthos

No	Species	Thach Phu province	Binh Dai province	Ba Tri province
	SAGITLOIDEA Class			
1	Sagitta			
	BIVALIA Class			
2	Scimitilla	x	x	
3	Slique	x		x
4	Dsocula	x		
5	Selidicorbela			
6	Cosbicula bocourti		x	
7	Macalina bauguierri			x
	GASTROPODA Class			
8	Urithide	x		
9	Grithidea djadjarensis			x
10	Cerithium			x
11	Cossidula			x
12	Bigon niostoma			x
13	Bithynia misella			x
14	Polypylis			x
15	Sermyla tornatella		x	x
16	Melannoides tuberculatus			x
17	Pachydrobia		x	
18	Oliveila		x	
19	Nasourius		x	
20	Tritis		x	
21	Cantroridius		x	
22	Pestis ciolasea		x	
23	Reneanria cingabifora		x	
24	Torebra	x		
	POLYCHAETA Class			
25	Namalycastis longiciris		x	x
26	Dendronereis aestuarina	x	x	x
27	Nereis sp.			x
28	Nepthys polybranchia	x	x	x
29	Spiribranchus		x	

30	Sabella melanostigma	x		x
	SIPUNGOLOIDEA Class			
31	Dendrostoanum	x		x
	OLIGOCHAETA Class			
32	Aulophorus furcatus			x
33	Limodrilus hoffmeisteri	x	x	x
34	Branchiura sowerbyi			x
	CRUSTACEA Class			
35	Grandidierella	x	x	x
	Corophlium intermadium			x
	Kamaka palmata			x
	Melita vietnamica	x	x	
	Melita sp.	x	x	x
	Acetes indicus	x	x	x
	Misid	x	x	x
	Euphausid	x	x	x
	Alpheus giabler	x	x	x
	Acmacoplena balatri shen			x
	Apseudes			x
	Caridina			x
	Metaphase			x
	Apalucles			x
	Paradanus sanguinol entus			x
	Uca			x
	Macrobra chium			x
	Penaeus sp.			x
	Metapenaus ensis			x
	Metapenaus lysianassa			x
	Metapenaus monoceris			x
	Metapenaus intermedius			x
	Metapenaus brevicormis			x
	Metapenaus eboracensis		x	
	Metapenaus affinis		x	
	Peneidae larva		x	
	INSECTA Class			
	Agrion		x	
	Trames		x	
	Ninfeldia		x	
Total		22	31	40

Table 8. List of bird species recorded for Ba Tri IBA

No.	Species	Scientific Name	Notes
1	Collared Kingfisher	*Todiramphus chloris*	
2	Plaintive Cuckoo	*Cacomantis merulinus*	
3	Red Collared Dove	*Streptopelia tranquebarica*	
4	Black-tailed Godwit	*Limosa limosa*	
5	Bar-tailed Godwit	*Limosa lapponica*	*
6	Whimbrel	*Numenius phaeopus*	
7	Eurasian Curlew	*Numenius arquata*	
8	Common Greenshank	*Tringa nebularia*	
9	Common Redshank	*Tringa totanus*	*
10	Marsh Sandpiper	*Tringa stagnatilis*	*
11	Common Sandpiper	*Actitis hypoleucos*	
12	Terek Sandpiper	*Xenus cinereus*	*
13	Ruddy Turnstone	*Arenaria interpres*	*
14	Red-necked Stint	*Calidris ruficollis*	*
15	Sanderling	*Calidris alba*	
16	Curlew Sandpiper	*Calidris ferruginea*	*
17	Broad-billed Sandpiper	*Limicola falcinellus*	*
18	Spoon-billed Sandpiper	*Eurynorynchus pygmeus*	VU, *
19	Pacific Golden Plover	*Pluvialis fulva*	
20	Grey Plover	*Pluvialis squatarola*	
21	Little Ringed Plover	*Charadrius dubius*	
22	Kentish Plover	*Charadrius alexandrinus*	*
23	Malaysian Plover	*Charadrius peronii*	NT
24	Lesser Sand Plover	*Charadrius mongolus*	
25	Greater Sand Plover	*Charadrius leschenaultii*	
26	Black-headed Gull	*Larus ridibundus*	
27	Whiskered Tern	*Chlidonias hybridus*	*
28	White-winged Tern	*Chlidonias leucoptera*	*
29	Gull-billed Tern	*Gelochelidon nilotica*	
30	Caspian Tern	*Sterna caspia*	
31	Lesser Crested Tern	*Thalasseus bengalensis*	*
32	Common Tern	*Sterna hirundo*	
33	Arctic Tern	*Sterna paradisaea*	*
34	Little Tern	*Sterna albifrons*	*
35	Little Cormorant	*Phalacrocorax niger*	
36	Intermediate Egret	*Egretta intermedia*	*
37	Little Egret	*Egretta garzetta*	
38	Chinese Egret	*Egretta eulophotes*	VU
39	Grey Heron	*Ardea cinerea*	
40	Great Egret	*Casmerodius albus*	
41	Cattle Egret	*Bubulcus ibis*	
42	Chinese Pond Heron	*Ardeola bacchus*	
43	Yellow Bittern	*Ixobrychus sinensis*	*

No.	Species	Scientific Name	Notes
44	Painted Stork	*Mycteria leucocephala*	NT, *
45	Moorhen	*Gallinula chloropus*	*
46	Golden-bellied Gerygone	*Gerygone sulphurea*	
47	Brown Shrike	*Lanius cristatus*	
48	Pied Fantail	*Rhipidura javanica*	
49	Black Drongo	*Dicrurus macrocercus*	
50	Barn Swallow	*Hirundo rustica*	
51	Plain Prinia	*Prinia inornata*	
52	Ashy Tailorbird	*Orthotomus ruficeps*	
53	Eurasian Tree Sparrow	*Passer montanus*	
54	Paddyfield Pipit	*Anthus rufulus*	
55	Streaked Weaver	*Ploceus manyar*	

Bird names, sequence and species limits follow Inskipp *et al*. (1996).
Notes: VU = Vulnerable, NT = Near-threatened as per. BirdLife International (2004),
* species was not recorded during this survey

Appendix 3. pictures of stakeholder meeting and sampling











Appendix 4. The results of questionnaires for The first Public Consultation

I- After the dyke and culverts crossing the dyke are completed:

1- Water supply for agriculture:

Good: 24 Normal: 0 Shortage: 2 No idea: 3

2- Water supply for aquiculture:

Good: 21 Normal: 5 Shortage: 0 No idea: 3

3- Breeding:

Advantage: 22 Disadvantage: 0 No idea: 7

4- Salting:

Advantage: 11 Disadvantage: 10 No idea: 8

5- Climate

Good: 1 (%) Bad: 0 (0 %) Normal: 26 (%) No idea: 2

5- Drought, flood:

Limited: 15 (%) Increase: 9(%) Normal: 3 (%) No idea: 2

6- Affect on ecosystem (forest, domestic animal, crops, ...)?:

Yes: 6 (%) No: 19 (%) No idea: 4 (%)

II- Advantages will be brought by the project

Reducing natural disease: 29 (%) Convenient traffic: 9

Convenience for agriculture and aquiculture: 29 (100%)

Better environment: 5 Stable life: 29 (100%)

No idea: 2(%)

III- Disadvantages when implementing the project**:**

- Reduce agricultural area;
- Have to emigrate inhabitant;
- Difficult in production;
- Light polluted and local polluted environment;
- Light affected nature in the first constructing years;
- Losing aquatic farming area;
- Limited traffic, especially heavy load vessels.

IV- Other ideas:

- Proposing the project implementation as soon as possible;
- Assisting local people in relocation and compensating reasonably;
- Adding the bridges to ensure continuous traffic;
- Adding Ben Do culvert at Tan Xuan market;
- Widening dyke face from 7 to 10m;
- Need to care EIA and mitigation measures;
- Changing crops structure for interior households;
- Building resettlement area after the project is implemented.

Reference

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7. FS of Ba Tri Sea-dyke project, MARD and Ben Tre province, 2004.