MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

CENTRAL PROJECT OFFICE FOR WATER RESOURCES PROJECT

PROJECT: MEKONG DELTA INTEGRATED CLIMATE RESILIENCE AND SUSTAINABLE LIVELIHOODS (MD-ICRSL)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

SUBPROJECT

INFRASTRUCTURE TO DEVELOP SUSTAINABLE LIVELIHOODS FOR PEOPLE IN THE COASTAL AREA IN BA TRI, BEN TRE TO ADAPT TO CLIMATE CHANGE

(Final)

March 2016

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ABBREVIATIONS

BMP	Best Management Practices
CC	Climate change
CMC	Construction monitoring consultant
CPMU	Central Project Management Unit
CPO	Central Project Office
DARD	Ben Tre Department of Agriculture and Rural Development
DONRE	Department of Natural Resources and Environment
EA	Environmental Assessment
ECOP	Environmental Code of Practice
EIA	Environmental impact assessment
EMC	External Monitoring Consultant
EMP	Environmental Management Plan
EMS	Environmental monitoring system
ESIA	Environmental and Social Impacts Assessment
ESMP	Environmental and Social Management Plan
FFS	Farmer Field School
FS	Feasibility study
GAP	Good Agricultural Practices
GHP	Good Handling Practices
GOV	Government of Vietnam
HACCP	Hazard Analysis Critical Control Point
HH	Household
MARD	Ministry of Agriculture and Rural Development
MD-ICRSL	Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project
MKD	Mekong Delta
NGO	Non-governmental organization
ODA	Official Development Assistance
P/PC	Provincial/ People's Committee
PPMU	Provincial Project Management Unit
QCVN	National Technical Regulations
SIWRR	Southern Institute of Water Resources Research
SNV	Netherlands Development Organisation
IUCN	International Union for Conservation of Nature,
TCVN	Vietnam standard
WB	World Bank
WHO	World Health Organization

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CHAPTER 1. INTRODUCTION AND SUBPROJECT DESCRIPTION

1.1. SUBPROJECT BACKGROUND

Subproject "*Infrastructure to develop sustainable livelihoods for people in the coastal area in Ba Tri, Ben Tre to adapt to climate change*" is a subproject to be implemented under Component 3[1] of the Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods (MD-ICRSL) Project which is proposed by the Government of Vietnam (GOV) for financing from the World Bank (WB). The Central Project Management Unit (CPMU) of the Central Project Office (CPO) of the Ministry of Agriculture and Rural Development (MARD) is responsible for the overall management of the MD-ICRSL project. The development objective of the MD-ICRSL project is to enhance tools for climate-smart planning, and improve climate resilience of land and water management practices in selected provinces of the Mekong Delta in Vietnam. The Subproject owner is the MARD. The Provincial Project Management Unit (PPMU) of Ben Tre Department of Agriculture and Rural Development (DARD) are responsible for the planning and implementation of the subproject during preparation and construction. The Division of Water Resources of Ben Tre DARD will be responsible during operation. The subproject will be financed by GOV (central and local) and the WB.

1.1.1. Link of the subproject to the Regional Environmental Assessment

During the MDICRSL project identification and preparation a Regional Environmental Assessment have been carried out to identify the main environmental and social issues and challenges that relevant to the project and subproject design and environmental management. The section below provides a summary of the REA findings and recommendations for the subproject.

a) The main environmental and social challenges in the Delta estuary

The Delta estuary the riverine levies and alluvial floodplains of Can Tho, Vinh Long, Tien Giang, Long An, Kien Giang, Soc Trang and Ben Tre. The inter-tidal zone is under the mixed influence of upstream hydrology as well as coastal processes such as tidally-induced saline intrusion and channel-flow reversal. In the delta estuary under mixed coastal and freshwater influence, rice is still an important crop accounting for 30% of provincial area, with brackish aquaculture accounting for a further 11%. Rapid population growth and intensive agricultural and aquaculture development over the past decades have significantly reduced the natural values in the delta estuary.

Salinization of the estuary

- **Salinity intrusion into the delta estuary is reducing agricultural productivity and leading to dry season freshwater shortages.** Tidal fluctuations drive saline intrusion more than 80km inland, affecting 40% of the Mekong Delta. Seven provinces are highly prone to saline intrusion, including: Kien Giang, Tra Vinh, Ben Tre, Soc Trang, Ca

[1]Component 3 (Adapting to Salinity Transitions in the Estuary) has been designed to address the challenges related to salinity intrusion, coastal erosion, sustainable aquaculture and improved livelihoods for communities living in the coastal areas. This will potentially consist of: i) construction of coastal defenses consisting of combinations of compacted earth embankments and coastal mangrove belts; ii) modification of water and agricultural infrastructure along the coastal zone to allow flexibility for sustainable aquaculture activities and adapt to changing salinity levels; iii) support to farmers to transition (where suitable) to more sustainable brackish water activities such as mangrove-shrimp, rice-shrimp, and other aquaculture activities; and iv) supporting climate smart agriculture by facilitating water use efficiency in the dry season

Mau, Bac Lieu and Long An, with more than 1 million hectares experiencing salinity concentrations above 4g/L.

- **The situation of salinity intrusion in Mekong Delta is complex.** Each year the situation is different, depending on the magnitude of the previous years flooding, the ability to supply fresh water upstream in the dry season, the production level of Summer-Autumn paddy and the onset of the rainy season. Salinity can intrude far inland when rains start late, as happened for instance in 1977, 1993, 1998 and in 2004-2005. Highest salinity levels are reached at the end of the dry season, usually in April, but when rains are late sometimes even into early May. Figure 44 below shows the duration of salinity intrusion (>4g/L) in the delta estuary provinces of Ben Tre, Tra Vinh and Soc Trang.
- **Expected sea level rise will further increase salinity levels in the delta's river branches and its water network.** A sea level rise of one metre would increase the area of 4g/L salinity with 334,000 ha in relation to the benchmark year of 2004, a rise of 25%. Deep salinity intrusion is occurring already during dry seasons, giving rise to significant crop losses. Its extent and frequency is likely to increase due to climate change, giving rise to even higher and more frequent economic losses.
- **Water control infrastructure has been constructed in coastal provinces to control salinity intrusion into the estuaries**. Sea dikes have been constructed along estuaries and coasts in Tien Giang, Tra Vinh, Soc Trang, Bac Lieu, Kien Giang, Ben Tre and Ca Mau provinces**.** In Ben Tre and Ca Mau the sea dike system is not closed, and only gives partial protection. Both the height and strength of the dikes need upgrading.
- **Saline water is prevented to enter the canals by the construction of sluices that can be closed when the seawater rises with the tide above river water levels**. However, many canals do not have such sluices. Where sluices do exist, this creates conflicts between the freshwater needs of agriculture and the brackish water needs for aquaculture, which will be explored further in the following section. A large decline in capture fisheries is also associated with construction of a sea dikes to cut off saltwater flow into mangrove habitats so it could be used for rice farming. Estuarine fish and other animals rely on these intertidal habitats for feeding so impacts on coastal and freshwater fisheries also need to be considered.

Estuary balance between saline and freshwater farming

- **Balancing the needs of freshwater agriculture and brackish aquaculture is required to effectively adapt to salinity intrusion in the delta estuary**. In the delta estuary under the influence of both river flow and tidal action, the provincial authorities are faced with the decision to protect freshwater farming systems from salinity intrusion or open up the estuary floodplains for saline tolerant systems. The brackish water environment in the coastal provinces of the delta estuary and are gaining importance, not only due to emerging salinity issues, but also by the growing importance of adapting to this unfavourable situation. Measures to create a clear borderline between brackish and the freshwater environment remain underdeveloped.
- **Investment in large water control infrastructure for salinity intrusion will have far-reaching and long-lasting impacts on the delta system.** At present Ben Tre province is exploring the potential for a major investment in dykes and sluice gates, including a ring of sluice gates is proposed at the canal entrances for Ben Tre provinces. The provincial authorities are making decisions for the installation of sluices and dikes, which will shape the future land use in the province and the farming opportunities

available to local communities. In the past, the development of water control infrastructure has lead to conflicting interests and inflexible water management when local rice farmers sought to benefit their income through the conversion of their farms from rice to shrimp. Rice production has been unstable due to droughts, salinity intrusion and excessive flooding in the delta estuary.

- **Aquaculture area and aquaculture and shrimp production has increased in the delta estuary.** From 1995-2013 the total aquaculture area (ha), aquaculture and shrimp production increased significantly in Ben Tre, Tra Vinh and Soc Trang. Aquaculture in the delta estuary primarily includes *pangasius* catfish (Ben Tre and Tra Vinh only), shrimp and bivalve.
- **The areas of high value fruit crops have decreased from 2005 to 2012 due to issues with drought, salinity intrusion and conversion to aquaculture**.

Dry season freshwater shortages and droughts

- **Coping with dry season fresh water shortages and droughts and securing fresh water supply is a critical challenge for the delta estuary**. Ben Tre, Tra Vinh and Soc Trang, like many other coastal provinces suffer from several negative trends, like increased salinity intrusion, decreasing availability of fresh water of sufficient quality, depletion of aquifers. Sea-level rise and dry-season salinity intrusion limit the possibilities for fresh water agriculture and horticulture. Water quality problems put strain on (saline) aquaculture. There is a conflict in water use and availability between brackish areas and fresh areas, and more broadly between agricultural, industrial and domestic water uses. Some parts of Soc Trang and Kien Giang experience dramatic changes in seasonal freshwater available as surface waters in the dry season are almost exclusively dominated by tidal forces and the main source of freshwater is rainfall.
- **The droughts in 2002 and 2004-05 caused extensive damage to agricultural crops and water supply in the delta estuary**. The drought of 2002 was a dry season drought that occurred from February to April. Some 70,300 ha of the delta were affected, with crops lost from 17,800 ha (25 per cent of the affected area). Crop losses in the Mekong Delta accounted for about 25 per cent of the national crop loss and, based on these figures, the cost of this drought to the delta was estimated as approximately US$24 million (US$1350 per ha of crop loss).
- **The 2004 wet season finished early, causing salinity intrusion to occur further upstream than normal leading to widespread failure of the autumn rice crop and reduced dry season water supply.** More than 104,000 ha of rice were damaged in the delta. Ben Tre was the worst affected province, where 7000 ha of rice and 15,000 ha of fruit orchards worth US$33 million were destroyed. As well, more than 82,000 families were forced to buy water. The total drought damage bill to the delta was US$42 million.
- **Water supply in many areas, such as Ca Mau, Bac Lieu and Soc Trang water is used without treatment, so water quality is below the required standards**. Existing water infrastructure is said to operate at no more than 55-65% of the design capacity. According to the report of the Southern Institute for Urban and Rural Planning, around 60-65% of the urban population in the Delta receive water from the existing supply systems. The groundwater has been exploited for industrial and agricultural use since 1941. Up till now, there are about 200 large wells to provide water for urban areas and over 25,000 small-scale drilled wells to provide water for rural areas. The current total exploited groundwater amounts in the order of 480,000 m3/day**.** The freshwater shortages calls for a detailed assessment of the effectiveness of horticulture, freshwater

agriculture and brackish aquaculture in the delta estuary, especially as climate change is expected to bring increased average temperatures and further salinity intrusion.

- **Reduced retention area and sea level rise increase the vulnerability to flooding in the delta estuary leading to an increased need for capital-intensive measures for flood protection**. Conversion of agricultural land and floodplains decreases flood retention in the wet season, exacerbating the impacts of flooding in urban areas. Raising dykes in the upper delta to enable triple instead of double crop rice takes retention area from the river system decreases and increases flooding risks downstream. Drainage capacity is insufficient in many areas during periods of heavy rainfall and high river discharges, causing floodwaters to recede late.
- **The trend in industrialization and urbanization is growth, taking more land out of agricultural production**. At the same time more people need to be provided with food and fresh water. Ongoing industrialization will also take up more space and increase the demand for water as well as the production of wastewater. Both trends will increase the need for proper spatial planning, efficient water supply and further investments in water treatment.

Ethnic minorities and reduced farm-based income

- **A high number of Khmer people are living in Soc Trang and Tra Vinh, the Khmer are some of the poorest households in the Mekong Delta**. The Khmer people living in the Tra Cu district of Tra Vinh are living with poor water sanitation and hygiene conditions and relying on untreated groundwater for drinking. Their livelihoods totally depend on the natural resource base. Government initiatives have been targeted at the Khmer people and some improvements have been made. However, the proportion of Khmer households with improved income and wealth was lower than other households.
- **Khmer households and farmers are vulnerable to water related issues in the delta estuary**. Khmer farmers in the Soc Trang and Tra Vinh provinces are experiencing rice losses due to salinization and droughts in the early rainy season and pollution of inlet canal water is causing high mortality rates of culture shrimp. The pollution of surface water from disposal of human and animal wastes and run-off agro-chemicals from rice fields are impacting human health, agriculture and aquaculture. Poor sanitation conditions have increased the prevalence of mosquitoes carrying dengue and malaria.

b) Strategic direction for the Delta Estuary - Adapting to salinity transitions

The strategy for the delta estuary must address flood protection, freshwater supply for the horticultural/agricultural areas of Ben Tre and Tra Vinh, the limitation of groundwater aquifer exploitation to sustainable levels and livelihoods improvements. Adapting to salinity intrusion is required to address the challenges related to salinity intrusion, flooding through transitions to sustainable aquaculture and improved livelihoods for communities living in the coastal areas. The key components in the strategy for the delta estuary and other coastal areas is to strengthen coastal protection through a mix of 'building with nature' type (where possible) and infrastructural measures (where needed) and facilitate a gradual transition from existing fresh water based rice production towards a brackish and diversified aquaculture system that adapts to increasingly saline conditions. An additional priority is the protection of groundwater aquifers, due to increasing evidence that excessive groundwater extraction accelerates land subsidence.

This subproject has been designed taking into account the strategic direction recommended by the REA to include restoration of mangroves along the provincial coastline, dredging of infield 3rd order canals, and constructing sluice gates to improve water quality, efficiency and

sustainability of aquaculture in the brackish water zone, and supporting a gradual transition from rice and other freshwater crops in the saline intruded zone to a brackish water economy including aquaculture through demonstration and aquaculture extension together with necessary adjustments to land-use plans in a longer term.

1.1.2. Need of the subproject

Ba Tri is a coastal district of Ben Tre Province which is frequently affected by saltwater intrusion, storms, cyclones, tidal surges, etc. causing serious damages to production and living in the region. According to the report of Ba Tri District, the loss in 5 years (2010 – 2014) by affected of salinization and the rise of water levels was VND 238 billion, in which the aquaculture sector lost VND 127 billion).

The proposed of Subproject will focus on the following activities: i) Building sluice gates to control salinity intrusion; ii) Developing shrimp model in coastal protection forests; iii) Dredging canals to improve water quality for aquaculture to meet the needs of production restructuring, disaster prevention, and waterway transport development; iv) Investing in livelihood models for climate change adaptation in the coastal region of Ba Tri district; and v) Enhancing the understanding of current climate change adaptation practices. Especially, the Subproject will support the Farmers' Unions and market links, promoting the good practice in agriculture and aquaculture cultivation, providing technical guidance and training for aquaculture, and raising awareness about climate change. The subproject scope is presented in *Figure 1.1*.

1.1.3. Subproject objectives

General objectives: The primary objective of this subproject is to address the challenges related to salinity intrusion, sustainable and improved livelihoods for communities living in the coastal zone of Ba Tri district, Ben Tre Province.

Key objectives:

- Constructing coastal defences consisting of combinations of compacted earth embankments and coastal mangrove belts;
- Modifying water and agricultural infrastructure along the coastal zone to allow flexibility for sustainable aquaculture activities and adapt to changing salinity levels;
- Supporting farmers in to transition (where suitable) to more sustainable brackish water activities such as mangrove-shrimp, rice-shrimp, and other aquaculture activities; and
- Supporting climate smart agriculture by facilitating water use efficiency in the dry season.

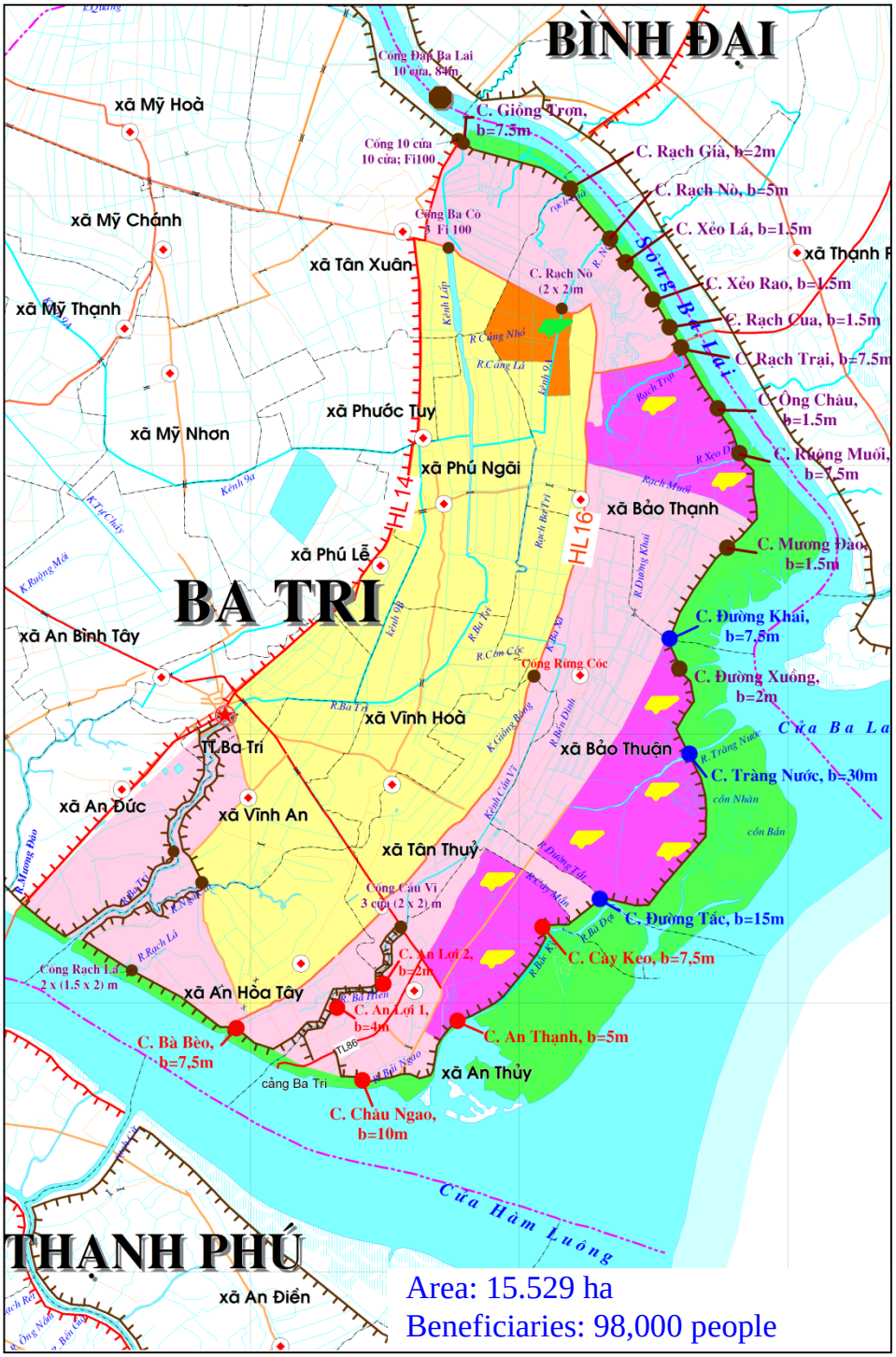


Figure 1.1. The production zoning map in the subproject region

1.2. OVERVIEW OF ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

1.2.1. Objectives of the report

The Environmental and Social Impacts Assessment (ESIA) and Environmental and Social Management Plan (ESMP) have been prepared in parallel with the feasibility study of the subproject in order to identify and assess the potential impacts, and propose measures for

preventing, minimizing and controlling potential negative social and environmental impacts that may occur during project implementation. The environmental friendly solutions aiming at sustainable development has also been considered in the subproject.

The ESIA report has been made in compliance with the World Bank Safeguard Policy and related policies of Vietnamese Government.

1.2.2. Organization of environmental impact assessment

Subproject approval authority: Ben Tre Provincial People committee (Ben Tre PPC)

Subproject owner: Ben Tre Department of Agriculture and Rural Development (DARD)

The consultant: Southern Institute of Water Resources Research (SIWRR)

Represented by: Dr. Tran Ba Hoang - Position: Director

Address: 658 Vo Van Kiet, Ward 1, District 5, Ho Chi Minh City.

Phone: (08) 39233700 - Fax: (08) 39235028

SIWRR was established in 1978 based on the Decision No 864 QD/TC dated 19 August, 1978 of the Ministry of Water Resources (now Ministry of Agriculture and Rural Development). Over 35 years of operation, development and growth, the Institute's activities have always been focusing on agriculture and rural development, integrated water resources management, natural disaster mitigation, land reclamation, environmental protection, etc. in the Southern provinces, especially in the Mekong Delta.

SIWRR has legal capacity to prepare this report. Regarding the research facility, SIWRR has second facility for experimental laboratories located in Binh Duong Province with three specialized laboratories registered LAS -1037, LAS - 155, LAS - 143 with the Ministry of Construction.

Besides being ISO 9001 – 2008 certified, the Labs have been accredited by the Laboratory Accreditation System. Regarding Machinery and Equipment: In addition to common machinery and equipment, the Institute's professional units are also equipped with many advanced research machines and devices such as Distomat wind meter; Wave height-speed-direction and current data in a single Instrument, Acoustic Doppler Velocimeter, Sediment Instruments for all environment, Echo-sounding meter, ADCP (acoustic doppler current profilers), GPS, gas chromatography, atomic absorption spectrometer, Programmable electromagnetic four quadrant liquid velocity meter, control unit for ultrasonic high concentration meter (UHCM), concrete compression gauging machine, cement bending compression machine and steel laminating machine, triaxial compressor (ELLE), etc. and advanced supporting softwares: ArcGIS, Satellite image processing software, MIKE set, HYDROGIS, DUFLOW, KOD, SAL, VRSAP, IMSOP, SOIL, SOICHEM. Regarding human resources, SIWRR has 178 staffs working in different professional scientific and technological fields. To implement this report, SIWRR has nominated the necessary staffs (*Table 1.1*) with good competence and high experience not only on specialist knowledge but English as well. They are really reliable staffs of our Institute to fulfill the tasks of this report.

Table 1.1: List of Involved Consulting Members and Their Roles

No	Full name	Background	Assigned tasks
I	**Representative of Subproject Owner – CPO Irrigation**		
1	Nguyen Van Ngan	Water Resources	▪ Directing the implementation of reporting environmental impact assessment.

No	Full name	Background	Assigned tasks
II	**Consultant – Southern Institute of Water Resouces Research**		
1	MSc. Duong Thi Thanh	Environmental Sciences	▪ Team leader - The administrative procedures, contacts and transactions related to the reporting EA. ▪ Public consultation. ▪ Composing EIA report.
2	MSc. Dong Thi An Thuy	Environment and Climate Change	▪ Writing report on analyzing and evaluating the impact of the works on the environmental quality of land, water and air in stages of the subproject. ▪ Analyzing and assessing impacts of climate change on the region, considering and impacts of the subproject with or without climate change. ▪ Public consultation.
3	Ass. Prof. Vo Khac Tri	Water Resources	▪ Undertaking hydraulic and water quality modelling. ▪ Assessing the results of water quality and salinity intrusion models.
4	MSc. Le Van Kiem	Construction - Water Works, Water Supply	▪ Developing and implementing scenarios of salinity intrusion. ▪ Developing and implementing scenarios of organic pollution forecasting. ▪ Composing section on hydrological and meteorological characteristics in the subproject area and the affected areas.
6	BSc. Nguyen Thi Tam	Analytical Chemistry	▪ Conducting report on the existing environmental quality (water, soil, air and sediment quality). ▪ Developing environmental monitoring and management in subproject life. ▪ Estimating costs for environmental monitoring. ▪ Organizing public consultation.
6	Prof. Dr. Tran Thi Thanh	Water Resources – Land Improvement	▪ Conducting report on existing water resources works and river/canal system in the subproject area and its surrounding areas.
7	BSc. Tran Thi Thu Huong	Biology	▪ Undertaking report on analysis and evaluation of the subproject impacts on the biodiversity due to subproject implementation.

No	Full name	Background	Assigned tasks
			▪ Proposing mitigations to control and mitigate subproject impacts on biodiversity.
8	MSc. Pham The Vinh	Construction of Marine Works	▪ Undertaking report on impacts of the subproject on water transport. ▪ Developing program to control and mitigate impacts of the subproject on water transport.
9	Ass Prof. Dr. Thai Thanh Luom	Forestry	▪ Developing forest management plan during subproject operation.
10	Dr. Nguyen Minh Nien	Aquaculture	▪ Analysis impacts of shrimp model on environment and propose mitigation measures.

1.2.3. ESIA Implementation Coordination Agencies

- Ben Tre Department of Natural Resources and Environment (DONRE).
- Ben Tre Statistics Bureau.
- The local People's Committees and other local organizations.

1.3. NATIONAL LAWS AND REGULATIONS AND WORLD BANK SAFEGUARD POLICIES

1.3.1. Relevant National Laws and Regulations

In Vietnam, there are national laws, regulations, and policies related to implementation of safeguard related activities and measures including and the key ones related to the project are briefly summarized as follows:

- Environmental Protection Law No. 55/2014/QH13 of the National Assembly of Vietnam dated June 23, 2014. This law enacted policies and regulations on environmental safeguards, and rights and obligations of organizations, households and individuals related to environmental protection activities.
- Land Law No. 45/2013/QH13 of the National Assembly of Vietnam dated November 29, 2013 prescribes the regime of land ownership, powers and responsibilities of the State in representing the entire-people owner of land and uniformly managing land, the regime of land management and use, the rights and obligations of land users involving land in the territory of the Socialist Republic of Vietnam.
- Law on Natural Disaster Prevention and Control No. 33/2013/QH13 of the National Assembly of Vietnam dated on June 19, 2013 provides natural disaster prevention and control activities; specifies the rights and obligations of agencies, organizations, households and individuals engaged in natural disaster prevention and control activities; and details the state management of, and assurance of resources for, natural disaster prevention and control.
- Law on water resources No. 17/2012/QH13 of the National Assembly of Vietnam dated June 21, 2012 provides on management, protection, exploitation and use of water resources, as well as the prevention of, combat against and overcoming of harmful effects caused by water in the territory of the Socialist Republic of Vietnam.

- Law on amending and supplementing a number of articles of the law on cultural heritages No. 32/2009/QH12 of the National Assembly of Vietnam dated June 18, 2009 to amend and supplement a number of articles of the Law on Cultural Heritages.
- Law on biodiversity No. 20/2008/QH12 of the National Assembly of Vietnam dated November 13, 2008 provides for the conservation and sustainable development of biodiversity; rights and obligations of organizations, households and individuals in the conservation and sustainable development of biodiversity.
- Law on Forest Protection and Development No. 29/2004/QH11 of the National Assembly of Vietnam dated December 03, 2004 provides for the management, protection, development and use of forests; and forest owners' rights and obligations.
- Law on Fisheries No. 17/2003/QH11 passed by the National Assembly of the Socialist Republic of Vietnam on 26 November 2003 and took effect since 01 July 2004;
- Law on inland waterway navigation No 23/2004/QH11 on Inland Waterway Navigation passed by the National Assembly of the Socialist Republic of Vietnam on of 15 June 2004.
- Decree No. 38/2015/ND-CP of 24 April 2015 of the Government on management of waste and discarded materials;
- Decree No. 39/2015/NĐ-CP of the Government dated 27 April 2015 on assistance policy applied to ethnic minority and poor women who comply the population policy will take effect as from 15 June 2015.
- Decree No. 18/2015/ND-CP dated February 14, 2015 of the Government on environmental protection planning, strategic environmental assessment, environmental impact assessment, and environmental protection commitment.
- Decree No.19/2015/ND-CP of 14 February 2015 of the Government detailing the implementation of a number of articles of the Law on Environmental Protection;
- Decree No.43/2014/ND-CP dated May 15, 2014 of the Government providing guidance on detailed implementation of some articles from the Land Law 2013.
- Decree No.44/2014/ND-CP dated 15 May 2014 of the Government providing regulations on land prices.
- Decree No.47/2014/ND-CP dated 15 May 2014 of the Government on compensation, support, and resettlement when land acquisition is required by the State.
- Decree No. 179/2013/NĐ-CP dated 14 November 2013 of the Government prescribing administrative sanctions for environmental protection.
- Decree No. 25/2013/ND-CP of 29 March 2013 of the Government on environmental protection charges for wastewater;
- Decree No. 67/2012/ND-CP of the Government dated 10 September 2012 on the amendment of Decree No. 143/2003/ND-CP of the Government dated 28 November 2003 on detailing the implementation of a number of articles of the ordinance on exploitation and protection of irrigation works
- Decree No. 113/2010/NĐ-CP dated 3 December 2010 of the Government on valuation of damages caused to the environment.
- Decree No. 174/2007/ND-CP of 29 November 2007 on environmental protection charges for solid waste;

- Circular No. 27/2015/TT-BTNMT dated 19 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment, and environmental protection plan.
- Decree No. 39/2015/NĐ-CP of the Government dated 27 April 2015 on assistance policy applied to ethnic minority and poor women who comply the population policy.
- Decree No. 38/2015/NĐ-CP of the Government dated 24 April 2015 on waste management including hazardous wastes, daily-life solid waste, ordinary industrial solid waste, liquid waste products, wastewater, industrial emissions and other particular wastes; environmental protection in discarded material imports.
- Circular No. 36/2014/TT-BTNMT dated 30 June 2014, specifying detailed methods of valuation of land prices, construction, adjustment of land prices; specific land prices valuation and land prices valuation consulting service.
- Circular No.37/2014/TT-BTNMT dated 30 June 2014, providing detailed regulation compensation, assistance, and resettlement when the State acquires land.
- Circular No. 30/2014/TT-BTNM, regulating the records for land allocation or land lease, the change of land use purposes, land acquisition
- Circular No. 12/2011/TT-BTNMT dated 14 January 2011 of the Ministry of Natural Resources and Environment on hazardous waste management.
- Circular No. 19/2011/TT - BYT of 06 June 2011 of the Ministry of Health guiding labour hygiene, labourers' health and occupational diseases.
- Circular No 13/2007/TT-BXD of December 31st 2007. Providing guidance on a number of articles of decree no. 59/2007/nd-cp dated 09/4/2007 by the government on solid waste management.
- Circular No. 36/2015/TT-BTNMT of 30 June 2015 on hazardous waste management.
- Circular No. 19/2011/TT - BYT of 06 June 2011 of the Ministry of Health guiding labour hygiene, labourers' health and occupational diseases.
- Circular No. 22/2010/TT-BXD the Ministry of Construction of December 3, 2010: On labour safety in work construction.
- Decision No. 1956/2009/QD-TTg, dated November 17, 2009, by the Prime Minister approving the Master Plan on vocational training for rural labours by 2020.
- Decision No. 52/2012/QD-TTg, dated November 16,2012 on the support policies on employment and vocational training to farmers whose agricultural land has been recovered by the State.
- Decision No. 3733/2002/QD-BYT dated 10 October 2002 on the application of 21 standards on safety and health.
- Decision No. 3733/2002/QD-BYT dated 10 October 2002 on the application of 21 standards on safety and health.
- Decision No. 23/2006/QĐ-BTNMT of 26 December 2006 of the Minister of Natural Resources and Environment) with list of hazardous substance
- Decision No. 96/2006/QD-TTg dated 04 May 2006 on management and implementation of bomb mine explosive material disposal.

- Decision No. 35/2005/QD-BGTVT dated July 21, 2005 of the Ministry of Transport promulgating the Regulation on quality, technical safety and environmental protection inspection of motor vehicles imported into Vietnam.
- Decision No 25/2004/QD-BGTVT MOT 25/11/2004 on the promulgating regulations on registration and inspection of inland waterway transport.

There are also a number of regulations and technical guidelines related to environmental quality and other requirements that need to be observed during the assessment of potential impacts as well as during implementation of the project and the key ones are highlighted as follow:

- QCVN 01:2009/BYT: National technical regulation on drinking water quality.
- QCVN 02:2009/BYT: National technical regulation on domestic water quality.
- QCVN 08-MT:2015/BTNMT: National technical regulation on water surface quality.
- QCVN 09:2008/BTNMT: National technical regulation on underground water quality.
- QCVN 10:2008/BTNMT: National technical regulation on water quality in coastal areas.
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater.
- QCVN 40:2011/BTNMT: National technical regulation on industrial wastewater.
- QCVN 39:2011/BTNMT: National technical regulation on Water Quality for irrigated agriculture.
- QCVN 38:2011/BTNMT: National technical regulation on Surface Water Quality for protection of aquatic life.
- QCVN 02-19: 2014/BNNPTNT: National technical regulation on brackish water shrimp culture farm - Conditions for veterinary hygiene, environmental protection and food safety.
- QCVN 03:2008/BTNMT: National technical regulation on permitted limit of heavy metal in land.
- QCVN 15:2008/BTNMT: National technical regulation on the pesticide residues in the soils.
- QCVN 43:2012/BTNMT - National technical regulation on sediment quality in fresh water areas.
- QCVN 05:2013: National technical regulation on ambient air quality.
- QCVN 06:2008: National technical regulation on hazardous substances in ambient air.
- QCVN 19:2009/BTNMT: National technical regulation on industrial emission of dust and inorganic substances.
- QCVN 20:2009/BTNMT: National technical regulations on industrial emission of some organic substances.
- QCVN 26:2010/BTNMT: National technical regulation on noise.
- QCVN 27:2010/BTNMT: National technical regulation on vibration.
- QCVN 07:2009/BTNM: National Technical Regulation on Hazardous Waste Thresholds.
- QCVN 31:2010/BTNMT: National technical regulation on enviroment for imported steel scrap.
- QCVN 32:2010/BTNMT: National technical regulation on environment for imported plastic scrap.

- QCVN 33:2010/BTNMT: National technical regulation on evironment for imported paper scrap.
- Solid waste standards: TCVN 6705-2000: Non-hazardous waste. Classification; TCVN 6706-2000: Hazardous waste. Classification
- QCVN 17:2011/BGTVT: National technical regulation on Rules for Pollution Prevention of inland waterway ships.
- TCVN 4447:1987: Earth works-Codes for construction;
- TCVN 5308-91: Technical regulation on safety in construction
- TCVN 6438-2005: Road vehicles. Maximum permitted emission limits of exhaust gas.
- TCVN 7222: 2002: General requirements on centralized wastewater treatment plant.
- Other relevant sector technical regulation and standards

1.3.2. Applicable World Bank Safeguard Policies

The environmental and social screening according to the criteria described in the Donor's policy on environmental assessment has been carried out in line with the Environmental and Social Management Framework (ESMF) which has been designed to be applied for the Project (MD-ICRSLP). Of the nine WB safeguard policies triggered for the Project 5 policies, Environmental Assessment (OP/BP 4.01); Natural Habitats (OP/BP 4.04); Forests (OP/BP 4.36); Pest Management (OP/BP 4.09); and Involuntary Resettlement (OP/BP/4.12). The subproject has also to comply with the WB's requirements on public consultation and Policy on Access to Information. Overall, the proposed project will bring about long-term environmental benefits and positive impacts to the lives of the people in the subproject area Ben Tre Province. The subproject will have some potential negative environmental and social impacts in associated with the construction of the 5 sluice gates and dredging 14 canals. The potential negative impacts of the civil works during construction are known including generation of noise, dust, solid waste, traffic and social disturbance, and are at a moderate level. Therefore, the subproject as categorized as a Category B project for environment.

The subproject Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) have been prepared in line with the government Environmental Impact Assessment EIA regulations and the World Bank safeguards requirements.

World Bank Group Environmental, Health, and Safety Guidelines

World Bank-financed projects should also take into account the World Bank Group Environmental, Health, and Safety Guidelines[2] (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group and are generally considered to be achievable in new facilities at reasonable costs by existing technology. The environmental assessment process may recommend alternative (higher or lower) levels or measures, which, if acceptable to the World Bank, become project- or site-specific requirements. This subproject should conform to the general EHS Guidelines and industry specific EHS Guidelines on Annual Crop Production and Aquaculture.

[2]The EHS Guidelines can be consulted at www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines.

1.4. ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGIES AND APPROACHES

Given that the ESIA report will be submitted both to the Government and the WB, the ESIA report has adopted the conventional methods being used for the preparation of an EIA in Vietnam (Sections 1.4.1 and 1.4.2) as well as the technical guidance from the ESMF with respect to the preparation of an ESMP for the ***subprojects aiming for dredging the existing canals, piloting new livelihood models in the estuary and peninsula, expanding aquaculture and shrimp farming, and planting mangrove forests in coastal areas***, as recommended by the Regional Environmental Assessment (REA), which will be presented in Chapter 3.

1.4.1. Methods of ESIA

1.4.1.1. Rapid Assessment Method

The Rapid Assessment Method was issued by the World Health Organization (WHO) in 1993. Basis of this method is nature of materials, technologies and rules of natural processes as well as experiences in rating pollution load.

In Vietnam, this method is introduced and applied in many ESIA studies, performing the relatively accurate calculation of the pollution load in the context of limited measurement and analysis instruments. In this report, the pollution load coefficients are taken under the EIA guidelines of the World Bank (Environmental Assessment Sourcebook, Volume II, Sectoral Guidelines, Environment, World Bank, Washington D.C 8/1991) and Handbook of Emission, Non-Industrial and Industrial source, Netherlands).

1.4.1.2. Impact Matrix Method

Building correlation between effects of each subproject activity to each issue and environmental composition are shown in the impact matrix. On such basis, to orientate detailed contents to be studied with impacts.

1.4.1.3. Comparison Method

The comparison method is to assess the environmental quality, effluent quality, pollution load, etc. On the basis of comparison are with the concerning environment norms and standards, the regulations of the Ministry of Health as well as the related researches and experiments.

1.4.1.4. Impact Identification Method

This method is applied through the following specific steps: describe the environment system; identify the subproject components that affect the environment; and identify the full range of related waste streams, environmental issues to serve the detailed evaluation.

1.4.1.5. Checklist Method

It is used quite common (since the establishment of the National Environmental Protection Agencies in some countries - NEPA) and bring positive results thank to many advantages as clear approach, systematic provision during system analysis and evaluation. It includes 2 main categories: (1) The description listing table which lists the environment components in need of research in addition to the information on the measurement, prediction and evaluation; and (2)

Simple checklist which will list environmental components to be studied and likely to be affected.

1.4.1.6. Method of Public Consultation and Disclosure of Information

Public consultation is used to help identify opportunities and risks, improved project design and implementation, and increase project ownership and sustainability. Public consultation is specifically required by the World Bank's environmental and social safeguard policies. This is a two-way process in which beneficiaries provide advice and input on the design of proposed subproject that affect their lives and environment, promotes dialogue between governments, communities, NGOs and implementing agencies to discuss all aspects of the proposed subproject. The feedbacks from consultation will be incorporated into the subproject ESIA and design.

Those affected by the subproject include those resettled and those in the nearby community affected by subproject impacts, intended beneficiaries of the subproject, key interest groups – depends upon the project, local NGOs/Mass organizations, including women's unions, local, state and central governments, other donor and development agencies, and other stakeholders.

Disclosure of the project information including the subproject safeguards instruments allows the public access to information on environmental and social aspects of subprojects. Disclosure is mandated by policies for the WB's Environmental Assessment, Involuntary Resettlement and Indigenous Peoples. The subproject safeguards instruments will be disclosed in country and in local languages and at the World Bank Infoshop, like consultation, it is an on-going process during project preparation and supervision.

1.4.2. Other Methods

1.4.2.1. Information and secondary data inheritance, summary and analysis

This method is deployed to identify and assess natural conditions and socio-economic conditions of the subproject area through data and information collected from various sources such as the statistic yearbooks, regional socio-economic profile reports, regional baseline environmental and relevant studies. At the same time, the inheritance of the available studies and reports is really essential to use up available findings and further identify limitations.

1.4.2.2. Field survey method

Field survey is compulsory for ESIA/EIA to identify the status of the subproject area, relevant surrounding objects to select sampling positions, survey of status of natural environmental components, hydrography, weather conditions, land use, vegetation cover, fauna and flora in the subproject areas. These survey results will be used for assessment of natural conditions of the subproject area.

1.4.2.3. Consensus and Expert Adjustment Method

Based on expert's knowledge and experiences in environmental science of EIA, the specialists of the consultant team and other scientific research units will discuss and agree the findings of impacts and identification of mitigation measures.

1.4.2.4. Sampling and Laboratory analysis

Sampling and laboratory analysis samples of environmental components (soil, water, air) are integral parts to identify and evaluate status of environmental baseline in the subproject area as follows:

- Surface and underground water quality: samples were taken and analysed, complying with the Vietnam standards, and results compared with National Technical Regulation on Surface Water Quality (QCVN 08-MT:2015/BTNMT) and National Technical Regulation on Coastal Water Quality (QCVN 10:2008/BTNMT) and National Technical Regulation on Underground Water Quality (QCVN 09:2008/BTNMT).
- Ambient air quality: samples were taken and analysed, complying with the Vietnam standards, and results compared to QCVN 05:2013/BTNMT– National Technical Regulation on ambient air quality.
- Noise and vibration: samples were taken and analysed, complying with the Vietnam standards, and the results compared to QCVN 26:2010/BTNMT- National Technical Regulation on Noise and QCVN 27:2010/BTNMT- National Technical Regulation on Vibration.

1.4.3. Data analysis

Collected data and information will be aggregated and synthesized to:

- Calculate and establish the tables, graphs;
- Assess the environmental quality;
- Calculate and evaluate generally the positive and negative impacts;
- Propose mitigation measures;
- Build environmental monitoring program.
- Send the report to the environmental experts (senior experts of World Bank, DONRE) for comments.
- Revise and complete the EIA report and submit it to the authorities for approval.
- Complete the final reports after receiving the comments of the Appraisal Council.

1.5. SUBPROJECT DESCRIPTION

1.5.1. Subproject Name

"*Infrastructure to develop stable livelihoods for people in the coastal area in Ba Tri, Ben Tre to adapt to climate change*"

1.5.2. Subproject owner

- Subproject owner: Ben Tre Department of Agriculture and Rural Development (DARD).
- Address: 26, 3/02 Road, ward 3, Ben Tre city, Ben Tre province.
- Telephone: 075.3822101 - 3575439- Fax: 075.3825601
- Representative: Mr Bui Van Lam

1.5.3. Subproject location and affected area

Ben Tre is one of the Mekong downstream provinces, which belongs to Tien tributary entering into the East Sea with four major estuaries in Ben Tre Province: Cua Dai, Ham Luong, Co Chien, Ba Lai. The Subproject is located in the area between the two estuaries of the Ba Lai and Ham Luong Rivers, with 25km of coastline.

The directly benefited area of the Subproject includes the 10 coastal communes of Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay, Vinh Hoa, Vinh An, An Duc, Phu Ngai in Ba Tri district - Ben Tre Province. The natural area of the directly benefited area is about 15,529ha. The subproject region is far from Ben Tre town about 40 km, which borders to (*Figure 1.2*):

- The East Sea on the South-eastern side.
- Ham Luong River on the Southwest.
- Ba Lai River on the North-eastern side.
- Ba Tri town (Ba Tri district) on the Northwest.

The subproject area includes the 10 coastal communes with a natural area of 15,529ha; the population is more than 98,000 people; the average population density is 631people/km^2. Most local residents are farmers (70%), others do fishing, aquaculture, salt-making, and a small part do services.

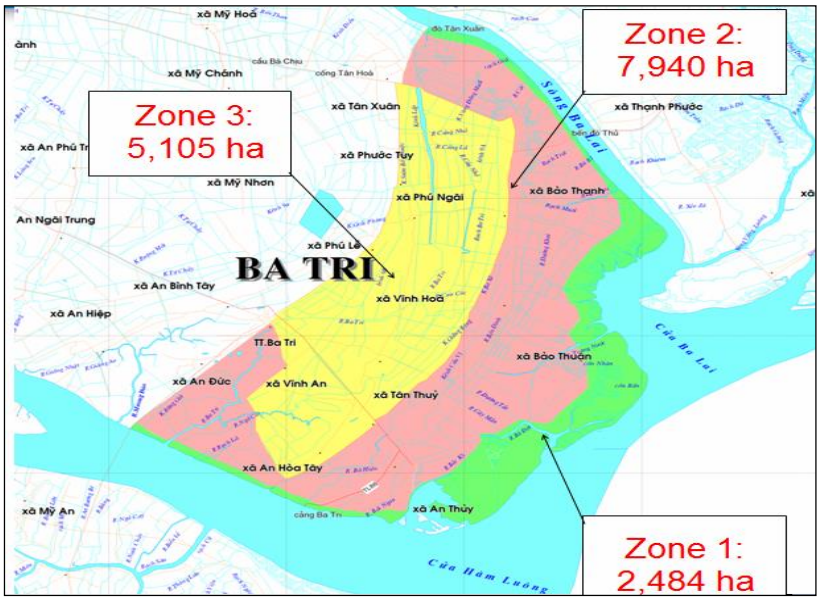


Figure 1.2. The zoning map in the subproject region

Ben Tre sea-dike was built covering the territory of the communes: Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy and An Hoa Tay in Ba Tri district, Ben Tre Province. The subproject region is one of the slow economic - social development areas of Ben Tre Province. The technical infrastructure is poor, especially the traffic conditions in the construction area, which is very limited and difficult in addition to difficult natural conditions such as:

- Lack of freshwater in the dry season due to salt intrusion. The aquaculture sector is undeveloped due to the fact that sluice gates and ponds are incomplete (for extensive farming households), leading to low and unstable yield (the average yield is 0.3 tons/ha). For industrial shrimp farms, due to weather effects (salinity, rain, floods, typhoons, storms,

tidal surges etc.), shrimp epidemic diseases caused significant losses for many households. As a result, people are afraid of restructuring into aquaculture; therefore, the current area of aquaculture practices is mainly located from district road No. 16 to the border of the protective forests of Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay communes with industrial, semi-industrial, extensive and intensive shrimp farms.

- The status of high tides, flooding in the rainy season and drought in dry season makes it difficult for production, causing huge economic losses and serious impacts on the environments in the subproject region. Besides, the salt intrusion in the dry weather affects both production and serious water shortage for residents in the six coastal communes.
- The implementation of the Subproject aims to prevent adverse effects from the sea, adapt to climate change and sea level rise, and prevent erosion of dike system to protect the lives, property and production of people in the coastal areas, and to improve the ecological environment along the coast.
- The subproject is also designed to address poor infrastructure, incomplete irrigation systems by (i) providing budget for the construction of essential works to control salinity, tidal surges to ensure the sustainable development of the aquaculture sector while minimize damage to rice-growing areas, crop areas; (ii) upgrading water supply and drainage canals to serve the aquaculture.

The construction of the Subproject will mobilize the local workforce, contributing to solving unemployment, increasing temporary income of workers, and promoting the development of business and services such as dining, entertainment etc.

1.5.4. Subproject components

The Subproject includes 03 components including support of the implementation of the livelihood models described below in the subproject area. These models have been selected and designed based on the results of some pilot models being implemented in the Mekong Delta. However, the final design and locations of the demonstration sites will be confirmed after discussion and confirmation with the local authorities and communities during the preparation of an implementation plan.

Component 1: (ZONE 1: 2,484 ha): Restoring mangrove belt

1. Additional mangrove planting in shrimp ponds (250 ha)/a.

Survey and design: 250ha.

Earthwork + Seedlings: 250ha.

2. Certification of shrimp mangrove eco-farming.

Training for farmers: 1000 HHs.

Certification of shrimp-mangrove eco farming: 1000ha.

Component 2: (ZONE 2: 7,940 ha): Improving sustainability of brackish water systems

1. Building 5 sluice gates to reducing economic losses caused by high tides.

2. Dredging 14 canals to improve water quality for aquaculture.

3. Improving biosecurity of shrimp aquaculture: 2500ha/8 cooperatives.

a. Establish farmer cooperatives: 8 cooperatives.

b. Demonstration models: 1 site/cooperative.

c. Training for farmers: 2500ha/300 HHs.

Component 3: (ZONE 3: 5,105 ha): Climate change adaptation for zone 3 (Saltwater intrusion)

1. Demonstration model rice - shrimp culture. Training for farmers: 180ha/150hhs.

2. Farmer Field School (FFS) Training for rice - shrimp culture model.

3. Raising Climate Change awareness & supporting establishment of commune Climate Change response teams.

Other activities: Preparing and implementing commune action plans:

a. Technical assistance (TA) assessments and planning for community action plans.

b. Training for extension staff and farmers on GAP.

c. Preparing and implementing commune action plans.

1.5.5. Items and scope of the subproject components

1.5.5.1. Component 1: (ZONE 1: 2,484 ha): Restoring Mangrove Belt

Objective: To restore coastal mangrove systems by additional planting of mangroves along the coastline and inside shrimp ponds (shrimp -mangrove eco-farming)

The scope of Component 1:

1. Additional mangrove planting in shrimp ponds (250 ha): Survey and design (250ha), Earthwork + Seedings (250ha). 2. Certification of shrimp mangrove eco-farming: Training for farmers (1,000 households), Establishing farmer groups, and Certifying shrimp-mangrove eco farming (1,000ha). The Mangrove-Shrimp Model is a mixture of shrimp and mangrove forest where forest area accounts for 50 % of the land area.	 Location of the Component 1: Mangrove-Shrimp Model in the subproject area

Advantage: The environment is natural. The mangroves take up organic pollution from the shrimp. The sizes of mature shrimps are large, fetching good prices. This system is considered the most sustainable system.

Certification of shrimp-mangrove eco farming support by the international shrimp market. The requirements for obtaining certification are:

- Forest area must be at least a certain percentage of the area of the land plot depending on the types of certificate (e.g., Natural land Certificate: 40% as a starting point moving to 50% within 2 years);

- The farming procedures must follow the standards guidelines;
- Post larvae must be sourced from a certified hatchery provider;

The environment must be better protected, particularly:

- Pens and cages for animals and livestocks as well as sanitation facilities must meet standards;
- Records of farming activities must be kept;
- Supporting documents proving origin of products must be kept;
- Storage and preservation facilities must be available for storage of harvesting.

1.5.5.2. Component 2: (ZONE 2: 7,940 ha): Improving Sustainability of Brackish Water Systems

Objective: To improve stability and efficiency of brackish water aquaculture production through reducing losses due to high tides, improving water quality and extension, and establishing farmer organizations and promoting good aquaculture practices (GAP).

The scope of component 2:

1. Constructing 5 sluice gates to reducing economic losses caused by high tides;

2. Dredging 14 canals to improve water quality for aquaculture;

3. Improving biosecurity of shrimp aquaculture (2, 500ha/8coop);

   a. Establishing farmer coop: 8 coops;

   b. Demonstrating models (1 site/coop): 8 site/coop;

   c. Training for farmers (2,500ha/300hhs): 2500 households.

The content of the component includes:

a). Constructing 5 sluice gates

5 sluice gates will be constructed along the Ba Tri sea dike with the aperture of 2 to 20m and the forced open-close valves. Scale of the five sluice gates construction is summarized in *Table 1.2* and locations of 5 sluice gates are shown in *Figure 1.3*.

Tidal and salinity controlling sluice gates will be built using a monolithic structure (hard structure) with a joint chamber (*Figure 1.4*). Piers and bottom beams are monolithic with hard links. This structure is upgraded from monolithic piers and bottom beams. With this structure, the bottom is cut off a part to form the bottom slab structure connected with the base of piers (*Figure 1.5*). The valve structure is flat as shown in *Figure 1.6*.

Table 1.2: Total scale of the five sluice gates

N⁰	***Name of sluice gates***	***Model***	***Width of level water (m)***	***Elevation (m)***	***Top of Piers (m)***
1	Duong Khai	Opencast, reinforced concrete M300 M300	7.5	3.0	+3.5
2	Trang Nuoc	Opencast, reinforced concrete M300 M300	20.0	4.0	+3.5
3	Duong Tac	Opencast, reinforced concrete M300 M300	20.0	4.0	+3.5

4	Cay Keo	Opencast, reinforced concrete M300 M300	5.0	-3.0	+3.5
5	An Thanh	Dike sluice box, reinforced concrete M300	2.0	-2.0	2.0 x 2.0

Figure 1.3: Location of 5 Sluice gates

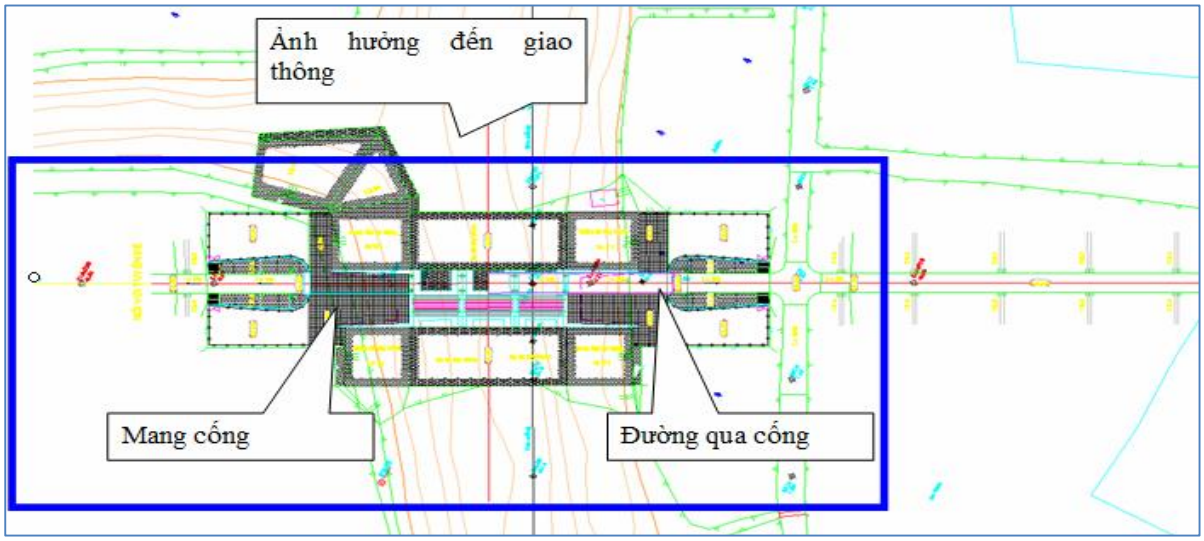


Figure 1.4:Lay out of construction site for sluice gate

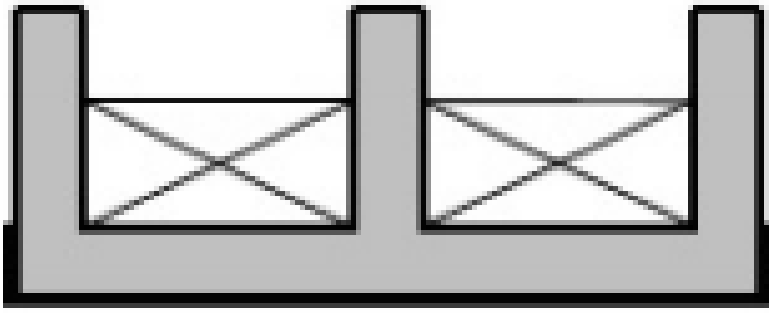


Figure 1.5: The structure of the joint chamber

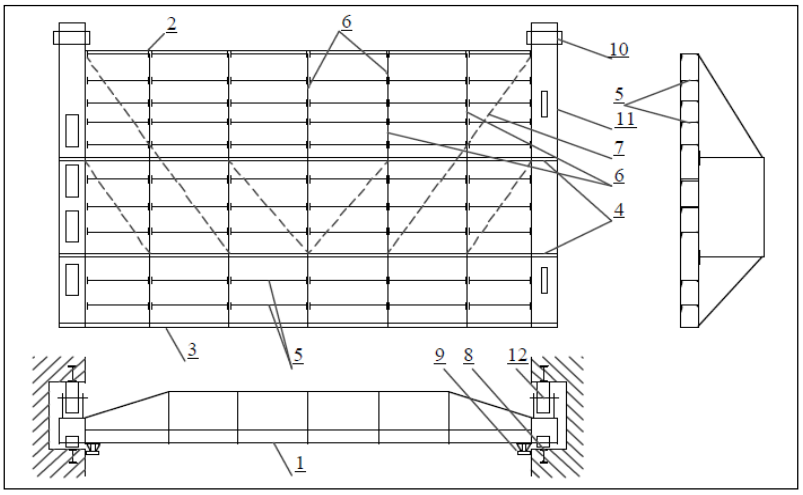


Figure 1.6: The flat valve gate

b). Dredging 14 canals to improve water quality for aquaculture practices

Dredging the canal system to improve the water supply quality for aquaculture (*Figure 1.7*). The dimensions of dredging are shown in *Table 1.3*.

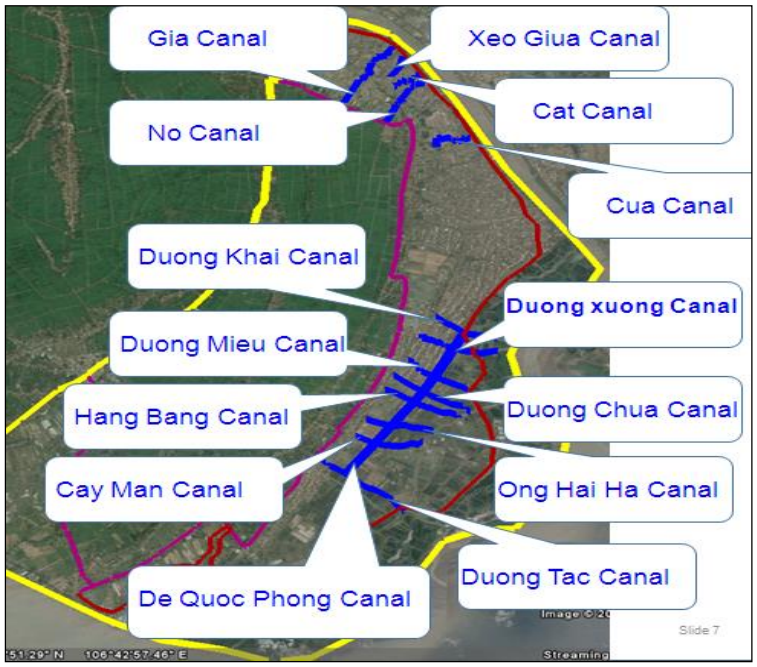


Figure 1.7: Dredging location map

Table 1.3: Total Quantity of dredging canal

N⁰	**Item**	**Location** (communes)	**Dimension**				**Quantity (m^3)**
			Length (m)	Up Wide (m)	Down wide (m)	Height (m)	
1	Gia canal	Bao Thanh	2,350	13	4	1.5	26,438
2	Xeo Giua canal	Bao Thanh	720	12	3	1.5	6,804
3	Cat canal	Bao Thanh	1,100	13	4	1.5	12,375

4	No canal	Bao Thanh	1,750	13	4	1.5	19,688
5	Cua canal	Bao Thanh	1,600	13	4	1.5	18,000
6	Duong Khai canal	Bao Thuan	2,040	15	6	1.5	30,294
7	Duong Xuong canal	Bao Thuan	2,400	15	6	1.5	35,640
8	Duong Mieu canal	Bao Thuan	1,720	15	6	1.5	25,542
9	Duong Chua canal	Bao Thuan	2,180	15	6	1.5	32,373
10	Cay Bang canal	Bao Thuan	2,000	15	6	1.5	29,700
11	Ong Hai Ha canal	Bao Thuan	1,630	15	6	1.5	24,206
12	Đe Quoc Phong canal	Bao Thuan	5,000	16.5	6	2	108,000
13	Đuong Tac canal	Bao Thuan	2,540	15	6	1.5	37,719
14	Cay Mam canal	Tân Thuy	1,640	15	6	1.5	24,354
	Total		28,700				**431,133**

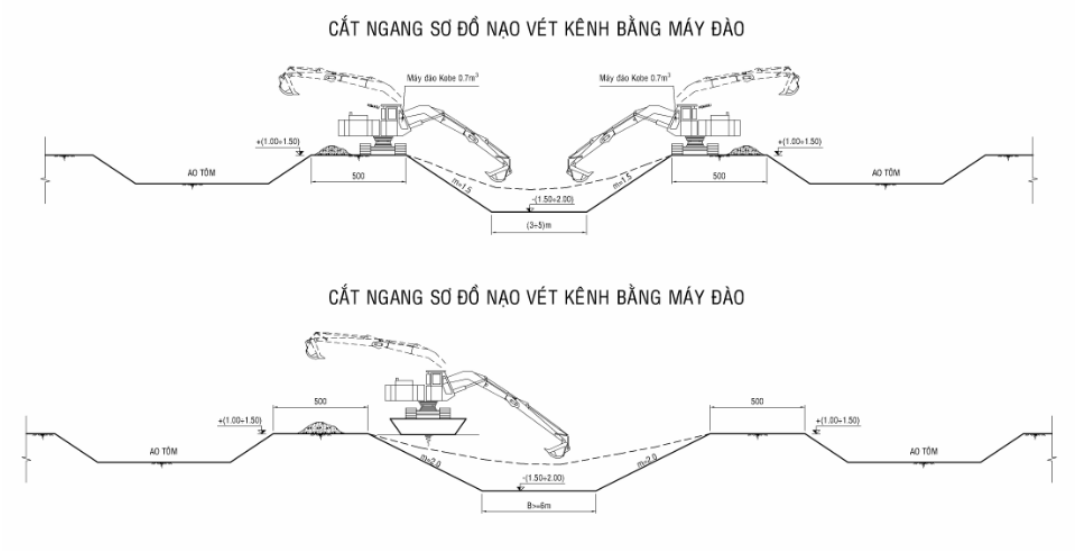


Figure 1.8: Canal cross- section of dredging

c). Improving biosecurity of shrimp

The production models to be built in the coastal communes of Bao Thanh, Bao Thuan and Tan Thuy (*Figure 1.9*). Technical grow Biosafety shrimp by following steps:

Design Pond:

- Bund solid, avoid leakage during growing.
- To ensure good water quality: 10-25 ‰ salinity, temperature around 25-31^{o}C.
- Ensure electrical and convenient communication.
- Design rectangular pond.

The aspect of biological safety:

- Reduce or no water exchange due to control pathogens at minimize in ponds.

- Use prevented net around the pond to prevent carriers pathogenic translators such as birds, disinfect water, avoid cross contamination, should have use certification for quality breed, water quality management and personal hygiene utensils.
- Use bio organic products.

Prepare pond

- Dredge bottom to release the organic humus from previous stage, dry pond bottom.
- Measures such as use lime in pond.
- Supply water through a sieve, the depth of the pond is maintained at least 1.5 m.
- Water disinfection by chlorine dose of 60 ppm.
- Inorganic Fertilization to stimulate development of natural food, with ratio of urea and phosphorus is 2: 1.

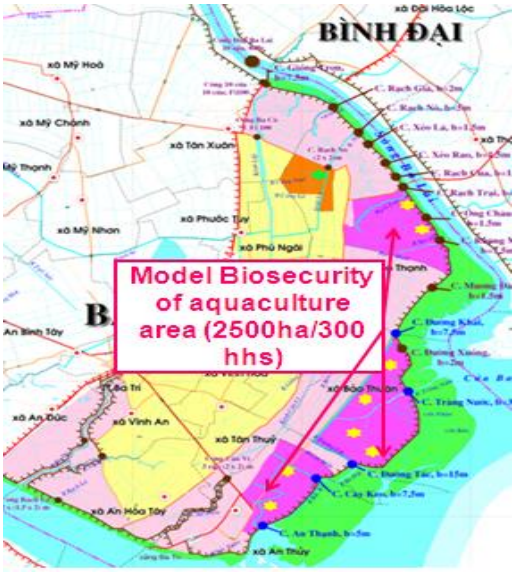


Figure 1.9: The locations of demonstration area

Stocking

- Release the base from the healthy breed which certified breed.
- Stocking density is 12 fry/m^2.
- Tame breed to reduce stress when stocking.
- Stocking right time / right season.

Manage water quality in aquaculture

- Maintain a stable environment by using bio organic products.
- Mode suitable aeration in closed culture systems.
- The environmental parameters as alkalinity, pH and oxygen are maintained in the optimal range.
- Nitrogen dose (N) and phosphorus dose (P) are maintained at high levels in shrimp culture systems of Biosafety.

Methods for feed

- Appropriate feeding regime through periodic sampling and testing sieve.
- Avoid superfluous feed to curb redundant food.
- When shrimp shell out (malt) or having any stress (shock) phenomenon, food should be reduced in shrimp feed.
- Periodically control in pond, in case necessary pond treatment by liming.

Shrimp health management

- Periodic health control of shrimps by biosafety method.
- Use bio organic products such as *Bacillus spp* efficiency, *Lactobacillus spp, Pseudomonas spp* and *Sacharomyses spp*.
- Best Management Practices (BMP) as prevent pathogenic carriers, pond management, breed quality certified quarantine and no use of chemical antibiotics.

Measures (methods) harvest and postharvest

- Minimize the shocking at the time of harvesting shrimp.
- Shrimp are preserved in ice in the best way and be transported to the processing plant based on the HACCP system.

1.5.5.3. Component 3: (Zone 3: 5,105 ha): Adaptation and Mitigation for Zone 3 (Saltwater Intrusion)

Objective: To build capacity and necessary steps for gradual transition to brackish water economy.

The scope of component 3:

1. Raising public awareness on climate change and supporting the establishment of communal climate change response teams:

- Conducting campaigns on information dissemination and awareness raising;
- Supporting the establishment of 6 communal climate change response teams.

2. Preparing and implementing commune action plans: TA assessments and planning for 6 community action plans. Training for extension staff and farmers on GAP. Preparing and implementing commune action plans.

3. Piloting climate resilience models: Building and adopting rice and forest-shrimp models (Giant freshwater shrimp/ crawfish shrimp – *Macrobrachium rosenbergii*) for 180 ha of 150 households.

4. FFS Training (Farmer Field School – FFS)

*** Piloting climate resilience models Adaptation Model Rice and Giant Freshwater Shrimp for 180 ha of 150 households**

The production models to be built in the Tan Xuan commune (*Figure 1.10*).

Technical giant freshwater prawn combined rice growing as follows:

Conditions of field:

- Near the river, canal, canals to the drainage level easily.
- Water supply should be clean, proper pH.

- Applying IPM in rice cultivation.
- Nearly a convenient place for the care and management.

Construct field:

- The area of field from 0,5-2ha, common is 1ha.
- Dike must be assured, no flooding, width of 2-3m shore; higher 0.5m above of the water level.
- The field should be flat land, water levels on the farm reaches 0.3 m.
- Ditch surround farm is 2-3m wide, 0.5 to 1.2 m deep. Flat bottom ditch slopes towards the drainage culvert.
- Drain: should have 1 drain for take water into farm and 1 drainage culvert. Manhole with nets to prevent pest into rice fields or shrimp escape. Important places have pens.

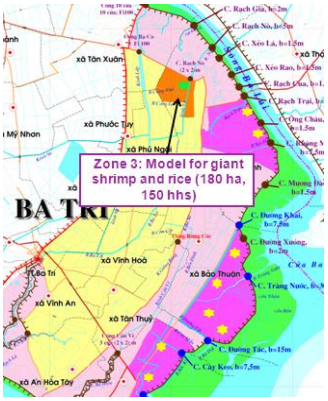


Figure 1.10: The locations of demonstration area

Prepare shrimp farming:

- Water drain off, clean grass, moss, mud pumped ditch, embankment cover, bottom dry during 7-10 days.
- Lime to disinfect and eliminate acid, increase the pH level.
- Dose 1.5-2kg per 1000m^2. Keep the water level 0.3 m. After drying pond 7-10 days, taking water into fields and breeding stock
- Liming before manure.

Shrimp breeding stock:

- Shrimp must be healthy, homogeneous, may use Stocking natural shrimp or artificial shrimp production.
- Stocking density: 0.5-1 individual per m^2. First shrimp are stocked into the ditch, then shift to field

Management and take care shrimp:

- Food for shrimp include food rich protein such as powder fish, crushed snails or soy dipping, and flours such as rice bran, corn, wheat, etc. synthetic foods.
- The weight of food is equal 2-5 % by weight in shrimp farming.
- Feeding should spread around the fields and ditches.
- Be sure to clean (fresh) water. If available should change 10 % of water for daily.
- In case of using pesticides for treatment disease on rice, the farmer should drain water in the rice field for shrimp protection against pesticides.
- Checking the dikes, the drains, leaking,
- Check periodically at 10 - 15 days per time to observe the growing of shrimp in ponds.
- After 4-6 months of growing, shrimps can be harvested at the size 70-100g/ shrimp

1.5.6. Measures of construction organization, construction technology for component 2

1.5.6.1. Sluice gates construction

To meet the objectives, the construction should include: Construction of 5 sluice gates; in the large canals which have inland navigation function, open sluice / navigation locks must be built to allow continuous navigation even when they are not necessary to prevent high tides and salinity control; sluice gates work in the compulsory operation to control the water level & salinity.

*** The construction steps** of sluice gates:

Step 1: Prepare construction site, positioning, driving foundation treatment piles under the sluice gates construction stages.

Step 2: Excavate and fill up foundation pits to the design elevation.

Step 3: Construction of steel piles, sluice gates out for construction of scaffolding for cofferdams.

Step 4: Treat foundation pits, construction of reinforced concrete structures under the construction stage of sluice gates.

Step 5: Once reinforced concrete structures are completed, proceed the valve installation and valve control system, that opens and closes valves.

Step 6: Construction of dissipative structures that connect upstream and downstream of sluice gates.

Step 7: Complete the construction of sluice gates.

1.5.6.2. Measures for dredging organization

The order and process of the dredging steps are presented in *Figure 1.11*.

Step 1: Preparation of construction machine and equipment and construction site

Complete documents and procedures related to the construction; request for permits of construction site; notify the dredging schedule.

Establish the steering committee and directly responsible divisions in the field.

Take over the worksite, landmark coordinates, elevation marks and legal documents, which are necessary for the construction of works.

Develop the quality management process, labour safety, environment sanitation, fire fighting and prevention, rules.

Based on the list of construction equipment, the steering committee will issue mobilization orders for equipment at site. The equipment mobilized to the construction site is right on number, types and construction locations based on the mobilization orders.

Step 2: Using the total station to check and position dredging center lines and dredging marginal.

Position center-lines and marginal of the dredging area by GPS, Echo-sounder, Theodolite.

Step 3: Installation of signals and buoys for dredging and transport of dredging sludge.

The dredging route has 2 buoys and warning signs for traffic safety.

Step 4: Using vertical dredger on barge for the dredging

The dredging is implemented by layers; each layer is < 2m high; the dredging slope is always guaranteed to be not being destabilized; check the dredging by the total station and the echo sounder. The dredging process is as follows:

The dredging vessels are positioned correctly at dredging locations → barges are alongside → dredgers with wire buckets start dredging sludge to move it into embankment.

Step 5: Completion and acceptance of works to put into use

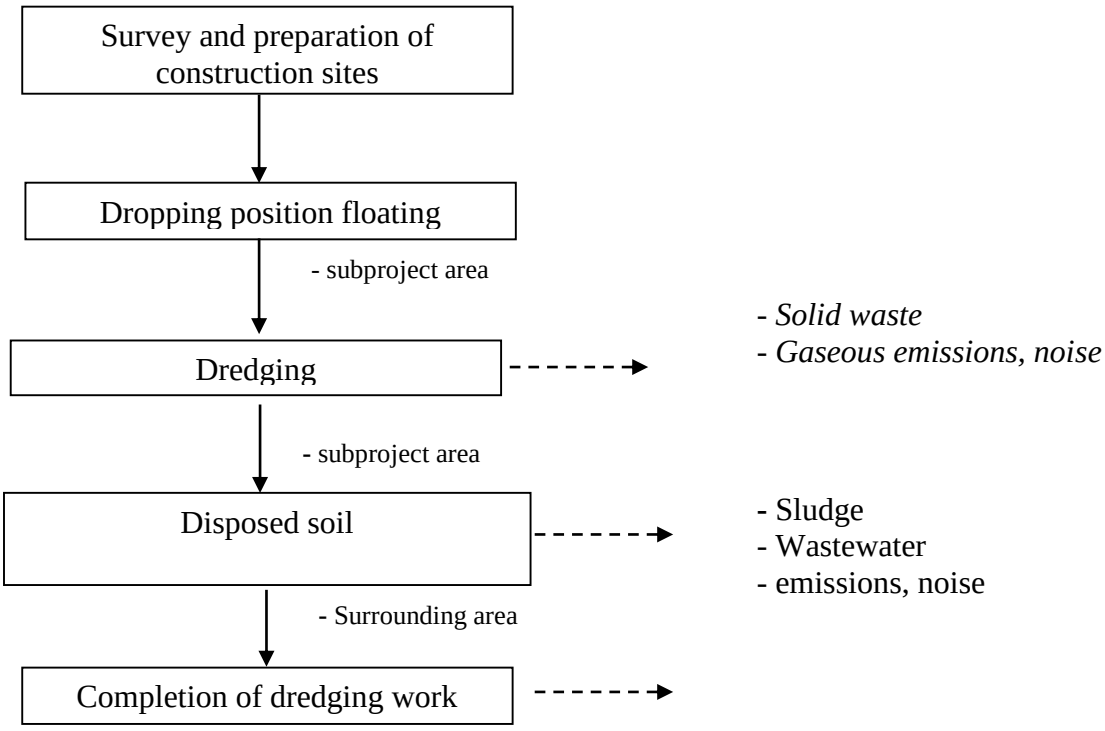


Figure 1.11: 5 steps for dredging

1.5.7. The list of proposed machinery and equipment

The equipment and machine proposed for the construction are summarized in the following table and they are common used, however, their depreciation rates remains 10-20% only and are regularly maintained (*Table 1.4*).

Table 1.4 : List of tools and equipment using for the subproject construction

N^0	**Equipment and tools**	**Equipment characteristic**	**Status**
I	*Excavation of soil and sand*		
1	Bulldozer	110 CV	Good
2	Excavator	0,6 m^3	Good
3	Dumping truck	9T	Good
4	Compactor	-	Good
5	Tracked crane	(0,7÷1,1)m^3	Good
II	*Reinforcement, formwork*		

N^0	Equipment and tools	Equipment characteristic	Status
1	Iron bending machine 5 KW	5 KW	Good
2	Iron cutting machine	-	Good
3	crane boom	5T	Good
4	welding machine	50 KW	Good
5	welding transformer	50 KW	Good
III	*Foundation treatment*		
1	Piling machine	-	Good
2	Support barge	200T tug 180CV	Good
IV	*Concrete work*		
1	Concrete mixer	750L	Good
2	Fixed concrete batching plant	30m^3/h	Good
3	Cement silos	-	Good
4	Cold station	-	Good
5	Bulldozer	110 CV	Good
6	Truck for transportation and mixing of concrete	-	Good
7	Crawler crane	-	Good
8	Needle vibrator	1.5kW	Good
9	Vibrator plate compactor	1.5kW	Good
10	Concrete jack hammer	-	Good
11	concrete drilling machine	f 32 mm	Good
V	*Other equipment*		
1	Concrete strength tester	-	Good
2	Concrete Thermometer	-	Good
3	Car pump	-	Good
4	Generators	200 KVA	Good
5	Electric winch	5T	Good
6	Fire extinguisher	-	Good

Source: FS report of the subproject, 2015

List of tools and equipment using for the the dredging is summarized in *Table 1.5*.

Table 1.5: List of tools and equipment using for the dredging

N^0	Equipment and tools	Equipment characteristic	Status
I	*Dredging Equipments*		
1	Excavator 0,8 m^3	volumetric 0,8 m^3	Good
2	Barge	volumetric bq 100T	Good

N^0	Equipment and tools	Equipment characteristic	Status
3	Dredger	100 CV	Good
4	Bulldozer	110 CV	Good
II	**Tools**		
1	Machine echo sounder	Syquest, Odom	Good
2	Machine locators DGPS	Promark 3	Good
3	Machine Total Station	Leica	Good
4	AT-B3 – Auto Level	Topcon	Good
5	Water levels		Good
6	Steel ruler, plumb		Good
III	*Other equipment*		
1	Boats	60CV	Good
2	Icom PTT		Good

1.5.8. Materials of the subproject

1.5.8.1. Filling materials

Some working items need filling of soil such as the connecting roads, approach roads to sluice gates. However, their quantity is not too large so that soil can be reused from the soil excavation concerning the sluice gates foundation or canals without planning material yards.

1.5.8.2. Other materials

In the construction area, there is no quarry, sand mining to provide for the construction works. Local materials are dike-filling soil, sluice gates-filling soil etc. The construction scale of the subproject does not requires opening of new borrow pits or quarries. Other building materials are transported from the following provinces:

- Sand, stone, gravel will be purchased from secondary wholesale providers located long the Ba Hien canal, Tra Vinh province, about 8-20km from the construction. All the construction materials will be transported to the subproject by water way. At this stage, decision on where to buy sand and stones from these providers could not be made because specific requirements on the quality of these materials will only be available during the detailed technical design stage. Nevertheless, during subproject implementation due diligence procedures will be followed to ensure that these sources are legally-produced and practicing sound environmental and social management. Requirements for environmental and social due diligence of materials sources are included in the ESMP
- Iron bars, cement are purchased from factories in Ben Tre and Tra Vinh.
- Melaleuca piles, petrol and lubricant are purchased in Ben Tre.

1.5.8.3. Energy

The power supply is to serve the construction and the later operation and management. The main power supply is from the national grid. The power line and 250 kVA substation is

supplied from 22 kV medium-voltage line in the region and is lowered at 0.4 kV voltage to serve the construction and the later operation and management.

1.5.9. Subproject progress

- Completion of detailed outline (pre-feasibility study): 05/2016
- Completion of feasibility study report: 08/2016
- Preparation time for the first investment phase: 2016-2017.
- Construction time: from 2/2017 to 12 /2021.

1.5.10. Investment cost

The total funding for the implementation of the subproject is US$ 14,213,000 in which the ODA funding is US$10,700,000.

1.6. ORGANIZATION OF PROJECT MANAGEMENT AND IMPLEMENTATION

The institutional management for the subproject is as follows:

- The Ministry of Agriculture and Rural Development, on behalf of the Government of Vietnam, is the Executive agency.
- The Central Project Organization (CPO) is on behalf of the Ministry of Agriculture and Rural Development to act as the management unit of the subprojects that belong to the "Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods Project" sponsored by the WB. A Central Project Management Unit (CPMU) for the above project is set up by the Ministry of Agriculture and Rural Development under the CPO.
- The Department of Agriculture and Rural Development (DARD) in Ben Tre Province, on behalf of the People's Committee of Ben Tre Province, is the subproject employer.
- The Project Management Unit for the Subproject "Infrastructure to develop sustainable livelihoods for people in the coastal area in Ba Tri, Ben Tre to adapt to climate change" was established from the Ben Tre Project Management Unit for Agricultural Investment Projects will directly govern and operate the Subproject implementation (PPMU).
- Ben Tre Department of Irrigation and Ben Tre Department of Agriculture and Rural Development are responsible for managing the Subproject after it is completed.
- Ben Tre Irrigation Work Exploitation One-member Co.Ltd. (IMC) takes responsibility to take over the works after the construction stage finishes managing and exploiting under the agreeable processes of the subproject.

CHAPTER 2. NATURAL, ENVIRONMENTAL, ECONOMIC AND SOCIAL CONDITIONS IN SUBPROJECT AREA

2.1. NATURAL CONDITION

2.1.1. Topographical, geological conditions

2.1.1.1. Topographical conditions

The terrain in the region is relatively flat. The sand dune is the highest, running parallel to the coast. The natural ground elevation is 0.8 - 1.2m. With such natural elevation, the proactive prevention of salinity, water reserve in rainy season and dry season is very difficult while the sluice gates is unfavourable because the lowland lies deep infield (0.6 - 0.8 m high). The region is strongly affected by ocean tides of the East Sea, Ham Luong River and Ba Lai River through infield canals engraining infield.

In the subproject premise there are plenty of natural watercourses and sand dunes, which separate the region into small areas. In the subproject area, a local salinity dike runs parallel with the East Coast. The dike starts from Truong Dang (the Party School - near the end of Provincial road 885) and passes An Thuy commune, Tan Thuy commune, Bao Thuan commune and ends at Bao Thanh commune (Ruong Muoi ditch). The dike is a small scale and engrains infield. The canals originating from the East Sea to come to inland that cut through the dike are still being open without control works, so the operation efficiency is not high. In addition, there are some irrigation works which have been invested as 10 sluice gates, Rach No sluice gates, Rach La irrigation system, infrastructure projects that serve tiger-shrimp feeding in Bao Thuan, An Hoa Tay, Tan Xuan etc. together with the local dyke and canal system attached to the system of works. The waterway traffic is quite convenient, especially for the planning and construction of irrigation works.

2.1.1.2. Geological condition of construction works:

The stratigraphy, in general, in the construction area is as follows:

Layer D: filling soil layer. The composition of this layer includes blue-grey clay, brown-grey clay, with some sand, gravel and plant roots; soft plastic - hard plastic state.

Layer 1b: riverbed mud clay; dark grey, black –brown grey; liquid state.

Layer 1: estuary marsh sediment, fine-grained sand, sandy loam, loamy clay, black-grey, blue-grey black-brown-grey, lenticular structure mixed with lateritized sand and granule, somewhere has tiny broken shells and plant humus; plastic - liquid state.

Layer 1a: Originated same as Layer 1 but contains higher sand grains somewhere which forms loamy clay, sand-clay; plastic - liquid state; somewhere has very soft-plastic soft soil. This layer exists in layer 1 at lenticular structure without distinct marks which make particle fine; the humidity and ductility is locally reduced.

Layer 1c: mainly composed of fine clayed-sand, mixed with clay seam - loamy clay - slightly loamy clay, grey-yellow-brownish grey clay with less tight structure, which is regarded as the marking layer with significant seashells. In addition, there is lenticular structure in layer 1 and layer 1a.

Layer 1d: is the lenticular structure of fine sand mixed with medium – heavy loamy clay, at high-viscosity of liquid state. Layer 1d is mixed in Layer 1 in lenticular structure; when there

is the considerable density, the independent fine-sand lenticular structures reserve molecular water which increases the amount of raw particles and local viscosity.

Layer 2: Late Quaternary marine sediments with medium sandy clay - medium clay, light yellow-brown - white - blue. Hard - semi hard plastic state.

Layer 2a: Late Quaternary marine sediments with heavy loamy clay – sandy clay, bright yellow-brownish-white - light blue. Hard - semi hard plastic state.

Layer 1c sometimes meets Layer 1d and Layer 1a due to focusing lenticular structures and thin mud.

c. Hydrogeological conditions:

Based on geological documents, the components and nature of surface water and groundwater in the construction area are as follows:

- Surface water resources:

The surface water in the subproject region is considered abundant due to being wrapped by Ba Lai River in the north and Ham Luong River in the south, which are branches of Tien River. However, the water quality is poor due to the salinity intrusion, so mining surface water for agriculture and daily life is very limited.

- Groundwater resources:

According to the groundwater documents of the Geology - Hydrology Union (mapping of 1/250,000) and the drilling results of the Rural Water Program, groundwater in the subproject area is divided as following:

- The tasteless Pleistocene aquifers focus in Thanh Phu and An Thuy, where there are 2 aquifers: the first aquifer appears at the depth of 30-50m and the 2nd aquifer appears at the depth of 60-90m. The groundwater here is typical by high chloride (Cl^-) content (454-925mg/l) and alum (Fe^{2+}:0.4-36mg/l). However this water source can be used for drinking in case of water scarce.
- The bottom Pleistocene aquifer at the of the depth of 165-175m is saline and has very poor quality and high mineralization, which cannot be used for drinking and farming.
- The upper Pliocene aquifer appears at the depth of 160-197m, rich in water Q= 6.65-16.6l/s and the water is tasteless with low mineral content but can be used for domestic purposes.
- The lower Pliocene aquifer appears at the depth of 346-446m and has low total mineralization. The trace elements are smaller than the normative limits (QCVN 01: 2009/BYT).

2.1.2. Climate, meteorology conditions

2.1.2.1. Temperature

The average monthly temperature is high (26.8 – 27.3^{o}C) and relatively stable during the year, in January, February the temperature is the lowest of the year, averaging 25.2 – 25.5^{o}C (*Table 2.1* and *Figure 2.1*).

The average temperature in Ben Tre increases in North West – South East direction. The maximum temperature has the same spatial distribution to the average, e.g. the area with highest temperature lies in North East of the province. The distribution is reversed in case of minimum temperature, the minimum temperature is at the South East of the province and gradually increases Northwestwards.

Period with max and min temperature connects with time of ENSO, years with highest max temperature (37.3^0C) usually fall in period of El Nino (2003), and years with lowest min temperature (17.2^0C) fall in period of La Nina (1999)

Table 2.1: Max, min, and average temperature of Ba Tri station

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Tavg	Tmax	Tmin
1990	25.6	26.2	27.3	29.2	28.8	27.8	27.5	27.1	25.8	27.2	26.3	25.6	27.0	37.1	20.1
1991	26.1	26.0	26.7	28.4	28.7	27.5	27.0	26.8	26.7	26.4	26.1	25.8	26.9	34.1	20.6
1992	24.8	26.0	27.1	28.9	29.3	27.8	27.0	26.3	27.1	26.1	25.8	25.5	26.8	35.3	19.7
1993	25.4	24.7	26.6	28.1	28.5	27.7	27.2	26.7	26.6	26.6	26.7	25.2	26.7	35.0	18.6
1994	25.5	26.1	27.2	28.3	28.1	27.1	26.6	26.8	26.4	26.3	26.9	26.0	26.8	36.2	19.8
1995	25.6	25.3	26.8	28.7	28.6	27.9	27.0	27.2	26.3	27.0	26.5	24.9	26.8	34.5	18.9
1996	24.6	25.1	26.3	28.0	28.0	27.4	26.7	27.3	26.8	26.6	26.4	25.0	26.5	35.2	19.3
1997	24.6	26.0	26.4	27.8	28.3	28.1	26.7	27.0	27.1	27.2	27.0	26.7	26.9	34.8	20.8
1998	26.9	26.6	27.6	28.6	29.8	28.1	28.1	27.4	26.9	26.9	26.4	25.4	27.4	36.0	18.7
1999	26.2	25.8	27.4	27.7	27.4	27.0	26.7	26.9	27.1	26.6	26.5	24.8	26.7	34.7	17.2
2000	25.9	25.9	26.9	27.9	28.0	27.2	26.9	26.8	27.2	26.4	26.3	26.0	26.8	34.4	20.2
2001	25.6	25.8	26.9	28.8	28.4	27.2	27.6	26.9	27.3	27.1	25.9	25.8	26.9	36.1	18.3
2002	25.1	25.3	26.3	28.4	28.6	28.0	28.2	26.6	27.2	27.1	26.8	26.9	27.0	35.6	19.7
2003	25.3	26.4	27.8	29.1	28.0	28.3	26.9	27.3	27.0	26.6	27.1	25.2	27.1	37.3	19.6
2004	25.6	25.1	27.1	29.2	28.7	27.4	27.3	27.0	27.2	26.6	27.5	25.2	27.0	36.8	20.0
2005	24.7	26.1	27.0	28.8	29.0	28.1	26.6	27.4	27.1	27.2	26.8	25.4	27.1	36.2	19.0

(Source: South Center of Hydrology and Meteorology)

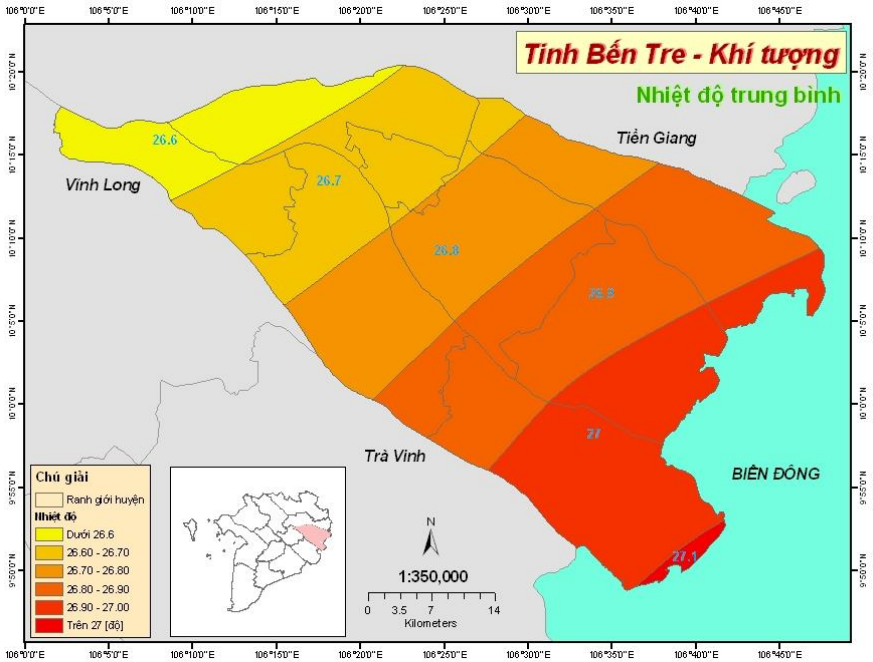


Figure 2.1: Distribution of yearly average temperature in Ben Tre

2.1.2.2. Wind direction and wind speed

There are two major monsoons during the year:

The Eastern North-eastern 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 penetrates 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 occurs in early rainy season when tropic convergence is very active (July, August).

Table 2.2. Monthly characteristics of wind of Ba Tri station

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
Value (mm)	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

(Source: South Center of Hydrology and Meteorology)

2.1.2.3. Hurricane

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 reason 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' embankments and surrounding sluice gates 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.

Typhoon No.9 statistically completely collapsed 4338 main houses, damaged roofs of 16,403 main houses. 56 schools were affected, of which 16 classrooms were collapsed; roofs of 215 classrooms were turned over, many teaching and learning tools were damaged. 42 working offices, 17 health clinics and two cultural institutions were badly damaged. There were 2 dead and 99 injuries, 10 sunken ships. The total loss of Ba Tri district was estimated VND 282.67 billion.

2.1.2.4. Rainfall

Rain is dominant and significant for agricultural production in the project area. Rain is the main source of fresh water with relatively good quality and the majority of people in the Mekong delta use it. The rainy season in Ben Tre starts from May to November which coincides with the southwest monsoon. The annual average rainfall ranges 1,500 ÷ 1,250 mm; the average rainfall is 1,404 mm/year, classified as low in the Mekong delta. The distribution of rainfall in the province is not large; heavy rain appears in Ben Tre city and lowers in coastal areas (1,210 ÷1,240mm only).

The seasonal rainfall distribution is a feature of the Southern region in general and in the project area in particular. Rainy season really begins on 4-18/05 and ends on 13-30/10. The total raining days in rainy season are really 156-164 days but the rainfall does account for 75-82% of total annual rainfall. The number of rainy days in rainy season is really uneven

(approximately 50-60 days). During dry season, the rainfall is only from 1.5% to 6% of the total annual rainfall. Rainfall concentrates in July (299.2 mm), August (216 mm), September (209.4 mm) and October with the max rainfall of 366.2 mm.

In summary, the climate is very favourable for agricultural production, especially the factors: temperature, light, humidity etc. The only difficulty to overcome is the rain, especially rain appears very little in dry season, causing stagnated production due to lack of fresh water.

Table 2.3. Month Average Rainfall of Ba Tri station

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
Value (mm)	0.4	0.7	4.4	38.5	157.	207	174	174	286	278	93	9.9	1404

Table 2.4: The number of rainfall days of Ba Tri station

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
Value (mm)	2	1	1	4	15	20	20	20	20	19	11	4	132

Source: FS report of the subproject, 2015

During rainy season sometimes drought occurs. Drought appears 5-10 days in May, June, July that local people often referred to as Ba Chang drought, which lasts about 15 to 20 days.

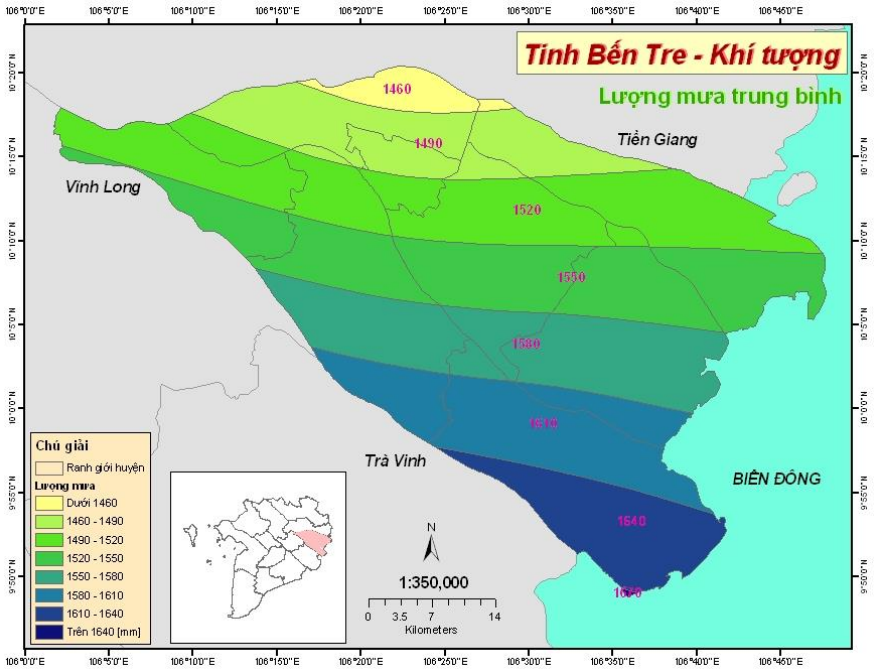


Figure 2.2: Multi-year average rainfall distribution in Ben Tre

It can be seen from the map that in Ben Tre, rainfall distribution decreases towards the North. The north west of the province has the lowest average rainfall (1550 mm), the South East of the province has the highest average rainfall (1580 mm).

2.1.2.5. Other factors

a. Humidity:

The air humidity is closely related to rainfall regime. The rainy season from May to November is the wet season with the average humidity of 83% - 86%.

Dry season appears from December to April. The average humidity is 76% - 80%. The lowest humidity appears in February to April, averaging about 77% (*Table 2.5*).

Table 2.5 Monthly Average Humidity of Ba Tri station

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
Value (%)	81	81	80	80	83	85	86	86	88	88	86	82	84

(Source: South Center of Hydrology and Meteorology)

b. Evaporation:

The total evaporation throughout the year is about 959-1126mm. The evaporation is less in rainy season. The monthly average evaporation is 55-90 mm (*Table 2.6*).

Dry season evaporates greater. In most dry season months, the average evaporation is 100 mm per month.

The average daily evaporation is 2.9 mm.

The average daily evaporation of the largest evaporation month is 4.2 mm.

The average daily evaporation of the less evaporation month is 2.2 mm.

The largest evaporation month: February.

The less evaporation month: October.

Table 2.6. Monthly Average Evaporation of Ba Tri station

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
Value (mm/7day)	3.7	4.2	4.0	4.1	3.0	3.0	2.7	2.5	2.3	2.2	2.6	3.1	2.9

Source: FS report of the subproject, 2015

2.1.3. Hydrological/oceanographic conditions

2.1.3.1. River and tide water level

The Subproject area is surrounded by Tien River, Ham Luong River and the East Sea. The regional hydrological regime is strongly affected annually by tidal regime of the East Sea and the Mekong River Upstream - through Ba Lai River and Ham Luong River.

Because Ba Tri district lies in such location, the East Sea tides penetrate deep into regional canals. In flood season, the biggest amplitude in Tan Thuy is 3.18 – 3.24m. During flood season, the region is flooded by rains and tides.

The East Sea tides affect the subproject area year-round, even during flood season. September and October (Mekong River flood peak period) meet the most powerful influence of Mekong River floods. The tidal amplitude in My Tho, My Thuan, Cho Lach, My Hoa reach the biggest

in September and October but in the eastern stations: Binh Dai, Tan Thuy, Vam Kenh, the biggest values reach in December, January and lowest values reach in June and July.

The average daily tide-level in most months of the year usually reaches at the max values +1.0m, which creates favourable conditions for local gravity of water flow.

The average daily falling tide-level in September and October which reaches the greatest values in the year is lower than (-0.5m) (My Tho), in September is (-93cm), in October is (-80cm), so in the subproject area, water is virtually free flowing and sluice gates throughout the year (*Table 2.7*).

Table 2.7 frequency level hydrological stations in the subproject area (H: m,)

N⁰	***Station***	***Frequency level (P:%)***					
		0.2%	***0.5%***	***1.0%***	***1.5%***	***2.0%***	***3.0%***
1	Cho Lach (Ham Luong)	2.16	2.11	2.06	2.04	2.02	1.98
2	An Thuan (cua H. Luong)	2.01	1.97	1.93	1.91	1.89	1.86
3	Binh Đai (Cua Đai river)	2.04	1.99	1.95	1.93	1.90	1.87
4	My Hoa (Ham Luong river)	1.87	1.84	1.81	1.80	1.78	1.76
5	Binh Đai - Cho Lach	2.1	2.05	2.01	1.99	1.97	1.93
6	An Thuan - My Hoa	1.94	1.9	1.87	1.86	1.84	1.81
7	Ben Trai (Co Chien river)	2.04	2.00	1.96	1.95	1.93	1.90

Source: FS report of the subproject, 2015

Among the hydrological stations above, An Thuan hydrological station (Ham Luong estuary) is next to the subproject area.

Ba Lai is the main river in Ben Tre and is the tributary of the Mekong River which flows through the Mekong Delta and empties into the sea. The hydrological regime here is subject to the East Sea tides of semi-irregular tides. In most days, there are 2 times of flood-tide and ebb-tide. The difference amplitude between flood-tide days is 2.5-3.5m and is below 1m in ebb-tide days. The water flow in Ba Lai estuary is 59 m^3/s in the dry season and 240 m^3/s in the flooding season[3].

** Canal network*

The project zone shares some common characteristics with the Mekong river delta and is located within a plenty of canals area. The relatively even topography, natural and artificial canals, linked each to other, create a complicated canal network. 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 aquaculture production such as Gia canal, Xeo Giua canal, Cat canal, No canal, Cua canal, Duong Khai canal, Duong Xuong canal, Duong Mieu canal, Duong Chua canal, Cay Bang canal, Ong Hai Ha canal, Đe Quoc Phong canal, Duong Tac canal, Cay Mam canal. Canals within coastal saline water area come from East Sea and mainly support aquaculture farming and salt production.

** Salinity intrusion*

[3] www.bentre.gov.vn

Salinity is closely linked to upstream flow regime. The higher water discharge comes from upstream, the lower salinity in the subproject area and vice versa. On the other hand, salinity depends on tide mode and wind surges. When wind surge is strong, salinity will increase.

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 significant. 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 mouth.

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 months 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.

The salty boundary primarily depends on the upstream fresh water. The smaller amount of fresh water, the deeper saltwater boundary in inland. In dry season the salty boundary almost covers the entire subproject area. The calculation of the saline level in the region is shown in *Figure 2.3* and *Figure 2.4*.

It can be seen from the map that at the subproject site salinity reached 40‰ (while the requirement for shrimp raising lies within 15 - 20‰, that made mass dead of prawn, great damages.

As interviewed with local officials on the weather change, the increase in the sea surface temperature and the salinity made 100% *Meretrix lyrata* in the subproject area died in March and April 2011.

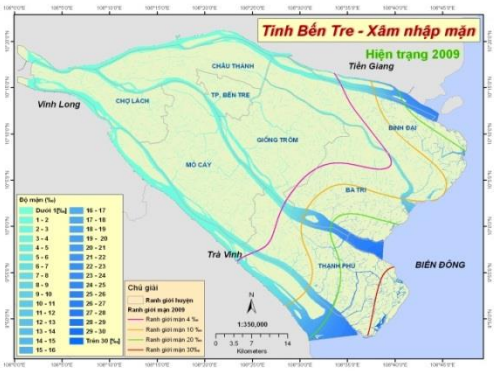


Figure 2.3: Salinity intrusion in Ben tre in 2009

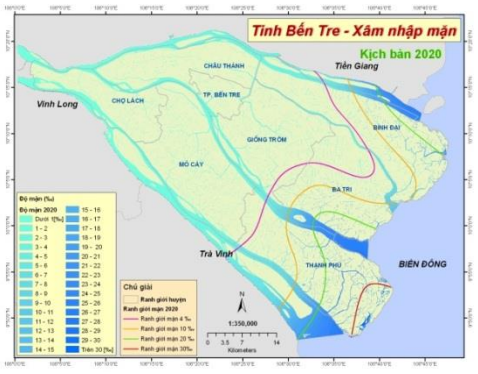


Figure 2.4: Salinity intrusion in Ben tre in 2020-sea level rise of 11cm

2.1.3.2. Sea level rise due to climate change

In recent years, the region has been suffered from heavy impacts of natural disasters and extreme weather phenomena, notably in the lowland in the sub-project area, which is affected by the rising sea level, riverbank erosion and coast erosion, salinisation and droughts. The phenomenon of rising water in the rainy season causes very serious damages, extensive flooding in large areas of agricultural land (orchards, vegetables, rice fields, aquaculture etc.); the lowlands, sand dunes, riparian land are eroded by flooding flow; which floods and damages traffic works, irrigation works, embankment dike etc.

The rising water is mainly caused by tidal surges, appearing from mid to late of rainy season (August, September, October and November of the lunar calendar) and in the beginning and middle of month (1st and 15th). Water surges appear 2 times per month, from 4 to 7 days. In 2006, strong winds and high tides caused damages to the economic sectors, agriculture, salt and aquaculture production in Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, damaging crops, breaking fishing ponds of mostly extensive shrimp farmers (overflow of shrimp ponds), unable to harvest salt. The total loss was amounted to VND 6,617 billion.

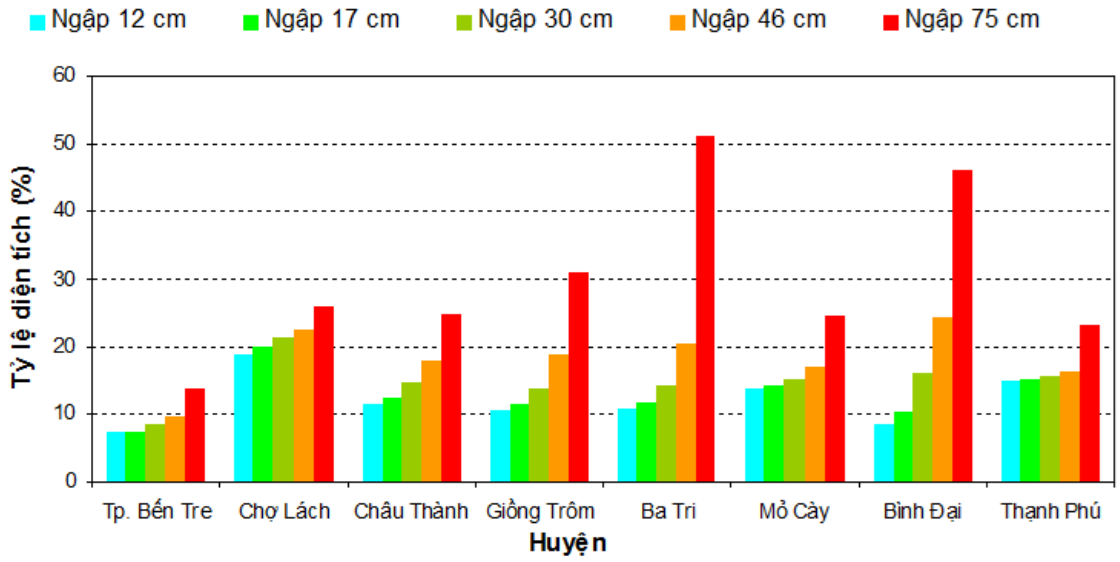


Figure 2.5: Area ratio of flooded dictricts of Bentre

2.2. ENVIRONMENTAL QUALITY BASELINE IN THE SUBPROJECT AREA

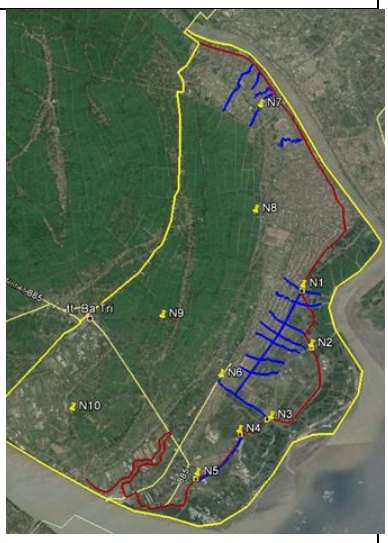
To assess the current state of the quality of environmental components in the subproject area, the Ecology and Environmental Center of the Southern Institute of Water Resources Research carried out sampling campaigns, analysis, site survey of the following environmental components:

- Water resources (surface water, groundwater);
- Air Environmental Status.
- Noise and vibration.
- Soil and Sediments.
- Aquatic organisms.

2.2.1. Water Resources

The results show that analytical indicators of most of samples are within the permitted limits of National technical regulation on coastal water quality (QCVN 10: 2008/BTNMT) (Table 2.9).

Table 2.8: Position of Sampling Surface Water

Code	Coordinates		Sampling location	Location map
	Latitude	Latitude		
N1	10° 3'6.96"N	106°40'10.62"E	Duong Khai sluice gate	
N2	10° 1'54.01"N	106°40'20.95"E	Trang Nuoc sluice gate	
N3	10° 0'26.02"N	106°39'31.16"E	Duong Tac sluice gate	
N4	10° 0'8.91"N	106°38'51.81"E	Cai Keo sluice gate	
N5	9°59'16.47"N	106°37'59.21"E	An Thanh sluice gate	
N6	10° 1'17.31"N	106°38'28.94"E	end of Duong Tac canal	
N7	10° 6'48.24"N	106°39'18.11"E	No canal	
N8	10° 4'38.95"N	106°39'11.99"E	Canal next to Bao Thanh market	
N9	10° 2'29.85"N	106°37'15.90"E	Ba Tri canal	
N10	10° 0'36.35"N	106°35'23.82"E	Nga Cat canal	

Comment:

Compared with the Vietnamese standards for surface water quality, QCVN 08-MT:2015/BTNMT, the surface water sample analysis results (Appendix 1.1) show that:

- pH value, concentrations of N-NO_3, Cl, Pb, As, Zn, Cd, Cr (IV) at all measuring points are within the permitted standard.
- N-NH_4 concentration: 2 of the 40 samples exceeded the permitted standard from 1.1 to 3 times.
- BOD concentration in most sampling points are less than the permitted standard (QCVN08-2008), only 5 of the 20 samples have a BOD concentration exceeding 1.2 to 1.5 times the standard.
- DO concentration: 16 of the 20 samples meet the standard (≥ 6mg/l). However, the lowest DO concentration in remaining samples is so high (≥ 4.1 mg/l).
- TSS concentration: 8 of the 20 samples meet the standard (<50mg/l).
- Fe concentration: only one sample is in the permitted limit, the remaining samples excess the standard from 10 to 30 times.
- Coliform: Coliform value at all sampling points are very high and exceeded the standards from 1-80 times (Coliform <2.5×10^3 MPN/100ml).

Analysis indicates that surface water in the subproject area is without heavy metal contamination, the main pollution sources are organic.

Table 2.9: Surface water quality analysis results

	Parameter	pH	EC	Salinity	Turbidity	DO	TSS	BOD_5	TOC	TN	N-NH_4^+	N-NO_2^-	N-NO_3^-	P-PO_4^{3-}	Cl^-	Cd	Hg	Pb	As	Fe_{TS}	Cu	Zn	Grease	Cl-originated pesticide	P-originated pesticide	T co
Code	**Unit**		dS/m	‰	NTU	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	1 tb
QCVN 10-2008		**6.5-8.5**	**-**	**-**	**-**	**>5**	**50**	**-**	**-**	**-**	**0.1**	**-**	**-**	**-**	**-**	**0.005**	**0.001**	**0.05**	**0.01**	**0.1**	**0.03**	**0.05**	**0**	**0.008-0.013**	**0.32-0.4**	
	H	7.4	43.1	28.4	81	7.6	58	2.6	2.1	1.2	0.07	0.03	0.9	0.08	13265	KPH	KPH	KPH	KPH	1.2	KPH	KPH	KPH	KPH	KPH	
N1	L	7.2	45	26.1	60	6.5	66	3.4	2.9	1.1	0.06	0.03	0.8	0.04	11868	KPH	KPH	KPH	KPH	2.5	KPH	KPH	KPH	KPH	KPH	
	H	7.5	29.7	24.7	28	6	31	4.9	4	1.8	0.09	0.08	1.3	0.1	11479	KPH	KPH	KPH	KPH	0.8	KPH	KPH	KPH	KPH	KPH	
N2	L	7.1	30.8	21.3	22	6.3	28	4.3	3.6	1.4	0.1	0.04	1.02	0.13	11156	KPH	KPH	KPH	KPH	1.1	KPH	KPH	KPH	KPH	KPH	
	H	7.3	36.7	23.2	18	5.3	23	4.5	3.6	1.6	0.11	0.1	1.08	0.06	12078	KPH	KPH	KPH	KPH	1.2	KPH	KPH	KPH	KPH	KPH	
N3	L	7.3	34.6	20.1	22	6.1	42	5.4	4.3	1.6	0.1	0.08	1.11	0.1	10300	KPH	KPH	KPH	KPH	2.8	KPH	KPH	KPH	KPH	KPH	
	H	7.1	36	23.8	17	5.5	55	2.9	2.4	1.4	0.06	0.1	1.08	0.1	12360	KPH	KPH	KPH	KPH	1.1	KPH	KPH	KPH	KPH	KPH	
N4	L	7.2	41.6	21.4	31	6.6	69	4.2	3.5	1.4	0.09	0.07	0.95	0.09	11036	KPH	KPH	KPH	KPH	1.7	KPH	KPH	KPH	KPH	KPH	
	H	7	32.3	18.6	25	6.5	18	6.2	4.9	1.7	0.2	0.09	1.04	0.18	10070	KPH	KPH	KPH	KPH	1	KPH	KPH	KPH	KPH	KPH	
N5	L	7.1	33.9	17.1	21	5.8	33	7.4	5.9	1.9	0.27	0.05	1.16	0.16	9322	KPH	KPH	KPH	KPH	1.9	KPH	KPH	KPH	KPH	KPH	
	H	7	30	18.5	84	6.4	180	3.8	3.3	1.7	0.05	0.09	1.32	0.03	8403	KPH	KPH	KPH	KPH	2.8	KPH	KPH	KPH	KPH	KPH	
N6	L	7.2	44.2	15.7	109	6.6	143	4.5	3.7	1.5	0.05	0.1	1.07	0.05	8642	KPH	KPH	KPH	KPH	3.3	KPH	KPH	KPH	KPH	KPH	
	H	7	31.9	19.9	51	6.3	60	8.1	6.3	1.7	0.28	0.09	0.82	0.14	10851	KPH	KPH	KPH	KPH	2.3	KPH	KPH	KPH	KPH	KPH	
N7	L	7.1	32.3	13.4	45	5.7	48	7.7	6.2	2.2	0.34	0.08	1.31	0.11	6980	KPH	KPH	KPH	KPH	2.3	KPH	KPH	KPH	KPH	KPH	
	H	7	19.7	11.7	164	6	233	4.8	4	1.2	0.06	0.07	0.8	0.09	5992	KPH	KPH	KPH	KPH	2.5	KPH	KPH	KPH	KPH	KPH	
N8	L	7.1	30.7	15.5	81	6.5	256	6.2	5.1	1.5	0.09	0.09	0.99	0.09	8253	KPH	KPH	KPH	KPH	3	KPH	KPH	KPH	KPH	KPH	
	H	6.5	2.4	1.2	23	6.9	35	10.1	7.9	2	0.06	0.02	1.32	0.15	621	KPH	KPH	KPH	KPH	1.7	KPH	KPH	KPH	KPH	KPH	
N9	L	6.6	2.4	1.2	28	6.1	44	9.2	7.3	1.5	0.07	0.04	0.85	0.1	609	KPH	KPH	KPH	KPH	1.7	KPH	KPH	KPH	KPH	KPH	
	H	8.1	3.6	1.9	27	6.4	50	7.8	6.2	2.1	0.32	0.02	1.3	0.04	917	KPH	KPH	KPH	KPH	1.2	KPH	KPH	KPH	KPH	KPH	
N10	L	7.2	3.5	1.8	38	5.9	38	8.7	7	1.9	0.27	0.02	1.08	0.06	849	KPH	KPH	KPH	KPH	1.3	KPH	KPH	KPH	KPH	KPH	

2.2.1.1. Groundwater environment

Table 2.10, Table 2.11 present position of sampling underground water and analytical results of underground water quality. Analytical results show that most of analytical indicators pass permitted limits according to QCVN 09:2008/BTNMT (national technical regulation on surface water).

Table 2.10: Positions of Sampling Underground Water

Code	***Coordinates***		***Sampling location***	***Location map***
	Latitude	***Latitude***		
GK1	10° 6'27.19"N	106°39'6.42"E	Residential of No canal-HL16	
GK2	10° 1'36.21"N	106°38'43.31"E	Residential along HL16 road	
GK3	9°59'10.36"N	106°37'41.28"E	Residential near An Thanh sluice	

Table 2.11: Groundwater quality analysis results

N^0	**Parameter**	**Unit**	**GK1**	**GK2**	**GK3**	**QCVN 09:2008/BTNMT (Column A1)**	**QCVN 02:2009/BYT**
1	pH	-	6.72	7.09	7.12	**5.5-8.5**	**6.0-8.5**
2	Hardness	mg$CaCO_3$/l	250	182	197	**500**	**350**
3	TS	mg/l	429	437	374	**1500**	
4	NH_4	mg/l	1.12	0.11	0.82	**0.1**	**3**
5	COD	mg/l	1.31	1.75	1.27	**4**	**4**
6	N-NO_2	mg/l	0.11	0	0.13	**1**	
7	N-NO_3	mg/l	0.09	0.34	0.41	**15**	
8	Cl	mg/l	245	276	297	**250**	**300**
9	As	mg/l	0	0	0	**0.05**	**0.01**
10	Fe	mg/l	1.27	0.73	0.97	**5**	**0.5**
11	Mn	mg/l	0.09	0.12	0.17	**0.5**	
12	E. Coli	MPN/100ml	3	0	0	**ND**	**50**

The analysis shows that groundwater quality in all Zone in the subproject area is quite good parameters such as pH, hardness, TS, N-NH_4, COD, N-NO_2, N-NO_3, Cl, As, Fe, Mn are within the permitted limits of Vietnam standards (QCVN 09-2008). However, only coliform in samples at the household adjacent intersection between 9A Canal and district road 16 exceed the permitted standard. Coliform contamination in groundwater may be due to exploitation techniques and not good management. Wells that are damaged and not used are reasons to pollute high coliform in groundwater causing negative impacts on users' health.

2.2.1.2. Wastewater sample analysis results

Table 2.12, Table 2.13 present positions and analytical results of sampling domestic wastewater. Analytical results show that some parameters that are within permitted limits on national technical regulation on domestic waste water quality (QCVN 14:2008/BTNMT).

Table 2.12: Positions of Sampling Domestic Wastewater

N°	***Code***	***Coordinates***		***Sampling location***	***Location map***
		Latitude	***Latitude***		
1	NT1	10° 6'27.81"N	106°39'18.29"E	At residential of No canal-HL16	
2	NT2	10° 1'45.67"N	106°38'49.93"E	At residential along HL16, near Ong Hai Ha canal,	
3	NT3	9°59'22.85"N	106°37'51.26"E	At residential near An Thanh sluice	

Table 2.13: Wastewater quality analysis results

N^0	**Parameter**	**Unit**	**N1**	**N2**	**N3**	**QCVN 14:2008/BTNMT**
1	pH		6.82	6.91	6.47	**5 - 9**
2	EC	*µS/cm*	415	417	527	-
3	TDS	mg/l	231	284	317	-
4	Turbidity	*NTU*	30.2	25.1	33.9	
5	SS	*mg/l*	317	184	241	**100**
6	DO	*mgO_2/l*	0.8	1.3	0.5	-
7	BOD_5	*mg/l*	96	75	180	**50**
8	TOC	*mg/l*	172	144	324	-
9	TN	*mg/l*	5.1	6.8	9.1	-
10	$N\text{-}NH_4^+$	*mg/l*	1.37	3.15	4.28	**10**
11	$N\text{-}NO_2^-$	*mg/l*	0.21	0.54	0.87	-
12	$N\text{-}NO_3^-$	*mg/l*	1.33	0.81	1.46	**50**
13	Cl^-	*mg/l*	87.2	68.7	103.4	-
14	Cd	*mg/l*	KPH	KPH	KPH	-
15	Hg	*mg/l*	KPH	KPH	KPH	-
16	Pb	*mg/l*	KPH	KPH	KPH	-
17	As	*mg/l*	KPH	KPH	KPH	-
18	Fe	*mg/l*	0.47	0.15	0.28	-
19	Cu	*mg/l*	KPH	KPH	KPH	-
20	Zn	*mg/l*	0.080	0.062	0.091	-
21	Total coliform	*MPN/100ml*	47000	31000	130000	**5000**

Compared with Vietnamese standards on wastewater quality, QCVN 14-2008 (Column B), the analysis results of wastewater samples in the subproject area showed that:

- The values of pH, TDS, N-NO_2, N-NO_3, N-NH_4 at all measuring points are within the permitted standard.
- BOD concentration in analyzed samples excessed the permitted standard from 1.2 to 3,5 times.
- Coliform values at all analyzed points were very high and exceeded the standards from 8-25 times (Coliform <5 × 10^3 MPN/100ml).
- Generally, wastewater in the project area is mainly polluted by organic substances and coliform.

2.2.2. Air Environmental Status

Table 2.14, Table 2.15 present position and analytical results of Ambient Air Samples. The measurement results show that analysis indicators are within permitted limits of QCVN 05:2013/BTNMT, within one hour.

Air pollution sources in the subproject areas are mainly from increase of transport means. Air sample analysis results at some points in the project area showed that most of the air quality parameters are within the permitted standard. Overall, quality of air environment in the subproject area is relatively unpolluted.

Table 2.14: Air sampling position

No.	***Code***	***Coordinates***		***Sampling location***	***Location map***
		Longitude	***Latitude***		
1	KK1	10° 3'4.83"N	106°40'10.32"E	Left Branch of Duong Khai sluice gate	
2	KK2	10° 1'52.38"N	106°40'20.13"E	Right Branch of Trang Nuoc sluice gate	
3	KK3	10° 0'26.84"N	106°39'27.58"E	Left Branch Duong Tac sluice gate	
4	KK4	9°59'11.63"N	106°37'56.50"E	Right Branch An Thanh sluice gate	
5	KK5	10° 1'14.46"N	106°38'28.72"E	The end of Duong Tac canal	
6	KK6	10° 6'27.07"N	106°39'6.66"E	at Intersection of N° canal-HL16	

Table 2.15: Ambient air quality analysis results

N⁰	Code	T⁰	Humidity	TSP	NO_2	SO_2	CO	Noise		
								Instant	Max	Min
		^0C	%	$\mu g/m^3$				dB		
1	KK1	30.6	81	86	22	17	830	60.4	72.1	46.4
2	KK2	31.9	83	140	24	29	1300	61.4	76.4	47.3
3	KK3	31.1	85	80	31	17	950	56.5	73.1	42.5
4	KK4	31.9	81	160	34	25	1200	64.2	78.6	46.4
5	KK5	30.7	83	94	21	22	1300	58.7	70.4	41.1
6	KK6	30.4	79	110	27	28	1400	58.4	76.8	47.2
7	KK7	30.9	77	140	43	24	1400	61.7	80.3	50.7
8	KK8	30.6	82	82	22	22	1200	60.1	76.4	45.2
QCVN05:2013		-	-	**300**	**200**	**350**	**30,000**	-	-	-
QCVN26:2010		-	-	-	-	-	-	-	-	**70**

2.2.3. Soil and canal sediment quality

To assess soil and canal sediment quality in the subproject, samples were collected and the content of heavy metals such as Cd, As, Cu, Pb and Zn, nitrogen and phosphorus analyzed. The soil and sediment sample analysis results will provide indicators of the potential impacts arising from the dredging and disposal of construction waste during the construction and operation phases as well.

Analysis results presented in Table 2.16 - Table 2.19 showed that sediment and soil samples in the project area are within the permitted standard. Therefore, the soil and sediment can be utilized as leveling materials during construction and operation phases.

Table 2.16: Soil quality analysis results

N⁰	Code		pH $_{H2O}$ (1:5)	pH $_{KCl}$ (1:5)	EC (1:5)	Sal (1:5)	Cl^-	Organic humus	Nt	P-PO_4^{3-}	SO_4^{2-}	Fe_{TS}	Cd	Hg	Pb	As	Cu	Zn
					dS/m	‰	*%*			*mg/100g*		*mg/kg*						
1	Đ1	T1	6.7	6.4	6.33	4.1	1.13	2.93	0.16	6.09	126	204	0.017	KPH	0.029	0.37	7.17	83.6
2		T2	6.3	6.0	7.68	5	1.42	2.11	0.13	5.22	174	242	0.030	KPH	0.005	0.26	7.98	90.6
3		T3	7.2	6.9	8.44	5.5	1.60	1.68	0.09	5.75	192	247	0.014	KPH	0.005	0.11	6.81	26.6
5	Đ2	T1	7.8	7.6	7.09	4.6	1.29	2.26	0.13	9.04	175	267	0.031	KPH	0.005	0.32	7.26	42.6
6		T2	6.6	6.3	7.45	4.8	1.36	1.77	0.11	5.94	315.8	187	0.016	KPH	0.046	0.59	7.96	50.6
7		T3	7.3	7.0	8.31	5.4	1.58	1.94	0.1	5.28	127	276	0.010	KPH	0.039	0.49	6.66	51.6
9	Đ3	T1	5.7	5.4	6.36	4.1	1.14	2.34	0.14	7.21	108	133	0.018	KPH	0.021	0.33	5.06	50.6
10		T2	6.3	6.0	8.11	5.3	1.53	1.83	0.12	5.56	152	86	0.021	KPH	0.020	0.17	5.66	33.6
11		T3	7.8	7.7	7.95	5.2	1.52	1.39	0.08	5.47	108	192	0.025	KPH	0.026	0.29	6.06	40.6
13	Đ4	T1	6.5	6.1	7.12	4.6	1.28	2.29	0.14	7.06	155	223	0.040	KPH	0.042	0.51	4.26	28.6
14		T2	6.9	6.6	7.32	4.8	1.33	1.81	0.14	4.97	95.7	183	0.044	KPH	0.033	0.17	6.16	63.6
15		T3	7.3	7.0	7.95	5.2	1.51	1.01	0.07	5.36	172	230	0.057	KPH	0.046	0.23	7.06	51.6
17	Đ5	T1	6.9	6.5	7.09	4.6	1.20	2.26	0.13	4.02	680	201	0.024	KPH	0.018	0.19	3.46	72.6
18		T2	6.6	6.1	8.08	5.3	1.47	1.99	0.11	3.79	683	170	0.020	KPH	0.024	0.22	6.96	34.6
19		T3	6.1	5.8	8.67	5.6	1.61	1.62	0.1	5.25	150	238	0.036	KPH	0.032	0.19	3.66	40.6
21	Đ6	T1	6.8	6.5	7.6	4.9	1.40	2.52	0.17	7.64	131	173	0.022	KPH	0.022	0.26	7.06	33.6
22		T2	6.4	6.0	8.54	5.6	1.54	1.43	0.1	5.58	186.4	100	0.025	KPH	0.059	0.51	6.26	70.6
23		T3	7.7	7.4	8.93	5.8	1.69	1.53	0.09	3.73	161	252	0.020	KPH	0.027	0.22	7.26	66.6
25	Đ7	T1	5.6	5.1	0.53	0.2	0.05	2.52	0.16	5.44	594	287	0.027	KPH	0.023	0.36	5.76	76.6
26		T2	5.1	4.3	0.71	0.35	0.10	2.01	0.12	4.75	452	128	0.044	KPH	0.027	0.36	6.16	25.6
27		T3	7.0	6.7	1.2	0.6	0.17	1.3	0.08	5.13	162.4	296	0.037	KPH	0.012	0.21	8.46	63.6
29	Đ8	T1	6.5	6.1	0.38	0.2	0.05	2.89	0.17	7.21	65	267	0.003	KPH	0.016	0.16	5.56	47.6
30		T2	6.2	5.9	0.52	0.3	0.09	1.92	0.11	5.72	240	214	0.003	KPH	0.038	0.36	5.76	45.6
31		T3	6.7	6.5	0.59	0.3	0.09	1.38	0.08	5.38	86	248	0.003	KPH	0.022	0.20	9.06	28.6

Table 2.17: Soil sampling position

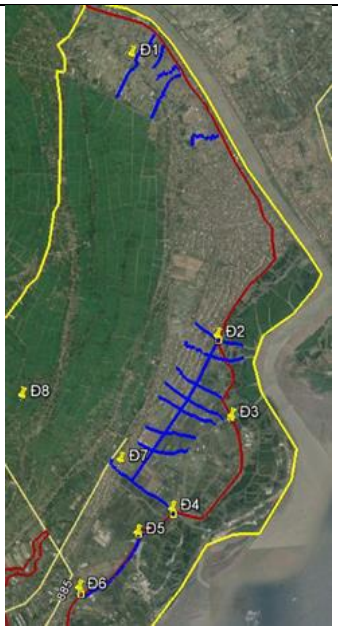
Nº.	***Code of Station***	***Coordinates***		***Sampling location***	***Location map***
		Latitude	***Latitude***		
1	Đ1	10° 7'20.73"N	106°38'46.24"E	Branch of Rach Gia Canal	 1 station took 3 samples at 3 soil layers: 1st layer depth of 0-20 cm (T1), 2nd layer depth of 50 - 70 cm (T2), 3rd layer depth 1.3 - 1.5 m (T2).
2	Đ2	10° 3'5.18"N	106°40'8.29"E	Branch of Duong Khai sluice gate	
3	Đ3	10° 1'52.27"N	106°40'21.79"E	Branch of Trang Nuoc sluice gate	
4	Đ4	10° 0'27.94"N	106°39'25.01"E	Branch of Duong Tac sluice gate	
5	Đ5	10° 0'6.50"N	106°38'51.65"E	Branch of Cai Keo sluice gate	
6	Đ6	9°59'16.50"N	106°37'55.56"E	Branch of An Thanh sluice gate	
7	Đ7	10° 1'12.54"N	106°38'35.49"E	End of Duong Tac canal	
8	Đ8	10° 2'11.23"N	106°37'0.85"E	Infield near Ba Tri canal	

Table 2.18: Sediment sampling position

No.	***Locations***	***Coordinates***		***Description of sampling location***
		Longitude	***Latitude***	
1	TT1	10° 5'35.18"N	106°38'57.17"E	Infield canal
2	TT2	10° 2'29.95"N	106°36'58.00"E	Ba Tri canal
3	TT3	10° 3'59.21"N	106°39'20.63"E	Giong Bong canal
4	TT4	10° 0'18.70"N	106°37'30.37"E	Cau Vi canal
5	TTN1	10° 7'21.22"N	106°38'52.33"E	Rach Gia canal
6	TTN2	10° 7'30.79"N	106°39'17.30"E	Xeo Giua canal
7	TTN3	10° 7'9.95"N	106°39'26.26"E	Cat canal
8	TTN4	10° 6'50.96"N	106°39'17.61"E	No canal
9	TTN5	10° 6'11.54"N	106°39'50.40"E	Cua canal
10	TTN6	10° 3'7.21"N	106°40'10.11"E	Duong Khai canal
11	TTN7	10° 2'58.34"N	106°39'50.17"E	Duong Xuong canal
12	TTN8	10° 2'26.37"N	106°39'49.90"E	Duong Mieu canal
13	TTN9	10° 1'53.81"N	106°40'17.11"E	Duong Chua canal
14	TTN10	10° 2'13.20"N	106°39'17.78"E	Cay Bang canal
15	TTN11	10° 1'39.68"N	106°39'39.86"E	Ong Hai Ha canal
16	TTN12	10° 1'26.21"N	106°39'9.27"E	Cay Mam canal
17	TTN13	10° 0'29.42"N	106°39'27.13"E	Duong Tac canal
18	TTN14	9°59'14.49"N	106°38'4.41"E	Canal along Quoc Phong dyke

Table 2.19: Sediment quality analysis results

TT	Code	pH_{H2O} (1:5)	pH_{KCl} (1:5)	Fe_{TS}	Cd	Hg	Pb	As	Cu	Zn
				mg/kg						
1	**TT1**	6.82	6.11	55.2	0.16	KPH	0.318	0.135	3.42	47.2
2	**TT2**	6.04	5.77	29.7	0.513	KPH	0.251	0.141	8.14	59.6
3	**TT3**	6.53	5.95	47.1	0.217	KPH	0.473	0.372	4.01	34.1
4	**TT4**	6.27	5.81	58.3	0.241	KPH	0.847	0.319	7.88	75.3
5	**TTN1**	6.72	5.80	50.1	0.06	KPH	0.92	0.16	6.72	51.6
6	**TTN2**	6.59	5.91	48.9	0.05	KPH	1.07	0.20	8.15	59.1
7	**TTN3**	7.08	5.59	38.0	0,12	KPH	1.26	0.19	7.36	63.2
8	**TTN4**	6.34	5.78	41.6	0.11	KPH	0.89	0.26	5.32	52.9
9	**TTN5**	6.68	5.73	36.5	0.07	KPH	1.53	0.34	4.50	48.3
10	**TTN5**	7.04	5.96	42.8	0.05	KPH	2.61	0.15	9.26	40.0
11	**TTN6**	6.93	5.90	36.5	0.16	KPH	0.92	0.24	8.37	61.4
12	**TTN7**	6.52	5.74	30.8	0.09	KPH	1.76	0.29	6.12	52.3
13	**TTN8**	6.73	6.01	29.6	0.07	KPH	1.08	0.16	7.08	48.4
14	**TTN9**	6.27	5.48	34.7	0.07	KPH	1.23	0.28	5.70	37.6
15	**TTN10**	6.43	5.72	40.2	0.01	KPH	0.78	0.30	6.17	61.2
16	**TTN11**	6.62	5.56	31.1	0.03	KPH	1.32	0.19	4.90	56.7
17	**TTN12**	6.81	5.92	34.2	0.01	KPH	1.56	0.22	8.06	49.5
18	**TTN13**	6.77	5.84	29.9	0.02	KPH	1.37	0.31	6.34	50.6
19	**TTN14**	6.92	6.12	32.6	0.02	KPH	1.07	0.15	7.61	39.7

2.2.4. Biological Resources

2.2.4.1. The coastal mangrove forests in Ben Tre province

With the natural area of 236,020ha, Ben Tre established and developed the natural unique ecosystems for long time, especially the mangrove ecosystem. The Province's mangrove forest is approximately 3,759ha and the forest coverage is nearly 1.59% of the Province's natural land. The coverage of regional forestry planning is 47.97%, 3.45% of the natural area 3 coastal districts.

The mangrove forest play an extremely important role in the economic and social development, which makes the ecological environment balance in the Mekong Delta region in general and in Ben Tre province in particular. The mangrove forest is home, habitat of spawning ground for many species of aquatic animals as well as important bird species, reptiles and other amphibians.

The mangrove forest in the coastal estuaries of the province is threatened by the decline in the size and structure of vegetation. There are only 145 species, 56 families in the typical flora of the tropical rain. The typical species of mangrove forest in coastal estuaries are *Avicennia, Avicennia balanophora, Avicennia bicolor, Sonneratia caseolaris, Sonneratia alba, "Gia", Xylocarpus granatum*.

For the fauna, the species and number of individuals of the terrestrial vertebrate classes are relatively poor. The aves class remains the highest with 80 species of 11 ordos, 35 families. The reptile class has 15 species of 10 families. The amphibians class has 5 species of 3 families and 1 ordo. Besides the aquatic has 226 species of 7 classes; 5 phylums of plankton species of plants; 105 species of plankton animal of 8 groups. The fish fauna has 117 species belonging to 28 families, 15 ordos. In addition, there are several species of molluscs, crustaceans.

The statistics indicates that the mangrove forest in the coastal areas of Ben Tre province is rich in the biodiversity. However, the biodiversity is at risk of loss. Forest animals tend to reduce both in number and quantity of species and many are endangered of extinct. The decrease in the number of fauna species reflects the excessive and indiscriminate hunting in addition to the deforestation. The loss of grassland causes the loss of habitat of several species of animals.

The forest area is shrunk. The vegetation barely has rare species. Therefore, the remaining forest should be zoned and protected, which is the only method to preserve the existing diversity of forest in the coastal estuaries of Ben Tre. In recent years, the protection and development of mangrove ecosystem in the coastal provinces in the region are interested. However, potential impacts do threaten the mangrove ecosystem in the Mekong Delta in general and Ben Tre province in particular. This situation requires effective solutions in the planning of protected areas of coastal wetlands and organizing exploitation of natural resources associated with the development of this unique ecosystem for the protection and sustainable development of the regional ecosystem.

The forests in the sub-project area are mainly located in Zone 1, Zone 2 where there are sluice gates construction and dredging activities, but there are no mangrove forest except some *rhizophora apiculata* which are planted alternating with shrimp ponds and salt pans. The plants are sporadic which cannot concentrate into a population.

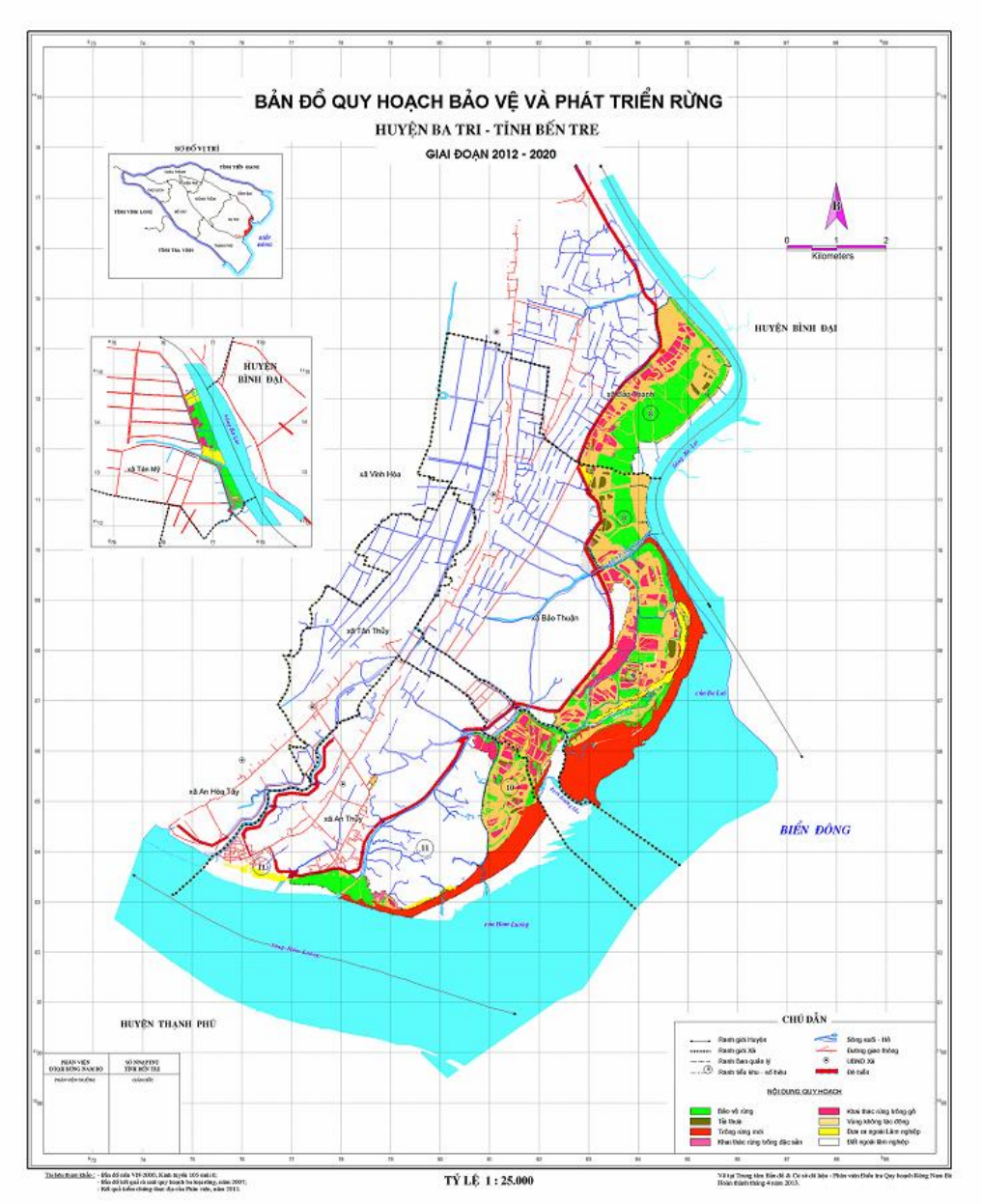


Figure 2.6. Current land use in the subproject area

2.2.4.2. Marine and coastal wetland biodiversity

Ba Tri district is characterized by the coastal estuaries, which is one of the ecosystems that characterize the tropical sea, rich in bio-resources and biodiversity and is considered the highest biological productive ecosystem compared with the East Sea coastal ecosystems in the South of Vietnam, including aquatic species, plankton species with tiny sizes. The fish stocks in the region are plentiful of marine and freshwater fish from the Mekong River system.

The Sub-project area is located in Ham Luong River basin. The survey data in 2009-2010 in the study: "Planning and development of the co-management model for the biodiversity reserve in Ham Luong River estuary in two districts of Ba Tri and Thanh Phu, Ben Tre province" the Department of Agriculture and Rural Development of Ben Tre province implemented and DANIDA – Denmark sponsored, were recorded as follows:

a. Regarding the biodiversity of the aquatic fauna:

* The Phytoplankton: (please refer to the Appendix 1.1a, 1.1b, 1.4)

As recorded by the survey results, in the estuarine of Ham Luong river and the adjacent canals and ditches there are 162 species, 45 families and 24 ordos of 6 algae phylums in total. Bacillariophyta is the dominate species in Ham Luong River with 81 species (50%), followed by *Cyanobacteria* with 28 species (17.3%), *Chlorophyta* with 27 species (16.7%), *Pyrrhophyta* with 14 species (8.6%), *Euglenophyta* with 11 species (6.8%) and *Chrysophyta* with 1 species (0.6%).

The study results that the number of cells at the study sites ranged from 1,088-54,438 cells/liter. The dominant species in the study sites include *Cyanobacteria (Microcystis, Oscillatoria)* and *Bacillariophyta (Coscinodiscus, Thalassiosionema, Skeletonema and Actinoptychus).* The dominant species: Skeletonema thrive strongly (accounting for 78-94%), this dinoflagellates contains appropriate nutritions for the types larvaes, crabs etc.

* The Zooplankton: (please refer to the Appendix 1.2a, 1.2b, 1.5)

The survey recorded 53 species, belonging to the groups: Protozoa, Rotifera, Arthropoda (Copepoda, Cladocera, Ostracoda, Decapoda, Insecta), Hydrozoa, Chordata, Chaetognatha and several types of larvae, in which the crustacean group occupies the largest number of 15 species, accounting for 40.5% of the total species which were recorded. Next is the rotifer group with 8 species, accounting for 21.6%, the larvae group with 7 species, accounting for 18.9%. For the remaining groups, the number of recorded species is relatively low, ranging from 1-4 species/group, accounting for 2.7 to 10.8%.

The individual density of Zooplanktons recorded in May 2009 is high, ranging from 18,500-293,000/m^3. Dominating in the individual density in most survey sites is the Copepoda nauplius larva.

* The Zoobenthos: (please refer to the Appendix 1.3a, 1.3b, 1. 6)

The survey of large species of zoobenthos invertebrate animals in Ham Luong estuary identified 84 species belonging to 4 phylums: Mollusca, Annelida, Arthropoda, Echinodermata and larva.

The distribution density of the zoobenthos in Ham Luong estuary ranges from 10-570/m^2.

b. The flora: (please refer to the Appendix 1.7)

The survey in Ham Luong estuary recorded 147 species of vascular plants belonging to 58 families. The survey along the entire study area also shows the following main groups of population: the vegetation corridor along the river, infield canals, mangroves, rice fields & crops, soil & aquaculture ponds, garden-forest and residential areas.

* Aquatic resources:

According to the survey for the exploitation and protective planning of coastal and offsea fishery resources, there are mainly coastal species as shrimp, squid, crab, flower crab, synodontidae, snapper, striped mullet, sciaenidae, white dragon, *trichiurus lepturus*, *leiognathidae, nemipterus furcosus, priacanthidae, barracuda*, mackerel, *cynoglossidae*, goat fish, raw fish.

The fish in the coastal and riverine areas of Ben Tre province includes 120 species belonging to 28 families, 15 fish ordors. Perciformes dominate in both families (21 families) and species (54 species), *Carangidae* (9 species), *Sciaenidae* (8 species), *Leiognathidae* (6 species), Pleuronectiformes (14 species belonging to 3 families), *Cynoglossidae* (8 species), *Bothidae*

(4 species), *Soleidae* (2 species), *Clupeiforms* (13 species), *Cluipeidae* (6 species), *Engraulidae* (6 species).

The fish composition in the coastal and estuary areas of Ben Tre province reflects the diverse of species, ecology but the quantity of each species is not large, in which the fish families that play an important role to the regional fishery estuary are *Carangidae, Lutianidae, Synodontidae, Sciaenidae, Mullidae, Clupeidae, Engraulidae, Leiognathidae, Gobiidae, Cynoglossidae, Bothidae, Theraponidae, Gerridae, Sillaginidae* etc.

The fishes are more abundant in rainy season than in dry season: rainy season have 18/28 families, 81/120 species (67.5 ‰ of the total species); while dry season have 16/51 families, only 56/120 species (representing 46.67 ‰ of the total species). The fish groups can be divided as follows:

* The brackish fish group: usually small sized species like *Oxyurichthys tentacularis, Glossogobius giuris*. The zoobenthos fish in the estuary or in the lagoons are the coastal objects. This number does not account small in the entire annual fishing output in the province.

* The migratory sea fish group: include zooplankton as *Clupeiforms*, zoobenthos as *Liga, Oxyurichthys papuensis*. The sea and brackish fish are mostly from the *Perciformes, Clupeiformes, Aulopiformes, Scorpaeniformes, Pleuronectiformes, Anguilliformes*.

* The freshwater fish group: includes *Puntius gonionotus, Clarias macrocephalus* etc.

* The fish group on farm: typical are *Channa striata, Oreochromis, Clarias, Trichogaster*.

The types of shrimp: in the province 20 species are identified, including 12 species of marine shrimp (of 5 families) and 8 species of freshwater shrimp (of 2 families). Salty brackish water shrimp, the most common wild shrimps are *Penaeus merguiensis, Penaeus monodon* and freshwater *Macrobrachium rosenbergii*.

The types of crabs: 2 large-sized marine crab species with high economic values are *Scylla paramamosain* and *Scylla serrata*, which are mainly distributed in coastal brackish area, in the mangrove forests, aquaculture shrimp swamps etc.

Additionally, the molluscs resources include *Meretrix, Andara, Mytilus, Ostrea, Lutraria, Sanguinolaria, Cyclina, Cyrena, Mactra, don Glaucomya, Aliodis, Dosinia, Cerithidium*.

Cerithidium, Nerita live in bottom sediment or gravel, stick on stones in the middle and lower intertidal areas and concentrate into yards. These are valuable food species, which are exploited daily and some are valuable for export. Currently, some species such as *meretrix lyrata, andara granosa* etc. are kept in semi-natural estuarine and coastal intertidal zones, which have been bringing high economic efficiency.

The *meretrix lyrata* area in the subproject area in 3 aquaculture cooperatives: An Thuy, Tan Thuy, Bao Thuan is the concentrated-feeding *meretrix lyrata*.

2.3. SOCIAL AND ECONOMIC CONDITIONS

2.3.1. Economic conditions

The statistics shows that the per capita income in the region remains low and unstable. The per capita income in Ba Tri district is 28.70 million VND/year. The disparity between income groups in the population since 2008 is relatively high for 6.2 times, demonstrating that the growing rich-poor gap tends to increase. The life of people in the region does face many difficulties. The income status of households in the sub-project communes are as follows:

Table 2.20. Investigated income of farming households

N⁰	***Commune***	***Rich household group***	***Fair household group***	***Medium household group***	***Poor household group***	***Total households***
1	Tan Xuan	385	713	220	193	1511
2	Bao Thanh	968	233	143	240	1584
3	Bao Thuan	310	632	403	204	1549
4	Tan Thuy	50	150	898	908	2006
5	An Thuy	1216	1040	494	390	3140
6	An Hoa Tay	552	655	741	910	2858
7	Tan Xuan	532	696	578	506	2312
8	Bao Thanh	250	501	1581	172	2504
9	Bao Thuan	982	1634	534	778	3928
Total		**5245**	**6254**	**5592**	**4301**	**21392**
Rate (%)		***24.5***	***29.2***	***26.1***	***20.1***	

(Source: People Committees, 2/2016)

The primary influences to the local low-income status are natural calamities: too salty (dry season), tidal surges (rainy season), abnormal weather conditions in recent years (drought, flooding, storms, tropical depressions, thunders etc.). The area of arable land for Agriculture - Forestry – Fishery has not been exploited efficiently with seasonally unstable production, which are totally dependent on nature, especially for the recent movement of Penaeus monodon farming in the region that faces high salinity or continuous rains, which reduce salinity and cause mass mortality of shrimps or high tides which broke embankments and made many households lost.

The urgency posed for the water-sources sector and the concerned sectors is quickly solving the flooding phenomenon, mitigating damages caused by floods and storms, taking initiative in preventing floods, waves, tides and reasonable control of water resources in the region to gradually lighten natural disasters, take the initiative in crop production, increase crop-husbandry yields (fishery and salt-making) and cultivation areas.

The status of land use:

The total natural area of land in Ba Tri district is 35,581.75 hectares, accounting for 15.08% of the total natural area of the province. The total agricultural land is 28,320.24 hectares, accounting for 79.59% of the total natural area. The total non-agricultural land is 7,261.51 hectares, accounting for 20.41% of the natural area. The land in the project area is mostly exploited by people with no waste land/vacant land except some coastal mudflats and protection forests managed by the State.

The paddy, vegetable and aquaculture land increases markedly, however the production land increases locally where each subproject invested and the productivity remains uncertain because of no measures of works that protect the production safety from annually abnormance of natural disasters, weather, and tides.

Production status:

The subproject region is relatively abundant and diversified in economic sectors. The significant production activities in the region are agriculture (rice, vegetables, fruit trees on residential land, raising cattle, pigs, goats, chickens, ducks etc.) Aquaculture (raising sea shrimp, Meretrixs, oysters in sea-beaches, fish in ponds, salt fields, ditches, mining infield and sea). Forestry (planting protective forests, mining firewood, water coconut leaves etc.). Salt industry (salt production). Industry (seafood processing establishments, fishing ports etc.) Handicraft services (small trading, markets and small handicraft establishments, shrimp/fish hatcheries, fish breeding, shrimp food). Especially in recent years the movement of industrial shrimp farming are thriving in most communes in the project area, however, due to weather conditions (salinity, tides, rain etc.), the shrimp yield is unstable and the shrimp epidemic mortality in industrial ponds happen constantly every year.

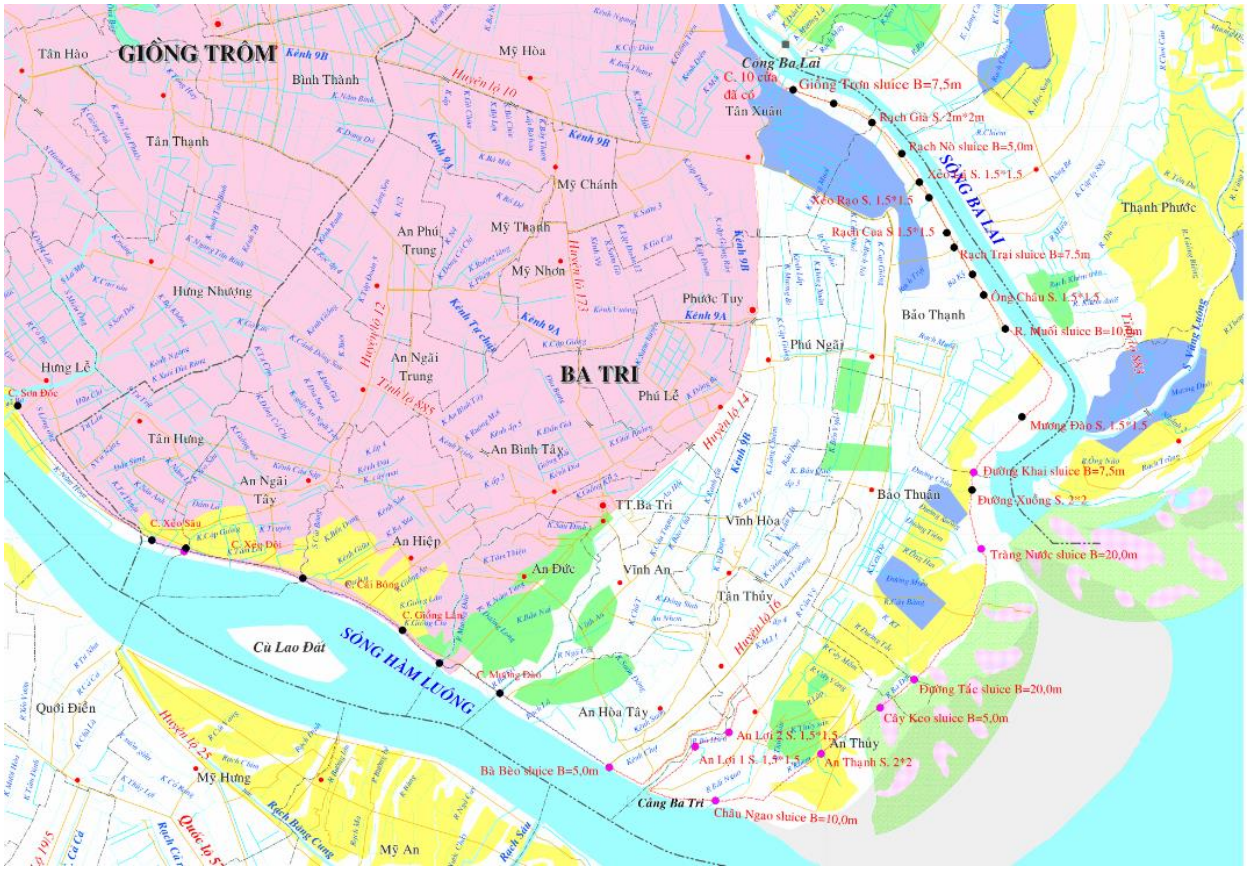


Figure 2.7. Current land use in the Ba Tri

Rice:

The rice farming area inside the dike of district Highway 16 (from Tan Thuy to Tan Xuan) is changeable and largely dependent on rains. When rainfall is distributed evenly and saltwater intrusion is less, the cultivated area will reach a large scale. Rice is almost cultivated in 1, 2 crops on most of the area. The 3-crop area of rice is very small (succeed Chau Binh - Vam Ho Project and Cay Da Project and a part of dike in the irrigated basin of Chin A canal, Dong Xuan). Ba Lai Irrigation Project has supplied freshwater for this area for more than one year but because the system is not complete, the water storage in Ba Lai reservoir is low and the infield canal in the subproject area is narrow, shallow, so the freshwater source is not high and the productivity and yield remain low and seasonally precarious, meeting only 50 - 60% of the average yield of the Mekong River Delta Region.

According to the feasibility study report, the 2015 paddy growing area in the subproject area is 3,405.79ha. In 2015, the summer-autumn crop reaches 4.7 tons/ha, the autumn-winter crop

reaches between 5.5 tonnes and 6 tonnes/ha and the 2015 winter-spring crop in Tan Xuan, Bao Thanh, Bao Thuan, Vinh Hoa, Vinh An, Tan Thuy etc. due to small size, difficult farming conditions, located at the end of the water source, which are heavily influenced by the salt intrusion, the crop yield reaches 4.8 tonnes/ha lower 1 tons compared to the previous year. The rice yield in the region is very erratic and largely dependent on the weather.

Crops:

The cultivated area for vegetables and other crops is mainly located in the agricultural area (2 rice crops + 1 vegetable crop or 1 rice crop + 2 vegetable crops). The vegetable area mainly includes peanuts, corns, potatoes, cassavas, beans, melons, peppers, onions etc. and other vegetables mostly planted on sandy soil. Currently the movement of intercropping gardens tends to increase more and more, which proves high efficient.

Due to soil is saline, crop yield is not high, and the cultivated area is only about 80% of the agricultural land.

Aquaculture:

Aquaculture land focuses on the outside dike to the boundary of protection forest in the communes: Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy, An Thuy, An Hoa Tay, which belongs to the projects of Program 773, the technical infrastructure project for industrial shrimp in Bao Thuan, shrimp farming project (164ha) in An Hoa Tay under the industrial, semi-industrial, extensive and improved extensive forms. In some communes as Bao Thanh, Tan Thuy, An Thuy, people changed salt-production to industrial shrimp and extensive farming. However due to the limited capital and high-risk, the industrial shrimp area in the region is not high (639.6ha/4,250.6 ha).

Due to incomplete offtakes and ponds (for extensive farming households), the yield is low and unstable (the shrimp average yield is 0.3 tons/ha). As for the industrial shrimp area, due to weather affection (salinity, rains, floods, typhoons, storms, surges etc.), epidemic mortality always happen, many households lost, the average yield (under normal conditions) is 5 -: - 7 tons/ha.

Additionally, in some coastal mudflats, people also take advantage to feed oysters, Meretrixs with high productivity but the prices are volatile.

The annual fishing production of the entire project area is about 21,560 tons, mostly in An Thuy and Tan Xuan communes.

The coastal communes including Thuy An, Tan Thuy, Bao Thuan have the Meretrix lyrata area of 872ha (2010). Households participating in the Meretrix lyrata and Andara granosa cooperative model in riparian areas and fishing courtyards. The average one workday for working or exploiting Meretrix lyrata and Andara granosa is paid 100,000-120,000 VND/person (from 2- 4 hours/day). Each period of exploitation lasts about 5-10 days, 2 times per month. This is a fair income for rural areas, contributing to the poverty alleviation, increasing income and reducing the unemployment rate in coastal rural areas. However, due to the climate change, the Andara granosa output tends to decrease in 2009 from 3,436 tons into 1,493 tons (2010). According the Department of Agricuture and Rural Development of Ba Tri district, the aquaculture in the subproject area is as follows:

Currently, the management regulation is incomplete. The lack of aquaculture techniques, using extraction destructive tools, impacts from agricultural activities have been depleted the regional fishery resources, polluted the water environment and changed the composition of the natural food of aquatic species in estuaries.

Table 2.21: The aquaculture in the subproject area phase 2001 – 2010

(Unit: ha)

N⁰	*Item*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
1	Aquaculture area	3,782	4,295	3,116	4,609	4,439	3,941	4,059	4,282	4,507	4,071
*	Black tiger shrimp	2,444	2,490	1,705	2,804	3,170	2,957	3,161	3,189	3,016	2,979
-	Intensive Shrimp Farming and Semi - Intensive				814	905	936	1,123	1,077	910	680
-	Improved Extensive Shrimp Farming				1,353	1,698	1,493	1,178	1,495	1,629	1,802
-	Shrimp - rice				95	114	75	165	120	5	0
-	Shrimp - Mangrove				542	453	453	695	497	472	497
*	White leg shrimp								105	114	90
*	Seafish									72	22
*	Mollusca	1,338	1,805	1,411	1,805	1,269	984	898	988	1,305	980
-	Clam									1,150	872
-	Blood cockle									155	108
2	Quantity	34,168	31,313	30,249	18,999	13,299	7,632	10,904	12,090	12,715	10,777
-	Shrimp aquaculture	733	915	1,155	2,668	3,789	3,450	4,023	3,676	3,707	5,005
-	Mollusca	31,635	28,850	27,536	15,401	8,512	2,261	3,269	3,083	3,436	1,493
3	Yield	7.95	6.50	7.99	3.58	2.60	1.68	2.34	2.48	2.52	2.38
-	Shrimp aquaculture	0.30	0.37	0.68	0.95	1.20	1.17	1.27	1.15	1.23	1.68
-	Mollusca	23.64	15.98	19.52	8.53	6.71	2.30	3.64	3.12	2.63	1.52

Source: Department of Agriculture and Rural Development of Ba Tri district

Aquaculture area of communes in subproject area from 2015 to 2020 presented in the table

Table 2.22: Aquaculture area (ha) of communes in subproject area in 2015

N^0	Commune	Total area	Mixture of shrimp and other	Black tiger shrimp			White leg shrimp	clam	Blood cockle
				Intensive Shrimp Farming and Semi - Intensive	Extensive Shrimp Farming	Shrimp - Mangrove			
1	An Đuc	120		120					
2	Tan Xuan	260	20	40	100		100		
3	Vinh An	125		125					
4	Vinh Hoa	12	12						
5	An Hoa Tay	91		80	11				
6	Tan Thuy	409	13	13	150	33		200	
7	Bao Thanh	654		70	274	180	50		80
8	Bao Thuan	1,568		135	785	150	120	350	28
9	An Thuy	1,544		97	380	137	130	800	
	Total	**4783**	**45**	**680**	**1700**	**500**	**400**	**1,350**	**108**

Source:Department of Agricuture and Rural Development of Ba Tri district

Table 2.23: Aquaculture of communes in subproject area to 2020 *(Unit: ha)*

N^0	Commune	Total area (ha)	Mixture of shrimp and other	Black tiger shrimp (ha)			White leg shrimp	clam	Blood cockle
				Intensive Shrimp Farming and Semi - Intensive	Extensive Shrimp Farming	Shrimp - Mangrove			
1	An Duc	120		120					
2	Tan Xuan	260	20	40	100		100		
3	Vinh An	125		125					
4	Vinh Hoa	12	12						
5	An Hoa Tay	96		80	16				
6	Tan Thuy	409	13	13	150	33		200	
7	Bao Thanh	1,039		70	609	180	100		80
8	Bao Thuan	1,468		135	555	150	150	450	28
9	An Thuy	1,544		97	360	137	150	800	
	Total	**5,073**	**45**	**680**	**1790**	**500**	**500**	**1,450**	**108**

Source: Department of Agriculture and Rural Development of Ba Tri district

Salt production:

The salt production in Ben Tre was generally formed hundreds of years ago, which becomes a longstanding tradition job in the coastal areas of Ba Tri and Binh Dai districts. People in Tan Xuan, Bao Thanh, Bao Thuan, Tan Thuy communes mainly produce salt in the areas close to the coast and estuaries. The total area of salt production in the project area is 887ha, especially in Bao Thanh commune (650ha), the average salt production is 45 - 50 kg/ha/crop.

However, the salt prices fluctuate, the salt production is almost dependent on nature, especially the weather, so the lives of people who make salt encounter numerous difficulties of flood tides and storms. Some salt farming households gave off their job to change to other sectors. Many salt-farming areas are abandoned. To direct the salt-production in the project area, the Ministry of Agriculture and Rural Development introduced the Technical Infrastructure Project that serves the salt-production for 650ha in Bao Thanh commune (dredging canals, local embankments, pump system, electrical system and internal roads in salt fields), which is the necessary and urgent work to stabilize the lives of people in the salt production area.

In recent years, the sea-shrimp movement thrives in the coastal districts and brings higher efficiency than other sectors (although it is highly risky), especially the industrial *penaeus monodon* raising, people in the area transferred from salt-farming into shrimp farming and extensive shrimp farming. The salt area converted into shrimp farming accounts the highest in Bao Thuan, Tan Thuy, An Thuy communes. In these communes, salt area remains very little and in some communes, there is no salt area.

Animal husbandry:

Livestock is ranked second after farming. The livestock is small in family scale to take advantage of family labor, agricultural by-products, additional income, family food and power for crop production. The total cattle in the entire project area is 8,346; the total pigs and goats in the entire project area is 28,050; the total poultry in the entire project area is 145,478.

The infrastructure and equipment for production:

Generally, the facilities serving production and living in the project area is very limited and not asynchronous like machines for agricultural production, information, communication and education, especially housing for people (80% thatched houses). To raise the labor productivity, the rate of agricultural mechanization should be increased in the same time with the rural industrial development on the basis of exploiting local materials to create more jobs for people, increase income and contribute the effective capital circulation in people.

2.3.2. Social conditions

2.3.2.1. Population

The Subproject, covering 10 coastal communes, has the great potential for the integrated economic development: industry - agriculture - forestry - aquaculture – salt - tourism - small services etc., but this potential has not been exploited effectively.

The natural land of the area: 15.529ha, the population: 98,000 inhabitants; average density: 631 persons per square km of them 52% are female; the main workforce is 45%. Most are farmers (70%) ; the rest are fishmen, aquatic farmers, salt makers and servicing people.

Table 2.24: Population of communes in subproject area

N^0	*Commune*	*Population (person)*	*Male (person)*	*Rate (%)*	*Female (person)*	*Rate (%)*
1	Phu Ngai	6527	2675	41,0	3852	59,0

N⁰	*Commune*	*Population (person)*	*Male (person)*	*Rate (%)*	*Female (person)*	*Rate (%)*
2	Vinh Hòa	6681	3369	50,4	3312	49,6
3	Vinh An	6882	3398	49,4	3484	50,6
4	An Đuc	8841	4609	52,1	4232	47,9
5	Tan Xuan	13068	6832	52,3	6236	47,7
6	Bao Thanh	11960	6103	51,0	5857	49,0
7	Bao Thuan	10107	5035	49,8	5072	50,2
8	Tan Thuy	10584	5379	50,8	5205	49,2
9	An Thuy	19194	7678	40,0	11618	60,5

(*Source: People Committees, 2/2016*).

The noticeable characteristics is that most population settle on the sand dunes (dry, high and have fresh water sources etc.), along roads and canals. Some population lives in the islets (Con Ho, Con Tron - An Thuy commune; Con Nhan, Con Ngoai - Bao Thuan commune etc.), which close to the coast and earn for living by fishing, forestry combined with short-term crops on soil mounds. Except the commune centers and focal points that develop the fishery trading (Shrimp Store - An Thuy commune), most people in the region live in thatched houses or small and simple houses, which have a lot of troubles when there are storms, tidal surges from the sea.

In recent years the region's population tends to increase due to the integrated economic potential of land. The communes began to plan economic development orientation, targeting on the development of the marine and coastal economic sectors, including the extensive and industrial farming movement of *penaeus monodon* which is well developed in the coastal communes.

The typical feature in the project area is that the population changes seasonally. People's lives are not stable; the source of labor capacity in the project area has not been used up. Therefore, it requires the agriculture - forestry - fishery sectors the intensive investment by areas to suit the ability of land and crops.

The majority of residents in the region have experiences and certain production levels. However due to the limited production conditions (water sources, saline soil, lack of capital, difficult traffic conditions, natural disasters etc.), the productivity of plants and animals remains low and the production efficiency is not high.

2.3.2.2. Public health

The current communal health system is poor and needy. The medical staff are less qualification so that patients have to go to the district hospitals for their health examination, which cost time and money.

2.3.2.3. Education and training

In general, the education and training in the project area is paid attention by the local branches of the Communist Party and the local government. The education and training is considered as one of the major tasks. The communes in the project area have primary schools and secondary schools. The school enrolment and graduation rates are relatively high but changeable because students drop schools or do not come to class. The number of schools and students to schools at all levels in 6 communes in the project area are listed in the following table.

Table 2.25: School students status in the subproject area

N⁰	*Commune*	*Primary-school*		*Junior high school*		*High school*	
		Classes	*Number of students*	*Classes*	*Number of students*	*Classes*	*Number of students*
1	Phu Ngai	16	481	18	620	18	620
2	Vinh Hòa	15	416	12	377		
3	Vinh An	15	485	10	353		
4	An Đuc	15	425	10	314		
5	Tan Xuan	35	984	24	883		
6	Bao Thanh	26	750	18	578		
7	Bao Thuan	18	642	28	1272	16	429
8	Tan Thuy	28	785	18	626		
9	An Thuy	44	1362	24	872		
10	An Hoa Tay	-	-	26	909		

(Source: People Committees, 2/2016)

The level of education is still a disparity between men and women. Woman, besides taking care of housework in family, must join the works like men to partly ensure their difficult living conditions. The education for girls also receives less attention than boys. The low family income as well as the works required in the coastal areas are the main causes leading to difficulties in education. The number of children which do not attend schools and drop out of schools due to economic reasons is relatively high.

2.3.2.4. Culture - Information - Sports

Culture and Information: in each commune in the project area, there is 01 loud speaker radio. In a year, it broadcasts 760 hours and conveys the province's radio every morning for the new information about the policies of the Communist Party - Government. The postal services and cultural entertainments were also interested by the Government at all levels to cater to the needs of people in the region such as cultural houses and cultural/political points for the Youth etc.

Sports: The communes launch sports events for the youth with specific activities as football, volleyball etc. to push up the sport movements for the youth. In addition, the communes organize cultural – sports meetings in the big festivals and holidays.

2.3.3. The status of infrastructure

2.3.3.1. Drainage and Salinity Control

The sluice gates take two-dimensional functions: controlling salinity intrusion and taking water. The sluice gates in combination with the existing canals, ditches and dikes increase the gravity irrigation in the region. The sea dyke system is constantly strengthened and newly built. Ba Tri sea dike has been built with 31km long and 5 wide and the crest level is +3.50m. There are 20 sluice gates planned under the dike but only 11 pipe sluice gates are built and 5 sluice gates are left open, so saltwater intrusion is uncontrollable in Zone 2, which should be invested to protect people's production, life in the coastal area.

2.3.3.2. Water Supply

In the subproject area, the rainfall occupies the lowest in the region. The main water sources are from rivers, sand dunes and deep ground water in water scarce areas. The subproject area are abundant in surface water but because of locating in the river downstream, coastal area, saline intrusion often takes place in dry months. The water supply work in the region belongs to the Rural Water Supply and Sanitation Center and some private economic sectors. The water supply systems have no coherence in the whole. The drinking water supply for people in the subproject area meets difficulties. Total households who use piped water from Tan My water plant and some other small water supply schemes are 5432 households. 11,194 households of 6 coastal communes in the subproject area have no clean water. The drinking water need for these households is extremely urgent.

Table 2.26 The number households served with piped water system

N^0	Commune	2015			
		Number people	Household	Water meter	Rate (%)
1	Tan Xuan	13,175	3,137	1,131	8.58
2	Bao Thanh	11,193	2,665	1,604	14.33
3	Bao Thuan	9,156	2,180	1,001	10.93
4	Tan Thuy	15,826	3,768	572	3.61
5	An Thuy	10,114	2,408	664	6.57
6	An Hoa Tay	10,336	2,468	460	4.45
	Total	**69,800**	**16,626**	**5,432**	

2.3.3.3. Traffic Network

Current local traffic Network consists of both waterway and landroute. There was Ba Lai sluice gates 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 sluice gates 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.

2.4. GENDER CHARACTERISTICS

According to site investigation, the majority of households are headed by male persons. Except some households, female is a main householder due to unexpected conditions of single - mum or divorced marital status.

Agricultural practices are the main income source of female persons, meanwhile male persons involve into non-agricultural activities or are seasonal workers in urban areas. Generally, the workforce of female is dominant in agricultural production, but their incomes are lower than male. Meanwhile, women or females play a crucial role in their families for many different responsibilities such as chore, looking after children and other houseworks. Women have also participated in many social activities along with man. However, women have to play dual roles as workforce and family careers, there are some hurdles still remain including time available, opportunity and other requirements for social activities. Therefore, the supporting aim of the Subproject is to reduce burdens and responsibilities for women through incremental incomes from production in association with their position opportunities to participate into community-based activities.

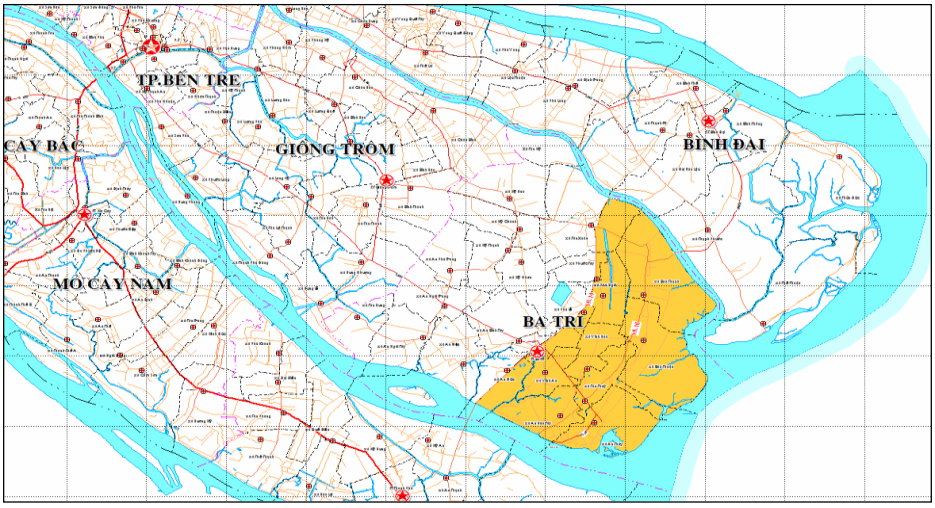


Figure 2.8: Map of the Traffic Situation in the Subproject Area

2.5. PHYSICAL CULTURAL RESOURCES

In the Subproject area, there are three (03) national historical sites and one (01) local site. These historical sites are valuable and worthy of spirit life to local people as well as tourism attraction. Specific names and locations of historical sites are described in *Table 2.27*.

Table 2.27. Historical and Cultural Sites in the Subproject area

N⁰	***Name of Historical Sites***		***Description***
1.	**National sites**		
	Gravestone Relic and Nguyen Dinh Chieu Monument		The relic has an area of 13,00m^2, which is located in An Duc commune, which is 2km away from Ba Tri town, and 15km for the Dredging site. ▪ This relic was recognized by Ministry of Culture – Information on 27 April 1990.

N⁰	*Name of Historical Sites*		*Description*
	Vo Truong Toan Gravestone		▪ It is located in Bao Thanh commune, 18km away from Ba Tri town, and 2km from the Dredging site. ▪ This relic was recognized by the Ministry of Culture – Information on 24 Jan 1998.
	Nguyen Van Cung and Cay Da Doi		▪ It is located in Tan Xuan commune, 16km away from Ba Tri town, and 5 km from the Dredging site. ▪ It is recognized by the Ministry of Culture – Information on 07 May 1997.
2.	**Provincial Monuments and Relics**		
	Phan Thanh Gian Gravestone		▪ The monument is located in Bao Thanh commune, which is 12km away from ba Tri town and 2 km from the Dredging site.

2.6. SITE – SPECIFIC CHARACTERISTICS

2.6.1. Sluice Gate

The construction area of sluice gates is mainly weeds and brush trees. Local transportation system is not available. During high tide regime (spring tide), boat is the only one transportation facility accessing to this construction area. There 5 sluice gates will be constructed in the Subproject area, including: Duong Khai, Trang Nuoc, Duong Tac, Cay keo and An Thanh. Each sluice gate is illustrated by pictures in the following table:

Table 2.28. Sensitive Features around sluice gates

	Name of sluice gate	*Picture*	*Description*	*Social and economic conditions*
1	Duong Khai		This sluice gate is at the beginning point of Duong Khai, Bao Thanh commune. It is 745m away from coastal mangrove forest.	▪ Production activities of surrounding areas are shrimp farms and salt making. ▪ Low waterway transportation activity.
2	Trang Nuoc		The sluice gate is located on Trang Nuoc canal, which is 1000m away from Ba Tri coastal mangrove forest area.	▪ Extensive shrimp farming. ▪ Low waterway transportation activity.

	Name of sluice gate	***Picture***	***Description***	***Social and economic conditions***
3	Duong Tac		It is located on Duong Tac canal with 20m width, and is about 1,270m away canal mouth.	▪ Intensive and extensive shrimp farms. ▪ Low waterway transportation activity.
4	Cay Keo		The sluice gate is located on Cay keo canal with 5m width.	▪ Extensive shrimp farms. ▪ Low waterway transportation activity.
5	An Thanh		It is located on An Thanh canal with 4m in width.	▪ Intensive shrimp farms. ▪ Residential area is 200m away from the sluice gate. ▪ Low waterway transportation.

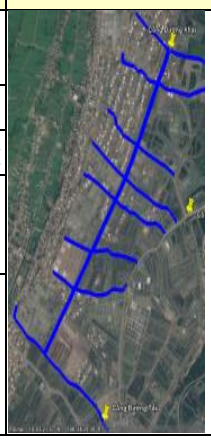
2.6.2. Dredging canal systems

All 14 proposed dredged canals are connected to the sea in which water flow and level are directly influenced by uneven semi – tidal regime. Shrimp farms are not able to cultivated due to salt intrusion. During the period of spring tide and neap tide, water level of the canal is up to 3m and is lowered at 0.5m, respectively. Shrub and scattered trees are mainly vegetation on both sides of canal's branches, with low waterway transportation activity.

Location and socio-economic activities in these existing canals are summarized and illustrated in the following table:

Table 2.29. Sensitive Features around canals

	Canal name	**Picture**	**Location**	**Production Activities of Existing Canals in Subproject Area**
1	Gia		Bao Thanh commune	 
2	Xeo Giua			
3	Cat			
4	No			
5	Cua			Salt production and Black tiger shrimp area.
6	Duong Khai		Bao Thuan commune	 
7	Duong Xuong			
8	Duong Mieu			
9	Duong Chua			

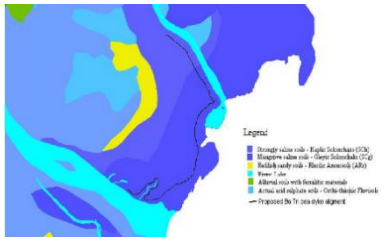
	Canal name	Picture	Location	Production Activities of Existing Canals in Subproject Area
10	Cay Bang			Black tiger shrimp area and salt production
11	Ong Hai Ha			Black tiger shrimp area 
12	Đe Quoc Phong			
13	Đuong Tac			
14	Cay Mam		Tan Thuy commune	Black tiger shrimp area and salt production











Existing canals

Soil types in the subproject area

CHAPTER 3. ALTERNATIVES ANALYSIS OF SUBPROJECT

This chapter aims to provide justification on how and why this subproject is selected based on the approach recommended by the Regional Environmental Assessment (REA) and the Resional Social Assessment (RSA) for the MDICRSL project for the transition zone to the estuary region (Section 3.1) as well as the alternative analysis considered during the design of the subproject (Setion 3.2). The ESMP (Chapter 6) has explicitly incorporated a technical assistance to ensure that extensive consultation is made during the development of the sluice operational manual and that DARD will have adequate capacity to manage and control future development of aquaculture farming including possible scale up of the proposed livelihood models. These measures are intended to prevent and/or mitigate potential negative impacts on land and water uses due to operation of sluice gates as well as possible expansion of aquaculture activities in the subproject and nearby areas. The technical assistance will plan and implement the mitigation measures to address the potential impacts during operation phase of the subproject.

3.1. Need for the Subproject

Need for implementation of the subproject has been identified in the REA and RSA prepared for the MDICRSL Project. It has been concluded that overall the proposed subprojects are designed to have positive environmental and social impacts and monitoring changes during construction and operation of water control infrastructure and livelihood models is required. The additional surface and groundwater monitoring and assessing changes in coastal and riverbank erosion under Component 1 of the MDICRSL Project will be important for measuring and managing the long term regional impacts of the Subprojects 2, 3 and 4 and the implementation of subprojects in Phase I will provide important insights into the design and safeguard instruments for the Phase II subprojects.

The proposed subproject will be implemented under Component 3 of the MDICRSL Project. Below highlights justification for the subproject and measures to mitigate potential negative impacts as recommended in the REA and RSA and they have been considered during the preparation of Chapters 4, 5, and 6.

a) Impacts of dredging

The main possible impacts on the local environment during maintenance dredging and/or construction of secondary and/or tertiary sluices would be: (a) contamination of the lands and water resulting from the disposal of dredged materials; (b) contamination of the roads and lands resulting from the transportation of the dredged materials; and (c) an increase in suspended solids in water due to disturbances of bottom sediment. A sampling survey suggested that dredged materials are mainly silt and clay with high organic content with the content of the heavy metals and residual pesticides being below the national thresholds. Therefore, the risk of contamination to the disposal land and ground water is small.

In the Mekong Delta, it is customary that dredged materials be stored on the land next to the canal for drying for one or two years and then used as a basis for roads or dykes. However, it should be noted that the dredging would take place over extensive areas and over the whole project implementation period. Important information such as estimated quantity and likely quality of the sediments, availability of lands for disposal is at the detailed design stage. In this context, it is appropriate to develop a detailed plan for the disposal of the dredged materials at the detailed design stage.

b) Impacts of sustainable livelihood models in the estuary and peninsula

The livelihood models in the delta estuary and peninsula will support to farmers to transition (where suitable) to more sustainable brackish water activities such as mangrove-shrimp, rice-shrimp, and other aquaculture activities and to implement climate smart agriculture by facilitating water use efficiency in the dry season. Livelihood programs are very important in the delta estuary and coastal provinces ashouseholds in the transition between fresh and brackish water had lower income than those in other zones. Livelihoods of people in this zone are more vulnerable to freshwater availability from the upstream, to salinity intrusion from estuaries and/or adjacent shrimp farming areas and to extreme dry season freshwater shortages.

Providing livelihoods support measures to farmers to adapt to salinity intrusion and transition to brackish aquaculture is an important initiative. Salinity issues in the estuary areas have caused production losses to rice and high value agriculture. The transition to high value agriculture will provide many social benefits to local communities and households involved in the livelihood models. Construction of salinity control infrastructure in the past has been inflexible and locked farmers into development pathways. The transition to aquaculture in the estuary areas will be complex as currently high value crops provide more farm-based income than aquaculture and supports employment opportunities for local people.

The mangrove-shrimp and rice-shrimp are more sustainable options for aquaculture. The development of livelihood models will need to consider the potential environmental impacts of aquaculture and shrimp farming including the release of organic wastes, agro-chemicals, antibiotics, the transmission of diseases and the ecological impact on freshwater and coastal fisheries in the Mekong Delta.

c) Expanding aquaculture and shrimp farming

The large areas of land required for intensive and semi-intensive shrimp farming have led to significant natural habitat loss through conversion of mangroves and wetlands into shrimp ponds. The investment in large water control infrastructure has lead to conflicting interests and inflexible water management when local rice farmers sought to benefit their income through the conversion of their farms from rice to shrimp.

The project will promote integrated rice-shrimp and mangrove-shrimp farming that are considered to be more environmentally sustainable aquaculture because it is extensive and uses less agro-chemicals (i.e. fertilizers, antibiotics) and can lead to restoration of mangrove areas. Environmental concerns such as effluents from the shrimp farms, disposal of the sediments in the shrimp ponds into canals and rivers need to be managed. Applying sustainable rice-shrimp model using VietGap standard to develop operational guidelines for water management systems in the project area will lead to more sustainable shrimp farming in the estuary and peninsula.

Nevertheless, there are some environmental concerns relating to the current rice-shrimp farming systems. First, the current shrimp farming method is based on high water exchange, which would result in high accumulation of sediment in the rice farms in the long-term. Many farmers reportedly dispose of accumulated sediment back into the canals or nearby river, which would induce negative environmental impacts. Furthermore, recent introduction of exotic species and introduction of more intensive shrimp aquaculture may also lead to more pollution in the effluent of the wastewater from the shrimp farming.

d) Impacts of protecting mangrove forests in coastal areas

To adapt to saline intrusion and prevent coastal erosion in Ben Tre, measures will include ecosystem-based aquaculture, resilient infrastructure for aquaculture and mangrove

reforestation. Mangroves play a critical role in biodiversity and ecosystem productivity in the coastal areas of the Mekong Delta. In some areas of the delta, dikes are already being strengthened or heightened and mangroves are being planted to improve protection from storm surges and coastal erosion The GIZ Integrated Coastal and Mangrove Protection (ICMP) program is supporting Vietnam to manage its coastal ecosystems in order to strengthen resilience to climate change. To manage environmental impacts, a forest Management Plans (0P 4.36) will be prepared for all mangrove reforestation work undertaken as part of the project.

Integrated coastal management requires a combination of sea dykes, mangrove restoration and sustainable shrimp farming to protect the peninsula from coastal erosion and sea level rise. Increasing the mangrove area will protect against coastal erosion, storm surges and may increase biodiversity. This activity should be supported by biodiversity conservation and monitoring to protect saline and estuarine species in the mangrove areas. The sustainable management of coastal (near-shore) fisheries and other aquatic animals is important to support livelihoods of landless and protect biodiversity.

3.2. ASSESSING "WITH" AND "WITHOUT" SUBPROJECT

This section includes the analysis of environmental and social impacts in case of "without" and "with" subproject as follows:

- *"Without" subproject:* this means environmental and social issues are ongoing as present. For example, the fresh water sources for drinking and production are in the scarcity; often salinity intrusion has been causing serious damages to the production and the livelihood in the people area.
- *"With the subproject":* this means the subproject portfolio includes: constructing 9 salt-preventive sluice gates, dredging 14 infield canals, building the water supply station of 330m^3/h, supporting local governments the sustainable livelihood models which proactively adapt to climate and sea-level rise.

The analysis details on environment and social impacts are shown in *Table 3.1*.

Table 3.1: Environmental and social impacts in case of "without the subproject" and "with the subproject"

	Impacts	**Selected alternatives**	
		"Without the Subproject"	**"With the Subproject"**
1	**ENVIRONMENTAL ASPECTS**		
	Water Quality Improvement	The canal water is currently affected by wastewater from rice production and aquaculture.	The canal water quality will be improved and better drainage condition due to dredging.
	Land Use Change	▪ Zone 2 is a mainly salt-making area. ▪ The main economic activity in Zone 3 is rice cultivation. This will affect soil quality due to utilization of chemical fertilizers.	▪ Zone 2 is brackish shrimp farming and economic sustainability. ▪ Possible resulting to the conversion of land-use purpose in Zone 3, from traditional rice-growing to the specialized farming to make high competitiveness in the market. ▪ Gradually, improve the added value of agricultural production and the income for local people, to actively adapt to climate and sea-level rise.

	Impacts	Selected alternatives	
		"Without the Subproject"	**"With the Subproject"**
	Biodiversity	▪ There are no critical, sensitive natural habitats and species listed in the Red Book of Vietnam and IUCN in the subproject area. ▪ Currently, the sluice gates of Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh have no salinity regulatory works that make pathway for aquatic species to find food as well as to reside. However, the salinity constantly changes, which is also an affecting factor on the aquatic ecosystem in the Subproject area.	▪ The construction of tidal control sluice gates may affect the movement and foraging of some aquatic species. ▪ However, the operation condition is flexible, active, short time and uncontinuous open – close regime. Therefore, this effect is negligible.
	Salinity controlling	▪ Uncontrolled	▪ Salinity, surge tides and drainage conditions are well controlled and regulated by the sluice gates system.
	Coping with climate change	▪ The Subproject is located in the coastal region which is forecast to be severely affected by saltwater intrusion due to sea level rise, leading to serious scarcity of fresh water resources.	▪ A part budget of the Subproject is proposed for supporting local people and authorities. This enables sustainable development and conversion of livelihood models in adapting with climate change impacts. ▪ Raising public awareness on climate change and support the establishment of the communal climate change response teams. ▪ Forming the community-based model and building capacity that actively responds to climate change. ▪ Upon the completion of the Subproject, livelihoods of local people are sustained in the context of climate change.
2	**SOCIAL ASPECTS**		
	Land acquisition and resettlement	▪ There is no land acquisition and resettlement.	▪ There is no land acquisition and resettlement.
	Income of local people	▪ Agricultural production is not really sustainable and the state of "planting, cutting" perennials and "bumper crops, cheap at prices" is popularly observed; ▪ Most agricultural products are poor quality and less competitive	▪ These limitations will be addressed quickly in association with fulfilling the complete irrigation works, electrical supply system; enhanced production quality models and linking production – market chain.

	Impacts	Selected alternatives	
		"Without the Subproject"	**"With the Subproject"**
		because of the small-scale, fragmented production; ▪ Large quantity of farm products, but in homogeneous; ▪ Inadequate technical contribution to agricultural values. Particularly, there is a lack of cohesiveness in the added value chain in terms of production - purchase - processing - storage - consuming of products.	
	Aquaculture practices	▪ Climate-related risks are often observed. A serious phenomenon of massive deaths of scallop in 2011 was recorded due to climate-related factors, including climate change, salt intrusion, extremely high temperature and insufficient nutrition sources. ▪ It was estimated that 1,500 tons of mature scallop and 2,635 tons of young scallop were dead, which caused total loss values up to 127.6 billion VND in three (03) fishery cooperatives (An Thuy, Tan Thuy and Bao Thuan communes).	▪ The saline intrusion areas (aquaculture and salt-making areas) will no longer depend entirely on nature and can be more active in prevention and minimization of natural disasters through the sea dike system and tide-prevention sluices (sluice gates). ▪ In the dry season, sluice gates will be closed to prevent saltwater, if the salinity is too high. In case of late seeding crop, which caused late harvesting, shrimps would be shocked due to rains leading to reduction in salinity level, salt water in-canal salt water and in-pond salt water storage measures will be applied. ▪ Eco-shrimp farming and implemented biological safety measures will help local farmers to minimize difficulties and risks faced by climate-related risks. These will also enable sustainable aquaculture practices, increase product values and support export activities.
	Rice production	▪ Salt water intrusion caused yield reduction of rice, crops, and fruit trees. In the Winter-Spring crop (2014 – 2015), the total area which was directly affected by salt intrusion was about 3,825 ha, loss value was estimated over 63 billion VND.	▪ Salt intrusion can be minimized, production activities are no longer face with risks of saltwater intrusion due to the proactive open – close sluice gate system. ▪ An increase in production though the number of crops decreases. Crops and livestocks will be diverse. ▪ Enabling rice – shrimp models. This kind of integrated model minimizes epidemic diseases, promotes clean shrimp products and brings sustainable economic efficiency.

	Impacts	Selected alternatives	
		"Without the Subproject"	**"With the Subproject"**
	Freshwater supply for production	▪ Insufficient fresh water resources for agricultural practices. ▪ The entire area of zone 3 is facing with a shortage of freshwater in the dry weather due to inadequate sluices for freshwater intake and lacking of regulatory works preventing saltwater intrusion.	▪ Once saltwater intrusion is controlled resulting in a reduction in salinity in Zone 3, production activities will be sustained through a combination of propaganda with public awareness on the advantage and prevalence of local crops and livestocks.
	Improve traffic demand of people in the area	▪ The existing 31km long of transport infrastructure in the sea-dyke system is not yet connected completely.	▪ Construction of 5 tidal sluices making a complete connection of transport route with 11 existing sluice gates on a 31 km sea-dyke system.
	Interruption of living and production of people	▪ There is no obstruction for local waterway transport. ▪ Without sluice gates, boats travel easily within the Subproject area.	▪ Waterway traffic can be affected when closing sluice gates. ▪ However, this effect is negligible as sluice gates are closed for a short time and the operation plan will be publicly noticed for local people to arrange their traveling schedules.

3.3. ANALYSIS OF ALTERNATIVES

Component 1: No alternatives to be considered.

Component 2: The optional alternatives in terms of structural techniques for sluice gates presented in *Table 3.2* show that the alternatives to be selected are economic optimal and environmental and social impacts are at the acceptable levels.

Table 3.2: Optional alternatives in terms of Technical Aspect for the sluice gates of the Subproject

	Component	Selected alternatives	
		Alternative 1	**Alternative 2**
1	**Sluice gates structure**	▪ On-site reinforced concrete structure by using steel-pile cofferdams or soil-retaining dikes impounding to keep dry the entire construction pits and foundations.	▪ Assembled concrete structure: sluice gates pillars and valve towers (divided into segments, 2-3m each segment) are precast reinforced concrete structure.
	Advantage	▪ The concrete work is simple that requires medium techniques and machines/equipment.	▪ The time for completion of assembled works is short. ▪ The quality of concrete structures is guaranteed.

	Component	Selected alternatives	
		Alternative 1	**Alternative 2**
		▪ The material supply source (sand, stone, cement and steel) is abundant, and is not far from the construction area, about 15 - 20km. ▪ Material transportation is convenient, by road or waterway	▪ Fabrication of structures of works does not depend on the weather condition.
	Disadvantage	▪ Difficulty in creating dry pits. For high water column H = (6 - 8) m, steel-pile cofferdams or soil-retaining dikes must be installed to keep dry the entire construction pits. ▪ The quality is harder to control than casting structures in plants.	▪ Modern construction machines and equipment are required. ▪ Workers must be skillful, technicians are highly qualified. ▪ Trucking, assembling components in large quantities and bulk, about 100 tons from plants to the construction sites is very difficult, specialized equipment and machines are needed.
	Environmental and Social aspects	▪ The construction depends on the weather, and therefore, it is not easy to minimize unexpected impacts. ▪ Social impact will be significant due to the acquisition of land for construction, warehouses, workers' camps to serve for the concreting. ▪ The execution time is long, leading to the environmental effects will be longer.	▪ Less environmental pollution in the construction sites than the in-situ reinforced concrete plan because there is a substantial amount of workers and machines at the workshop. ▪ Social impacts will be less as main components are manufactured at the workshop.
	Economic efficiency	Cheap, saving cost	High cost
	Conclusion	**<u>Selected</u>**	**Not selected**
2	**Type of structure**	▪ *Rigid structure:* reinforced concrete is monolithic between pillars and bottom beams.	▪ *Soft structure:* removable concrete, soft links between pillars and bottom beams.
	Advantages	▪ Acting force is distributed on both pillars and bottom beams. ▪ The structure is more stable and reliable when it is subjected to external force caused by small foundation pressure. The horizontal force is evenly distributed to both	▪ Pillar is the main load-bearing structure, the bottom suffers dead-load only, so the bending moment is small, which help minimize required reinforcement. ▪ Require narrower construction site; the construction in steel-pile cofferdams costs lower.

	Component	Selected alternatives	
		Alternative 1	**Alternative 2**
		bottom pillars and bottom beams. ▪ The number of piles is smaller. ▪ The construction work, monitoring of work quality is implemented by experienced staff. ▪ The design is in accordance with sluice gates aperture of 50 - 30m. ▪ Local contractors have a lot of experiences in this kind of designing proposed structure. ▪ Safe design, management and operation of the opening and closing valves.	▪ The volume of construction at the same time is small and can be arranged flexibly. ▪ Designed in accordance with the sluice gates aperture > 20m.
	Disadvantages	▪ Bottom beams are bearing structures (mainly bending moment), so it must be thick enough and reinforced, especially the cavity at aperture > 20m. ▪ A wider work site is required; the cost will be higher when applying cofferdams. ▪ The volume of construction required simultaneously is larger and inflexible.	▪ The structure is less stable as foundation pressure on pillar is huge. ▪ Linked by soft joints or abutment. ▪ Affect on absorbent safety of the construction works when the joints/links get troubles/incidents. ▪ Valve gate works is unsafe when subsidence or sinking between the two pillars occurs. ▪ The foundation pressure posed by the work is large. The treatment of pillar bottom is difficult. ▪ Horizontal force will affect on pillar. Piles must be dense, pillar bottom slab area must be increased when there is a large difference of water column/level. ▪ Local contractors are less experience in design, construction, quality monitoring in the irrigation sector. ▪ The settlement at 2 pillars appears easily, therefore, the coupling for components must be compatible with the operation of the door and limit subsidence.
	Environmental and Social aspects	▪ Local navigation will be affected during the construction phase. ▪ A large construction site, the area of acquired land and compensation is large.	▪ Influence on navigation is minimized during the construction phase. ▪ No need for large construction site; land acquisition and compensation are less; can be constructed in cofferdams,

	Component	Selected alternatives	
		Alternative 1	**Alternative 2**
			construction works can be carried out in watery condition.
	Economic efficiency	For sluice gates with cavity aperture ≥ 20m, the investment cost will be greater.	The rate of investment is feasible.
	Conclusion	**Selected**	**Not selected**

Component 3: There are no alternatives to be considered.

CHAPTER 4. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

It is noted that although the potential negative impacts of works (dredging and building sluice gates) to be conducted under Components 2 of this subproject is in line with the key findings of the REA for the MDICRSL that it will generally increase the level of air, noise, vibration, and water pollution as well as increasing local traffic congestion including road safety risks and disturbance to local residents and they could be mitigated by (a) ensuring that contractors apply good construction practices and initiate/maintain close consultation with local authorities and communities throughout the construction period and (b) close supervision of field engineers and/or environmental officer as recommended in the REA. However, to comply with Government's expectation for the EIA analysis, the ESIA also included the results of the analysis related to air/noise and water pollution in Section 4.4.4. As suggested by the REA, these impacts will be mitigated through the application of the Environmental Code of Practices (ECOP) which has been prepared in lien with the ESMF.

Potential negative impacts of the subproject activities during operation of sluice gates and application of the livelihood models have also been found to be moderate and they can be mitigated through a technical assistance to be provided during the preparation and implementation of the livelihood development models (Component 1 and 3 of this subproject). The technical assistance will also address the need for extensive consultation with water users and key stakeholders during the development of sluice operations and possible impacts due to expansion of aquaculture faring and the livelihood model without adequate management and control.

4.1. CLASSIFICATION AND SCALE OF IMPACTS

In the implementation of the subproject, there will be some potential impacts on the environment and society in the subproject area and the surroundings. The impacts may be temporary in each phase of the subproject or may be recurring during the subproject lifespan.

The common collateral impacts are classified into two types: impacts caused by daily activities and impacts caused by the accidence/incidences. The first type involves in the normal operation activities of the subproject while the later one involves in the unwanted accidences from the activities. During the evaluation process, the degree of the impact on the environment will be determined based on the following criteria:

Significant impact (S)

- Significant changes, over a significant area, to key characteristics or features or to the landscape's character or distinctiveness for more than 2 years.
- The impact goes beyond regulatory standards or long-lasting and widespread impacts
- Altering the ecosystems or ecological functions on a large area causing losses at the moderate scale (lasting over 2 years) but having the ability to restore within 10 years;
- Tentatively affect human health;
- Causing financial damage to the users or communities.

Moderate impact (M)

- Noticeable but not significant changes for more than 2 years or significant changes for more than 6 months but less than 2 years, over a significant area, to key characteristics or features or to the landscape's character or distinctiveness.
- Altering the ecosystems or ecological functions locally in a short time with potentially good recovering capacity. The impact level is similar to the changes at present but potentially causing accumulated impact.
- Possibly (unlikely) affect human health; may causes difficulties to some users.

Low Impact (L).

- Noticeable changes for less than 2 years, significant changes for less than 6 months, or.
- Changes occur only in the current variation range or barely discernible changes for any length of time, within acceptable standards and their impacts can be totally controlled.
- The impacts may affect the operation but does not hinder the users or the public.
- Mild impact on the human health or quality of life.

No impact (Insignificant/Negligible) N

- Any change would be negligible, unnoticeable or there are no predicted changes;
- Changes that are not perceivable or can be measurable based on the basic operation;
- No mutual influence and therefore no changes occurred.

4.2. POSITIVE IMPACTS

4.2.1. Socio-economic condition

The current saline soil and saline water can be affected to decline both quality and quantity of some local crops. The two crops in many areas are not arable due to salinization and lack of fresh water for irrigation as well as dilution for aquaculture. According to the survey results, the proportion of irrigated arable land in the Subproject area is low (accounts 11.7% of the surveyed households whose arable land is irrigated). The majority of households have no way but pumped water for their cultivation and fishery land, which leads to high production costs. The common state of soil salinization, flooding or water shortage in many places causes significant effects on production and people's life. Accordingly, local people have faced with difficulties related to water resources for agricultural practices such as fresh water shortage, flooding, salinity, water pollution, even shortage of saltwater for aquaculture cultivation in the rainy season.

Once the Subproject is completed, the system of canal and sluice works, which prevent salt intrusion, will be improved to reserve freshwater for irrigation. Therefore, local people can be able to produce local plants and animals, which are competitive in the market. This will gradually improve the value of agricultural production and income and actively adapt to climate change and sea level rise. The combination of agriculture, aquaculture and livestocks at the household and cooperatives level will accelerate the alleviation of poverty in the region, making the number of subproject beneficiaries 98,000 people. According to site investigation in associated with public consultation, the percentage of households utilizing 1 rice-crop per year and 2 rice-crop per year are 10.1% and 42.2%, respectively. Interestingly, about 17.8% of the respondents said that they will increase crops if water provision is sufficient. Further, about 2.3% of respondents want to switch to aquaculture and 10.2% will combine rice cultivation

with aquaculture, 0.7% shift to the rice-crop model, and about 4.4 % switch to cultivation of high-yield crops (which need more water).

4.2.2. Capacity of Climate Resilience

Given the context of agriculture-based livelihoods, the three (03) proposed components of the Subproject aim to underpin local livelihoods in association with the enhancement of local adaptive capacity climate change effects through:

- Restoring mangrove belt in combination with sustainable livelihoods by developing aquaculture models of mangrove – shrimp and rice – shrimp;
- Improving sustainability of brackish water aquaculture by dredging 14 canals to control tidal surge; and
- Building adaptive capacity by supporting adaptation and mitigation measures for local people.

Component 1: Mangrove – shrimp

Mangrove-shrimp to organically certify is to establish an "organic coast" that both produces high-value certified shrimp and protects from the rise of sea level as well as extreme weather events. According to IUCN, the mangrove – shrimp model can contribute to natural disaster risk reduction and enhance livelihoods. In fact, the plantation of 9,462 ha forest of 166 communes in Northern Vietnam (in which mangrove forests accounting for 8,961 ha), reduce damages caused by tropical cyclones for dyke systems. Damages cost about 80,000-295,000 USD, but total saving costs are over weighted the damages, estimated about 15 million USD.

In this scenario, integration of mangrove-shrimp farming and organic certification offer a strong example of an ecosystem-based adaptation to climate change. Further, with a direct financial incentive which is being provided to farmers to plant and conserve mangroves, it can also be seen as an effective form of Payment for Ecosystem Services (PES).

Whether or not certified organic shrimp farming results in permanent improvements to livelihoods and the environment remains to be seen. Nevertheless, with strong business and provincial government support, there are grounds to believe that the project will deliver economic and environmental benefits that, because the project aims to change the underlying business model, will persist after the project ends.

Component 2: Improving Sustainability of Brackish Zone

The activities of the Subproject in Zone 2 lend a hand to protect vulnerable people to adapt to climate change are mainly performed via the climate change adaptation works, better welfare network and risk management activities. The Subproject will construct 5 tidal-sluices in the sea-dike area to minimize effects and enhance the resilience to climate change.

The dredging activities for 14 canals will facilitate the improvement of irrigation works and efficiency of water use. In addition, it is suitable to turn to cropping structure in the context of extreme weather conditions by crop diversification, restructuring of monoculture crops to intercropping and rotation crops. Further, paddy fields are also protected from salt water during serious drought periods.

Component 3: **Building Capacity for Climate Change Resilience**

The fieldwork results combined with the interviews of local people in the subproject region reveal that most vulnerable people much depend on natural conditions for their living activities.

Therefore, in a long – run, this component of the Subproject will bring positive benefits for local people in terms of awareness and adaptive capacity.

Consequently, raising public awareness on climate change and support the establishment of communal response teams to climate change adaptation are the vital of concerns and needed solutions that help local people to minimize climate vulnerabilities and to strengthen their resilient capacity to climate change. These supporting measures include:

- Providing necessary skills and knowledge to adapt to climate change. Knowledge helps increase people's ability to cope with climate shocks in the short-term and to adapt with climate change in the long-term.
- Sharing lessons learned among local people to be affected may enhance the adaptation activities of the Subproject.
- Deploying the appropriate model in rice fields, training and field seminars (FS) is improving social resources and increasing the access to information sources, which may create more effective economic development opportunities.
- Establishing/Supporting farmers' unions and market linkages will amplify the access and connections to markets and to promote the establishment of partnerships and cooperation among communities, private companies and local organizations to create long-term stable income for the people in the subproject region.

This model of capacity building will gradually change people's perception and attract them to engage in the alternative livelihood activities. This will enable transformation from spontaneous adaptation activities to planned adaptation measures.

4.2.3. Positive overall impacts

The positive overall impacts of subproject implementation as following

- Operation of the proposed 5 sluices to be constructed under the subproject will help increasing ability of Ben Tre province to manage water resources in the subproject area more systematically, which will in turn enhance effectiveness of agricutlure production and reduce potential conflict among local people regarding land and water uses. Rice farming will require freshwater, while shrimp farming will require high quality of water and can create water pollution and soil pollution seriously affecting rice production. Nonetheless, it is necessary for the province to establish clear procedures for operation of these sluices through close consultation with the local farmers and other water users to ensure that they agree and be aware of the water supply situation as well as know rules and regulations regarding on-farm management and other requirements. Overall, these sluices will be operated according to an operation manual which will be acceptable to farmers. During the subproject appropriate water quality monitoring program will also be carried out to ensure that adverse negative impacts will not occur.
- Plantation of mangrove forests in the target area will also help prevent coastal erosion and soil erosion of the embankment, and over time it can create a mangrove forest buffer zone for the area as well as provide lessons learnt that could be used to applied in other areas.
- Dredging: the dredging will be done in the livehood model areas. This can result in increase of water for production in the models.
- Implementation of the livelihood models will enhance opportunity for the local farmers to build their knowledge and experience on implementation of appropriate technology that could be friendly to the local environment as well as bring them more income. Nonetheless,

an approrpaite training program and a social survey will have to be made to ensure that farmers have knowledge and be aware of the tehnical and financial risks, while Ben Tre province will have to establish and implement a program to register all farmers in the subproject areas as well as in the province to ensure that negative impacts will not occur due to uncontrolled development of inappropriate scalling up of these models.

4.3. IMPACT OF CLIMATE CHANGE

4.3.1. Impacts of climate change on the subproject area

The subproject area in Ba Tri district is regularly affected by saltwater intrusion, storms, low pressures, tidal surges, cyclones etc. which cause serious damages to local people's production and people's lives. The inland saltwater intrusion affects agricultural and fishery practices, which are two main sources of local livelihoods.

The field surveys combined with household interviews in the subproject region found that the impact of climate change in recent years significantly reduces drinking water sources of residents as well as irrigation water for their crops. In the dry season, communal people in the subproject region meet the serious fresh water shortage due to the reduction in water flow from upstream parts resulted from the decrease of rainfall. In addition to the effect of sea level rise, especially the deeper saltwater intrusion, in some areas salinity occurs for 4-6 months per year, making people face with water scarcity daily purposes. More than 11,000 households in the area are not provided with clean water except water from inner canals which are seriously polluted from agricultural wastes and residues from plant protective chemicals. Households located in the areas where is near the year-round salty waters must buy raw-water from some households who trucked water elsewhere with inadequate quality, sanitation and high prices as well.

Rice farming is the main source of staple food of local people with two crops a year: winter-spring and summer-autumn. Farming is usually associated with livestock feeding, mostly pigs and poultry, to increase income. Given this context, most local people is poor, in which Women are the primary labor force in agricultural practices. According to statistical data carried out by Ba Tri district Department of Agriculture and Rural Development, climate change and climate – related risks caused huge damages on rice production in recent years as follows:

- *In the Winter-Spring crop 2009 – 2010:* saline intrusion reduced the rice yield at about 580 ha in several communes such as Bao Thanh, Bao Thuan, Vinh An, An Hoa Tay, Tan Thuy, Tan Xuan, and An Hiep. The recorded productivity is less than 3tons/ha.
- *In the Winter-Spring crop 2010 - 2011:* The paddy area affected by salt intrusion was about 1,900 ha causing about 30% reduction in productivity in the communes of Bao Thanh, Bao Thuan, Tan Xuan, Phu Ngai, Tan My, My Hoa, Vinh Hoa, My Chanh, My Nhon, and Phu Le town. Particularly, Bao Thanh, Tan Xuan and Vinh Hoa communes account for 52 ha of the damage area in which the damage percentage reached 60-80%. The estimated value of loss was over 20 billion VND.
- *In the Winter-Spring 2012 – 2013:* Ba Tri district lost entirely 247.4 ha of rice in total, and a sharp reduction (30% - 70%) in productivity was recoreded in 1,288 ha due to saltwater intrusion. The value of damage was estimated at 24.5 billion VND.
- *In the Winter-Spring 2014 - 2015:* rice productivity and quality were affected by salinity in which about 3,825 ha were more than 30% of productivity reduction. Especially, rice productivity of 632 ha in An Ngai Tay, An Hiep, Vinh An, Bao Thanh, Bao Thuan, Tan

Xuan, and Tan Thuy communes were substantially decreased at 70%. The estimated value of damage is 63 billion VND.

In addition to immediate losses of income, local people also suffer from burdens of desalination and reclamation as well as fertilizer supplementation. The losses in agricultural production impoverish a number of people in the region who has pledged all land and financial property to become employed workers. As a result, the existing situation will be more exacerbated in the age of climate change in a long-time.

For aquaculture practices, not all households have enough money to invest in aquaculture, except some wealthy households. Aquaculture production tends to be decreased recently because of a number factor, including diseases, water pollution, reduced salinity of brackish water (due to flooding), salinization (due to salt intrusion and droughts) and climate change. However, aquaculture activities also cause environmental pollution as a large amount of untreated wastewater from aquaculture ponds is directly discharged into canals that supplies water for the neighbourhood. According to Ba Tri Department of Agriculture and Rural Development, the damages of aquaculture practices in recent years are summarized as follows:

- In 2011, a massive death of scallop (meretrix lyrata) due to a number of factors resulted from natural climate – related risks and environmental change, such as extremely high temperature (exceeding biological threshold of scallop), salinity, climate change, inadequate nutrition and pathogens. Total loss was estimated at 127.6 billion VND in which 1,500 tons of adult scallop and 2,635 tons of young (baby) scallop were died in 3 cooperatives of An Thuy, Tan Thuy, Bao Thuan.
- The total value of fishery losses from 2010 to 2015 was estimated about VND 238.105 billion VND.
- Damages of aquaculture production caused many people lost money. The reasons for this difficulty are posed by above-mentioned factors that made low aquaculture output. There is a fact that local people do not have adaptive capacities to respond to the vagaries of climatic variations. Some farmers stopped or downsized their aquaculture farming to reduce losses. Other households burdened severe losses that they pledged land to pay bank loans for their investments.

It is clear to say that climate vagaries obviously caused vulnerabilities to agricultural production and fishery in the region where most people are the poor. Most importantly, local people do not have financial and human resources to apply various ways to minimize the risks of climate change. People in the Subproject area are implementing adaptive activities spontaneously to cope with the nature rather than planned adaptive activities. This means that there is a need for supporting and building adaptive capacity for people to make this project sustainable and resilient to climate change.

4.3.2. The impact of climate vulnerabilities on the livelihood models

Impacts of climate vulnerabilities on the livelihood models include:

- An increase in temperature, especially more days with hot and extreme temperature. This will accelerate temperature of surface water and accelerate evaporation, leading to an increase in the degree of salinity. However, the integrative models of forest – shrimp and rice – shrimp are less vulnerable to high temperature due to the coverage of forest and canopy protecting pond systems.
- The rainy season will become shorter and the dry season is longer, which accelerate the extent of salinity affecting the integrative models of forest – shrimp and rice – shrimp.

- The rise of sea level will cause high tides posing the risk of breaking bunds of shrimp farms and resulting to the escape of shrimps from ponds.
- Unpredictable weather conditions like prolonged rainy season will wash away pollutants to ponds. This will cause high risks for proposed integrative livelihood models
- Drought periods is likely prolonged which will create transitions making shrimp becomes more susceptible to disease.

4.3.3. The impact of the Subproject to adapt to climate change

From the current state of aquaculture activities and agricultural activities taking place in the subproject region in the context of climate change, it can be asserted that in order to help people adapt to climate change, we needs proper response planning to have overall approaches, including the need to integrate sustainable livelihood programs with disaster risk management programs.

Component 1: Mangrove-shrimp to organically certified mangrove-shrimp.

"Organic certification of mangrove-shrimp" is to establish an "organic coast" that both produces high-value certified shrimp and protects against rising sea level and potentially stronger storms. In this scenario, integrated mangrove-shrimp farming and organic certification offer a strong example of an ecosystem-based adaptation to climate change. Because a direct financial incentive is being provided to farmers to plant and conserve mangroves, it can also be seen as an effective form of Payment for Ecosystem Services (PES).

Whether or not certified organic shrimp farming results in permanent improvements to livelihoods and the environment remain a question. Nevertheless, with strong business and provincial government support, there are grounds to believe that the project will deliver economic and environmental benefits that, because the subproject aims to change the underlying business model, will persist after the subproject ends.

Component 2: The activities of the Subproject in Zone 2: the subproject's activities which lend a hand to protect vulnerable people to adapt to climate change are mainly performed via the climate change adaptation works, better welfare network and risk management activities. The Subproject will build 9 tidal-sluices in the sea-dike area to minimize effects and enhance the resilience to climate change.

The dredging activities for 14 canals in the subproject region facilitate the canal irrigation system of canals to adapt to droughts thank to the improvement of irrigation works and efficient use of water. In addition to the water and sluice gates infrastructure, there are suitable planting structures for the extreme conditions of weather by the crop diversification, restructuring of monoculture crops to intercropping and rotation crops. Also in salinization condition, the canal system can sluice gates saltwater out of the fields.

The construction of the water supply station of Ba Lai enables 10,000 households in the Subproject area to improve the living conditions to ensure the hygiene and prevent diseases. Improving water quality and water supply will help improve health and reduce labor costs and other cost for collecting water. These improvements can help improve living quality and prosperity for the community thank to the reduction of working time, improvement of health and income.

Component 3: The fieldwork results combined with the interviews of people in the subproject region reveal that most vulnerable people are not only those who live in the boundary areas between land and sea but also those whose living activities depend greatly on the nature.

Therefore, raising climate change awareness and establishment of the communal response teams, assessing the status of climate change impacts, infrastructure, organization and management, analysis of disaster risks, selection of a model that the community can actively respond to climate change, building and strengthening capacity, preparation and implementation of the communal action plans etc. are the active solutions that help people minimize their vulnerability and strengthen their resilience to climate change in order to achieve the poverty reduction goals. These solutions support to strengthen the capacity to adapt to climate change through equipping necessary skills and knowledge to adapt to climate change. Knowledge helps increase people's ability to cope with climate shocks in the short-term and adapt to climate change in the long-term. Sharing lessons learned among the people to be affected the same climate change may enhance the adaptation activities of the Subproject.

Deploying giant fresh water shrimp culture in rice fields, training and field farmer seminars (FS) is improving social resources and increasing the access to information sources, which may create more effective economic development opportunities. Currently the poor in the subproject region hesitates to risk dangers, they do not boldly change and pay much attention to the supplementary livelihood activities. The model will gradually change their perception and attract them to engage in the alternative livelihood activities. The people in the subproject region will transform from their spontaneous adaptation to their planned adaptation to impacts of climate change.

Establishing/Supporting Farmers' Unions and market linkages will be the supports to amplify the access and connections to markets and to promote the establishment of partnerships and cooperation among communities, private companies and local organizations to create long-term stable income for the people in the subproject region.

4.4. POTENTIAL NEGATIVE IMPACT

4.4.1. Type and Scale of Impacts

Short-term and long-term negative impacts are the results of lack of environmental management of the Subproject in the construction phase. Therefore, the following items should be deployed to predict positive effects and negative effects to the physical environment, biological environment and human habitat caused by the operation of Subproject from pre-construction, construction to operation phases.

Based on the data analysis, site investigation, discussions with local government officers, the potential negative impacts caused by the Subproject on the economy, society and environment are summarized in *Table 4.1*.

Table 4.1: Summary of Impacts Caused by the Implementation of the Subproject

The Impact	Physical Environment			Biological Envi.		Socio - Economic				Other issues	Remark
	Air and Noise envi.	Soil and Water envi.	Solid Waste, Slurry/ Sludge	Forest, Natural Area	Fish, Marine Creatures	Land acquisition, Resettlement	Indigenous People	Physical / Tangible cultural Resources	Livelihood, social disturbance, Land use	Local flooding, traffic (land/water), safety	
Construction of five sluice gates											
Pre-construction	N	N	L	N	N	L	N	N	L	N	No household will physically resettled.
Construction	L	M	M	N	L	N	N	N	L	M	The works in the construction stage may increase pollution level of air, noise, vibration, waste and water pollution, increase water turbidity, affect local people and disrupt waterway.
Operation	L	M	L	N	M	N	N	N	L	M	
Dredging 14 canals											
Pre-construction	N	N	N	N	N	L	N	N	N	N	
Construction	L	M	M	M	M	M	N	N	M	M	The densely populated areas with narrow roads should be concerned; small dredging, local stagnancy, construction site will affect residents.
Operation	L	M	M	N	N	N	N	N	N	M	Ensure the efficient and effective operation and maintenance; prevent

											dispose waste in canals, local stagnancy.
Livelihood Models											
Detailed design of the models	N	N	N	N	N	N	N	N	N	N	
Construction of the small facilities for the models	N	N	N	N	N	N	N	N	N	N	
Operation of the models	L	M	M	N	L	N	N	N	N	M	
Notes (1): * Other impacts to local people; (2) N = No impact; L = small impact (small scale, local and temporary); M = moderate impact (average scale, impacts can be minimized by management and prevention measures); H: Significant impact. For M and H impacts: Monitoring and implementing mitigation measures as well as adequate institutional capacity should be implemented.											

Table 4.2: Potential Negative Impacts of the 5 Sluice Gates

The Impact	Physical Environment			Biological Envi.		Socio - Economic				Other issues	Remark
	Air and Noise envi.	Soil and Water envi.	Solid Waste, Slurry/ Sludge	Forest, Natural Area	Fish, Marine Creatures	Land acquisition, Resettlement	Indigenous People	Physical / Tangible cultural Resources	Livelihood, social disturbance, Land use	Local flooding, traffic (land/water), safety	
Construction of the Duong Khai (DK1) - Duong Khai canal; Gate width 7.5 m; **Location** 745m away from the East sea; **Land/water uses:** Production activities of surrounding areas are shrimp farms and salt making. Low waterway transportation											
Pre-construction	N	N	L	N	N	L	N	N	L	N	L
Construction	L	M	M	N	L	N	N	N	L	M	M
Operation	L	M	L	N	M	N	N	N	L	M	M
Construction of the Trang Nuoc (TN2) – Trang Nuoc Canal; Gate width 20m; Location 1000m away from Ba Tri coastal mangrove forest area; **Land/water uses:** Extensive shrimp farming. Low waterway transportation											
Pre-construction	N	N	L	N	N	L	N	N	L	N	L

Construction	L	M	M	N	L	N	N	N	L	M	M
Operation	L	M	L	N	M	N	N	N	L	M	M
Construction of the Duong Tac (DT3) - Duong Tac Canal; Gate width 20m; **Location** about 1,270m away the canal mouth to the East sea; **Land/water uses:** Intensive and extensive shrimp farms. Low waterway transportation											
Pre-construction	N	N	L	N	N	L	N	N	L	N	L
Construction	L	M	M	N	L	N	N	N	L	M	M
Operation	L	M	L	N	M	N	N	N	L	M	M
Construction of the Cay Keo (CK4) -- Cay Keo Canal; Gate width 5m; **Land/water uses:** Extensive shrimp farms. Low waterway transportation											
Pre-construction	N	N	L	N	N	L	N	N	L	N	L
Construction	L	M	M	N	L	N	N	N	L	M	M
Operation	L	M	L	N	M	N	N	N	L	M	M
Construction of the An Thanh (AT5) - An Thanh Canal; Gate width 2m; **Location** on An Thanh canal; **Hot spots:** Residential area is 200m away from the sluice gate; **Land/water uses:** Intensive shrimp farms											
Pre-construction	N	N	L	N	N	L	N	N	L	N	L
Construction	L	M	M	N	L	N	N	N	L	M	M
Operation	L	M	L	N	M	N	N	N	L	M	M

Table 4.3: Potential Negative Impacts of dredging

The Impact	Physical Environment			Biological Envi.		Socio - Economic				Other issues	Remark	
	Air and Noise envi.	Soil and Water envi.	Solid Waste, Slurry/ Sludge	Forest, Natural Area	Fish, Marine Creatures	Land acquisition, Resettlement	Indigenous People	Physical / Tangible cultural Resources	Livelihood, social disturbance, Land use	Local flooding, traffic (land/water), safety		
Dreding of 14 canal; total disposal material is 431,133m^3												

Pre-construction	N	N	N	N	N	L	N	N	N	N	L	
Construction	L	M	M	M	M	M	N	N	M	M	M	
Operation	L	M	M	N	N	N	N	N	N	M	M	

Table 4.4: Potential Negative Impacts of the Livelihood Models in 3 zones

The Impact	Physical Environment			Biological Envi.		Socio - Economic				Other issues	Remark	
	Air and Noise envi.	Soil and Water envi.	Solid Waste, Slurry/ Sludge	Forest, Natural Area	Fish, Marine Creatures	Land acquisition, Resettlement	Indigenous People	Physical / Tangible cultural Resources	Livelihood, social disturbance, Land use	Local flooding, traffic (land/water), safety		
Component 1: Restoring mangrove Belt; Location: Zone 1 (mangrove belt/coastal); Additional mangrove planting in shrimp ponds (250ha) ; Certification of shrimp mangrove ecofarming (1000ha); **Production Area:** 1200 ha of Ba Tri district; **Objective:** To restore coastal mangrove systems by additional planting of mangroves along the coastline and inside shrimp ponds (shrimp -mangrove eco-farming);												
Mangrove planting in shrimp ponds	N	N	N	N	N	N	N	N	N	N	N	
Construction of the small facilities for the models	N	N	N	N	N	N	N	N	N	N	N	No construction
Operation of the models	L	M	M	N	L	N	N	N	N	N	M	
Implementation of Component 2 (Improving sustainability of Brackish water systems): Location: Zone 2 (Between Road No 16 and sea dyke – Saline water); **Production:** brackish water aquaculture production; **Production Area:** 2500 ha; *Objective:* To improve stability and efficicieny of brackish water aquaculture production through reducing losses due to high tides, improving water quality and extension, establishing farmer organizations and promoting GAP.												
Improving biosecurity of shrimp aquaculture	N	N	N	N	N	N	N	N	N	N	N	Need consultation

Construction of the small facilities for the models	N	N	N	N	N	N	N	N	N	N	N	Dredge bottom to release the organic humus from previous stage
Operation of the models	L	M	M	N	L	N	N	N	N	N	M	
Implementation of Adaptation and Mitigation for Zone 3 (Saltwater Intrusion): Location: Zone 3 (inside sea dyke –Road No 16–Fresh water); **Production:** Piloting climate resilience models: Building and adopting rice and forest-shrimp models (Giant freshwater shrimp/ crawfish shrimp – *Macrobrachium rosenbergii*) for 180 ha of 150 households; **Objective:** To build capacity and necessary steps for gradual transition to brackish water economy.; **Production Area:** 5,105 ha; Calendar: None:												
Detailed design of the Pilot	N	N	N	N	N	N	N	N	N	N	N	Need consultation
Construction of the small facilities for the Pilot	N	N	N	N	N	N	N	N	N	N	N	Prepare pond for shrimp farming
Operation of the Pilot	L	M	M	N	L	N	N	N	N	N	M	

4.4.2. Potential Impacts of sluice gate construction and dredging activities to Sensitive Facilities and Areas

In the Subproject area, there are three (03) national historical relics and one (01) local relics which are valuable to spirit life of local people and tourism attraction. Therefore, the subproject are may have indirect impact on these sensitive areas which are described in *Table 4.5*.

Table 4.5. Historical and Cultural Sites in the Subproject area

	Name of Sensitive Areas		Location	Distance to Construction Works	Description
1	Gravestone Relic and Nguyen Dinh Chieu Monument		An Duc commune	15km	The relic has an area of 13,00m^2, which was recognized by Ministry of Culture – Information on 27 April 1990.
2	Vo Truong Toan Gravestone		Bao Thanh commune	2km	This relic was recognized by the Ministry of Culture – Information on 24 Jan 1998.
3	Nguyen Van Cung and Cay Da Doi		Tan Xuan commune	5 km	It is recognized by the Ministry of Culture – Information on 07 May 1997.
4	Phan Thanh Gian Gravestone		Bao Thanh commune	12 km	The monument is located in Bao Thanh commune.

4.4.3. Impact Assessment during Pre-construction Phase

Due to land for construction of the subproject was done in the other WB's project and the End-of-Assignment Report on RAP of this project showed that there are no problems/issues in the process of compensation and resettlement. So there is no impact due to land acquisition of the subproject sluice gates.

The subproject area may have unexploded ordnances (UXOs) left during the wars. Therefore, there is risk of human safety and asset damage during construction if the UXOs have not be cleared before commencement of the civil works.

In the locations of livelihood models are mainly water surface land and agricultural land. Aquaculture production will take place in the existing ponds and no land acquisition and land clearance is needed. So impacts due to clearance and pre-construction phase are negligible.

4.4.4. Impact Assessment during Construction Phase

4.4.4.1. Impact sources

The impact sources in the construction stage primarily arise from the following activities:

- Construction of 5 sluice gates.
- Dredging sedimentation for 14 canals, which affects the aquaculture water quality.

4.4.4.2. Identifying Source Of Impacts

Table 4.6 presents source of impacts, impacts and scale of impact will occur in contruction period basing on its activities.

Table 4.6: Impacts During The Pre-Construction Phase

N⁰	*Source of impacts*	*Impacts*	*Significance of Impact*
(i) Construction of 5 sluices			
A – Impact sources related to waste			
1	Clearance	- Emissions generated from construction vehicles. - Solid waste generated from the reclamation.	- Small, short term, can be mitigated - Small, short term, can be mitigated - Small, short term, can be mitigated
2	The preparation process prior Construction	Dust, emissions from material transportation.	- Small, short term, can be mitigated
3	Worker activities	- Domestic waste water - Domestic solid waste	- Small, short term, can be mitigated - Small, short term, can be mitigated
4	Maintenance of vehicle and machinery	- Hazardous waste	- Small, short term, can be mitigated
B - Impact sources not-related to waste			
1	clearance	- Disruption of daily life, negative effects on local businesses - Conflicts between people in the construction area and subproject owners.	- Moderate, long term, can be mitigated - Small, long term, can be mitigated
2	The preparation process prior Construction	- Noise and vibration from machinery, vehicles. - Impacts to surface of plant cover impact to ecosystems.	- Small, long term, can be mitigated - Small, long term, can be mitigated
3	Vehicles, machinery	- Noise and vibration from machinery, vehicles	- Small, long term, can be mitigated

4	Concentrated workers at the subproject site	- Affect on local economic – social condition. The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Small, long term, can be mitigated - Small, long term, can be mitigated
5		Traffic congestion during the construction phase. - Impact on aquaculture	- Small, short term, can be mitigated - Small, short term, can be mitigated
(ii) Dredging 14 canals			
A – Impact sources related to waste			
1	Vehicles, machinery	- Dust, emissions from machinery, and material transportation.	- Small, short term, can be mitigated
2	Excavators	Water to be dredged with sludge	- Moderate, short term, can be mitigated
3	Worker activities	- Domestic waste water - Domestic solid waste	- Small, short term, can be mitigated - Small, short term, can be mitigated
4	Maintenance of vehicle and machinery	- Hazardous waste	- Small, long term, can be mitigated
B – Impact sources not-related to waste			
1	Vehicles, machinery	-Noise and vibration from machinery	- Small, short term, can be mitigated
2	Ecosystem	Impacts to surface of plant cover impact to ecosystems	- Small, short term, can be mitigated
3	Traffic	Traffic congestion during the construction phase.	- Moderate, short term, can be mitigated
4	Concentrated workers at the subproject site	- Affect on local economic – social condition. The ability in generating a number of diseases and social problems caused by the concentrated workers.	- Small, long term, can be mitigated - Small, long term, can be mitigated
5	Socio-economics	Impact on aquaculture	- Small, short term, can be mitigated

4.4.4.3. Assessing impacts during the construction stage of sluice gates

During the construction of sluice gates that prevent salinization, the construction activities mainly affect the biological resources, air quality and surface water in the surrounding area. The impacts on the environment are as follows:

a) Impacts related to waste

a.1) Dust - emissions:

During the construction stage of the sluice gates items that prevent salinization, dust and gases arise mainly from the transport activities of soil, sand, sludge, building materials and the

construction (special dust and emissions from the operation of the concrete mixing plant - which is located in the construction area of sluice gates). The composition of pollutants includes: dust and gases (SO_2, CO, NO_x, HC etc.) arising from the operation of equipment and machine that consume gasoline as barges and motorized construction equipment.

* Dust - emissions from construction of sluice gates:

Dust - emissions from the construction process are mainly from the machinery operation on construction sites. The loads of dust - emissions are calculated based on the amount of equipment and the fuel consumption.

The construction vehicle includes cranes, bulldozers, excavators, hammers, compactors, concrete mixers (estimated tonnage is 10 tons).

The fuel consumption in the case that the equipment and machine operate continuously is estimated at 10 kg/h.

According to the World Health Organization - WHO, the air pollution levels of the engine with capacity of over 16 tones are as follows:

Table 4.7: The emission coefficients of each pollutant

Engine type	*Unit*	*Suspended dust (TSP)*	*SO_2*	*NOx*	*CO*	*HC*
Truck and diesel engine > 16 tons	kg/tons of fuel consumption	4.3	20S	55	28	2.6
The emission level from fuel usage (M)	kg/h	0.043	0.02	0.55	0.28	0.052
Total load, Es	mg/s.m^2	0.0094	0.0044	0.1202	0.001	0.0612

* S is the % of S in diesel oil, the actual S = 0.05

As assumed that the emission level is stable over time and evenly distributes over an area of 240m^2 of each sluice gates and the total area of 5 sluice gates is 1,200 m^2, the concentrations of pollutants in the subproject region is calculated on the large-scale emission source by the following formula:

(1) $$C_{\infty} = \frac{E_s.L}{u.H} + C_{vào}$$

In which:

C∞ : Stable concentrations of pollutants in the pollution area, mg/m^3

C_{input}: concentrations of pollutants in the subproject region, mg/m^3

Es : Load of pollutants, mg/s.m^2, Es = $\frac{M}{\text{subpoject area (1200m}^2\text{)}}$

(M: The emission amount because of fuel consumption, kg/h = emission coefficient x amount of fuels)

L: Subproject length according to the wind direction, L= 120 m

H: The height of the disturbing area (from the ground to the motion stop of hot air molecules, which evaporate from on the ground; it is respective with the stable air temperature at 28^0C, close to the ground, it is 30^0C; select H = 200m).

u: The stable average wind speed (select u = 2.6 m/s, corresponding to the actual weather conditions of the region).

The calculated results of pollutant concentrations are listed in the following Table 4.8:

Table 4.8: The concentrations of pollutants in the construction areas of sluice gates

The concentration of pollutants	*Unit*	*Suspended dust (TSP)*	*SO_2*	*NO_x*	*CO*	*HC*
Baseline environment C_{in}	mg/m^3	0.12	0.037	0,29	-	-
Subproject area C∞	mg/m^3	0.0022	0.001	0.028	10.017	0.0142
Total concentration	mg/m^3	0.122	0.038	0.22	-	-
QCVN 05:2013/BTNMT	mg/m^3	0.3	0.35	0.2	30	5*

* QCVN 05: 2013/BTNMT- National technical regulations on some toxic substances in the ambient air.

Thus, according to the calculated results, the amount of dust and gases generated in the process of sluice gates construction remains within the permitted limits.

The concentration of air pollutants emitted by motor vehicles, machinery and equipment during the construction process depends very much on the number of construction vehicles, machinery state, wind direction, density of operating machinery. However, the sources of toxic emissions are low sources and the possibility of spreading away is very poor. Therefore, they only pollute locally and affect downwind areas and directly affect workers in construction areas.

** Dust - emissions from transport activities during construction of sluice gates:*

The volume of soil, sand, sludge from excavation of foundation, road construction etc. is calculated approximately 2,110m^3, which will be reused a part to fill sluice gates embankment, sluice gates connecting roads. The reused volume of soil is taken by 70% of the required soil (mixing 70% soil with 30% sand for filling sluice gates, road embankment). Soil yard retained for filling is planned right on the riverside adjacent to the construction site. The specific area of soil yard is provided in table 4.6 below. The remaining soil of about 18-240 m^3 at each sluice gates will be used for filling dike/shore embankment by local government, so there is no transport of excavated soil to dumpsite.

Table 4.9: The digging and filling quantity for construction of sluice gates

N°.	Names of sluice gates	Digging quantity (m^3)	Filling quantity (m^3)	Surplus quantity (m^3)	Soil yard (m^2)
1	Duong Khai	225	157.5	67.5	300
2	Trang Nuoc	800	560	240	500
3	Duong Tac	800	560	240	500
4	Cay Keo	225	157.5	67.5	300

5	An Thanh	60	42	18	200
Total		**2,110**	**1,477**	**633**	

Currently the regional road transportation is extremely difficult, so the transportation of raw materials to build sluice gates is entirely by waterway, by barges. As calculated, the amount of raw materials and the number of barge voyages to the construction areas are presented in Table 4.10.

Table 4.10: The materials quantity used for construction of sluice gates

No.	*Names of sluice gates*	*Quantity of stones, concrete (m^3)*	*Quantity of steel of all types (tons)*	*Number of piles, columns, beams (unit)*	*Estimated number of barge trips (voyage)*	*Construction time (months)*
1	Duong Khai	662	113	245	10	6
2	Trang Nuoc	2,647	452	982	35	12
3	Duong Tac	2,647	452	982	35	12
4	Cay Keo	662	113	245	10	6
5	An Thanh	331	56	123	5	3
Total		**6,949**	**1,186**	**2,577**		

The construction process takes place about 3-12 month for each sluice gates as shown in Table 4.10. The number of barges that transport materials to the construction area is not as greater as 3-5 voyages per month. The average transport distance for materials purchased in Ba Tri town by river is 70 km long (see Figure 4.1).

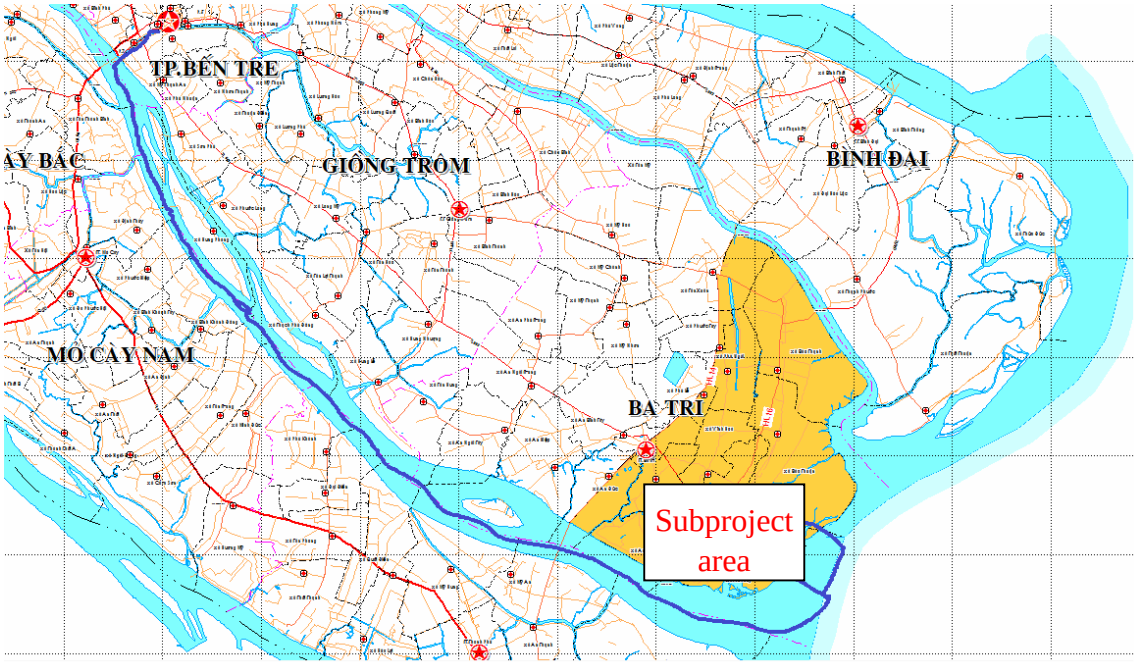


Figure 4.1: Map of the transport for materials to the Subproject Area

The load and the pollution coefficients of the air pollutants caused by barges that transport materials are presented in the following table.

Table 4.11 : The dispersion coefficients of barges powered by diesel engines

No.	*Pollutants*	*Unit*	*Dust*	*SO_2 (kg)*	*NOx (kg)*	*CO (kg)*	*VOC (kg)*
1	Ships and barges	1,000 km	0.68	13.6	9.07	0.0036	0.41

Source: Assessment of Sources of Air, Water and Land pollution, WHO, 1993

Notes: S is the sulfur content in the oil, S = 0.05% (Source: Petrolimex)

Table 4.12 : The estimated amount of pollutants of barge per voyage

No.	*Pollutants*	*Unit*	*Dust*	*SO_2 (g)*	*NOx (g)*	*CO (g)*	*VOC (g)*
1	Coefficient	g/km	0.68	0.68	9.07	0.0036	0.41
2	Barge trips	70 km	95.2	95.2	1270	50.4	57.4

The results show that the load of polluted emissions from the transporting process of materials are negligible.

Calculating the emissions: SO_2, SO_3, CO, NOx, Hydrocarbon, Aldehyde from barges is based on the transport time and the transport distance and the pollution coefficients. The emissions during the combustion of 1kg diesel at 200°C is 38m^3, the diesel used by barges and tugs is 21 kg/h, the total emissions in 1 second will be 0.22 m^3. The load and the concentrations of pollutants from barges that carry raw materials into the construction site are presented in the following table:

Table 4.13: The load and concentrations of pollutants of barges transporting raw materials

No.	*Pollutants*	*Emission coefficient (g/kg)*	*Load (g/h)*	*Load (mg/s)*	*Concentration (mg/m^3)*	*QCVN 19 : 2009 BTNMT*	*QCVN 20 : 2009 BTNMT*
1	Aldehyde	0.24	4.99	1.39	6.32	-	270
2	CO	0.24	4.99	1.39	6.32	1000	-
3	Hydrocarbon	0.24	4.99	1.39	6.32	-	-
4	NOx	8.56	179.78	49.94	225	850	-
5	SO_2	0.93	19.601	5.445	24.5	500	-
6	SO_3	0.01	0.025	0.069	0.26	50	-
7	Dust	1.78	37.45	10.40	46.90	200	-

Notes: - Nm^3: The volume of gas specified in standard conditions

QCVN 19: 2009/BTNMT (Column B): National Technical Regulation on Industrial emissions for Dust and Inorganic Substances.

QCVN 20: 2009/BTNMT (Column B): National Technical Regulation on Industrial emissions for Organic Substances.

The comparison of the concentrations of pollutants arising from the operation of construction equipment with QCVN 19: 2009/BTNMT and QCVN 20: 2009/BTNMT (Column B) shows that they are within the permissible limits. The calculation results no emissions greater than about 0.22 m^3/s, the concentrations of pollutants is below the permissible standards, and the sources of emissions are mobile, the impact that spreads pollutants caused by barges that transport construction materials into sluice gates construction sites very quickly is considered negligible.

** Dust caused by wind from material yards (sand):*

According to a survey around 5 sluice gates, only An Thanh sluice gate has a residential area away from 200m, the others are located in the salt-production fields and Intensive Shrimp Farming and Semi - Intensive Shrimp Farming.

In the subproject region, the number of sunshine hours in a day is relatively high. If the average wind speed is greater, the influence of dust in material yards when building An Thanh sluice gate on a residential area are likely occur if the material yards are not carefully covered.

From the analysis above, it can be seen that the concentrations of toxic gases generated by the transport and operation of construction equipment are very low, moreover, the pollutants are dispersed over a large space, the averaged dispersion height is 5m, the amount of dust and toxic gases will be greatly reduced. Compared to the allowed limits in QCVN 05: 2013/BTNMT and QCVN 06: 2013/BTNMT, the concentrations of air pollutants are much lower.

Thus, we can say that the effects of dust and air pollutants on the environment and people's health in the construction sites of sluice gates are negligible. However, when carrying out the construction, the subproject owner and the Contractors should have appropriate construction methods and mitigation measures to control negative impacts consistent with the actual situation to minimize impact on the environment, workers, and local communities near An Thanh sluice gate. These measures will be presented in detail in Chapter 5.

a.2) Waste waters:

During the construction stage, the water environment will be influenced by two main impact sources: rainwater runoff and domestic wastewater from construction workers 'camps.

** Wastewater from domestic activities of sluice gates construction workers:*

Domestic wastewater contains organic matters, suspended solids (SS), nutrients (N, P) and microorganisms etc. BOD, COD and odours will attract pathogenic parasites (flies, mosquitoes etc.) that cause air pollution and pollution spread under the water flow. The highest concentration of labor on the construction site of each sluice gate is assumed about 20 workers, the average water use on the construction site is 60 liters/person/day for rural areas (TCXDVN 33: 2006), the amount of wastewater generated in the construction area of each sluice gates is as follows:

Q = 80% x 20 persons/day x 60 liters/person = 0.96 m^3/day

(The amount of wastewater is calculated equal with 80% supply water).

The total wastewater during the construction of 5 sluice gates is approximately 4.8m^3/day.

The estimated total labor on the construction site of 5 sluice gate are assumed about 100 workers. The estimated amount of wastewater is based on the emission coefficients of pollutants in domestic wastewater in the developing countries proposed by the WHO. The load

calculation results and the concentration of pollutants in wastewater from workers' camps are presented in the following table.

Table 4.14: The load and concentrations of pollutants in workers 'wastewater

No.	*Pollutants*	*Emission coefficient (g/person/day)*	*Load (kg/day)*	*Untreated concentration (mg/l)**	*QCVN 14 – 2008 (Column B)*
1	BOD_5	45 – 54	4.5 – 5.4	110 - 400	50
2	COD	72 – 102	7.2 – 10.2	250 - 1000	-
3	TSS	70 – 145	7 – 14.5	350 - 1200	100
4	TN	6 – 12	0.6 – 1.2	20 - 85	-
5	$N\text{-}NH_4$	2.4 – 4.8	0.24 - 0.48	12 - 50	10
6	Pt	0.8 – 4	0.08 – 0.4	4 - 15	10

*Source : WHO, 1993 * Metcalf and Eddy. 1979.*

The calculation results show that the concentrations of pollutants exceeding the standard many times, which we can see that the impact of wastewater from construction workers is moderate. Therefore, during the construction, wastewater must be collected and treated and construction unreasonable plans must be organized to limit environmental impacts on water, land, people's health and construction workers.

**** Storm water on the site:***

Rainwater runoff through construction areas will sluice gates away oil, dust etc. and all kinds of domestic waste and construction waste that pollute receiving waters. Compared with other types of wastewater, rainwater is fairly clean (the statistics of the World Health Organization - WHO show that the concentration of pollutants in rainwater after the next period is about 0.5 to 1.5 mgN/l; 0.004 to 0.03 mgP/l; 10-20 mgCOD/l and 10-20 mgTSS/l).

Heavy rains on construction sites of sluice gates may wash away dirt and grease and oil splattered on the ground, which causes puddle water, erosion of construction works which have not yet solidified, clog the sluice gates system etc.

To assess the impact of storm-water runoff in the construction sites of the sluice gates on the environment around them, we will use the calculation method of hydraulic sluice gate system via the limited intensity formula (source: Environmental Engineering Handbook, 2005) as follows:

$$Q = \frac{C \times I \times A}{1000}$$

In which:

Q: The maximum runoff amount of water (m^3/day)

C: Coefficient of water flow, choose C = 0.6

I: Maximum precipitation (mm/day), select the maximum value in Ba Tri rainfall is 150 mm/day during the construction.

A: Construction area (m^2)

Thus, the amount of storm-water runoff in a day at the construction site is 1200 m^2 on rainy days as estimated as follows:

Q (m^3/day) = 0.60 * 0.15m/day * 1200m^2 = 108 m^3/day

However the capacity of canal system in the construction sites of the sluice gates is very good, without flooding when there are heavy rains. To minimize impacts, appropriate measures need to be taken to avoid solid wastes and waste water.

** Wastewater from construction sites:*

Construction wastewater includes water used for washing materials, water used for moisturizing concrete etc. This amount of water is not much and often flows on the surface, partly evaporates, and partly penetrates into thick sand layer before merging into shallow groundwater or surface water into the region.

a.3) Solid waste:

Two main sources of solid waste affecting the environment are: solid waste from construction and solid waste from daily life of workers.

** Solid waste arising from the construction of sluice gates items:*

Solid waste in the construction process includes dirt and mud dredged from organic sediment layer; pile-boring during the construction of sluice gates, stones and sand and building materials scattered in the construction process, packages of building materials etc.

The volume of wastes is estimated as follows:

Silt, sand mixing in bentonite from sluice gates construction: the construction technology of bored piles by bentonite is applied for the construction of sluice gates that prevent salinization. Soil excavated from the sluice gates foundation is reused for filling and levelling.

In addition, solid waste in the construction process also arises as construction materials are spilled during the construction process such as lime, mortar, broken bricks, bags of cement, iron and steel scraps. The construction solid waste is inert with the environment, so their impact is negligible. However, if these wastes are not well controlled, they may cause obstruction to the construction and increase the amount of dust in and around the construction area.

Other different types of waste such as wood, metal scraps, packages etc, can be sold as scraps and are not release to the environment.

** Solid waste arise from domestic activities of sluice gates construction workers:*

Domestic wastes on the site include empty cans, bottles (food and beverage), paper etc. The amount of waste is determined according to the level of emission of 0.4kg/person/day and the number of regular workers employed at site is 20 people (the emission norm is equal to 50% under Decision No. 04/2008/QD - BXD of the Ministry of Construction).

So, the volume of waste from domestic activities of sluice gates construction workers are:

0.4 kg/person/day x 20 people = 8kg/day.

The volume of solid waste generated from domestic activities of workers in each sluice gates construction site is 8 kg/day. The total of 5 sluice gates arises about 40 kg/day.

The main components of domestic waste include organic matters that can decompose easily and cause bad odours, annoy workers on the construction site if waste is not collected and handled thoroughly. The Subproject owner and the construction companies will have appropriate measures for management, treatment, so they are at low levels.

** Hazardous waste from the construction process of sluice gates:*

During the construction, concrete is transported directly from other places, which is not mixed in the construction sites of the sluice gates. Waste grease and oil under Decision Nº.23/2006/QD-BTNMT is classified as hazardous waste. Therefore, the composition of hazardous waste includes: a small amount of waste oil and grease, oily rags and packages containing hazardous components (waste oil containers) etc.

The construction companies do not carry out machinery maintenance at construction sites. Waste oil from small repair process of transportation and construction vehicles is inevitable. The amount of waste oil depends on the following factors: number of transport vehicles and mechanical construction equipment on site, cycles of lubrication oil change for machines, amount of lubrication oil discharged in a single change/maintenance of oil. The survey of waste oil in HCM city and Hanoi city, according to the Research theme: recycling waste oil into liquid fuel by the Centre for Military Science Technology, shows that the average amount of lubricant oil discharged from the transportation and construction mechanization vehicle is 7 liters/time. The average oil-change cycle is 3-6 months oil, depending on the intensity of vehicle operation. The volume of this waste is estimated as follows:

Table 4.15. The volume of hazardous waste estimated in the construction

No.	Name of waste	Status	Quantity (kg/quarter)	
			1 sluice gate	5 sluice gates
1	Waste oil, waste fuel	Liquid	15	75
2	Oily rags	Solid	21	105
3	Used containers of chemicals (oil)	Solid, Liquid	15	75
	The total amount of hazardous waste		**51**	**255**

Thus, the total amount of hazardous waste during the construction of 1 sluice gate is 51 kg/3 months. The total of 5 sluice gates is 255kg. This amount of hazardous waste, if are not well managed, may dilute in rainwater into the surface water in the region or seepage into the ground and pollute the soil environment. The Subproject will take steps to collect, preserve, transport and treat it in accordance with the regulations (specifically covered in Chapter 5).

a.4) Impact on soil:

+ Impact due to construction activities: The development may change groundwater levels - as an opportunity to provide undesirable chemical elements as Al, Fe, take away the alkali and alkaline earth components, decompose humus, decrease activity of microorganisms in soil, reduce soil fertility, and degrade soil. Without the treatment of waste stones and sand, they will cause bad outcome to cropland, especially sand and gravel, concrete mortar, wastewater from concrete mixing plants which have highly alkaline and contains cement residues will degrade the soil. As the consequences, these effects will change physical and mechanical properties of soil as soil hardening, aggregation. They also change the chemical characteristics as acidification, soil contamination of heavy metals etc., making soil degraded and reduce cultivation efficiency.

In summary, the subproject impacts on the soil quality are not low but measures that mitigate them must be taken.

+ Impacts by workers' domestic activities: non-degradable solid waste (packages, plastic) and some other inorganic solids will contaminate soil in the construction area. The Investor in conjunction with the construction Contractors will take measures to collect and treat them to avoid harmful impacts on the environment.

a.5) Impact on groundwater:

Causes that affect the quality of groundwater resources in the construction process are as follows:

- Surface water is the main source of groundwater, so the contamination of surface water will lead to the contamination of water aquifers.
- The pile driving, drilling, digging sluice gates nails and pillars will perforate the topsoil and make the direct exchange between contaminated surface water and groundwater and pollute the water aquifers.

For shallow aquifers, the earthworks and leveling will make the groundwater exposed; surface water and storm-water containing pollutants will enter into the aquifers and cause groundwater pollution.

The artificial change of the water flows will alters the natural rule of the water flows and entail the water tables which possibly be lowered or increased depending on the change of surface flow system, which is one of the causes that change of the quality and flow of the aquifers.

The main sources of the Subproject's wastewater are from domestic wastewater and solid waste, construction wastewater, waste from earthworks and hazardous waste. The above types of waste will be collected and treated as regulated to avoid affecting the infiltration of waste into soil and groundwater.

b) Assessing impact sources which are not related to waste

During the construction of sluice gates, noise and vibration will arise, which are caused by the motor activities and make negative changes to the landscape and biodiversity etc.

b.1) Impacts of noise:

During the construction of sluice gates, noise may arise from the mechanic transportation and construction equipment, from operations of workers, in which noise arising from transportation vehicles, construction machines, generators, concrete mixers etc. are the matters of concern.

The machines can make noise at high levels within working scale. However noise spreads in the air and stops rapidly by distance and is localized, the extent impact on the neighbourhood is almost negligible. We can refer the maximum noise levels of vehicles in the following table:

Table 4.16: The maximum noise level of some facilities and equipment at source

No.	*Means of transport and motor construction equipment*	*Noise levels at source (dBA)*	
		Range	*Average*
1	Bulldozers		93.0
2	Rollers	72.0 – 74.0	73.0
3	Excavator with front bucket	72.0 – 84.0	78.0
4	Tractor	77.0 – 96.0	86.5
5	Scrapers, graders	80.0 – 93.0	86.5

No.	*Means of transport and motor construction equipment*	*Noise levels at source (dBA)*	
		Range	*Average*
6	Paver	87.0 – 88.5	87.7
7	Truck	82.0 – 94.0	88.0
8	Concrete mixers	75.0 – 88.0	81.5
9	Mobile cranes	76.0 – 87.0	81.5
10	Generator	72.0 – 82.5	72.2
11	Compressor	75.0 – 87.0	81.0
12	Pile drivers	96.0 – 106.0	100.5
QCVN 26: 2010/BTNMT: the noise level in common areas caused by construction activities is 70dBA (6h - 21h)			
The standards of the Ministry of Health (Decision No.3733/2002/QD-BYT dated 10/10/2002), noise regulation in manufacturing sector: the exposure time in 8 hours is 85dBA.			

Source: Environment air - Pham Ngoc Dang - Science and Technology Publisher.

We can predict impacts of noise to the neighbourhood of the construction site (Reference: Pham Ngoc Dang - Air Environment, Science and Technology Publisher, 1997) as follows:

$Li = Lp - \Delta Ld - \Delta Lc$

In which:

- Lp: Noise at the distance far from source 15 m.

- ΔLd: Noise reduction in distance d and is calculated by the following formula:

$\Delta Ld = 20.\lg [(r2/r1)](1+ a)$ (dBA)

- a: The coefficient that takes into account of noise absorption of the ground terrain. Because the ground area is considered empty without trees, so a = 0.

- r: The distance from source to the measuring point, r = 15 m.

- ΔLc: The level of noise reduction when passing obstacles. In this case, the calculation excludes obstacles, $\Delta Lc = 0$ (dBA).

The total noise at one measuring point caused by all sources is calculated based on the following formula:

$$\sum L = 10\lg \sum_{i}^{n} 100Li \quad \text{(dBA)}$$

From the above formula, we can calculate the noise caused by construction vehicles by distance as follows:

Table 4.17. Forecast noise in the neighbourhood

No.	Noise sources	Distance			Total noise		
		15m*	20m	50 m	15m*	20m	50 m
1	Concrete mixers	75	72.5	64.5	86	81.89	75.63

2	Cranes	72.5	70	62			
3	Welders	76	73.5	65.5			
4	Drillers	79	76.5	68.5			
5	Saw machine	77.5	75	67			
The labor safety standard: 3733/2002/QD-BYT		85 dBA					
QCVN 26:2010/BTNMT: - Normal area		70 dBA					

** Source: Pham Ngoc Dang, 2003.*

According to the above table:

+ In the location that is away from a noise source 15m, when the source makes noise simultaneously, the noise level will exceed the acceptable standards for the working environment but the level of increase is not significant. However, to ensure the working environment which is not contaminated in the construction process, necessary attention must be paid to this location.

+ In the location that is away from a noise source 20m, when the source makes noise individually or simultaneously, the noise level remains within the acceptable standards for the working environment.

+ If equipment that makes too high noise works simultaneously, the noise level may exceeds the acceptable standard (> 70dBA) in some areas away from the sluice gates construction area 15m, 20m and 50m. So in the construction process, noise source must be paid attention to ensure no impact to people in the surrounding area of An Thanh sluice gates.

Special attention should be paid to the concrete piling-driving areas because the noise intensity of the device can reach 98 dBA at the distance of 15m.

b.2) Impacts on regional economy - society:

**** Conflicts between construction workers and local people:***

Although most sluice gates are located away from residential areas, there are exchanges between local people with construction companies. Each sluice gates construction area has an average of 20 workers, who will cause certain impacts to the local social environment, security, practices as well as habits of local people.

The impacts on employment disputes between local people and workers as well as between workers may leave unfortunate consequences.

Infectious diseases caused by deprivation and unhygienic conditions may arise and spread at a rapid pace.

The social evils like gambling, alcoholism, prostitution etc. may increase and create bad habits for part of local youth people. These types of services are dependent on large construction sites, which are common in all regions in the country. These types of services attract a lot of young people, which are not only workers but also local people, which makes conflicts arise between the groups of young people. In such circumstances, if there is not close management cooperation between the construction companies and the local authorities, significant damages to physical and mental health of workers and local people may be unavoidable.

The increase of workers may cause environment impact because of solid waste and wastewater. If the sanitation, waste collection is not done regularly and seriously, the possibility of

spreading of infectious diseases from workers to local people and vice versa (malaria, dengue etc.) very likely occur. The process of storage and accumulation of waste will be the habitat for mediated disease species and insects (rats, flies, mosquitoes, cockroaches and microorganisms), which make the risk of infection for local communities and the surrounding areas more serious.

**** Economic impacts***

Impacts on local production (salt production and shrimp culture). Currently around 5 sluice gates, the local economic activities are mainly salt-production (*Figure 4.2*) and intensive shrimp farming and semi-intensive shrimp farming. Increasing turbidity and water pollution during the construction of sluice gates will impact on quality of salt and shrimp, causing loss of income of local people.

Water quality in the canals using for salt production is low and salt in the subproject area is the lowest one in Vietnam. Currently many households are still having thousands tones of salt produced 2014 and 2015 but could not sell because there were no buyers. Local governments are encouraging some inefficient area of salt production to convert to intensive and extensive shrimp farming. The most area of transition from salt to the shrimp is in Bao Thuan, Tan Thuy, An Thuy communes. The areas of salt fields in these communes is very small even bare. In addition, all in-canal construction activities will be in steel sheet pile cofferdams, so increasing of turbidity will be minimized and only occurs about 20m upstream and about 50m downstream from the pile construction locations. The impacts of sluice gates construction on local production is low, especially impact on salt production. However, the contractors will strictly manage construction activities to avoid this impact.

Local inundation. Construction of each chamber of sluice gate will partly narrow cross sections of the canals which may cause local inundation in the construction site. However, there is no local residents living surrounding the influence area of inundation of 4 sluice gates except one residential area in the An Thanh sluice gate, so this impact will be low and short term.

Figure 4.2. Salt fields in the subproject area

b.3) Impact on navigation:

The building locations of sluice gates are on dike and canals, where there is dike embankment. This means water transport activities in the construction area of sluice gates are very diverse and complex. During the construction, there would be an increase of waterway traffic on Trang Nuoc and Duong Tac canals in the subproject area due to raw material transport for construction. This may result in the appearance of spontaneous berths which strengthen the congestion. Therefore, vessel collisions, water traffic accidents, disputes in anchorage area may occur. Without construction warning signs, water vessels will be out of order, especially in evenings. For these reasons, sign boards, signal lights, fences around sluice gates must be installed and necessary preventive measures must be taken to reduce road accidents during the construction of sluice gates.

The subproject owner is acutely aware of the importance of the above impacts and commits to take measures as well as closely coordination with the Inland Waterway Station, Dyke Station, Traffic Station and local authorities to overcome traffic congestion during the construction as much as possible. Besides we will integrate the mitigation measures for the operation stage in Chapter 5 of this report.

b.4) Assessing hydrological impacts

During the sluice gates construction, the temporary block of waterway will be local bad for the flood mode. The construction means on the canals will impede the canal flow in flood season, which make pressure to shore and will cause shore erosion. Fortunately, these impacts are minor and temporary.

b.5) Assessing impacts on ecosystems and resources

The construction will bring certain negative impacts on the organisms. The loss of habitat includes loss of natural water habitats and shrimp and fish farming.

**** Terrestrial ecosystem***

Most land along the sluice gates is salt-production land, so the vegetation to be cleared for construction will be minor. The surveys found that the animals and plants here are not rare species to be protected as listed in Vietnam's Red Book. The animals are mostly migratory species like storks and domestic animals. Therefore, the impact on the terrestrial ecology in the subproject area is negligible.

**** Aquatic ecosystem***

Regarding the aquatic ecosystem, the impacts will become direct for submerged plants and planktons. They are the basic components of habitat, the food for fish and successive trophic levels. According to the statistics, in the construction sites of sluice gates, the population of species of aquatic organisms and benthos is very rich in quantity, quality and variety.

For the Subproject, the building works pave certain implications of impacts on the underwater ecosystem. The aquatic species may be affected by the following reasons:

- Turbidity pollution due to the construction, which makes oxygen levels in water significantly reduced, the feeding of underwater animals is also affected by limited food sources or inability to detect food sources.
- Leaking gasoline, chemicals etc. from the transport vehicles, construction vehicles and fuel spillage during transportation etc.
- Changes in the hydrological regime, water pollution will affect aquatic biological resources and their diversity on the canals.

The concentration of construction motor-vehicles will result in the spillage of fuel, oil, grease or overflowing when failures happen during the operation and repair of vehicles. Oil and fuel seeps into soil and is swept away by rainwater into rivers and canals, which pollute the waters and causes negative impacts on the aquatic ecosystem. The planktons in water like algae and other animals such as shrimp, fish may be affected. Some may be sick or die because of their inadaptability. However, the extent of this impact can be mitigated during the construction and operation of the equipment. The contractor, construction companies, consultants should closely monitor and take appropriate solutions for collection to avoid the spillage or leakage of such wastes to the water flows. However, the scope of this impact is considered small (about 20m upstream and about 50m downstream from the pile construction locations) and the impact time in the pile construction of canals, rivers is short.

b.6) Assessing erosion and sedimentation impacts

**** Impacts by erosion:***

The process of erosion and siltation, transformation of river/canal beds and bank erosion is very complex as the result of the interactions between water flows and river/canal beds in nature and under human impacts, in which water flows directly plays the major role to this

process when the rivers/canals bear weak geological, chemical, mechanical conditions. The river/canal beds and the morphology here features the nuances of the tidal rivers.

The Subproject Owner will adopt appropriate measures to control shoreline erosion during the construction of sluice gates. The measures will be presented in detail in Chapter 5 of this report.

**** Impact by sedimentation:***

The spillage during the construction, transport of construction materials as sludge, soil, sand arises during the construction. This mainly occurs during the construction period and the impact scale is average, which focuses on the aquatic environment at the infield supply canals.

b.7) Affecting sensitive areas

In the construction area of 5 sluice gates, no temples, churches, administrative offices, banks, historic parks, restaurants, hotels, schools, hospitals are found.

* Impacts on Historical, Natural and Cultural Resources: No impact is anticipated on the historical, natural and cultural resources.

* Impact on Protected Wetlands: There are no recognized local or national wetlands in the subproject area. Therefore, the construction will not affect any protected wetland.

c. Environmental incidents in the construction of sluice gates

***c.1) Impact due to chemical spillage*:**

During the construction stage, the main potential impacts to soil come from a few chemical accidents. Any chemicals, when being spilled, must be cleaned quickly. The amount of hazardous chemicals used at the construction site is low and it will be strictly managed, so this impact on the soil quality is negligible.

c.2) Labour accidents:

During the construction stage, the movement and operation of equipment, especially cranes, pile-driving machines may hurt workers who stand underneath. Workers who do not comply with the regulations on labour safety when transporting materials may cause falling and injury to others. In addition, other incidents as electric shock and lightning are potentially fatal. The risk of exposure to pathogens in solid waste is also quite high for workers. In these works, smoking or carelessness may cause fire. Most causes of these problems are originated from the consciousness to abide by the regulations on labour safety of the construction workers, which is not high. Lack of equipment for labour protection and unsafe working conditions are also the indirect causes of accidents and incidents.

The consequences of accidents may be property damages, equipment damages, injuries, which directly affect the health and lives of workers and lead to different consequences for their families. To restrict these unfortunate accidents which may happen, strong measures that force workers to comply correctly and fully the regulations and protective measures during the construction must be developed. Shielding/covering around sluice gates, earthwork area to prevent regrettable accidents not only for workers but also for people living around must be implemented. The installation of warning systems, temporary lighting to help people recognize the construction areas easily must be in full, too.

**** c.3) The unexpected situations that may occur during the construction process include:***

- Finding of cultural artefacts/archaeological facilities during the earthwork.
- There are complaints from the public about environmental issues related to construction activities.

- Findings of UXOs.
- Review and forecast of impacts caused by dredging item

4.4.4.4. Assessing impacts during the dredging

a) Impact related to waste

The main activities in the dredging process include:

- The operation of dredging means (dredgers, excavators and barges that support the dredging)
- Water scooped up with muddy sediments.
- Domestic activities of dredging officers and workers on site.

a.1) Dust and emission waste.

** Emissions from dredgers, excavators, bulldozers:*

The calculation of the loads of the pollutants coming from dredging activities (the total volume of 14 dredging canals is estimated **431,133** m^3) is based on WHO's pollution coefficients, in which the diesel oil is 0.835 kg/l. The pollution loads caused by excavators 0.8 m^3 & 1.6m^3, bulldozers and dredgers are presented in the following table.

Table 4.18: The air pollution coefficients of DO/FO combustion engines (Unit: Pound/1000 Gallons of oil).

No.	*Pollutants*	*Power plant*	*Industry*		*Living*
			Not entirely burn	*Entirely burn*	
1	Aldehyde	0.6	2	2	2
2	CO	0.04	2	2	2
3	Hydrocarbon	3.2	2	2	3
4	NO_x	104	72	72	72
5	SO_2	157.S	157.S	157.S	157.S
6	SO_3	2.4.S	2.S	2.S	2.S
7	Dust	10	23	15	8

Source: EPA, Dinh Xuan Thang, 2007 (1pound = 450gram; 1 gallon = 3.785 litres; the conversion coefficient from pound/1000 gallons into grams/kg is 0.1189).

The calculations of the emissions: SO_2, SO_3, CO, NOx, hydrocarbons, aldehyde from excavators 0.8m^3, excavators 1.6m^3, bulldozers, dredger are as follows. Currently, Vietnam's petroleum market has two main types of diesel fuel: 0.05%S and 0.25%S. To control emissions from operating dredging equipment and transport vehicles, the Subproject owner will be interested in the less sulfur fuel (S = 0.05%), so the emissions from the combustion of 1kg diesel oil at temperature of 200°C is 38 m^3. According to the norm of raw materials, oil used for excavators 0.8 m^3 is 6.76kg/h, excavators 1.6 m^3 is 11.82 kg/h, bulldozers is 4.82kg/h, dredger is 31.78kg/h. The loads and the concentrations of pollutants from excavators 0.8m^3, excavators 1.6m^3, bulldozers, dredger are presented in Table 4.19.

The calculation results that the highest pollution load focuses on the dredgers. The air pollution loads from other machines are not much. The Subproject Owner will apply measures to control machinery and equipment tightly when carrying out the dredging activities.

Table 4.19: The total load of pollutants from dredgers

No.	Dredging equipment	Pollution parameters					
		Aldehyde	*CO*	*Hydrocarbon*	*NO_x*	*SO_2*	*Dust*
Emission coefficients of substances from diesel equipment (kg/t of diesel) (WHO 1993)		0.24	0.24	0.24	8.56	0.93	1.78
		Total load (kg)					
1	Excavators 0.8m^3	10.45	10.45	10.45	372.70	40.49	77.50
2	Excavators 1.6m^3	9.13	9.13	9.13	325.73	35.39	67.73
3	Bulldozers	7.45	7.45	7.45	265.81	28.88	55.27
4	Dredgers	24.55	24.55	24.55	875.79	95.15	182.12

Source: Rapid Environmental Assessment, WHO, 1993

(Content of sulfur in diesel is 0.05%)

Table 4.20 : The load of pollutants arising from excavators, dredgers for dredging sections

No.	Dredging equipment	The load of pollutants (mg/s)						
		Consumption fuel (tons)	*Alde-hyde*	*CO*	*Hydrocarbon*	*NO_x*	*SO_2*	*Dust*
1	Excavators 0.8m^3	43,540	0.90	0.90	0.90	32.16	3.49	6.69
2	Excavators 1.6m^3	38,052	0.79	0.79	0.79	28.10	3.05	5.84
3	Bulldozers	31,052	0.64	0.64	0.64	22.93	2.49	4.77
4	Dredgers	102,312	2.12	2.12	2.12	75.57	8.21	15.71

Typically in a combustion process, the residual fuel emissions are 30%. When the temperature of the emissions (or exhaust fumes) is 200^0C, the combustion emission of 38 m3 DO is 1kg.

Based on the flows (m^3/s) and the loads (mg/s) of emissions above, the calculation results of emissions of excavators 0.8m^3, excavators1.6m^3, bulldozers, dredgers are shown in Table 4.21.

Comparing the concentrations of pollutants from the operation of the construction equipment with QCVN 19: 2009/BTNMT and QCVN 20: 2009/BTNMT (Column B) shows that the concentrations of pollutants are within the permissible standards. Therefore, impacts on the air environment from the operation of excavators 0.8 m^3, excavators 1.6 m^3, bulldozers, dredgers are negligible.

** Smell from dump sites of soil and sludge:*

The dredging operations do not impact much on the ambient air quality but odour from the anaerobic decomposition of organic sediment sludge as CO, H_2S, CH_4 affect the air quality in the dredging area where sludge is piled up on shore.

The result analysis shows that the sludge composition in the dredging area contains mostly sand and mud without organic matters, so the possibility of odour is quite low or if there is odour, the impact scale is minor.

Table 4.21 : The concentration of pollutants arising from machine and equipment

N°	*Pollutants*	*Aldehyde*	*CO*	*Hydro carbon*	*NOx*	*SO_2*	*Dust*
1	Pollutant concentrations (mg/m^3)	6.32	6.32	6.32	225	24.5	46.9
2	QCVN 19 : 2009 /BTNMT (mg/Nm^3)	-	1000	-	850	500	200
3	QCVN 20 : 2009 /BTNMT (mg/Nm^3)	270	-	-	-	-	-

Notes: - Nm^3: The volume of emissions converted to the standard conditions - QCVN 19: 2009/BTNMT (Column B): National Technical Regulation on Industrial Emissions for Dust and Inorganic Substances.

QCVN 20: 2009/BTNMT (Column B): National Technical Regulation on Industrial Emissions for Organic Substances.

Conclusion:

As the results of the calculations, the concentrations of pollutants such as dust, NO_x arising from the operations of dredging machines are not exceeding the permitted values. The Subproject scale in each dredging canal is small and machines work not continuously 30 days - 60 days in a canal construction area only. Besides, the construction environment is large and ventilated, so the impacts on the surrounding environment are negligible. Emissions primarily affect workers who operate equipment and work near the equipment.

a.2) Liquid waste:

The liquid-waste sources that impact environment include water to be dredged with sludge, domestic wastewater from workers at construction site and pollution from storm-water runoff that carries pollutants into the water body.

** Water to be dredged with sludge:*

The dredging process will disrupt the stability of canal sediment, namely, the concentrations of pollutants in water may increase because pollutants are released from sediment. In addition, water leak from the sludge during the dredging also contributes to increasing the concentrations of pollutants. This effect is particularly acute if water is used for domestic purposes and aquaculture. However, the dredging impacts of 14 canals in the affected areas are negligible because of the following reasons: the canals to be dredged contain good sediment quality for crops; the dredging takes place on autumn-winter season without aquaculture operations in the region; the operations on canals remain a single purpose of water traffic of the kinds of small boats. Thus, the impacts on the water environment from dredging operations on the canals are negligible. However, the water scooped up canal banks with mud during the dredging process may flow into rice fields. The daily scooped volume is about 100 m^3/day. The characteristics of this leachate are that it contains high concentrations of suspended solids and some deposition metals in sediment which will adversely affect the environment.

The references to the water quality analysis at the outfall of the dredging dump site in Tac Cay Tram canal - Hau Giang province are presented in the table below:

Table 4.22: The quality of the water outfall of sludge dump site dredged from Tac Cay Tram canal

N°.	*Station*	*Results*				
		T (^{0}C)	*pH*	*DO (mg/l)*	*SS (mg/l)*	*F.Coli*
1	Km 257	30.2	3.12	1.1	1452	210
2	Km 257	30.4	2.98	1.4	1224	110
3	Km 257	30.1	3.03	1.9	869	90

Source: EPC, 2003

The results show that in the water quality scooped up with sludge during the dredging, the suspended solid concentrations reach 9 to 25 times compared with QCVN 40: 2011/BTNMT. However, the suspended solids are components of sludge dredged in canals, so the amount of suspended solids does not alter the composition of canal water but may affect crops, so conveying this water into settling tank to ensure enough sedimentation time before it recirculates into canals must be implemented. The specific solutions are presented in Chapter 5.

** Domestic wastewater from workers:*

During the dredging stage, wastewater is mainly domestic wastewater from barges, vessels where workers are living. According to the National Standard: QCVN 17: 2011/BGTVT issued by the Ministry of Transportation, the amount of wastewater estimated for worker on boards is 50 litres/person/day. On average, number of workers is 60 workers on boards and 4 persons in charge in dredging area. As calculated, the total domestic wastewater from workers in each canal dredging area is about 3.2 m^3/day. Based on the pollution coefficient issued by the World Health Organization, the total load of pollutants in domestic wastewater from 64 workers in the dredging area is calculated and presented in the following table:

Table 4.23: The load and concentrations of pollutants in workers' domestic wastewater

No.	*Pollutants*	*Emission coefficient (kg/person/day)*	*Load (kg/day)*	*Untreated concentration (mg/l)**	*QCVN 14 – 2008 (Column B)*
1	BOD_5	45 – 54	45 – 54	110 - 400	50
2	COD	72 – 102	72 – 102	250 - 1000	-
3	TSS	70 – 145	70 – 145	350 - 1200	100
4	TN	6 – 12	6 – 12	20 - 85	-
5	$N\text{-}NH_4$	2.4 – 4.8	2.4 - 4.8	12 - 50	10
6	Pt	0.8 – 4	0.8 – 4.0	4 - 15	10

*Source : WHO, 1993 *Metcalf and Eddy. 1979.*

Comparing with QCVN 14-2008 - Column B, workers' untreated domestic wastewater contains higher levels of pollutants than the permitted values: BOD increases 18 times, other pollutants exceed the permitted values for many times which cannot be discharged directly into the environment. The Subproject owner will apply regulations to the construction companies which must register their vehicles and equipment in compliance with the provisions of the National Regulation (QCVN 17: 2011/BGTVT) about the Pollution Prevention from Internal Waterway Vessels.

** Effects of rainwater runoff or dredging water runoff:*

By nature, rainwater is considered clean and normal water without negative impacts on the environment. However, when rainwater lands in the ground which contains contaminants such as grease, dust, waste, substances, it will carry them and becomes a contaminated water source. The construction works are mainly on the water and the surface to be washed off is the vessel and equipment surface, so the management of this surface will be easier than the management of construction surface on land. When it rains, contaminated rainwater runoff will appear when there are project activities which the construction companies do not abide by the waste control. This factor can be controlled by management and technical solutions. Therefore, to minimize this impact, the Subproject owner and the Contractors must have strict control measures of waste sources, particularly when the construction takes place in bad weather.

a.3) Solid waste:

The solid waste sources in the dredging are determined including domestic waste from the operation of workers on construction site and the dredged sediment.

**Impact of domestic solid waste:*

Domestic waste mainly includes such organic ingredients as vegetables and leftovers which are biodegradable. Besides there are other type of waste, especially plastic bags, which are difficult to decompose and may exist hundreds of years. If this waste is not collected but dropped into canals in dredging area, it will affect the water environment. Plastic bags affect the canal sediment or vessels when their propellers catch them.

The number of workers engaged in the dredging process is 64 people. As estimated, the amount of waste discharged by one person is 0.4 kg/person/day, the amount of waste generated by 64 workers is about 26 kg/day. Since most workers do not stay in one place but distribute in vessels in different locations, so the actual amount of waste loads will be smaller than as estimated. This waste is easily collected at source, manages and minimized by appropriate measures, so the environment impact is low.

** Dredged sludge:*

During the dredging canals, a large amount of sludge must be treated. The volume of dredged material is estimated **431,133** m^3. The dredged material includes: sediment and solid wastes in canal bottom, bottom soil and bank soil. According to the local survey, the demand for local filling embankment in large. At the same time, local governments committed to using this dried sludge for filling dike embankment in the region. According to the monitoring result, the quality of sludge in the dredged canals, the concentration of pollutants and heavy metals remain within the allowable limits of soil of QCVN 03: 2008 which can used as levelling material when people need. Since the dredging will be conducted in a large area along about 28km of canals, the impacts of dredged material are localized and or small significance.

a.4) Impact due to hazardous waste.

Arising source: hazardous waste arises mainly due to the operation of construction equipment such as barges, dredgers, excavators etc.

Compositions: lubricant sludge, viscous waste, oily rags etc.

Arising time: infrequent, occur during dredging, only arise when there are emergency repairs. The construction time takes place on each canal about 30 -60 days only, so there is no maintenance work. There are no lubricants from maintenance of machine, ships and barges. Unexpected repairs are estimated 7 litres/time on average (Research on recycling viscosity waste into liquid fuel - Military Engineering Science and Technology Center - Ministry of

Defence 2002). Lubricant is regarded as hazardous waste with the identification number of A3020.

The spillage or leakage of oil from construction means into water very likely occur. It forms oil film and their dispersed products. The oil pollution and their dispersed products affect the self-cleaning of water. Oil films hinder the penetration of light to the photosynthesis of phytoplankton which reduces oxygen dissolved in water. Oil dispersed products may kill plankton organisms, benthos which play an important role in the self-cleaning process.

So during the dredging, the Subproject owner requires the Contractors to comply with the oil supply process: collecting, storing, transporting oil according to the regulations of Circular No.36/2015/TT-BTNMT on the management of hazardous waste issued by the Ministry of Natural Resources and Environment. Vessels must abide by the National regulations: QCVN 17: 2011/BGTVT - Guidelines for the Prevention of Pollution from Inland Waterway Vessels, Part 2 - Structure and Equipment to Prevent Pollution Caused by Oil and Part 4 - Structure and Equipment to Prevent Pollution Caused by Hazardous Liquids.

b. Impacts not-related to waste

b.1) Noise

Overall, the extent and scope of noise during construction of the items depends on their technical characteristics, duration, operation frequency of machine and equipment as well as the direction and distance to the receivers. The construction time of the sub-project takes place primarily in the daytime while noise is also a factor that affects the life of people, especially at night. The research results show that the noise level away from source 1m, 20m and 50m of construction equipment are shown in the table below.

Table 4.24: The maximum noise level of some vehicles and equipment

No.	*Vehicles*	*Noise level 1m far from source (dBA)(1)*		*Noise level 20m far from source (dBA)(2)*	*Noise level 50m far from source (dBA)(2)*
		Distance	Average		
1	Excavator with front bucket	72.0 - 84.0	78.0	52.0	44.0
2	Tractor	77.0 - 96.0	86.5	60.5	52.5
3	Scrapers, graders	80.0 - 93.0	86.5	60.5	52.5
QCVN 26: 2010/BTNMT for common area from 6-21h		70 dBA			

Source: (1): Mackemize, L.Da, 1985. (2): Air pollution, Pham Ngoc Dang, 1997.

Use the following formula for identifying sound spreading in the air to calculate noise spreading in the air:

$$\Delta L = 20\lg (r_2/r_1)^{1+a} \text{ (dB)}$$

In which: r_1 is the distance where initial noise is measured; r_2: the distance from calculating point to the noise source (m); a: the coefficient that takes into the absorption of ground noise.

The maximum noise level due to the operation of dredgers and motorized construction equipment at the location away from the noise source 20 meters is smaller the permissible limit of QCVN 26/2010. Besides, the dredging location is away from residential areas, so the impact of noise is negligible, which only directly impact on workers working on boats and on barges.

b.2) Environmental impact during the dredging

The environmental issue of concern caused by dredging is that the surface water in dredging area to be affected is not related to the amount of waste by mixing bottom sediments. The total dredged volume of sediment in canals is about **431,133** m^3.

The dredging by excavators, dredgers make sludge dispersed in water. Besides, the hydrological regime of the area is also affected by the dispersal of sediments, the dredging quantity, the time, facilities, appropriate time etc. The dredging process causes impacts on the environmental components as follows:

** Sediment dispersion and deposition.*

The dredging will affect the lives of aquatic species. The most direct impact is the removal of the substrate, including benthic organisms and smothering invertebrates as well as losing their habitat. There are other effects related to the dredging, the influence of suspended solids in the water on the life of aquatic species. Some experiments and researches on the impact of suspended solids in the water on the lives of aquatic species have been made. DOER (2000) [5] reviewed these studies and linked with the suspended solid evidences related to the dredging. The research shows that where there is high turbidity of suspended sediment, eggs and larvae of fish are one of the most sensitive species to the degree of suspended sediment in water. The underwater population of creatures like fish can able to swim out of the disturbed area. The sludge particles sinking to the bottom or dispersed in water make water in turbidity and force the creatures to move out of the area due to loss of stable habitat. Shellfish are virtually unaffected by the level of sediment caused by the dredging as the sediment levels affect over 10,000 mg/l (DOER 2000) [5]. The disturbance boosts the decomposition of organic matters by microorganisms. Oxygen depletion in water causes immediate impact on aquatic life and indirectly impact on the aquatic resources. The concentration of suspended solids in the water caused by long dredging will restrict light into the water layer and affect the photosynthesis of algae, moss and irritate the fish species (small particles get into gills and make fish smothered). The hydrology in the region (tide, currents) also significantly influences the dispersal of sediments. However, the construction by large bucket of 1.6 m^3 in short time and narrow scale will cause negligible environmental impact.

** The recovery in the dredging area*:

The experiences in the estuaries are used as reference materials to evaluate the recovery time in the dredging area. Among the available materials on the recovery of the benthic communities along river, notably the scientific report of the USACE and EPA and as reported by the USACE, if the substrate is stabilized at small and medium speed, the recovery time in the dredging area will be under 5 years.

Measured by the US EPA for the recovery in dredging areas in Alaska river pointed out the restoration of the biological diversity of invertebrate is determined after 1 year (A. M. Prussian et al. 1999).

The referred documents in the world about dredging in the coastal areas indicate that the recovery speed of the benthic community after their habitat is dredged change significantly[4] . The recovery speed and morphology of residence are listed in the following table:

Table 4.25: The recovery time observed in dredging areas

No.	*Dredging area*	*Morphological residence*	*Recovery time*
1	Coos Bay, Oregon	Sludge is regularly disturbed	4 weeks

[4] (Nedwell & Elliot, 1998; Newell, Seiderer & Hitchcock 1998 print http: //www.ukmarinesac.org.uk/activities/ports/ph5_2_2.htm#a1)

No.	*Dredging area*	*Morphological residence*	*Recovery time*
2	Cagaliari Bay, Sardinia	Canal sludge	6 months
3	Mobile Bay, Alabama	Canal sludge	6 months
4	Goose Creek, Long Island	Lagoon sludge	>11 months
5	Klaver Bank, North Sea	Sand-gravel-stone	1-2 years
6	Chesapeake Bay	Sludge-sand	18 months
7	Lowestoft, Norfolk	Gravel	>2 years
8	Dutch coast	Sand	3 years
9	Boca Ciega Bay, Florida	Shell-sand	10 years

The general observation shows that the fastest recovery speed happens in the estuaries, where fine sediments are disturbed and where opportunistic species predominate. In general, the recovery time increases in the stable area of sand and gravel, where the species are long-lived with complex biological interactions which control community structure of dominating organisms.

The research in contaminated estuaries in the North East of England also indicated that the recovery time of the benthic community is more than 6 months (MP Quigley and JA Hall, 1999). The research in a small dredging area (2625m^2) of the similar environment in the North African port of Ceuta also pointed out that a disturbed area takes about 6 months to restore the community structures of benthic organisms to become similar to an undisturbed area (Jose M Guera-Garcia et al. 2003).

Based on the resulting data, the resilience after dredging will be approximately 6 months.

b.3) Impacts on water transport

The dredged canals mostly uses for water navigation. The contractors will notify and set up regulating station to direct boats to move to another canal in the region. The density of boats on the canal to be dredged is not high. From actual surveys and the dredging item, the construction will hinder movement of small boats on canal. Therefore if there is no warning station, controlling and regulating traffic better, canal boats will go into under-dredging canals and they have to turn back, which waste time and money of the vehicle owners. Thus the contractors must be prepared the traffic management plan on dredged canals before dredging. The plan is proposed in Chapter 5.

b.4) Impact on fauna and ecosystem

As the dredging work in the area have been exploited and used for domestic purposes, the aquatic fauna in the area is not many. According to the documents, the aquatic fauna in the region contains no species in the Red Book to be endangered.

The dredging will inevitably affect the canal benthic fauna. However, as discussed above, the level of impact will not be great because the dredging area is very smaller than the canal area, the creatures are able to migrate to other areas where there is not being dredged. The level of impact to the aquatic fauna is low and sweeping out the surrounding area.

b.5) Impact on economy and society

The construction time for each canal is short, only about 30-60 days, the number of construction workers is 64 people, there are less inhabited areas, so conflicts between workers and local people unlikely occur.

b.6) Impact on aquaculture and salt production

The canal dredging will increase turbidity which may affect aquaculture and salt production. However the Subproject owner committed no dredging in the aquaculture and intaking water for salt production (Just only canal dredging in dry season and the low tide). However, to limit the impact of uncertainty in the construction, the construction companies must coordinate closely with the local government and people for the communications and do not take water for any purposes during dredging time or stop the dredging when people get water if necessary.

b.7) Impact on sensitive areas

The canal dredging area is mainly located on Intensive Shrimp Farming and Semi - Intensive Shrimp Farming and salt production. During the dry season there is no shrimp culture. There are not sensitive points in dredging area as temples, churches, administrative offices, banks, historic parks, restaurants, hotels, schools, hospitals.

* Impacts on Historical, Natural and Cultural Resources: No impact is anticipated on the historical, natural and cultural resources.

* Impact on Protected Wetlands: There are no important local or national wetlands in the subproject area, and thus the construction will not affect any protected wetland.

c. Assessing impact due to the incidents during the dredging item

The dredging does not generate a lot of pollution wastewater as well as not dust. However, the incidents often more risky, causing significant impacts to the environmental resources and damages on property and lives. The most common risks during the dredging may include: labor accidents, traffic accidents, accidents in soil dump site.

c.1) Labour accidents:

Labour accidents as falling from board due to negligence when working on boats, electrocution caused by careless, manipulation and other mechanical repairs on boats, entangling in anchor ropes or winches on boats etc. mainly affect workers in the field, causing personal injury or occupational disease, or death. This impact on the communities around is insignificant.

c.2) Traffic accidents:

Traffic accidents from sinking boats and boat collision will cause oil spill. The reasons are the lack of navigation regulation to let boats go into dredging area; dredger turns incorrectly and does not ensure technical operations; dredger shell has defect, cracking or insufficient strength after a period of operation, dredging in bad weather, boats encounter unexpected obstacles which have not been cleared etc. Traffic accidents led to the oil spill and affect canal water quality and sediment in the region.

c.3) Unexpected circumstances likely occur during construction: like sluice gates construction.

4.4.5. Impact Assessment during Operation Phase

4.4.5.1. Identifying Source of Impacts

The impact sources during the operation stage are primarily from the operation of 5 sluice gates which prevent tidal surges.

After canals are dredged, the environment and response to climate change will be improved in the future. Therefore, no negative impacts from the operation of the dredged canals are expected.

4.4.5.2. Assessing impact in the operation phase of sluice gates

After completion of the 5 sluice gates, in addition to the already completed 31 km of sea-dyke and 11 existing sluice gates, there will be an extensive infrastructure network which ensures the prevention of saltwater intrusion, sea water intrusion by tides, tidal surges and storm waves and protect 13,045 hectares land and 85,000 people. At the same time, it creates a favorable infrastructure for the stable production and sustainable economic and social improvement for the people living in the subproject region.

The 5 sluice gates will connect with the existing infrastructure of Ba Tri sea-dike to ensure the safety for people and thousands of hectares of rice and aquaculture, control tide and provide water for production, prevent salinity intrusion and reduce damages on rice and vegetables. It will create a new opportunities for the region and to be a prerequisite of the regional economic development as it increases the production from 2 to 3 crops, increases livestock and aquaculture, increase rice output and fruit output. Completing the 5 sluice gates will result in completed road infrastructure for the region and ensure the traffic safety when vehicles move on the dike. However, when the system is put to use, the main environmental impacts are as follows:

a) Impact related to waste

a.1) Impact on air environment

When the construction of 5 sluice gates is completed, the approach roads to dike and 11 existing sluice gates are connected. More vehicles will make use of the road in the dike, which increases emissions, dust and noise. However, according to the field survey, the subproject is located the rural region with low traffic demand and vehicles are mostly bicycles and motorcycles, so the emissions and impacts are not many which can be controlled by the solution that bans motorized vehicles traveling on the dike to protect dike body.

Also, the operation of the facility increases the production rotation and the greening time in the region. The low-lying areas inside District Road N^{o} 16 will be sluice gates quickly and more thoroughly, land will be flushed better and salty alum evaporation will be low in dry season, causing the air quality to improve. In addition, the air environment of the hot and dry weather caused by microclimate and environmental changes, thanks to the larger water storage in canals which increases the evaporation, will improve.

a.2) Impact on water environment

When the tidal sluice gates operate, inside the District Road N^{o} 16, the water quality will change significantly. The tidal sluice gates regulate discharging water directly into the sea, making water logging and will reduce pollution.

When the system operates, the production structure of the benefited region will not be affected but production crops increase that contributes to the stability of people.

Other negative side effect that may occur to the water quality during operation is when the sluice gates are closed and less water circulation in this region happens with the risk of increase of contamination of water sources. The project management units responsible for the sluice gates operation must ensure the harmony between economic interests and environmental protection.

b) Impacts not related to waste

b.1) Changes in the distribution and concentration of salt water intrusion

After the sluice gates are built, almost saltwater in the entire subproject area will be controlled as salty water in the subproject region is mainly depends on the ocean tides and upstream flow. The impacts of the subproject sluice gates combined with the sea-dike will be positive, which will limit the penetration of the tidal salt water into the infield canals. When the sluice gates provide fresh water, they will reduce the salt concentration in river.

Sluice gates discharge impacts: there are several periods when the sluice gates are closed including: (i) in the dry season when salinity is too high (above 20‰) the sluice gates are closed so that freshwater from Ba Lai River can be taken in through the canal system to maintain suitable salinity level for the shrimp, and (ii) in the rainy season from June onwards, the sluice gates are closed to keep freshwater for rice farming.

If the saline degree is too high in the dry season the sewers on District Road N^{o} 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 sluice gates on District Road N^{o} 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 subproject area.

b.2) Changes in hydrology

When the system of tidal sluice gates and dikes is completed, the hydrology regime inside the dike will change the water flow. The water levels will depend on the operating mode of the sluice gates. More deposit appears outside the dike. Damages caused by storms and high tides will not cause damages to the inside of the dike.

Water flow changes in dry season: In case, the sluice gates are closed, there are not considerable changes because the region is mainly affected by the East Sea tides. The out/in flows to the subproject area decrease during the period when the sluice gates close, which will make the water circulation less, enable the deterioration of water quality and large sedimentation in canals.

b.3) Impact on groundwater environment

The salt prevention that control risks leads to the increase use of chemical fertilizers in the area. Without proper and reasonable use, they will affect the shallow groundwater quality. However, this effect is unclear.

b.4) Impact on soil environment

Inside the sluice gates are mostly saline soils. When salt intrusion is prevented, salty soil in the area inside district Road 16 that receives freshwater will be washed to meet the growing of crops.

Also, if excessive chemical fertilizers used in the agricultural production in Zone 3 in the subproject region will make soil compacted; the soil salinization increases; the soil porosity reduces; the absorption of plant roots will be poorer; the water permeability is less, which makes the storage of plant protection chemicals in the soil increase. Moreover, the microorganisms which are beneficial to the soil are depleted; the soil mineralization decrease; therefore, in the long term, the soil quality will diminish.

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.

b.5) Impacts on biological resources and biodiversity

** Terrestrial and freshwater ecosystems*

The sluice gates combined with the existing tidal dike lead to significant changes to the freshwater ecosystem. In the freshening area, the ecosystem will thrive better thank to the abundant fresh water resource, irrigation and sluice gate usage, adequate water supply for dry season, livestock and poultry are also benefited in dry season. However, it will have local flooding due to siltation of canals. Therefore, regular dredging will maximize the effectiveness of the sluice gates-dike system in the subproject region.

The freshwater species that live in the subproject region mainly consists of *Channa, Snakehead fish, Eel, Siniperca, Clarias Batrachus, Barbodes Goninotus, Barbonymus Schwanenfeldii, Mad Bar*b etc. With open sluice gates, their migration entirely depends on the tidal level and salt water intrusion. However, when the sluice gates are closed, tidal water will be prevented to enter. This means that during the dry season, when saltwater penetrates into the infield, the sluice gates will be closed to prevent saltwater intrusion. This enables the migration of freshwater species to the sluice gates locations. In rainy season when the sluice gates are open, the freshwater species can migrate outside to feed. In summary, when the subproject works the freshwater aquatic species will benefit the living space as well as search of food areas, which help them have ability to grow and thrive.

**** Coastal Ecosystems***

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

The sluice gates system can control saltwater intrusion and provide fresh water to change salinity level to improve the water quality in the region. Any changes in the environmental conditions also have impacts on the regional biota, inside sluice gates, coconuts may be affected because of less salt water, however, coconuts are adaptable to low salinity conditions, even in fresh water.

The aquatic life in the ponds also enjoy more fresh water when it is add to dilute saltwater to suit shrimp growth. When completed, the sluice gates will lead to expand the area of intensive aquaculture ponds and reduce the area of suitable habitat for a number of bird species such as saltpans, extensive aquaculture ponds etc.

Tides cause significant impacts as changing migratory habits of some species of fish and other aquatic species. In the ecosystem of the coastal estuaries, there are many species of aquatic organisms, especially fish, shrimp etc., which own migrating habits to search for food sources and breeding grounds. This migration is completely dependent on the water quality, food sources and migrating habit of each species. When no sluice gates appear, many species live in the brackish waters of the coastal estuaries will migrate inland into rivers following the extent of the tidal salt water intrusion. When the sluice gates that control saline appear, the habits as well as the migratory ranges of the species will be changed. Sometimes, when fresh water is required, sluice gates will be closed to prevent the intrusion of saltwater into deep inland, affecting agricultural activities (Zone1) and shrimp activities (Zone 2). That means the popular brackish species such as fish (*Engraulidae, Liga, Sillaginidae* etc.) which live in brackish waters previously likely move deeper into the infield to find food following the salinization flow, so their foraging range are limited in front of sluice gates.

When the gates are opened, the water released through the sluice gates carries accumulated agro-chemicals which can be detrimental to the coastal and mangrove ecosystems. The freshwater released through the gates might affect the blood cockles and saline ecosystem around the estuaries of the outlet canals. These effects careful consideration in the environmental impact assessment.

Almost the important habitat area for shorebird population will be situated outside the sluice gates. Therefore the impact of sluice gates operation in this case is considered negligible.

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 favor 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.

**** Fish migration***

The sluice gates will create a barrier preventing the movement of aquatic species (fish, shrimp, etc.). 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 sluice gates will partly block their migration way further in to land. Life cycles of migratory species such as shrimp, mud crab and some fishes might by interrupted.

Based on the field work in October 2015, which included interviewing local residents, and The survey data in 2009-2010 in the study: "Planning and development of the co-management model for the biodiversity reserve in Ham Luong River estuary in two districts of Ba Tri and Thanh Phu, Ben Tre province…., 70 species of fish belonging to 40 families of 13 orders occurring in the Ham Luong river system were identified (Table 1.7, for full list of species see Appendix 1). Among them, the perciformes order had 30 species, constituting 42,9 % of total amount of species. The fish found in Zone 2 consist of: *Corica laciniata, Setipinna taty, Coilia grayii, Barbonymus gonionotus, Mystus rhegma, Pangasius krempfi , Pangasius polyuranodon, Pangasianodon, hypophthalmus, Plotosus lineatus , Plotosus canius, Monopterus albus, Oreochromis niloticus niloticus, Butis butis, Oxyeleotris siamensis, Pseudapocryptes elongatus, Boleophthalmus boddarti, Anabas testudineus, Trichogaster trichopterus, Osphronemus goramy, Channa striata*. Among the fish species of Canal system, none species are listed as threatened in the Red Data Book of Vietnam (2000).

According to the knowledge of local people, fishes are generally distinguished into two kinds: black fish and white fish:

– Black fish: fish species often survive the dry season in the bottom layer in the wet mud among vegetation. Often found in rice fields, as well as in sluggish parts of rivers and streams. Mostly carnivorous and detritus feeders. This group includes the families of Anabantidae, Channidae, Synbranchidae, Bagridae... Most of the species has dark colour.

– White fish: this group includes Cyprinidae, and catfishes belonging to the families of Pangansiidae, Siluridae, etc.

The canal system is not continuous water body with fish migration barriers is District Road No 16. In such a system the fish community will always be comprised of small migratory populations, special not suitable for Anadromous species. With respect to migration habits the fish community can be divided into:

1. Anadromous species: Species that live in the sea and which goes up into the river for spawning.

2. Catadromous species: Species that live in the river and which migrate to the sea for spawning.

3. Potamodromous species: Species that perform annual migrations within the river system, either for spawning or for feeding purposes.

4. Stationary species: Species that live in the same area of the river all their life

A representative for the catadromous species is the important and highly priced (up to 100,000 VND per kg) *Pseudapocryptes elongatus* (Goby). The goby (*Pseudapocryptes elongatus*) abundantly follows the tidal currents for migration to sea in January and February meanwhile it was rarely during October to December. The goby migrated to sea two times per month during the full moon (15th day of lunar calendar) and new moon (30th day of lunar calendar) period, in which they mainly migrated during the new moon period. Almost of the migrated goby was examined as immature fish. The goby migrated abundantly when the salinity, current velocity and tidal range were higher. Except for the dry season, fish migration period of month to coincide with time served offtake open aquaculture. Therefore the environmental impact to fish migration to the sea is Moderate.

Many fish species migrate within the canal system this group includes: *Pangasius krempfi, Pangasianodon hypophthalmus, Barbonymus gonionotus, Mystus rhegma, Giant freshwater shrimp ...* both for spawning and for feeding. These are called potamodromous species. Their migration distance can be both long and short, depending on the species. Other species live more or less in the same area of the river all the time (stationary species). The hydrological regime is a major factor in steering the timing of the fish migrations. The migrations are trigged by seasonal rise and decline of water level and water flow. Upstream spawning migration of adults generally starts at the beginning of the rainy season, when flows increase and water levels are rising. Meanwhile sluice gates saline control only closed into the dry season so the impact migratory Potamodromous species is Moderate.

b.6) Impact on traffic

** Water navigation*

The water level, the salinization regime, the fresh water supply to the subproject area are coordinated suitably for both freshwater and saltwater areas. When there area detrimental changes of salinity to shrimps, appropriate saltwater will be taken from canals and sluice gates will be closed to enable households to get water into their aquaculture pond. When the seawater salinity is too high to wait for appropriate level, sluice gates are closed to feed fresh water to dilute water to meet the requirements. In both cases, when sluice gates are closed, vehicles can not reach the subproject region. The sluice gates elevation is designed + 2.5m. The embankment is designed 2.3-2.5m. At the time of peak flood tide, which is higher than the designed embankment elevation, sluice gates must be closed and it will affect the navigation, especially for large tonnage vessels with tall flags while sluice gates height is limited, however this case is rare in comparison with the current status.

** Road traffic*

Due to the low terrain condition, which is separated by many rivers and canals, the construction of traffic bridge-sluice gates will contribute to facilitating the circulation of goods, social

interaction of people in the island area, which creates a continuous network of waterway and roadway in the region.

b.7) Impact of conflicts in water use

The use of water in rivers and canals takes place naturally under the water-flow conditions but will be changed when the regulation works on rivers appear. Since the purpose and demand for water differs in each area, the required water quantity and water quality differs. For example, while the rice farmers want to keep fresh water in canals and rivers for their irrigation, others need salt water for their aquaculture ponds and salt fields. These differences can be conflicts between the upstream and the downstream, between different water-user groups, which will be difficult for the regulation works to meet their demand at the same time.

Fortunately, time for salt production in the area is mainly from December to May next year and during this time, sluice gates will totally open and even though, as mentioned above, salt farmers now are changing to other brackish productions so this impacts of sluice gates closing will be low.

However, the construction of sluice gates that control salty water must be minded this issue to develop appropriate solutions for the operation of the sluice gates.

b.8) Impact on socio-economy

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. 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 subproject zone area.

Once the subproject 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.

Aquaculture farming area in Zone 1 (there are Mangrove belt) 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 cannot be expanded due to the inactive regulation of salinity.

When sluice gates are 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.

4.4.5.3. Impact of supporting from Livelihood Models

4.3.5.3.1. Environmental impact assessment

**** Mangrove-shrimp to organically certified mangrove-shrimp model:***

The offspring of natural shrimps are obtained according to tide inlet. Some offspring are added to create up a population density between 1 – 3 shrimps/m^2.

**** Biosecurity of shrimp aquaculture model:***

Amount of feeding is controlled according to the standard; only eco-friendly microorganisms are used for shrimp farming, a litter chemicals. Because of meeting the standards and following standard processes, the environmental impact of shrimp farming is negligible. Nevertheless, shrimp farming is currently so risky, due to uncontrollable shrimp related diseases. The main actual or potential environmental impacts of shrimp farming fall into the following categories:

Organic matter and nutrient pollution:

The water in shrimp ponds is high in nutrients and organic matter, especially towards the end of the production cycle. These nutrients are derived mainly from waste food and metabolic products, as well as from the small quantities of fertilizer added at the start of the cycle to stimulate plankton blooms (Boyd, 1998).

When pond water containing high concentrations of nutrients and organic matter from a large number of shrimp farms is discharged into coastal waters, the effects can be negative, depending on the ecosystem's capacity to receive the discharges. Potential negative effects include (Clay 1996; Dierberg & Kiattisimkul 1996; Lin 1995):

- Unusual rates of sedimentation;
- Eutrophication, with increased risk of harmful algal blooms;
- Change in the nutrient cycle;
- Oxygen depletion;
- Toxicity from sulfide compounds and ammonia following degradation of organic matter; and increased incidence of disease, stemming from poor water quality and stress on aquatic life.

These impacts may be detrimental to the farm itself, to neighboring farms, and to the around environment. However, that increased levels of nutrients and organic matter may be desirable for some coastal ecosystems. Indeed one valuable function of mangroves is their capacity to absorb and use the detritus and nutrients that arrive in estuaries and coastal waters. So long as carrying capacity is not exceeded, the nutrient and organic matter discharges from shrimp ponds may actually be beneficial.

Although there are examples of lake eutrophication as a result of fish farming, few examples are reported in coastal waters. Other than at harvest, the concentration of nutrients and organic matter in effluents from shrimp farms are relatively low compared, for example, with treated sewage (*Table 4.26*). However, when pond effluent is added to other sources of nutrients (e.g., from agricultural and domestic wastes), the risks of algal blooms or suffocation of marine organisms may become significant. At that point, nutrient discharge should be minimized.

Table 4.26: Quality of intensive shrimp pond effluent compared with domestic wastewater

N⁰	Component (mg/l)	Shrimp effluent	Domestic wastewater		
			Untreated	Primary treated	Secondary treated
1	BOD_5	4 – 10,2	300	200	30
2	TN	0,03-1,24	74	60	40
3	TP	0,011-2,02	20	15	12
4	SS	30-225	-	500	15

Source: Beveridge, Phillips, & Mackintosh 1997

The significance of the impacts of organic matter and nutrients from aquaculture depend on management practices on the one hand, and environmental capacity on the other. Good management practices can radically reduce the export of nutrients to the environment, and where farms are well dispersed, or carrying capacity is high (e.g., because the local environment is effectively flushed), effects are likely to be minimal. The most severe impacts arise at the time of harvest, when accumulated and concentrated organic matter and pond bottom sediments may be discharged to the environment either passively, following re-suspension during the harvesting process, or through active flushing with high-pressure hoses (*Table 4.27*).

Table 4.27: Variations in effluent quality from an intensive shrimp farm in southern Thailand

N^0	Parameter (mg/l)	Routine discharge	Draining & harvest
1	Total N	0.5–3.4	1900–2600
2	Total P	0.05–0.4	40–110

Source: Lin 1995

Chemicals

In addition to the use of fertilizers discussed above, shrimp farmers now use a wide range of chemicals to prevent and manage disease, to manage water and pond soil quality, and to facilitate harvesting and transportation. They include the following:

- Soil and water treatments (e.g., EDTA, lime, zeolite);
- Disinfectants (e.g., sodium or calcium hypochlorite and chloramine, benzalkonium chloride (BKC), formalin, iodine, ozone);
- Pesticides and herbicides (e.g., saponin, rotenone, anhydrous ammonia, Gusathion, Sevin, organophosphates, organotins);
- Antibacterial agents (e.g., nitrofurans, erythromycin, chloramphenicol, oxolinic acid, various sulphonamides, oxytetracycline);
- Other therapeutants (e.g., formalin, acriflavine, malachite green, methylene blue, potassium permanganate, Trifluralin);
- Feed additives (e.g. immunostimulants, preservatives and anti-oxidants, feeding attractants, vitamins);
- Anesthetics (e.g., benzocaine, quinaldine); and
- Hormones.

In addition, chemicals may be leached from plastics and other structural materials used in shrimp farming.

The most commonly used chemicals in shrimp culture are chlorine for disinfecting tanks, ponds, and (increasingly) the water supply; quick lime, saponin, and rotenone for pond soil disinfection; formalin for disinfecting broodstock and larvae, and as a general disinfectant and disease treatment; BKC and EDTA for pond water management; and various antibiotics for disease treatment. Relatively small quantities of anesthetics may be used in the transportation of broodstock. Hormones are not widely used in the shrimp industry. The overall use of chemicals in aquaculture has recently been reviewed by GESAMP (1997).

As with agriculture and other forms of aquaculture, the use of some of these chemicals raises a variety of environmental concerns. Perhaps the greatest is the indiscriminate use of antibiotics to control or prevent disease outbreaks, and in particular the use of antibiotics that affect human health, such as chloramphenicol. Several bacterial and viral diseases have plagued the shrimp farming industry in recent years, and large quantities of antibiotics and other drugs have been used to reduce shrimp mortality. Some of the medicine will eventually end up in the environment, exposing other organisms. One report notes that approximately 70 to 80% of the administered antibiotics will ultimately end up in the environment as a result of uneaten food and contaminated excrement (Greenpeace 1995, cited in Clay 1996). Three primary environmental concerns are associated with the use of antibiotics:

– The proliferation of antibiotic-resistant (and thus more dangerous) pathogens as a result of incorrect or continual use of antibiotics, and/or their persistence in sediments.

– The transfer of antibiotics to wild fish and other organisms in the vicinity of farms using medicated feeds.

– The effect of antibiotics on natural bacterial decomposition in bottom sediments, and their influence on the ecological structure of benthic microbial communities.

Drugs and other chemicals are commonly overused, since the costs of possible losses from disease are very high compared with the costs of treatment. Furthermore, when instructions specify a certain dosage, operators sometimes believe that doubling the dosage will double the effect of the drug, so they use more than the recommended dosage. Lack of training and knowledge can therefore lead to poor production rates, or even disasters. The effect of most of the chemicals used in shrimp farming depends on the amount used, exposure time, and dilution. Even if a compound does not cause harmful effects in moderate amounts in an environment with good dilution properties, the effects might be severe if large amounts of the same compound are discharged in coastal environments with poor water exchange.

Chlorine is used to disinfect ponds between generations of shrimp. It is used to disinfect water for use in hatcheries, and increasingly to disinfect water in reservoir ponds (used to fill production ponds). The most common compounds used are sodium and calcium hypochlorite. Chloramine is sometimes used to disinfect tanks and equipment. In the presence of organic matter, both hypochlorite and chloramine are rapidly reduced to nontoxic compounds, and it is the remaining available chlorine that causes inactivation of viruses (Hedge et al. 1996). Neither hypochlorite nor chloramine are bioaccumulative, and they are likely to have only localized biological effects. Research is currently under way to explore the possibility of creating complex persistent chlorinated organic compounds, but these could have serious environmental impacts.

Formalin (aqueous solution of 40% formaldehyde) is used extensively against fungus, viruses, bacteria, and ectoparasites in shrimp farming. Formaldehyde has low persistence, with a half-life of 36 hours.

Along with sodium hydroxide (NaOH), formalin exists in nature and should not have a significant impact on the wider environment under normal farm usage (Tobiesen & Braaten 1995).

The effect of the chemicals on humans who handle them should also be considered (GESAMP 1997).

For example, organophosphates and malachite green are respiratory enzyme poisons. Rotenone can cause respiratory paralysis. Ingestion of chloramphenicol may cause aplastic anemia. Formalin can cause cancer and severe allergic reactions in people through long-term exposure.

Even though some of the most frequently used chemicals in shrimp farming are only moderately toxic, they can have severe effects on the environment and people working at the shrimp farms, depending on amounts used, dilution, repeated measures, and preventive measures.

Many of the chemicals used in shrimp farming (e.g., formalin, furazolidone, dichlorvos) are not persistent, with half-lives ranging from 36 to 200 hours. Oxytetracycline, oxolinic acid, and flumequine, on the other hand, are relatively persistent and can be found in pond sediments six months or more after treatment.

Organisms in the wider environment may be susceptible to some of the chemicals used in aquaculture, especially those used to combat ectoparasites. In practice, their use is rather less common in the case of shrimp than in finfish farming. Other organisms in the local environment may take up chemicals directed at the aquaculture enterprise. Mollusks, for example, may take up chemotherapeutants, especially if grown in polyculture. Mollusks may then pose a hazard to humans who eat them, although there is little evidence of this to date.

There is widespread concern among consumers relating to chemical residues in farmed products. Most shrimp destined for export are now tested for antibiotic and other residues. However, such testing may result in consignments that fail the tests being marketed locally, where regulations are less stringent.

Disease

Some of the diseases that trouble the shrimp farming industry are directly caused by environmental problems, while a number of other diseases are triggered or spread more effectively by the stress induced by environmental problems. None of the shrimp diseases are known to be pathogenic to humans. In recent years, shrimp farming has been afflicted with outbreaks of viral diseases that have greatly undermined profitability and sustainability of operations.

Viral diseases: More than 15 different viruses have been identified for Penaeid shrimp over the past 20 years. Many of the known viruses infect larvae and juveniles, and they can be species-specific. Shrimp may become less resistant under conditions of stress, such as overcrowding, water temperature fluctuation, low oxygen levels, or high levels of pollutants (Lundin 1996).

White Spot Virus Disease: In the Eastern Hemisphere, White Spot Virus Disease is the most common and serious shrimp disease affecting shrimp farms (Rosenberry 1996). White spot was also probably responsible for the major shrimp farming disasters in Vietnam. It has caused problems in Ben Tre province.

Bacterial diseases: Many different forms of bacteria can affect shrimp, frequently as opportunistic follow-ups to viral infection or environmental stress (Lundin 1996). The short-term strategy for dealing with bacteria has been to use antibiotics as well as improving pond cleaning and increasing water exchange.

Vibrio species, in particular V. harveyii (luminescent bacteria), have posed significant problems in Vietnam, including the Ben Tre province, affecting hatcheries and grow-out ponds.

Other diseases: Other diseases affecting shrimp include rickettsia, such as the Texas necrotizing hepatopancreatitis (TNHP) in Penaeus vannamei, and rickettsia-like infection of Pandalus. Fungi also occasionally infect shrimp. Protozoa can cause considerable damage to shrimp as well, particularly under poor farming conditions.

However, under the subproject and with the construction of new sluice, water circulation in the pilot area can be regulated so that water supply could be separate from the drainage. Effort

will also be made to minimize any discharge from the farms. The impact is considered moderate.

**** Rice crop + Giant Freshwater Shrimp model:***

The environmental impact of this farming model is not high. However, unless the offspring of shrimp and water bodies for farming are controlled properly, this model is much too risky. In particular, when there are shrimp related diseases in a farm, and water from the farm is discharged to surrounding water bodies, these diseases will be spread over a larger area.

* The impacts of these models on the environment mainly from organic wastewater and solid waste.

Wastewater: The livelihood model increase will bring about the larger volume of wastewater from rice - shrimp fields. The amount of wastewater from these fields if not being treated thoroughly will affect the quality of the freshwater resources, which in turn affect the daily lives of households living in the planning region and in the surrounding region in addition to people's health and the agriculture and aquaculture efficiency in the long run.

The Rice crop + Giant Freshwater Shrimp model bring the amount of chemicals, fertilizers, pesticides, which affect the water quality, soil and aquatic life in the subproject region. However, with the goal that develops sustainable livelihoods, apart from the construction of works, the subproject introduces sustainable livelihood models for the region and encourages the preservation and rational use of chemical fertilizers and pesticides in addition to raising awareness about the environmental protection for the people, so the affection by the use of pesticides can be minimized.

Solid waste: The waste sludge from cleaning aquaculture models, which contains organic contaminants, nutrients, heavy metals, mineral elements and microorganisms. If there are not any proper treatment measures, these matters will cause pollution on soil, water, air and the spread of diseases.

In case, if the community's awareness about environmental protection in the subproject region is not improved, their indiscriminate disposal of packages from agricultural production and aquaculture into canals may also occur in operational stage. This can make many canals more contaminated. Therefore the community involvement in the environmental management, especially in the operational stage is vital.

However, as mentioned earlier, when the sluice gates 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.

4.3.5.3.2. Economic impact

**** Mangrove-shrimp to organically certified mangrove-shrimp model (Zone 1):***

If the model is not certified by GAP, the annual profit of farming is about 32 million VND/ha. Otherwise, the GAP certified model provides an annual profit of around 45 – 48 million VND/ha. An increase of profit is up to 13 – 16 million VND/ha.

Given that the ratio between shrimp area and area of mangroves, which are already recognized as vital to sustainable aquaculture and durability of any shore constructions. The profit of the model may lead to the conversion of mangroves forest into shrimp. If 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 subproject area and its surrounding will rise.

**** Biosecurity of shrimp aquaculture model (Zone 2):***

This model is very profitable. If the treatment of the aquaculture pond, selection of shrimp offspring, feeding, harvesting and eco-friendly processes are properly managed, shrimp related diseases are controllable. This will decrease the costs and increase productivity, which might result in a profit up to 300 million VND/ha. Meanwhile, a conventional model, without shrimp related diseases, results in a profit of about 100 million VND/ha.

**** Rice crop+ Giant Freshwater Shrimp aquaculture model (Zone 3):***

The average profit for this model is calculated to be about 25 – 30 million VND/ha, whereas a water rice cultivation model provides a profit of about 20 – 25 million VND/ha. As a result, if the model is properly managed and the shrimp related diseases are controlled, the profit obtained from this combined model is 5 million VND higher than the water rice cultivation model.

4.3.5.3.3. Social impact

**** Mangrove-shrimp to organically certified mangrove-shrimp model:***

Zone 1 is a mangrove forest along the sea with a poor access by road. Transportation is mainly done by navigation. There is a high ratio of low-income households in this zone. The households are provided a quota of land use to protect forest. There is also a high ratio of illiteracy and school leavers in this zone. The forest – shrimp model will create jobs and increase the income for local people. Gender related issues are not affected when this combined model is implemented.

Demand for labour for this combined model is low because of low production intensity and light harvest year-round. The local people themselves can accordingly take part in the daily production. The demand for labour is significantly increased during the period of sludge removal and wood harvest (at the end of tree growth period of 12 – 15 years).

Because the production activities are scattered in the remote areas and are large farms, there is low feasibility of forming of cooperation to assist the local people to gain higher profit. Nevertheless, the households using this combined model can create a group to promote training programs, information sharing and to communicate with the companies that certify the GAP standards. Formation of the group can be a motivation to expand this combined model.

The implement of this combined model does not affect cultural heritages.

**** Biosecurity of shrimp aquaculture model:***

The ratio of low-income households per total households in the eco-friendly shrimp farming area is lower, lowest in Zone 1. Most of the poor people in Zone 2 not own any land. They rent land for farming. Eco-friendly shrimp farming improves the incomes of farmers. As a consequence, the low-income people gradually save enough money to afford their own farmland, which again will have a positive impact on their income.

Women can be fully involved in eco-friendly shrimp farming. However, because due to the old traditional ideas in the subproject areas that women cause bad luck for the shrimp farming, job opportunities for women are limited. Investment risk and risky propensity of eco-friendly shrimp farming is quite high. Women are consequently not considered to be involved in the shrimp farming. Meanwhile, there are no additional proposals to promote women's incomes in the subproject.

Formation of cooperation for the purpose of improvement of the farmers' incomes is feasible. Cooperatives can be used to create jobs and approach loans. Profitable aspect of the combined model is a motivation to expand this model in order to enhance the farmers' incomes.

Social impact of infrastructure: construction of sewer systems as well as improvement of transport by road and water. Ships navigating on the canals could have to wait. There is necessity of consulting by and communicating with community for the operation of the sluice gates.

**** Rice crop + Giant Freshwater Shrimp aquaculture model:***

In this zone, the farmlands belong to the farmers. The ratio of low-income household per total households in this zone is lower than that in Zone 2. However, most of the low-income people not own any land. They are hired by the landlords of the farmland. If the subproject only supports the landlords, the low-income people who not own any land will be are ignored. Therefore, the subproject needs an additional solution to increase the income of people's that not own any land. This could be cows, pigs and ducks feeding, etc.

Gender issues**:** the ratio of illiteracy of women in this zone is higher than that of men. As a consequence, the combined model is more beneficial for the men than the women in this area.

Labour demand for this combined model is not substantially changed. As a result, job creation due to implementation of the combined model is negligible.

Due to the high population density along the district Road 16, formation of cooperation to support the local people is feasible. Nevertheless, two factors should be considered: 1) educational level is low; and 2) women are the main force of labour in this area. Therefore, the combined model in Zone 3 can form cooperatives in combination with the farmers' association for safe production by using less pesticides and fertilizers. Safe production can be supplied among farmers and to the market. The farmers' association with the support of the farming promotion staff can provide trainings on water rice and safe shrimp for the association members. The association members who are well organized and gain high profit can share their experience and financially support other poor households.

Because there is not activity that substantially affects culture in this subproject, the impact on culture is negligible.

4.3.5.3.4. Impact on infrastructure:

The sluice gate system on the district Road 16 is operated to protect Zone 3 from saline intrusion during high tides. Closing of sluice gates can cause traffic jam for transport by both road and water. However, sluice gate closes to protect the zone from saline intrusion during the high tide take place during short periods: twice per month, 3 – 4 times per day. Sluice gate closure during the dry season can last longer than several weeks. Therefore, there is necessity of close communication by and with the community concerning the operation of the sluice gates.

The subproject proposes the formation of formal farmer cooperatives. While this may be fine in theory, and may provide more bargaining power to farmers, it is an ambitious objective given that there is the lack of farmer experience and familiarity with cooperatives in the area. A preferred approach may be to implement less formal collective groups which would build on the SNV Netherlands Development Organization (SNV)/IUCN experience of farmer groups as a starting point.

4.3.5.3.5. Potential impacts from future expansion of models

**** Mangrove-shrimp to organically certified mangrove-shrimp model (Zone 1):***

The great earnings of shrimp culture may be make expanding shrimp aquaculture industry poses one of the gravest threats to mangrove forests. The great earnings of shrimp culture are short lived, while the real costs in terms of consequent environmental ruin and social disruption are long term and astronomical. While the immediate profits from shrimp farming may satisfy a few, vast numbers of coastal residents, once dependent on healthy coastal ecosystems for fishing and farming, will be displaced and impoverished.

However mangroves will not be converted into shrimp when farmer know the conditions and standards of GAP certification for Mangrove-shrimp model. Also in the shrimp Zone 1 no protection if the forests were cut down. Intensive shrimp farming in the area Zone 1 is a huge risk because of uncontrollable nature and environment factors.

On the one hand, mangroves area along sluice gate will not be altered more into aquaculture pond as farmers tend to stay behind the sluice gates and dyke to have their pond protected so, to some extent, mangroves left in this area can have some better protection from cutting.

**** Biosecurity of shrimp aquaculture model (Zone 2):***

Given that aquaculture farming could bring more benefits to farmers, it is likely that expansion of the aquaculture activities and/or the proposed models could occur quickly without inadequate management and/or control. From the environmental and social perspectives, implementation of Model 2 of monoculture may trigger induced impacts which include: Changes in land use from salt production to intensive shrimp farming and increased water pollution. These in turn would negatively affect biodiversity, water supply, and income of the poor who may not afford intensive shrimp farming. These induced impacts should be addressed comprehensively at the provincial and local levels. This change does not put pressure on infrastructure and society because this area has been planned for the aquaculture development. In addition, 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.

**** Rice crop+ Giant Freshwater Shrimp aquaculture model (Zone 3):***

Profits earned from the model will encourage a transition from rice cultivation to shrimp farming. In the early stages of the transition, the rice shrimp intercropping model are encouraged to apply to ensure ecological balance and food security. With the huge success of the first shrimp crop, people tend to give up rice cultivation. Even local people farm shrimp all throughout the year or empty the land without rice cultivation due to the low value of rice production which is no longer attractive to farmers as shrimp.

In addition, there are not many rice farmers which have made it difficult for other farmers want to grow rice because the insects, birds and rats devouring, causing heavy casualties, not even to harvest rice. Gradually, due to the limited land area while wants to increase the productivity, the farmers had to dig away part of paddy land in the shrimp ponds to make deeper shrimp ponds to feed many more shrimp. The rice fields have now become the " pond " shrimp. Mode of living of the local people now depends entirely on marine ecosystems. Shrimp people farming in the rainy season and leave land in the dry season. However, shrimp farming is also a potential risk profession. Therefore, in parallel with the success brought by shrimp farming, the phenomenon of land pledging or labor migration due to shrimp farming loss has also appeared in the area.

On the one hand, 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.

In the event of a change in the mode of production of rice - shrimp into the Zone 3, social and the environmental issues appear as shrimp theft, conflict of resource benefits in community and pollution environment.

Due to the large area of arable land and scattered human habitation, theft of shrimp will cause annoyance and anxiety to the community. Compared to freshwater fish and other agricultural products, shrimp is vulnerable to theft in large numbers. The farmers must constantly guard the shrimp ponds. The rhythm of life is affected due to frequent theft of crop production at night.

Shrimp is not required much labor and economic conditions could be improved so that people have more leisure time than rice. Besides, the conflict over water shrimp farming is potential.

On the one hand, waste from the shrimp ponds are polluted source impact on the general culture water of the community. Because of the planning, Zone 3 minimize the effects of salinization, water supply are shared on a system. When shrimp die due to diseases, the wastewater directly discharge to environment causing disease outbreaks throughout the region, especially if the transition to shrimp model at high-density.

Spontaneous individual change to brackish water without adequate support will fail. Therefore need to build capacity and necessary steps for gradual transition to brackish water economy and should be a planning and closely compliance control for the Zone 3 to achieve the objectives of the subproject.

4.4.5.4. Environmental and social incidents

**** Risks Sluice gate operation***

Risks and incidents happening during operation are mainly derived from subjective causes; sometimes there are objective reasons. The reasons that might lead to risks and incidents are: (i) Technical quality of the works is not guaranteed from the beginning; (ii) Operation of these sluice gates does not follow the regulations; (iii) Regular maintenance activities do not comply with regulations; (iv) People lacking awareness of protection of the works;

Damage incidents to sluicegates are among the most serious incidents in terms of the environment, and may cause adverse impacts on the ecosystem and socio-economic activities in the area affected by the incident, especially when the ecological environment has been improved through a reduction in salinity.

If a sluicegate is damaged, the salinity from the main rivers will quickly enter into the water environment of the fields. Salt water will immediately interact with every aspect of the environment, leading to severe consequences, including damage of rice, fruit trees, and other crops; depletion of freshwater aquatic sources in the area, directly affecting aquaculture in the area; salinity intrusion into surface water, contaminating the soil environment.

**** Risks in aquaculture, agriculture production:***

Natural disasters like flooding in storm reason: upstream flooding waters will wash away alum, decomposable organic matters and toxic plant protection agents, mix them in water flows of rivers and canals, and change the environmental condition abruptly (pH decreases, low purity). The pollutant increase in water environment indirectly pollutes crops and livestock activities via collecting system. Overflowing flood waters possibly destroy dykes, causing loss of crops,

adding alum in aquaculture ponds because infield water rise overflows into aquaculture ponds and fields, causing loss or adverse impacts on economic crops and livestock.
Plant diseases and livestock die-off: The occurring probability depends on the quality of the water environment, the climate and the health of aquatic animals and plants. The effect exerts serious economic damages to the farming and pollutes the environment.

Outbreaks and spread of shrimp diseases cause serious environmental problems, including:

- Increased risk of infections in wild populations of shrimp and other crustaceans.
- Widespread use of antibiotics and chemicals that can harm wild populations and human health.
- Large amounts of dead shrimp.
- Large areas abandoned by shrimp farmers.

The diseases caused by specific agents like viruses, bacteria, and fungi originate in wild shrimp and other crustacean populations. Concentrated outbreaks of an infectious disease in shrimp farms are likely to increase the risk of infecting wild stocks locally, as well as farther away from the farms. This could cause increased mortality in wild stocks, resulting in alterations to the ecosystem and reduced production of shrimp biomass. If dead shrimp are not removed quickly from shrimp ponds and properly disposed of, their presence increases the spread of disease in the pond and environment surrounding.

4.4.5.5. Regional Impacts

A Regional Environmental Assessment (REA) has been prepared for the whole MDICRSL project. The REA analysed the regional impacts of the subprojects under Components 3 of the MDICRSL project are summarized in the table below. Most of the regional impacts of the subproject are positive including: Reduced coastal erosion; Increased income from high value aquaculture; Improved surface water quality from reduced intensive shrimp; Reduced use of groundwater; Increased mangrove forest areas and biodiversity; Increased protection from coastal erosion and sea level; Establish mangrove-clam farming systems. The REA indicates that the subproject may have negative regional impacts due to construction of the infrastructure to develop sustainable livelihood in the coastal area in Ba Tri, Ben Tre province to adapt to climate change and implementation of the livelihood models. The key regional adverse impacts include:

- ***Impactd due to dredging:*** Loss of vegetation covers, agricultural land and habitat; Increase in suspended solids in water due to disturbances of bottom sediment; Contamination of land and water from disposal of dredged material;
- ***Development of livelihood models in delta estuary and peninsula:*** Surface water quality issues of aquaculture and shrimp farming; Livelihood programs not provided to Khmer, other ethnic minorities and women
- ***Expanding aquaculture and shrimp farming***: Reduced income for intensive shrimp farmers; Conflict between fresh and brackish water uses.

The REA, however, suggests that these impacts can be mitigated at the subproject level by implementation of the subproject ESMP, and by (a) ensuring that contractors apply good construction practices and initiate/maintain close consultation with local authorities and communities throughout the construction period and (b) close supervision of field engineers and/or environmental officer as recommended in the REA.

The regional negative impacts of the subproject activities during operation of sluice gates and application of the livelihood models can be mitigated through a technical assistance to be provided during the preparation and implementation of the livelihood development models (Component 1 and 3 of this subproject). The technical assistance will also address the need for extensive consultation with water users and key staekholders during the development of sluice operations and possible impacts due to expansion of aquaculture farming the livelihood model without adequate management and control. In addition, the water resources monitoring program and MARD real time operations system for hydraulic infrastructure under Component 1 of the MDICRSL project will informed information for management of these regional impacts.

Table: Summary of regional impacts for Components 3 of the MDICRSL Project

Activity	**Demand on natural resources**	**Significant impacts**	**Impact**
		Intensity/Extent/Duration	**Rating**
Dredging	Dredging of approximately 150-200km of land (ha).	• Loss of vegetation covers, agricultural land and habitat ***W/Lo/Lt***	**Minor**
		• Increase in suspended solids in water due to disturbances of bottom sediment W/Lo/St	**Minor**
		• Contamination of land and water from disposal of dredged material (volume) **M/Lo/St**	**Moderate**
Development of livelihood models in delta estuary and peninsula	Pilot areas of land (ha) for brackish aquaculture.	• Increased income from high value aquaculture ***M/Lo/Mt***	**Moderate**
		• Livelihood programs not provided to Khmer, other ethnic minorities and women ***M/Lo/Mt***	**Moderate**
		• Surface water quality issues of aquaculture and shrimp farming ***M/Sr/St***	**Moderate**
Expanding aquaculture and shrimp farming	Conversion of land for sustainable shrimp farming.	• Reduced income for intensive shrimp farmers ***M/Lo/St***	**Moderate**
		• Conflict between fresh and brackish water uses ***M/Lo/St***	**Minor**
		• Improved surface water quality from reduced intensive shrimp ***M/Sr/Lt***	**Moderate**
		• Reduced use of groundwater ***M/Sr/Mt***	**Moderate**
Protecting mangrove forests in coastal areas	Increased area of mangroves in coastal areas.	• Increased mangrove forest areas and biodiversity ***H/Sr/Mt***	**Major**
		• Increased protection from coastal erosion and sea level ***H/Sr/Mt***	**Moderate**
		• Establish mangrove-clam farming systems ***M/Lo/Mt***	**Moderate**

Note:

- **Impact intensity is** evaluated as high (H), medium (M), or weak (W)
- **Spatial extent** is evaluated as regional (R), subregional (Sr), or local (Lo)
- **Duration** is evaluated as long-term (Lt), medium term (Mt), or short term (St)
- **Color codes:** Blue for positive regional impacts; Grey for negative regional impacts

CHAPTER 5. PROPOSED MITIGATION AND PREVENTION MEASURES

The impact analysis conducted in Chapter 4 suggested that the potential negative impacts of the subprojects are considered low to moderate and most of them would be localized, temporary, and reversible. These impacts can be prevented and/or mitigated through the application of the Environmental Code of Practice (ECOP) that has been developed as part of the ESMF as well as the site-specific measures that have been developed to address site-specific issues during the preparation of this ESIA. In this context, this chapter presents the measures to mitigate the site-specific impacts of the subproject activities while the Environmental and Social Management Plan (ESMP) covering the ECOP and site specific is presented in Chapter 6.

5.1. IMPLEMENTATION PRINCIPLE

Identified negative impacts of the Subprojects include the following components:

- Building forest-shrimp model with GAP certified to innovate the forest area, ecological environment to meet the international standard's regulations and aquaculture biosafety model.
- Constructing 5 sluice gates for minimizing salinity and enhancing water use efficiency during droung periods.
- Dredging 14 canals and waterways to enable drainage conditions and efficient water use.

All these impacts are analysed and assessed in Chapter 4. Therefore, to minimize the negative impacts on natural resources and the environments, sources of pollution need to be under the control and the potential presence of environmental risk needs to be minimized. The Subproject's owner (Ben Tre DARD) and contractors have to implement many technological measures to minimize and mitigate negative impacts during: (i) Pre-construction phase; (ii) Construction phase; and (iii) Operation phase

Based on the environmental impacts evaluated in Chapter 4, mitigation measures will be proposed in this chapter in order to minimize the envirommental impacts caused by the subproject

5.2. MITIGATION MEASURES IN THE PRE-CONSTRUCTION PHASE

As discussed in Section 4.4.1, key site-specific impacts for the subproject during preconstruction phase mainly from landmines and explosives (UXOs) which still persist in the ground. To prevent and/or mitigate this impacts the subproject owner will allocate fund for UXO clearance of all the construction areas. The subproject owner will sign a contract with the specialized military unit in Ben Tre province to carry out an UXO clearance at the construction sites. This activity will be implemented before construction commence.

5.3. MITIGATION MEASURES IN THE CONSTRUCTION PHASE

To minimize the negative impacts duringthe construction phase, the Subproject's Owner has to request Contractors for implementing the following measures:

5.3.1. Sluice gates construction

5.3.1.1. Impact sources related to waste

***a.1)* Air quality**

** Dust – air emission from sluice gates construction*

Dust and air emission have to be controlled in the construction area during activities such as, but not limited to: concrete mixing, digging activities, materials transportation.

- Isolate sluice gates construction area to reduce dust dispersion;
- Minimize impacts of dust emission to the community in An Thanh sluice gates area, especially to children and elderly. Spray waters during the dry season at least twice a day.
- Periodically maintain machinery and transport means (6 months/time for new equipment or every 3 months for older devices). Dust and air emission must meet the QCVN 19, 20-2009/BTNMT.
- Do not burn waste on site and dry sweep.

** Dust – air emission from transportation during sluice gates construction*

- Transported materials such as concrete, limestone and sand have to be covered to avoid spreading.
- To spray water on the road near the construction area especially at An Thanh sluice gates.
- Loaded weight must not exceed the standard.
- Streamline traffic and navigation with consultations with local government and community.

** Dust transported by wind from granulair materials (sand):*

- Use a storage facilities, and materials will be covered to avoid dust spreading. Allocate a storage house to avoid transport by wind.
- Material storage house and construction machines are managed and controlled strictly. Materials such as, but not limited to sand and soils are covered.
- Daily cleaning, including maintenance of machines.
- Provide safety equipments, proper tools, protective clothing as well as ensuring the application of safety measures during construction.
- Watering the surface.
- Successive construction method.
- Monitoring air quality.

a.2) Liquid waste:

** Rainwater at construction site:*

- The rainwater runoff flows flow into the water collection system.
- Chemical and fuels are stored in tanks, placing in the concrete base with fence covered, avoiding contact with water.
- Establish and comply with a solid waste management system at the camp and construction site.

– Sweep the oil spreading.

– Surface water monitoring at the construction site including: TSS, pH, BOD,coliform in order to mee the QCVN 10: 2008/BTNMT.

** Domestic wastewater:*

– Establish and comply with a wastewater management system.

– Wastewater water monitoring periodically every 3 months at the construction site including: SS, pH, DO, BOD_5, COD, fecal coliform.

– Assign daily toilet cleaners.

– Hire a Contractor to clear the cesspool before completion.

a.3) Solid waste:

* Construction-generated solid waste:

– The Contractors have to collect residue materials to fill the sluice gates or road. Recyclable materials such as wood, steel and packagesshould be collected and transported away of the construction site. Contrators have to dispose the solid waste at the designated disposal site.

– The solid waste have to be keep in covered/ closed containers.

– Do not burn the solid waste at the construction site.

– Do not treat any materials on site, as well as disposal into a water source.

**Domestic waste:*

– Contractors have to collect and treat the waste according to the Circular 59/2007/ NĐ – CP và TCVN 6705-2000.

– Place waste containers at the camp and construction area in order to collect daily waste.

– Domestic waste have to be collected daily and moved by waste collection Contractors of Ba Tri District.

– Do not bury or burn at the construction site.

– Hire a contractor to clear the cesspool before completion.

a.4) Harzadous waste:

– Comply with transportation management and hazardous waste treatment circulars 36/2015/TT-BTNMT issued by MONRE.

– Do not pour the oil into the soil. Spillage have to be collected and treated safely.

– Do not repair pumps and machines at the construction site.

– Oil spillage vehicles and machines have to be removed from the construction site for immediate repair.

– Define a machine repairing area in case of unexpected situations.

– Inform and report to the board of management and supervision consultants in case of any accident and spillage. Implement corrective actions.

– Used oil should be removed and transported from the construction site and sold.

– Oil rags will be collected into the containers, remove and treated at an approved area.

a.5) Soil impact

– Prevent soil erosion by appropriate construction techniques

– Regulate lubricant storage area: oil must be stored in containers not to leak out into the environment.

– Constructors should not dump waste into the soil (petrol, oil, grease,...).

5.3.1.2. Impact sources not-related to waste

b.1) Noise

To minimize the impact of construction activities on the community and the local environment, the construction will implement measures such as:

– All means of transportation, construction machines, generators, concrete mixers ensure vibration noise to the people in the region comply with Vietnam QCVN, 26:2010/BTNMT; QCVN 27:2010/BTNMT.

– Vehicles and construction equipment shouldnot cause more than 90dB. At the An Thanh sluice gates area the noise should be smaller than 70dB.

– The device has high noise level should be only be used during daytime. If necessary to operate at night, noise abatement equipment shuld be fitted.

– All means must be registered and meet safety standards issued by the registry

– Construction is usually not done during the night. In some cases the Contractor has to work at night, for instance when continiously pouring of concrete is required. If construction activities take place at night, the local government and community need to be informed of the scheduled construction activities in advance.

– Residents are allowed to present worries, difficulties and propose measures to reduce noise before the start of construction at night. The Contractor should address the concerns and apply mitigating measures when appropriate.

– Maintenance of construction equipment in the best operating conditions and at the lowest possible noise level.

– Planning and construction solutions accordingly.

– Observation of noise and vibration during construction every three months.

– Provide earplugs for the workers, who work with high noise machinery as piling, generators, mixers, etc....

– Set up a bulletin board at the construction site to provide information about the building schedule, roads as well as contact information of site managers, environmental staff, phone number and the message that anyone affected can use to express their concerns and provide their suggestions.

b.2) Mitigate impacts on local production

– Washing instruments/vehicles next to the water bodies is forbidden to avoid leaching of waste, sludge, soil, oil contaminated water.

–All in-canal construction activities, especially in An Thanh, Duong Khai, Trang Nuoc, Cay Keo, Duong Tac canals should be in steel sheet pile coffer dam (*Figure 5.1*) to manage turbidity in canals to avoid impacts of salt production and shrimp farming.

Figure 5.1: Steel sheet pile coffer dam for in-river construction activities

b.3) Control social impact

To address the potential negative impact on the local society by the construction workers. The Subproject owner to coordinate implementing activities related to workers' camps with the Contractors of the 5 sluice gates as follows:

- All workers working at construction sites should be adequately trained. Contractors must consider all aspects of labor administration and addressing the risk of tension between the workers and the local community, risk control, prostitution, infectious disease, theft, drug abuse and alcoholism. The area of the construction camp must be approved by the local government.
- Prepare fence with warning signs to restrict unauthorized people to access the construction sites.
- Do not allow workers that are not on duty at the construction site.
- Construct camp accommodation for construction workers.
- Regularly training for the construction workers on how to deal with the community.
- Contact the relevant authorities to manage the places to stay for the construction workers.
- Prohibit workers to use weapons, gambling, fighting, causing inconvenience and disturbance in or near the communities.
- In case of incidents, the Contractor will implement measures to end the problem and work with local authorities to compensate for the damages.
- Any problems and complaints must be acknowledged and addressed immediately. The settlement should be officially recorded.
- The health checks for employees every 6 months to avoid the spread of disease to local people.
- Informing people about the construction schedule .
- Limit construction activities at night. When required, the construction atnight should be planned carefully and the local people need to be informed in advance so that necessary measures can be taken;
- Prepare signs, publicizing the project information on the posters pasted in the field and headquarters of CPC, the culture house of the village community.

– The Contractor regularly exchange information with community representatives on the activities on site, the situation of the construction and estimated completion time in order to maintain an open relationship between the Contractor and the people;

– Have a list of addresses of the agencies and organizations involved in the construction;

– Monitoring the community's concerns and information needs of the construction schedule.

– Answering questions by telephone and mail in a timely manner and accurately. Avoid conflicts of culture/ society between workers and local residents.

b.3) **Control traffic impact**

During the construction process the Subproject's Owner cooperate with Contractors to ensure traffic safety, comply with the safety requirements of the national and local authoritiesnand implement the necessary measures to avoid accidents. Plans for implementation include:

– Signs to regulate traffic in the construction area. Maintain adequate measures to regulate traffic and these measures should be advised to and approved by construction supervisor and project owners in advance.

– All activities related to water transport will comply with the agreed hours of work in each area.

– Place signs around the construction site to guide traffic, installing sign posts for temporary paths and different work items, safety instructions

– The Contractor have to perform and supervise the work to regulate the traffic. Limit of the transport of supplies on transport routes during peak hours.

– In the event of a breakdown in communication, cooperate with the provincial and local authorities in Ben Tre province.

b.4) **Control hydrology impacts**

As the impacts on the flow is negligible, no mitigation method is proposed.

b.5) **Control ecosystems and resources impact**

Contractor must comply with national regulations and local policies related to the protected species, protected areas of wildlife, conservation of natural landscapes in the mangrove areas and control the disturbance to these areas. It is strictly prohibited for workers to use electricity for fishing andusing wild animals for food.

Control liquid and solid waste, as described in section a.2, a.3.

b.6) **Control erosion and sedimentation impact**

The process of excavating and construction of sluice gate abutments need done quickly in order to stabilize the excavation area, control sluice gate and deposited of sediment.

– Construction in the dry season is preferred.

– Insert plates to slow the flow of the water flow at the location where the sluice gates are constructed.

– Do not disturb areas without construction activities.

– When the construction finishes, restore the original environmental conditions. Earth recovery must be done properly in accordance with the technical specifications.

b.7) **Controlling immpact on aquaculture operation**

When preparing/planning the construction works, the Constractor will work with the local people to inform them about the planning and construction time so that aquaculture farmers can plan when to collect water and prevent the intake of water with high turbidity due to construction works.

- Usually the intake of water into the shrimp ponds takes place in the day from 12 to 17 and from 28 to 3 each month of the lunar calendar. Therefore, dredging or other water related activities should not take place during those periods.
- Arranging suitable construction time to avoid dredging during low tide.
- Controlling all liquid and solid waste.

5.3.1.3. Preventing and troubleshooting environmental incidents of construction

c.1) Preventing control and troubleshooting of chemical spillage:

The measures to manage chemical grease while construction are as follows:

- Organize training for workers at site so they recognize and can use hazardous chemicals at the site.
- Used oil and grease will be removed from the site and sold for reuse.
- The used oil, grease, and a sweep cloth, rags,... will be collected into containers and transported by a company for reuse, or to be processed at an approved area.
- Unused materials or bitumen products will be returned to the manufacturer.
- Use appropriate chemicals and labeling.
- Chemical wastes must be collected and treated according to Circular 36/2015/ TT - BTNMT on hazardous waste management as published by the Ministry of Natural Resources and Environment.
- When there is incident concerning oil spillage: contaminated soil have to be excavated and buried at a approved waste treatment area.

c.2) Occupational health and safety control and prevention of working accident

Measures to ensure labor safety and health in the construction process will be implemented by the Subproject owner and Contractors including:

* For human beings:

- All personnel are checking the health, safety and sanitation trained as prescribed in Circular No. 37/ 2005/ TT - 29/12/2005 BLDTBXH of the Ministry of Labour - Veterans and Social Affairs, Health and Safety measures to ensure TCVN 5308 - 91. After completion of training, a list of Health and Safety cards are issued for each employee.
- Purchasing life insurance for employees working at the site.
- All laborers working on the construction site should be in compliance with the technical standard of Health and Safety TCVN 5308-91 in construction, in accordance with the current regulations of the State and best execution rules and safety regulations on construction sites.
- Equipped with all the safety tools such as a safety belt when working at elevated area, boots, gloves, helmet, life-jacket, etc. while working to meet TCVN 2287-78: labor safety standards system.

– Officers and workers assigned to work in accordance with their training. Do not use the untrained/ unskilled workers.

– Difficult and dangerous tasks should be supervised and monitored closely.

– Workers using equipments are strictly forbidden to leave the equipments in operation. Do not smoke near the fuel tank.

– Provide adequate hygiene and clean water to workers at the construction site.

– Setting labor rules - prohibiting: Drinking alcohol and stimulants at work. Do not carry inadequate labor protection. Improper use of equipment and operating procedures..

– Committee Board of the construction site to execute regularly check to see if safety measures are implemented accordingly.

– Prepare a medicine cabinet. Assign permanent medical staff at the construction site. Organize first aid training and establish first aid group at the construction site.

– No construction works when there are potentially dangerous situations such as heavy rain and lightning...

– Provide adequate lighting at night;

– Provide and install adequate fire fighting equipment at the site.

– Provide Information and training for employees on social principles including prevention of HIV/AIDS.

– When there is flood announcement, stop construction, assign people on duty, establish and equipp essential facilities for response team to the bad situation caused by natural disasters.

– Establish information systems and ensure smooth communication 24/day and 7/week.

*** For construction equipments**

✓ All construction equipment on site have to comply with the standard 2290-78 for manufacturing equipment, general requirements for safety.

✓ Construction machinery facilities are granted registration certificate and accreditation by the authorities.

✓ Mandantory requirement for drivers of excavators, drilling, pile driving, concrete mixing machines...: if detected an abnormal phenomenon, works should be stopped in order to examine and fix the problem. Construction is only permitted in safe situations.

✓ When an incident happens, conduct First Aid and transport the victim immediately to the nearest health center.

c.3) Dealing with unexpected situations

* Archaeological/Cultural objects found during excavation:

– Contractor keeps the site intact and report to Supervisor/PMU, museums and Local Department of Culture and Information.

– Submit the artifact to museum/cultural management agency.

– Evaluate the situation in order to decide whether earthwork can be continued or should be stopped for further survey.

– Director of local Department of Culture and Information will be responsible for managing the found artifacts as stipulated by Article 21 of Decree No. 92/2002 Implementation Guidance for Culture and Heritage Law.

- Human remains found during excavation:

– Notify local authorities.

– Determine how to solve the situation: duties of individuals involved, time and location for relocation.

– Implement the recommended measures.

– Complaints from the community on environmental issues related to construction activities: Immediately implement mitigating measures if possible. Officialy record the issues and measures in the construction logbook. Discussions with subproject owner/ local authorities to resolve conflicts.

– Explosives found: Place danger signs. Producing accident report. Notify local authorities. Contact local military to request support.

5.3.2. Measures to control the impact of dredging

5.3.2.1. Controlling the impact related to waste

a.1) Measures to minimize air pollution

As discussed in Chapter 4 when the devices are operating normally in compliance with regulatory standards, the impact of pollution from dredging operations on the environment is not too serious. But to ensure safety and limit the effects, Investors should coordinate with the Contractors concerning the following solutions:

– Do not use too old ships, barges (over 20 years).

– All dredging construction equipment must be periodically checked and maintained in accordance with regulations. Ensure the parameters of emissions, noise, vibration meets the requirement by the registration department for the technical and environmental safety (according to Circular N^{o}. 30 - BGTVT dated 15 April, 2011) and QCVN 26: 2010/BTNMT. Prior to dredging works, machines must be registered and accreditation granted by the repsonisble authority. These measures bring high effective treatment and can result inreach 95-100%, minimize the impact on the environment.

– Spray solution to cover the smell, if there is any, in the morning in the case of dredging a canal ends at a distance of 200m from households like the Gia canal, No canal, Cua canal. This measure will decrease the negative impact by 60 to 70%.

– Encourage contractors to use diesel fuel with low sulfur content 0.05 %.

– Do not dredging at night, weekend and holidays such as Saturday, Sunday.

– Domestic waste to be put ashore every day, be treated to avoid decomposition generating stench.

– The waste water tank on the construction ship have to be pumped ashore as prescribed by QCVN 17: 2011/ BGTVT national technical standards and regulations on prevention of pollution of inland waterway means through a contract with the Ba Tri District collection team.

a.2) Measures to minimize water pollution

Reducing pollution of water quality due to dredging

As discussed in Chapter 4, dredging activties certainly cause aqueous environmental impact. To minimize the negative impact, subproject owner should collaborate with the construction company to strictly implement the suitable construction process, with the appropriate construction solutions to control the dispersal of sediment in acceptable environmental conditions include:

- Dredging method: Using dredger with limited pollution to minimize the disturbance. Use the watertight bucket dredger can minimize the spread of residual cloudiness and turbulent in the canal at the dredging area. The order of dredging from downstream direction to upstream of the canals. Dredgers are are technical and administrative registered in Vietnam registry department under Decision No 25/2004/QD-BGTVT of Ministry of Transportation dated on 25 November, 2004 on the promulgating regulations on registration and inspection of inland waterway transport.
- Investor require all contrators used vehicles of the dredging involved company must ensure the technical requirements specified in QCVN 17:2011/BGTVT: National Technical Regulation on rules on the Prevention of Pollution from inland waterway vessels in terms of control of domestic wastewater, waste and wastewater contaiminated with oil.
- To conduct dredging during the dry season and the tide at low, when there is no aquaculture and activities take water for salt production.

Figure 5.2: Images the dredging



- As the dredged materials are in the state of mud at first and soil particles are suspended for 24 to 48 hours. All drainage water from disposal land shall be driven to the drains and discharged back to the canal. In order to limit the negative impacts of mud (produced by dredging) on the environment as well as the water quality of the canals, the dredged sediment will be transported to a containing area which is appropriately located and properly design with an adequate size. The dredged spoil will be pumped to the disposal land and then overflow to a settlement pond, where turbidity and total suspended solids are settled. After some time, effluent is returned to the canals. Design of the dike around each disposal as follows: Height: 2m, Footing width: 5 m, and Surface width: 1m (Figure 5.4).

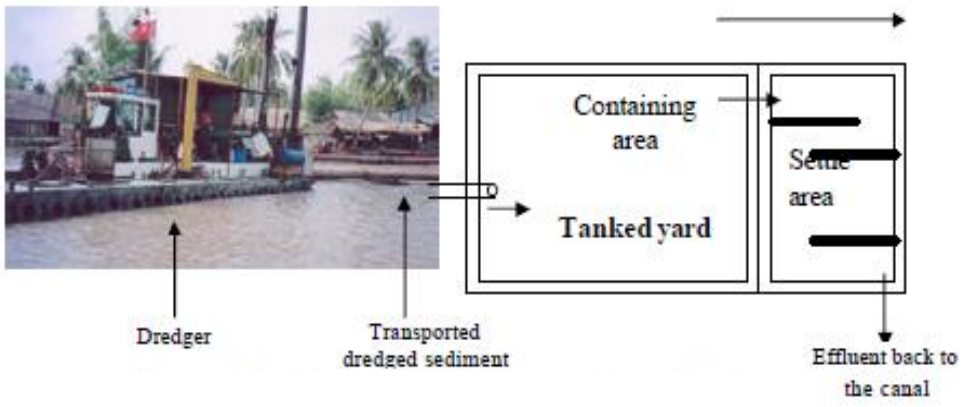


Figure 5.3: Layout of Spoil disposal site

– Before carrying out, the dredging crews perform mooring as regulated. When weather is bad: as night or day with fog or rain with less than 300m of vision, the construction teams will turn on signal lamps as regulated.

– Before dredging, the Subproject owner together with the construction company will notify management of inland waterway, community and local government at least 1 week in advance so that people involved know and can collect water in advance when required.

– Dredging bucket operation should comply to the regulated process and reduce withdrawing velocity to reduce sediment dispersion.

– Implement environmental monitoring for water quality parameters such as SS, pH, DO and T^0 during dredging.

– In the case of there is incident causing damage, Investor and Contractors commit adequate compensation the loss to people.

– Dredging activities, dredger, barges are regularly monitored and technical inspected periodically. Perform check on hygiene of the equipments and instruct the worker operate equipments correctly.

– Do not work when bad weather causes unsafe for transport.

– Workers are strictly prohibited dispose waste and waste engine oil, grease from the dredger and barges into the canal. Motor oil, used oil, and other hazardous substances and hazardous waste have to be collected, stored in containers at the construction site, the containers do not leak, are labeled, stored properly, and returned to the manufacturers.

– In case of a boat sinks, Subproject owner and Contractors have to coordinate with local authhoritites for immediate rescue and contact to the rescue center for most effective solutions.

- *Leachate quality control due to dredger*

– Soil, sludge from the bottom of the canal will be drawn to both sides. The leachates scooped up with dredger, scrappers are flowed into the stilling basin before flowing back to the canals..

– Monitor the water in the stilling basin. Where the water quality does not meet the standard requirements, the construction must stop dredging and wait for SS concentration not exceed the allowed norm.

– In case water with low quality from stilling basin overflows, crews will take measures to stop the problem and work with local authorities to compensate the loss.

– Stop all the dredging works during heavy rain or any dangerous situations.

**** Domestic wastewater:***

– To comply with QCVN 17: 2011/ BGTVT: National technical standards and regulations on prevention of pollution by inland waterway vessel on domestic sewage control, on each dredging canal and install mobile toilets.

– Domestic wastewater is to be collected in composite septic tanks equipped on-board. Effective treatment of septic tanks from 55-70 % concentration of contaminants.

– The operating principle of this tank is sedimentation and anaerobic digestion residue. Solid residue is left in the tank for a certain time. The organic matter are anaerobic decomposed, partially forming gases, partly made up of inorganic dissolved. Part of sediment will be periodically withdrawn and brought ashore to treat.

– BOD_5 removal effectivities of 3- compartment septic tanks and SS are 55-60 % and 75-80%. The domestic waste water contains mostly dissolved and suspended organic ingredients. Due to the limited volume of waste water per day on a dredger, after flowing through a septic tank, wastewater will be discharged into the canal. With the self-cleaning capability of the receiving water body, the waste water after it leaves septic tanks will be diluted by water and not influence the receiving water and aquatic livings.

– Environmental quality monitoring of wastewater during construction of indicators such as SS, pH, DO, BOD_5, COD, fecal coliform.

a.3) Solid waste management

* Minimize pollution by domestic solid waste

Subproject owner together with the construction company will implement the following measures to control domestic waste:

– Put garbage containers on all ships to collect daily garbage as prescribed in QCVN 17: 2011/ BGTVT: National technical standards and regulations on prevention of pollution by inland waterway vehicles.

– Require workers to not litter garbage after meal.

– Prohibition to burn solid waste from barges ashore or throw garbage into canals.

– Contractors to hire Ba Tri District waste collection team to collect the waste in every 2 days.

**** Dredging sludge control***

Before dredging, Subproject owner will inform the local authorities and community dredging plan Survey results show that components mud from the canals have metal concentration meeting the environment standards and can be used for the purpose of filling after drained. The mud poured on both sides has dried to 75% moisture content is checked soil reusable quality as in compliance with the regulations QCVN 03: 2008/ BTNMT: national regulation of heavy metal content in soil before reusing.

Subproject owner coordinate with Contractors to regularly check the leachate reservoirs, especially after heavy rains to observe the damage due to created flow, soil erosion or sedimentation. At the same time regenerate the land area before completing the work.

Check the salinity of the mud before reuse for planting purposes, in case of unsatisfactory SAR number to reuse for planting, people wait 3 rains in order to decrease salinity, use balance fertilizers of nitrogen, phosphate and potassium, and adding more fertilizers containing phosphorus as DAP, NPK or sufer phosphate and lime to create conditions for developing crops.

a.4) Hazardous waste management

Subproject owner and contractors are committed to apply the following measures to control hazardous wastes in dredging as follows:

- No maintenance of construction equipment on excavation site.
- To collect all the waste lubricant oil, packaged, labeled and stored according to regulations for hazardous waste and contract to the collection company for waste collection, transportation and disposal according to Circular No. 36/2015/ TT - BTNMT.
- Do not let the fuel tank shell and oil tank outdoor on the barger.
- Signing the contract with organizers who are capable of handling hazardous waste coming to collect and handle periodically.

5.3.2.2. Control Impact sources not-related to waste

b.1) Noise

Subproject owner will require dredging contractors to follow:

- The equipments, ships and barges before entering the site must have granted accreditation certificate.
- Do not dredge at night.
- The dredging operator must be professionally trained and isresponsible for the operation and maintenance of equipment.
- Planning and dredging measures are proper and approved.
- Environmental education for workers.
- Noise monitoring during construction.

b.2) Control traffic safely

Subproject owner together with Contractors to implement measures to reduce traffic accidents:

- Apply for permission and inform on the canal dredging traffic announcement on the mass media.
- To establish safety groups to ensure the safety traffic during dredging works.
- Inform local authorities and local people, the extraction management units about dredging construction time, and traffic regulation time in order to plan the regulation.
- Installation of signal buoys in the construction area (specialized floats in maritime transportation). The signs to identify areas under construction to control the means with caution, reduce speed to ensure safety. Each dredging area installs 02 buoys at the 2 ends, 100m away from the dredging area.
- The communications is done by Very High Frequency (VHF) radios and speakers and some other communications devices as under the guidance of regulating stations.

– Strictly observe Inland Waterway Laws.

b.3) Minimize impacts from dredging to aquaculture and salt production

As discussed in Chapter 4 dredging operations can have negative impacts to aquaculture and salt production in the dredging area. The analysis shows that negative impacts can be controlled through management solutions that include:

– To conduct dredging during the dry season and the tide at low when there is no aquaculture and activities take water for salt production. No dredging in rainy season and high tide

– When preparing the construction, the Contractor must coordinate with local authorities, the inhabitants of Ba Tri District to inform about planning and construction time. Local residents can manage to take water accordingly and not use turbid water affected by dredging.

– In urgent cases, the dredging from high must be approved by DARD Ben Tre and the ward authorities and communities.

b.4) Impact on economy and society

To minimize the economic and social impact in the dredging area, Subproject owner requires the Contractors to implement the following methods:

– Priority use of the local workforce.

– Sign up temporary residence for workers with local police.

– Inform local authorities, to know the people participating in dredging, the project start and completion time. This will help the local authority to plan and ahve appropriate management measures in place.

– The protection of the health of workers and residents during construction shall comply with the specific provisions of the health measures and food hygiene in the dredging area.

– To minimize problems of conflicts between workers and conflicts between workers and local communities, a Construction Board is required. In case of a conflict between the workers, the intervention commander must timely settle, to avoid problems.

b.5) Erosion control

Erosion control solution in dredging are applied as follows:

– Observe and monitor erosion phenomenon during dredging.

– Appoint officials to daily monitor the erosion.

– No dredging during heavy rainfall and/ or flooding.

– Construction should be in compliance with the design dredging slope.

b.6) The support measures

During dredging, Subproject owner and construction units to coordinate with local authorities about measures to mitigate environmental impacts include:

– Information on local public media: Subproject owner in coordination with local authorities should announce on newspapers and local radio, information on dredging including implementation plans, and items of information the environmental impacts and mitigation measures, etc...

– Flyer about the environment: a flyer about the impacts and the mitigation measures will be prepared based on the approved ESIA report. This flyer will be posted at the headquarters of

the districts People's Committees of the communes, as well as sent to local unions such as farmer associations, women's associations and all affected households in the dredging area. Leaflet will include the following information:

- Describe the characteristics of the dredging area.
- Describe the effects of dredging on the environment as well as the impact on residential areas, affect soil erosion, noise, etc...
- Description of measures to minimize the environmental impact to be applied.
- The responsible authorities in the process of monitoring the implementation of measures to minimize environmental impact;
- The claims and solving procedures for issues arising from the dredging activities.
- Inform local authorities about the environmental impact: the impact of environmental issues arising during construction and operation of the facility if it is found to be public information in meetings with local authorities in finding solutions to avoid conflict, affecting the progress of dredging.
- Clearance up the field after dredging.

5.3.2.3. Preventing and troubleshooting environment incidents due to dredging activties

c.1) The labor accidents

**** Preventing lobor accidents***

Measures to improve labor safety and ensure health of workers in the implementation process of dredging was by constructor include:

For human beings

- All personnel to check health, safety - labor sanitation trained as prescribed in Circular No. 37/ 2005/ TT/BLDTBXH of the Ministry of Labour - Invalids Social Affairs, Health and Safety measures dated on 29 December according to ISO 5308 ensure -91. After the check is completed, a Health and Safety card is issued for each employee.
- Overall laborers working on the construction site work in compliance with, the provisions of the technical norms Health and Safety TCVN 5308-91 in construction safety, Health and Safety standards in accordance with the current regulations of the State and execution for rules and safety regulations on construction sites.
- All personnel work in compliance with standards TCVN 3254-89 Fire safety: General requirements. TCVN 5585: 91: Diving: Safety requirements. TCVN 3255-86 Explosive Safety: General requirements. TCVN 3146-86 Welding works Electric: General requirements for safety when using electric welding, brazing when doing repairing task.
- Equipped with all the safety tools to ensure labor safety, such as life jackets, buoys when working in water, a safety belts when working at elevate locations, boots, gloves, helmet... while working meet TCVN 2287-78: system safety standards.
- Workers to be assigned to work in accordance with their professional training. Do not use the untrained/ unskilled workers.
- When peforming difficult and dangerous tasks, the work should be monitored by other closely.

- It is strictly forbidden for workers who operating equipment leave the equipment in operation and not smoke near the fuel tank.
- Providing adequate clean water for workers on barges.
- Construct labor rules with prohibiting: drinking alcohol, stimulant drugs at work; not carry adequate labor protection; improper use of equipment operating procedures.
- Committee of the construction site regularly inspect the Work Safety.
- Assign a medical team, prepare amedicine cabinet, definepermanent medical staff at the site, organize first aid training and define first aid teams at the site. Define cooperation and agreement with local health authorities on health care and first aid for workers on the construction site.
- Training on HIV prevention measures and free condom distribution to workers.
- Training in responding and handling bad situations of Work Safety on the construction site, the rescue vehicles, escaped tools, first aid medicine cabinet... always full and ready to use.
- Installation of warning signs reminding work safety, dangerous positions on the field for employees to be careful and work with precautions
- When there is information of storm and typhoon, move dredging facilities in safe havens, assign people to assist, equip the response team to bad situations caused by natural disasters with items such as buoys, lifeboats, emergency medicine cabinet, boats, tugs, communication tool....
- Establish information systems and ensure smooth communication 24/day and 7/week.

+ For construction equipment

- All dredging equipment on site have to meet the standard TCVN 2290-78 manufacturing equipment. General requirements for safety.
- Dredging machinery vehicles registered and inspected according to Decision No. 25/ 2004/ QD - BGTVT dated on November 25, 2004 and the Decision No. 29/2004/ QD - BGTVT dated on November 25, 2004.
- Signal buoy installed in construction zones to warn and instruct traffic.
- Require operators to stop the works and fix the problem in case abnormal things are observed. Construction is only permitted during in safe conditions.
- When incidents occur, they must immediately seek for measures to rescue, first aid and immediately move the victim to the nearest medical centers.
- Report to the people committee, communal police of the incident area.

c.2) The traffic accidents:

- Although traffic is regulated well but if there are incidents of collision causing the sinking of vessels, immediately measures should de taken to to save lives and protect the area. Save the victims and bring them to the health care centre.
- Report to the people committee, communal police of the incident area, waterways management board, waterway police, inspection team inland waterway transport, and the relevant authorities to tackle the consequences.

– If there are spills from boats, prevent oil and other substances from spreading and causing negative impacts.

– Salvage vessel and materials and make sure the waterways is not obstructed.

– Regulate traffic and implement warning signs at both side of the incident.

***c.3)* Respond to unexpected situations: Similar to drain construction phase**

5.4. MITIGATION MEASURES IN THE OPERATION PHASE

After finishing the construction of drains, dredging canals, Contractors:

– Dismantle, collect buoys, signboards. Also conduct rapid cleaning equipment, machinery and materials activities and move workers to assembly area to avoid polluting the area shortly after the completion of works.

– Develop operating procedures for drain operation and signalling traffic on canals.

– Installation waterway traffic signboards, prior to operation.

– Regular inspection and maintenance of control equipment to open and close sluice gates, dike, etc. to limit incidents.

– Soil and water sampling in locations can be specified to control the environment and ensure environmental safety.

5.4.1. Measures to mitigate impacts due to sluice gates operation

a) Waste impact

a.1) Air impact

Air pollution, noise, primarily in the operational phase is due to operating vehicles on sewer and waterway and through the canal. Especially the dust comes from tires when cars are moving. To reduce dust pollution reduction, all vehicles should comply with the traffic speed control, environmental safety requirements such as using proper fuel and engine capacity.

a.2) Water environment impact:

* Surface water quality

– Strengthening environmental hygiene in salt separated area;

– Set reasonable operating procedures, reducing the time to close the sluice gates to a minimum, timely and flexible in operating the system. Strengthening the salinity monitoring frequency on Co Chien, Ben Tre, Ham Luong Rivers, measuring salinity and take advantage of every opportunity to operate the drains, especially for the large drain.

– Perform dredging, widening drain canals at both ends of drain, ensure rapid tidal intake and drainage.

– Regularly check environmental hygiene at the production facilities, livestock and processing livestock and aquaculture.

– 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 prohibited 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.

– Need some fisheries development planning and rational agriculture.

– Integrating IPM content in the training program and agriculture promoting programs.

***b) Waste unrelated impacts**

b.1) Changes in the distribution of salt water intrusion and salinity

As discusses in Chapter 4, operation of the sluice gates can result in both positive and negative impacts but all impacts will be low to moderate and can be mitigated through consultation and agreement among local agency responsible for sluice operations, water users, and local people. To mitigate the potential impacts the following measures will be carried out by the subproject owner:

– Preparation and operation of an operational plan: During implementation of the subproject, a consultation process will be conducted with all key stakeholders to establish an operations plan for these sluice gates and the final plan will be publically disclosed. The plan will take into account new 5 sluices will not be constructed. It is expected that the draft plan will be available for the first consultation in 2017 so that the final plan can be available for public consultation and finalization in 2019. A budget will be allocated for the activities (see Chapter 6).

– Planning and undertaking water quality monitoring: To ensure that operation of the sluice gates will not create significant impacts on local environment and local people/activities, a water quality monitoring program will be conducted upstream and downstream of the sluice gates as well as nearby critical areas that may have significant impacts. The water quality monitoring will include some selected biological parameters and the plan will be finalized in consultation with key stakeholders. Chapter 6 presents a draft plan for water quality monitoring to be conducted during the implementation of the subproject.

b.2) Control of hydrological change for erosion prevention

– The impact to flow is negligible. However, to minimize the potential change of the hydrological regime, the designed technique should consider the layout of the piers between the flow lines at positions that are less likely to alter velocity and flow direction.

– To prevent erosion, the canal roofs are designed to reduce the maximum velocity and the wave impact to the boats; reinforcement of embankments at the most important positions; after construction, dredging, creating available vegetation on both sides of the channel to prevent erosion; Periodic dredging operation system as defined; protect the safety corridor; adjust the vessel speed to limit the impact of wave on the shore.

– Periodically inspections of the piers at the edge of the embankment for timely handling measures when erosion occurs.

– Predict the areas where landslides could occur (roads, dikes, embankments).

– Based on each location in the subprojects selected the crops are: Hospice sour, Page, mangrove.

– After finishing all the work, the subproject owner will hand over to local management.

b.3)Impact on the soil environment and groundwater

- Strictly manage liquid and solid waste sources and avoid impact of soil pollution.
- Develop a plan for caring and fertilizing the plants at the right time and in the right way. Not leave excess fertilizer and plant protection chemicals which will contaminate the soil. Compliance rules 4R (right time, right type, right way and enough doses) in spraying pesticides and fertilizing.

b.4) Impacts on biological resources and biodiversity

- Land use controls and zoning to prevent expanding shrimp farms and maintain seasonally flooded ecosystem.
- Expand the forest plantation area, increase opportunities for afforestation restoration of natural course of land and green corridors, multiple benefits through mangrove forest management.
- Managing closely the supply sources of pesticides, products used in aquatic farming.
- Increase control by District FPD.
- Improve people awareness and environmental education. Awareness and environmental education activities for the local communities on wildlife protection
- Established management areas managed by the community.
- Raising awareness to the people and government at all levels of the value of biodiversity, creating a sense of responsibility for local conservation.

b.6) Control impact on traffic

**** Road transport***

Traffic organization and safety should be under the "Road Signs Charter and 22TCN 273 -01", consisting of the components:

- Ensure sufficient visibility for the participating vehicles on the road.
- Allocate signs, marker system.

*** Waterway transportation**

- Place warning buoys and warning signs according to the approved traffic safety plan. Notify and request transportation means to abide strictly and fully the provisions of the Law on Waterway Traffic Safety.
- The vehicles travelling on the river and canals have to registered in Vietnam Register under Decision N^{o}. 25/2004 /QD-BGTVT and the Decision N^{o}. 29/2004 /QD-BGTVT.
- To comply strictly and fully the provisions of the Law on waterway traffic safety and to comply with Vietnam maritime law.

b.7) Impact of water use conflicts

- Closely consult with local authorities and people on development of operational procedures of the 5 sluice gates.
- During the dry season, the sluice gates will be open and close on a regular natural basis of the water resources in the region to ensure safety, stability and development of all water user groups in the subproject area.

- The rational use of chemical fertilizers and pesticides. Closely monitoring salinity at different locations is a reasonable method for operating the sluice gates to prevent salinization.
- Researching operation process and supervising the implementation sluice gates. Ensuring water resource in the area is always cleaned out and the water quality is better.
- In the process of planning and operation of the drains, the water user should be consulted and specific actions should be ready to respond.
- Must fully integrate downstream water pollution problems, the concern of the water users on the operational plan, the operator limited liability company Ben Tre Irrigation Exploitation should ensure the needs of water users.
- There is a need for extensive discussions aimed at the local people's livelihoods, demands consultations and collaboration among local people and company Ben Tre Irrigation Exploitation.
- To develop the pastoral sector the provision of information and public education activities through the mass media.

5.4.2. Control Impact from Livelihood Models

The causes of environmental impacts are multiple, although seldom present all at once: poor planning and management of water supply and effluent; poor sitting; poor design and technology; poor management practices and lack of knowledge about potential environmental damage; high disease incidence and associated use of chemicals; insufficient legal frameworks and regulatory instruments; weak law enforcement; and the prospect of rapid, high profits. Disease prevention and management implement Good farm management (GFM). Farm management Good plan will prevent contamination and environmental deterioration. Good farm management may be done by the use of disease resistant shrimp fry, selection of farming season, suitable farming system. The various measures for reducing environmental impacts may be classified as follows:

5.4.2.1. Seed quality and screening

Selection of shrimp fry is one of the success factors of shrimp farming. The good quality shrimp fry will grow well and have high survival rate. Skilled assessment of seed health prior to purchase should reduce disease risks.

Stocking density is the other success factor that is essential to shrimp management. In case of stocking at high density, large amount of feed used may cause water pollution which will lead to shrimp stress and disease susceptibility.

Fry should be obtained from hatchery certified by the Department of Fisheries. Fry should be healthy. The record of certificate of, or testing report on health should be made available.

5.4.2.2. Pond filling and water preparation

Design of shrimp pond:

- Good design of shrimp ponds—in particular, design of water supply and discharge systems—can have a major impact on sustainability.

– Ensure high-quality water supply and optimal pond water conditions; Water in the pond should be maintained in appropriate depth as well as oxygen management because water depth will affect the culture management, (The best water depth is 1.5-2.0m).

– Closely located to quality water suitable for shrimp culture: DO > 5 mg/l, pH 7.0 to 8.3, Salinity 15 to 20 mg/g, NH_3 <0,1 mg/l, H_2S <0,03 mg/l, degrees in the water < 30 - 45 cm[5].

– Treatment of influent water supply (for example with chlorine) to eliminate pathogens and carriers may reduce disease incidence and associated use of chemicals.

– Materials and equipment such as seine and net should be used to screen out pest and disease carrier into the pond during the periods of pond preparation, water preparation and raising.

– Intensive aeration may itself serve as a form of water treatment. Aerator should be installed to maintain suitable living condition of shrimp and located in proper position to reduce soil leaching into the pond.

– Pond vacating and/or appropriate preparation should be practiced prior to starting new crop.

5.4.2.3. Mitigation of organic pollution

Feed management

The quantity of waste nutrients and organic matter produced in a shrimp farming system is directly related to the feed conversion efficiency, and this in turn depends on feed quality and feeding practice.

High-quality feed, and feeding the right amounts at the right time, can radically reduce nutrient and organic matter wastes, while at the same time reducing costs. Low-pollution diets (specifically low phosphorus diets) can also be manufactured specifically to reduce this type of pollution. Feed management following:

– Food meet standard 28 TCN 102: 2004.

– Regularly used of higher - quality, low - pollution diets will reduce feed - associated wastes in pond water and thus improve effluent quality.

– Hold on and adoption of low-fishmeal diets should protect shrimp farmers from the likely rise in prices of fishmeal, as well as reducing pressure from aquaculture on these prices.

– Farmer should regularly examine quality of feed. In practice, famer should feed at the rate of 1-2 kg/100,000 shrimp/day depending on stocking density of fry and amount of natural feeds available in pond. The increase of daily feeding is fixed at the rate of 0.5-1 kg/100,000 shrimp/day until the shrimp reaching the age of 15-20 days, where the examination of shrimp feeding will be detected by using feeding tray when possible, the adjustment of feeding rate will be practiced each meal according to the results of feeding tray examination.

– Feed storage shall be separately located. The storage area shall be dry, clean and with a proper condition to maintain feed quality, temperature, and prevent the disease-carriers such as rats, birds and other animals.

– Fresh feed is allowed only in necessary case and if used, proper management shall be practiced to prevent water pollution. Prevention is the most suitable approach to control and maintain shrimp in good health. The health management could reduce stress and maintain normal growth and high survival rate. The health management will be involving other

[5] Source Sandeep K Mukhi, B K Das, B Masdavi, C K Misra and K Pani Prasad, 2001

management such as the examination on shrimp health, feed quality and feeding, water and sediment quality management.

– Providing the right amount of high-quality food at the right time throughout the production cycle can greatly reduce feed and metabolic wastes.

Water management:

– Poor water quality affects not only the shrimp in the concerned ponds but also those in neighboring ponds, as well as life in adjoining water bodies. The eruption and spread of disease often occurs in connection with poor water quality; disastrous outbreaks affecting entire regions can result. Water management is as follows:

– Careful management of soil, in particular soil acidity, through appropriate treatment including regular flushing, liming, or lining with laterite soils, may improve pond water quality and reduce shrimp stress and disease;

– Careful management of water at the time of harvest, and effective use of settling ponds, can greatly reduce nutrient and organic matter loadings on the environment;

– Effluent and Sediment Management Effluent contains high level of nutrients, microorganisms, planktons, and other substances. A large proportion of the nutrients are in suspended solids, and it is relatively easy to remove about half of these in simple settling ponds. It is particularly effective—and particularly important—to settle effluents released at the time of harvest. If water exchange is relatively low during most of the culture period, the area of settling ponds relative to production ponds need not be very high.

– Settled solids can be removed and dried to oxidize organic matter, and may be suitable for other uses. In most circumstances, settling ponds are likely to be the simplest and most cost-effective approach to making effluents of acceptable quality.

– A good farming practice will reduce effluent but enhance quality. Some direct removal of ammonia may also occur during intensive aeration. Settling ponds suitable for both routine and harvest effluents should be constructed.

– Applying the 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.

– Building water treatment pond for water treatment and management for improve effluent quality; Efforts shall be taken to improve the quality of effluent and to meet standard as required by laws. Effluent should not be discharged to the fresh water canals and arable lands. Building water treatment pond for water treatment and management for improve effluent quality. 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 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.
Effluent shall be treated or subject to quality control before discharged. The effluent parameters shall meet qualifications as required by laws as follows: (1) pH 5.5 - 9. (2) BOD not exceeded 50 mg/l. (3) Suspension solid not exceeded 100 mg/l. (4) Coliform not exceeded 5000 MPN/100ml (QCVN 02-19/2014/BNNPTNT: National technical regulation On brackish water shrimp culture farm - Conditions for veterinary hygiene, environmental protection and food safety).
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.

- Sediment and effluent management must be done with the water treatment ponds suitable to avoid the environmental impact.
- Sediments from culture ponds, outlet canals and reservoirs should be reused or discharged without causing environmental impact. Careful disposal of pond sediments (rather than simple flushing) to allow for oxidation and decomposition will greatly reduce the nutrient and organic matter loading to the environment; Sediment discharge shall not cause environmental impact. If possible these sediments shall be reused.
- Prevent salinization of adjacent agricultural lands, groundwater, or freshwater irrigation systems. Lining of ponds or dikes may reduce seepage and, in some cases, saline contamination.
- Precaution should be taken during effluent discharge, in order to control floating of suspension particles. Flow rate of the effluent discharge should be controlled.
- Material or tools such as net or seine at the inlet and outlet water should be used for prevention the escaped shrimp.

5.4.2.4. Mitigation of chemicals' effects

Two basic rules should apply to the use of chemicals in aquaculture: minimal use and correct use. Use can be minimized if disease incidence can be reduced by other means (see discussion below). Correct use depends upon effective information dissemination and communication, including agricultural extension and other training. Shrimp farming generates substantial profits, and the industry itself is therefore well capable of funding improved information and training. However, the role of companies that market chemicals in providing advice at the grassroots level in many countries is of concern, since their interests are inevitably biased toward greater chemical usage. The recommendations are as follows:

- Knowledge and skills in identifying and treating disease will greatly reduce the incidence of disease and the associated use of chemicals.
- Observance of an adequate withdrawal period when chemicals and therapeutants have to be used, to clear the shrimp of residues, will improve their marketability and raise their market value.
- Reduce the likelihood of disease and the use of undesirable chemicals;
- Regularly check for shrimp health and water quality. If the health problem was found, diagnosis and analysis shall be done immediately.

- Prohibited substances indicated in the Animal Feed Quality Control Decision N^{o} 07/2005/QĐ-BTS, date 24/02/2005 and its amendments and other relevant laws are not allowed.
- Use of veterinary drugs, chemicals, hazardous substances and probiotics in aquaculture Uses of veterinary drugs and chemicals should be regarded as the last resort for shrimp health management when diseases are found because veterinary drugs and some chemicals may be residual in shrimp that would be harmful to consumer health. In fact, the improvement of culture pond environment is the best way for better health and recovery from the disease infection. The prevention and disease treatment are specifically depended on causes of a particular disease, the recommendations are as follows.
- Regularly maintain inlet and outlet canals and dike to reduce soil leaching and sedimentation.
- Use organic fertilizer from organic agricultural farm to increase the natural feeds, if necessary. This should be done with efficient feeding to minimize the excessive feed supply.
- Rapid identification and correct treatment of disease Early identification and treatment of disease is essential to prevent disease spread. Correct and timely treatment will also reduce the environmental impact of many of the chemicals and medicines used in disease control.
- Vaccination diseases: The prevention and disease treatment are specifically depended on causes of a particular disease, the recommendations are as follows:
    - Veterinary drugs registered with the competent authority shall be applied. The veterinary drugs on the banned list for aquaculture under the national regulation and of the importing countries are not allowed. The application of veterinary drugs shall be restricted according to the manufacturer's instruction of relevant drugs as well as a withdrawal period.
    - The storage of veterinary drugs shall be adhered to the label and direction. The veterinary drugs prescribed by veterinarian shall be separately kept from the unprescribed drugs.
    - Veterinary drugs shall be used when disease was properly diagnosed under supervision of veterinarian or fishery biologist who is expert in aquatic animal disease. The expired veterinary drugs according to product label shall not be used. The handling or disposal of expired veterinary drugs shall be in responsible manner.
    - Hazardous substances and probiotics for aquaculture registered with the competent authority shall be used. The banned list for aquaculture under the national regulation and of the importing countries is not allowed. The application shall be used according to label and provided information.
    - If the dead or sick shrimp is found, the cause of symptoms diagnosis shall be done immediately. While, improving water quality, reducing feed or increasing aeration should be performed in order to reduce shrimp stress. If the mortality is continuously observed, the harvest of shrimp production is recommended.
- Strictly preventive measures such as disinfect the farm equipment, assign responsible worker for such infected pond and stop water exchange shall be in place to control the disease transmission from pond to pond or from farm to farm.
- In case of the outbreak of aquatic animal disease, competent authority and surrounding farmers, members of the shrimp organization shall be notified immediately.

5.4.2.5. Energy source and fuel management:

Energy source and fuel Fuel, lubricants and grease for lubrication of farm machines namely, vehicles, water pumps, aerator and other farm machines, are normally used in shrimp farm. Some of those fuels are highly potentially flammable and/or explosive. Farmer should pay much attention on potential danger to workers. Moreover, the spillover of unconventional removal of those fuels may have adverse affect to shrimps and pollute wider area. The recommendations are as follows:

- Fuels and lubricants should be labeled and stored away from flammable and explosive materials and be careful about the spillover.
- Changing of lubricant should be done carefully and avoid leakage or spillover.
- Devices and equipment for removal and cleaning up fuels on the ground should be promptly provided.
- Using of water pump and aerator should be under control measure for water conservation and energy saving.

5.4.2.6. Farm sanitation management

Shrimp farm normally has large amount of waste that could be a source of pollution. If waste is not managed properly, may cause smell or hazardous substances to health of people living in farm and surrounding area. The kitchen leavings, expired food and other wastes might attract waste feeders such as disease carrier animal. In this regards, farm sanitation is necessary for maintaining good quality of shrimp more appetizing. Daily maintenance of farm sanitation will greatly contribute to farm management in compliance with farm standard requirements. The recommendations are as follows:

- Garbage and refuse should be separately kept for proper disposal and to prevent the contamination to the culture pond.
- Keep in order the production input, materials and equipment so as not to harbour disease carrier animals.
- Bathroom and toilet shall not be located near the culture pond and not directly drained that may contaminate the pond. Disposal tank of the toilet shall be no leakage and equipped with highly efficient decomposed system. Besides, waste water and effluence from other resident buildings shall be well managed away from production pond and surrounding area.
- Fresh manure such as chicken or cow manures shall not be used in shrimp farm. If necessary, the manure shall be treated by any means in order to prevent contamination to the culture pond.
- Pets are not allowed in the culture pond. In case guarding dog is needed, much attention should be paid to dog droppings and regular cleaning the place.

5.4.2.7. Labour management

- Labour and welfare working in shrimp farm is considered to be risky from using of potentially dangerous equipment and hazard materials.
- Welfare for worker should be appropriately provided for such as accommodation, drinking water, water, medicine cupboard and other facilities.

– Safety environment for work and living condition such as well ventilate dwelling place, bathroom and toilet should be provided adequately.

– Adequate training on work safety and first aid in particularly the accident from electric shock, loss in blood, drowning and other possible emergency first aid should be provided.

5.4.2.8. Social and environmental responsibilities

– The problems between shrimp farmers and vicinity, residents as well as between employer and employee are rather complicated. Thus, farmer organization should be an effective approach to enhance farming efficiency.

– Participating in social activities with local community. Group activities should be well organized to regularly exchange the knowledge on shrimp farming.

– Meeting or technical training should be conducted on the issues of farm management, inputs application as regards to shrimp production.

– Training courses for farmers on GFM 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 GFM is applied should also be conducted.

5.4.3. Mitigation measures negative impacts for expansion of models

Currently, the local authorities 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).

**** Mangrove-shrimp to organically certified mangrove-shrimp (Zone 1):***

Mangrove-shrimp to organically certified mangrove-shrimp model in zone 1 is to simultaneously achieve a coastal protection outcome through a market driven sustainable livelihood. It does this by increasing farmer incentives to invest in increasing mangrove cover to a minimum of 50 % of tree cover on their farms. The farmers can sell their shrimp at a 10-percent price premium with significant benefits.

The subproject aims to expand shrimp - mangrove eco-farming to 2,484 ha. To restore coastal mangrove systems by additional planting along the coastline and inside shrimp ponds. The following recommendations increase the success and extension of shrimp - mangrove eco-farming:

– The local authority need to give right financial incentives for farmers they are likely to apply production shrimp and expand mangrove forest cover.

– The DARD must help farmers design, provision of mangrove seedlings, certification costs, linking farmers to markets.

– 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.

- Training FFS for farmers the farming procedures follow the standards guidelines. The shrimp farming in the area that is not yet certified need to practice in the area already certified.
- Increase control by District FPD.
- Public technical documentation shrimp international standards issued to farmers.
- Setting up internal control systems in shrimp - mangrove eco-farming communities.
- Establishing of community management of shrimp - mangrove eco-farming.
- Supporting for the afforestation area is not up to the standard of GAP.
- Guidance for farmers notes and keeps management documents according to international standards.
- Linking farmers to markets by link enterprise companies with farmers.
- Workshop set up chain linking: Providing seeds, supplies, ..
- Establishing links with the business chain purchasing, processing and exporting seafood.
- Lobbying of civil society organizations is important to motivate more buyers to procure ECO shrimp and thus to further increase its market volume. The domestic market for ECO shrimp can be enlarged by continuous media coverage regarding the environmental and health benefits of organic shrimp aquaculture.
- Developing and promoting brand internationally certified - mangrove eco-farming.

**** Biosecurity of shrimp aquaculture (Zone 2):***

- Control land use plans with the multi-disciplinary assistance of agricultural, aquaculture and forestry (mangrove-shrimp).
- Need the expertise of agricultural and aquaculture specialists to optimize the structural works supporting expansion models. For example, water quality, issues risks, quality produce, and market confidence, and reach commercial sizes to fetch optimal prices.
- Share and transfer lessons and experience between Biosecurity of shrimp in the subprojects. Sharing lessons and experience between Biosecurity of shrimp in subproject could also help increase safe production.
- Operation sluice gates can better control the water availability and quality needs of the respective Biosecurity of shrimp will be critical to reducing farmers' climate/environmental risks.
- These clean production systems could be similarly developed in zone Biosecurity of shrimp system.
- These models could be adopted in the Zone 2 Biosecurity of shrimp systems - which have relatively high productivity - to increase income.
- Expansion models near successful Biosecurity of shrimp in order to change farmer's perceptions. Farmer to farmer exchanges of knowledge and experience would also be more likely to occur, and easier to facilitate.
- Farmers should be provided with financial and economic analysis of the demonstrations once the pilots are demonstrated to be financially beneficial. Scaling-up should branch out from these areas. The same approach could also be used in the Neighboring farmers.

- Conduct water quality control for Biosecurity of shrimp zone (both fresh and brackish water) if the livelihoods are to be sustainable.
- Collecting data Biosecurity of shrimp systems.
- Establishing of community management Biosecurity of shrimp farming.
- Training courses for farmers on GFM introduction and application.
- Training methods of collecting water samples, samples of shrimp diseases.
- Public manuals measuring environmental factors and sampling water bowl disease.
- Building regulations farming communities.
- Organize environmental commitment signed between farmers.
- Organization of environmental monitoring and notification of monitoring results and recommends solutions to social radio.

**** Rice crop+ Giant Freshwater Shrimp aquaculture (Zone 3):***

Rice culture transition into aquaculture is opportunities of changing climate change. Status issues in Zone 3:

- Lack of freshwater and saline intrusion in Winter-Spring season.
- Contaminated freshwater from rice paddle fields discharged to rivers affecting shrimp farming downstream.
- Low productivity and profit from rice farming, lack of farming diversification.
- Poor farmers (including landless), no necessary infrastructure to allow them to transition to brackish aquaculture which requires investment and skills Spontaneous individual change to brackish water without adequate support will fail.

In the context of changing climate change, and rice culture transition into aquaculture is opportunities and challenges. No Quick Changes, thus to enhance the rice culture transition into aquaculture, it is necessary to:

1. Priority is to maintain incomes for farmers, avoid economic shocks: Allow to continue freshwater production where still economically viable, adjust the cropping systems (away from rice) and calendar to cope with shortage of freshwater in dry season. No big investments in infrastructure to maintain freshwater production, especially for rice.

2. Develop a transitional plan with clear and realistic goals. The plan should clearly identify various steps to be taken in making the transition to aquaculture and be sure to include realistic time frames.

3. Build capacity and necessary steps to allow smooth transition: improve the technical capacity of farmers; create effective mechanisms for strengthening, promoting, and disseminating locally initiated efforts.

3. Subsidize and improve access to credit services.

4. Establish commune CC Response Team to raise local awareness, identify collective action plan, pilot CC farming models, and establish farmer organizations.

5. Improve links between production and markets; and establish effective mechanisms for coordination.

Activities as the benefit time scale see Figure

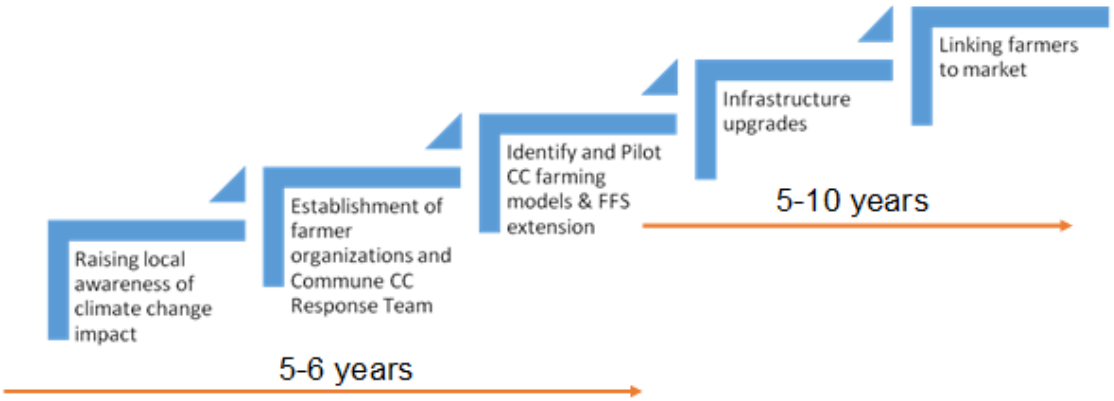


Figure 5.4: The benefit time scale for transiting activities

The land use changes and water infrastructure must take into account the future conversion of the intensive shrimp growing area behind District Road 16 and how effluent – rice agrochemicals in the short term, aquaculture effluent in the long term – will be discharged into downstream areas.

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 Ben Tre DARD for consideration and approval.

5.4.4. Environmental and social incidents

c.1) The risks in aquaculture and agriculture

The risk management objective was to develop practical measures for containing/ preventing shrimp disease outbreaks that should specifically cover identification of shrimp disease risk factors, diagnosis of problems and management strategies to control disease in farms to identify practical farm risk management interventions. Eventually two key were identified:

- Good farm management (GFM) that are practical farm-level interventions to address the key "risk factors". These were subsequently expanded to include all relevant shrimp disease risk factors, plus food safety and environmental risks. The (GFM) use are good pond preparation, good quality seed selection, water quality management, feed management, health monitoring, pond bottom monitoring, disease management, emergency harvest, harvest and post-harvest, food safety and environmental awareness. Apply synthesized disease prevention method.
- Farmer organization/self-help groups/clusters to address social and financial risks associated with farming and allow effective dissemination of the (GFM) among group members. The GFM will disseminated through communication channels involving farmer meetings, regular pond visits, training of extension workers and publication of ten brochures on steps of GFM adoption and booklets on shrimp health management and extension.

The GFM will implemented through farmer groups and clusters, a cluster being a group of interdependent shrimp ponds situated in a specified geographical locality and typically being comprised of the farmers whose ponds are dependent on the same water source. The cluster could make it practical to communicate risks and risk management to farmers more effectively to reduce risks and maximize returns. Inform the local residents about the procedures to detect and report accidents to the authorities.

**** 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.

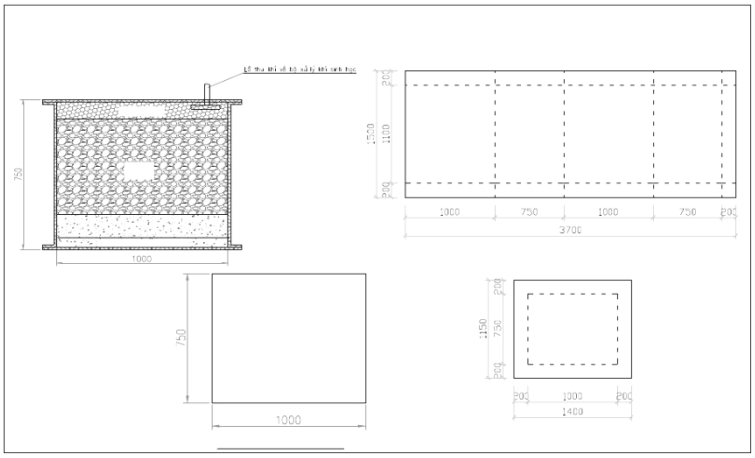
****Repair and prevention of the spreading of diseases***

When discover diseases in the pond or in canal, immediately close sluice 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 sluice gates, totally isolate with outside environment.
- Fish out all the dead shrimps, bury with lime them by bags handled safely. Thoroughly discard weak shrimps, limit birds or other livestock to eat sick shrimp. The Bag made of HDPE thickness σ = 1.5 mm. Depending on the amount of mortality should handle that different sized bags. The bag for 200kg shrimp die size is 0.75 x 0.75 m x 1 m. Figure of Bag following



- 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.

**** 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 through sluice gates. 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.

C.2) Measures for responding and handling sluice gate incidents

Incidents involving damage to the sluice gate or dyke rupture may result in salinity intrusion. When such incident occurs the following steps should be carried out:

- Timely covering and shielding plants with earth bags and closing the sluice gate to prevent saltwater from entering the fields.
- Timely mobilization of equipment and rescue teams to the site to embank and reinforce the damaged dyke section.
- Promptly repairing or replacing malfunctioning gate.

The risk management objective was to develop practical measures for containing/ preventing shrimp disease outbreaks that should specifically cover identification of shrimp disease risk factors, diagnosis of problems and management strategies to.

CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Based on the assessment of the potential negative impacts discussed in Chapter 4 and the mitigation measures proposed in Chapter 5, this chapter presents the Environmental and Social Management Plan (ESMP) for the subproject. The ESMP identifies actions to be carried out under the subproject including the environmental monitoring program and the implementation arrangements, taking into account the need to comply with the Government's EIA regulations and the WB's safeguard policies, including those of the World Bank Group's Environmental, Health, and Safety Guidelines.

6.1. BASIC PRINCIPLES

As a part of the ESIA, an Environmental and Social Management Plan (ESMP) is a safeguards instrument that is typically used in many projects and which consists of information on and guidance for the process of mitigating and managing adverse environmental impacts throughout project implementation. Typically in Vietnam, an ESMP comprises a list of typical mitigation measures to be carried out by contractors, an environmental monitoring program, organization arrangements, and an estimated monitoring cost.

There is a comprehensive regulatory framework in Vietnam related to ESIA preparation, environmental standards, protection and management of forest and cultural property, and other aspects related to construction and operation of facilities and infrastructures in Vietnam. This ESMP is consistent with these regulations.

To facilitate effective implementation of the ESMP, the PPMU Ben Tre will: (a) Establish an Environment and Social Unit (ESU) responsible for ensuring timely implementation of the ESMP, including monitoring, reporting, and capacity building related to safeguards; (b) Assign the Construction Supervision Consultant (CSC) to also be responsible for supervision of the contractor's safeguard performance as part of the construction contract and this requirement will be included in the CSC's terms of reference; and (c) Hire qualified national consultants as the Independent Environmental Monitoring Consultant (IEMC) to assist the ESU in performing its task.

DARD of Ben Tre will be responsible for implementation of the mitigation measures during the operation stage of the project and they will ensure that the mitigation measures are implemented and adequate budget is provided. MARD will provide the overall policy guidance and oversight of the subproject implementation. Roles and responsibilities of the specialized agencies and the DONRE will also be critical.

Activities to be carried out to mitigate impacts due to land acquisition and resettlement are presented separately (RAP and RPF) and they will be carried out and monitored separately.

6.2. SUMMARY OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

6.2.1. Positive impacts

Building 5 sluice gates will bring positive impacts to the subproject area as follows:

- Improving regulation of freshwater supply and salinity intrusion. When the subproject is completed and put into operation, the effects on saltwater intrusion and inundation due to flood tide controls are positive. Under the regulatory activities of the sluice gates, the intrusion of salinity into inland canals and rivers will be limited. Once the Subproject is

completed, the system of canal and sluice works, which prevent salt intrusion, will be improved to reserve freshwater for irrigation. Therefore, local people can be able to grow local plants and animals of superiority, which are competitive in the market, in specialized areas to gradually improve the added value of agricultural production and income and actively adapt to climate change and sea level rise. The application of the combined models: rice-shrimp, shrimp-forest, agriculture, livestock etc. at the household level and cooperatives will accelerate the alleviation of poverty in the region, making the number of subproject beneficiaries 98,000 people. Contributing to economic development.

- Enhancing biological resources and biodiversity: Livelihood models operation will be reduced use of fertilizers and pesticides as well as chemicals used in aquaculture. As such, the quality of the environment is expected to improve. Improved biological resources and biodiversity also enhance the livelihood solutions for people shifting to sustainable farming methods.

6.2.2. Negative impact

The implementation of the subproject would mainly cause land acquisition, increase dust generation, air pollution, domestic waste, and health and safety issues. Site investigation and document review were conducted for identifying and assessing these potential negative impacts, including consultation with the local communities and affected people.

The potential negative impacts of the subproject are identified in and could be minimized by applying the proposed mitigation measures developed for the project, which are described in Table 6.1. The negative impacts of project could be summarized as follows:

a. Building 5 sluice gates

- Potential increase in traffic accident especially in 5 bridges over the sluice gates.
- Interruption of waterway navigation during construction.
- Increase in other negative impacts on environment during construction and operation stages.
- Impacts on aquatic life, water quality and waterway navigation if closing the sluice gate in the long time.

b. Dredging works

- Stirring of the mud causing turbid, muddy water flowing down the canal from shore, affects the production water taking activities in the region, negatively impact on organisms.
- Leakage of oil and hazardous material spills can cause negative impacts on the environment.
- Waterway traffic disturbances.

Table 6.1: Potential Negative Impacts of the Subproject

No.	Impacts/ Issues	Impact Description	Location/Affected Object	Significance of impacts	Impact duration
A	***Construction of 5 sluice gates (***Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates).				
I	**Pre-construction Phase**				
1	UXOs remain	The subproject area may have mines left during the wars. Therefore, if the construction work has no demining detectors or thoroughly demining, it can damage to the lives of people or assets caused by mine explosion.	- Construction sites	Moderate	Long-term
II	**Construction Phase**				
1	Dust generation/ Air pollution	- Earthworks and excavation activities the 5 sluice gates will generate dust. - The amount of dust generated from these activities depends on volume of digging and backfilling, and also depends on the number of machines and trucks working on site. - The total volume of soil excavation is expected to be 2,110m^3 in 15-60 days. The construction will be on the river, canal, in sequences, which will help to minimize dust generation issues so air pollution caused by soil excavation is moderate	- Workers at the construction sites.	Small	Short-term
2	Impacts from noise and vibration	Operating the construction machines, vehicles will cause the noise and the biggest noise is from the pile driving. Noise level at location 100m is less than the limit. No sensitive receptors but some houses within 1km from the construction sites of 5 sluice gates	- Workers at the construction sites.	Small	Short-term
		The operation of the mixing station will generate noise pollution at a distance of about 45 meters (in day-time) and 90 meters (in night-time).	- Workers at the construction sites.	Small	Short-term
3	Surface water pollution from excavation and filling activities, worker's camp and construction equipment.	- No active the maintenance activity in the site. - Wastewater from worker's camps (4.8 m^3/day) contains organics easy to decompose, so if this kind of wastewater is directly discharged to the environment it would make the receiving water sources polluted. - Runoff water on the construction site contains high concentration of suspend solid and leakage oil from machine hat lead to increasing the concentration of pollution matters such as: SS, COD, oil in the surrounding water sources.	- Water quality and aquatic life in the Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, and An Thanh canals - Surrounding 5 workers' camps	Small	Short-term
4	Drainage and sedimentation	- Lacking of control of the temporary material yards in the subproject area may be lead to erosion and sedimentation problems.	- Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, and An Thanh canals	Small	Short-term
5	Solid waste	- Solid waste includes construction solid waste and domestic solid waste. - Construction solid waste includes waste soil and waste rock. They will be reused for backfilling and the local authorities have plan to reuse the remaining solid	- At the construction sites and worker's camps.	Moderate	Short-term

		wastes. These are non-hazardous wastes but it need to be handled to avoid impacts on air, water qualities, and big dirty masses in the subproject area. - Domestic waste and rubbish (domestic solid waste) generated from workers' camp that contain organic wastes such as rubbish, paper, carton box, etc and other wastes. The average generation volume of the domestic solid waste is about 0.4 kg/person/day. - This domestic waste will be collected to avoid environmental pollution. Due to the volume of this kind of waste is not big, they can be collected into the rubbish collection system along the subproject			
6	Hazardous wastes	- Other wastes as waste batteries, accumulators, plastic cores contain printing ink, etc. generated with small volume (estimate about 255 kg/ quarter), but not directly at the construction sites, almost at the construction management offices and repair workshops. These wastes will be collected, transported and treated by a licensed agency according the provisions of the Hazardous Waste Management. - The waste oil and oil-containing wipers from periodical oil change also identified as hazardous wastes. The amount of waste oil is estimated that: i) the amount of oil discharged each time is 07 litters. The amount of hazardous wastes is not much, but they could cause adverse impacts to the environment, insanitary, source of diseases on the site. Therefore, it is necessary to collect, transport and treat appropriately.	At the areas of material and equipment storages.	Moderate	Short-term
7	Interruption of waterway navigation and product	Sluice gates construction will happen mainly in the canals can cause interruption of waterway navigation, and irrigation activities. However, construction activities are in a coffer, only partly narrow theirs cross sections of canals. The impact on waterway navigation, and irrigation activities is moderate	In the construction sections of Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh canals Salt production and Black tiger shrimp region sluice gates.	Moderate	Short-term
8	Worker and public safety	Workers and local people could be at risk if they travel around or closed to construction sites, or fall to the open pit, buried in the material, etc.	At the construction area.	Small	Short-term
9	Traffic safety	- All the materials will be transported by water, accidents can occur due to boats colliding during the travel to the work sites. These incidents can cause serious impacts to the environment, especially to the water quality, such as increasing turbidity by stirring the bed on contact or through oil spills from engine damage - Narrow partly cross-section of Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh canals will lead waterway incidents	Along transportation route At the construction section of Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates.	Moderate	Short-term
10	Communication with local communities	Lack of communication and consultation with local communities can lead to an opposition to the subproject delays in the construction process, increased costs and unsatisfactory solutions.	Communities and local authorities in the	Low	Short-term

			construction area of An Thanh sluice gate.		
11	Workforce management	Worker concentration will cause the following impacts: - Increased demand for infrastructure and utilities. - Pollution caused by waste and domestic wastewater. - Increase risk of communicable diseases, such as malaria, HIV/AIDS, etc threaten health of workers and local people. - Affect local social secure, increase crime rate, drug use, prostitution, social conflict, etc.	Communities and local authorities in the construction area of 5 sluice gates		
12	Cultural impacts	- There are also no important historical and cultural sites identified in the subproject construction sites. - No adverse impacts on other historical and cultural heritage features are expected during the construction phase of the subproject	At any location in the subproject area if cultural work findings.	Negligible	Short-term
13	Occurrence of accidents related to construction phase	- Workers who do not comply with the regulations on labor safety when transporting materials may cause falling and injury to others.	In the whole of construction area	Moderate	Short-term
III	**Operation phase**				
1	Waterway limitation	This impact is small because the closing time of 5 sluice gates is very short	At Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates.	Small	Long-term
2	Water pollution	Closing of the sluice gates will reduce water exchange in the subproject area and the risk of water pollution may be increase. But this impact is small due to short time of sluice gates closing	At Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates.	Small	Long-term
3	Fish migration	The sluice gates will create up a barrier preventing the movement of the wild animal, especially the aquatic species (fish, shrimp, etc.). 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 sluice gates will partly block their migration way further in to land. Life cycles of migratory species such as shrimp, mud crab and some fishes might by interrupted. The canal system is a uncontinuous water body with fish migration barriers is District Road No 16. In such a system the fish community will always be comprised of small migratory populations, special not suitable for Anadromous species. With respect to migration habits the fish community can be divided into: 1. Anadromous species: Species that live in the sea and which goes up into the river for spawning.	At Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates.	Moderate	Long-term

		2. Catadromous species: Species that live in the river and which migrate to the sea for spawning. 3. Potamodromous species: Species that perform annual migrations within the river system, either for spawning or for feeding purposes. 4. Stationary species: Species that live in the same area of the river all their life A representative for the catadromous species is the important and highly priced (up to 100,000 VND per kg) *Pseudapocryptes elongatus* (Goby). The goby (*Pseudapocryptes elongatus*) abundantly follows the tidal currents for migration to sea in January and February meanwhile it was rarely during October to December. The goby migrated to sea two times per month during the full moon (15th day of lunar calendar) and new moon (30th day of lunar calendar) period, in which they mainly migrated during the new moon period. Almost of the migrated goby was examined as unmatured fish. The goby migrated abundantly when the salinity, current velocity and tidal range were higher. Except for the dry season, fish migration period of month to coincide with time served offtake open aquaculture. Many fish species migrate within the canal system this group includes: *Pangasius krempfi, Pangasianodon hypophthalmus, Barbonymus gonionotus, Mystus rhegma, Giant freshwater shrimp …* both for spawning and for feeding. These are called potamodromous species. Their migration distance can be both long and short, depending on the species. Other species live more or less in the same area of the river all the time (stationary species). The hydrological regime is a major factor in steering the timing of the fish migrations. The migrations are trigged by seasonal rise and decline of water level and water flow. Upstream spawning migration of adults generally starts at the beginning of the rainy season, when flows increase and water levels are rising. Meanwhile sluice gates saline control only closed into the dry season so the impact migratory Potamodromous species is Moderate.			
4	Risks and incidents	Damage of sluice gates: the salinity from the main rivers will quickly enter into the water environment of the fields. Salt water will immediately interact with every aspect of the environment, leading to severe consequences, including damage of freshwater aquatic sources in the area, directly affecting aquaculture in the area; salinity intrusion into surface water, contaminating the soil environment.	At Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates.	Moderate	Long-term
B	**Dredging 14 canals *(***Gia, Xeo Giua, Cat, No, Cua, Duong Khai, Duong Xuong, Duong Mieu, Duong Chua, Cay Bang, Ong Hai Ha, Đe Quoc Phong, Đuong Tac, Cay Mam canals).				
I	**Construction Phase**				
1	Dust and emission waste	Calculation emissions of excavators 0.8m^3, excavators1.6m^3, bulldozers, dredgers are	- Workers at the construction sites.	Negligible	Short-term

		Aldehyde: 6.32 mg/m^3, *CO:* 6.32 mg/m^3 *Hydro carbon:* 6.32 mg/m^3, *NOx:* 225 mg/m^3, SO_2 : 24.5 mg/m^3, *Dust*: 46.9 mg/m^3. The impacts on the air environment from the operation of excavators 0.8 m^3, excavators 1.6 m^3, bulldozers, dredgers are negligible.			
2	Smell from dump sites of soil and sludge	The sludge composition in the dredging area contains mostly sand and mud without organic matters. The impacts of odors is quite low	- Workers at the construction sites.	Negligible	Short-term
3	Water to be dredged with sludge Domestic wastewater from workers	- The water quality scooped up with sludge during the dredging, the suspended solid concentrations reach 9 to 25 times compared with QCVN 40: 2011/BTNMT. - Domestic wastewater from workers in each canal dredging area is about 3.2 m^3/day contains organics easy to decompose, so if this kind of wastewater is directly discharged to the environment it would make the receiving water sources polluted	- Water quality and aquatic life of Gia, Xeo Giua, Cat, No, Cua, Duong Khai, Duong Xuong, Duong Mieu, Duong Chua, Cay Bang, Ong Hai Ha, Đe Quoc Phong, Đuong Tac, Cay Mam canals.	High	Short-term
4	Solid waste	- The volume of dredged material is estimated 431,133m^3. The dredged material includes: sediment and solid wastes in canal bottom, bottom soil and banks'canals. - Domestic waste and rubbish (domestic solid waste) generated from workers' camp that contain organic wastes such as rubbish, paper, carton box, etc and other wastes. The average generation volume of the domestic solid waste is about 0.4 kg/person/day. - This domestic waste will be collected to avoid environmental pollution.	Soil quality of Gia, Xeo Giua, Cat, No, Cua, Duong Khai, Duong Xuong, Duong Mieu, Duong Chua, Cay Bang, Ong Hai Ha, Đe Quoc Phong, Đuong Tac, Cay Mam canals region.	Moderate	Short-term
5	Hazardous wastes	The waste oil and oil-containing wipers from periodical oil change also identified as hazardous wastes. The amount of waste oil is estimated that: i) the amount of oil discharged each time is 07 litters. The amount of hazardous wastes is not much, but they could cause adverse impacts to the environment, insanitary, source of diseases on the site. Therefore, it is necessary to collect, transport and treat appropriately.	At the areas of material and equipment storages.	Moderate	Short-term
6	Impact on fauna and ecosystem	The disturbance boosts the decomposition of organic matters by microorganisms. Oxygen depletion in water causes immediate impact on aquatic life and indirectly impact on the aquatic resources. However, the dredging when low tide and by large bucket of 1.6 m^3 in short time and narrow scale will cause low environmental impact. - The dredging will inevitably affect the canal benthic fauna.	At Gia, Xeo Giua, Cat, No, Cua, Duong Khai, Duong Xuong, Duong Mieu, Duong Chua, Cay Bang, Ong Hai Ha, Đe Quoc Phong, Đuong Tac, Cay Mam canals.	Moderate	Short-term

	Impact on aquaculture and salt production	The canal dredging will increase turbidity which may affect aquaculture and salt production. But Just only canal dredging in dry season and the low tide. The impact on aquaculture is moderate.	At 14 canals region.	Moderate	Short-term
7	Interruption of waterway navigation	The canal dredging mostly happens in water surface of the canals. The boats and ships of local must move to another canal in the region. The impact on waterway navigation is moderate.	At 14 canals.	Moderate	Short-term
8	Worker and public safety	Workers and local people could be at risk if they travel around or closed to construction sites, or fall to the open pit, buried in the material, etc.	At the construction area.	Low	Short-term
10	Communication with local communities	Lack of communication and consultation with local communities can lead to an opposition to the subproject delays in the construction process, increased costs and unsatisfactory solutions.	Communities and local authorities near the Dredging area of At Gia, Xeo Giua, Cat, No, Cua canals.	Low	Short-term
11	Workforce management	Worker concentration will cause the following impacts: - Increased demand for infrastructure and utilities. - Pollution caused by waste and domestic wastewater. - Increase risk of communicable diseases, such as malaria, HIV/AIDS, etc threaten health of workers and local people. - Affect local social secure, increase crime rate, drug use, prostitution, social conflict, etc.	Communities and local authorities in the construction area of 14 canals.	Low	Short-term
12	Occurrence of accidents related to Dredging phase	- Workers who do not comply with the regulations on labor safety when transporting materials may cause falling and injury to others.	In the whole of dredging area	Moderate	Short-term
III	**Operation Phase**	- Erosion and sedimentation	In the whole of canals	Moderate	Long – term
C	***Mangrove-shrimp to organically certified mangrove-shrimp model***				
I	In preconstruction phase	In the locations of mangrove - shrimp ponds for additional mangrove planting to achieve requirements of ecofarming certification are mainly water surface land and agricultural land, there have very few houses and reforestation will take place in the existing ponds and no land acquisition and land clearance. So impacts in this phase are negligible.	Mangrove - shrimp ponds	Negligible	Short- term
II	In construction phase	*Rhizophora* will be planted by putting about one-third of the seed length into the mud. Therefore, the impact of reforestation during this phase is very low.	Mangrove - shrimp ponds	Negligible	Short- term
III	In operation phase	Shrimp survival and biomass decreased significantly when the shrimp were cultured at the relatively higher concentrations of *Rhizophora* leaves and leachates; in contrast, moderate amounts of *Rhizophora* leaves or their leachates had positive effects on shrimps. But this impact is *low* due to water circulation may help to prevent low oxygen conditions and reduce local accumulations of mangrove leaves and good take care of *Rhizophora* to avoid defoliation of *Rhizophora.*	Mangrove - shrimp ponds	Low	Short- term

IV	Induced impacts due to possible expansion of the models in the zone and nearby area without proper control and management	The great earnings of shrimp culture may be make expanding shrimp aquaculture industry poses one of the gravest threats to mangrove forests. The great earnings of shrimp culture are short lived, while the real costs in terms of consequent environmental ruin and social disruption are long term and astronomical. While the immediate profits from shrimp farming may satisfy a few, vast numbers of coastal residents, once dependent on healthy coastal ecosystems for fishing and farming, will be displaced and impoverished. However mangroves will not be converted into shrimp when farmer know the conditions and standards of GAP certification for Mangrove-shrimp model. Also in the shrimp Zone 1 no protection if the forests were cut down. Intensive shrimp farming in the area Zone 1 is a huge risk because of uncontrollable nature and environment factors.	In the Zone and nearby areas	Moderate	Long term
D	***Biosecurity of shrimp aquaculture model***				
I	In preconstruction phase	These activities require no land acquisition and resettlement, as well as public infrastructure encroachment because they are developed on the existing ponds.	Aquaculture ponds using for demonstrations	Negligible	Short- term
II	In construction phase	The demonstration sites are located in the existing ponds, so no need to dig new ponds or building infrastructure for the demonstrations, only cleaning out the mud layer on the bottom of the ponds and very few people live surrounding so impacts on local environment and people in this phase is low.	Aquaculture ponds using for demonstrations	Negligible	Short- term
III	In operation phase	Currently, ponds for demonstration are now raising intensive shrimp, the impacts of this method on the environment mainly from organic wastes water and solid waste. However, in case of "without subproject", these impacts still occur, and when implementation of the subproject, objectives will be diversified not only shrimp but also Biosecurity of shrimp aquaculture will be done in form of cleaner production, the impact on the environment will reduced. When pond water containing high concentrations of nutrients and organic matter from a large number of shrimp farms is discharged into coastal waters, the effects can be negative, depending on the ecosystem's capacity to receive the discharges. Potential negative effects include : Unusual rates of sedimentation; Eutrophication, with increased risk of harmful algal blooms; Change in the nutrient cycle; Oxygen depletion; Toxicity from sulfide compounds and ammonia following degradation of organic matter; and Increased incidence of disease, stemming from poor water quality and stress on aquatic life.	Aquaculture ponds using for demonstrations	Moderate	Long – term
IV	Induced impacts due to possible expansion of the models in the zone and nearby area without proper control and management	Given that aquaculture farming could bring more benefits to farmers, it is likely that expansion of the aquaculture activities and/or the proposed models could occur quickly without inadequate management and/or control. From the environmental and social perspectives, implementation of Model 2 of monoculture may trigger induced impacts which include: Changes in landuse from salt production to intensive shrimp farming and increased water pollution. These in turn would negatively affect	In the Zone and nearby areas	Moderate	Long term

		biodiversity, water supply, and income of the poor who may not afford intensive shrimp farming. These induced impacts should be addressed comprehensively at the provincial and local levels. In addition, 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.			
E	***Rice crop + Giant Freshwater Shrimp aquaculture model***				
I	In preconstruction phase	These activities require no land acquisition and resettlement, as well as public infrastructure encroachment because they are developed on the existing ponds.	Rice- field using for demonstrations	Negligible	Short- term
II	In construction phase	The demonstration sites are located in the existing ponds, so no need to dig new ponds or building infrastructure for the demonstrations, only cleaning out the mud layer on the bottom of the ponds and very few people live surrounding so impacts on local environment and people in this phase is low.	Rice -field using for demonstrations	Negligible	Short- term
III	In operation phase	Currently, field for demonstration is now raising rice, the impacts of this method on the environment mainly from organic wasteswater and solid waste. However, in case of "with out subproject", these impacts still occur, and when implementation of the subproject, objectives will be diversified not only rice but also Giant Freshwater Shrimp will be done in form of cleaner production, the impact on the environment will reduced however the problems of concern are water polution (chemicals, fertilizers, pesticides), the spread of disease. When outbreaks occur, the government offers free treatment of ponds when disease appears. If the shrimp are older than one month when they become infected, farmers will not notify authorities but try to salvage their investment by releasing water to harvest the shrimp to sell. However, these modes use for demonstration purposes only and its impacts will be localized and minimized through increasing farmer awareness on the impacts of the diseases and develop good quality seeds.	Rice - shrimp field using for demonstrations	Moderate	Long – term
IV	Induced impacts due to possible expansion of the models in the zone and nearby area without proper control and management	Profits earned from the model will encourage a transition from rice cultivation to shrimp farming. In the early stages of the transition, the rice shrimp intercropping model are encouraged to apply to ensure ecological balance and food security. With the huge success of the first shrimp crop, people tend to give up rice cultivation. Even local people farm shrimp all throughout the year or empty the land without rice cultivation due to the low value of rice production which is no longer attractive to farmers as shrimp. In addition, there are not many rice farmers which have made it difficult for other farmers want to grow rice because the insects, birds and rats devouring, causing heavy	In the Zone and nearby areas	Moderate	Long term

		casualties, not even to harvest rice. Gradually, due to the limited land area while wants to increase the productivity, the farmers had to dig away part of paddy land in the shrimp ponds to make deeper shrimp ponds to feed many more shrimp. The rice fields have now become the " pond " shrimp. Mode of living of the local people now depends entirely on marine ecosystems. However, shrimp farming is also a potential risk profession. Therefore, in parallel with the success brought by shrimp farming, the phenomenon of land pledging or labor migration due to shrimp farming loss has also appeared in the area. On the one hand, 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. In the event of a change in the mode of production of rice - shrimp into the Zone 3, social and the environmental issues appear as shrimp theft, conflict of resource benefits in community and pollution environment. Due to the large area of arable land and scattered human habitation, theft of shrimp will cause annoyance and anxiety to the community. Compared to freshwater fish and other agricultural products, shrimp is vulnerable to theft in large numbers. The farmers must constantly guard the shrimp ponds. The rhythm of life is affected due to frequent theft of crop production at night. Shrimp is not required much labor and economic conditions could be improved so that people have more leisure time than rice. Besides, the conflict over water shrimp farming is potential. On the one hand, waste from the shrimp ponds are polluted source impact on the general culture water of the community. Because of the planning, Zone 3 minimize the effects of salinization, water supply are shared on a system. When shrimp die due to diseases, the wastewater directly discharge to environment causing disease outbreaks throughout the region, especially if the transition to shrimp model at high-density. Spontaneous individual change to brackish water without adequate support will fail. Therefore need to build capacity and necessary steps for gradual transition to brackish water economy and should be a planning and closely compliance control for the Zone 3 to achieve the objectives of the subprojects.			

6.3. MITIGATION MEASURES

This section presents the measures to be carried out by the subproject owner (Ben Tre DARD) during the implementation of the subproject to mitigate the potential negative impacts of the subproject activities considered to be general impacts and the site-specific impacts. Section 6.3.1 (Table 6.2) presents the potential negative impacts of the subproject activities considered as general impacts and they could be mitigated through ECOP while Section 6.3.2 (Table 6.3) presents site-specific impacts that require special attention. Nonetheless, it is noted that if the contracts for Component 1 and 3 are implemented through different contractor, the simplified ECOP shown in Annex 3 will be applied.

For works of Component 2, during the preparation of bidding documents, the Ben Tre project management unit (PPMU) will incorporate both the mitigation measures identified under the preconstruction and construction phases under the ECOP and site-specific requirements into the bidding and contract documents and ensure that the contractor are well aware of these obligations. During construction, the PPMU will assign the Construction Supervision Consultant (CSC) to also be responsible for the day-to-day supervision and monitoring of contractor performance in compliance with these measures. During construction, the contractor will be required to prepare and implement a Contractor Environmental and Social Management Plan (CESMP) in line with these requirements. The Ben Tre PPMU will also include results of contractor performance in the subproject monthly progress report to be submitted to the Cetral Project Management Unit (CPMU) of the Central Project Management Office (CPO) to be established in CanTho.

During operation of the Components 1 and 2 activities, the subproject owner (Ben Tre DARD) will be responsible for ensuring that the responsible agencies of the province will take actions to implement the activities identified in ECOP (Table 6.2) as well as those identified under the site-specific requirements (Table 6.3). One technical assistance will be provide for safeguard training as well as ensuring that the sluice operation procedure will be developed in close consultation with water users and key stakeholders. For the Component 3, in additional to the technical assistance to be provided during the planning and implementation of the 5 models, one additional technical assistance will be needed to mitigate the potential negative socio-economic impacts on poor farmers and the potential negative impacts that may occur due to possible expansion of the models in the future.

6.3.1. Mitigation measures of general impacts

The mitigation measures of general impacts during pre-construction, construction, and operation phases, the environmental codes of practices, related to the general construction activities of the 5 sluice gates and canal dredging are presented in Table 6.2.

Table 6.2: Mitigation Measures of General Impacts (ECOPs) related to Subproject's Activities

Environmental - social issues	***Mitigation measure***	***Vietnam code/regulation***	***Responsibility***	***Verification of effectiveness of measures***
A. For 5 sluice gates (Duong Khai, Trang Nuoc, Duong Tac, Cay Keo, An Thanh sluice gates).				
I. During pre-construction				
Land acquisition UXO clearance	- Subproject located in the potential UXO which could threat to worker which could create accidents due to UXO. - Coordinate with the appropriate agencies at the design stage to identify if UXO is a potential threat to works. - Ensure that the contractors shall only commence site works after the subproject areas are already been cleared.	-	Contractor implementing the package of searching and removing/destroying UXO PPMU Ben Tre	- Implementation report supervision reports of the PPMU Ben Tre
II. During construction				
1.Dust generation and air pollution	- The Contractor is responsible for compliance with relevant Vietnamese legislation with respect to ambient air quality. - The Contractor shall ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents and shall implement a dust control plan to maintain a safe working environment and minimize disturbances for surrounding residential areas/dwellings. - The Contractor shall implement dust suppression measures (e.g. covering of material stockpiles, etc.) as required. - Material loads shall be suitably covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust. - Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors. - Dust masks should be used by workers where dust levels are excessive - All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. - Vehicles in Vietnam must undergo a regular emissions check and obtain certification: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT. - There should be no burning of waste or construction materials on site. - Cement processing plants should be far from residential areas.	- TCVN 6438-2005 - No. 35/2005/QD-BGTVT - QCVN 19: 2009/BTNMT:. - QCVN 20: 2009/BTNMT:	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
2.Impacts from noise and vibration	- The contractor is responsible for compliance with the relevant Vietnamese legislation with respect to noise and vibration. - All vehicles must have appropriate "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QDBGTVT, to avoid exceeding noise emission from poorly maintained machines. - When needed, measures to reduce noise to acceptable levels must be implemented and could include silencers, mufflers, acoustically dampened panels or placement of noisy machines in acoustically protected areas. - Avoiding or minimizing transportation through community areas and avoiding as well as material processing areas (such as cement mixing).	- QCVN 26:2010/BTNMT: - QCVN 27:2010/BTNMT:	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
3.Water pollution	- The Contractor must be responsible for compliance with Vietnamese legislation relevant to wastewater discharges into watercourses. - Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any waterbody. - Wastewater containing pollutants over standards set by relevant Vietnamese technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. - Make appropriate arrangements for collecting, diverting or intercepting wastewater from households to ensure minimal discharge or local clogging and flooding. - Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contracts have been obtained. - At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.	- QCVN 09:2008/BTNMT: - QCVN14:2008/BTNMT: - QCVN 40: 2011/BTNMT: - TCVN 7222: 2002:	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
4.Drainage and sedimentation control	- The Contractor shall follow the detailed drainage design included in the construction plans, intended to prevent storm water from causing local flooding or scouring slopes and areas of unprotected soil, resulting in heavy sediment loads affecting local watercourses. - Ensure the drainage system is always maintained cleared of mud and other obstructions. - Areas of the site not disturbed by construction activities shall be maintained in their existing conditions.	- TCVN 4447:1987: Earth works-Codes for construction; - Decree No. 22/2010/TT-BXD - QCVN 08-MT:2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	- Earthworks, and fill slopes shall be properly maintained, in accordance with the construction specifications, including measures such as installation of drains, use of plant cover. - To avoid sediment-laded runoff that could adversely impact watercourses, install sediment control structures where needed to slow or redirect runoff and trap sediment until vegetation is established. Sediment control structures could include windrows of logging slash, rock berms, sediment catchment basins, straw bales, storm drain inlet protection systems, or brush fences. - The amount of excavated soil will be stored along the route at the locations agreed upon with the local authorities and people. At the same time, the contractor will try to avoid construction plans or earthworks in the rainy season to avoid leaching and water pollution problems. In the case of construction during the rainy season, the contractors should have appropriate construction methods to prevent local flooding such as embankments, shielding excavated land by canvas, digging temporary drainage ditches and pumping for drying the construction site and limit flooding.			
5. Solid waste	- The Contractors have to collect residue materials to fill the sluice gates or road. Recyclable materials such as wood, steel and packages should be collected and transported away of the construction site. Contractors have to dispose the solid waste at the designated disposal site. - The solid waste have to be keep in covered/ closed containers. - Do not burn the solid waste at the construction site. - Do not treat any materials on site, as well as disposal into a water source. - Contractors have to collect and treat the waste according to the Circular 59/2007/ NĐ – CP and TCVN 6705-2000. - Place waste containers at the camp and construction area in order to collect daily waste. - Domestic waste has to be collected daily and moved by waste collection Contractors of Ba Tri District. - Do not bury or burn at the construction site. - Hire a contractor to clear the cesspool before completion.	- Decree No. 59/2007/ND-CP	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
6. Haz`ardous waste	- Comply with transportation management and hazardous waste treatment circulars 36/2015/TT-BTNMT issued by MONRE. - Do not pour the oil into the soil. Spillage has to be collected and treated safely. - Do not repair pumps and machines at the construction site.	- Decision No. 23/2006/QD-BTNMT - Circular No. 36/2015/TT-BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	- Oil spillage vehicles and machines have to be removed from the construction site for immediate repair. - Define a machine repairing area in case of unexpected situations. - Inform and report to the board of management and supervision consultants in case of any accident and spillage. Implement corrective actions. - Used oil should be removed and transported from the construction site and sold.			
7. Management of stockpiles, quarries and borrow pits	- Large scale stockpiles will need site-specific measures that go beyond those in these ECOPs. - All locations to be used must be previously identified in the approved construction specifications. Sensitive sites such as scenic spots, areas of natural habitat, areas near sensitive receptors, or areas near water should be avoided. - An open ditch shall be built around the excavated soil storage area to intercept wastewater. - Stockpile topsoil when first opening a borrow pit and use it later to restore the area to near natural conditions. - If needed, disposal sites shall include a retaining wall. - If the need for new sites arises during construction, they must be pre-approved by the Construction Engineer. - If access roads are needed, they must have been considered in the environmental assessment. - PPMU's Environment Officer should conduct due diligence to make sure that borrow pits and quarries are legally operating, with licensed and that sound environment and social standards are being practiced. - Include the requirement that the contractors shall be required to buy materials from licensed borrow pit and quarry operators into the civil work contractual documents. - PPMU's Environment Officer should undertake a rapid review of quarry sites to assess if operations are in compliance with Vietnamese laws and Bank requirements prior to construction. - Include monitoring of borrow pits and quarries.	- Decision No. 23/2006/QD-BTNMT - Decree No. 59/2007/ND-CP - Decree No. 38/2015/ND-CP.	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
8. Disruption of vegetative	- The Contractor shall prepare a Clearance, Revegetation and Restoration Management	- Law on Environment protection	Contractor	- Supervision reports of CSC

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
cover and ecological resources	- Plan for prior approval by the Construction Engineer, following relevant regulations. The Clearance Plan shall be approved by the Construction Supervision Consultant and followed strictly by the contractor. Areas to be cleared should be minimized as much as possible. - Site clearance in a forested area is subject to permission from Ben Tre DARD. - The contractor shall remove topsoil from all areas where topsoil will be impacted by construction activities, including temporary activities such as storage and stockpiling, etc; the stripped topsoil shall be stockpiled in areas agreed to by the Construction Supervision Consultant for later use in re-vegetation and shall be adequately protected. - The application of chemicals for vegetation clearing is not permitted. - Trees cannot be cut down unless explicitly authorized in the vegetation clearing plan. - When needed, temporary protective fencing will be erected to efficiently protect the preserved trees before commencement of any works within the site. - No area of potential importance as an ecological resource should be disturbed unless there is prior authorization from CSC, who should consult with PPMUs, IEMC and the relevant local authorities. This could include areas of breeding or feeding for birds or animals, fish spawning areas, or any area that is protected as a green space. - The Contractor shall ensure that no hunting, trapping, shooting, poisoning of fauna takes place.	- No. 55/2014/QH13		- Supervision and monitoring reports of PPMU Ben Tre
9. Traffic management	- Signs to regulate traffic in the construction area. Maintain adequate measures to regulate traffic and these measures should be advised to and approved by construction supervisor and project owners in advance. - All activities related to water transport will comply with the agreed hours of work in each area. - Place signs around the construction site to guide traffic, installing sign posts for temporary paths and different work items, safety instructions - The Contractors have to perform and supervise the work to regulate the traffic. Limit of the transport of supplies on transport routes during peak hours. - In the event of a breakdown in communication, cooperate with the provincial and local authorities in Ben Tre province.	- Law on inland waterway navigation No 23/2004/QH11 - Law on construction No. 50/2014/QH13 - Circular No.22/2010/TT-BDX	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
10. Interruption of	- Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance).	- Decree No. 73/2010/NDCP on	Contractor	- Supervision reports of CSC

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
utility services	- Interruptions of water supply to agricultural areas must be avoided. - The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. - Any damages to existing cable utility systems shall be reported to the authorities and repaired as soon as possible.	administrative penalization security and society issues		- Supervision and monitoring reports of PPMU Ben Tre
11. Restoration of affected areas	- Cleared areas such as borrow pits which are no longer in use, disposal areas, site facilities, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied during construction of the subproject works shall be restored using landscaping, adequate drainage and revegetation. - Start revegetation at the earliest opportunity. Appropriate local native species of vegetation shall be selected for the planting and restoration of the natural landforms. - Spoil heaps and excavated slopes shall be re-profiled to stable conditions, and grassed to prevent erosion. - All affected areas shall be landscaped and any necessary remedial works shall be undertaken without delay, including green-spaces, roads, bridges and other existing works. - Trees shall be planted at exposed land and on slopes to prevent or reduce land collapse and keep stability of slopes. - Restore all damaged roads and bridges caused by subproject activities.	- Law on Environment protection - No. 55/2014/QH13	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
12. Worker and public Safety	- Contractor shall comply with all Vietnamese regulations regarding worker safety. - Prepare and implement an action plan to cope with risk and emergency. - Preparation of emergency aid service at the construction site. - Training workers on occupational safety regulations. - If blasting is to be used, additional mitigation measures and safety precautions must be outlined in the ESMP. - Ensure that ear pieces are provided to and used by workers who must use noisy machines such as piling, explosion, mixing, etc., for noise control and workers protection. - During demolition of existing infrastructure, workers and the general public must be protected from falling debris by measures such as chutes, traffic control, and use of restricted access zones. - The contractor shall provide safety measures such as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people.	- Circular No. 22/2010/TT-BXD - Directive No. 02 /2008/CT-BXD - TCVN 5308-91: - Decision No. 96/2006/QD-TTg	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	- Contractors' contracts to include conditions to ensure occupational health and safety; do not differentiate payment between women and men, for work of equal value; prevent use of child labor; and comply with the government's labor laws and related international treaty obligations. - Maximize employment of women and poor HH during construction.			

13. Communication with local communities	- Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). - Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. - Reduced playground space, loss of playing fields and car parking: The loss of amenities during the construction process is often an unavoidable source of inconvenience to users in sensitive areas. However, early consultation with those affected provides the opportunity to investigate and implement alternatives. - Disseminate subproject information to affected parties (for example local authority, enterprises and affected households, etc) through community meetings before construction commencement, focusing on female headed households, poor and vulnerable populations. - Provide a community relations contact from whom interested parties can receive information on site activities, subproject status and subproject implementation results. - Provide all information, especially technical findings, in a language that is understandable to the general public and in a form useful to interested citizens and elected officials through the preparation of fact sheets and news releases, when major findings become available during the subproject phase. - Monitor community concerns and information requirements as the subproject progresses. - Respond to telephone inquiries and written correspondence in a timely and accurate manner. - Inform local residents about construction and work schedules, interruption of services, traffic detour routes and provisional waterway routes, blasting and demolition, as appropriate. - Provide technical documents and drawings to PC's community, especially a sketch of the construction area and the ESMP of the construction site. - Notification boards shall be erected at all construction sites providing information about the subproject, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the opportunity to voice their concerns and suggestions.	- Decree No. 73/2010/ND-CP on administrative penalization security and society issues	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
14. Chance find procedures	- If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall: - Stop the construction activities in the area of the chance find. - Delineate the discovered site or area. - Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the Department of Culture, Sports and Tourism takes over. - Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less). - Relevant local or national authorities are in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This will require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; including the aesthetic, historic, scientific or research, social and economic values. - Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remains of cultural or archeological importance) conservation, preservation, restoration and salvage. - If the cultural sites and/or relics are of high value and site preservation is recommended by the professionals and required by the cultural relics authority, the Subproject's owner will need to make necessary design changes to accommodate the request and preserve the site. - Decisions concerning the management of the finding shall be communicated in writing by relevant authorities. - Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.	- Law on Cultural Heritage 32/2009/QH12 - Decree No. 98/2010/ND-CP dated 21/09/2010 of the Government on implementing a number of articles of Law on cultural heritage and Law on amendment and supplementation of a number of articles of Law on cultural heritage.	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
III. In operation phase				
1. Surface water quality	– Strengthening environmental hygiene in salt separated area; – Set reasonable operating procedures, reducing the time to close the sluice gates to a minimum, timely and flexible in operating the system. Strengthening the salinity monitoring frequency on Co Chien, Ben Tre, Ham Luong Rivers,	- QCVN 10:2008/BTNMT - QCVN 14:2008/BTNMT	Liability company Ben Tre Irrigation Exploitation	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	measuring salinity and take advantage of every opportunity to operate the drains, especially for the large drain. – Perform dredging, widening drain canals at both ends of drain, ensure rapid tidal intake and drainage. – Regularly check environmental hygiene at the production facilities, livestock and processing livestock and aquaculture. – 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. – Need some fisheries development planning and rational agriculture. - Integrating content on IPM in the training program and agriculture promoting programs.			
2. Water use conflicts	During the dry season, the gates will be open and close on a regular basis to the water in the region to ensure safety, stability and development of aquaculture. The rational use of chemical fertilizers and pesticides. Closely monitoring salinity at different locations is a reasonable method for operating the sluice gates to prevent salinization. Researching operation process and supervising the implementation sluice gates. Ensuring water resource in the area is always cleaned out and the water quality is better. 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 Sluice gates. In every case of changing the work regime of the sluice gates, only operate the valve of sluices when the water level at downstream is stable In the process of planning and operation of the drains, the water user should be consulted and specific actions should be ready to respond.	Law on water resources No. 17/2012/QH13	Liability company Ben Tre Irrigation Exploitation Local government	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	Must fully integrate downstream water pollution problems, the concern of the water users on the operational plan, the operator limited liability company Ben Tre Irrigation Exploitation should ensure the needs of water users. There is a need for extensive discussions aimed at the local people's livelihoods, demands consultations and collaboration among local people and company Ben Tre Irrigation Exploitation. – To develop the pastoral sector the provision of information and public education activities through the mass media.			
3. Biodiversity	– Land use controls and zoning to prevent expanding shimp farms and maintain seasonally flooded ecosystem. – Expand the forest plantation area, increase opportunities for afforestation restoration of natural course of land and green corridors, multiple benefits through mangove forest management. – Managing closely the supply sources of pesticides, products used in aquatic farming. – Increase control by District FPD. – Improve people awareness and environmental education. Awareness and environmental education activities for the local communities on wildlife protection – Established management areas managed by the community. - Raising awareness to the people and government at all levels of the value of biodiversity, creating a sense of responsibility for local conservation	Law on Environment protection No. 55/2014/QH13	Liability company Ben Tre Irrigation Exploitation Local government	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE
4. Waterway limitation	- The sluice will be opened most of time - Develop a plan to optimize time of sluice gate closures and notify local authorities and people. - Notify local people and authorities regarding sluice gate operation (opening and closing times).	Law on inland waterway navigation No 23/2004/QH11	Liability company Ben Tre Irrigation Exploitation Local government	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE
B. Dredging 14 canals (Gia, Xeo Giua, Cat, No, Cua, Duong Khai, Duong Xuong, Duong Mieu, Duong Chua, Cay Bang, Ong Hai Ha, De Quoc Phong, Duong Tac, Cay Mam canals).				
1. Dust and emission waste	- Do not use too old ships, barges. - All dredging construction equipment must be periodically checked and maintained in accordance with regulations. Ensure the parameters of emissions, noise, vibration meets the requirement by the registration department for the technical and environmental safety.	- Circular No. 30 - BGTVT dated 15.4.2011. - No. 35/2005/QD-BGTVT; - QCVN 19: 2009/BTNMT:.	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	- Spray solution to cover the smell in the morning in the case of dredging a canal ends at a distance of 200m from households like Gia canal, No canal, Cua canal. - Domestic waste to be put ashore every day, be treated to avoid decomposition generating stench. - The waste water tank on the construction ship as prescribed by QCVN 17: 2011/ BGTVT: national technical standards and regulations on prevention of pollution of inland waterway.	- QCVN 20: 2009/BTNMT: - QCVN 26: 2010/BTNMT QCVN 17: 2011/ BGTVT national technical standards and regulations on prevention of pollution of inland waterway.		
2. Smell from dump sites of soil and sludge	- Spray solution to cover the smell in the morning in the case of dredging a canal ends at a distance of 200m from households like Gia canal, No canal and Cua canal. This measure will decrease the negative impact by 60 to 70%	QCVN 20: 2009/BTNMT:	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
3.Water waste	- Selecting dredging equipment and Planning appropriate dredging methods to reduce pollution. - Environmental monitoring at the dredging areas during the construction period. - Dredging in dry season and when low tide. - Build Mobile septic tanks on barges. - Implement environmental monitoring for water quality parameters such as SS, pH, DO and temperature, etc. during dredging.	- QCVN 17: 2011/BGTVT - QCVN14:2008/BTNMT - QCVN 40: 2011/BTNMT - Decision No 25/2004/QD-BGTVT MOT 25/11/2004	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
4.Solid waste	- Domestic waste: Put rubbish bin. - Do not burn waste on site - Dredging material: Determining the location of construction spoil relocation area with the consent of the receiving local governments. - Use excavated materials for land levelling. Collecting sand stone, digging material scattered - Waste arising from the canal: contract with companies specialized collected - Prohibition to burn solid waste from barges ashore or throw garbage into canals. - Contractors to hire Ba Tri District waste collection team to collect the waste in every 2 days	- Decision No. 23/2006/QD-BTNMT - Decree No. 59/2007/ND-CP - Decree No. 38/2015/ND-CP - QCVN 17: 2011/ BGTVT - QCVN 03: 2008/ BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
5.Hazardous wastes	- Train site officers and workers about suit control with hazardous materials. - Contracts with companies specialized in the collection hazardous materials.	- Circular No.36/2015/TT-BTNMT	Contractor	- Supervision reports of CSC

Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
				- Supervision and monitoring reports of PPMU Ben Tre
6.Impact on fauna and ecosystem	- Implement environmental monitoring for water quality parameters such as SS, pH, DO and temperature during dredging. - Excavation spoils and soil dredging should be reused so the excess water does no - Disperse back into the river. - Earthworks should be conducted during dry periods. - All construction fluids such as oils, and fuels should be stored and handled well away from surface waters. - No waste of any kind is to be thrown in surface waters. - No washing or repair of machinery near surface waters	- Law on Environment protection No. 55/2014/QH13	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
7.Impact on aquaculture and salt production	- To conduct dredging during the dry season and the tide at low when there is no aquaculture and activities take water for salt production. No dredging in rainy season and high tide - When preparing the construction, the Contractor must coordinate with local authorities, the inhabitants of Ba Tri District to inform about planning and construction time. Local residents can manage to take water accordingly and not use turbid water affected by dredging. - In urgent cases, the dredging from high must be approved by DARD Ben Tre and the ward authorities and communities.	- QCVN 10:2008/BTNMT - QCVN 14:2008/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
8.Interruption of waterway navigation	- Streamline traffic and navigation with consultations with local government and community - Implement necessary measures such as placing signs, signage,... to ensure public and traffic safety, - Notice the dredging plan for the ward authorities and communities, at least one week before construction.			-
9.Worker and public safety	- Provide emergency medical services at construction sites. - Install construction barriers/ fences and dangerous warning signs. - Limit speed at the dredging sites. - Installation of lighting at night. - Equipped workers with labor protection instruments. - Avoid long exposure to waste. - Training workers on safety regulations. - Keep the construction area safe and orderly.	- Circular No. 22/2010/TT-BXD - TCVN 5308-91: Technical regulation on safety in construction - Decision No. 96/2006/QD-TTg dated 04 May 2006 on	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

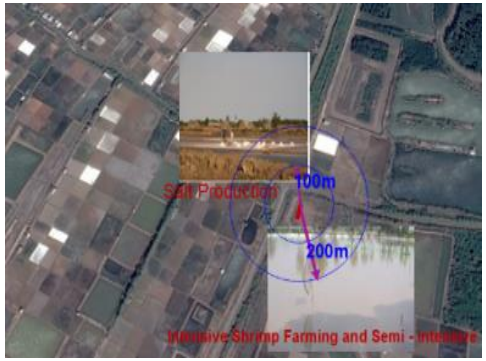
Environmental - social issues	*Mitigation measure*	*Vietnam code/regulation*	*Responsibility*	*Verification of effectiveness of measures*
	- Calculate and apply the necessary measures to prevent landsides. - Workers should carry protective clothing and goggle to protect. - In case of problems, stop the dredging and implement of necessary measures.	management and implementation of bomb mine explosive material disposal. -		
10.Communication with local communities	- Notice the dredging plan for the ward authorities and communities, at least one week before construction. - Management training and coaching reasonable way, not to spill or fill excavated approach to land's household - Priority use of the local workforce. - Sign up temporary residence for workers with local police. - Inform local authorities, to know the people participating in dredging, the subproject start and completion time. This will help the local authority to plan and ahve appropriate management measures. - The protection of the health of workers and residents during construction shall comply with the specific provisions of the health measures and food hygiene in the dredging area. - To minimize problems of conflicts between workers and conflicts between workers and local communities. In case of a conflict between the workers, the intervention commander must timely settle, to avoid problems.	- Decree No. 73/2010/ND-CP	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
11.Workforce management	- Prohibiting: drinking alcohol, stimulant drugs at work; not carry adequate labor protection; improper use of equipment operating procedures. - Workers to be assigned to work in accordance with their professional training. Do not use the untrained/ unskilled workers. - When performing difficult and dangerous tasks, the work should be monitored by other closely. - It is strictly forbidden for workers who operating equipment leave the equipment in operation and not smoke near the fuel tank. - Providing adequate clean water for workers on barges. - All personnel to check health, safety - labor sanitation trained - Health and Safety measures according to ISO 5308-91. After the check is completed, a Health and Safety card is issued for each employee.	- Circular No. 37/ 2005/ TT - 29/12/2005	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

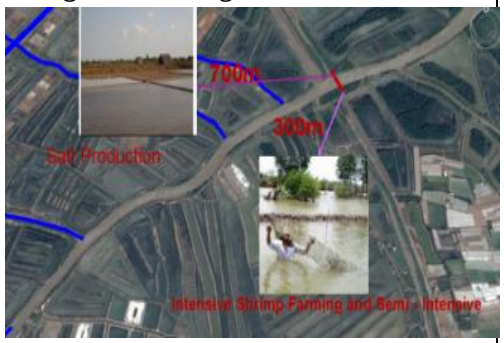
Environmental - social issues	***Mitigation measure***	***Vietnam code/regulation***	***Responsibility***	***Verification of effectiveness of measures***
12.Occurrence of accidents related to Dredging phase	- Overall laborers working on the dredging site work in compliance with, the provisions. - All dredging equipment on site have to meet the standard TCVN 2290-78 - Dredging machinery vehicles registered and inspected according. - Signal buoy installed in construction zones to warn and instruct traffic. - Require operators to stop the works and fix the problem in case abnormal things are observed. Dredging is only permitted during in safe conditions.	- TCVN 5308-91. the technical norms Health and Safety. - TCVN 2290-78 manufacturing equipment. - Decision No. 25/ 2004/ QD - BGTVT 25/11/2004 MOT - Decision No. 29/2004/ QD - BGTVT 25/11/2004 MOT.	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
II. In operation phase				
Maintenance Canals	- Setting up maintenance Canals. - Request dredging and good management of waste and sewage from aquaculture. - To prevent erosion, the canal roofs are designed to reduce the maximum velocity and the wave impact to the boats; reinforcement of embankments at the most important positions; after construction, dredging, creating available vegetation on both sides of the channel to prevent erosion ; Periodic dredging operation system as defined ; protect the safety corridor ; adjust the vessel speed to limit the impact of wave on the shore. - Periodically inspections of the piers at the edge of the embankment for timely handling measures when erosion occurs. - Predict the areas where landslides could occur.	- Law on water resources No. 17/2012/QH13	Liability company Ben Tre Irrigation Exploitation Local government	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

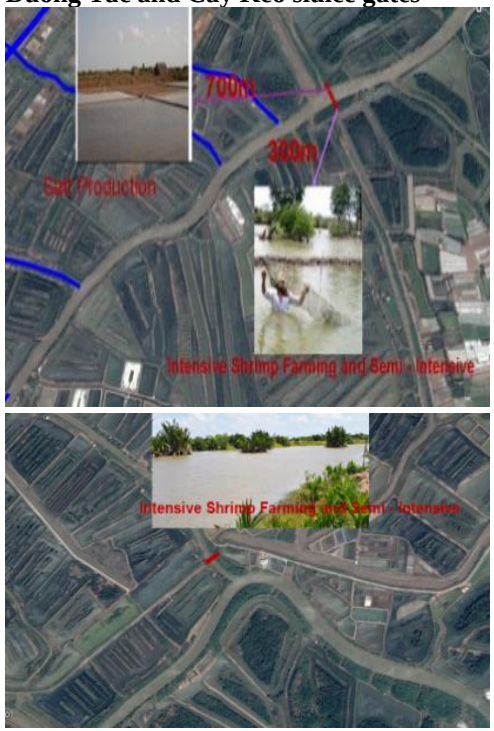
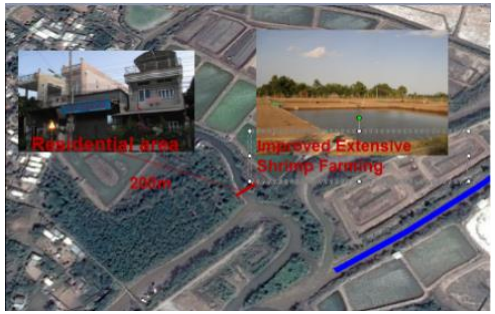
6.3.2. Site-specific Impacts and Mitigation Measures

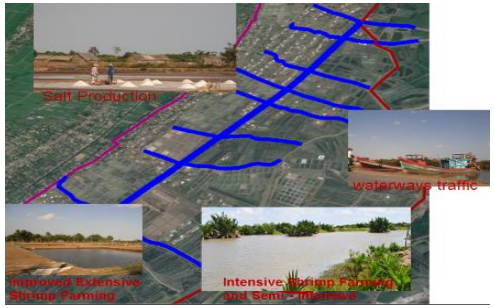
Error! Not a valid bookmark self-reference. presents site-specific impacts and mitigation measures that could not addressed through the application of the ECOPs. This may be because the impacts are very site-specific in nature and thus require very site-specific mitigation measures.

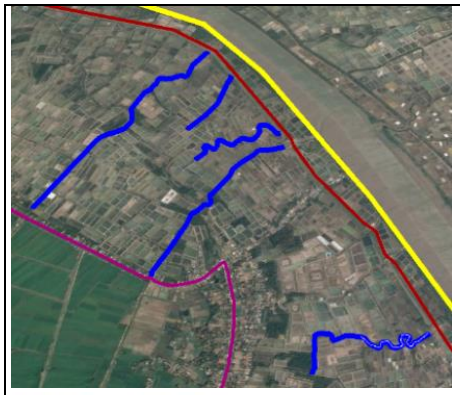
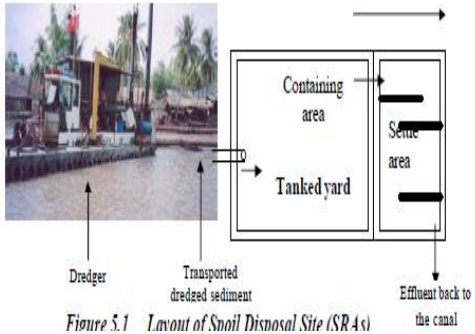
Table 6.3: Site -specific Mitigation Measures

Sensitive Area or Activity	Mitigation Measures	Vietnam code/ regulation	Responsibility	Verification of effectiveness of measures
A. For 5 sluice gates and canal dredging				
I. During pre-constrution phase				
Clearance of UXOs	- The subproject will allocate fund for clearance of the UXO remained after the war at the construction areas. The subproject owner will sign a contract with the specialized military unit in Ben Tre province to carry out the UXO clearance at the construction sites. This activity will be implemented right after completing land acquisition and compensation and before any dismantling, demolition or ground levelling takes place. - Ensure that the contractors shall only commence site works after the subproject areas are already been cleared	- Decision No. 96/2006/QD-TTg dated 04 May 2006 on management and implementation of bomb mine explosive material disposal.	- PPMU Ben Tre	- Implementation report - Supervision reports of the PPMU Ben Tre
II. During construction phase				
1. Salt production and shrimp farming at Duong Khai canal 	- Inform the local authorities, community, and shrimp pond owners of the construction activities and their potential impacts one month before start of the construction. - Ring-fence construction areas and create separate drainage to control erosion and sedimentation to the shrimp ponds and salt fields. - Collect wastewater, solid wastes, and contruction spoils and dispose at a designated site as required in the contractor's SEMP. - Use appropriate construction methods to reduce suspended solids in the water column such as steel sheet pile coffer dam. - Provide alternative water diversion to the shrimp ponds and sea water diversion channel to the salt filed if required.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 10:2008/BTNMT - Circular 36/2015/BTNMT - QCVN 14:2008/BTNMT - QCVN	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

	- Immediately rehabilitate any canal damaged by the construction activities. - Immediately address any problem caused by the subproject and raised by the local authorities, community, and affected shrimp pond owners and salt producers.			
2. Salt production and shrimp farming at Trang Nuoc sluice gate 	- Inform the local authorities, community, and shrimp pond owners of the construction activities and their potential impacts one month before start of the construction. - Ring-fence construction areas and create separate drainage to control erosion and sedimentation to the shrimp ponds and salt fields. - Collect wastewater, solid wastes, and contruction spoils and dispose at a designated site as required in the contractor's SEMP. - Use appropriate construction methods to reduce suspended solids in the water column such as steel sheet pile coffer dam. - Provide alternative water diversion to the shrimp ponds and sea water diversion channel to the salt filed if required. - Immediately rehabilitate any canal damaged by the construction activities. - Immediately address any problem caused by the subproject and raised by the local authorities, community, and affected shrimp pond owners and salt producers.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 10:2008/BTNMT - Circular 36/2015/BTNMT - QCVN 14:2008/BTNMT - QCVN	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

3. Salt production and shrimp farming at Duong Tac and Cay Keo sluice gates 	- Inform the local authorities, community, and shrimp pond owners of the construction activities and their potential impacts one month before start of the construction. - Ring-fence construction areas and create separate drainage to control erosion and sedimentation to the shrimp ponds and salt fields. - Collect wastewater, solid wastes, and contruction spoils and dispose at a designated site as required in the contractor's SEMP. - Use appropriate construction methods to reduce suspended solids in the water column such as steel sheet pile coffer dam. - Provide alternative water diversion to the shrimp ponds and sea water diversion channel to the salt filed if required. - Immediately rehabilitate any canal damaged by the construction activities. - Immediately address any problem caused by the subproject and raised by the local authorities, community, and affected shrimp pond owners and salt producers.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 10:2008/BTNMT - Circular 36/2015/BTNMT - QCVN 14:2008/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre
4. the residential area and shrimp farming at An Thanh sluice gates 	- Inform the local authorities, community, and shrimp pond owners of the construction activities and their potential impacts one month before start of the construction. - Ring-fence construction areas and create separate drainage to control erosion and sedimentation to the shrimp ponds and salt fields. - Collect wastewater, solid wastes, and contruction spoils and dispose at a designated site as required in the contractor's SEMP.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 10:2008/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Ben Tre

	- Use appropriate construction methods to reduce suspended solids in the water column such as steel sheet pile coffer dam. - Provide alternative water diversion to the shrimp ponds and sea water diversion channel to the salt filed if required. - Immediately rehabilitate any canal damaged by the construction activities. - Spray enough water during dry days to suppress dust. - Prohibit construction activities before 6:30 am and after 8:00pm. - Ensure traffic safety by installing safety fence, road safety warning sign, traffic instruction, around construction area. - Immediately address any problem caused by the subproject and raised by the local authorities, community, and affected shrimp pond owners and salt producers.	- QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT		
5. Dredging 	***For the five sluice gates:*** The total dredged materials would be 2,110 m^3. The total filling soil needed is 1,477 m^3. Therefore, the excess is 633 m^3 which will be temporarily stored at the five sites (Table 2.5). Anlysis of the soils indicates that they are not polluted by hazardous substances, and thus can be reused by the local people for filling eroded dykes or house foundation. ***For dredging the canals:*** The total dredged volume is 431,133m^3 over 28,700m of the 14 canals. Analysis results presented in Table 2.16 - Table 2.19 showed that sediment and soil samples in these areas are within the permitted standard and are not contaminated with the heavy metals or organic matters. Therefore, the dredged soil and sediment can be utilized as leveling materials during construction and operation phases, and no disposal sites are needed. The following site-specific mitigation meares need to be implemented:	- QCVN 10:2008/BTNMT - QCVN 14:2008/BTNMT - QCVN 17: 2011/ BGTVT national technical standards and regulations on prevention of pollution of inland waterway.	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PMU

  *Figure 5.1 Layout of Spoil Disposal Site (SDAs)*	- Only dredge in the dry season and the tide at low level when there is no aquaculture and activities take water for salt production. - Notify the local community about the schedule of dredging works. - Create drainage ditches along the dredged canals between the canals and the aquaculture ponds to avoid erosion and sedimentation to the ponds. - Implement environmental monitoring for Contractors during the construction period. - Regulate traffic to minimize the impact on waterways traffic. - Strict control of chemicals and hazardous waste, store in areas that are not flooded and located far from water bodies. - Liability to pay loss if the incident causing loss to the area residents. - All complaints about environmental pollution, households can directly contact the local people community for guidance and settlement. - As the dredged materials are in the state of mud at first and soil particles are suspended for 24 to 48 hours. All drainage water from disposal land shall be driven to the drains and discharged back to the canal. In order to limit the negative impacts of mud (produced by dredging) on the environment as well as the water quality of the canals, the dredged sediment will be transported to a containing area which is appropriately located and properly design with an adequate size. The dredged spoil will be pumped to the disposal land and then overflow to a settlement pond, where turbidity and total suspended solids are settled. After some time, effluent is returned to the canals.			
B. Mangrove plantation (component 1)				

Mangrove forest management	Obtain permission from the before planting, thinning or harvesting mangroves, including (i) thining tree as first thinning to a density of 5,000 trees/ha at 9 to 10 years of age and second thinning to a density of 2,000 -2,500 trees/ha at 14 -15 years of age; (ii) Harvesting at about 20 years of age, after harvesting, prepare to plant a new cycle and obtain permission from the before planting, thinning or harvesting mangroves.	- Law on Forest Protection and Development No. 29/2004/QH11	- Division of Foresty of Ben Tre province - Ben Tre PPMU	- Supervision reports of CSC - Supervision and monitoring reports of Ben Tre DARD
C. Implementation of Livelihood Models (3 Zones)				
I. Ensure adequate measures to mitigate potential negative impacts on poor farmers dur to implementation of the Mangrove-shrimp to organically certified mangrove-shrimp model	- Forest area must be at least a certain percentage of the area of the land plot depending on the types of certificate (e.g., Natureland Certificate: 40% as a starting point moving to 50% within 2 years). So, farmers always keep the forest area as requirements of certification authorities. - Obtain permission from the before planting, thinning or harvesting mangroves, including (i) thining tree as first thinning to a density of 5,000 trees/ha at 9 to 10 years of age and second thinning to a density of 2,000 -2,500 trees/ha at 14 -15 years of age; (ii) Harvesting at about 20 years of age, after harvesting, prepare to plant a new cycle and obtain permission from the before planting, thinning or harvesting mangroves. - Do not place soil from pond construction or cleaning in mangrove areas, because Rhizophora trees do not grow well or may die on high land without flooding by the tide. - Do not pump soil from pond construction or cleaning into waterways. - Use soil from pond construction and cleaning to build up an area of high land for domestic use or where other crops can be grown. - Regularly circulate water in the ponds to prevent low oxygen conditions and reduce local accumulations of mangrove leaves.	- Law on Forest Protection and Development No. 29/2004/QH11 - Law on Fisheries No. 17/2003/QH11 -	Division of Foresty of Ben Tre province Ben Tre PPMU Division of Aquaculture of Ben Tre province - Agriculture and Fishery Extension Center of Ben Tre province	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

Prevent expanding shrimp aquaculture industry poses one of the gravest threats to mangrove forests	The following recommendations increase the success and extension of shrimp - mangrove eco-farming: - The local authority need to give right financial incentives for farmers they are likely to apply production shrimp and expand mangrove forest cover. - The DARD must help farmers design, provision of mangrove seedlings, certification costs, linking farmers to markets. - 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. - Training for farmers the farming procedures follow the standards guidelines. The shrimp farming in the area that is not yet certified need to practice in the area already certified. - Increase control by District FPD. - Public technical documentation shrimp international standards issued to farmers. - Setting up internal control systems in shrimp - mangrove eco-farming communities. - Establishing of community management of shrimp - mangrove eco-farming. - Supporting for the afforestation area is not up to the standard of GAP. - Guidance for farmers notes and keeps management documents according to international standards. - Linking farmers to markets by link enterprise companies with farmers. - Workshop set up chain linking: Providing seeds, supplies - Establishing links with the business chain purchasing, processing and exporting seafood. - Lobbying of civil society organizations is important to motivate more buyers to procure ECO shrimp and thus to further increase its market volume. The domestic	- Law on Forest Protection and Development No. 29/2004/QH11 - Law on Fisheries No. 17/2003/QH11 -	Division of Foresty of Ben Tre province Ben Tre PPMU Division of Aquaculture of Ben Tre province - Agriculture and Fishery Extension Center of Ben Tre province	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

	market for ECO shrimp can be enlarged by continuous media coverage regarding the environmental and health benefits of organic shrimp aquaculture. Developing and promoting brand internationally certified - mangrove eco-farming.			
II. Ensure adequate measures to mitigate potential negative impacts on poor farmers dur to implementation of the Biosecurity of shrimp model	*Seed quality and screening:* The good quality shrimp fry will grow well and have high survival rate. Skilled assessment of seed health prior to purchase should reduce disease risks. *Pond filling and water preparation:* - Good design of shrimp ponds—in particular, design of water supply and discharge systems—can have a major impact on sustainability. - Ensure high-quality water supply and optimal pond water conditions; - Closely located to quality water suitable for shrimp culture - Treatment of influent water supply to eliminate pathogens and carriers may reduce disease incidence and associated use of chemicals. - Intensive aeration may itself serve as a form of water treatment. *Mitigation of organic pollution*: Feed management, Water management (see *5.4.2.3)* *Mitigation of chemicals' effects (*see *5.4.2.4)* *Energy source and fuel management (5.4.2.5)* *Farm sanitation management (*see *5.4.2.6)* *Labour management (*see *5.4.2.7)* *Social and environmental responsibilities (*see *5.4.2.8)*	- Law on Fisheries No. 17/2003/QH11 - QCVN 09:2008/BTNMT - QCVN 02 - 19 : 2014/BNNPTNT -	Division of Aquaculture of Ben Tre province Agriculture and Fishery Extension Center of Ben Tre - Ben Tre PPMU	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE
Reduce potential negative impacts due to possible expansion of the Biosecurity of shrimp model	- Control land use plans with the multi-disciplinary assistance of agricultural, aquaculture and forestry (mangrove-shrimp). - Need the expertise of agricultural and aquaculture specialists to optimize the structural works supporting expansion models. For example, water quality, issues risks, quality produce, and market confidence, and reach commercial sizes to fetch optimal prices.	- Law on Fisheries No. 17/2003/QH11 - QCVN 09:2008/BTNMT - QCVN 02 - 19 : 2014/BNNPTNT -	Division of Aquaculture of Ben Tre province Agriculture and Fishery Extension	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

	- Share and transfer lessons and experience between Biosecurity of shrimp in the subprojects. Sharing lessons and experience between Biosecurity of shrimp in subproject could also help increase safe production. - Operation sluice gates can better control the water availability and quality needs of the respective Biosecurity of shrimp will be critical to reducing farmers' climate/environmental risks. - These clean production systems could be similarly developed in zone Biosecurity of shrimp system. - These models could be adopted in the Zone 2 Biosecurity of shrimp systems - which have relatively high productivity - to increase income. - Expansion models near successful Biosecurity of shrimp in order to change farmer's perceptions. Farmer to farmer exchanges of knowledge and experience would also be more likely to occur, and easier to facilitate. - Farmers should be provided with financial and economic analysis of the demonstrations once the pilots are demonstrated to be financially beneficial. Scaling-up should branch out from these areas. The same approach could also be used in the Neighboring farmers. - Conduct water quality control for Biosecurity of shrimp zone (both fresh and brackish water) if the livelihoods are to be sustainable. - Collecting data Biosecurity of shrimp systems. - Establishing of community management Biosecurity of shrimp farming. - Training courses for farmers on GFM introduction and application. - Training methods of collecting water samples, samples of shrimp diseases. - Public manuals measuring environmental factors and sampling water bowl disease. - Building regulations farming communities. - Organize environmental commitment signed between farmers.		Center of Ben Tre Ben Tre PPMU	

	- Organization of environmental monitoring and notification of monitoring results and recommends solutions to social radio.			
Ensure adequate measures to mitigate potential negative impacts on poor farmers dur to implementation of the Rice crop+ Giant Freshwater Shrimp model	- Treatment waster water from aquaculture farming before discharging into water course. - Develop and integrate real-time environmental monitoring tools into the livelihood component of the subproject. - Share and transfer lessons and experience between subprojects under the MD-ICRSL project. - Use farmer cooperatives or collective groups to implement livelihood adaptation models. - Locate pilot livelihood demonstrations near successful models in order to change farmer's perceptions. - Reduce the risk of over-supply by working with agribusinesses on a staged incremental approach. - Start-up capital needs to be provided to fund the livelihood investments. - Hire aquaculture and agriculture specialists to support cooperatives/collective groups. - Establish hatcheries capable of producing high quality aquaculture seed as close as possible to the subproject site.	- Law on Fisheries No. 17/2003/QH11 - QCVN 09:2008/BTNMT - QCVN 02 - 19 : 2014/BNNPTNT -	Division of Aquaculture of Ben Tre province Agriculture and Fishery Extension Center of Ben Tre Ben Tre PPMU	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE
Reduce potential negative impacts due to possible expansion of the the Rice crop+ Giant Freshwater Shrimp model	- Priority is to maitain incomes for farmers, avoid economic shocks: Allow continuing freshwater production where still economically viable, adjust the cropping systems (away from rice) and calendar to cope with shortage of freshwater in dry season. No big investments in infrastructure to maintain freshwater production, especially for rice. - Develop a transitional plan with clear and realistic goals. The plan should clearly identify various steps to be taken in making the transition to aquaculture and be sure to include realistic time frames. - Build capacity and necessary steps to allow smooth transition: improve the technical capacity of farmers; create effective mechanisms for strengthening, promoting, and disseminating locally initiated efforts.	- Law on Fisheries No. 17/2003/QH11 - QCVN 09:2008/BTNMT - QCVN 02 - 19 : 2014/BNNPTNT: N -	Division of Aquaculture of Ben Tre province Agriculture and Fishery Extension Center of Ben Tre Ben Tre PPMU	- Ba Tri District People's Committee - Ben Tre DARD - Ben Tre DONRE

	- Subsidize and improve access to credit services. - Establish commune CC Response Team to raise local awareness, identify collective action plan, pilot CC farming models, and establish farmer organizations. - Improve links between production and markets; and establish effective mechanisms for coordination. - The land use changes and water infrastructure must take into account the future conversion of the intensive shrimp growing area behind District Road 16 and how effluent – rice agrochemicals in the short term, aquaculture effluent in the long term – will be discharged into downstream areas. - 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 DARD Ben Tre for consideration and approval.			

Addressing Regional Environmental Impacts

The REA report systematically and qualitatively assesses the regional impacts of the proposed subprojects. The regional impacts, both positive and negative, are generally mild and moderate for two reasons: i) the scale of the investments, from a regional perspective, are small; and ii) the investments are designed to be low-regret and conform with the 2013 Mekong Delta Plan strategies for sustainable development. In addition to addressing the regional environmental impacts at the subproject level through satisfactory implementation of the subproject ESMP, a Technical Assistance (TA) will be provided to help address regional issues. A well-designed Component 1 ($48 million) of the MDICRSL supports the following initiatives through technical assistance activities in the Project which will be extended to the subproject level:

- **Formulation of a Mekong Delta Climate Sustainability Assessment**: This will be comprehensive assessment of Delta sustainability issues, including status, trends, and recommendations on how to adaptively manage the Delta in context of rapidly changing environmental conditions. It will be a document that informs the government's next five year regional, local, and sectoral planning in the Delta. The Assessment should be completed by 2019 and will help to inform planning exercises in the Vietnam government, including the Ministry of Planning and Investment's (MPI) "Socio-Economic Development Plan for the Mekong Delta", provincial socio-economic development and land use plans, and sector master plans for the next planning cycle (2021-2025). The Assessment will develop a set of key environmental and socio-economic indicators related to MD sustainability taking into account the regional environmental impacts of the MD development, and then assess the status, trends, and driving factors related to those indicators. The Assessment will also identify any data or knowledge gaps which need to be addressed for the next Assessment process, which ideally should take place every five years. Finally, the Assessment will provide a set of recommendations related to the next planning cycle in order promote adaptive management of the Delta.
- **Upgrading Monitoring Programs:** Including remote sensing, land use, water quantity and quality, groundwater, coastal and river morphology, coastal zone protection, etc. to provide better information. These programs will help produce better tools and information for both planning and management purposes, including informing design of phase II subprojects to address the regional environmental impacts. The results of the programs will be shared with the project provinces and broader MD stakeholders, and other relevant capacity building activities will be developed and carried out during project implementation.
- **Establishment of the Mekong Delta Center:** Several research institutes and departments are involved in gathering and analyzing data and information on the Delta; however, there are no current mandates for data sharing which would contribute to the integrated and multi-sectoral solutions that are often needed. The Center is envisioned to serve as a hub for Delta-wide information, including water, land use, environmental and climate change information, education and outreach, and provide support to specialized studies and research projects that inform decisions and investments in the Mekong Delta. For addressing regional environmental impacts the provinces will benefit from data provided by the center.
- **MARD Real Time Operations System for Hydraulic Infrastructure:** This will be a decision support center to provide real-time information on salinity, floods, and droughts to allow for better operation of infrastructure, especially the sluice gates, to meet real-time conditions and demands. Under the system a database on MD sea dykes and mangrove forests will be established for a systematic assessment and monitoring of sea dykes and

mangrove belts, which will allow for better monitoring, maintenance, and investments for these critical coastal assets.

6.4. ENVIRONMENTAL MONITORING PROGRAM

The main objective of the environment monitoring program is to ensure that (a) the potential negative impacts of the project are minimized; (b) the ESMP is effectively implemented; and (c) the ESMP is adequate to mitigate the potential negative impacts. Given that monitoring the implementation of the RAP will be conducted separately, the environmental monitoring program will comprise: (a) monitoring the safeguard performance of the contractor during site clearance and construction; (b) environmental quality monitoring; (c) community-based monitoring; and (d) monitoring effectiveness of the ESMP.

6.4.1. Monitoring of Contractor's Safeguard Performance

Three levels of safeguard monitoring will be implemented: routine monitoring, periodic monitoring, and community monitoring, as follows:

- Routine monitoring: The routine monitoring will be made by the Construction Supervision Consultant (CSC) as assigned by PPMU Ben Tre. The CSC will include the monitoring results in the project progress reports.
- Periodic monitoring (every six months): As part of the overall monitoring of the ESMP, the ESU assisted by the Independent Environmental Monitoring Consultant (IEMC) will also monitor the contractor performance every 6 months and the results will be reported to the PPMU Ben Tre and the WB.
- Community monitoring: Monitoring by local communities will be conducted following the Government practices with the technical and management support from the PPMU Ben Tre.

6.4.2. Environmental Quality Monitoring

To ensure an acceptable level of environmental quality, monitoring of dust, noise, vibration, air quality, and water quality will be made at project specific locations that are likely to be significantly affected by the construction activities, or requested by local authorities and communities for specific purposes. ESU/IEMC will be responsible for the monitoring of the program.

Below is a list of the key issues and scope of monitoring that will be considered in the implementation of the monitoring program (*Table 6.4*):

- *General Construction Impacts:* To include local flooding; traffic management especially in residential areas; air, noise, and dust levels in residential areas; and water quality upstream and downstream of construction sites, with specific attention on impacts to local residents;
- *Others:* As agreed with local agencies and communities during the preparation of the monitoring program.

The monitoring scope provides general guidance on the monitoring program and estimated cost considering that the activities will be carried out before construction (subproject baseline environment), during construction (assumed 1 years), and during the first 2 years of subproject operation. Detailed monitoring programs will be prepared during the detailed design stage. An estimated cost for monitoring is incorporated into the ESMP cost (Section 6.6). Many of these measurements are required by Vietnamese regulations and would need to be done even if not directly related to expected subproject impacts.

Table 6.4: Scope of environmental monitoring during construction and operation

No	Contents	Specific requirements		Applied standard
		5 sluices	14 canals	
I	**Construction phase**			
1	Air/noise, vibration			QCVN 05:2013/BTNMT, QCVN 26:2010/BTNMT; QCVN 27:2010/BTNMT
a	Parameters	TSP, NO_2, SO_2, CO, noise, vibration		
b	Locations	5 stations		
c	Frequency	03 months/time x 12 months		
2	Water + micro organism + aquatic life			QCVN 08-MT:2015/BTNMT
a	Parameters	pH, Turbidity, Salinity, DO, TSS, BOD_5, TN, TP, oil & grease, coliform, phytoplankton, zooplankton, zoobenthos		
b	Locations	5 stations	14 stations	
c	Frequency	03 months/time x 12 months	03 months/time x 6 months	
3	Sediment			QCVN 43:2012/BTNMT;
a	Parameters	pH_{KCl}, salinity, Cu, Pb, Zn, Cd, As, TP, TN, TC		
b	Locations	5 stations	14 stations	
c	Frequency	03 months/time x 12 months	03 months/time x 6 months	
II	**Operation phase**			
1	Water + micro organism + aquatic life			QCVN 08-MT:2015/BTNMT
a	Parameters	pH, Turbidity, Salinity, DO, TSS, BOD_5, TN, TP, oil & grease, coliform, phytoplankton, zooplankton, zoobenthos		
b	Locations	5 stations	14 stations	
c	Frequency	06 months/time during the first 2 years of operation	06 months/time during the first 2 years of operation	
2	Sediment			QCVN 43:2012/BTNMT;
a	Parameters	pH_{KCl}, salinity, Cu, Pb, Zn, Cd, As, TP, TN, TC		
b	Locations	5 stations	14 stations	
c	Frequency	06 months/time during the first 2 years of operation		

6.4.3. Community-based monitoring

Community-based monitoring is a voluntary activity of people living in commune/ward areas.

Community Supervision Board will be established by Decision N°. 80/2005/QD-TTg and others relevant regulations. Community Supervision Board will be responsible for:

- Monitoring and assessing the observance of investment management regulations by agencies competent to decide on investment, Subproject owner, subproject management unit, contractors and subproject-implementing units in the investment process (including environmental issues);
- Detecting and recommending to the competent state agencies on violations of regulations on investment management (including environmental issues) so as to promptly prevent and handle acts that violate regulations, cause wastage and/or loss of state capital and properties or infringe the interests of the community.

6.4.4. Monitoring Effectiveness of the ESMP

The ESU assisted by IEMC will monitor performance of the ESMP implementation during the detailed design/bidding stage as well as during construction and first year operation of the facilities to ensure that (a) appropriate dredging and disposal of drainage sludge is properly carried out, in accordance with the ESMP; (b) other impacts identified in the ESMP are effectively managed and mitigated; and (c) traffic management is adequate and the level of impacts is acceptable (no complaints or outstanding cases). Results are to be properly kept in the subproject file for possible review by PPMU and the WB. Cost for the monitoring will be part of the PPMU cost.

6.5. ROLE AND RESPONSIBILITIES FOR ESMP IMPLEMENTATION

6.5.1. Implementation arrangement

Role and responsibilities for ESMP implementation are described in *Figure 6.1* and *Table 6.5*.

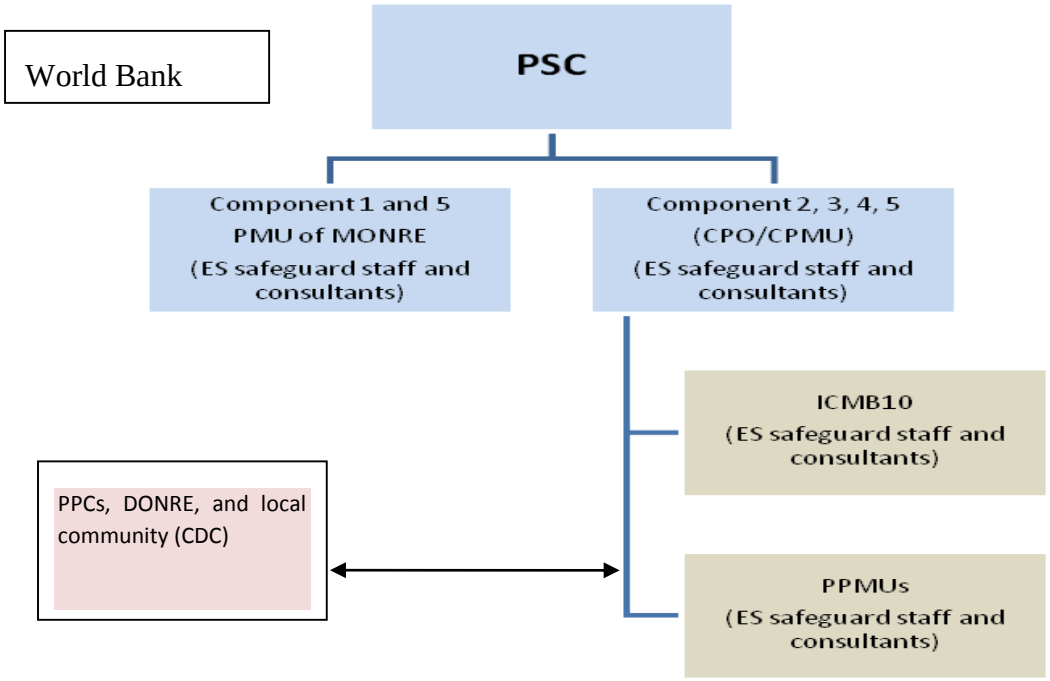


Figure 6.1: Organization structure for safeguard monitoring

Table 6.5: Institutional Responsibilities for the Project and Subproject Safeguard Implementation

Community/ Agencies	Responsibilities
Project Implementing Agency (IA) and PMU (The IA means MARD and MONRE while PMU here means the PMU of MONRE and CPMU and ICMB10 of MARD and PPMU of the Ben Tre province)	- The IA will be responsible for overseeing the Project implementation including ESMF implementation and environmental performance of contractors. - PMU, representative of the IA, will be responsible for monitoring the overall Project implementation, including environmental compliance of the Project. PMU will have the final responsibility for ESMF implementation and environmental performance of the Project during the construction and operational phases. - Specifically the PMU will: (i) closely coordinate with local authorities in the participation of the community during project preparation and implementation; (ii) monitor and supervise ESMP implementation including incorporation of ESMP into the detailed technical designs and bidding and contractual documents; (iii) ensure that an environmental management system is set up and functions properly; (iv) be in charge of reporting on ESMP implementation to the IA and the World Bank. - In order to be effective in the implementation process, PMU will establish an Environmental and Social Unit (ESU) with at least two safeguard staff to help with the environmental aspects of the Project.
Environmental and Social Unit (ESU) under PMU	- The ESU is responsible for monitoring the implementation of the World Bank's environmental safeguard policies in all stages and process of the Project. Specifically, this unit will be responsible for: (i) screening subprojects against eligibility criteria, for environment and social impacts, policies triggered and instrument/s to be prepared;(ii) reviewing the subproject EIAs/EPPs and ESIAs/ESMPs prepared by consultants to ensure quality of the documents; (iii) helping PMU incorporate ESMPs into the detailed technical designs and civil works bidding and contractual documents; (iv) helping PMU incorporate responsibilities for ESMP monitoring and supervision into the TORs, bidding and contractual documents for the Construction Supervision Consultant (CSC) and other safeguard consultants (SSC, ESC, IMA, and EMC) as needed; v) providing relevant inputs to the consultant selection process; (v) reviewing reports submitted by the CSC and safeguard consultants; (vi) conducting periodic site checks; (vii) advising the PMU on solutions to environmental issues of the project; and viii) preparing environmental performance section on the progress and review reports to be submitted to the Implementing Agency and the World Bank.
PPMUs, DARDs, ICMB10, PMU of MONRE	- As the subproject/activity owner, PPMU/ICMB10/PMU of MONRE is responsible for implementation of all the ESMP activities to be carried out under the Project, including fostering effective coordination and cooperation between contractor, local authorities, and local communities during construction phase. PPMU/ICMB10/PMU of MONRE will be assisted by the environmental staff, safeguard consultants, and CSC/or field engineer. - Division of Aquaculture of Ben Tre Province DARD and Agriculture and Fishery Extension Center of Ben Tre Province are responsible for livelihoods models.

	- During operation, the responsibility to operate the sluice gate will be transferred to the Provincial Department of Water Resources (PDWR) of DARD and they will be responsible for monitoring of water quality and ecosystem before and after the operation of the sluice gates and submit water quality report to the DONRE one time per three months.
Construction Supervision Consultant (CSC) and/or Field Engineer	- The CSC will be responsible for routine supervising and monitoring all construction activities and for ensuring that Contractors comply with the requirements of the contracts and the ECOP. The CSC will engage sufficient number of qualified staff (e.g. Environmental Engineers) with adequate knowledge on environmental protection and construction project management to perform the required duties and to supervise the Contractor's performance. - The CSC will also assist the PMU/PPMU/ICMB10/PMU of MONRE in reporting and maintaining close coordination with the local community.
Contractor	- Based on the approved environmental specifications (ECOP) in the bidding and contractual documents, the Contractor is responsible for establishing a Contractor ESMP (CESMP) for each construction site area, submit the plan to PPMU/ICMB10/PMU of MONRE and CSC for review and approval before commencement of construction. In addition, it is required that the Contractor get all permissions for construction (traffic control and diversion, excavation, labor safety, etc. before civil works) following current regulations. - The Contractor is required to appoint a competent individual as the contractor's on-site *Safety and Environment Officer (SEO)* who will be responsible for monitoring the contractor's compliance with health and safety requirements, the CESMP requirements, and the environmental specifications (ECOP). - Take actions to mitigate all potential negative impacts in line with the objective described in the CESMP. - Actively communicate with local residents and take actions to prevent disturbance during construction. - Ensure that all staff and workers understand the procedure and their tasks in the environmental management program. - Report to the PPMU/ICMB10/PMU of MONRE on any difficulties and their solutions. - Report to local authority and PPMU/ICMB10/PMU of MONRE if environmental accidents occur and coordinate with agencies and keys stakeholders to resolve these issues.
Independent Envionmental Monitoring Consultants (IEMC)	- IEMC will, under the contract scope, provide support to PPMU/ICMB10/PMU of MONRE to establish and operate an environmental management system, offers suggestions for adjusting and building capacity for relevant agencies during project implementation and monitor the CESMP implementation in both construction and operation stages. IEMC will also be responsible to support PPMU/ICMB10/PMU of MONRE to prepare monitoring reports on ESMP implementation. - The IEMC will have extensive knowledge and experience in environmental monitoring and auditing to provide independent, objective and professional advice on the environmental performance of the Project.

Local community	- Community: According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and the CPMU/PPMU/ICMB10/PMU of MONRE. If unexpected problems occur, they will report to the CSC and/or CPMU/PPMU/ICMB10/PMU of MONRE.
Social organizations, NGOs and civil society groups	- These organizations could be a bridge between the PPC/DPC, communities, Contractors, and the CPMU/PPMU/ICMB10/PMU of MONRE by assisting in community monitoring. - Mobilizing communities' participation in the subproject, providing training to communities and Participating in solving environmental problems, if any.
Province and District People's Committees (PPCs/DPCs), Provincial DONRE	- Oversee implementation of subprojects under recommendations of DONRE and PPMU/ICMB10/PMU of MONRE to ensure compliance of Government policy and regulations. DONRE is responsible for monitoring the compliance with the Government environmental requirements.

6.5.2. Environmental Compliance Framework

6.5.2.1. Environmental Duties of the Contractor

The contractor firstly shall adhere to minimize the impact that may be result of the project construction activities and secondly, apply the mitigation measures under ESMP to prevent harm and nuisances on local communities and environment caused by the impacts in construction and operation stages.

Remedial actions that cannot be effectively carried out during construction should be carried out on completion of the works (and before issuance of the acceptance of completion of works)

The duties of the Contractor include but not limiting to:

- ✓ Compliance with relevant legislative requirements governing the environment, public health and safety;
- ✓ Work within the scope of contractual requirements and other tender conditions;
- ✓ Organize representatives of the construction team to participate in the joint site inspections undertaken by the Environmental Supervisor (ES) of the CSC;
- ✓ Carry out any corrective actions instructed by the Environmental Control Officer (ECO) of the PPMU and ES;
- ✓ In case of non-compliances/discrepancies, carry out investigation and submit proposals on mitigation measures, and implement remedial measures to reduce environmental impact;
- ✓ Stop construction activities, which generate adverse impacts upon receiving instructions from the ECO and ES. Propose and carry out corrective actions and implement alternative construction method, if required, in order to minimize the environmental impacts; Non-compliance by the Contractor will be cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of the ECO and ES.

6.5.2.2. Contractor's Safety and Environment Officer (SEO)

The contractor shall be required to appoint a competent individual as the Contractor‘s on-site

safety and environment officer (SEO). The SEO must be appropriately trained in environmental management and must possess the skills necessary to transfer environmental management knowledge to all personnel involved in the contract. The SEO will be responsible for monitoring the contractor‘s compliance with the ESMP requirements and the environmental specifications. The duties of the SEO shall include but not be limited to the following:

- ✓ Carry out environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented;
- ✓ Monitor compliance with environmental protection measures, pollution prevention and control measures and contractual requirements;
- ✓ Monitor the implementation of environmental mitigation measures;
- ✓ Prepare audit reports for the environmental monitoring data and site environmental conditions;
- ✓ Investigate complaints and recommend any required corrective measures;
- ✓ Advise the contractor on environment improvement, awareness and proactive pollution prevention measures;
- ✓ Recommend suitable mitigation measures to the contractor in the case of non-compliance. Carry out additional monitoring of noncompliance instructed by the ECO/ES;
- ✓ Inform the contractor and ECO/ES of environmental issues, submit contractor’s ESMP Implementation Plan to the ECO/ES, and relevant authorities, if required;
- ✓ Keep detailed records of all site activities that may relate to the environment.

6.5.2.3. Independent Environmental Monitoring Consultant (IEMC)

In order to minimize the environmental impacts during construction stage of the Project, the Project owner shall ensure that environmental quality monitoring requirements are established for the project. An Independent Environmental Monitoring Consultant (IEMC) appointed by CPMU shall carry out the monitoring.

- ✓ IEMC will be responsible for carrying out environmental sampling, monitoring and marking report during all stages of the Project. Environmental quality monitoring will be report periodically to PPMU (every 06 months in construction stage and in operation stage).
- ✓ IEMC will also supply specialized assistance to CPMU and ECO in environmental matters.

6.5.2.4. Environmental Supervision during Construction

During construction stage, a qualified Construction Supervision Consultant (CSC) reporting to the PPMU shall carry out the environmental supervision. The CSC is responsible for inspecting, and supervising all construction activities to ensure that mitigation measures adopted in the ESMP are properly implemented, and that the negative environmental impacts of the Project are minimized. The CSC shall engage sufficient number of Environmental Supervision Engineers with adequate knowledge on environmental protection and construction project management to perform the required duties and to supervise the Contractor’s performance. Specifically ES will:

- ✓ Review and assess on behalf of the PPMU whether the construction design meets the requirements of the mitigation and management measures of the ESMP,

- ✓ Supervise site environmental management system of contractors including their performance, experience and handling of site environmental issues, and provide corrective instructions;
- ✓ Review the ESMP implementation by the contractors, verify and confirm environmental supervision procedures, parameters, monitoring locations, equipment and results;
- ✓ Report ESMP implementation status to PPMU and prepare the environmental supervision statement during the construction stage; and
- ✓ Approve invoices or payments.

6.5.2.5. Compliance with Legal and Contractual Requirements

The constructions activities shall comply not only with contractual environmental protection and pollution control requirements but also with environmental protection and pollution control laws of the Socialist Republic of Viet Nam.

All the works method statements submitted by the Contractor to the ECO for approval shall also be sent to the ES to see whether sufficient environmental protection and pollution control measures have been included.

The ES shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any potential for violating the laws can be prevented.

The Contractor shall copy relevant documents to the SEO and the ES. The document shall at least include the updated work progress report, the updated work measure, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit. The SEO and the ES shall also have access, upon request, to the Site Log-Book.

After reviewing the documents, the SEO or the ES shall advise the ECO and the contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the SEO or the ES concludes that the status on license/permit application and any environmental protection and pollution control preparation works may not comply with the work measure or may result in potential violation of environmental protection and pollution control requirements, they shall advise the Contractor and the ECO accordingly.

6.5.2.6. Environmental Claims and Penalty System

In the compliance framework, if non-compliance with environmental regulations are discovered by ECO/CSC/ES/IEMC during the site supervision, 2% values of interim payment of the contractor of this month will be held back. The Contractor will be given a grace period (determined by CSC/ES) to repair the violation. If the Contractor performs the repairs within the grace period (confirmed by CSC/ES), no penalty is incurred and keeping money will be pay. However, if the Contractor fails to successfully make the necessary repairs within the grace period, the Contractor will pay the cost for a third party to repair the damages (deduction from keeping money).

In case of IEMC/CSC/ES not detected of non-compliance with environmental regulations of the contractor, they will be responsibility payment to repair the violation.

6.5.3. Reporting Arrangements

ESMP monitoring and reporting requirements are summarized in *Table 6.6*.

Table 6.6: Regular Reporting Requirements

No.	***Report Prepared by***	***Submitted to***	***Frequency of Reporting***
1	Contractor to the Employer	PPMU Ben Tre	Once before construction commences and monthly thereafter
2	Construction Supervision consultant (CSC)	PPMU Ben Tre	Weekly and monthly
4	Community Monitoring	PPMU Ben Tre	When the community has any complaint about the subproject safeguards implementation
5	PPMU Ben Tre	CPMU	Monthly
6	CPMU	WB	Every six-month

6.6. CAPACITY BUILDING PROGRAM

6.6.1. Technical assistance support for the implementation of safeguards

An assessment of safeguards implementation capacity of existing PPMU staff indicates the staff have limited knowledge on WB safeguard requirements as well as limited knowledge of environmental and social issues. Such lack of capacity represents a risk to project implementation of safeguards requirements contained in the ESMP and, as required by the WB policy, is to be addressed through capacity building. Therefore it is proposed to provide capacity building through technical assistance that will support the PPMU during the implementation of the safeguards requirements. The technical assistance will provide the necessary technical support for the PPMU in its work with contractors as well as other entities involved in the implementation of the ESMP.

The scope of the technical assistance would cover support from experts and training that would include knowledge on safeguards requirements and procedures for the subproject as well as training that covers both specific knowledge on safeguard procedures and requirements for the subproject staff, consultants, and national contractor. More specifically, the support would include, for example, assistance in the preparation of documents and implementation of training programs on environmental management and environmental monitoring for contractors, CSC and relevant staff of PPMU (environmental staff and coordinators of packages) to do their tasks. It would also include assisting the PPMUs' environmental staff with the review of contract documents on the bidding packages for construction items of the subproject to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements; as well as provide general environmental guidance as requested by the PPMU to enhance overall project implementation and performance.

Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the project implementation. The WB safeguard specialists will participate in the capacity building, in particular in the training activities as appropriate.

Special technical assistance: Additional technical assistance will be necessary for ensuring that (a) the potential negative impacts during sluice operations will be minimized and accepted by key stakeholders, (b) the mitigation measures for potential impacts on socio-economic conditions of poor farmers is adequate and farmers have improved knowledge to minimize technical and marketing risks, and (c) regulatory measures to control and manage possible induced impacts due to possible expansion of the livelihood models is inplace before the

subproject closing. It is expected that 2 national firms will be mobilized to provide these technical services: for (1) for safeguard training and the development and consultation of the operation plan for the sluice gates including meetings and workshops for 2 years during 2017-2019 and (2) (i) the planning and undertaking socio-economic survey for the farmers in the pilot sites and nearby areas for 3 years during (2017-2020), (ii) development of a registration program on aquacutlure farming in the subproject and nearby areas, and (iii) development of FFS application and implementation of a series of technical workshops, TOT, and development of guidelines and awareness materials, and study visits and building farmer network etc. to be implemented during 2017-2020. TORs for these technical assistances will be prepared by the subproject owner in close consultation with CPMU.

6.6.2. Training programs proposed

Table 6.7 provides the basic training programs for safeguards during subproject implementation. The training programs will be developed and delivered by the Technical Assistance team for the implementation of safeguards for the PPMU training. The PPMU/IEMC with the support of the the Technical Assistance team for the implementation of safeguards will provide the training to contractors, CSC and other groups. In addition, given limited safeguard capacity of the main stakeholders of the project, The Bank will provide a training on Preparation of ESIA and Integration of Cumulative Impact Assessment (CIA) into ESIA which is part of the safeguards capacity program to develop during implementation while identifying and agreeing on one of the specific training or capacity building activities. The Bank consultant will provide a five-day training on integration of CIA into ESIA and on how to address the quality and the implementation of the EIAs in conjunction with other safeguards instruments

Other more specific and tailored training will be developed and agreed upon between PPMU, IEMC and the Technical Assistance team for the implementation of safeguards during project implementation based upon a reassessment of needs and the status of safeguards implementation with the following contents (*Table 6.7*):

- Target groups for the training include PPMU staff, ESU staff, field engineers, CSC, construction contractors.
- Training schedule: At least 1 month before the implementation of the first contract. The training can be adjusted in line with the implementation schedule of the subproject/contracts.
- Training frequency: The basic training programs proposed in will take place every six months on a yearly basis and its content updated and adapted to implementation issues. Training frequency and content will be reassessed during implementation depending on needs.

Table 6.7: Training Programs for Capacity Building on Environmental Supervision and Management

1. Objects	**CPO, CPMU, PPMUs, ESIA Consultants**
Training course	Preparation of Environmental and Social Impacts Assessment and integration of cumulative impact assessment (CIA) into ESIA.
Participants	CPO, CPMU, PPMUs technical staff and ESIA Consultants. The week long or so training referred to integrates CIA but goes beyond to address the quality and the implementation of the EIAs in conjunction with other safeguards instruments.

Course duration and time	A five-day training to be conducted in June 2016, before implementation of the MDICRSL project
Content	–World Bank requirements for ESIAs –Preparation of ESIA –Intergation of CIA into ESIA –Quality requirements and quality control of ESIA –Implementation of the EIAs in conjunction with other safeguards instruments.
Responsibilities	The World Bank
2. Objects	**PROVINCE PROJECT MANAGEMENT UNIT**
Training course	Environmental supervision, monitoring and reporting.
Participators	Environmental staff and technical staff.
Training Frequency	At least 1 month before implementation of the first contract. The follow-up training will be scheduled as needed.
Time	Four days of training twice a year to be repeated on a yearly basis.
Content	–General environmental management relating to the subproject including requirements of WB, DONRE, and cooperating with relevant enterprises. –Requirements on environmental supervision. –Supervision and implementation of mitigation measures; community participation in environmental supervision. –Guide and supervise contractor, CSC and community representatives in implementation of environmental supervision. –Forms used in environmental supervision. –Risk response and control. –Reporting and submit forms.
Responsibilities	PPMU, IEMC with support of the Technical Assistance team for the implementation of safeguards.
3. Objects	**CSC, CONTRACTOR**
Training course	Implementation of mitigation measures.
Participators	CSC; on-site construction management staff; environmental staff of contractor.
Training frequency	After bidding, update based on requirements.
Time	three days of training twice a year to be repeated on a yearly basis
Content	–Overview of environmental monitoring. –Requirements of environmental monitoring. –Role and responsibilities of contractors and CSC. –Content and methods of environmental monitoring. –Response and risk control. –Propagate monitoring forms and guide how to fill in the forms and risk reports. –Preparation and submission of reports.
Responsibilities	PPMU, IEMC with support of the Technical Assistance team for the implementation of safeguards.

6.7. ESTIMATED ESMP COST

The EMP cost will comprise: (a) cost for resettlement and land acquisition; (b) cost for implementation of the mitigation measures by the contractor; (c) cost for supervision by the

CSC; (d) cost for the Environmental Management Consultant (EMC) including monitoring of environmental quality; (e) cost for water quality/ecology monitoring during operation for at least 2 years; and (f) supervision and safeguard management costs incurred by PPMU and CPMU. All the costs will be included as the subproject cost as shown in *Table 6.8*.

- Cost for the implementation of the mitigation measures during construction will be part of the contract costs while the costs for monitoring by the CSC is provided for in the construction supervision contracts.
- Cost for EMC and monitoring of environmental quality during construction is included in the subproject cost.
- Costs for PPMU operations related to the EMP are provided for in the subproject management budget of the PPMU.
- Cost for technical assistance for safeguard training and technical services to be provided to mitigate the potential negative impacts during construction and operations of the sluice gates including the development of operational plan for sluices in consultation with water users and key stakeholders.
- Cost for technical assistance for mitigation of potential negative impacts due to the implementation of the 3 livelihood models especially (a) on poor farmers including undertaking socioeconomic survey, promoting aquaculture products, and implementation of the FFS on aquaculture models in the subproject areas and building farmers networks, and (b) for establishment of a registration system for aquaculture farmings to mitigate potential negative impacts due to possible expansion of the models in the future. It is estimated that the EMP implementation cost (excluding those to be included in civil works contract and CSC contract and RAP) will be about **8,121,276,000** VND (398,000USD) over a 5 years period. Estimation cost for ESMP is shown in Table 6.8.

Table 6.8: Cost for ESMP in the entire subproject (VND)

Activity	Source of fund	Total cost (VND)
(a) Resettlement and land acquisition	Part of subproject cost	0
(b) Mitigation measures during the construction phase	Part of contract cost	
(c) Safety monitoring during the construction phase (2 manmonth x18 months x 10 millions VND/months)	Part of subproject cost	360,000,000
(d) PPMU environmental staff	Part of subproject cost	180,000,000
Environmental monitoring in the entire subproject (see *Table 6.9*)	Part of subproject cost	861,276,000
(e) Environmental monitoring consultant (EMC)	Part of subproject cost	720,000,000
(f) Technical assistance (national consultant) for safeguard training and development and consultation of the operation plan for the sluice gates including meetings and workshops for 3 years during 2017-2019	Part of subproject cost	$100,000
(g) Technical assistance (national consultant) for (i) planning and undertaking socio-economic survey	Part of subproject cost	$200,000

for the farmers in the pilot sites and nearby areas for 5 years during (2016-2020), (ii) development of a registration program on aquacutlure farming in the subproject and nearby areas, and (iii) development of FFS application and implementation of a series of technical workshops, TOT, and development of guidelines and awareness materials, and study visits and building farmer network etc. (to be implemented during 2016-2020)		

Table 6.9: Cost for environmental monitoring in the entire subproject

No.	Subproject's phase	Subproject activities		Unit	Quantity	Unit price (VND)	Total (VND)
		5 sluice gates	14 canals				
I	**Construction phase**						**415,536,000**
1	Total of sampling	12 months x 3 months/time =4 times	6 months x 3 months/time =2 times	Time			
2	Air/noise, vibration	10 stations x 4 times		Sample	40	654,000	26,160,000
3	Water + micro organism + aquatic life	5 stations x 2 samples/station (high tide -low tide) x 4 times	14 stations x 2 samples/station (high tide - low tide) x 2 times	Sample	96	2,247,000	215,712,000
4	Sediment	5 stations x 1 sample/station x 4 times	14 stations x 1 samples/station x 2 times	Sample	48	1,371,000	65,808,000
5	Wastewater	5 stations x 1 sample/station x 4 times	14 stations x 1 samples/station x 2 times	Sample	48	2,247,000	107,856,000
II	**Operation phase (**before operation and 1 year after operation**)**						**445,740,000**
1	Total of sampling (24 months x 6 months/time)	4 times	4 times	Time			
2	Water + micro organism + aquatic life	5 stations x 2 samples/station (high tide -low tide) x 4 times	14 stations x 2 samples/station (high tide - low tide) x 4 times	Sample	152	2,247,000	341,544,000
3	Sediment	5 stations x 1 sample/station x 4 times	14 stations x 1 samples/station x 4 times	Sample	76	1,371,000	104,196,000
	Total= I+II						**861,276,000**

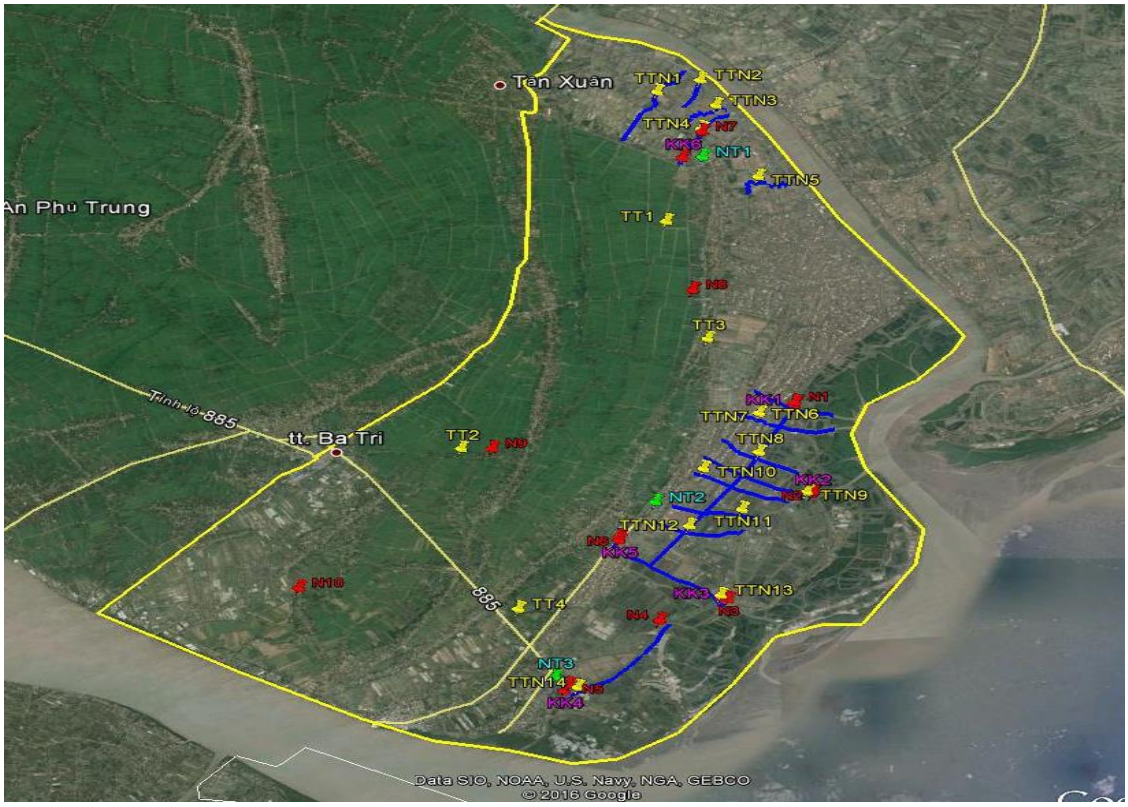


Figure 6.2: Environment monitoring Sampling Locations, Construction and Operation phase

Note: N: Surface Water; NT: Wastewater; TT: Sediment locations sluice gates; TTN: Sediment locations canals; KK: Air Quality

6.8. GRIEVANCE REDRESS MECHANISM (GRM)

Within the Vietnamese legal framework citizen rights to complain are protected. As part of overall implementation of the subproject, a grievance redress mechanism (GRM) will be developed by ESU of the PPMU which will identify procedures, responsible persons and contact information. It will be readily accessible, handle grievances and resolve them at the lowest level as quickly as possible. The mechanism will provide the framework within which complaints about environmental and safety issues can be handled, grievances can be addressed and disputes can be settled quickly. The GRM will be in place before the subproject construction commences.

During construction, the GRM will be managed by the Contractor under supervision of the CSC. The Contractor will inform the communities and communes affected by the contract about the GRM in place to handle complaints and concerns about the subproject. This will be done via the Information Disclosure and Consultation Process under which the Contractor will communicate with the affected communities and interested authorities on a regular basis: Meetings will be held at least quarterly, a monthly information brochure will be published, announcements will be placed in local media, and notices of upcoming planned activities will be posted, and so on.

All complaints and corresponding actions undertaken by the Contractor will be recorded in the subproject safeguard monitoring report. Complaints and claims for damages could be lodged as follows:

- Verbally: direct to the CSC and/or the Contractor safeguard staff or representative at the subproject office.
- In writing: by hand-delivering or posting a written complaint to the address specified.
- By telephone, fax, e-mail: to the CSC, the Contractor safeguard staff or Contractor's representative.

On receipt of a complaint, the CSC, Contractor safeguard staff or representative will register the complaint in the complaints file and maintain a log of events pertaining to it thereafter, until its resolution. Immediately after receipt, three copies of the complaint will be made. The original will be kept in the file, one copy will be used by the Contractor's safeguard staff, one copy will be forwarded to the CSC, and the third copy to the PPMU within 24 hours of the complaint being made.

Information to be recorded in the complaints log will include:

- The date and time of the complaint.
- The name, address and contact details of the complainant.
- A short description of the issue of complaint.
- Actions taken to address the complaint, including persons contacted and findings at each step in the complaint redress process.
- The dates and times when the complainant is contacted during the redress process.
- The final resolution of the complaint.
- The date, time and manner in which the complainant was informed thereof.
- The complainant's signature when resolution has been obtained.

Small complaints will be dealt with within one week. Within two weeks (and weekly thereafter), a written reply will be delivered to the complainant (by hand, post, fax, e-mail) indicating the procedures taken and progress to date.

The main objective will be to resolve an issue as quickly as possible by the simplest means involving as few people as possible, at the lowest possible level. Only when an issue cannot be resolved at the simplest level and/or within 15 days, will other authorities become involved. Such a situation may arise, for example, when damages are claimed and the amount to be paid cannot be resolved or the cause of the damages determined.

World Bank Grievance Redress Mechanism: Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanism or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to adddress project-related concerns. Subproject affected communities and individuals may submit their complaints to the WB's independent Inspection Panel which determines whether harms occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at anytime after concerns have been brought directly to the WB's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For information on how to submit complaints to the World Bank Inspecition Panel, please visit www.inspectionpanel.org.

CHAPTER 7. PUBLIC CONSULTATION AND DISCLOSURE

In the ESIA process, information disclosure and public consultation on environment ensures the acceptance of local authorities, local NGOs and local affected people in the subproject area. Public participation is one of basic conditions that ensure the local authority and community's support for project and take their view into account. Through public consultation, unidentified environmental adverse impacts and mitigation measures can be recognized and included in ESIA report. In fact, if community takes part early in the project preparation, the relationship between community and project officials becomes closer. Thereafter, the community can continue to contribute their feedback and any concerns they may have during project implementation.

7.1. OBJECTIVES OF PUBLIC CONSULTATION

The World Bank's policy (OP/BP 4.01) on Environmental Impact Assessment requires that the Project Affected People (PAPs) and local authorities to be provided with notification and consultation during the preparation of ESIA report.

Public consultation (in the preparation of ESIA report for the subproject) must comply with the requirements in the Government's Decree No. 18/2015/ND-CP dated 14 February 2015 on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan, and Circular No. 27/2015/TT-BTNMT dated 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plan.

Objectives of public consultation:

- The consultation with the participation of local authorities and local people in the subproject site during the preparation and implementation of ESMP and ESIA is to provide essential information for further understanding about the project, impacts of the subproject implementation and potential mitigation measures for the subproject;
- Clarify issues discussed in the beginning period of the project;
- Inform benefits achieved when the subproject is implemented;
- State responsibilities and awareness of stakeholders, beneficiary people in the subproject site during the subproject implementation;
- Encourage the community participation in determining the environmental impacts of the subproject;
- Collect information about demands as well as correspondences of local people and authorities in the construction and recommendation in order to mitigate environmental impacts or considering adjustment in the technical design stage.

7.2. IMPLEMENTATION METHODS

This is a Category A project, thus it was required by WB to carry out the public consultation twice during the ESIA process. Technical consultants and environmental consultants collaborated closely with PMU, local authorities and community in affected areas to perform these two public consultations in order to meet the WB's requirement.

- The first round: As soon as environmental screening is completed and before TOR for ESIA report is finalized.

– Second round: After the first draft of EIA report is prepared.

To implement the ESIA report of the subproject, the CPO organized consultation meetings with the People's Committees and Vietnam Fatherland Front of 10 communes in Ba Tri.

Before consulting at communes, CPO held general meetings at Ben Tre Province to introduce the project, the subproject and collect opinions for the subproject. The meeting was held at the office of Ben Tre DARD. The participants at these meetings consist of representatives of DPC, provincial departments as DONRE, DOST, DOIT, etc.

After holding the general meetings at the province, CPO carried out consultations at affected communes to introduce the subproject, collect information about the status of environmental sanitation at the locality, discuss potential environmental impacts and mitigation measures as well as coordinate with the local authorites in holding public consultation in the subproject area.

7.3. PUBLIC CONSULTATION RESULTS

Generally, through the public consultations at the subproject area, the authorities and local people supported the subproject and desired the subproject to be implemented early. Some consultation opinions are summarized as follows:

The first consultation. The first public consutation was carried out at the meeting hall of Ba Tri DPC on October 22, 2015.

- ✓ All participants agreed with the subproject implementation and its investment items.
- ✓ In Bao Thanh commune, some sluices has been built and amplitude of tide is higher and higher leading to households of salt making inside the dike are get in trouble by freshwater intrusion, thus proposing the construction of sluice gate is the first priority and construction activities should be taken in the dry season in order to minimize impact on the people in the subproject area.
- ✓ During the operation phase of subproject, if sluice gates will be consistent with the operation scheme, it will not affect the people. However, there is a need to propose solution for saline water taking for households are producing salt after the dike.
- ✓ Trang Nuoc and Duong Tac canals are served as goods transportation and storm shelters, these activities will be impacted when building sluice gates in these canals.
- ✓ Some sluice gates are put into operation shortly, but some of them are corrosed, degraded so there need to consider when chosing structural and building materials for sluice gates and having suitable maintenance and operation planning.

The second consultation. The second public consultation was conducted the meeting hall of Ba Tri DPC on January 24, 2016.

The consultation was organized with Commune's People Committee with the participation of local organizations, unions and some households in the subproject area. Main content of the meetings is to provide information of the subproject ESIA, the expected impacts on environment and associated mitigation measures and to obtain feedbacks from the communities. The results of the consultation are as follows:

- ✓ All participants welcomed the subproject implementation and its investment items.
- ✓ For dredged sludge: according to the community experience, the mud in the region has good quality and local people are very short of land for filling embankments and leveling ground, so we would like to have the dredged sludge for filling embankments and leveling ground.

- ✓ During construction phase, contractors need to dredge quickly in order not to affect the community agricultural and aquaculture activities and lives.
- ✓ Now people are contributing money to buid temporary bridges. If the subproject builds sluice gates in these locations, it should be quick so that to people have not to contribute money for building sluice gates as when the sluice gates are built, the bridges to be donated by people must be dismantled, which waste money.

All the comments and inputs from the consultations were taken into account by the subproject owners and the EA consultants and have been incorporated into the subproject design and the final ESIA.

7.4. ENVIRONMENTAL INFORMATION DISCLOSURE

Following requirements for information dissemination in OP/BP 4.01, the CPO and PPMU have disclosed the final draft Vietnamese version of the subproject ESIA report and the summary report at the office of Ben Tre PPC and CPC of the subproject communes. Prior to the project appraisal the final draft ESIA report (English version) has also been disclosed at the World Bank InfoShop as per the Bank requirement. The final ESIA will be disclosed locally and at the InfoShop as required.

CONCLUSIONS, RECOMMENDATIONS AND COMMITMENTS

1. CONCLUSIONS

The report for subproject Infrastructure to develop stable livelihoods for people in the coastal area in Ba Tri, Ben Tre to adapt to climate change after environment and social analysis concludes that the project falls in 'low impact' category and have overall positive benefits on the life and environment of the people. Land acquisition or livelihood losses envisaged due to the proposed project are very low. As per environmental and social management framework guidelines of WB and MONRE, Environmental and Social Impact Assessment, with an ESMP was prepared for addressing potential environmental and social impacts arising from implementaiton of the proposed subproject.

These impacts have been identified and fully analyzed in Chapter 4. The impacts of the clearance phase and construction phase of the subproject items include:

- ✓ Air pollutants, dust and noise pollution caused by means and construction machines.
- ✓ Storm water runoff and wastewater from camps of construction workers.
- ✓ Construction waste and domestic waste of workers on construction site.
- ✓ Sludge discharged during dredging.
- ✓ Stirring the mud causing turbid, muddy water flowing down the canal from shore, affects the production water taking activities in the region, negatively impact on organisms.
- ✓ Waterway traffic interuption.
- ✓ Social environment Public Health and Safety including enhanced HIV/AIDS and other infectious disease risk.

These impacts can be overcome and minimized if applied strictly mitigation measures as described in Chapter 5.

The environmental impacts in operation phase of project are mainly positive impacts, contributing to sustainable livelihood development for climate change in the subproject area. To use these construction works safely, sustainably and bring high economic efficiency, it needs to have specific regulations, and apply fully mitigation measures of negative impacts as given in Chapter 5. It should have communication and education programs to raise awareness of people in works and environment protection.

2. RECOMMENDATION

Environmental and Social Impact Assessment report again confirms that the negative environmental impacts are small to moderate, temporary and can be mitigated during the subproject implementation process. It can be fully minimized and overcome by simple technical solutions at low cost.

During the pre-construction, construction and operation phases, concerned parties must comply strictly with the subproject ESMP to ensure sustainable efficiency of the subproject.

The impacts to community, environment and sustainable livelihood development for Climate change adaptation of Ben Tre province is mainly positive and long term.

Since, it is recommended to competent authorities, World Bank to consider and approve the next steps to implement the subproject on time.

It is recommended that environmental management agencies monitor to ensure construction process complying technological parameters and implement environmental monitoring during subproject construction and operation.

3. COMMITMENT OF THE SUBPROJECT'S OWNER

The subproject's owner, agencies, construction organization, management agencies and construction works operation unit commit that:

- ✓ Strictly complying with environmental regulations of Vietnam and the safeguards policies of the World Bank. Assuring that environmental parameters meet current Vietnamese environmental standards and technical regulations.
- ✓ Implementing all environmental protection measures and mitigation measures during construction phase as mentioned above.
- ✓ Be responsible to the law of Vietnam if breaking international conventions and Vietnamese standards on environment.

Committing to implement environmental protection measures in accordance with the current law of Vietnam. Annually sending environmental monitoring reports to the people's committee of the Ba Tri District, Ben Tre DONRE and other involved departments.

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APPENDIX 1. AQUATIC SPECIES IN HAM LUONG RIVER

Appendix 1.1: The list of phytoplantkton species at Ham Luong River region (2008 – 2009)

N0	Class-Breed- Species	M10/2008	M11/2008	M5/2009	M6/2009
	CYANOPHYTA				
	CHROOCOCCALES				
	CHROOCOCCACEAE				
1	Chroococcus sp.		+	+	+
2	Micocystis sp.				+
3	Microcystis aeruginosa Kutz	+	+	+	+
4	Microcystis botrys Teiling		+	+	
5	Microcystis wesenbergii Komárek	+	+	+	
6	Snowella litoralis (Häyrén) Komárek	+	+		
	SYNECHOCOCCALES				
	MERISMOPEDIACEAE				
7	Aphanocapsa sp.		+	+	
	NOSTOCALES				
	OSCILLATORIACEAE				
8	Arthrospira sp.	+	+	+	
9	Lyngbya sp.	+	+	+	+
10	Oscillatoria acuta Bruhl & Bisw	+	+	+	
11	Oscillatoria lemmermannii Woloszynska	+	+	+	+
12	Oscillatoria limosa Agardh		+		
13	Oscillatoria perornata Skuja	+	+	+	+
14	Oscillatoria princeps Vaucher	+			
15	Oscillatoria subbrevis Schmidle	+	+		+
16	Oscillatoria sp.				+
17	Oscillatoria cf tenuis Agardh		+	+	
18	Phormidium mucicola Huber-Pestalozzi		+	+	
19	Planktothrix sp.			+	
20	Trichodesmium erythraeum Ehrenberg			+	
	SPIRULINACEAE				
21	Spirulina sp.		+		
	ANABAENACEAE				
22	Anabaenopsis sp.	+	+	+	+
23	Anabaena spiroides Klebahn	+	+		
24	Anabaena sp.	+	+	+	+
25	Anabaena viguieri Denis & Frémy	+		+	
	NOSTOCACEAE				
26	Aphanizomenon sp.	+	+		
27	Cylindrospermopsis sp.		+		
	PSEUDANABAENALES				
	PSEUDANABAENACEAE				

N0	Class-Breed- Species	M10/2008	M11/2008	M5/2009	M6/2009
28	Pseudanabaena sp.	+	+	+	
	CHRYSOPHYTA				
	DICTYOCHALES				
	DICTYOCHACEAE				
29	Dictyocha fibula Ehrenberg		+	+	+
	BACILLARIOPHYTA				
	ACHNANTHALES				
	ACHNANTHACEAE				
30	Achnanthes sp.		+		+
	BIDDULPHIALES				
	CHAETOCERACEAE				
31	Bacteriastrum varians Lauder		+		+
32	Chaetoceros affinis Lauder	+	+		
33	Chaetoceros curvisetus Cleve	+			+
34	Chaetoceros debilis Cleve	+			
35	Chaetoceros diversus Cleve			+	
36	Chaetoceros lorenzianus Grunow				+
37	Chaetoceros teres Cleve	+			+
	BIDDULPHIACEAE				
38	Ditylum sol Bailey	+		+	+
39	Ditylum brightwelli (West.). Journ	+	+	+	+
40	Biddulphia heteroceros Grun	+	+	+	+
41	Biddulphia mobilensis Bailey			+	
42	Biddulphia obtusa (Kützing) Hustedt	+			
43	Biddulphia regia (Schultze) Ostenfeld	+	+	+	+
44	Biddulphia reticumlum (Ehrenberg) Boyer			+	+
45	Biddulphia sinensis Grev.	+	+		+
46	Bellerochea homologicalis Stosch			+	
47	Cerataulina dentata Hasle in Hasle & Syvertsen	+			+
	RHIZOSOLENIACEAE				
48	Rhizosolenia alata Brightwell	+	+	+	+
49	Rhizosolenia acuminata Gran			+	
50	Rhizosolenia calca-avis Schultze			+	+
51	Rhizosolenia imbricata Brightwell	+	+	+	+
52	Rhizosolenia setigera Brightwell			+	+
	HEMIAULALES				
	HEMIAULACEAE				
53	Hemiaulus sinensis Greville	+		+	+
	STREPTOTHECACEAE				
54	Streptotheca thamesis Shrubsole			+	+
	CENTRALES.				

N0	Class-Breed- Species	M10/2008	M11/2008	M5/2009	M6/2009
	COSINODISCAEAE				
55	Actinoptychus annulatus (Wallich) Grunow	+	+	+	+
56	Coscinodiscus asteromphalus Ehrenberg	+	+	+	+
57	Coscinodiscus bipartitus Rattray	+	+	+	+
58	Coscinodiscus gigas Ehrenberg		+	+	
59	Coscinodiscus excentricus Ehrenberg	+			
60	Coscinodiscus jonesianus (Greville) Ostenfeld	+	+	+	+
61	Coscinodiscus lineatus Ehrenberg	+	+	+	+
62	Coscinodiscus marginatus Ehrenberg	+	+		
63	Coscinodiscus radiatus Ehrenberg	+	+	+	+
64	Coscinodiscus subtilis Ehrenberg	+	+	+	+
65	Coscinodiscus thorii Duda	+	+	+	+
66	Cyclotella comta (Ehrenb.) Grunow	+	+	+	+
67	Cyclotella meneghiniana Kützing			+	+
	NAVICULALES				
	NAVICULACEAE				
68	Navicula elegans W. Smith	+	+		+
69	Pleurosigma angulatum Wm. Smith	+	+	+	+
70	Pleurosigma affinis W. Smith		+	+	+
71	Gyrosigma acuminatum (Kutz.) Rabh		+	+	+
72	Gyrosigma attenuatum (Kütz.) Rabenh		+		
73	Gyrosigma distortum (W. Smith) Cleve		+		
74	Gyrosigma sinensis Greville		+	+	+
	PINNULARIACEAE				
75	Pinnularia sp.	+			
76	Cymbella affinis Kütz		+		
77	Cymbella lanceolata (Ehrenberg) Kirchner		+		
78	Diploneis sp.		+		
	AMPHIPLEURACEAE				
79	Amphipleura pellucida Kützing	+	+		+
80	Frustulia sp.		+		
	MELOSIRACEAE				
81	Melosira granulata (Ehr.) Ralfs	+	+	+	+
82	M. gr. var.angustissima fo spiralis O.Müll	+	+	+	
83	M. gra.var.angustissima O. Müll	+	+	+	
84	Melosira sulcata Ehr and Kuetz		+	+	+
85	Melosira varians Agardh	+			
	RAPHINALES				
	NITZSCHIACEAE				
86	Nitzschia closterium Ehrenberg	+	+		
87	Nitzschia longissima (Bréb.) Ralfs	+	+	+	+

N0	Class-Breed- Species	M10/2008	M11/2008	M5/2009	M6/2009
88	Nitzschia lorenziana Grunow	+	+	+	+
89	Nitzschia paradoxa (Gmelin) Grunow	+	+	+	+
90	Pseudonitzschia sp.			+	+
	SURIRELLACEAE				
91	Surirella capronii (Fitzer) Hustedt	+	+		+
92	Surirella elegans (V. Schl) Ehr.	+	+		
93	Surirella gemma (Ehrenb.) Kütz	+			+
94	Surirella robusta Ehrenberg	+	+		+
	PENNALES				
	TABELLARIACEAE				
95	Climacosphenia moniligera Ehrenberg	+	+		+
	FRAGILARIACEAE				
96	Asterionella japonica Cleve				+
97	Fragilaria sp.		+		
98	Synedra acus Kütz	+	+		
99	Synedra ulna (Nitzsch) Ehrenberg	+	+		
100	Thalassiosionema nitzschioides (Grunow) Grunow	+	+	+	+
101	Thalassiothrix frauenfeldii Grunow		+		+
	SKELETONEMACEAE				
102	Skeletonema costatum (Grev.) Cleve	+	+	+	+
	THALASSIOSIRACEA				
103	Thalassiosira sp.	+		+	+
104	Thalassiosira sp1				+
105	Planktoniella sol (Wallich) Schuet	+	+	+	+
106	Tryplioptychus cocconeiformis Hendey		+	+	
	STEPHANODISCACEAE				
107	Stephanodiscus sp.			+	+
	LAUDERIACEAE				
108	Lauderia borealis Gran			+	+
	RHOPALODIALES				
	RHOPALODIACEAE				
109	Epithemia sp.			+	
	TRICERATIALES				
	TRICERATIACEAE				
110	Triceratium favus Ehrenberg		+		+
	CHLOROPHYTA				
	CHLOROCOCCALES				
	ANKSTRODESMACEAE				
111	Ankistrodesmus gracilis (Reinsch) Korshikov	+			
	OOCYSTACEAE				
112	Oocystis sp.	+			+

N0	Class-Breed- Species	M10/2008	M11/2008	M5/2009	M6/2009
113	Chodatella subsalsa Lemmermann	+	+		
114	Tetraedron gracile (Reinsch) Hansg	+	+		
	RHADIOCOCCACEAE				
115	Coenococcus sp.			+	
	HYDRODICTYACEAE				
116	Pediastrum duplex Meyen	+	+	+	+
117	Pediastrum simplex Meyen	+	+	+	
118	Pediastrum tetras (Ehrenberg) Ralfs		+		
	SCENEDESMACEAE				
119	Actinastrum hantzschii Lagerheim	+	+		+
120	Actidesmium hookeri Reinsch	+			
121	Coelastrum microsporum Naeg			+	
122	Scenedesmus acuminatus (Lagerheim) Chodat	+	+	+	+
123	Scenedesmus bijugatus (Turp.) Kütz		+	+	
124	Scenedesmus denticulatus Lagerhiem	+	+		
125	Scenedesmus quadricauda (Turpin) Brébisson	+	+	+	+
	ZYGNEMATALES				
	PENIACEAE				
126	Arthrodesmus sp.		+		
127	Closterium gracile Breb	+	+	+	
128	Closterium intermedium Ralfs		+		
129	Closterium lineatum Ehrenberg		+		
130	Closterium moniliferum (Bory) Ehrbg	+	+		
	ZYGNEMATACEAE				
131	Spirogyra ionia Wade	+	+		
132	Spirogyra prolifica Kuetzing		+		+
	DESMIDIALES				
	DESMIDIACEAE				
133	Staurastrum paradoxum Meyen	+	+		
134	Staurastrum tohopekaligense var insigne West			+	
	VOLVOCALES				
	VOLVOCACEAE				
135	Eudorina elegans Ehrenberg	+		+	+
136	Pandorina charkoviensis Korsch	+	+	+	+
137	Volvox aureus Ehrenberg	+		+	
	EUGLENOPHYTA				
	EUGLENALES				
	EUGLENACEAE				
138	Euglena acus Ehrenberg	+	+	+	+
139	Euglena spirogyra Ehrenberg	+	+	+	+
140	Euglena sp.	+			

N0	Class-Breed- Species	M10/2008	M11/2008	M5/2009	M6/2009
141	Phacus caudatus Huebner		+	+	+
142	Phacus curvicauda Swirenko	+	+	+	
143	Phacus longicauda (Ehrenberg) Dujardin	+	+	+	+
144	Phacus pleuronectes (O.F. Müller) Dujardin	+	+	+	+
145	Phacus tortus (Lemmermann) Skvortzow	+	+		
146	Strombomonas napiformis (Playfair) Deflandre	+	+		
147	Strombomonas sp.	+	+		
148	Trachelomonas volvocina Ehrenberg		+		
	DINOPHYTA				
	GONYAULACALES				
	GONYAULACACEAE				
149	Gonyaulax spinifera Diesing			+	+
150	Gonyaulax verior Sournia			+	
	PROROCENTRALES				
	PROROCENTRACEAE				
151	Prorocentrum mican Ehrenberg			+	+
	PERIDINIALES				
	CERATIACEAE				
152	Ceratium hirundinella Dujardin	+			
153	Ceratium furca (Ehrenberg) Claparède et Lachmann	+	+	+	+
154	Ceratium tripos Nitzsch			+	
	PERIDINIACEAE				
155	Protoperidinium leonis Balech			+	+
156	Protoperidinium pellucidum Bergh	+		+	+
157	Protoperidinium sp.			+	+
158	Protoperidinium sp1			+	+
159	Protoperidinium sp2			+	+
	DINOPHYSIALES				
	DINOPHYSIACEAE				
160	Dinophysis caudata Saville-Kent	+		+	+
161	Dinophysis sp.			+	+
	NOTILUCALES				
	NOTILUCACEAE				
162	Noctiluca scintillans (Macartney) Kofoid et Swezy	+			+
Total specices		96	106	95	89

Appendix 1.2 The list of Zooplankton species of Ham Luong River region (2008 – 2009)

N0	Class-Breed- Species	Oct-08	Nov-08	May-09	Jun-09
	PROTOZOA				
	Spirotrichea				
	Tintinnida				
	Codonellidae				
1	Tintinnopsis cylindrita Daday			*	*
2	Tintinnopsis nordguisti Leprotin			*	
	Codonellidae				
3	Codonella aspera Kofoid & Campbel			*	*
	Xystonellidae				
4	Favella sp			*	*
	ROTIFERA				
	Monogononta				
	Ploimida				
	Asplanchnidae				
5	Asplanchna (Asplanchna) priodonta Gosse	*	*	*	
	Brachionidae				
6	Brachionus plicatilis O.F.Muller	*		*	*
7	Brachionus angularis Gosse	*		*	*
8	Brachionus calyciflorus Pallas	*	*		
9	Brachionus falcatus Pallas	*	*	*	
10	Brachionus quadridentatus Hermann	*	*		
11	Brachionus caudatus Apstein		*		
12	Keratella cochlearis (Gosse)		*	*	*
	Conochilidae				
13	Conochilus hippocrepis Schrank		*		
	Synchaetidae				
14	Polyarthra vulgaris Carlin			*	*
	Lecanidae				
15	Lecane (Monostyla) bulla (Gosse)			*	
	Floscullariacea				
	Filiniidae				
16	Filinia longiseta Ehrenberg	*	*		
17	Filinia brachiata (Rousselet)		*		
	Hexarthridae				
18	Hexarthra mira Hudson			*	
	ARTHROPODA				
	Branchiopoda				
	Cladocera				
	Moinidae				
19	Moina dubia de Guerne et Richard	*	*		

20	Moina macrocopa Straus		*		
	Bosminidae				
21	Bosmina longirostris (O.F. Müller)	*	*		
22	Bosminopsis deitersi Richard	*	*		
	Daphniidae				
23	Daphnia lumholtzi Sars		*		
24	Ceriodaphnia rigaudi Richard	*	*		
	Sididae				
25	Diaphanosoma sarsi Richard	*	*	*	*
26	Diaphanosoma excisum Sars	*	*		
	Chydoridae				
27	Chydorus sphaericus (O.F. Müller)		*		
28	Alona rectangula Sars		*		
29	Dunhevedia crassa King	*			
30	Alonella excisa Fischer			*	
	Macrothricidae				
31	Macrothrix spinosa King		*		
32	Ilyocryptus halyi Brady		*		
	Copepoda				
	Cyclopoida				
	Cyclopidae				
33	Thermocyclops hyalinus (Rehberg)	*	*	*	*
34	Tropocyclops prasinus Fischer	*	*		
35	Mesocyclops leuckarti Claus		*		
36	Microcyclops varicans Sars	*			
	Oithonidae				
37	Oithona simplex Farran	*	*	*	*
38	Oithona nana Giesbrecht				*
	Calanoida				
	Mazellinidae				
39	Mazellina sp	*			
	Diaptomidae				
40	Neodiaptomus malaindosinensis Lai & Fernando		*		
41	Neodiaptomus yangtsekiangensis Mashiko	*			
42	Neodiaptomus botulifer Kiefer	*			
43	Allodiaptomus raoi Kiefer		*		
44	Allodiaptomus gladiolus Shen et Lee	*			
45	Heliodiaptomus serratus Shen et Tai		*		
	Paracalanidae				
46	Paracalanus parvus Claus	*	*	*	*
	Centropagidae				
47	Sinocalanus leavidactilus Shen & Tai	*	*	*	

	Acartiidae				
48	Acartia clausi Giesbrecht	*	*		
49	Acartia pacifica Steuer			*	*
50	Acartiella siamensis Shen & Lee	*	*		
	Pontellidae				
51	Labidocera sp	*			
	Lucicutiidae				
52	Lucicutia sp				*
	Harpacticoida				
	Euterpinidae				
53	Euterpina acutifrons Dana		*	*	*
	Laophontidae				
54	Laophonte brevirostris Claus			*	*
	Metidae				
55	Metis sp			*	*
	Ectinosomitidae				
56	Microsetella norvegica Boeck			*	
	Canthocamptidae				
57	Attheyella vietnamica Borutsky			*	
	Ostracoda				
	Cyprididae				
58	Heterocypris anomala Klie		*	*	
	Malacostraca				
	Decapoda				
	Luciferidae				
59	Lucifer sp			*	*
	AQUATIC INSECTA				
60	Emphemeroptera		*		
	Diptera				
61	Chironomidae			*	*
	CNIDARIA				
	HYDROZOA				
	Leptothecatae				
	Campanulariidae				
62	Laomedea geniculata (Linnaeus)		*		
	Anthoathecata				
	Hydractiniidae				
63	Podocoryna sp			*	
	CHORDATA				
	Appendicularia				
	Oikopleuridae				
64	Oikopleura sp	*		*	*

	CHAETOGNATHA				
	Sagittoidea				
	Aphragmophora				
	Sagittidae				
65	Sagitta sp			*	*
	LARVA				
66	Copepoda nauplius	*	*	*	*
67	Metanauplius larva			*	*
68	Fish young	*	*	*	
69	Bivalvia larva		*	*	*
70	Gastropoda larva			*	
71	Amphipoda larva		*		
72	Zoea larva	*	*		*
73	Mysis larva	*	*	*	*
74	Polychaeta larva	*	*	*	*
Total specices		33	43	37	27

Appendix 1.3 The list of Zoobenthod species of Ham Luong River region (2008 – 2009)

N0	Class-Breed- Species	Time			
		Oct-08	Nov-08	May-09	Jun-09
	Phylum MOLLUSCA				
	Class GASTROPODA				
	Buccinidae				
1	Clea helena Busch, 1847	*	*	*	
2	Babylonia spirata Linnaeus, C., 1758	*			
	Thiaridae				
3	Melanoides tuberculatus Muller, 1774	*	*	*	
4	Sermyla tornatella Lea, 1850	*			
	Viviparidae				
5	Filopaludina filosa Reeve, 1863	*	*		
	Iravadiidae				
6	Fairbankia cochinchinensis Bavay & Dautzenberg, 1910	*	*	*	
	Terebridae				
7	Terebra sp	*			
8	Hastula mera Hinds, 1844			*	
	Naticidae				
9	Polinices didyma Roding, 1798			*	
	Turritellidae				
10	Turritella terebra Linne 1758			*	
	Valvatidae				
11	Valvata tricarinata Say, 1817	*			
	Cerithiidae				
12	Cerithidea cingulata Gmelin, 1791	*	*		
	Neritidae				
13	Nerita sp	*			
14	Nerita violacea		*		
15	Neritina waigiensis Lesson, 1831			*	*
	Melanellidae				
16	Melanella candida Marrat, 1880	*			
	Olividae				
17	Oliva sp	*			*
	Hydrobiidae				
18	Paludinella sp				*
	Nassariidae				
19	Nassarius velatus Gould, 1850	*	*		
	Class BIVALVIA				
	Cuspidariidae				
20	Cuspidaria sp				*
	Mytilidae				

N0	Class-Breed- Species	Time			
		Oct-08	Nov-08	May-09	Jun-09
21	Brachidontes sp			*	*
	Pholadidae				
22	Monothyra orientalis Gmelin, 1791		*		
	Arcidae				
23	Anadara granosa Linnaeus, 1758	*	*		
	Veneridae				
24	Meretrix lyrata Sowerby, 1851	*	*	*	*
25	Meretrix meretrixLinnaeus, 1758		*		
	Cutellidae				
26	Siliqua costata Say, 1822		*		
	Donacidae				
27	Donax townsendi Sowerby, 1894	*			
28	Donax trunculus Linne, 1758	*			
	Tellinidae				
29	Tellina sp	*			
	Corbulidae				
30	Corbula erythrodon Lamarck, 1818	*			
	Unionidae				
31	Pilsbryoconcha exilis exilis Lea, 1838			*	
	Class SCAPHOPODA				
	Dentaliidae				
32	Antalis tibana Nomura, 1940			*	
	Phylum ANNELIDA				
	Class POLYCHAETA				
	Nereidae				
33	Namalycastis longicirris Takahasi, 1933	*	*	*	*
	Nereididae				
34	Ceratonereis erythraeensis Fauvel, 1918	*	*		
35	Ceratonereis marmorata Horst, 1924	*	*		
36	Ceratonereis mirabilis Kinberg, 1865			*	
	Sabellidae				
37	Chone sp			*	*
38	Branchiomma cingulata Grube, 1870			*	
	Sternaspidae				
39	Sternaspis scutata Renier, 1807	*	*		
	Spionidae				
40	Boccardia proboscidea Hartman, 1940	*			
41	Prionospio sp				*
	Orbiniidae				
42	Orbinia johnsoni Hering, 1928	*			

N0	Class-Breed- Species	Time			
		Oct-08	Nov-08	May-09	Jun-09
43	Scoloplos armiger O. F. Müller, 1776				*
	Cossuridae				
44	Cossura brunnea Sasakawa, 1994	*			
	Onuphidae				
45	Diopatra chiliensis Quatrefages, 1866				*
	Trichobranchidae				
46	Terebellides stroemii Sars, 1835			*	
	Capitellidae				
47	Heteromastus filiformis Claparède, 1864			*	
	Phylum ARTHROPODA				
	Class CRUSTACEA				
	Order Mysidacea				
	Mysidae				
48	Siriella clausi G.O. Sars, 1877	*	*	*	
	Order Decapoda-Macrura				
	Alpheidae				
49	Alpheus crassimanus Heller, 1865	*	*		*
	Penaeidae				
50	Metapenaeus brevicornis H.M.Edward, 1837	*	*		
	Ogyrididae				
51	Ogyrides striaticauda Kemp, 1915	*	*		*
	Upogebiidae				
52	Upogebia major de Haan, 1841		*		
	Order Decapoda-Brachyura				
	Grapsidae				
53	Varuna litterata Fabricius, 1798	*			
	Leucosiidae				
54	Philyra globulosa H.Milne Edwards, 1837	*			
	Porcellanidae				
55	Petrolisthes asiaticus Leach, 1820	*			
56	Petrolisthes spLeach, 1820			*	
	Portunidae				
57	Scylla serrata Forskål, 1775				*
	Order Decapoda Anomura				
	Paguridae				
57	Calcinus gaimardi A.M.Edwards, 1848			*	*
	Order Amphipoda				
	Hyalidae				
59	Hyale sp		*	*	*
60	Hyale sp.1	*			

N0	Class-Breed- Species	Time			
		Oct-08	Nov-08	May-09	Jun-09
61	Hyale sp.2	*			
62	Hyale hawaiensis Joseph, 1972		*		
	Corophiidae				
63	Corophium sp	*			
64	Corophium minutum Dang, 1965		*		
	Ampeliscidae				
65	Ampelisca orops Imbach, 1967	*			
66	Ampelisca cyclops Walker, 1904		*		
67	Byblis pilosaImbach, 1967	*	*		
68	Ampelisca tridens Walker, 1904	*	*		
69	Ampelisca sp	*			*
	Order Isopoda				
	Spaeromatidae				
70	Spaeroma hookeri Leach, 1969	*	*		
	Anthuridae				
71	Cyathura sp		*		
72	Cyathura truncata Dang,1965	*	*	*	*
	Idotheidae				
73	Idothea sp	*	*		*
	Hyssuridae				
74	Eisothistos sp				*
	Calabozoidae				
75	Calabozoa pellucida Van Lieshout, 1983			*	*
	Order Tanaidacea				
	Apseudidae				
76	Apseudes vietnamensis Dang, 1965	*	*		*
	Phylum NEMERTEA				
	Class ANOPLA				
	Lineidae				
77	Cerebratulus lacteus Leidy, 1851		*		
	Phylum SIPUNCULA				
	Class SIPUNCULIDEA				
	Sipunculidae				
78	Sipunculus nudus Linnaeus, 1767	*			
	Phylum ECHINODERMATA				
	Class HOLOTHUROIDEA				
	Holothuriidae				
79	Aphelodactyla australis		*		
	Class OPHIUROIDEA				
80	Amphiuridae			*	

N0	Class-Breed- Species	Time			
		Oct-08	Nov-08	May-09	Jun-09
	LARVA				
81	Decapoda-brachyura	*	*	*	*
82	Polychaeta larva	*	*		
83	Bivalvia larva	*		*	*
84	Gastropoda larva	*			
Total specices		49	36	26	24

Appendix 1.4 The list of fish species of Ham Luong River region (2008 – 2009)

N^0	Vietnam Name	SPECIES
I	BỘ CÁ ĐUỐI	RAJIFORMES
1	cá đuối bồng	Dasyatidae
1	Cá đuối bồng viền trắng	Himantura signifer Compagno & Robert, 1982
II	BỘ CÁ CHÁO BIỂN	ELOPIFORMES
2	Cá Cháo lớn	Megalopidae
2	Cá Cháo lớn	Megalops cyprinoides (Broussonet, 1782)
3	cá Cháo biển	Elopidae
3	Cá cháo biển	Slops saurus Linnaeus, 1766
III	BỘ CÁ MÒI ĐƯỜNG	ALBULIFORMES
4	cá Mòi đường	Albulidae
4	Cá Mòi đường	Albula vulpes (Linnaeus, 1758)
IV	BỘ CÁ CHÌNH	ANGUILLIFORMES
5	Cá Dưa	Muraenesocidae
5	Cá Lạc vàng	Congresox talabon (Cuvier, 1849)
6	Cá Chình răn	Ophichthidae
6	Cá Lịch cu	Pisodonophis boro (Hamilton, 1822)
V	BỘ CÁ TRÍCH	CLUPEIFORMES
7	Cá Trích	Clupeidae
7	Cá Cơm sông	Corica laciniata Fowler, 1935
8	Cá Cơm	Corica laciniata Fowler, 1935
9	Cá Cơm trích	Clupeoides borneensis Bleeker, 1851
10	Cá mòi không rằng chacun	Anodontostoma chacunda (Hamilton, 1822)
11	Cá cháy nam	Tenualosa thibaudeaui(Durand, 1940)
8	cá Trỏng	Engraulidae
12	Cá lẹp vàng	Setipinna taty (Valenciennes, 1848)
13	Cá Lành canh đỏ	Coilia mystus Linnaeus, 1775
14	Cá lành canh trắng	Coilia grayii Richardson, 1844
15	Cá Mê gà	Coilia macrognathos Bleeker, 1852
VI	BỘ CÁ CHÉP	CYPRINIFORMES
9	cá chép	Cyprinidae
16	Cá lòng tong đá	Rasbora argyrotaenia (Bleeker, 1850)
17	Cá dầm	Puntius brevis (Bleeker, 1860)
18	Cá mè vinh	Barbonymus gonionotus (Bleeker, 1850)
VII	BỘ CÁ NHEO	SILURIFORMES
10	cá Lăng	Bagridae
19	Cá Chốt vạch	Mystus rhegma Fowler, 1935
11	cá tra	Pangasiidae
20	Cá Bông lau	Pangasius krempfi Fang & Chaux, 1942
21	Cá Dứa	Pangasius polyuranodon Bleeker, 1852
22	Cá tra	Pangasianodon hypophthalmus (Sauvage, 1878)
12	cá úc	Ariidae

23	Cá úc chấm	Arius malculatus (Thunberg, 1822)
24	Cá úc trăng	Arius sciurus Smith, 1931
25	Cá úc nghệ trunca	Arius truncatus Valenciennes, 1840
26	Cá úc thiều	Arius stormii (Bleeker, 1858)
13	cá ngát	Plotosidae
27	Cá Ngát sọc	Plotosus lineatus (Thunberg, 1791)
28	Cá Ngát nam	Plotosus canius Hamilton, 1822
VIII	BỘ CÁ ĐÈN SÔNG	AULOPIFORMES
14	cá khoai	Synodontidae
29	Cá khoai	Harpadon nehereus Hamilton, 1822
30	Cá mối thường	Saurida argentea Macleay, 1881
IX	BỘ CA NHAI	BELONIFORMES.
15	Cá Nhái	Belonidae
31	Cá Nhái	Xennentodon canciloides (Bleeker), 1853
16	Cá Lìm kìm	Hemiramphidae
32	Cá Lìm kìm sông	Zenarchopterus ectuntio (Hamilton, 1822)
33	Cá Kìm sông	Hyporhamphus unifasciatus (Ranzant, 1842)
X	BỘ MANG LIỀN	SYNBRANCHIFOMES
17	Lươn	Synbranchidae
34	Lươn đồng	Monopterus albus (Zuiew, 1793)
35	Cá Lịch sông	Macrotrema caligans (Cantor, 1849)
XI	BỘ CA MÙ LÀN	SCORPAENIFORMES
18	Cá Chai	Platycephalidae
36	Cá Chai	Platycephalus indicus (Linnaeus, 1758)
XII	BỘ CÁ VƯỢC	PERCIFORMES
19	Cá Chẽm	Centropomidae.
37	Cá Chẽm	Lates calcarifer (Bloch, 1790)
20	cá sơn	Ambassidae
38	Cá sơn xương	Ambassis gymnocephalus (Lacépède, 1802)
21	cá căng	Terapontidae
39	Cá ong	Terapon jarbua (Forsskăl, 1775)
40	Cá Căng	Terapon theraps (Cuvier, 1829)
22	Cá Đục	Sillaginidae
41	Cá đục bạc	Sillago sihama (Forsskăl, 1775)
42	Cá Đục chấm	Sillago maculata Quoy & Gaimard, 1824.
23	Cá Hồng	Lutijanidae
43	Cá Hường vẩy nhỏ	Coius microlepis (Bleeker, 1853)
24	Cá móm	Gerreidae
44	Cá Móm gai dài	Gerres filamentosus Cuvier, 1829
25	cá sạo	Haemulidae
45	Cá sạo chấm	Pomadasys maculatus (Bloch, 1797)
26	Cá Tráp	Sparidae
46	Cá tráp be đa	Acanthpagrus berda (Forsskăl, 1775)
27	cá đù	Sciaenidae

47	Cá Sửu	Nibea soldado (Lacépède 1802)
28	cá Nhụ	Polynemidae
48	Cá Chét	Eleutheronema tetradactylum (Shaw, 1804)
49	Cá Phèn vàng	Polynemus paradiseus Linnaeus, 1758
29	cá Mang rổ	Toxotoidae
50	Cá Mang rổ	Toxotes chatareus (Hamilton, 1822)
30	cá khiên	Drepanidae
51	Cá Khiên	Drepane punctatus (Linnaeus, 1758)
31	Cá Đối	Mugilidae
52	Cá Đối mục	Mugil cephalus Linnaeus, 1758
32	cá rô phi	Cichlidae
53	Cá rô phi vằn	Oreochromis niloticus niloticus (Linaeus, 1758)
33	Cá Bống đen	Eleotridae
54	Cá Bống cau	Butis butis (Hamilton, 1822)
55	Cá Bống dừa xiêm	Oxyeleotris siamensis (Gỹnther, 1861)
34	Cá Bống trắng	Gobiidae
56	Cá Bống Cát	Glossogobius aureas Akihito & Meguro, 1975
57	Cá Bống cát trắng	Glossogobius sparsipapillus Akihito & Meguro, 1976
58	Cá Bống kèo	Pseudapocryptes elongatus (Cuvier, 1816)
59	Cá Bống sao	Boleophthalmus boddarti (Pallas, 1770)
60	Cá Thòi lòi	Periophthalmodon schlosseri (Pallas, 1770)
61	Cá Rẻ cau	Taenioides gracilis (Valenciennes, 1837)
62	Cá Đèn cầy	Trypauchen vagina (Bloch & Shcneider, 1801)
35	Cá Nâu	Scatophagidae
63	Cá Nâu	Scatophagus argus (Linnaeus, 1776)
36	Cá Rô đồng	Anabantidae
64	Cá Rô đồng	Anabas testudineus (Bloch, 1792)
37	cá Tai Tượng	Osphronemidae
65	Cá Sặc bướm	Trichogaster trichopterus (Pallas, 1770)
66	Cá tai tượng	Osphronemus goramy Lacépède, 1801
38	Cá Quả	Channidae
67	Cá Lóc	Channa striata (Bloch, 1797)
XIII	BỘ CÁ BƠN	PLEURONETIFORMES
39	cá Bơn	Soleidae
68	Cá Bơn lưỡi mèo	Brachirus harmandi (Sauvage, 1878)
40	Cá Bơn cát	Cynoglossidae
69	Cá Bơn lưỡi trâu	Paraplagusia bilineata (Bloch, 1785)
70	Cá bơn điểm	Cynoglossus puncticeps (Richardson, 1846)

APPENDIX 2: LOCATION MAP FOR ENVIRONMENT MONITORING PRE-CONSTRUCTION

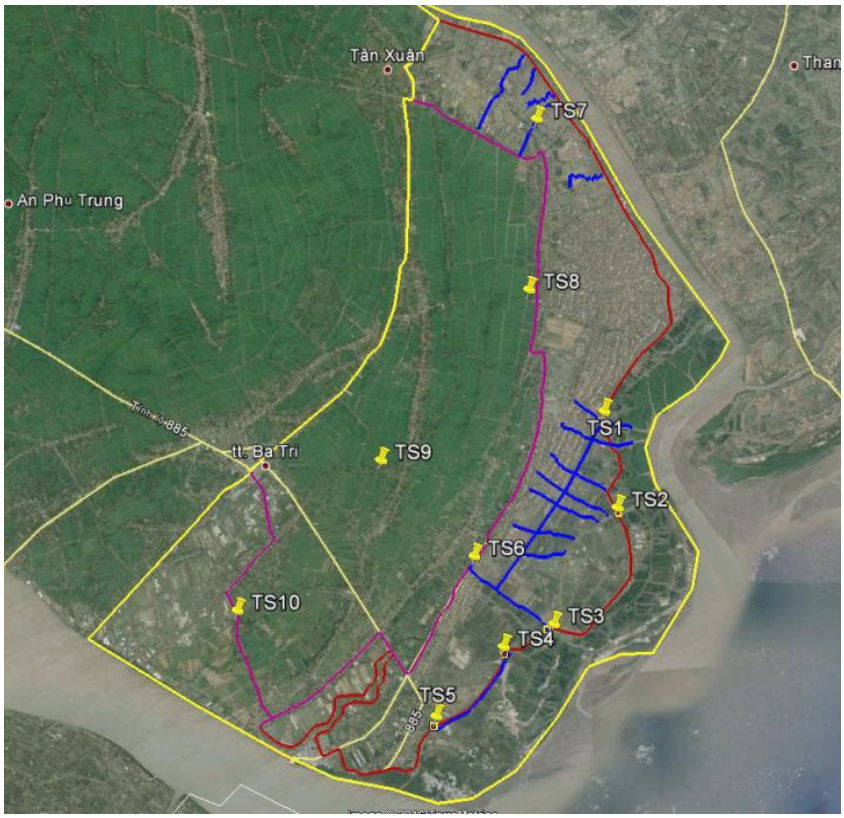

Figure : Location of sampling of micro organic

Code	Coordinates		Sampling location
	Latitude	Latitude	
TS1	10° 3'6.96"N	106°40'10.62"E	Duong Khai sluice gate
TS 2	10° 1'54.01"N	106°40'20.95"E	Trang Nuoc sluice gate
TS 3	10° 0'26.02"N	106°39'31.16"E	Duong Tac sluice gate
TS 4	10° 0'8.91"N	106°38'51.81"E	Cai Keo sluice gate
TS 5	9°59'16.47"N	106°37'59.21"E	An Thanh sluice gate
TS 6	10° 1'17.31"N	106°38'28.94"E	end of Duong Tac canal
TS 7	10° 6'48.24"N	106°39'18.11"E	No canal
TS 8	10° 4'38.95"N	106°39'11.99"E	Canal next to Bao Thanh market
TS 9	10° 2'29.85"N	106°37'15.90"E	Ba Tri canal
TS 10	10° 0'36.35"N	106°35'23.82"E	Nga Cat canal

ANNEX 3: SIMPLIFIED ECOP

1. This annex presents the Environmental Codes of Practice (ECOP) to be applied in the proposed subproject when small works are involved. The content and requirements following the WB guideline described in (the ESMF tool kit -annex 5).

A3.1 Objectives

2. The Environmental Codes of Practice (ECOP) is prepared to manage small environmental impacts during construction. The ECOPs will apply to manage small scale infrastructure investments subproject. ECOP will be a mandatory part of construction contract or bidding documents so that contractor complies with environmental covenants. The subproject owner (Ben Tre PPMU) and construction supervisors will be responsible for monitoring of compliance with ECOP and preparing the required reports.

3. There are a number of national technical regulations related to environmental, health and safety that apply to construction activities. Some of them are listed below:

- *Water Quality*: (QCVN 01:2009/BYT, QCVN 02:2009/BYT, QCVN 08-MT:2015/BTNMT, QCVN 09:2008/BTNMT, QCVN 10:2008/BTNMT, QCVN 14:2008/BTNMT, TCVN 5502:2003; TCVN 6773:2000, TCVN 6774:2000, TCVN 7222:2002)
- *Air and Soil Quality* (QCVN 05:2008/BTNMT, QCVN 06:2008/BTNMT, QCVN 07:2008/BTNMT
- *Solid Waste Management* (QCVN 03:2008/BTNMT, TCVN 6438:2001, TCVN 6696:2009, QCVN 07:2009)
- *Vibration and Noise* (QCVN 27:2010/BTNMT, QCVN 26:2010/BTNMT, TCVN 5949: 1998)
- *Labor Health and Safety*: Decision No.3733/2002/QĐ-BYT issued by Ministry of Healthcare dated on 10/10/2002 about the application of 21 Labor health and safety standards that concerned about microclimate, noise, vibration, Chemicals – Permitted level in the working environment
- The World Bank Group Environmental Health and Safety Guidelines which available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines

A4.2 Responsibilities

4. The subproject owner (Ben Tre PPMU) and Contractors are the key entities responsible for implementation of this ECOP. Key responsibilities of the PPMU and the contractors are as follows:

(a) Ben Tre PPMU

- PPMU is responsible for ensuring that the ECOP is effectively implemented. The PPMU will assign a qualified staff to be responsible for checking implementation compliance of Contractors, include the following: (a) monitoring the contractors' compliance with the environmental plan, (b) taking remedial actions in the event of non-compliance and/or adverse impacts, (c) investigating complaints, evaluating and identifying corrective measures; (d) advising the Contractor on environment improvement, awareness, proactive pollution prevention measures; (e) monitoring the activities of Contractors on replying to complaints; (f) providing guidance and on-the-job training to field engineers on various aspects to avoid/mitigate potential negative impacts to local environment and communities during construction.

(b) Contractor

- Contractor is responsible for carrying out civil works and informs PPMU/ICBM10, local authority and community about construction plan and risks associated with civil works. As such, contractor is responsible for implementing agreed measures to mitigate environmental risks associated with its civil works.
- Contractor is required to obey other national relevant legal regulations and laws.

Part 1 – Contractor's Responsibilities

7. This is an example and is not necessarily a full treatment of all requirements for a specific project. For example, there might be reason to have contractor deal with sexually transmitted diseases, medical and hazardous waste s (e.g., oil from vehicle or furnace repair and similar, oily rags).

Issues/Risks	Mitigation Measure
1) Dust generation/ Air pollution	• The Contractor implement dust control measures to ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents, maintain a safe working environment, such as: – Water dusty roads and construction sites; – covering of material stockpiles; – Material loads covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust; – Exposed soil and material stockpiles shall be protected against wind erosion.
2) Noise and vibration	• All vehicles must have appropriate "*Certificate of conformity from inspection of quality, technical safety and environmental protection"* following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines.
3) Water pollution	• Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any water body. • Wastewater over permissible values set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. • At completion of construction works, water collection tanks and septic tanks shall be covered and effectively sealed off.
4) Drainage and sedimentation	• The Contractor shall follow the detailed drainage design included in the construction plans, to ensure drainage system is always maintained cleared of mud and other obstructions. • Areas of the site not disturbed by construction activities shall be maintained in their existing conditions.
5) Solid waste	• At all places of work, the Contractor shall provide litter bins, containers and refuse collection facilities. • Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • No burning, on-site burying or dumping of solid waste shall occur. • Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc. shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses.
6) Chemical or hazardous wastes	• Used oil and grease shall be removed from site and sold to an approved used oil recycling company.

Issues/Risks	Mitigation Measure
	• Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site. • Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. • Store chemicals in safe manner, such as roofing, fenced and appropriate labeling.
7) Disruption of vegetative cover and ecological resources	• Areas to be cleared should be minimized as much as possible. • The Contractor shall remove topsoil from all areas where topsoil will be impacted on by rehabilitation activities, including temporary activities such as storage and stockpiling, etc; the stripped topsoil shall be stockpiled in areas agreed with the Construction Supervision Consultant for later use in re-vegetation and shall be adequately protected. • The application of chemicals for vegetation clearing is not permitted. • Prohibit cutting of any tree unless explicitly authorized in the vegetation clearing plan. • When needed, erect temporary protective fencing to efficiently protect the preserved trees before commencement of any works within the site. • The Contractor shall ensure that no hunting, trapping shooting, poisoning of fauna takes place.
8) Traffic management	• Before construction, carry out consultations with local government and community and with traffic police. • Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, hospitals, and markets. • Installation of lighting at night must be done if this is necessary to ensure safe traffic circulation. • Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning. • Employing safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. • Avoid material transportation for construction during rush hour. • Signpost shall be installed appropriately in both water-ways and roads where necessary.
9) Interruption of utility services	• Provide information to affected households on working schedules as well as planned disruptions of water/power at least 2 days in advance. • Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible.
10) Restoration of affected areas	• Cleared areas such as disposal areas, site facilities, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied during construction of the project works shall be restored using landscaping, adequate drainage and revegetation. • Trees shall be planted at exposed land and on slopes to prevent or reduce land collapse and keep stability of slopes. • Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas.

Issues/Risks	Mitigation Measure
11) Worker and public Safety	• Training workers on occupational safety regulations and provide sufficient protective clothing for workers in accordance with applicable Vietnamese laws. • Install fences, barriers, dangerous warning/prohibition site around the construction area which showing potential danger to public people. • The contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas. • If previous assessments indicate there could be unexploded ordnance (UXO), clearance must be done by qualified personnel and as per detailed plans approved by the Construction Engineer.
12) Communication with local communities	• The contractor shall coordinate with local authorities (leaders of local communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). • Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. • Disseminate project information to affected parties (for example local authority, enterprises and affected households, etc) through community meetings before construction commencement. • Provide a community relations contact from whom interested parties can receive information on site activities, project status and project implementation results. • Inform local residents about construction and work schedules, interruption of services, traffic detour routes and provisional bus routes, blasting and demolition, as appropriate. • Notification boards shall be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the channel to voice their concerns and suggestions.
13) Chance find procedures	• If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves during excavation or construction, the Contractor shall: • Stop the construction activities in the area of the chance find; • Delineate the discovered site or area; • Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities or the Department of Culture and Information takes over; • Notify the Construction Supervision Consultant who in turn will notify responsible local or national authorities in charge of the Cultural Property of Viet Nam (within 24 hours or less); • Relevant local or national authorities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values; • Decisions on how to handle the finding shall be taken by the responsible authorities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage;

Issues/Risks	Mitigation Measure
	• If the cultural sites and/or relics are of high value and site preservation is recommended by the professionals and required by the cultural relics authority, the Project's Owner will need to make necessary design changes to accommodate the request and preserve the site; • Decisions concerning the management of the finding shall be communicated in writing by relevant authorities; • Construction works could resume only after permission is granted from the responsible local authorities concerning safeguard of the heritage.

Part 2 – Contractor's Workers Environmental Code of Conducts

8. This is an example for typical project.

Do:	Do not
• Use the toilet facilities provided – report dirty or full facilities • Clear your work areas of litter and building rubbish at the end of each day – use the waste bins provided and ensure that litter will not blow away. • Report all fuel or oil spills immediately & stop the spill from continuing. • Smoke in designated areas only and dispose of cigarettes and matches carefully. (littering is an offence.) • Confine work and storage of equipment to within the immediate work area. • Use all safety equipment and comply with all safety procedures. • Prevent contamination or pollution of streams and water channels. • Ensure a working fire extinguisher is immediately at hand if any "hot work" is undertaken e.g. welding, grinding, gas cutting etc. • Report any injury of workers or animals. • Drive on designated routes only. • Prevent excessive dust and noise	• Remove or damage vegetation without direct instruction. • Make any fires. • Poach, injure, trap, feed or harm any animals – this includes birds, frogs, snakes, etc. • Enter any fenced off or marked area. • Drive recklessly or above speed limit • Allow waste, litter, oils or foreign materials into the stream • Litter or leave food lying around. • Cut trees for any reason outside the approved construction area • Buy any wild animals for food; • Use unapproved toxic materials, including lead-based paints, asbestos, etc.; • Disturb anything with architectural or historical value • Use of firearms (except authorized security guards) • Use of alcohol by workers during work hours • Wash cars or machinery in streams or creek • Do any maintenance (change of oils and filters) of cars and equipment outside authorized areas • Dispose trash in unauthorized places • Have caged wild animals (especially birds) in camps • Work without safety equipment (including boots and helmets) • Create nuisances and disturbances in or near communities • Use rivers and streams for washing clothes • Dispose indiscriminately rubbish or construction wastes or rubble • Spill potential pollutants, such as petroleum products • Collect firewood • Do explosive and chemical fishing • Use latrines outside the designated facilities; and • Burn wastes and/or cleared vegetation.

APPENDIX 4: PICTURES OF CONSULTATION MEETINGS

Figure 1. Household community consultations in the Ba Tri District – Ben Tre Province

Figure 2. Provincer level consultations in the Ben Tre Province


ĐẢNG CỘNG SẢN VIỆT NAM QUANG VINH MUÔN NĂM