SFG1698 V4 REV

MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT(MARD)

CENTRALOFFICE FOR WATER RESOURCES PROJECTS (CPO)

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

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

SUBPROJECT: INFRASTRUCTURE TO PREVENT COASTAL EROSION AND TO SUPPORT AQUACULTURE PRODUCTION IN AN MINH AND AN BIEN DISTRICTS, KIEN GIANG PROVINCE

(Final)

March 2016

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ABBREVIATIONS

CPMU	Central Project Management Unit of CPO
CPO	Central Project Office (MARD)
CSC	Construction Supervision Consultant
CSEP	Contract Specific Environmental Plan
DARD	Department of Agriculture and Rural Development
DONRE	Department of Natural Resources and Environment
DWR	Department of Water Resources
ECOP	Environmental Codes of Practice
EHSO	Environment Health and Safety Officer
EMC	Environmental Management Consultant
EMP	Environmental Management Plan
ESC	Environment Safeguard Coordinator
ESMF	Environment and Social Management Framework
ESU	Environment and Social Unit
GOV	Government of Vietnam
GRM	Grievance Redress Mechanism
HH	Household
IMC	Independent Monitoring Consultant
MARD	Ministry of Agriculture and Rural Development
MD-WRMRD	Mekong Delta Water Resources Management for Rural Development
MD-ICRSL	Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods
NGO	Non-Governmental Organisation
PMF	Pest Management Framework
PPC	Provincial People's Committees
PPMU	Provincial Project Management Unit
RPF	Resettlement Policy Framework
SIWRR	Southern Institute of Water Resouces Research
SSC	Social Safeguard Coordinator
TOR	Terms of Reference
UXO	Unexploded Ordnance
WB	World Bank

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1. SUBPROJECT BACKGROUND

1.1. Summary on the background and rationale for the subproject

For the coastal areas, dikes always serve as the protective shields for the safe and effective daily life and production of people. In order to protect local disasters and production in two districts of An Bien and An Minh, since early 90s of the last century, the government and the people of Kien Giang province have built the An Bien-An Minh sea dike and the relatively closed embankments which stretch from Ranh Gia Cape to Tieu Dua canal of nearly 70km long. However, in November 1997, Linda storm swept through the southern provinces and caused enormous damages to people and properties on the Mekong Delta provinces, making a series of local dikes heavily damaged, including the An Bien-An Minh sea dike. In this situation, to quickly stabilize people's life and production in the region, Kien Giang Provincial People's Committee implementedaproject on "Restoring and Upgrading the An Bien-An Minh sea dyke, Kien Giang province" in 1999. The project plans to construct a sea dike from Can Gao (Xeo Ro) to Rach Chu (Chu Vang) of nearly 55 km longand 27 open sluice gates with the aperture from 3.0 to 7.5 meters (m) built by the traditional technology. This system was designed for prevention of natural disasters, drainage, regulation between salt water and fresh water to serve the agricultural production, aquaculture and create geographical distribution of population. To date, the entire dike was completely constructed with the design elevation of +2.0m, however, due to limited budget, not all the sluice gates along the sea dyke could be built and the water could not being regulated for the production of local people.

Impacts of the climate change and sea level rises in recent times have also influenced quite clearly to this region. Surge tides, rising sea levels often occur, causing deforestation of mangrove, erosion of sea dykes, breaking of aquacultural embankments, and serious damages to the lives and economic development of citizens.

To maintain the current production and to adapt to climate changes in the future, Kien Giang province has recently spent part of the funds to build 06 sluice gates (Thu Bay, Xeo Doi, Xeo Quao, Xeo Nhao, Thuong Luong and Co Ghe). However, there are still 22 sluice gates have not been built, so it is unable to regulate water resource for production and prevent flooding.

Another project namely: "Infrastructure to prevent coastal erosion and to support aquaculture production in An Minh and An Bien districts, Kien Giang province" has been designed to actively regulate water for stable production, to minimize the impacts of flood in context of climate change and sea level rise, and to develop the sustainable production models consistent with local water conditions to improve people's livelihood in the coastal area of An Minh and An Bien districts.

1.2. The link of the subproject to the Regional Environmental Assessment (REA)

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 Peninsula

- **Delta peninsula:** Eastern and southern regions of the Delta, where coastal processes dominate local hydrology and local rainfall is the main freshwater input. On the delta peninsula dominated by coastal influences and limited freshwater inputs, brackish

aquaculture is the dominant land use accounting for 41% of the provincial area. The mangroves and forest areas remaining in the delta are critical for the natural resource base and coastal protection from storm surges and salinity intrusion.

Delta shrinking and land subsidence

- **Marine and fluvial processes of the delta maintain a balance between accretion and erosion of the delta land mass**. For the past 20 years the East Sea provinces of Ben Tre, Tien Giang, and Tra Vinh have been growing with net accretion rates of 1-10m/ year. The Kien Giang coast is very vulnerable to the impacts of coastal erosion. A decreasing river sediment supply to the coast is deemed to be the prime cause of this erosion, and most likely due to existing dam retention of sediment and to massive channel-bed sand mining in the delta, an activity on the increase over the last decade.
- **The Ca Mau peninsula remains hydrological isolated from the surface water processes of the Mekong River and its distributaries**. This means that the provinces of Ca Mau and Bac Lieu and 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 replenishment to the surface water system is direct rainfall with the monsoon rains. The timing and magnitude of wet season rainfall can have significant impacts on farming systems and groundwater dependency of the peninsula where rates of historic groundwater abstraction are the highest for the whole delta region. Intensification of groundwater exploitation has increased dramatically over the last decade, driven by the widespread diversification of shrimp farmers into horticulture and, to a lesser extent, salinity control in shrimp farming.
- **Land subsistence is occurring due to sustained, long-term drainage and groundwater extraction.** Considerable groundwater extraction from over one million wells in the Mekong Delta, for domestic, agricultural, and industrial use, is taking place, resulting in a steady decline in groundwater levels. As water is removed from the sedimentary structure, pore pressure is reduced and compaction occurs between layers, manifest as subsidence. Groundwater abstraction coupled with the areas unique geology, and natural land consolidation processes of a young delta like the Mekong have resulted in rates of land subsidence in the order of 0.5 – 3.3cm/year.

Deterioration of mangroves

- **The area of mangroves has rapidly declined over time in the coastal areas of Vietnam**. Mangroves declined from an estimated 408,500 ha in 1943 to 290,000 ha in 1962, to 252,000 ha in 1982; and to 155,290 ha in 2000 (Government of Vietnam, 2005). However, there is evidence that the area of mangroves increased in 2006 due to a National Action Plan for mangrove protection and development (Government of Vietnam, 2005). Despite this national increase, some areas in the Mekong Delta and other coastal areas are still in decline.
- **In the delta peninsula demand for land for shrimp ponds and agriculture has resulted in loss of mangrove forests**. Deforestation of mangroves in the Mekong Delta is mainly due to unplanned shrimp farming, urban development and the limited regulations and institutions in relation to integrated coastal management. The destruction of mangroves in the coastal zones of the delta for shrimp ponds took place in the 1990s. Deforestation slowed down after the Government enforced stricter management measures in 2000, and farmers also acknowledged that the sediment in mangroves were not suitable for shrimp farming. Increased fragmentation of

mangroves has reduced capacity to withstand coastal processes, such as wave actions, coastal currents and wind at exposed and semi-exposed coastline locations. The mangrove and land use has also been mapped highlighting the areas of mixed forest, Rhizophora, Rhizophora and shrimp, Avicennia and intensive shrimp. Mangroves play a critical role in biodiversity and ecosystem productivity in the delta peninsula.

- **The destruction of mangrove forests has increased vulnerability to storm surges and coastal erosion.** Large areas of coastlines are now eroding or are at risk of erosion. This is resulting in the loss of key mangrove resources and associated ecosystem services, and also directly threatening the livelihoods of local communities through increased vulnerability of coastal communities to storm surges and typhoons. Mangrove forests protect the coastline against flooding and inundation in storms, increases sedimentation and accretion, and reduces erosion.
- **National and provincial authorities are integrating climate resilient policies into wider programs of coastal zone management**. Major investments have been committed to upgrading national and provincial dike systems. MARD is carrying out a national plan worth US$109 million to restore mangroves along Viet Nam's coastline. In some areas of the delta, dikes are 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) programme is supporting Viet Nam to manage its coastal ecosystems in order to strengthen resilience to climate change.
- **Efforts are also being made to regenerate the mangrove areas and implement more sustainable shrimp farming practices**. The preservation and gradual regeneration of mangrove forests is not only critical for ecology and biodiversity of the delta, but also in terms of natural wastewater treatment for shrimp farming and aquaculture.

Intensive shrimp farming

- **Aquaculture is one of the fastest growing sectors in the Delta**. Out of 337,614 households in Vietnam) engaged in shrimp farming, 292,522 (86%) of households were from the Mekong Delta. Aquaculture area and production increased significantly in Bac Lieu and Ca Mau provinces from 2000 as a result of the agricultural diversification policy by the government. Farmers shifted from rice production to shrimp based farming systems for higher farm-based income. From 2000 onwards the area of brackish and freshwater farms increased significant, particularly in Ca Mau, Bac Lieu and Kien Giang provinces. Shrimp farming has replaced rice in some areas.
- **In recent years, several major shrimp crop failures have occurred from disease and water pollution in the delta peninsula.** The large areas of land required for extensive and semi-intensive farming have led to significant natural habitat loss through conversion of wetlands and mangroves into shrimp ponds. However, the negative environmental impacts from shrimp disease outbreaks, natural resource degradation, water use conflicts, food safety problems, and most recently, tariff barriers, are major concerns for the shrimp farming sector.
- **Salinity is a major issue associated with shrimp farming**. The system of dikes and dams preventing saline movement was removed, while many canals were enlarged or newly dug. As a result, a dense and vast system of canals characterises shrimp-farming communities, especially those engaging in extensive shrimp culture. 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.

- **Water quality is essential to shrimp farming. Farmers need to treat water appropriately before releasing water from their shrimp ponds into rivers of canals to avoid water pollution and biological contamination**. Water often polluted with unconsumed feed, chemicals, and possibly diseases is released directly into rivers or canals exposing downstream and neighbouring shrimp farms to negative impacts. Water quality is decisive factor for a successful shrimp crop and the water is easily contaminated by the practices of individual shrimp farmers.
- **Intensive shrimp farming is also affecting groundwater, leading to further land subsidence in the Delta Peninsula.** Fresh water is normally used to mix with seawater in order to make up for evaporation in ponds and produce the optimum salinity, especially in the dry season. Using freshwater from groundwater allows saltwater intrusion into groundwater reservoirs and the loss of water supplies for agriculture and domestic purposes. The social impacts of shrimp farming including the increase of poverty and landlessness, food insecurity, and impacts on health and education will be explored further in the following section.

Natural resource dependency of the poor and landless

- **Local communities are often excluded from intensive shrimp farming due to its requirement for high capital investment**. Instead many local poor people have sold or leased their ponds instead of participating in shrimp farming themselves. Some farmers were forced to take on shrimp farming as the irrigation systems favoured saline water. The Khmer ethnic group are further disadvantaged as extension services for shrimp farming are often provided only in the Vietnamese language.
- **High levels of rural to urban migration are occurring in the delta peninsula.** The problems of high population density, low educational levels, underdeveloped infrastructures and the scarcity of economic opportunities have led to unemployment and labour excess in coastal areas. Shrimp farming provides less employment opportunities for unskilled labour than rice production. Most young people are migrating from coastal areas to urban areas for employment and economic opportunities.

Loss of peat soil environments

- **The peat soils environment of the U Minh region has been declining rapidly due to land clearing and the development of canals**. In 1962, the extent of peat soil environments in the U Minh region (including both U Minh Thuong and U Minh Ha) was estimated to be 60,000 hectares. Land clearing for agriculture and the development of the canal network following the war destroyed most of the peat layer in the U Minh area. In 1978, a detailed survey concluded that the total area of peat was 32,000 hectares. After 1989, the remaining area of peat is about 20,000 hectares based on remote sensing images and has been declining further. Peatlands are critical for water regulation. Peat soils are generally meters deep and they store and maintain large quantities of water. Therefore, peatlands play an important role in protection against floods after heavy rainfall and storm surges. The peat soil environments in the Mekong Delta support *melaleuca* forests and wetland ecosystems providing natural resources and non-timber forest products for local livelihoods.

b) Strategy for the Delta Peninsula - Protecting coastal areas

Given the above environmental and social issue of the delta peninsula region the REA recommends the key strategies for the delta peninsula is the aim 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. Protecting coastal areas is required to address the challenges related to coastal erosion, groundwater over abstraction, through appropriate coastal protection measures and sustainable livelihoods for communities living in the delta peninsula area. The key components of the strategy for the delta peninsula is to address the increasing vulnerability of the brackish economy resulting from sea level rise (flood risk and salinization), coastal erosion, fresh water supply for agriculture and shrimp farming systems and livelihoods improvement.

The subproject has been designed in line with this strategic direction to include restoration of mangroves to enhance coastal defense, transition of shrimp farming into integrated mangrove-shrimp, construction/ upgrades of river and coastal embankments, and sluice gates to manage water conditions and demonstration and aquaculture extension to improve efficiency and sustainability of brackish water aquaculture.

1.3. The relationships of the subproject and other plans and programs approved by the state agencies

The proposed MD-ICRSLP and this subproject areclosely related to the current Government efforts to protect coastal resources and improve livelihood of local people, and the key plans and programs are highlighted below.

1.2.1 The program that strengthens and upgrades the sea dyke system from Quang Ngai to Kien Giang provinces

The scope of the program that strengthens and upgrades the sea dyke system from Quang Ngai to Kien Giang covers 15 provinces: Quang Ngai, Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan, Ba Ria - Vung Tau, Ho Chi Minh City, Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, Ca Mau and Kien Giang.

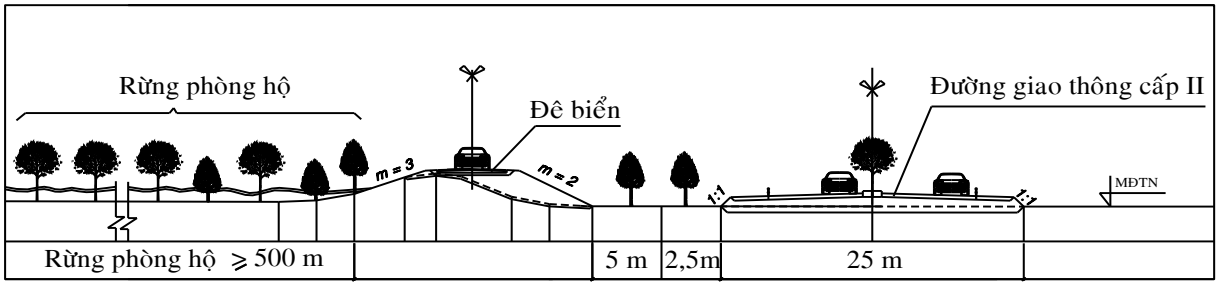


Figure 1: The cross section of the sea dike according to Decision 667/QD-TTg

An Minh - An Bien sea dike, Kien Giang province was constructed based on Decision 667/QD-TTg. However due to limited state budget, only a part of dike and some drains were constructed, so the program result for An Minh – An Bien region is not high.

1.2.2. The detailed planning of Vietnam's coastal roads

The detailed planning of Vietnam's coastal roads is based on Decision 129/QD-TTg dated January 18, 2010 includes the section of 67km long passing An Minh – An Bien:

Table 1: The detailed planning of the coastal road passing the project area

No.	Section	Length (km)	Current name of road	Planned scale		
				Road level	B_m/B_n	Load
1	An Bien - An Minh	67.0	Coastal road	Urban road	5.5/7.5	HL93

1.2.3. The land-use planning up to 2020, the land-use planning for 05 early years of period 2011-2015 - Kien Giang province

According to the land use planning up to 2020, the early 05-year-land-use plan (2011-2015) of Kien Giang province in the region is determined as rice production combined aquaculture.

2. RELEVANT LAWS, LEGISLATIONS AND REGULATIONS

2.1. Relevantnational laws and regulations

The laws, regulations, standards and technical guidelines on environment as a basis for the implementation of EIA and EIA reports of subprojects

- Law on Environmental Protection No. 55/2014/QH13 passed by the National Assembly on 23 June 2014 and took effect since 01 January 2015;
- Law on Land No. 45/2013/QH13 passed by the National Assembly of the Socialist Republic of Vietnam on 29 November 2013 and took effect since 01 July 2014;
- Law on Fisheries Land 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 Natural disaster prevention and control No. 33/2013/QH13 passed by the National Assembly of the Socialist Republic of Vietnam on 19 June 2013 and took effect since 01 May 2014;
- 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 Labor No.10/2012/QH13 of the National Assembly of Vietnam Socialist Republic of Vietnam dated June 18, 2012 provides labor standards; rights, obligations and responsibilities of employees, employers, employees' representative organizations and employers' representative organizations in industrial relations and other relations directly related to industrial relations; and state management of labor.
- 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 dated November 26, 2003 apply to fishery activities of Vietnamese organizations and individuals and foreign organizations and individuals on the land, islands, in the internal waters, the territorial sea, the exclusive economic zone and continental shelf of the Socialist Republic of Vietnam.
- Decree No. 18/2015/ND-CP of 14 February 2015 of the Government on environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plans;
- 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. 25/2013/ND-CP of 29 March 2013 of the Government on environmental protection charges for wastewater;
- Decree No. 174/2007/ND-CP of 29 November 2007 on environmental protection charges for solid waste;
- Decree No. 43/2014/ND-CP of 15 May 2014 of the Government detailing the implementation of a number of articles of the Land Law;
- Decree No. 59/2007/ND-CP dated 09 April 2007 of the Government on management of solid waste;
- Decree No. 140/2006/ND-CP of the Government dated 22 November 2006 on regulations for establishment, appraisal, approval and organization of implementing of strategies, planning, plans, programmes and development projects;
- Decree No. 47/2014/ND-CP of the Government dated 15 May 2014 on Regulations on compensation, support, and resettlement upon land expropriation by the state;
- 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. 179/2013/ND-CP of the Government dated 14 November 2013 on the sanction of administrative violations in the domain of environmental protection;
- 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/ND-CP of 24 April 2015 of the Government on management of waste and discarded materials;
- Circular No. 27/2015/TT-BTNMT of 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plans;
- Circular No. 36/2015/TT-BTNMT of 30 June 2015 on hazardous waste management;
- Circular No.37/2014/TT-BTNMT of 30 June 2014 on Detailed regulations on compensation, support, and resettlement upon land expropriation by the state;
- 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. 30/2014/TT-BTNMT, regulating the records for land allocation or land lease, the change of land use purposes, land acquisition;

- QCVN 03:2008/BTNMT: National technical regulation on the allowable limits of heavy metals in the soils.
- QCVN 05:2013/BTNMT: National technical regulation on ambient air quality
- QCVN 06:2008/BTNMT: National technical regulation on hazardous substances in ambient air.
- QCVN 07:2009/BTNM: National Technical Regulation on hazardous waste thresholds.
- QCVN 08-MT:2015/BTNMT: National technical regulation on surface water quality.
- QCVN 09:2008/BTNMT: National technical regulation on underground water quality.
- QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater.
- QCVN 15:2008/BTNMT: National technical regulation on the pesticide residues in the soils.
- QCVN 17:2011/BGTVT: National technical regulation on Rules for Pollution Prevention of inland waterway ships.
- QCVN 26:2010/BTNMT: National technical regulation on noise.
- QCVN 27:2010/BTNMT: National technical regulation on vibration.
- QCVN 38:2011/BTNMT: National technical regulation on Surface Water Quality for protection of aquatic lifes.
- QCVN 39:2011/BTNMT: National technical regulation on Water Quality for irrigated agriculture.
- QCVN 43:2012/BTNMT: National technical regulation on sediment quality in fresh water areas.
- Decision 3733/2002/-BYT October 10, 2002: Promulgating 21 labor hygiene standards, 05 principles and 07 labor hygiene measurements.

The documents and data of the subproject owner to be used in the process of environmental impact assessment:

- Report on the feasibility study of subproject: Sustainable Infrastructure for Coastal Protection and Protecting Livelihoods Against Climate Change Impacts In An Minh-An Bien District, Kien Giang province (updated 15/01/2016).
- The analysis results of the baseline environmental data in the subproject area the Southern Institute of Water Resources Research conducted in 10/2015 – 11/2015.
- The field survey data in November 2015.
- The socioeconomic data, orientation of land-use planning, production outputs An Minh and An Bien districts the Department of Agriculture and Rural Development of Kien Giang province and the People's Committee of An Minh, An Bien districts provided.
- The results of the public consultations on the subproject implementation in 10/2015.
- The results of the public consultations on the Subproject's draft report of the environmental and social impact assessment in 01/2016.

2.2. Applicable WB Safeguard Policies

Environmental and social sreening of the subproject was carried out in line withthe 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 MDICRSL Project, 5 policies (i.e. Environmental Assessment (OP/BP 4.01); Forests (OP/BP 4.36); Pest Management (OP/BP 4.09); Natural habitats (OP/BP 4.04); and Involuntary Resettlement (OP/BP 4.12)) have been determined to be triggered for the subproject. The safeguard screening also indicates that the subproject would have potential adverse impacts that are minor to moderate, localized, temporary and can be mitigatedthe subproject has been categorized as a Category B subproject. The subproject Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan (RAP) have been prepared in line with the gvernment Environmental Impact Assessment (EIA) regulation and the Bank safeguards policies requirements

3. ORGANIZATION OF ENVIRONMENTAL IMPACT ASSESSMENT

3.1. Organization of implementation

As part of project preparation of the Project (MD-ICRSLP), the Ministry of Agriculture and Rural Development (MARD) assigned the Vietnam Southern Institute for Water Resources Research (SIWRR) to prepare the ESIA report for the subproject to conform to the provisions of Vietnam and the requirements of the World Bank.

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 the ISO 9001 – 2008 of the Institute, 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 field. To implement this report, SIWRR has nominated the necessary staffs (*Table 2*) 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.

Organization of environmental impact assessment

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.

3.2. List of consultants working for this report and their roles

Table 2: List of consultants working for this report and their roles

No	Full name	Background	Assigned tasks
A	**Representative of subproject owner – Kien Giang DARD**		
1	Tran Vinh		Directing the implementation of reporting environmental impact assessment
2	Huynh Dang Khoa		- Providing subproject information for the consultant - Collaborating with the consultants in working with local authorities - Monitoring EIA report implementation of the consultant
B	**Consultant – Southern Institute of Water Resouces Research**		
1	Dong Thi An Thuy	Environmental Ecology	- Team leader - The administrative procedures, contacts and transactions related to the reporting EA - Public consultation Writing EA report
2	Vu Nguyen Hoang Giang	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	Pham The Vinh	Water resources	- Hydraulic and water quality modelling Assessing the results of water quality and salinity intrusion models
4	Nguyen Dang Luan	Construction - Water works, water supply	- Develop and implementing scenarios of salinity intrusion - Developing and implementing scenarios of organic pollution forcasting Writing section on hydrological and meteorological characteristics in the sub project area and the affected areas
5	Nguyen Thi Tam	Analytical chemistry	- Writing report on the existing environmental quality (water, soil, air and sediment quality). - Developing environmental monitoring and management in subproject life - Estimating costs of environmental monitoring. Organizing public consultation

No	Full name	Background	Assigned tasks
6	Tran Minh Tuan	Water resources and land improvement	Writing report on existing water resources works and river/canal system in the subproject area and its surroundings
7	Duong Thi Thanh	Biology	- Writing report on analysis and evaluation of the subproject impacts on the biodiversity due to subproject implementation Proposing mitigations to control and mitigate subproject impacts on biodiversity
8	Nguyen Duc Vuong	Construction of marine works	- Writing report on impacts of the subproject on water transport. Developing program to control and mitigate impacts of the subproject on water transport
9	Thai Thanh Luom	Forestry	Developing forest management plan during subproject operation
10	Nguyen Minh Nien	Aquaculture	Analysis impacts of shrimp model on environment and propose mitigation measures

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 4.1 and 4.2) as well as the technical guidance from the ESMF with respect to the preparation of an ESMP for the subprojects aiming for *upgrading and constructing new infrastructure and the development of the livelihood models in the upper part of the delta, as recommended by the Regional Environmental Assessment (REA),* which will be presented in Chapter 3.

4.1. Methods of ESIA

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).

4.1.2. Impact matrix method

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

4.1.3. Comparison method

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

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.

4.1.5. Listing 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: The description listing table whichlists the environment components in need of research in addition to the information on the measurement, prediction and evaluation; and Simple checklist which will list environmental components to be studied and likely to be affected.

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. A meaningful public consultation will be used. 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 ongoing process during project preparation and supervision.

4.2. Other Methods

4.2.1. Method of information and data inheritance, summary and analysis

This method is 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, and 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 findingds and further identify limitations.

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 environment, 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.

4.2.3. Consensus method

Based on knowledge and experiences in environmental science of EIA, the specialists of the consultant team and and other scientific research units with in the institute will discuss and agree the the fidings of the ESIA.

4.2.4. Sampling and analyzing methods in laboratory

Sampling and analyzing samples of environmental components (soil, water, air) are integral to identify and evaluate status of baseline environment quality in the subproject area as following:

- 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 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.

CHAPER 1. SUBPROJECT DESCRIPTION

1.1. Subproject name

Subproject name: "*Infrastructure to prevent coastal erosion and to support aquaculture production in An Minh and An Bien districts, Kien Giang province*"**Under project:**Mekong Delta Integrated Climate Resilience and Sustainable Livelihoods (MD-ICRSL) Project

1.2. Subproject owner

- **Subproject approval authority:**People's Committee of Kien Giang province
- **Subproject owner:**Kien Giang Department of Agriculture and Rural Development
- **Address:** 1066 Nguyen Trung Truc, An Hoa Ward, Rach Gia city, Kien Giang
- **Telephone:** 0773.812445 - Fax:0773.812417
- **Representative:** Mr Nguyen Van Tam

1.3. Subproject geographical location

The geographical locations of An Bien and An Minh districts of Kien Giang province are as follows: from 9º28' to 10º02'north latitude and from 104º51' to 105º06' east longitude. The subproject area covers approximately 60,800ha natural area, in the territory of the communes: Tay Yen, Tay Yen A, Nam Yen, Nam Thai, Nam Thai A, Dong Thai and Thu Ba town - An Bien district; Thuan Hoa, Dong Hoa, Tan Thanh, Dong Hung, Dong Hung A, Dong Hung B, Van Khanh, Van Khanh Dong, Van Khanh Tay and Muoi Mot town - An Minh district of Kien Giang province. The subproject area is surrounded by: (i) the West Sea in the West and Northwest; (ii) the Cai Lon river in the Northern and Eastern North; (iii) the Can Gao canal in the Southeast; and (iv) the Tieu Dua canal in the Southwest(see *Figure 2*).

1.4. Subproject Description (selected alternatives)

1.4.1. Subproject's objectives

The subproject aims to ensure protection people's lives, to prevent inundation due to spring tide, to regulate salinity and to ensure flood drainage for stable production and livelihood in An Minh and An Bien districts of Kien Giang province.

Specific objectives of the subproject is to enhance resilience capacity to deal with natural condition, water resources and climate change in the area of 99,079 ha of An Minh and An Bien districts of Kien Giang (in which the direct beneficiary area is 60,800 ha) by (1) Contructing 9 sluice gates at the 9 priority channels that have been selected to allow flexibility for production transition, environmental protection, water supply, and people's livehoods; (2) implementation of appropriate technology on recovery of mangrove for protection of coastal line in the subproject area that is facing rapid coatsal erosion (10 km at the lower end of the subproject); and (3) Demonstrating livelihoods sites in the selected aquaculture area of the coastal zone (24,769ha from the Chong My canal to the mangrove belt in front of the seadyke) and in the shrimp-rice area (36,013ha) to increase income of local people and take advantage of salt water resource of the area including implementing activities to enhance the value of agricultural production products such as agricultural extension, capacity building, branding, marketing, trade promotion, technology transfer, etc.

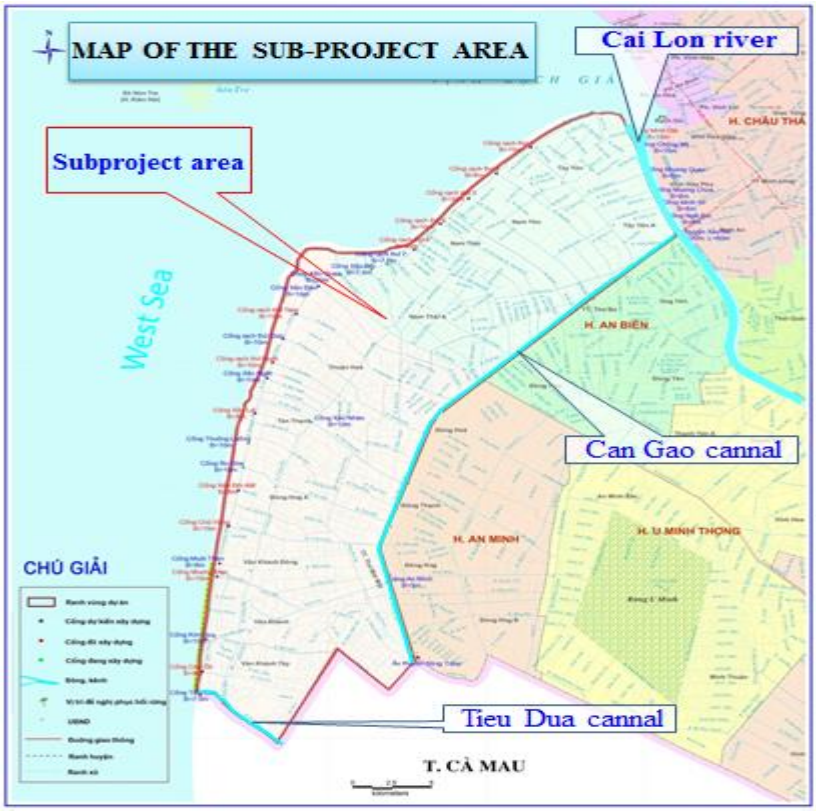


Figure 2: Map of the subproject area

1.4.2. Subproject components

The subproject activities will be implemented through the following 3 components:

1.4.2.1. Component 1: Construction of 9 new open-sluice gates along the western sea dike

This component will support the construction of 9 open-sluice gates along the western sea dike and main works items will include (1.1) construction of the 9 sluice gastes and (1.2) construction of other associated facilities including bridges over the sluice gates,and details are described as follows:

The 9 sluice gates will have an aperture of 8.0 to 30.0 m and with the flexible valves. Details are provided in*Table 3* and Figures 3, 4, 5, 6, 7, and 8 below.

Table 3: The main parameters of 9 sluice gates

No.	Sluice gate	Sluice gates				Bridges			
		Width	Threshold elevation	Crest elevation of valve gate	Crest elevation of pier	Load	Bm (m)	Spans	Navigable height
1	Thu Nhat	10	-2.50	+2.00	+3.00	HL93	9.00	3	2.35
2	Thu Hai	8	-2.50	+2.00	+3.00	HL93	9.00	3	2.35
3	Thu Ba	30	-2.50	+2.00	+3.00	HL93	9.00	5	3.00
4	Thu Nam	10	-2.50	+2.00	+3.00	HL93	9.00	3	2.35

No.	Sluice gate	Sluice gates				Bridges			
		Width	Threshold elevation	Crest elevation of valve gate	Crest elevation of pier	Load	Bm (m)	Spans	Navigable height
5	Thu Sau	30	-2.50	+2.00	+3.00	HL93	9.00	7	3.00
6	Xeo Ban	10	-2.50	+2.00	+3.00	HL93	9.00	5	2.35
7	Thu Tam	15	-2.50	+2.00	+3.00	HL93	9.00	3	2.35
8	Thu Chin	10	-2.50	+2.00	+3.00	HL93	9.00	5	2.35
9	Thu Muoi	10	-2.50	+2.00	+3.00	HL93	9.00	3	2.35

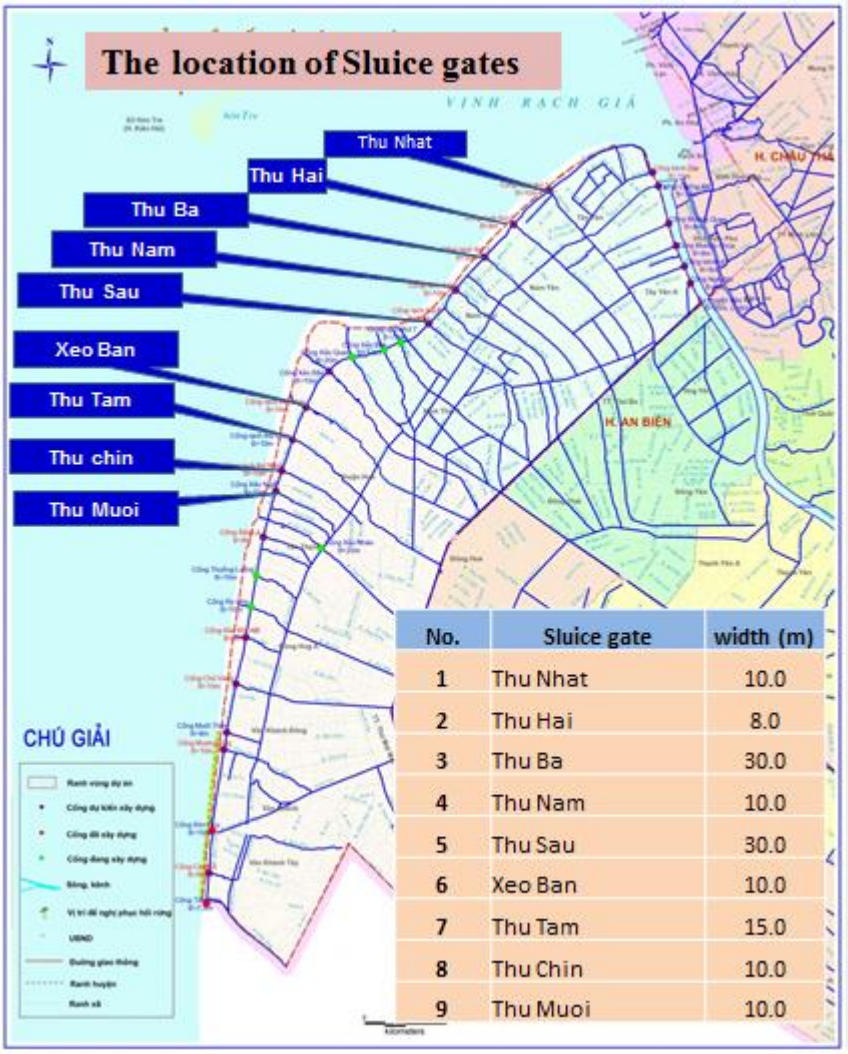


Figure 3: The locations of sluice gates

- Structure of sluices: The scale of sluice gate aperture consists of 01÷02 chambers s; each chambers is 8÷15 mwide; the structure is not monolithic with pier and bottom beam which are separate blocks and link each other by conjunction jointsor bearings.

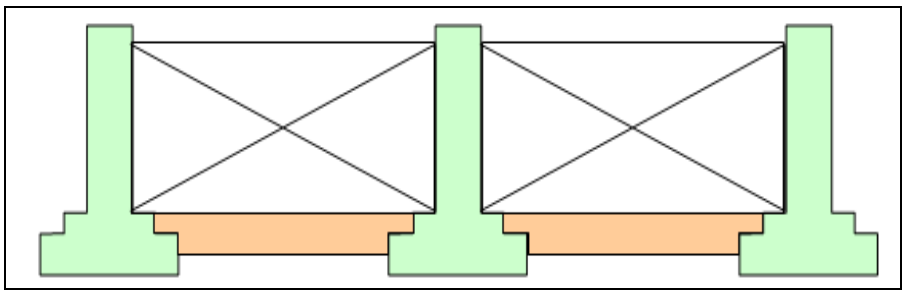


Figure 4: Pier and bottom beam link each other by bearings

- Structure of valve: the alternativeto be selected is clape valve gate of bottom axis. This gate has bottom axis to be attached to the work base. We can make large compartment thanks to many intermediate bearing n the bottom.

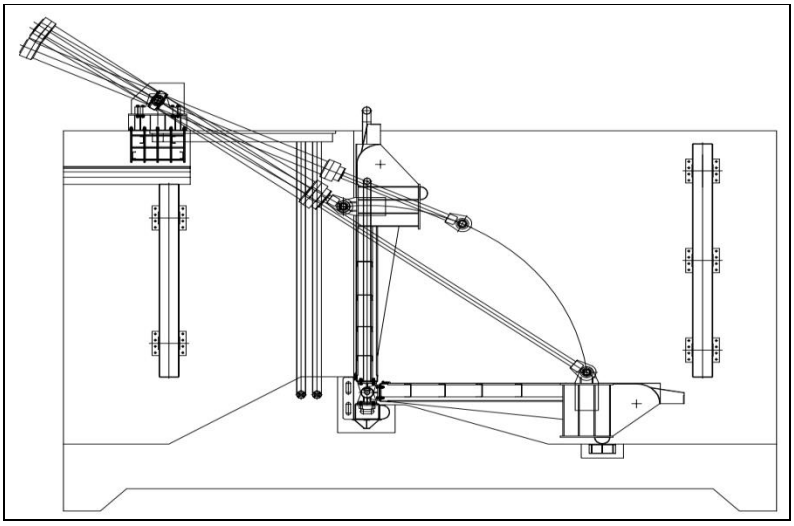


Figure 5: Clape valve gate of bottom axis

- Section of sluice gate:

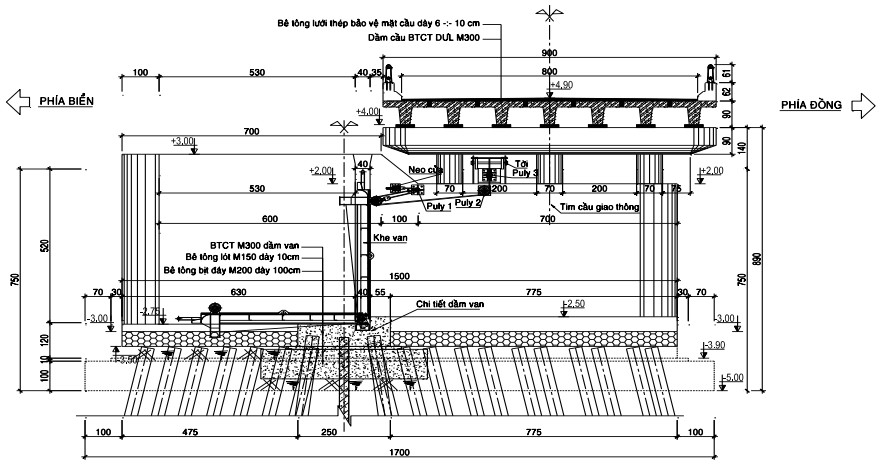


Figure 6: Longitudinal section of sluice gate combined traffic bridge HL93

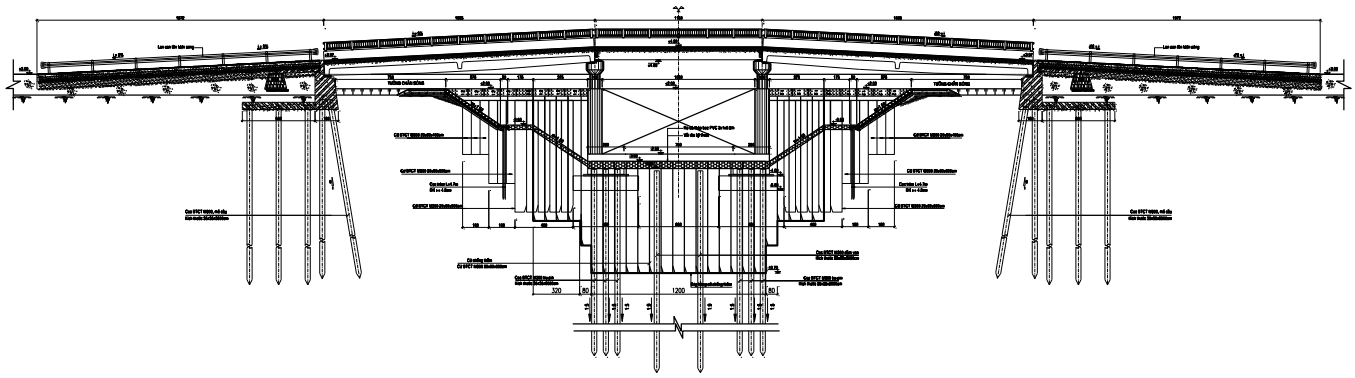


Figure 7: Horizontal section of sluice gate b = 10m combined with traffic bridge HL93

Figure 8: Typical shape of the sluice gate in the future

Theassociated facilities for each sluice gate will comprise of (a) 1 bridge (9 m wide) over the sluice gate, (b) 1 small management office (65m^2). Most of the construction materials will be transported via water transport and limited amount of materials will be transported via thewaterway transport.Details of the facilities are described below.

- Bridges over the sluice gates:
  - The bridge traffic load on sluice gate: HL93, pedestrian load 3x10^{-3} MPa
  - The width of the bridge cross-section is 9 m
  - The bridge beambottom elevation: +4.00. The navigable clearance: H = 2-3m
  - The slope of exterior beams: 5%
  - Use prestressed concrete beams, reinforced concrete slabs M300, arranged high-voltage lighting on bridge. The bridge abutments are treated by reinforced concrete pile foundation.
- Use prestressed concrete beams, reinforced materials: PVC coated gabions of 50cm thick, beneath is the geotextile.
  - The protective length of upstream and downstream L = 20 m
  - The width: B = 40 ÷ 80 m
- Transportationof construction materials:The off-site transportation: transport of materials and equipment along main canal as Cai Lon river, Cai Be river, Xeo Ro - Can Gao canal, Chong My canal Thu Nhat canal, Thu Hai canal, Thu Ba canal etc. and Xeo Nhao canal. The construction equipment and machinery can be transported by waterway traffic.
- Management house:

- House grade: III
- Location: on the right of sluice gate at field direction
- Using area: 65 m^2
- The management house include offices, a dining-room, bedrooms
- Structural reinforced concrete and brick house
- The house is located in of 1000m^2;

- The bridgesover the sluice gates linking to the local roads will be constructed at the following scale:
  - The bridge traffic load on sluice gates: 2.5 tons
  - The bridge cross section width is 2.5 m (the same with road width)
  - The beam bottom elevation: +2.50
  - The Slope of external beams: 5%
  - Reinforced concrete beams and slabs M300. The bridge abutments are treated by reinforced concrete pile foundation. The minimum width of the middle span is 7m.

1.4.2.2. Component 2: Protection of coastal erosion

This component will support the construction of wave energy reduction to the embankment foundation in the area facing critical coastal erosion (about 10 km) which is located at the end of the subproject area. Key activities will include construction of a structure to reduce wave energy as well as accumulate sedimentation in the areas so that mangrove could be planted and grow. Given the similar experience in CaMau and other coastal areas in the Mekong Delta, two structural solutions have been proposed comprising construction of the non-metal fiber reinforcedconcrete and a softwall of bamboo poles (see *Figure 9* to *Figure 11*). However, given the potential high cost and uncertainty regarding the bottom sedment, the subproject will support a technical assistance for hiring of a consultant firm (national and international) to review effectiveness of the proposed structure including preparation of a feasibility study and detailed design of this component. The proposed structures are as follows:

a). Construction of the wave reduction on foundation of the embankments:

- Scale: The work has the total length of 10km, consisting of 20 segments; each segment is 500m long, 2.5m high; the gap between the segments is 60 m.
- Embankment alternative: The prefabricated non-metal fiber reinforced concrete components are used to build the embankment, which have the advantages of good absorption for wave energy, reducing wave erosion affection behind the embankment.

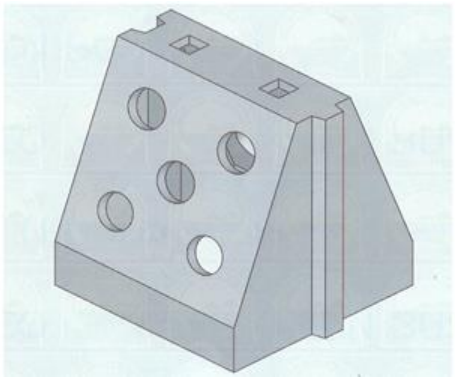


Figure 9: The non-metal fiber reinforced concrete components

b). Soft wall that causes deposition and supports planting protective forests:

- Soft wall that causes deposition: The T-shaped bamboo fence, each unit is 100m long; wall height is 1.5 m, 25m apart from each other.
- Softwall structure: includes double walls of piles and one layer of bundles of tree branches. The wall height is 1.5 m; the pile depth is 2.4m; the pile length is 3.7m, D ≥ 7cm; number of piles: 12 piles/1m long; wall width: Select the wall width: Bc = 0.4 m.

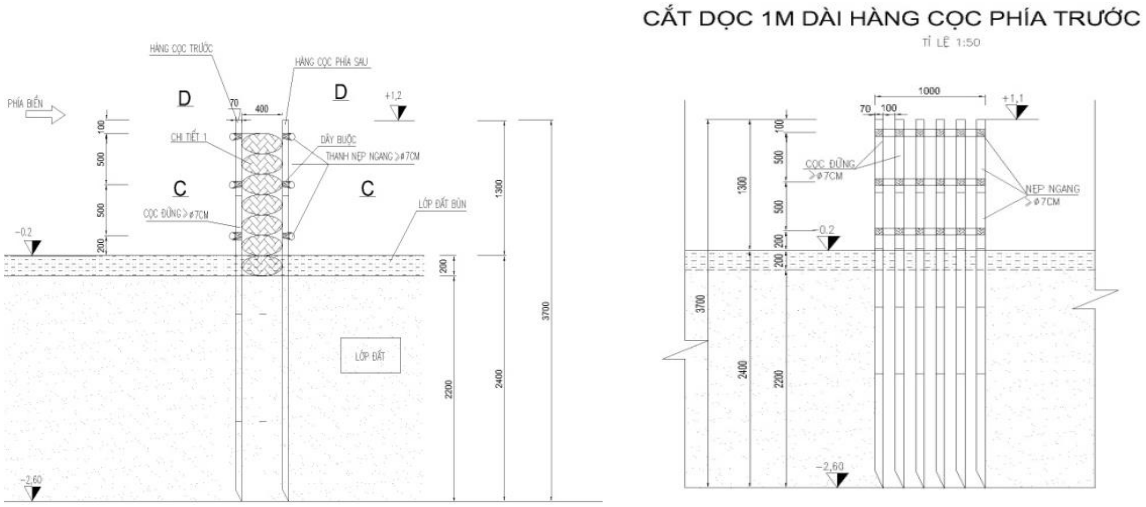


Figure 10: Cross-section and longitudinal section of softwall

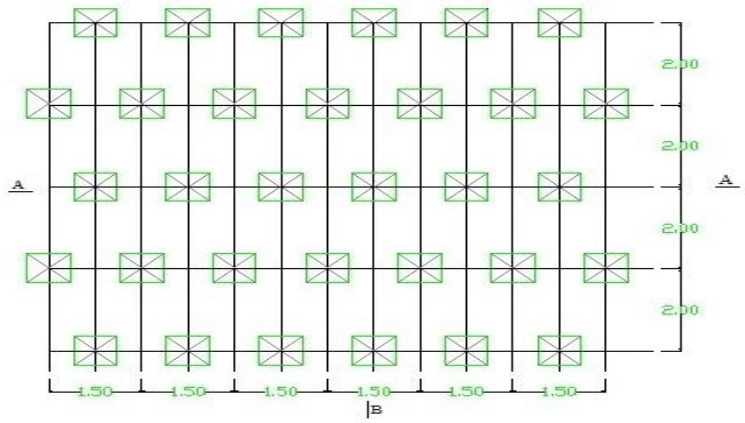


Figure 11: The layout of plants

1.4.2.3. Component 3: Development of livelihood models

This component will support the implementation of five livelihood models in the subproject area (see *Table 4* and *Figure 12*). 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.

Table 4: Scale of livelihood models

No.	Livelihood models	An Bien		An Minh		Total	
		Area (ha)	*# of demonstration*	*Area (ha)*	*# of demonstration*	*Area (ha)*	*# of demonstration*
I.	**The sea zone**						
Model 1	Raising *Andara granosa* under forest canopy (01 demonstration site will be in 03 hectares)	500	1	700	2	1,200	3
II.	**The zone inside the sea dike**						
Model 2	Mono culture shrimp 2 crops/year (01 demonstration site will be in 03 hectares)	1,500	7	2,500	13	4,000	20
Model 3	Polyculture of prawn (*Penaeus monodon)* (01 demonstration site will be in 03 hectares)	400	4	600	6	1,000	10
Model 4	Community management shrimp-rice (01 demonstration site will be in 40 hectares)	1,000	3	1,000	6	2,000	9
Model 5	Polyculture of prawn (Penaeus monodon) - Rice integrated praw (Macrobrachium rosenbergii) (01 demonstration site will be in 03 hectares)	300	2	200	1	500	3

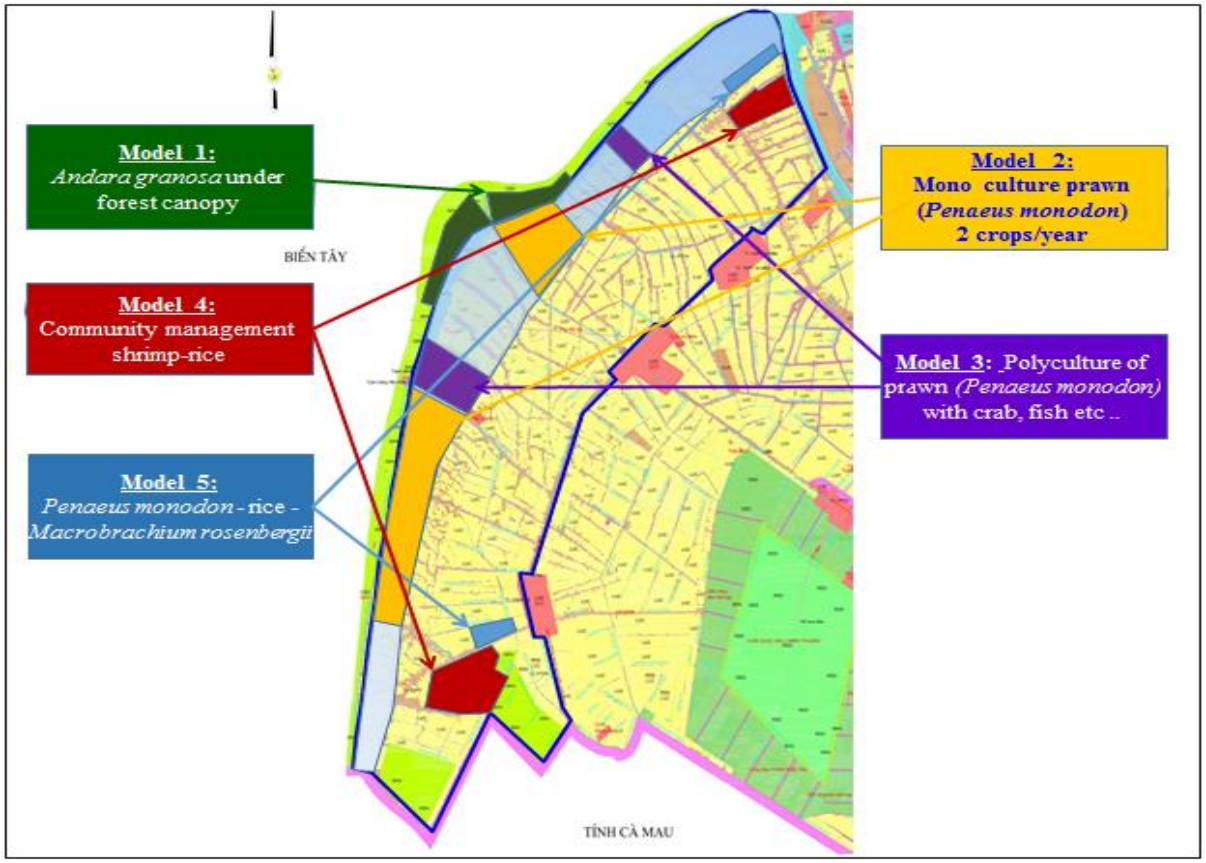


Figure 12: The locations of production and demonstration areas

The content of the production models are presented in detail as follows:

a). Zone 1: The coastal zone

❖ ***Model 1: Raising blood cockle (Anadara granosa) under forest canopy***

- Objective:The successful and efficient development and operation of the model that feed*Andara granosa* under the forest canopy (Biosecurity without pesticides) will make the profits of about 100 million VND/ha/year (the cockle price is 70,000 VND/kg) and contribute to improving incomes, the lives of people in the subproject area and enhance the protective forests.
- Size:There are 03 demonstration sites, the area for each site is 03 hectares and the production area is 1,200 ha, (in whichAn Bien district is 500ha and An Minh district is 700 ha).
- Location: Xeo Quao hamlet, Nam Thai commune A - An Bien district and Thuan Hoa commune - An Minh district.
- Breeding season: under the natural conditions of Kien Giang province, mainlyin the coastal zone of An Bien - An Minh, the annual appropriate crop for Andara granosa will start from November to August of next year (to avoid the transition between rain and dry seasons and harvestbefore freshwater coming in August -September), so Andara granosa would be harvested for relative big size (800 - 1,200 larvae/kg), see in *Table 5*.
- Implementation time: Development of the pilot model for the period 2016-2018. In 2016 the subproject will support 100% cost for about 9 hectares corresponding to 03 feeding ponds (1 pond area is 3 ha). In the next years, 2017-2018, the subproject will support 50% cost for approximately 1,200 ha.

Table 5: The seasonal calendar for feeding Andara granosa under the forest canopy

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
The Model for feeding Andara granosa under the forest canopy												
The time of season transition: dry season - rainy season												

b). Zone 2: The zone inside the sea dike

- ***Model 2: The mono culture shrimp zone of 2 crops/year (01 demonstration site will be in 03 hectares; there are 20 demonstration sites).***

- Objective: Developing and operating successfully and efficiently the modelof the mono culture shrimp of 2 crops/year (Biosecurity without pesticides) will make the profits of about 135 million VND/ha/year (the *Penaeus monodon* price is 150,000 VND/kg) and contribute to improving incomes, the lives of people in the project area and enhance the protective forests.
- Size: There are 20 pilot sites, the area of each site is 03 hectares.The production area is 4,000 ha (An Bien 1,500ha and An Minh 2,500 ha).
- Location: Nam Yen commune (Thu Ba canal, Thu Nam canal, sea dike canal, Chong My canal), An Bien district and Dong Hung A (Xeo La, sea dike canal, Ro Ghe, Chong My), An Minh district.
- Breeding season: 2 monoculture crops/year
- Species: *Penaeus monodon*
- Stocking density: 7 lavae/m^2
- Implementation time:Development of the pilot model for the period: 2016-2018. In 2016 the subproject will support 100% cost for about 60 hectares corresponding to 20 feeding ponds (1 pond area is 3 ha). In the next years, 2017-2018, the subproject will support 50% cost for approximately 4,000 ha.

- ***Model 3: Polyculture of prawn (Penaeus monodon) with (crab, fish etc). (each site will be developed in 03 hectares; there are 10 demonstration sites).***

- Objective: Developping and operating successfully and efficiently the modelof the polyculture shrimp of 2 crops/year (Biosecurity without pesticides) will earn the profits of about 35÷40 million VND/ha/year (the *Penaeus monodon* price is 150,000 VND/kg) and contribute to improve incomes, of people in the subproject area and enhance the protective forests.
- Size:There are 10 pilot sites in total, the area for each site is 03 hectares.The production area is 1000 ha, in which400 ha of An Bien district and 600 ha of An Minh district.
- Location: Nam Thai commune A (Xeo Doi, sea dike canal, Xeo Quao, Chong My canal)An Bien district and Thuan Hoa commune (Thu Muoi canal-sea dike canal, Xeo Ngat canal, Chong My canal), An Minh district.
- Species: Shrimp + combination (crab, fish etc.).

- Stocking density: (i) Shrimp: more than 5 lavae/m^2;and combined species (crab, fish etc.): 2 lavae/m^2
- Implementation time: Development of the pilot model for the period: 2016-2018. In 2016 the subproject will support 100% cost for about 30 hectares corresponding to 10 feeding ponds (1 pond area is 3 ha). In the next years, 2017-2018, the subproject will support 50% cost for approximately 1,000 ha.

❖ ***Model 4: Rice – shrimp culture***

- Objective: (i) developping and operating successfully and efficiently the modelof *Penaeus monodon* for the Community management shrimp-rice model(Biosecurity without pesticides, pests); and (ii) the profit is of about 60 million VND/ha/year (the *Macrobrachium rosenbergii* price is170,000 VND/kg) to contribute to improving incomes, the lives of people in the project area and enhance the protective forests.
- Size and location: there are 09 pilot sites, 01 demonstration site will be in 40 hectares and the production area is 2000 ha, in whichAn Bien district is 1000ha and An Minh district is 1000ha.
- Location: Tay Yen A commune (dike canal-Muong Quao canal- Thu Nhat canal, Canal 40) An Bien district and Van Khanh Tay commune (Canal 2-Kim Qui canal, Canal 5-Chong My canal) An Minh district.
- Species: Penaeus monodon
- Stocking density: 3-5 lavae/m^2
- Seasonal calendar: see in *Table 6*.
- Implementation time: Development of the pilot models for the period 2016-2018. In 2016 the Subproject will support 100% cost for about 360 hectares corresponding to 09 feeding ponds (1 pond area is 40 ha). In the next years, 2017-2018, the subproject will support 50% cost for approximately 2000 ha.

Table 6:The seasonal calendar of rice –shrimp production in subproject area

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Penaeus monodon												
Salt washing												
Rice cultivation												

Figure 13: Curent Rice – Shrimp culture in An Bien

❖ ***Model 5: Polyculture of shrimp(Penaeus monodon)-Rice integratedgiant fresh water shrimp (Macrobrachium rosenbergii)***

- Objectives: (i) Developping and operating successfully and efficiently the model of the *Penaeus monodon*- Rice integrated *Macrobrachium rosenbergii* model (Biosecurity without pesticides, pests) will bring the *Penaeus monodon* output of about 350÷400 kg/ha and the *Macrobrachium rosenbergii* output of about 750÷800 kg/ha; and (ii) The profits to be earned from the model is about 212 million VND/ha/year (the *Macrobrachium rosenbergii*price is 170,000 VND/kg) to contribute to improving incomes of people in the psubroject area and enhance the forests.
- Size and location: there are 03 demonstration sites, 01 demonstration site will be in 3hectares. The production area is 500 ha, in whichAn Bien district is 300 ha and An Minh district is 200 ha.
- Location: Rach Coc hamlet, Tay Yen commune (Dai canal-Dike canal-Chong My canal) An Bien district and Muong Dao hamlet C, Van Khanh commune (irrigation canal - Canal 2-Kim Qui canal (market), land-making area of An Minh district.
- Species: feeing *Penaeus monodon*in the dry season and *Macrobrachium rosenbergii* intersected with rice in rainy season.
- Stocking Stocking density: (i) *Penaeus monodon*: 3-5 lavae/m^2*;* and (ii)*Macrobrachium rosenbergii* : 3-5 lavae/m^2
- Seasonal calendar: see in *Table 7*.

Table 7: Seasonal calendar for Penaeus monodon- Rice – Macrobrachium rosenbergii model

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Penaeus monodon												
Salt washing												
Rice cultivation (combined *Macrobrachium rosenbergii*)												

- Implementation time: Development of thepilot modelforthe period 2016-2018.In 2016 the subproject will support 100% cost for about 9 hectares corresponding to 03 feeding ponds

(1 pond area is 3 ha). In the next years, 2017-2018, the subproject will support 50% cost for approximately 500 ha.

1.4.3. Construction method for the sluice gates

1.4.3.1. Construction planning

It is necessary to study the diversion of water flows for the construction of sluice gates. As the works are located on the defensedike inside the dike.The drainage canals run parallel to the dike, so the waterdiversion will be made through a canal and drainsvia another canal where the sluice which is not constructed. Therefore, the construction of these 9 sluice gates will not be carried out at the same time but in an alternate manner to ensure water supply for production.

1.4.3.2. Construction methods for the sluice gates

a). Construction methods atconstruction site

- The backfilling & road construction method: the embankment is the first work to be done when starting the construction. This work must be done by hand because machines are not accessible.
- Filling method for construction sites: this method depends on the construction time (rainy season or dry season), the embankment and the road construction work.
  - If filling the construction sites in dry season (December-June next year) and construction road is complete, motorized-equipment will be usedfor excavation and levelling (Bulldozer 108 CV, excavator, trucks).
  - If filling the construction sites in rainy season and the construction road is not used, the neccessary parts must be filled immediately by hand (pile casting yard, camping ground, cofferdam ground) and the rest will be implemmented by motorized-equipment.

b). Construction method for ground treatment piles

- Pile driving location: through the calculations, the soft ground must be treated as in *Table 8*.

Table 8: Locations to be reinforced

No.	Pilling locations	Type of pile
1	Sluice gate body	RC
2	Bridge marginal abutment	RC
3	Stilling yard bottom	Wooden pile
4	Connecting locations	Wooden pile

- The pile casting: conventionally, reinforced concrete piles used for foundation treatment can be bought from precast concrete factories. Because offar and costly distance from factories to construction locations, the cast-in-place piles to reduce cost is selected.
  - Pile casting method: mixing concrete by mixer capable of 400 ÷ 500 liters, no mixingby hand; carry concrete by hand or crane;and compact concrete byneedle vibrator.
  - Pile casting yard: combined in material yards (sand, stones) 200 ÷ 300 m^2; casting yard is leveled, lined by macadam (10 cm thick) and concrete M100 (7 cm thick).

- Construction method for pile driving:
  - Concrete piles: based on the load bearing of piles, and pile size, pile-driving hammer will be selected. Firstly, It is necessary to test pile driving to determine the actual length,then proceed driving all piles under the pile-driving design.
  - Wooden piles: driving piles by hammers.

c). Construction method for cofferdams

- Use shape steel cofferdams and steel piles (with positioning frames joined by steel braces) for casting sluice gate segments (*Figure 14*).
- The steel piling: the specialized vibratory hammer combined with barge + crane for driving wooden piles and steel piles.

Figure 14: Construction of foundation pits by steel cofferdams

d). Construction measure for foundation pits

- Use bucket-excavator, capable of 0.5m³ of long rod or hydraulic crane/scraper on barge 200 ÷ 400 tons; excavation of foundation pit is implemented in shape steel cofferdam; steel piles will be transferred on barges to yard.
- The construction of foundation pits is implemented top to bottom. The scraper will be use for places that excavators cannot reach.
- The excavator's work ends at the elevation of 0.5m from the foundation bottom elevation. The foundation pits are dug by hand (erosion suction) to the design elevation.
- Excavated soil is poured into 2 canal-banks in the sluice gate construction areas to reuse for embankment and ground filling.

e). Construction method for diversion canal

- Excavated soil is dumped at 2 canal-banks in the area. The canal excavation method is divided into 2 categories:
  - Mechanized equipment: dig to reuse soil for filling canal embankment, which is similar to the sluice foundation digging method but is not deeper than -3.00.
  - Hydraulic equipment (blowingscraper): dig the remaining volume then spray into the digging cavity to suck soil.
- Construction method for canal embankment: motorized-equipment used

f). Concrete works

- Steel processing: mainly by hand

- Formwork: Depending on the work items, appropriate types of formworks are used on the principle of ensuring quality and aesthetics of the works and saving construction cost.
- Concrete mixing:
  - Use a 500 liters concrete mixer combined with a excavator (crane) for large blocks.
  - use manually to pour small blocks.

g). Construction method for Geotextile in bed river

The specialized geotextile spreaderincludes steel axis mounted on rollerD90 of 4.5 meters long. The axis has hooks to pull cables. The axis works by cablestraction force; 2 cage-wheels can roll lightly on soil, sand, mud, gravel etc. The spreading of geotextile starts from the bank at the design elevation. The geotextile top is held by iron pins.

Geotextile is rolled out; its core is plastic duct D110 inserted into the roller. Geotextileis rolled out when truck runs thank to the relative rotation between the plastic duct and the roller and the truck chassis. After Geotextile is rolled out of, it is compacted down in the riverbed out of its width thank to the rotating tail shaft attached to the axis and geotextile is compacted on the ground.

The boat is connected to the buoys which move by 2 cable strands D12 and the cable length depends on the depth where spreading geotextile. The buoys move along the cables from shore to the buoys which are arranged along river to ensure spreading the geotextile in the correct direction. On the buoys, there are winches which release cables to move parallel with the direction cables.

When winches rotated cables will be pulled buoys offshore and then the vehicle's frame; making the axis moved and spreading geotextile. Moving along with the geotextile spreading the divers must keep geotextile unfold and staple them by L-shaped steel D6 50 ÷ 70cm long to hold the geotextile edges down to the river bed. The steel pins are fixed at the geotextile edges; every 30-40cm. In strong running water, complex, uneven terrain, the stapling will be at 10 - 20 cm.

The work is carried out as above until all geotextile spreaded. The divers must check and staple geotextile along the edges.

After a textileroll is spreaded out, the work began again in the following order:

- Pull buoys back the river bank far from the previous location of 3.5m along the riverbank.
- Shift both ends of direction cables about 3.5m upriver.
- Move spreader onshore and installed another textile roll. The new roll overlaps the previous roll about 0.5m at downstream.
- Turning winches on buoys to make them move offshore and entail textile spreading axis. The divers follow the textile spreading axis to check it and pin textile edges in 2-sides.

h). Construction method for stone carpets, gabions

- Rubble and carpet mesh boxes, gabions are loaded on specialized equipment by hand combined with barge cranes.
- Tow specialized equipment to the location of carpet dropping by tug 200CV.
- Positioning equipment at the locations where stone carpets, gabions are dropped. Use workers to load stoneson carpet mesh boxes, gabions. Drop stone carpets, gabions into river by specialized equipment crane. Use theodolite and divers to direct the locations where stone

carpets, gabions are dropped (following the division and calculation of quantity of stone carpets, gabions for each cell) and move the device from cell to cell.

i). Method for installation of mechanical equipment

The dimension of valve sluices is 4.5m high, 8 ÷ 15m wide and 15÷25 tons. Use the 400-ton barge with crane of 40÷60 tons to shipmonolithic valve sluices from factory to the installation locations of the sluice gate segments.

1.4.4. List of planned machinery and equipment

The list of equipment and machine thatserve the subproject construction is summarized in *Table 9* which are most used and the depreciation rate is 10-20% only and arekeep regular maintenance.

Table 9: The list of main machinery and equipment for one bridge/sluice gate construction

No.	Type of equipment	Numbe/sluice gate
1	Excavator 0.80m^3 BX	1
2	Loaders 1.25m^3	1
3	Hand compactor 80kg	1
4	Welder 23KW	1
5	Vertical driller 2.5KW	1
6	Concrete driller 0.62KW	1
7	Floating piled-river 2.5T	1
8	Barge 200T	1
9	Dredger 1.25 m^3	1
10	Concrete mixer 500L	1

Source: The Subproject's Feasibility Study Report in 2015

1.4.5. Main supplies, equipment, materials for the subproject construction

1.4.5.1. Materials

In the construction area, there is no quarry, sand mining to provide for the construction works. Dredged materials at the sluice gates will be reused for filling, no external earth is needed. 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 14 wholesale providers located long the Can Gao – Xeo Ro Canal, Kien Giang province, about 9-10km from the construction sites. 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

- Steel, cement: steel is bought at mills in the provinces of Kien Giang, Can Tho, Ho Chi Minh City. Cement is bought at mills in Kien Giang province.
- Wooden piles are bought in in Kien Giang.

1.4.5.2. The energy supply conditions

Currently, in the region, there is the national electrical grid to ensure sufficient electricity supply for the construction activities of sluice gates and sufficient for the consumption to operate the control of sluice gate when taken into operation phase.Within the distance of 1km, at the sluice gate location, there is petroleum supply station to provide the oil and petrol.

1.4.5.3. The mode of transportation of fuels and materials

Being the coastal area without underdeveloped road transportation infrastructure; therefore, all the materials and machinery, equipment for the construction of sluice gates will be transported by water way, which is particularly via the exisitng canal networks.

1.4.5.4. Summary of main materials of the subproject

Summary of main materials of the subproject is presented in*Table 10.*

Table 10: The quantity of construction works

No.	Material names	Unit	Quantity
1	RC of all kinds	m^3	28,154.28
2	Steel of all kinds	tons	5,286.47
3	Formworks	$100m^2$	532.68
4	Reinforced concrete piles, prestressed concrete sheet piles	m	37,905.40
5	Wooden piles	100m	4,788.53
6	Crushed stones of all kinds	m^3	538.18
7	Gabions 1 x 2 x 0.5m	units	948.00
8	Stone carpets 3 x 2 x 0,3m	carpets	440.00
9	Geotextiles	$100m^2$	526.99
10	Excavated soil of all types	m^3	48,402.52
11	Filling soil of all types	m^3	53,391.66

Source: The Subproject's Feasibility Study Report in 2015

1.4.6. The implementation schedule of the subproject

The subproject will be implemented over a 5 year period(from 2016 – 2020). The details of the implementation progress of the contents are in *Table 11*.

Table 11: Implementation schedule forthe subproject

Zone(Figures 12 and 27)	**Solutions**	**Investment stages**
Zone 1: (6,669 ha; 2,650	Study the coastal protection and mangrove plantationmeasures.	2016-2018

Zone(Figures 12 and 27)	**Solutions**	**Investment stages**
beneficiary people)	Protect 10 km coastline which is rapidly eroded (from Tieu Dua canal to Muoi Than canal). Review and restore mangrove forest system, planting mangroves and increasing forest belt of 150 hectares (ensuring 300m of forest belt).	
Zone 2 (54,131 ha; 240,429 beneficiary people)	Build livelihood models; introducing good feeding practices, wastewater treatment (aquaculture models combine: *Penaeus monodonand* Trichogaster, crabs, *Andara granosa*, Holothurian etc.); *Penaeus monodon* brand. Develop operating procedures for on-farm management to ensure efficient production as well as protection of water quality and other local environment.	2016-2018
	Construction of 9 sluice gates on coastal dike to prevent spring tide, control saltwater, keep freshwater, and improve flood drainage.	2016-2019

1.4.7. Investment cost

The total funding for the implementation of the subproject is US$33,070,000 in which the ODA funding is US$27,856,000

1.4.8. Summary of the key information of the subproject

The main subproject's information is summarized Table 12.

Table 12: Summary of the subproject's main information

Project stages	**Activities**	**Implementation progress**	**Technologies / methods**	**Environmental factors that likely arise**
Preparation	Design of construction drawing	2016	Bidding	No environment affection
	Land acquisition	2016	Inventory, compensation	The subproject acquires permanently 7.2 ha and temporarily 3.6 ha and 67 households need to be physically relocated.
	Site clearance	2016	Using motor vehicles for dismantling structrures, cutting trees and transporting them out of the construction sites	- Pollution of soil, water, air. - Impacts on natural environment. - Safey risk and disburbance to local residents - Health and safety of construction workers; - Safety risks of UXOs.
Construction	Transport of materials	2017-2019	Using barges transporting materials on waterways	- Pollution of soil, water, air. - Impacts on natural environment. - Safey risk and disburbance to local residents

Project stages	**Activities**	**Implementation progress**	**Technologies / methods**	**Environmental factors that likely arise**
				- Health and safety of construction workers; - Impacts on water navigation
	Construction of bridges, sluice gates	2016-2019	See details in section 1.4.3	- Pollution of soil, water, air. - Impacts on natural environment. - Safey risk and disburbance to local residents. - Health and safety of construction workers; - Impacts on the taking water for aquaculture. - Impacts on social order. - Impacts on the transportation of people.
	Construction of structure for protection of coastal erosion	2018- 2020	See details in section 1.4.3	- Pollution of soil, water, air. - Impacts on natural environment. - Safey risk and disburbance to local residents. - Health and safety of construction workers;
Operation	Operating sluice gates to serve rice production combined with aquaculture	2019- 2020	See details in section 1.4.9	- Pollution of soil, water, air. - Increasing waste from aquaculture. - Impacts on natural environment. - Safey risk and disburbance to local residents. - Health and safety of construction workers; - Impacts on the waterway traffic - Problems during operation.

CHAPER 2. NATURALENVIRONMENT & SOCIO-ECONOMIC CONDITIONS IN THE SUBPROJECT AREA

2.1. Natural setting

2.1.1. The geography, geology conditions

2.1.1.1. Geographical locations, terrain, geomorphological conditions

The geographic locations of An Bien – An Minh districts, Kien Giang province are as follows: from 9º28' to 10º02' north latitude and from 104º51' to 105º06' east longitude. The subproject area covers approximately 60,800ha natural area, in the territory of the communes: Tay Yen, Tay Yen A, Nam Yen, Nam Thai, Nam Thai A, Dong Thai and Thu Ba town - An Bien district; Thuan Hoa, Dong Hoa, Tan Thanh, Dong Hung, Dong Hung A, Dong Hung B, Van Khanh, Van Khanh Dong, Van Khanh Tay and Muoi Mot town - An Minh district, Kien Giang province, which are surrounded by: (i) the West Sea in the West and Northwest; (ii) the Cai Lon river in the Northern and Eastern North; (iii) the Can Gao canal in the Southeast; and (iv) the Tieu Dua canal in the Southwest.

The subproject area has relatively flat terrain. The main slope is northwest to southeast, with the average elevation of 0 to 0.4m over the sea level. This is a low-lying delta, saltwater intrusion appears in the dry seasons and difficult for the drainage in the rainy seasons.

2.1.1.2. Hydrogeology and engineering geology

a). Hydrogeology (underground water)

According to the drilling results of the *Rural Water Program*, the underground water appears at 80 - 100m deep. This stratigraphic water quality is well, which can be used for living.

b). Geological condition

The project area is formed by the types of sediments lying on the MeZoic bedrock at the depths of 250 - 600m (280m in An Bien). It contains the main layers: Holocene, Pleitocene, Pliocene, and Miocene. Distribution on the surface is usually the Holocene layer, which has high clay content and organic impurities and less bears load.

Through the surveys, field works and laboratory tests resulted by Southern Institute of Water Resources Research, the soils in the subproject area can be divided as follows:

- Layer 1a: filling layer, green-gray clay, gray gold clay with the average thickness of 0.8m;
- Layer 1: green-gray clay mud, some are mixed with sand layer. This layer has the average thickness of 12m;
- Layer 2: golden brown - gray clay with hard plastic state. This layer is located under layer 1. At the drilling locations to the end of the survey depth, the layer bottom is still undiscovered.

2.1.2. The conditions of climate, meteorology

2.1.2.1. Temperature

The subproject area is in tropical monsoon equatorial climate zone. In a year, there are two seasons. The dry season starts from December to April and the rainy season starts from May to

November.

The air temperature is high and little changes over years. The average annual temperature ranges at 26-27^{o}C. Apr is the hottest month, the average temperature ranges at 28-29^{o}C. In less hot months, the average temperature ranges at 21-25^{o}C.

Table 13: Air temperature

Features	Months												
	1	2	3	4	5	6	7	8	9	10	11	12	Years
T_{bq}(^{o}C)	25.9	26.5	27.8	28.9	28.7	28.2	28.0	27.6	27.5	27.4	26.9	25.8	27.5
T_{max}(^{o}C)	35.6	35.4	37.8	37.7	37.7	33.8	32.4	32.8	33.5	33.5	33.2	32.6	37.8
T_{min}(^{o}C)	18.2	19.3	17.1	22.3	23.4	22.3	22.3	22.6	22.9	22.1	20.4	19.0	17.1

Source: The Statistical Yearbook 2014, Kien Giang Province

2.1.2.2. The wind velocity and direction

The region contains 2 main windy seasons a year: in dry season (Dec-Apr) the northeast wind prevails with the frequency of 30-50%. Also the east wind has the frequency of 20-30%. The average wind speed is 1.6-2.8m/s. The wind that blows from the continent is dry and cold. The wind in rainy season (May-Oct) prevails southwest or west and blows from the sea, which brings more steam that causes downfall. The strongest wind period appears in Jun-Sep with the average speed of 3.3-3.6m / s. In Oct, Nov, Dec the wind is calm at 1.5-1.7m / s. In addition to the seasonal wind, there is day and night wind, which blows from inland or sea with the average speed of 2.5-3.0 m/s.

Table 14: The wind velocity and direction during the year

Features	Months												Years
	1	2	3	4	5	6	7	8	9	10	11	12	
V_{bq}(m/s)	1.6	2.4	2.4	2.8	2.9	3.9	3.9	4.5	3.4	1.8	1.7	1.6	2.7
V_{max}(m/s)	38	24	34	24	57	38	38	40	48	38	38	48	57
V_{min}(m/s)	NE	North	North	West	West	West	WWS	WWN	West	West	WS	EW	West

Source: The Statistical Yearbook 2014, Kien Giang Province

2.1.2.3. Rainfall

The subproject area is rich in rainfall. The average annual rainfall is 1,800-2,200mm, which form two seasons with contrasting modes: rainy season starts from May-November (5 months), accounting for 90-95% of the annual rainfall. Dry season starts from December -April (7 months) when the rainfall is very little, accounting for about 5-10% of the annual rainfall, which mainly focus on the first and last months and in the middle months of the dry season the rainfall is negligible and February almost has no rain (*Table 15*).

Table 15:Monthly rainfall, frequency 10% (mm)

Stations	**VII**	**VIII**	**IX**	**X**	**XI**
Rach Gia	429	559	470	423	318
Tan Hiep	445	535	428	375	250

Vi Thanh	394	468	418	427	282

Source: The Southern hydrometeorological station, 2014

On average, in rainy season, there are 3-5 days when the rainfall reaches 50mm and 1-2 days when the rainfall reaches 100mm, which appear in the months that have the highest rainfall in a year. More than 80% of the 5 days rains contain3 max rainy days (namely, in the rainy stages which rain as max as 5 days, the rainfall appears much on the first 3 days and little on the next 2 days); similarly, the rainy stages of three max days - has 1 max day (it rains heavily on the first day and little on the next 2 days). Normally, the rainy stages last 5 days (70% of the number of rains); in longer rainy stages, the rainfall concentrates on the first 5 days and in the next days of such stages the rainfall is very little. This allows the calculation of rains discharged design for the subproject area based on the 5 days rain stage. At 5 days rain stages, it rains heavily on the first days and light in the next days (*Table 16*).

Table 16:The max 5-day rainfall, frequency 10mm

Stations	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**
Ha Tien	187	189	180	243	200	217	106
Rach Gia	210	214	178	282	227	200	141

Source: The Southern hydrometeorological station, 2014

Annual rainy seasons appears 7-10 stages, lasting 5 days without continuous rain; 4-6 stages lasting 7 days without continuous rain, and lasting 15 days which usually occur in the first month and last month of a rainy season. Therefore, even in rainy seasons, drought does occur, which is not as severe as in dry seasons but in some years, it hit summer-autumn rice crops. According to the statistics, 1987 is the drought year which lasted as longest as 16 days without rain, including Rach Gia station: 8 days (6-13/July), Vi Thanh station: 10 days (3-12/July). In 1997, the June rainfall in Rach Gia was 27.5mm, whichaffected seriously the productivity of summer-autumn rice crops (*Table 17*).

Table 17: The weekly rainfall in 10 days with the frequency 75mm

Measuring stations	**Weeks**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**
Rach Gia	First	1	23	44	50	60	57	48	20	1
	Middle	13	34	32	50	49	65	45	4	1
	Final	6	55	37	42	57	67	23	2	1
Vi Thanh	First	2	31	37	29	74	56	59	18	1
	Middle	2	31	49	42	62	55	47	13	1
	Final	2	40	44	42	63	62	26	8	1

Source: The Southern hydrometeorological station, 2014

2.1.2.4. Other factors:

Humidity: The monthly humidity averages at 75-86%, the highest averages at above 90% and the lowest averages at 70-75%. The wet seasons starts from May-November, coinciding with the rainy seasons when the monthly humidity averages at 80-85% and the highest averages at 95%; in the middle months of dry season (February, March) the humidity is smaller, averaging 78-80% per month.

Table 18:Humidity

Characteristics	Months												Years
	1	2	3	4	5	6	7	8	9	10	11	12	
$T_{bq}(^oC)$	78	78	76	78	82	84	84	86	85	84	81	79	81
$T_{max}(^oC)$	98	99	98	98	100	99	99	99	98	99	99	98	100
$T_{min}(^oC)$	39	39	40	40	42	60	59	63	59	50	45	46	39

Source: Statistical Yearbook 2014, Kien Giang Province

Evaporation: The average evaporation is 1241mm per year. The highest average evaporating month is March (191.5mm) and the lowest average evaporating month is October (74mm). Regarding the surface water evaporation, the figures in "Vietnam's Meteorology – the State TBKHKT Program No.42A" give the results in the following spreadsheet:

Table 19: Evaporation in Kien Giang province

Characteristics	Months												Years
	1	2	3	4	5	6	7	8	9	10	11	12	
En(mm)	96	97	121	114	99	93	99	93	81	71	75	90	1130
En_{max}(mm)	164	180	239	201	254	246	220	208	177	183	159	164	2395
En_{min}(mm)	19	26	31	27	9	12	6	16	6	12	18	28	210

Source: Vietnam's meteorology - state program TBKHKT No. 42A

Storms: There are less storms in the Southern region. Storms come late mostly in Nov and Dec. The early rainy reason months (Apr and May) may be stormy but there are not significant damages like in the Central and North regions. Kien Giang is not directly affected by storms but the storm rain occupies a significant proportion, especially at the end of the rainy seasons.

Sunny: The subproject area has much sunshine. On average there are 2,200-2,600 hours of sunshine per year; the months of mid dry season have more sunshine (Jan-Apr.), averaging 8-9.5 hours / day; rainy season has little sunshine, averaging 5-6.5 hours / day. Sep – Oct have the less sunshine, averaging 4.9 hours / day, which are the months that have relatively large amount of rainfall in the coastal areas of Rach Gia.

2.1.3. Hydrology/oceanographic conditions

2.1.3.1. Water level

The water level in the project area is dominated by:

- The tidal regime in the west sea through Cai Lon river mouth. This is a mixed tide in favor of the diurnal with the amplitude of about 80-100cm. The low tide water level fluctuates at 20 - 40cm. The crest tide water level fluctuates at 60 - 80 cm. An average tidal cycle lasts for 15 days. During the year, the highest average water level occurs in Dec-Jan and the lowest occurs in May - Jun. The North West Sea affects the project area through Cai Lon mouth and the coastal canals from Cai Lon river to Tieu Dua canal.
- Local rain regime. Depending on the locations, the distance to the sea and the time of year, the water level changes on the canals are complicated.

The coastal area and the area along Cai Lon river: are directly influenced by western sea tides. The monthly crest average level of water at Xeo Ro station is around +0.4 to + 0.6m. The low

average water level of water at Xeo Ro station is -0.15 to + 0.4m. The maximum water level usually occurs in 11-12, the lowest occurs in April – may. The amplitude in dry season is 0.5 - 0.7m and in rainy season is 0.2 - 0.5m.

Table 20: The maximum water level and appearance frequency in Xeo Ro canal in some big flood years

Location	Features	1984	1991	1994	1996	2000
Xeo Ro canal	Hmax (cm)	79	91	80	90	89
	Date of appearance	02/11	27/10	29/10	30/10	03/11

Table 21: The frequency of the highest water level at Rach Gia station

Frequency design	1%	5%	10%	95%
Water level (cm)	125	113	106	69

The dry season is from December to June. The upstream flow is low, negligibly, affecting the water levels and the flows of the subproject area.

2.1.3.2. Flow, flow speed of water

The water flow and flow speed in the project area is governed by:

The tidal regime of the West sea via Cai Lon river mouth is the mixed tidal regime but in favor of diurnal one. The tidal amplitude ranges at 0.8 to 1m. In the semi-diurnal regime, 2 tide peaks of the day vary at 0.5 to 0.7m but the 2 tides are negligible different. This tidal regime facilitates the drainage in the region. The irregular tide regime of the Gulf of Thailand affects from the west to the whole province of Kien Giang, which is largely governed by the hydrological regime of rivers and canals in the province. However, it is also influenced by the flow regime of Hau River, overflowing of flood and infield rainfall regimes. A tidal cycle averages about 15 days. During the year, the period of high water appears in December, January and low water period appears in April, May, which coincides with the period of low water in Hau River. The difference between the two periods of high tides and low tide is about 20-30cm. The maximum amplitude of the West sea tide ranges at 95cm in November in Rach Gia and the minimum amplitude is 49 cm in Rach Gia in October.

Local rainfall regime. This region meets heavy rainfalls in the Mekong Delta. Regardless of big precipitation, it is not the decisive of the inland current trend but only create instantaneous flow, raising the water level and flow speed on the canals during the rainy seasons, especially in big flood months that meet tidal surges.

Depending on each area and each time that each element above may cause strong or weak influence to the hydrology in the subproject area.

The flood reason in 2000, the draining flow to Cai Lon - Cai Be rivers is around 700-850m^3/s and 400-600 m^3/s in flood reason in 2001.

2.1.3.3. Other factors

Other factors also affect the hydrological conditions in the subproject area, which are the characteristics of the regional rivers and canals.

The subproject area owns a dense network of rivers, canals, which are evenly distributed in the subproject area. The rivers and canals flow mostly to the West Sea or Cai Lon river. The main rivers in the subproject area are:

Cai Lon River: is the major river located in the northeast of the subproject area. It is 500 ÷ 650 m wide, changeable from 12 ÷ 14 meters. The river estuary is wide but shallower due to the siltation and sedimentation of the estuary of the West Sea. Cai Lon river is the biggest traffic door in the region and the very important drain and water transport way for the subproject area.

Can Gao River*:* runs through the subproject area and connects Cai Lon River (in the north) with Tac Thu River (in the south). This is the main irrigation route and a very important waterway in the region.

Tieu Dua canal*:* located on the south of the subproject area, it is the natural canal and also the boundary between the two provinces of Ca Mau and Kien Giang. It is over dry due to the sedimentation of the western sea, so its irrigation, drainage and waterway role is less.

The coastal canals of West Sea*:* the Western coastal region formed a fairly dense system of canals (each 2 kilometers, there is on canal on average). The features of this system is that it expands the width and decreases the depth, especially near the sea inlet, which is caused by the very strong sedimentation of the western sea, the out gates are significant deposited, so the flooding flows have gradually expanded the canal section on both sides.

Also, in the area there are numerous canals at all levels, forming a quite convenient network of irrigation, drainage and water transportation. This network of canals is the important water reservoir in the dry seasons.

Water on the canals is influenced by tides and rainfall, so depending on the time of a year; it is fresh, salty or brackish.

2.1.4. The status of soil, water, air quality

2.1.4.1. Air quality

To assess the air quality in the construction of works, the Consultant took five air samples at the locations near the sluice gates to be built and at the same time close to residential areas (*Figure 5)*; the coordinates of the locations and descriptions are in the appendix). The measurement and analysis of air environmental status in the region are shown in*Table 22*.

Figure 15: Air (KK) sampling stations

Table 22: The measurements of the ambient air quality in the subproject area in 11/2015

No.	Stations	Analysis indicators							
		T°C	**Humidity**	**Wind speed**	**Noise**	**Dust**	**SO_2**	**NO_2**	**CO**
		°C	(%)	m/s	dBA	mg/m^3	mg/m^3	mg/m^3	mg/m^3
1	**KK1**	29.0	85	2.4	42 - 64	0.09	0.018	0.022	0.16
2	**KK2**	30.0	84	1.2	45 - 67	0.11	0.021	0.024	0.24
3	**KK3**	30.5	84	1.5	44 - 68	0.1	0.017	0.033	0.32
4	**KK4**	31.0	83	1.4	43 - 74	0.12	0.016	0.041	0.41
5	**KK5**	31.2	81	1.4	52 - 76	0.18	0.023	0.048	0.54
QCVN 05:2013/BTNMT (1 hour)						0.3	0.35	0.2	30
QCVN 26:2010/BNTNMT					70				

The measurements result that:

- The concentration of dust: the suspended dust measured in the region in 11/2015 ranges at 0.09 to 0.18 mg/m^3 and within the standard QCVN 05: 2013 (1 hour).
- The concentration of CO, NO_2, SO_2: the measured gas concentrations meet QCVN 05:2013/BTNMT with the CO values range from 0.16 to 0.54 mg/m^3, NO_2 ranges from 0.022 to 0.048 mg/m^3 and SO_2 ranges from 0.016 to 0.021 mg/m^3.
- Noise: the noise level at the monitoring locations meet QCVN 26: 2010/BTNMT and average from 45.2 to 69.8 dBA.
- The total dust concentration in the atmosphere around the region according to the analysis results is still at low level (0.09 to 0.18 mg/m^3).

2.1.4.2. Soil and sedimentquality

a). Soil quality

To assess soil quality in the subproject area thereby seeking factors that may cause adverse environmental impacts to land in the subproject area, and as a basis for proposing a reasonable solutions both in the construction phase and in the operation phase, soil samples were collected at 10 stations (Figure 16) (1 station took 3 samples at 3 soil layers: 1st layer depth of 0-20 cm, 2nd layer depth of 50 - 70 cm, 3rd layer depth 1.3 - 1.5 m). The analysis and results of the soil quality are shown in *Table 23*and*Table 24*).

Figure 16: Soil (Đ) sampling stations

Table 23: The analaysis results of soild samples on the subproject area in November, 2015

TT	Stations	Layer	pH_{H2O} (1:5)	pH_{KCl} (1:5)	EC	Sanility	CHC	TP	TN	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	Fe_{TS}	Acid
					µS/cm	*‰*	*%*			*mg/100g*					*meq/100g*
1	**Đ1**	T1	6.17	5.48	2.91	1.50	2.29	0.050	0.167	83.00	100.50	475.40	146.46	484.17	0.10
2		T2	5.95	4.30	3.00	1.58	2.13	0.047	0.164	68.20	101.13	535.10	149.83	600.20	0.26
3		T3	5.80	4.25	3.02	1.62	2.10	0.040	0.161	67.30	101.56	543.50	152.70	578.30	0.29
4	**Đ2**	T1	6.21	5.07	2.04	1.08	2.49	0.055	0.183	60.03	106.13	291.33	145.67	385.53	0.10
5		T2	6.06	4.78	2.17	1.11	2.06	0.045	0.173	69.90	111.09	345.98	165.40	319.14	0.21
6		T3	6.00	4.70	2.19	1.15	2.01	0.041	0.168	68.90	111.73	352.88	168.30	311.37	0.28
7	**Đ3**	T1	5.77	4.23	1.98	1.05	2.49	0.055	0.180	79.28	105.49	291.44	149.30	378.27	0.36
8		T2	4.95	4.02	2.01	1.03	2.34	0.052	0.195	69.21	109.74	317.86	158.93	286.71	0.39
9		T3	4.90	4.00	2.10	1.08	2.32	0.050	0.195	69.11	109.94	324.70	164.73	255.84	0.41
10	**Đ4**	T1	5.59	4.89	2.12	1.13	3.02	0.066	0.186	84.88	87.59	268.59	158.95	383.97	0.21
11		T2	5.34	4.17	2.29	1.23	1.45	0.032	0.184	95.29	98.91	343.97	144.87	381.17	0.36
12		T3	5.24	4.09	2.32	1.29	1.40	0.028	0.174	94.39	99.02	352.55	147.27	378.32	0.44
13	**Đ5**	T1	5.73	4.95	2.09	1.11	3.29	0.072	0.308	91.00	123.83	186.12	310.72	299.00	0.21
14		T2	5.23	4.22	2.14	1.12	2.43	0.053	0.237	71.37	206.43	220.77	276.98	238.17	0.36
15		T3	5.21	4.12	2.19	1.18	2.22	0.051	0.221	70.32	207.44	225.38	278.58	234.56	0.44
16	**Đ6**	T1	5.35	4.78	1.35	0.72	2.24	0.049	0.166	35.92	67.70	180.86	150.26	150.44	0.21
17		T2	5.20	4.62	1.47	0.79	2.15	0.047	0.174	50.59	80.63	238.47	119.24	133.36	0.21
18		T3	5.15	4.57	1.52	0.82	2.10	0.045	0.169	52.32	81.75	258.52	122.14	132.27	0.25
19	**Đ7**	T1	5.69	5.27	1.34	0.71	2.57	0.057	0.180	33.57	73.43	178.33	142.66	168.00	0.10
20		T2	5.27	4.82	1.47	0.75	2.07	0.046	0.176	30.86	83.42	241.64	120.82	216.05	0.21
21		T3	5.10	4.75	1.54	0.78	2.01	0.043	0.178	31.70	85.41	262.44	118.74	219.45	0.33

Table 24: Analaysis results of heavy metals in the soil samplesin the subproject area in November, 2015

No.	Stations	Layer	Cd	Hg	Pb	As	Cu	Zn
			mg/kg					
1	**Đ1**	**T1**	0.024	KPH	0.53	0.26	7.2	48
2		**T2**	0.041	KPH	0.38	0.24	5.9	64
3		**T3**	0.034	KPH	0.24	0.31	6.3	73
4	**Đ2**	**T1**	0.021	KPH	0.68	0.56	3.6	46
5		**T2**	0.017	KPH	0.52	0.27	4.4	29
6		**T3**	0.033	KPH	0.61	0.38	5.9	41
7	**Đ3**	**T1**	0.019	KPH	0.55	0.21	7.2	34
8		**T2**	0.022	KPH	0.37	0.64	3.8	71
9		**T3**	0.017	KPH	0.64	0.54	6.2	52
10	**Đ4**	**T1**	0.037	KPH	0.24	0.41	8.6	64
11		**T2**	0.041	KPH	0.61	0.56	5.7	27
12		**T3**	0.054	KPH	0.53	0.42	9.2	35
13	**Đ5**	**T1**	0.021	KPH	0.68	0.56	3.6	46
14		**T2**	0.017	KPH	0.52	0.27	4.4	29
15		**T3**	0.033	KPH	0.61	0.38	5.9	41
16	**Đ6**	**T1**	0.028	KPH	0.61	0.27	7.4	34
17		**T2**	0.013	KPH	0.55	0.34	6.8	26
18		**T3**	0.007	KPH	0.81	0.24	7.4	51
19	**Đ7**	**T1**	0.037	KPH	0.24	0.41	8.6	64
20		**T2**	0.041	KPH	0.61	0.56	5.7	27
21		**T3**	0.054	KPH	0.53	0.42	9.2	35
QCVN 03:2008/BTNMT			2	-	70	12	50	200

Acidity of the soil. To assess the acidity of the soils, the active acidity (pH_{H2O}) and exchange acidity (pH_{KCl}) are used. To decentralize the soil acidity, the exchange acidity (*Table 25*) is used.The soil analysis results that the pH_{KCl} ranges from 4.00 to 5.48 (*Table 23*). The 1st soil layer samples (surface layer) are mainly light to medium acidic soil. The second and the third layer soils are heavy to medium acidic. Therefore, the construction should pay attention to this to limit the risk of acidity washing, affecting the aquatic environment and aquaculture ponds in the area.

Table 25: Soil acidity clasification

TT	pH_{KCl}	Levelofsoilacidity
1	< 4,0	Extremely acid
2	4.0 – 4.5	Very strongly acid
3	4.5 – 5.0	Moderately acid
4	5.0 – 6.0	Slightly acid
5	6,0 – 7.0	Neutral
6	> 7.0	Alkaline

Source: Le Van Khoa, 2000

Soil salinity. Salinity is an important indicator in assessing soil quality, especially soils in the coastal areas of tidal influence. Soil salinity not only affects plants, but also quality of civil work infrastructures due to corrosion by salt in the soil.Soil salinity is assessed through the electrical conductivity (EC) of soil extraction solution. Soil salinity is also measured through the total soluble salt content in the soil and content of chloride and sulfate (SO_4^{-2}). Classification of salinity in soil is shown*Table 26*.Analysis results shown in the (*Table 23*) reflect that the value of EC 1:5 of the soil samples range from 1.34 to 3.02 dS/m which belong to the groups of Moderately salinity soil and salinity soil.

Table 26: Soil salinity classes by EC

No	Class	EC 1:5 (dS/m)
1	Non-saline	<0.40
2	Slightly saline	0.41–0.80
3	Moderately saline	0.81–1.60
4	Saline	1.60–3.20
5	Very saline	>3.20

Source: Rana Munns, 2002.

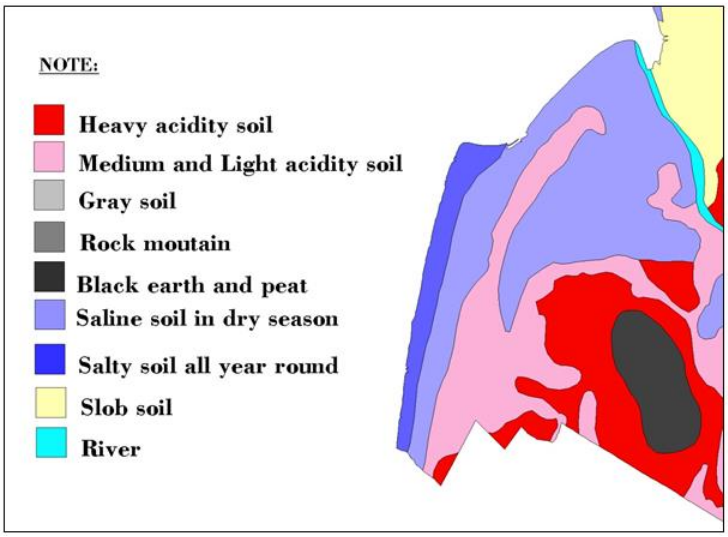


Figure 17: Map of soils in subproject area

Concentration of heavy metals in the soil. The results of heavy metals in the soil (*Table 24*) showed that the soil in the subproject area is not polluted by heavy metals. Cd ranges from 0.007 to 0.054 mg/kg; lead ranges from 0.24 to 0.81 mg/kg; arsenic ranges from 0.21 to 0.64 mg/kg; copper ranges from 3.6 to 9.2 mg / kg; zinc ranges from 26-73 mg/kg. They are below the thresholds as defined by the national technical regulations on soil quality (QCVN 43/2008/BTNMT).

b). Sediment quality

To assess sediment quality in the subproject area thereby seeking factors that may cause adverse environmental impact to the land in the subproject area, a basis for the proposed reasonable solutions in both the construction phase and operation works phase was derived from 10 sediment sample stations (*Figure 18*). To assess the bottom sediment quality of the canals in the construction areas of the works, the Consultant undertook 4 sediment samples of

bottom sediment (Figure 18). The analysis and results of the sediment quality is shown in *Table 27*.

Figure 18: Sediment (TT) sampling stations

The results of sediment reveal heavy metals in the sediment samples are below the thresholds as defined by the national technical regulations on soil quality (QCVN 43/2008/BTNMT).

The data also shows the pH values of the sediment samples. In most samples, the alkaline levels are minimal and the pH value is close to the alkaline unaffected boundary of soil. This is advantageous when the subproject dredges sediment from the cannals to fill the dike embankments.

Table 27: Analytical results of trace metal in the bottom sediment

TT	Stations	pH_{H2O} (1:5)	pH_{KCl} (1:5)	Sal.	HC	Fe_{TS}	Cd	Hg	Pb	As	Cu	Zn
				‰	%	mg/kg						
1	**TT1**	6.92	6.18	0.71	3.04	75.2	0.04	Not detected	2.53	0.13	2,53	7,17
2	**TT2**	7.00	6.72	0.75	2.11	85.6	0.08	Not detected	2.63	0.15	2,63	7,76
3	**TT3**	6.99	6.44	0.82	2.46	94.4	0.03	Not detected	2.18	0.25	2,18	7,51
4	**TT4**	6.89	6.61	0.77	1.10	69.5	0.07	Not detected	4.10	0.28	4,10	6,05
5	**TT5**	6.62	6.26	0.91	3.45	75.0	0.03	Not detected	2.70	0.18	2,70	8,09
6	**TT6**	7.16	6.87	0.90	3.30	73.5	0.03	Not detected	2.60	0.21	2,60	8,25
7	**TT7**	6.82	5.86	0.88	2.92	71.8	0.08	Not detected	2.45	0.18	2,45	7,16
8	**TT8**	7.36	6.49	0.92	1.75	62.5	0.05	Not detected	2.47	0.16	2,47	7,57
9	**TT9**	6.92	6.02	0.80	3.26	60.5	0.09	Not detected	2.30	0.16	2,30	7,29
10	**TT10**	6.50	6.12	0.40	3.55	95.1	0.07	Not detected	1.91	0.29	4,97	8,92
QCVN 43:2008/BTNMT							3.5	0.5	91.3	17	197	315

2.1.4.3. The quality of surface water environment

To assess the environmental status of the current surface water prior to the construction, the Consultants arranged 10 locations of environmental quality monitoring of surface water (*Figure*

19). The monitoring results will be used as baseline to evaluate the impact of the construction works as well as system of works in the operational phase of the subproject.

Figure 19: Surface water and aquatic organism (N) sampling stations

The analytical results (*Table 28*) show that:

- Because the sampling took place late in the rainy season, the water quality in the area is quite good and the water is not affected by alkalinity (the pH values range at 5.69 - 7.87, meeting the environmental regulation – Column B1).
- At the estuaries, coastal area, the water salinity in the canal watercourses at the monitoring locations is also quite high, ranging from 3.14 to 13.7‰.
- The organic pollution (BOD_5)ranges from 3.6 to 10.3 mg/l. Most monitoring locations are over reached QCVN 08-MT:2015/BTNMT- Column A2 (<6 mg/l), however they remain within the limits of Column B1 (<15 mg/l). As the surface water in the region is not used for living activities, it will not affect people's health.
- The coliform value in the water is high, ranging at 930-13000 MPN/100ml, which is larger than the allowed limits by QCVN 08-MT:2015/BTNMT- Column A, the rest exceeds the regulations in Column A2 (< 5,000 MPN/100 ml), mainly in the populous eastern canals as Thu Sau canal, Xeo Ban canal etc. namely, the regional status of the environmental sanitation is not good.
- The TN concentration in water canal ranges from 0.88 to 1.52 mg/l. The ammonium concentration ranges from 0.03 to 0.75mg/l, exceeding the regulations of QCVN 08-MT:2015/BTNMT- Column A but still within the allowed limits under the regulations in Column B (<1 mg/l). Other indicators are also within the limits permitted by QCVN 08-MT:2015/BTNMT- Column B.

Thus, with the characteristics that the project area is located at the west-sea coast and has not the closed system of works, most of the time of a year, the water in the canals is saline, which hinders people's agricultural production and living in the region. The regional surface water sources are polluted mild to moderate, mainly by organic pollution, nutrients and total coliform. The surface water quality has not been contaminated by toxic chemicals such as heavy metals and pesticides.

Table 28: The analaysis results of surfacewater samples on the subproject area in November, 2015

No.	Stations	Tide	pH	EC	Salinity	Turbidity	SS	DO	BOD_5	TOC	TN	$N\text{-}NH_4^+$	$N\text{-}NO_2^-$	$N\text{-}NO_3^-$	$P\text{-}PO_4^{3-}$
				µS/cm	‰	*NTU*	*mg/l*	*mgO_2/l*		*mg/l*					
1	**N1**	Low	7.81	14900	8.65	43.7	72.6	5.3	9.2	4.84	0.998	0.102	0.010	0.830	0.045
2		High	7.28	15100	8.79	36.4	56.8	5.7	8.5	4.46	0.885	0.050	<0.01	0.781	0.044
3	**N2**	Low	7.40	21400	13.20	24.9	40.0	5.4	8.1	4.13	0.973	0.101	0.031	0.802	0.032
4		High	7.05	21600	13.50	20.6	31.6	5.8	8.0	4.23	0.884	0.053	0.018	0.769	0.036
5	**N3**	Low	7.37	21000	12.80	26.2	41.5	5.1	10.3	5.33	0.896	0.062	0.010	0.790	0.028
6		High	7.14	21500	13.30	23.6	39.5	5.0	9.2	4.61	0.889	0.031	<0.01	0.836	0.018
7	**N4**	Low	7.87	19100	11.60	39.6	69.0	5.5	7.5	3.81	1.481	0.456	0.059	0.872	0.076
8		High	7.55	19500	11.90	36.2	62.0	5.7	6.6	3.27	1.369	0.336	0.041	0.857	0.110
9	**N5**	Low	5.73	15800	9.3	6.2	8.5	7.5	3.6	2.368	1.150	0.430	0.010	0.682	0.023
10		High	6.57	16300	9.80	5.6	7.1	6.4	5.5	4.08	0.949	0.280	0.010	0.637	0.018
11	**N6**	Low	6.54	21200	12.80	93.2	142.6	5.1	9.5	5.62	1.079	0.230	0.029	0.765	0.045
12		High	6.25	21400	13.10	86.8	127.8	5.5	8.7	5.14	1.007	0.207	0.025	0.736	0.032
13	**N7**	Low	7.99	6900	3.97	31.6	55.3	5.4	10.3	5.20	1.396	0.367	0.081	0.873	0.061
14		High	7.12	7160	4.13	25.5	42.3	5.8	11.1	5.75	1.186	0.235	0.063	0.829	0.048
15	**N8**	Low	7.03	7140	4.12	29.0	45.6	5.6	7.6	4.29	1.092	0.155	0.095	0.786	0.046
16		High	6.56	7620	4.39	32.8	50.3	5.4	7.9	4.36	0.952	0.074	0.066	0.767	0.037
17	**N9**	Low	7.60	7420	4.28	9.4	18.5	5.4	9.0	4.81	1.691	0.577	0.080	0.979	0.045
18		High	7.41	8020	4.62	26.9	43.5	5.4	8.1	4.35	1.232	0.304	0.055	0.808	0.053
19	**N10**	Low	6.41	5708	3.14	20.0	34.7	6.0	7.0	3.70	1.264	0.302	0.050	0.866	0.038
20		High	6.34	6410	3.63	17.9	27.4	6.1	5.8	3.48	1.116	0.254	0.041	0.766	0.045

No.	Stations	Tide	pH	EC	Salinity	Turbidity	SS	DO	BOD_5	TOC	TN	$N\text{-}NH_4^+$	$N\text{-}NO_2^-$	$N\text{-}NO_3^-$	$P\text{-}PO_4^{3-}$
				µS/cm	‰	*NTU*	*mg/l*	*mgO_2/l*		*mg/l*					
QCVN 08-MT:2015/BTNMT															
Column A1			6-8.5	-	-	-	20	≥ 6	4	-	-	0.1	0.01	2	0.1
Column A2			6-8.5	-	-	-	30	≥ 5	6	-	-	0.2	0.02	5	0.2
Column B1			5.5-9	-	-	-	50	≥ 4	15	-	-	0.5	0.04	10	0.3
Column B2			5.5-9	-	-	-	100	≥ 2	25	-	-	1	0.05	15	0.5

Table 29: The analaysis results of surfacewater samples on the subproject area in November, 2015 (continue)

No.	Stations	Tide	Totalalkalinity	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Fe_{TS}	Cl^-	K^+	Na^+	Acid	Al^{3+}	Total Coliform	Fecal Coliform
			$mgCaCO_3$/l			*mg/l*					*meq/l*		*10^2*MPN/100ml*	
1	**N1**	Low	1458.0	106.44	286.06	341.0	0.729	4881.6	107.4	2634.9	KPH	KPH	32	9.3
2		High	1477.6	107.87	289.90	346.9	0.719	4947.2	111.2	2694.9	KPH	KPH	17	0
3	**N2**	Low	2094.1	152.88	410.85	516.8	1.582	6925.2	155.5	3686.2	KPH	KPH	64	22
4		High	2113.7	154.31	414.69	538.8	1.486	7106.8	160.9	4015.6	KPH	KPH	52	11
5	**N3**	Low	2054.9	150.02	403.17	506.2	1.847	6880.2	153.7	3725.4	KPH	KPH	29	4.9
6		High	2103.9	153.59	412.77	535.3	1.806	7044.0	160.8	3836.1	KPH	KPH	20	3.2
7	**N4**	Low	1869.0	136.45	366.70	453.8	0.581	6257.7	158.4	3392.2	KPH	KPH	27	9.3
8		High	1908.2	139.31	374.37	429.6	1.793	6388.7	142.5	3463.5	KPH	KPH	54	20
9	**N5**	Low	1546.1	112.87	303.339	315.4	0.528	5176.5	111.9	2764.2	0.087	0.136	95	40
10		High	1595.0	116.45	312.9	386.7	0.432	5340.3	118.4	2886.0	0.088	0.106	130	28
11	**N6**	Low	2074.5	151.45	407.0	527.9	0.516	6945.7	155.5	3772.0	0.049	0.068	13	0
12		High	2094.1	152.88	410.9	517.6	0.368	7011.2	158.1	3785.6	0.060	0.071	11	0

No.	Stations	Tide	Totalalkalinity	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Fe_{TS}	Cl^-	K^+	Na^+	Acid	Al^{3+}	Total Coliform	Fecal Coliform
			$mgCaCO_3/l$			*mg/l*					*meq/l*		*10^2*MPN/100ml*	
13	**N7**	Low	726.1	53.01	142.45	169.5	0.939	2162.3	52.0	1182.8	KPH	KPH	11	0
14		High	784.8	57.29	153.97	183.0	0.884	2307.7	55.2	1315.0	KPH	KPH	19	0
15	**N8**	Low	558.5	40.78	109.58	131.1	0.533	2089.7	37.1	721.2	0.040	0.054	24	9
16		High	627.2	45.79	123.06	143.6	0.349	2168.4	42.7	779.5	0.061	0.068	33	11
17	**N9**	Low	698.7	51.01	137.08	160.8	0.490	2247.1	50.3	1022.4	KPH	KPH	32	7.8
18		High	745.6	54.44	146.29	173.9	0.591	2428.8	52.3	1232.0	0.060	0.050	16	2
19	**N10**	Low	675.2	49.29	132.47	166.1	1.116	1728.6	46.1	1002.1	KPH	KPH	59	14
20		High	700.6	51.15	137.46	157.4	0.955	1941.3	51.3	1116.2	KPH	KPH	7.4	0
QCVN 08-MT:2015/BTNMT														
Column A1			-	-	-	-	0.5	250	-	-	-	-	2500	-
Column A2			-	-	-	-	1	400	-	-	-	-	5000	-
Column B1			-	-	-	-	1,5	600	-	-	-	-	7500	-
Column B2			-	-	-	-	2	-	-	-	-	-	10000	-

2.1.4.4. Groundwater quality

To assess the groundwater quality in the construction sites, the Consultant took groundwater samples at 3 locations near the sluice gates to be built and close to residential areas (*Figure 20*). The measurement and analysis of the current environment status of groundwater in the area is shown in*Table30.*

Figure 20: Groundwater (GK) sampling stations

Table30: The analysis results of groundwater quality in the subproject area

No.	Parameter	Unit	Stations			QCVN 09: 2008
			GK1	GK2	GK3	
1	pH	-	6.67	6.53	6.7	5.5-8.5
5	Turbidity	NTU	1.34	5.62	1.41	-
6	EC	µS/cm	1469	5730	967	-
7	Salinity	‰	0.70	3.30	0.40	-
8	DO	mg/l	3.20	3.80	4.50	-
9	TOC	mg/l	2.07	0.89	1.33	-
10	Totalalkalinity	mg$CaCO_3$/l	300	420	240	500
11	TSS	mg/l	5	11	0	-
12	TN	mg/l	0.44	1.19	0.83	-
13	N-NH_4^+	mg/l	0.20	0.21	0.68	0.1
14	N-NO_2^-	mg/l	0	0	0	1.00
15	N-NO_3^-	mg/l	0.20	0.98	0.08	15
16	Cl^-	mg/l	44.90	1587.00	37.49	250
17	Ca^{2+}	mg/l	33.91	115.61	16.96	-
18	Mg^{2+}	mg/l	18.38	196.31	19.63	-
19	P-PO_4^{3-}	mg/l	0.11	0.05	0.10	-
20	Na_+	mg/l	230.17	1036.61	161.92	-
21	K^+	mg/l	8.84	37.19	6.30	-

No.	Parameter	Unit	Stations			QCVN 09: 2008
			GK1	GK2	GK3	
22	SO_4^{2-}	mg/l	13.85	9.82	5.83	400
23	Fe_{TS}	mg/l	0.54	0.79	0.65	5
24	Pb	µg/l	KPH	0.005	0.01	0.01
25	Zn	µg/l	KPH	KPH	KPH	3.0
26	Hg	µg/l	KPH	KPH	KPH	0.001
27	As	µg/l	0.064	0.042	0.058	50
28	E. Coli	MPN/100 mL	0	0	0	KPH
29	Total Coliform	MPN/100 mL	0	0	0	3

It is concluded that the groundwater at the sampling locations is slightly acidic (pH 6.53 to 6.7) and the sediment in water is low. The freshwater is not affected by saltwater intrusion. The groundwater is not polluted by nutrients, has low nitrate, and meets QCVN 09: 2008. The content of sulphate, manganese in water is low. The groundwater in the area is not affected by alkaline and iron concentration (Fe) ranges from 0.54 to 0.79 mg/l and is not infected by microorganisms.

2.1.4.5. The wastewater characteristics

Samples of wastewater were also collected and analyzed and the analytical resultsin *Table 31*show that domestic wastewater from the densely populated areas contains the relatively considerable pollution levels of BOD5: 128-138 mg/l; ammonium concentration: 8.4 – 12.1mg/l, notably the E.Coli: 2300 – 6,500MPN/100ml. Compared with the water quality standard, this wastewater does not meet the environmental standard to be discharged into the environment (QCVN 14: 2008/BTNMT).

Table 31: The analysis results of domestic wastewater quality in the subproject area

Parameter	Unit	Domestic wastewater			QCVN 1 4: 2008/BTNMT colum B
		NT1	NT2	NT3	
pH		6.76	6.5	6.8	5-9
EC	µs/cm	710	640	580	-
Color	Pt-Co	60	50	45	-
DO	mg/l	1.87	1.9	1.5	-
SO_4^{2-}	mg/l	26.1	22.4	18.4	-
Cl^-	mg/l	23.4	21.1	17.4	-
TN	mg/l	12.6	14.3	18.5	-
$N\text{-}NH_4^+$	mg/l	10.7	8.4	12.1	10
$N\text{-}NO_2^-$	mg/l	0.046	0.0	0.1	-
$N\text{-}NO_3^-$	mg/l	1.17	0.7	2.9	50
TP	mg/l	0.97	1.1	0.8	-
$P\text{-}PO_4^{3-}$	mg/l	0.68	0.8	0.5	10
TSS	mg/l	129	172.0	195.8	100

Parameter	Unit	Domestic wastewater			QCVN 1 4: 2008/BTNMT colum B
		NT1	NT2	NT3	
TDS	mg/l	371	350.0	327.0	1000
BOD_5	mg/l	128.58	125.6	138.6	50
COD	mg/l	241	247.0	264.0	-
H_2S	mg/l	0.34	0.2	0.2	4.0
Fe_{Ts}	mg/l	0.521	0.4	0.2	-
Total coliform	MPN/100 ml	11.000	5.200	79.000	5000
Fecal coliform	MPN/100 ml	4.800	2.300	6.500	-

2.1.4.6. The aquatic status

The analysis of aquatic samples at the monitoring sites in the project area (Figure 19) obtained the following results:

a). Phytoplankton

83 species of phytoplankton of 5 algae phylumsare are identified, in which the bacillariophyceae has 38 species (45.8%), the euglenophyceae has 15 species (18.1%), the cyanophyceae has 13 species (15, 7%), the chlorella Royal DX has 12 species (14.5%) and the pyrrhophyta has 5 species (6.0%). The data shows the dominance of the saltwater species (Bacillariophyta), see in *Table32*.In the canals where there is the dense population, the euglenophyta appears fairly common, which signs the accumulation of organic matters in water.

Table32: Phytoplankton in the subproject

No.	Phytoplankton	In the end of rainy season	
		Number of species	*Rate (%)*
1	Cyanophyta	13	15.7
2	Bacillariophyta	38	45.8
3	Chlorella	12	14.5
4	Euglenophyceae	15	18.1
5	Pyrrhophyta	5	6.0
Total		**83**	**100**

b). Zooplankton

The zooplankton species are relatively rich (35 species) of 5 groups and some types of larvae, in which the copepoda has the largest of 14 species (45.2%), the cladoceran has 8 species (25, 8%), the rotifers has 5 species (16.1%), the 2-celled species (6.5%) and two species of shell crustacean (6.5%) (Table 33).

Table 33: The zooplankton species in the subproject

No.	Zooplankton	In rainy season	
		Number of species	*Rate (%)*
1	Crustacean	2	6.5
2	Rotifers	5	16.1
3	Cladoceran	8	25.8

4	Mollusk	2	6.5
5	Copepoda	14	45.2
6	Larval	4	
Total		**35**	**100**

c). Zoobenthos

Unlike zooplankton and phytoplankton, which live in watery environments and drift with water movements and each water resource will have its zooplankton and phytoplankton, zoobenthos moves very low, especially Polychaete and Mollusca. So they will die-off when the environment changes dramatically exceeding their tolerance and new zoobenthos will be formed to adapt to new living conditions.

The result of zoobenthos analysis illustrates (*Table 34*) 22 species belongs to 4 phyla, in which Polychaeta 8 Species (36.4%), Crustacea is 6 species (27.3%) and Mollusca is 3 species (13.6%) and Gastropods is 5 species (22.7%).

Table 34: Zoobenthos in the subproject

No.	***Zoobenthos***	**In rainy season**	
		Number of species	*Rate (%)*
1	Polychaeta	8	36.4
2	Crustacea	6	27.3
3	Mollusca	3	13.6
4	Gastropods	5	22.7
Total		**22**	**100**

2.1.4.7. The current status of biological resources

The subproject area is lying in the western sea coast of 2 districts: An Minh and An Bien of Kien Giang province, where the coastal mangroves are featured by the following characteristics:

In Kien Giang, mangroves have high diversity of species. The survey conducted under the GIZ project (Integrated Coastal Management for Climate Change project)detected 27 of the 39 species found in Vietnam (*Table 35*) and that the high diversity of Kien Giang mangroves is an important factors for natural resource managers in the region. The resistance of the mangroves and the ability to provide its valued ecosystem services is improved through the diversity in species in each forest.

The mangrove forests in Kien Giang province in general and in An Minh - An Bien coastal zone in particular feature some interesting but contains similarities of other mangrove forests in Vietnam and in the Southeast Asia. The *Avicennia alba* predominates in the sea forest belt. The Avicennia alba population is regenerated in abandoned aquaculture ponds, which scatters in front of sea where rivers flow into sea and mixes in the populations of shrub about 2-3m taller the tide level. The common species such as "Coi", Lumnitzera littorea, Lumnitzera racemosa grow popularly in this area with "Gia" species. Nypa fruiticans populations usually appear in the coastline, in front of canals or riversides. There are a number of other natural populations as *Nypa fruiticans*, which mostly afforests. The forest belt of mangrove species are present in the back tidal area such as *Hibiscus tiliaceous* and *Thespesia populnea* and some other species, low-thick trees as *Pluchea indica*, bush like *Acanthus spp*, Acrostichum aureum Linn as *acrostichum spp*, crawling tree like *Clerodendrum inerme* growing on degraded land that was formerly mangroves.

Table 35: The biodiversity in coastal mangroves

Local name	Latinh name	Zone			
		An Biên	An Minh	Kiên Giang	Việt Nam
Ô rô trắng	Acanthus ebracteatus				1
Ô rô tím	Acanthus ilicifolius	1	1	1	1
Ráng	Acrostichum aureum	1	1	1	1
Ráng	Acrostichum speciosum	1	1	1	1
Sú	Aegiceras corniculatum			1	1
Sú đỏ	Aegiceras floridum				1
Mắm trắng	Avicennia alba	1	1	1	1
Mắm biển	Avicennia marina	1	1	1	1
Mắm lưỡi đòng (mắm đen)	Avicennia officinalis	1	1	1	1
Mắm quăn	Avicennia rumphiana				1
Tìm lang	Barringtonia racemosa				1
Vẹt trụ	Bruguiera cylindrica	1	1	1	1
Vẹt dù	Bruguiera gymnorhiza			1	1
	Bruguiera hainesii				1
Vẹt tách	Bruguiera parviflora				1
Vẹt khang (vẹt đen)	Bruguiera sexangula	1	1	1	1
Dà quánh	Ceriops zippeliana (C.decandra)	1	1	1	1
Dà vôi	Ceriops tagal	1	1	1	1
Quao nước	Dolichandrone spathacea	1	1	1	1
Giá	Excoecaria agallocha	1	1	1	1
Cui biển	Heritiera littoralis	1		1	1
Trang	Kandelia candel				1
Trang đỏ	Kandelia obovata				1
Cóc đỏ	Lumnitzeza littorea			1	1
Cóc trắng (vàng)	Lumnitzeza racemosa	1	1	1	1
Cóc hồng (cây lai)	Lumnitzeza X rosea				1
Dừa nước	Nypa fruiticans	1	1	1	1
	Pemphis acidula				1
Đước đôi	Rhizophora apiculata	1	1	1	1
	Rhizophora Xlamarckii			1	1
Đưng (đước bộp)	Rhizophora mucronata	1	1	1	1
Đâng (đước vòi)	Rhizophora stylosa				1
Côi	Scyphiphora hydrophylacea			1	1
Bần trắng	Sonneratia alba	1	1	1	1
	Sonneratia apetala				1

Local name	Latinh name	Zone			
		An Biên	An Minh	Kiên Giang	Việt Nam
Bần chua	Sonneratia lanceolatata	1	1	1	1
Bần ổi	Sonneratia ovata	1	1	1	1
Xu ổi	Xylocarpus granatum	1	1	1	1
Xu mekong	Xylocarpus moluccesis		1	1	1

Source: "The state independent theme: Assessing the impacts of the sea dike of Rach Gia gulf - Kien Giang province on the regional economic - social and environment conditions- the Southern Institute of Water Resources Research, 2015".

2.1.4.8. Biodiversity around subproject area

In the surrounding areas of the subproject location, there are some areas with high biodiversity feature including U Minh Thuong National Park, U Minh Ha National Park, the natural breeding grounds in the sea (Kien Luong area), Kien Luong limestone areas. Further is the Phu Quoc (island) region.

According to Decision No.1107/QD-BTNMT dated 12 May 2015 by Ministry of Natural Resources and Environment (MONRE), in Kien Giang province, there are two national parks, 1 natural reservation site and one protected area (*Table 36* and *Figure 21*).

Table 36: Protected areas in Kien Giang province according to Decision No.1107/QD-BTNMT

N^0	**Name**	**Area (ha)**	**Owner**
I	**National park**		**Kien Giang PPC**
1	Phu Quoc	29,135.9	
2	U Minh Thượng	8,038	
II	**Natural Reservation Site**		
3	Hon Chong	964,7	
III	**Habitat and Species management area**		
4	Habitat and Species management area on the sea	2,881.47	

U Minh Thuong National Park, being Cajuput forest on peat soil and being the habitat to many wild species, includes wild animals listed in the Red Book to be protected. In this area, scientists have identified 226 species of plants/ flora, 172 species of insects, 48 species of butterflies, 34 species of fish, 7 species of amphibians, 34 species of reptiles, 151 species of birds, 8 species of bats, 24 species of mammals. These are areas which have been protected with embankments to keep fresh water; therefore, there would be no affects by the subproject activities on the water resources of the region. These positions of sluice gate construction are quite far from the U Minh Thuong National Park with the nearest sluice gatebeing 25 km away from the park, therefore, the construction activities will have no impact on the national park.

U Minh Ha National Park, located in CaMau province, is flooded acid forest ecosystems with the area of 8,528 hectares. This is also the area with high biodiversity features. In this area, scientists have identified 176 species of wild plants/ flora, 32 species of mammals, 91 species

of birds, 11 species of amphibians and 36 reptiles. This is also the forest area having a dyke embankment to maintain freshwater and also very far from the subproject area. The location of the nearest sluice gate construction is about 40 km from the national park; therefore, the construction activities and operation of the subproject are not likely to have any impact on it.

Phu Quoc oceanic region: Phu Quoc sea is quite far away from the subproject area (over 100 km). This is an area with high biodiversity features with 184 species of phytoplankton, 53 species of zooplankton; 104 species of seaweed, 281 species of benthos, 215 species of hard coral, 151 species of fish (Source: State theses codes KC.09.04 / 06-10).

Kien Luong sea area of about 40 km away from the subproject area and has number of natural breeding areas of blood cockles and seashells. With a long distance, the activities of the subproject will not have any impact on this area.

On the area of Kien Luong, there is also limestone and coastal mangrove forests ecosystems; however, due to the far distances, the activities of the subprojects is relatively small, therefore, the impact caused by the operation of the subproject area is not possible.

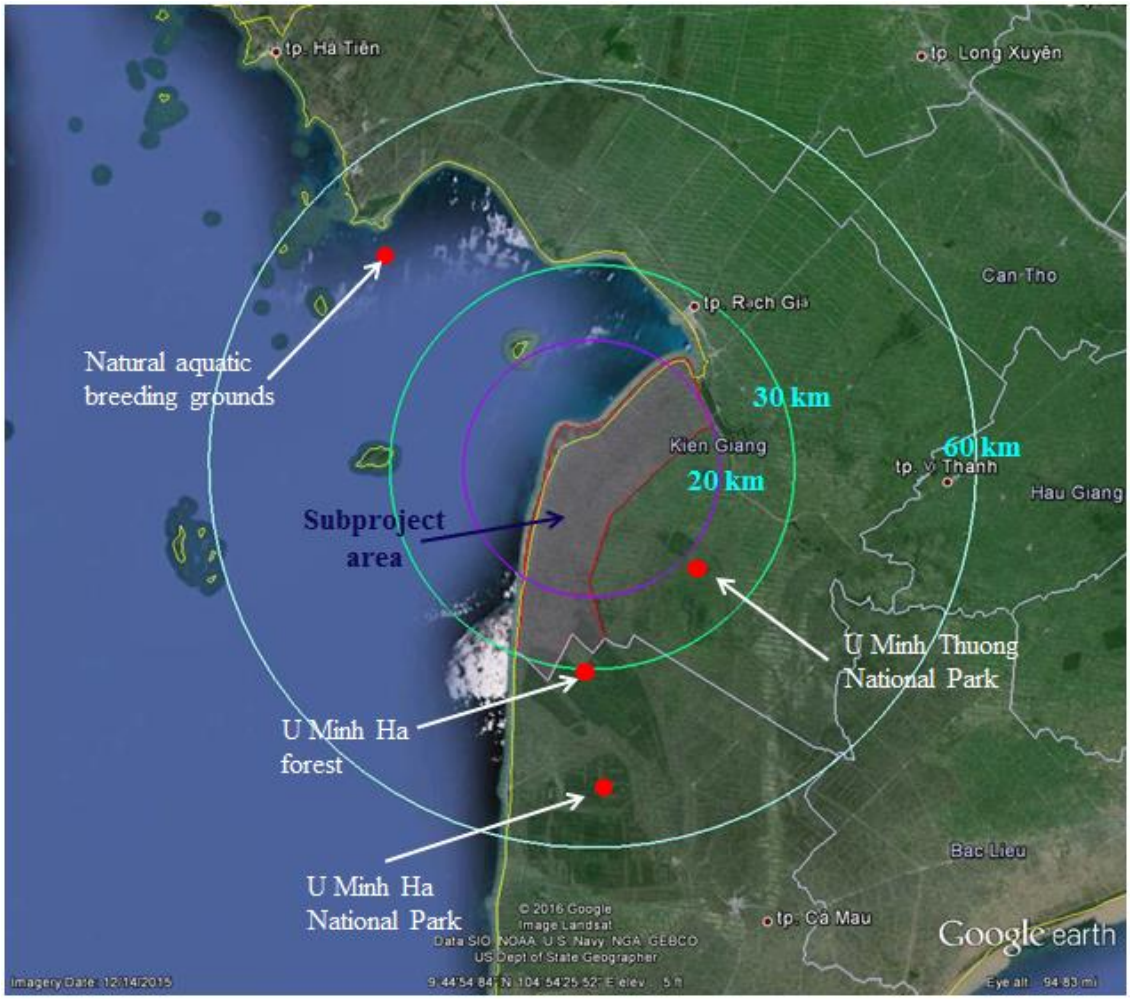


Figure 21: Protected areas in Kien Giang province

2.2. Social and economic conditions

2.2.1. Economic conditions

2.2.1.1. Agriculture, forestry, fishery

a). Agriculture

An Bien District

As of early 2015, the agricultural land is 35,019.2 hectares, accounting for 87.48% of the total natural area, of which paddy land is 28,431.49 ha (18,900ha of rice land and 9531 hectares of shrimp – rice land); other annual crop land is 200.54 ha; perennial crop land is 5,068.2 ha.

The district agriculture is mainly in saline land, which is difficult for production. There are 16,243.59ha saline soils and 17,431.05ha alkaline soil.

Regarding the rice production: Total annual harvested area is 46,033 ha, 98.35% compared to the plan, the average yield is 5.9 tonnes/ha, the total output is 271,598 tons, reaching 102.26% of the planning and increasing 10.90% over the same period:

- The seasonal cropharvest area is 8035 ha, with the yield of 5.2 tonnes/ha and the production of 41,884 tons, repective with 90.13% of the plan, increasing 1,508 tons over the same period.
- The Winter-Spring harvest area is 19,187ha with the yield of 5.2 tonnes/ha and the production of 124,811 tons, repective with 113.93% of the plan, increasing 14,911 tons over the same period.
- The Summer-Autumn harvest area is 18,793ha with the yield of 5.58 tonnes/ha and the production of 104,903 tons, repective with 97.55% of the plan, increasing 1,731 tons over the same period.

The area of industrial plants, annual plants, perennials generally tends to decrease compared to 2013 because of inefficient production and farmers switching to other short-term crops (the cassava yield is 31 tons, the watermelon is 150 tons, vegetables, beans and other crops gain 5,725 tons, 7,343 tons of sugarcane, 3,340 tons of coconut, 29 tons of pineapples).

The livestock gets advantages. The vaccination for cattle and poultry is maintained regularly, so there is no major outbreak of deaseases, which gives people peace of mind for their raising investment. The feeding food prices are relatively stable despite of high seed prices. Besides the product prices are basically stable. Herders get interests. The estimated yield is 4,031 tons, of which pork production is 3,178 tons and poultry production is 710 tonnes.

An Minh District

Identifying the agriculture an important economic sector, the DPC has timely concretized the issuance of documents to implement Resolution No. 26-NQ/TW of the Central Government on the agriculture, farmers and rural areas. In 2013, within the agricultural structure, the production value of crops accounts for 92.8%, livestock 6.0% and services 1.2%.

On cultivation: This is the key economic sector which plays the key role in the local economic – social development and uses up 74.18% of the natural area of the district. The cultivation products are mainly rice and vegetables. In 2013, the total cultivated area is 32,816ha (869ha of summer-autumn crop, 30,978ha of seasonal crop which is intersected on shrimp areas (under shrimp - rice model), 969ha winter-spring rice). The total paddy yield reaches 136,601 tonnes. The total rotation crops reaches about 420ha (mostly eggplants, pumpkins, melons, onions, etc.)

with the total output of 5,580ha. The coconut area accupies about 230ha, harvested 1,428 tonnes; the sugarcane area is about 84ha, harvested 5,040 tonnes.

On breeding: it is mostly in small scales of households. In 2013 the total herd of pigs in the province gains about 21,700 heads (90.4% of the plan), about 163,700 heads of poultry (70.9% of the plan). The total output is estimated at about 2,600 pork tonnes, 500 tonnes of poultry.

Currently the district has 1 cooperative and 133 production organizations, in which 13 organizations get the profit of 40 million VND/ha/year, 22 organizations get the profit of 50 million VND/ha/year, and 13 organizations get the profit of 70 million VND/ha/year.

b). Forestry

The protection forest in the project area covers 5,352ha, accounting for nearly 9% of the natural area, which concentrates in the coastal communes (in saline soils) of 70km long, from Cai Lon river to Cay Go canal. The plants are mainly mangroves (Avicennia and Mangrove Crabapple), which acts as the protective shield for the production, aquaculture and daily life of the people in the project area before billows, big winds.

According to the statistics of An Bien - An Minh forest management board, the current status of coastal protection forest of An Bien - An Minh with the total coastal route length is **61.3km** (Table 37). The coastal mudflats of An Bien - An Minh and mangrove forest are directly affected by tides, estuary currents in rainy seasons and South West winds, so the coastal sections are eroded and some are seriously damaged. The landslide phenomenon changes over time, in this year it causes landslide in this section while in another year it causes depoisit in this section (particularly in An Minh district, the deposit phenomenon rarely happens as it is directly affected by the southwest monsoon). Currently the mangrove forest of An Bien-An Minh is relatively good with the thickness of 50m - 1,600m, which mainly includes Avicennia and Mangrove Crabapple, being the protective shields whenever high tides, strong winds, large waves hit. However, in recent years due to multiple causes, some sections of mangrove forests are damaged, causing serious erosion of existing dike especially between An Bien - An Minh section adjacent to Cai Lon river in Tay Yen commune, An Bien district, which is eroded 400m in 2005 and must be handled by stone gabions.

Table 37: The status of coastal protection forest in An Bien - An Minh

No.	***Section***	***Length(km)***	***Corridordi ke(m)***	***From Corridordiketomang roveforest belt(The secondaryforest belt)(m)***	***The mainforest belt(m)***	***Existingforesttolowtide level***		***The secondaryfor est beltarea(ha)***	***Number of householdsall ocated***	***The planned areaof aquaculture (ha)***	***The planned areaof coastalprotection forests (ha)***
						Mudflats(m)	FootBeach (m)				
I	**AnMinh district**	**40.3**							**719**		**3027**
1	Van Khanh Tay commune section from Tieu Dua -	**4.3**	15	200				45.45/ 58.46	37	17.53	132
2	Van Khanh communesection from KimQui–Muong	**5.4**	15	300	50			76.45/ 105.74	38	31.72	221
3	Van Khanh Tay commune section from Muong Dao boder with Dong	**5.8**	15	650	20			135.79/ 168.25	86	50.47	266
4	Dong Hung A commune	**5.5**						181.66/ 351.46	149	105.43	487
	FromVanKhanh DongCommuneborde rs with Vam Ro Ghe	2	40	840	50	100					
	-From Vam Ro Ghe boder Tan Thanh commune	3.5	45	780	20						
5	Tan Thanh commune	**5.7**	50	780	50			72.56/ 297	128	89.1	418
6	Thuan Hoa commune	**13.6**						556.51/ 1104.63	281	331.38	1503
	-From Tan Thanh – Xeo Ban canal	10.1	60	1000							

No.	***Section***	***Length(km)***	***Corridordike(m)***	***From Corridordiketomangroveforest belt(The secondaryforest belt)(m)***	***The mainforest belt(m)***	***Existingforesttolowtide level***		***The secondaryforest beltarea(ha)***	***Number of householdsallocated***	***The planned areaof aquaculture (ha)***	***The planned areaof coastalprotection forests (ha)***
						Mudflats(m)	FootBeach(m)				
	-From Xeo Ban to Xeo Quao canal	3.5	60	1400	120	500					
II	**An Bien district**	**21**							**149**		**1.065**
1	NamThaiA commune fromXeo QuaotoXeoDua canal	4	50	1200	100	500		164.8/ 402.86	83	120.85	499
2	NamThai commune fromXeoDuatoThu Nam-BaBien canal	5	50	1000	800	500		79.91/ 142.18	21	42.65	204
3	NamYên commune fromBa BiểntoThuHai canal	6	50	400	50		100	36.26/ 109.35	22	32.8	187
4	Tay Yen communetừ ThuHai toGoc canal	6	40	300	30		50	14.84/ 56.13	23	16.83	75
	Total	**61.3**						**1,363.87/ 2,796.06**	**868**	**838.76**	**4092**

Source:Committee of Forest Management An Minh - An Bien

c). Fishery

An Bien District

As of early 2015, the aquaculture land is 529.02 ha. The total fishing and aquaculture estimate is 25,555 tonnes/year (93.85% of the plan and increased 6% over the same period of previous year) of which the fishing yield is 8,849 tonnes (94.84% of the plan and 101.5% over the same period of previous year) and the aquaculture and production reaches 16,706 tonnes (93.34% of the plan and 108.54% over the same period of previous year). The shrimp production reaches 3,684 tons (94.95% of the plan and increased 17.12% over the same period of previous eyar) and the fish production reaches 8,082 tonnes (87.66% of the plan and increased 3.32% over the same period of previous year). Other seafood production is 11,822 tonnes (99.69% of the plan and increased 5.24% over the same period of previous year; cuttlefish yield is 1,082 tons (98.47% of the plan and increased 4.55% over the same period or previous year.

An Minh District

Aquaculture is the strength of the district, which is the great potential for the quickly and efficiently economic shift. In 2010 the total feeding area of aquatic species is 70,689ha, in which the shrimp feeding occupies 37,373ha with the average yield of 0.29 tonnes/ha and the output is 22,165 tonnes (2.6 folds compared to 2005); the crab feeding occupies 30,659ha with the average yield of 0.158 tons/ha; the Andara granosa occupies 1,925ha with the average yield of 3.42 tonnes/ha; the brackish water fish and other species occupy 732ha (such as eel fish, lates calcarifer, oxyeleotris marmoratus etc.).

In 2013, the district produced (including intercropping, connection of crops) 80,407 ha of aquatic products with the total output of 29,461 tonnes (of which there are 13,454 tonnes of penaeus monodon, 8,274 tons of crabs, 5,639 tons of *Andara granosa*). The Penaeus monodon area is 40,951 ha, including 37,549 ha of shrimp – rice fields (intersected between shrimp and rice growing) with the yield of 339 kg/ha/year; 35,976 ha crab feeding, which primarily in shrimp – rice fields and in protective forest with the yield of 231 kg/ha/year; and 1,504 ha of *Andara granosa.*

2.2.1.2. Industry sector

Along with the comprehensive and in-depth agricultural development, two districts, An Bien and An Minh focus on industrial development and promote the development of seafood processing industry, mechanical repairs,the service sectors to meet the development requirements. But being the agricultural districts with the very low starting ground, their industry – handicraft are backward and mainly small scale processing and repair sectors (*Table 38*).

Table 38: The industrial values in two districts of An Bien and An Minh (10^6VND)

No	Industries	An Bien District				An Minh District			
		2011	2012	2013	2014	2011	2012	2013	2014
1	Processing industry	55,8	121,2	154,8	163,4	333,5	568,5	758,5	1,010,8
2	Production and distribution of electricity, gas, hot water, steam and air conditioning	25,1	27,9	33,5	35,67	52,4	58,8	59,000	65,1

3	Production and distribution of water, management and disposal of wastewater	1,7	1,98	2,0	2,2	1,4	2,3	2,8	3,5

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

2.2.1.3. The road and waterway traffic

a). The road traffic

Being the coastal area, the road system in the subproject area is not developed. At the proposed sluice gates there are no road for motorized vehicles, and the local peole depend on waterway traffic for transportation.

b). Water navigations

Being the coastal areas with the densely channel system while road traffic is limited; therefore, waterway traffic has an important role in the activities of the local residential people.

At the horizontal channels, waterway traffic is mainly for boats and junk-boats of local residential people to travel.

At the lengthwise channels, such as Xeo Ro channel, Chong My channel, 7th village (Lang Thu Bay) channel, they are the imporant freight transport routes.

Given that the coastal areaadjacent to the subproject location is quite shallow; therefore, the subproject location seems to have very few boats and ships moving in following the direction from the sea into the local area. The main traffic route in the local area is by the horizontal and lengthwise channels located in the inner subproject location.

Can Gao channel is the most important waterways transport route connecting Kien Giang in particular and the Mekong Delta provinces in general with Ca Mau province. This route is suitable for boats 200-500 tons.

At the proposedsluice gates construction sites, the canals are not important waterway transport routes. They mainly serves small boats and ships of local residential people.

2.2.1.4. Commercial - services – tourism sector

The services develops rapidly that contributes positively to the regional economic development and better meet the needs of business and production of people's life. The revenue from accommodations and catering services and commercial business establishments, hotels and restaurants becomes increasing. The structure of the service sector has been shifted. In addition to the traditional service sector, a number of new service are formed such as insurance, trading and settlement of debts and real estate business etc.

The volume of commodity circulation increases continuously at high speed, with the participation of all economic sectors, especially the private sector. The business methods are increasingly diversified and extensive to rural areas. In addition, the export activity is increasing. The exports are mainly seafoods. The export market is expanding with many customers in many areas. However, this activity remains spontaneous without specific planning and long-term strategy (*Table 39* and *Table 40*).

Table 39: The revenue of the accommodations and catering services at current prices

Years / Districts	2012	2013	Primarily in 2014
	Mil.VNĐ		
An Bien	137,430	163,541	183,166
AnMinh	41,870	44,821	50,647

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

Table 40: The statistics of commercial establishments, hotels, restaurants and services

Years / Districts	2012	2013	Primarily in 2014
	Quantity		
An Bien	3,661	3,653	3,865
An Minh	2,891	2,882	3,149

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

2.2.1.5. Commercial - services – tourism sector

2.2.2. The irrigation status and the saltwater intrusion effect to the agriculture sector in the subproject area

2.2.2.1. The irrigation status for agricultural production in the project area

The current irrigation system in the subproject area includes: primary – secondary - tertiary canals, sea dikes, river dikes and subregion embankments, sluice gates, temporary dams and infield works.

Before the year 2000, the entire subproject area is mainly rice harvest production, the system of works is mainly for agricultural development. The system of works is quite simple and primarily including the banks, the temporary dam to maintain freshwater and restriction the saltwater intrusion. Since the year 2000 to date, people converted to production in the form of salty-fresh (in the rainy season they harvest rice production and in dry season, they harvest the aquaculture in salt water) therefore, the people need active regulatory regime for production to be more stable.

a). The primary system of cannals

The primary system of cannals is relatively full, evenly distributed across the region. The canal width is large but shallow due to sediment process, especially in the Western Sea canals due to the sea sediment. The following is the scale of the current state of the canals (*Table 41*).

Table 41: The canal status in the subproject area

No.	Name of canal	Length (km)	Width (m)	Bottom elevation (m)
I	**Connect to the Cai Lon River**			
1	Nga Bat	4.0	17.0 ÷ 20.0	-1.41 ÷ -1.84
2	Canal 40	3.8	33.0 ÷ 39.0	-2.17 ÷ -2.39
3	Muong Chua	4.0	29.0 ÷ 32.0	-1.44 ÷ -1.84
4	Muong Quao	4.5	39.0 ÷ 41.0	-1.98 ÷ -2.38
5	Chong My			
6	Dai	6.0	48.0 ÷ 57.0	-2.54 ÷ -2.94

No.	Name of canal	Length (km)	Width (m)	Bottom elevation (m)
II	**Connect to the West sea**			
1	Thu Nhat	12.5	29.0 ÷ 38.0	-1.40 ÷ -2.48
2	Thu Nhi	12.5	26.0 ÷ 32.0	-1.05 ÷ -1.10
3	Thu Ba	12.0	64.0 ÷ 76.0	-1.96 ÷ -2.14
4	Thu Nam	12.0	35.0 ÷ 41.0	-2.70 ÷ -3.88
5	Thu Sau	7.0	55.0 ÷ 74.0	-1.91 ÷ -2.49
6	Thu Bay	12.5	35.0 ÷ 40.0	-1.78 ÷ -2.39
7	Xeo Doi	5.0	35.0 ÷ 37.0	-1.0 0÷ -1.03
8	Xeo Quao	12.5		
9	Xeo Ban	13.0	43.0 ÷ 48.0	-0.92÷ -1.29
10	Thu Tam	13.0	38.0 ÷ 40.0	-0.59÷ -1.00
11	Thu Chin	12.5	45.0 ÷ 56.0	-1.66 ÷ -1.79
12	Thu Muoi	12.0	28.0 ÷ 30.0	-1.60÷ -1.70
13	Xeo Ngat	12.0	36.0 ÷ 40.0	-1.33 ÷ -1.43
14	Xeo Nhau	12.0		
15	Xeo La	7.5	28.0 ÷ 35.0	-0.94 ÷ -1.11
16	Thuong Luong	7.0	26.0 ÷ 31.0	-1.24 ÷ -1.64
17	Ro Ghe	11.0		
18	Chu Vang	10.0		
19	Muoi Than	11.0	14.0 ÷ 16.0	-1.28 ÷ -1.67
20	Muong Dao	3.5	28.0 ÷ 35.0	-1.46 ÷ -1.61
21	Cay Go	9.2	16.0 ÷ 20.0	-1.10 ÷ -1.30

Source: The Subproject Statement Report (updated on 15/01/2015)

b). The secondary system of canals

The regional secondary system of canals has been developed well. The density is 1 ÷ 2 km/canal. The basic dimensions of the secondary canals are: b_{bottom} = 6 m, bottom elevation is -1.50 to -2.00. With high concentration of total suspended solids, the canals are rapidly deposited and need to dredge every 2 or 3 years.

c). The dyke and embankment system

The earthwork of the sea dyke of nearly 70 km long, along the subproject area towards the West Sea and Cai Lon river, was restored and upgraded, however, there are works on the dike that regulate water supply for production and drainage that have not been built. Every year, the local budget spending for the construction of temporary dams does not take small portion in addition to the very difficult and costly management and operation of the system.

- The sea-dike system: The construction of the sea-dike route of 70km long, 6m wide of dyke surface, and the elevation of +2.00 to +2.50, starting from Kenh Dai canal to Tieu Dua canal, is basically completed.
- The river-dike system of Cai Lon river: This route lengthens about 40km. Its status remains poor and interrupted by many sections, which do not meet the requirements (*Figure 22*).

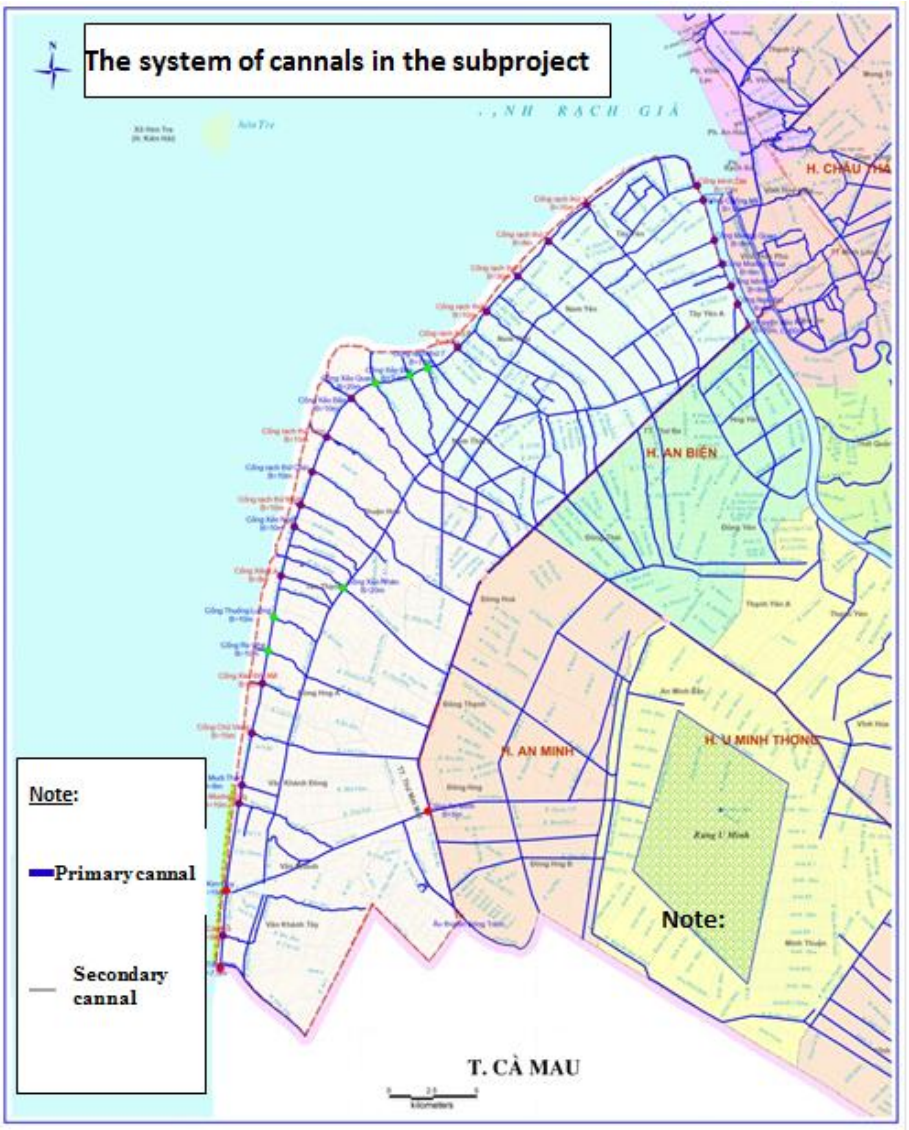


Figure 22: The canal status in the subproject area

d). Sluice gate system

The sluice gate system in the subproject area is mainly located along the West Sea with an aim to control salinity instrusion from the West Sea into the subproject area and to drain the area. The sluice gate status are shown in *Table 42* and *Figure 23*.

Table 42: The curent sluice gate in the subproject area

No.	Names of sluice gates	Mission	Status of sluice gates	
			Width B (m)	Bottom
1	Kim Quy	T+T+KSM	15.0	-2.5
2	An Minh	T+T+KSM	5.0	-2.5
3	Thu Tu	T+T+KSM	3.0	-2.0
4	Xep Doi	T+T+KSM	5.0	-2.5
5	Xeo Quao	T+T+KSM	20.0	-3.0
6	Thu Bay	T+T+KSM	7.5	-2.5
7	Xeo Nhao	T+T+KSM	20.0	-3.0
8	Thuong Luong	T+T+KSM	5.0	-2.5

No.	Names of sluice gates	Mission	Status of sluice gates	
			Width B (m)	Bottom
9	Ro Ghe	T+T+KSM	10.0	-2.5

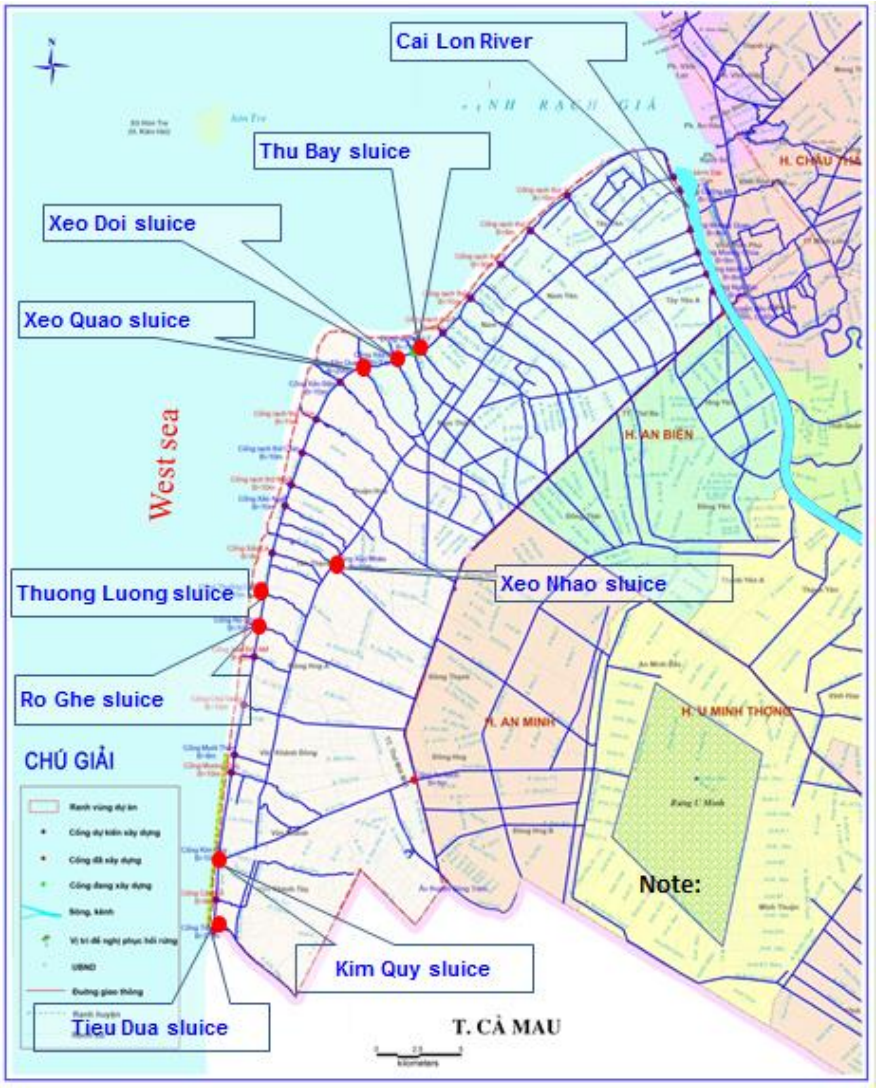


Figure 23: The 9 curent sluice gates in the subproject area

e). The system of on-farm works

The onfarm draining system includes the following items: secondary – tertiary canals, embankments, temporary low earth dams and culverts. A temporary dam is a small and low earth dyke that built across the channel by local authority or people to keep freshwater for production during dry season (*Table 43*, *Figure 24* and *Figure 25*).

Table 43: The Annual status of temporary dams

Items		2010-2011	2011-2012	2012-2013	2013-2014
Number of temporary dams	An Bien District	34	34	36	36
	An Minh District	18	18	24	22
	U Minh District	6	6	6	6
	Total	58	58	66	64
The soil volume for dam filling (m^3)		26,100	26,100	29,700	28,800

Cost (million VND)	1,996	2,548	2,586	3,071

Figure 24: Temporary earth dam on Thu Chin canal

Figure 25: Location of temporary earth dams on the canals connect to the West sea

2.2.2.2. The stage of tidal surges and saltwater intrusion

According to the reports on the Dry-season Salinization Survey Program in 2011-2012-2013 by the Irrigation Department of Kien Giang province, the typical evolutions of saltwater intrusion are as follows: saltwater appears in early January and disappears in mid-May. The saltwater margin of 4 g/l comes as long as 8 - 30km. In dry season, saltwater enters into such large river estuaries where sluice gates are not built as Cai Lon river, Cai Be river, Cai Gao canal. It follows tidal surges, so in ebb tides the saltwater concentration decreases respectively. In recent years the saltwater intrusion occurs in the large rivers only. In the canals that flow to the sea, except some sluice gates which were built, the local government annually costs hundreds of temporary dams nearly 4 billion VND/year to control the intrusion of saltwater in the subproject area.

Under the measurements and evaluations by the Southern Institute of Water Resources Research, the western inland of Xeo Ro – Can Gao canals in An Bien and An Minh, Tan Hiep districts is regularly infiltrated by saltwater intrusion where during dry seasons the average medium salinity reaches 18‰ in many areas of the province, even in somewhere it is measured 25‰. In particular, between 16 and 21/02/2011, saltwater encroached into many other areas in the province due to surge tide, which negatively impacts the agricultural irrigation, including rice and vegetables other crops (*Figure 26*).

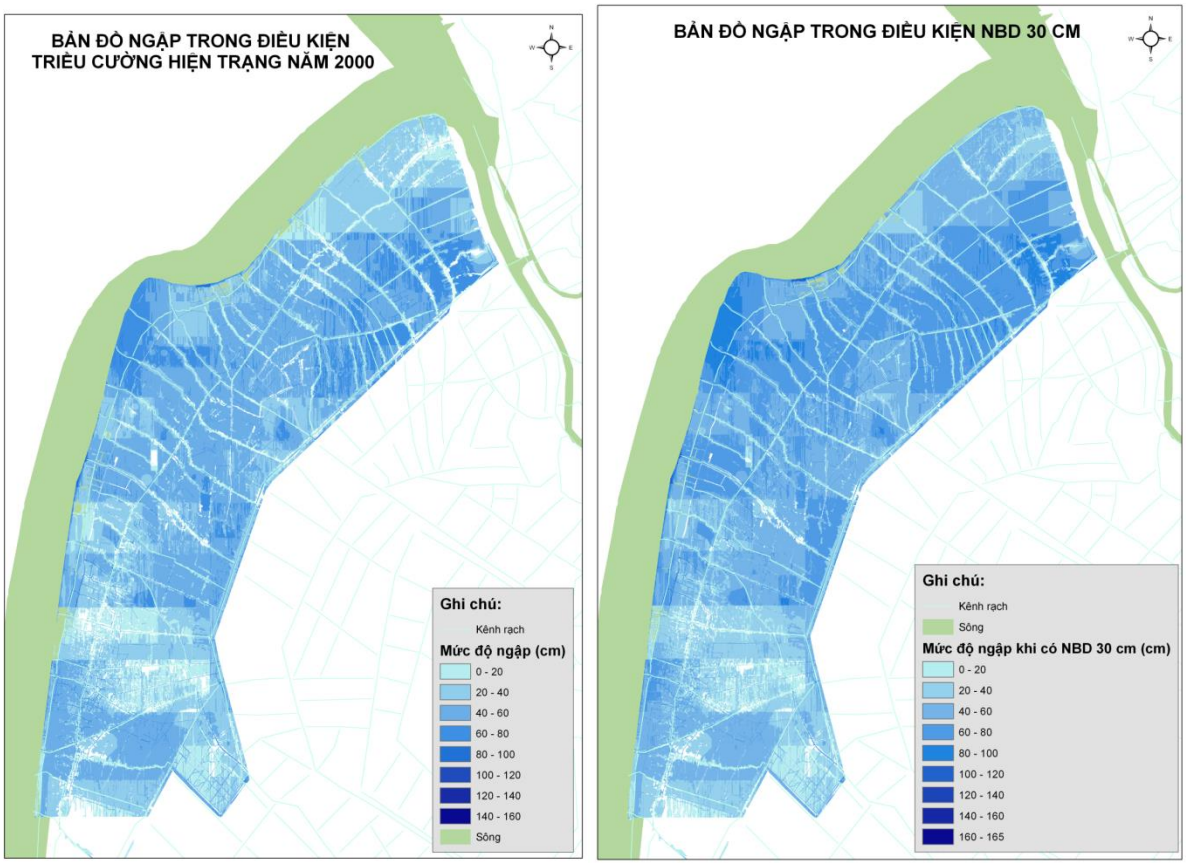


Figure 26: The flooding map in tidal conditions and in sea level rise conditions of 30cm.

Especially, in dry seasons when the sunny drought prolongs, the salinity intrusion appears along Cai Lon river, Cai Be river, via Xeo Ro – Can Gao canals; on Ca Mau direction it flows along Trem river, Cai Tau River; and on Bac Lieu direction, it flows along Chu Chi canal, Vinh Phong canal, Cho Hoi canal. In some years, the subporject area was entirely full of saline water. The failure to keep fresh water in dry seasons leads to the water shortage for

summer crop, which delays the seasonal cultivation (waiting rains to come) and upsets the agricultural production plans and seasonal calendar of Kien Giang province. *Table 44,Table 45* and *Figure 27*indicatate rice crop losses in An Minh district in 2015.

Table 44: The summary of seasonal rice crop losses in saline shrimp land in An Minh district in 2015 (as of 30/11/2015)

No.	Communes, Town	Cultivation area (ha)				The damagedarea (ha)	
		Planed	Transplanting	Sowing	Total	70-100%	30-100%
1	Thuan Hoa	1900	477	525	1002	820.0	182.1
2	Tan Thanh	1400	580	405	985	237.2	315.0
3	Dong Hung A	1000	558	73	631	568.0	63.0
4	Van Khanh	1787	630	31	661.3	312.1	168.0
5	Van Khanh Dong	1300	486	140	625	131.7	493.7
6	Van Khanh Tay	900	496	137	633	170.4	185.0
7	Dong Hoa	6591	2220	5030	7250	2,145	800.0
8	Dong Thanh	4510	3185	1305	4490	195.4	4.000.0
9	Dong Hung	4500	3648	809	4457	500.0	1.200.0
10	Dong Hung B	4382	5164	70	5234	397.0	680.0
11	Thu 11 town	730	650	160	810	215.4	250,0
	Total	**29,000**	**18,093**	**8,685**	**26,778**	**5,692.2**	**8,336.8**

Table 45: The monitoring table of the seasonal crops in 2015-2016 in An Bien district

No.	**Communes**	**Plan**			**Implement**			
		Area (ha)	**Yield (ton/ha)**	**Production (ton)**	**The sowingarea (ha)**	**The damagedarea(ha)**		
						Total	**30-70%**	**>70%**
1	Tay Yen	295	4.78	1,410	498.21	99.00	24.9	74.10
2	Tay Yen A	225	6.22	1,400	482.40	0.00	0	0.00
3	Nam Yen	3,000	4.27	12,815	2,357.63	927.85	158.7	769.15
4	Nam Thai	2,360	6.18	14,580	1,114.29	476.60	476.6	
5	Nam Thai A	2,450	5.98	14,650	1,200.00	626.00	360	266.00
6	Dong Thai	1,345	5.49	7,390	1,394.00	672.00		672.00
7	Hung Yen				358.00	0.00		
8	Dong Yen				233.00	0.00		
	Total	**9,675**	**5,40**	**52,245**	**7,637.53**	**2,801.45**	**1,020.20**	**1,781.25**

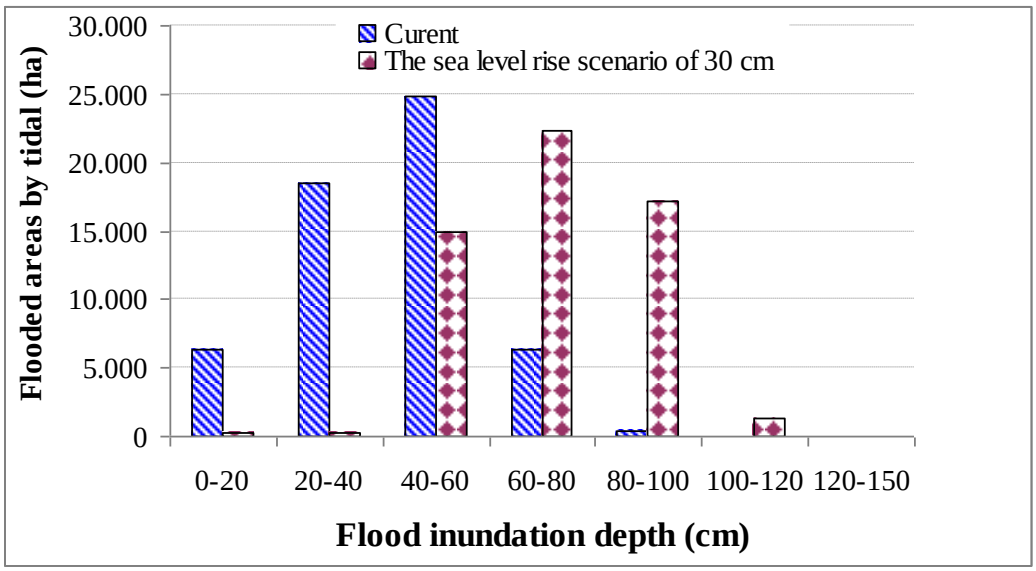


Figure 27: The flooded areas in tidal conditions and in sea level rise conditions of 30cm in 2000.

2.2.3. Current livelihood models

Features of the water in the subproject areas have changed remarkably over time in the current years; therefore, in the region, there are more production models (*Figure 28*).

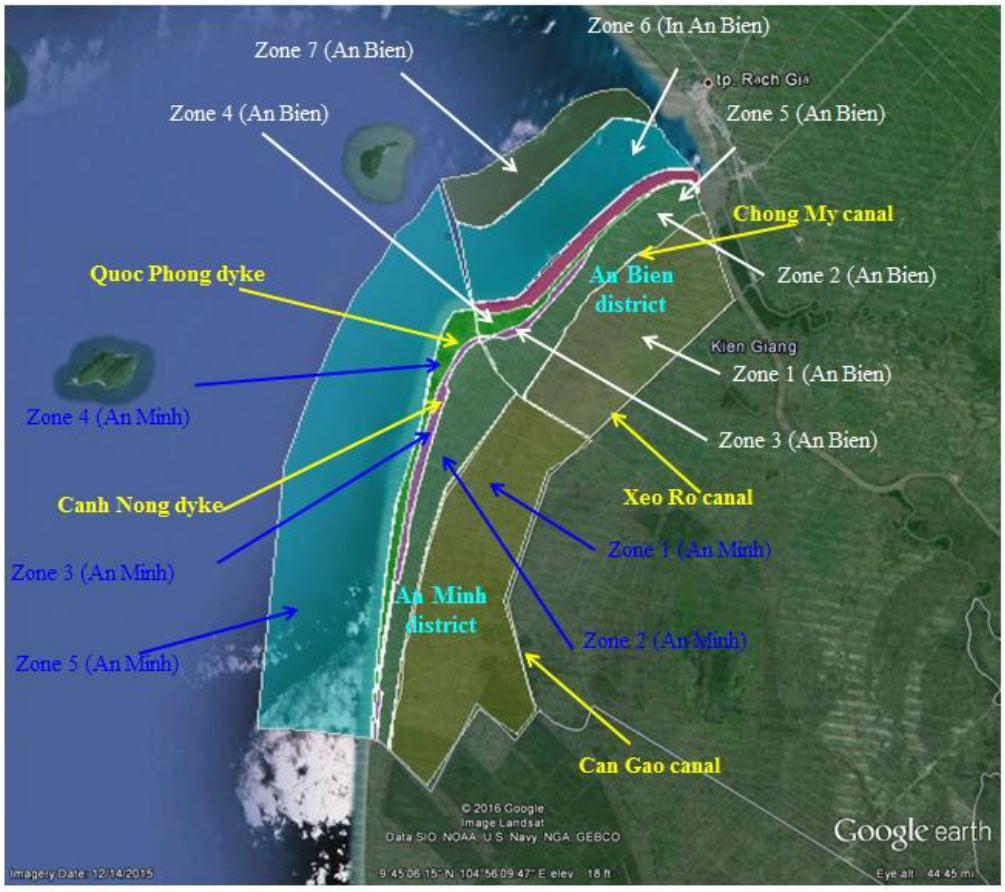


Figure 28: Curent production zone in the subproject

2.2.3.1. Existing livelihoods/farming systems in the subproject area

a). An Bien district

An Bien area can be divided into 7 subproject zones from land toward the sea (*Table 46*):

Table 46: Existing livelihoods/farming systems in An Bien district

Zone	Location	Farming system/livelihoods	Notes
Zone 1	Xeo Ro canal-Chong My dyke	- Double rice cropping - Alternating rice-shrimp - Freshwater aquaculture - Freshwater capture fisheries	A mosaic of farming systems
Zone 2	Chong My dyke-Canh Nong dyke	- Alternating shrimp-rice - Saline crab aquaculture - Saline water capture fisheries	
Zone 3	Canh Nong-Quoc Phong dyke	- Year round Improved Extensive shrimp - Saline water capture fisheries in the canals	There are several first intensive shrimp ponds near the Quoc Phong dyke, on the inside.
Zone 4	Quoc Phong dyke-end of mangrove forest	Forest-Aquaculture.	Here small bunds and ponds are built in the forest for recruitment of wild stocks of aquatic species. Forty percent of the total forest area is used for extensive forest-aquaculture farming and the remaining 60% is planted with mangroves (Avicennia, Aegiceras, and Brugiera)
Zone 5	1-km from end of forest outward.	Bare land	There is a 1-km wide stretch of bare land along the coast from the end of the forest outward. This area is not vegetated because of the daily fluctuation of tidal water. The tidal flat is exposed at low tides and inundated at high tides.
Zone 6	5-6 km of mud flat extending from the end of the bare land stretch outward.	Blood cockles and clam.	The mud flat is allocated to households who are contracted for forest management.
Zone 7	10-km of nearshore turbid sea water loaded with sediment	Capture fisheries	

Source: IUCN 2015, Kien Giang field report 1

b). An Minh district

An Minh area can be divided into 5 subproject zones from land toward the sea *Table 47*:

Table 47: Existing livelihoods/farming systems in An Minh district

Zone	Location	Farming system	Notes
Zone 1	Xeo Ro-Chong My	- Double rice cropping - Alternating Rice-Shrimp - Freshwater aquaculture - Freshwater capture fisheries	
Zone 2	Chong My-De Cap 2 (Canh Nong)	- Alternating Rice-Shrimp - Saline Crab Aquaculture - Saline capture fisheries	
Zone 3	De Cap 2-Quoc Phong	- Improved extensive shrimp - Double rice cropping - Saline water capture fisheries in the canals	A mosaic of farming system In some places, rice extends all the way to the Quoc Phong dyke.
Zone 4	Quoc Phong-end of forest	- A 300-m thick stretch of forest	50% of the land is used for recruiting wild stocks of shrimps and crabs.
Zone 5	Sea water	- Capture fisheries	Turbid water loaded with sediment. There is no traditional tidal flat or mud flat in this area. The slope is very steep in this area.

Source: IUCN 2015, Kien Giang field report 1

The difference between An Bien district area and An Minh district area is that the coastal area in An Bien receives a large sediment load from the Cai Lon and Cai Be rivers. The coast in An Minh district does not have a mud flat and the water is deep. The forest belt in An Minh is very narrow, subject to strong waves. Blood cockles cannot be farmed in this area due to lack of a mudflat. However, cockle juveniles can be captured here for sale to An Bien area during breeding season in June.

2.2.3.2. The status of production models in the subproject area

a). Double rice cropping (zone 1) (Interview with farmers)

- First crop of rice in the dry season: 2.4 tons/ha
- Second crop of rice in the rainy season: 5.0 tons/ha
- Average of the 2 crops: 3.9 tons/ha

The agriculture production report from An Minh district provides the following figures for the first 9 months in 2015 for the different zones. No data is available from An Bien district.

b). The Alternating Rice-Shrimp Zone

Black tiger shrimp: The total area stocked with black tiger shrimp is 39,678 ha, an increase of 3.8% compared to last year. Crab is also added to the system in 38,582 ha at an average yield of 0.22 tons/ha.

c). Intensive shrimp

There is a total of 20.5 ha of intensive shrimp in the area practicing 2 crops of shrimp per year. The average yield of the first crop is 4.6 tons/ha. The second crop has been stocked.

d). Double extensive aquaculture (shrimp and fish) cropping

There is a total of 7,053 ha, exceeding the plan by 19%. Of which, 4,000 ha are stocked with black tiger shrimp, 1,591 ha crab, 930 ha blood cockle. The average yield of black tiger shrimp is 0.25 ton/ha, crab 0.16 tons/ha, blood cockle 3.3 tons/ha.

e). Mangrove-aquaculture

There is a total of 3,874 ha of mangrove-aquaculture including 1,750 ha of black tiger shrimp, 1,500 ha of crab, and 624 of blood cockle. The average yield of shrimp is 0.13 tons/ha; crab 0.1 tons/ha, blood cockle 2.4 tons/ha.

f). Mud flat

A total of 1,054 ha out of 3,220 ha allocated is being used for stocking various varieties of bivalves at an average yield of 1.41 tons/ha.

2.2.4. Social conditions

2.2.4.1. Economic livelihood

According to the 2014 statistics, the subproject area has 156,696 people in total. The total population in 2 districts includes 243,079 people. The population density is 256 people/km2. Kinh people account for 91.08% , Khmer people account for 6.51% and other ethnic groups. The urban population accounts for 7.69% and the rural population accounts for 92.31%. By gender: the male population includes 123,708 people, accounting for 50.89% and the female population includes 119,371 people, accounting for 49.11%. The regional population distribution is uneven and typically as follows (*Table 48*):

- Most population in the project area concentrates in rural areas and in the 3rd and the 11th towns (Thu Muoi Mot and Thu Ba towns).
- The populationdensity remains low and is not evenly distributed, which mostly concentrates along major routes as Cai Lon River, Can Gao canal, Chong My canal, Thu Nhat canal, Thu Ba canal, Xeo Quao canal, Xeo Nhao canal etc. A few are scattered along small canals and the west coast. Some farmers are encroaching dike and dike safety corridor to build houses and do farming which severely violate the dike safety.

Table 48: The distribution of population in 2 districts: An Bien - An Minh in 2014

No.	Administrative Unit	Status		
		Population (persons)	**Natural area (km^2)**	**Density (people/km^2)**
1	An Bien District	125,196	400.29	313
2	An Minh District	117,883	590.50	200
	Total	**243,079**	**990.79**	**256**

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

a). The population features

The population at the working age in 2014 was 157,937 people, accounting for 64.97% of the total population. The labor force is abundant but majors in the agricultural sector. Workers are unskilled and untrained with low qualifications.

Generally, the number of workers engaged in the economic – social fields in the project area is not appropriate, particularly in the agricultural production. Due to the seasonal crops, the unemployment and low labor productivity remains. The labor force is abundant but the proportion of trained workers is not high. The unemployment of the newly graduates is one of the urgent issues to be addressed, especially in the slow economic transformation and the labor structure is unbalanced which severely depend on agriculture, forestry and fishery. The undeveloped industry, handicrafts, trade and services have been greatly limitations to the fully exploitation of human resources in the districts. In the future, the training to improve labor quality, labor skills must be more concerned to respond to the industrialization and modernization.

b). People's life

In recent years, the economy has prospered. The economies of two districts in the project area have many positive changes and significant achievements on many fronts. The infrastructure continues growing as transport, irrigation, schools, hospitals and cultural and welfare facilities. The material spirit life of the people is increasingly high.

The per capita income in 2014 reaches 20.66 million VND/year. So far the poverty, close-to-poor rates in two project districts are high. There are 3,808 poor households, accounting for 6.48% of all households in the whole region, and 4403 close-to-poor households, accounting for 7.49%, which concentrate in the communes: Nam Thai A; Nam Thai; Nam Yen; Dong Yen, Dong Thai (An Bien district): Thuan Hoa; Dong Hung A; Dong Hung B; Van Khanh, Van Khanh Dong (An Minh district).

There is the positive change in the regional economic structure. The proportion of industry, services and tourism increases and the agricultural sector decreases. But now in the subproject area, the per capita income remains low due to the high poverty rate.

2.2.4.2. Education and training

The project area has 79 schools with the total of 1,613 classes including primary schools, secondary schools, high schools (*Table 49*). The number of schools and teachers is increasing. However, schools are not stable due to the difficult economic and social conditions (*Table 50*).

Table 49: The statistics of universal schools

Years	**An Bien**			**An Minh**			**Total schools**
	Primary school	Secondary school	High school	Primary school	Secondary school	High school	
2011-2012	25	9	1	28	12	3	78
2012-2013	25	9	1	28	12	3	78
2013-2014	25	9	1	28	12	3	78
2014-2015	25	10	1	28	12	3	79

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

Table 50: The statistics of universal classrooms

Years	An Bien			An Minh			Total classes
	Primary school	***Secondary school***	***High school***	***Primary school***	***Secondary school***	***High school***	
2011-2012	557	158	37	614	172	43	1581
2012-2013	556	160	36	608	178	48	1586
2013-2014	566	167	36	612	186	48	1615
2014-2015	560	168	38	608	192	47	1613

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

2.2.4.3. Healthcare

In each district, there are district hospital and the belonging health stations or clinics (including the health stations of the communes, offices, factories). The whole region has 22 health stations but they are not supplied enough with equipment and manpower. The equipment are lack and outdated.

2.2.4.4. The infrastructure status

a). Electricity status

Currently the power line passes the subproject area, therefore there is electricity for construction and living (*Table 51*).

Table 51: The rate of households using electricity in two districts of An Bien and An Minh

Administrative	Unit	2011	2012	2013	2014
An Bien District	%	98.94	99.01	99.04	99.06
An Minh District	%	99.17	99.27	99.34	99.45

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

b). The rural status of fresh water

Currently in the province the majority of people use drinking water from 03 sources: rainwater, well water and tap water (*Table 51*). They often use rain water in rainy seasons and groundwater in dry seasons. Groundwater at 80-100m deep contains little alkaline, so people have to let groundwater deposited before use and most households have drilled wells.

The water supply in the subproject area has improved significantly over the years regardless of the low proportion of water use compared to the Mekong Delta provinces, which becomes a major challenge, especially for the poor.

Table 52: The rate of households using frest water in two districts of An Bien and An Minh

Administrative	Unit	2011	2012	2013	2014
An Bien District	%	97.82	98.18	98.30	98.60
An Minh District	%	38.57	39.03	41.34	45.31

Source: The 2014 Statistical Yearbook of An Bien, An Minh districts

2.3. Some typical features of the locations of the nine sluice gates to be constructed

2.3.1. Thu Nhat sluice gate

Thu Nhat sluice will be built on the Thu Nhat canal (*Figure 29*). The sluice gate's width is 10 meters, connecting two sides of the sea dikes. The sluice gate is located at a distance of approximately 230 m away from the estuary, 160m away from the mangrove forest belt. At the sluice gate construction location, Thu Nhat canal is with a width of approximately 20 m, however, it has permanent earth dykes to protect the agriculture and aquaculture production in the inner side.

There are not many people living in this area. In a radius of about 50 meters, there are some households living on the dike near the sluice gate's location.

The sluice gate will be built entirely on the channel, the bridge over the slusce will be built on the sea dike, therefore it should not seem to have any affect on people due to clearance and land acquisition.

To the Quoc Phong channel side, there is Tay Yen primary school which is 80 m away from the sluice gate construction location. Farther distance there is Tay Yen church which is 250 m away from the sluice gate construction location.

Rice farming and aquaculture activities: The inner location of the sluice gate, it is 2-crop rice production per year. The outer location of the sluice gate, it is the forest shrimp aquaculture farming where people take water directly from the sea along the Western beach.

Figure 29: Location of Thu Nhat sluice

2.3.2. Thu Hai Sluice gate

Sluice gate will be built on Thu Hai canal, at the intersection with West sea dyke area (*Figure 30*). The sluice gate will be built with the width of 8m, and it's 110m away from the mangrove forest belt, a 220m away from the channel gates. The channel section to build the sluice gate has the width of about 14m; however it has permanent earth dyke to protect the harvest production in the inner side.

The residential people density in the sluice gate construction regions is few. Within a radius of 100 meters from the building location of the sluice gate, there are only a few residential households living inside the dike, which are separated by channels along the Quoc Phong dyke. At the location of sluice gate construction, there is not any household living.

The sluice gate will be built entirely on the channel, the bridge will be built on the sea dike therefore it should not seem to have any affect on the residential people much.

Rice farming and aquaculture activities: The inner field is mainly shrimp - rice and 2-crop rice production per year. The outer location of the sluice gate, it is the forest shrimp aquaculture harvest where people take water directly from the sea along the West sea.

Figure 30: Location of Thu Hai sluice

2.3.3. Thu Ba Sluice gate

Sluice gate will be built on Thu Ba canal, at the intersection with West sea dyke area (*Figure 31*). The sluice gate is built with the width of 30m, and it's 270m away from the mangrove forest belt, a 290m away from the canal gates. The canal section to build the sluice gate has the width of about 70m.

The residential people density in the sluice gate construction regions is few and concentrated mainly in the head of channel. Within a radius of 50 meters from the building location of the sluice gate, there are 3 households living.

The sluice gate will be built entirely on the channel, the bridge will be built on the sea dike therefore it should not seem to have any affect on the residential people much.

There are not any physical cultural resources, public and religious structures located within or in close proximity to the subproject areas and can not be affected by the subproject activities.

Rice farming and aquaculture activities: The outer location of the sluice gate, it is the forest shrimp aquaculture harvest production; while the inner location of the sluice gate, people have extensive shrimp aquaculture harvest production.

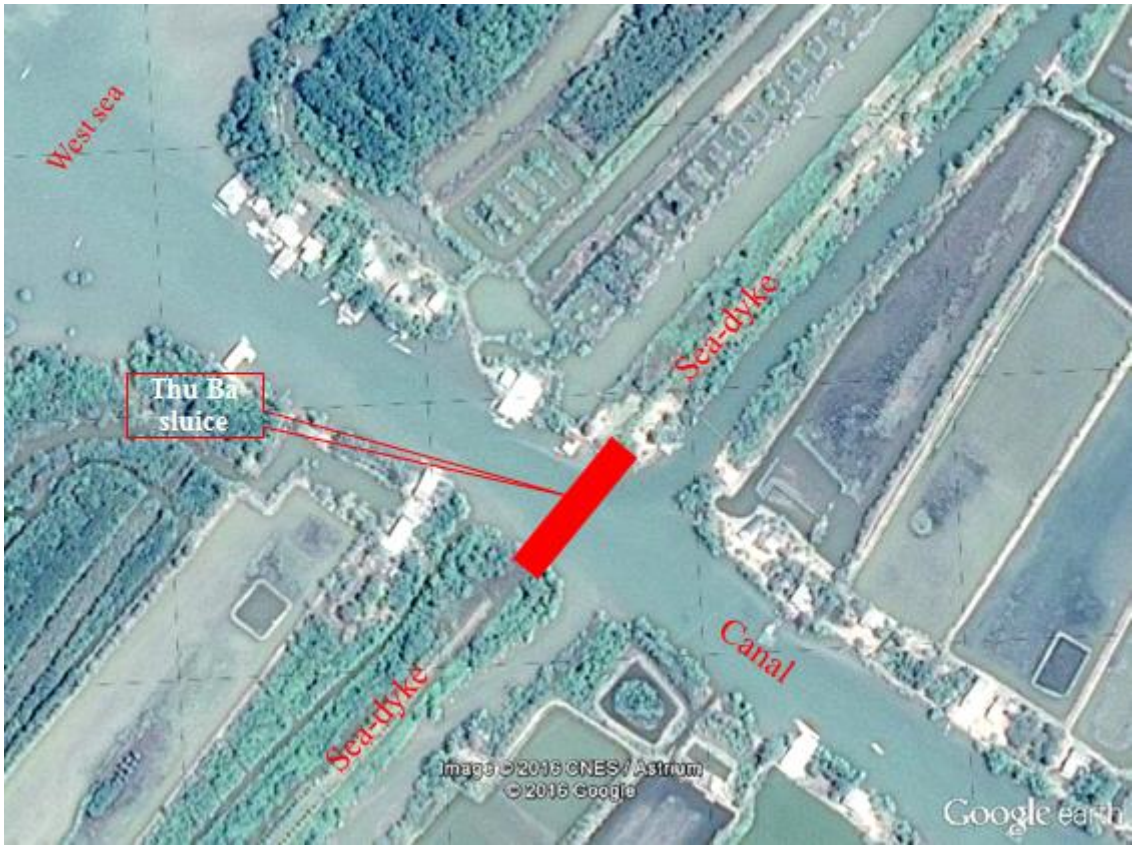


Figure 31: Location of Thu Ba sluice

2.3.4. Thu Nam Sluice gate

Sluice gate will be built on Thu Nam canal, at the intersection with West sea dyke area (*Figure 32*). The sluice gate is built with the width of 20m, and it's 160m away from the mangrove forest belt, a 240m away from the canal gates. The canal section to build the sluice gate has the width of about 30m.

The residential people density in the sluice gate construction regions is few and concentrated mainly in the inner dikes, which are separated by channels along the Quoc Phong dyke. Within a radius of 50 meters from the building location of the sluice gate, there are only a household living.

The sluice gate will be built entirely on the channel, the bridgewill be built on the sea dike therefore it should not seem to have any affect on the residential people much.

There are not any cultural works, public and religious near sluice location.

Rice farming and aquaculture activities: The outer location of the sluice gate, it is the forest shrimp aquaculture harvest production, using directly water from West sea; while the inner location of the sluice gate, people have extensive shrimp aquaculture harvest production.

Figure 32: Location of Thu Nam sluice

2.3.5. Thu Sau Sluice gate

Sluice gate will be built on Thu Sau canal, at the intersection with West sea dyke area (*Figure 33*). The sluice gate is built with the width of 30m, and it's 420m away from the mangrove forest belt, a 650m away from the canal estuary. The canal section to build the sluice gate has the width of about 88m.

Within a radius of 50 meters from the building location of the sluice gate,there is not any household living.

The sluice gate will be built entirely on the channel, the bridgewill be built on the sea dike; therefore it should not seem to have much affect on the residential people.

There are not any cultural works, public and religious near sluice location.

The outer location of the sluice gate, it is the forest shrimp aquaculture harvest production, using directly water from West sea; while the inner location of the sluice gate, people have extensive shrimp aquaculture harvest production. There is a household intensive shrimp farming with area of 2,36ha near sluice gate location with distance is 180m.

Figure 33: Location of Thu Sau sluice

2.3.6. Xeo Ban Sluice gate

Sluice gate will be built on Xeo Ban canal, at the intersection with West sea dyke area (*Figure 34*). The sluice gate is built with the width of 10m, and it's 1.78km away from the mangove forest belt. The canal section to build the sluice gate has the width of about 50m.

Residential areas are concentrated mainly in the inner dikes and separated by channel along Quoc Phong dyke with a width of 35m. Within a radius of 50 meters from the building location of the sluice gate, there is only a household living on the dyke.

The sluice gate will be built entirely on the channel, the bridge will be built on the sea dike; therefore it should not seem to have much affect on the residential people.

There are not any cultural works, public and religious near sluice location.

Harvest production activities: Inside and outside the sluice gate, residential people mostly harvest the extensive shrimp aquaculture farming, usising water sources from the West sea.

2.3.7. Thu Tam Sluice gate

The sluice gate will be built on Thu Tam canal with the width of 15m (*Figure 35*). The location of the sluice gate is 1.25km away from the western sea where there is no forest belt. The width of the canal at the construction location is 45m.

Within a radius of 50 meters from the sluice gate construction location, there are only 2 households living.

The sluice gate will be built entirely on the channel, the bridge will be built on the sea dike so the clearance and land acquisition to build the sluice gate is very few.

There are not any cultural works, public and religious near sluice location.

Rice farming and aquaculture activities: Inside and outside the sluice gate, residential people mostly harvest the extensive shrimp aquaculture farming.

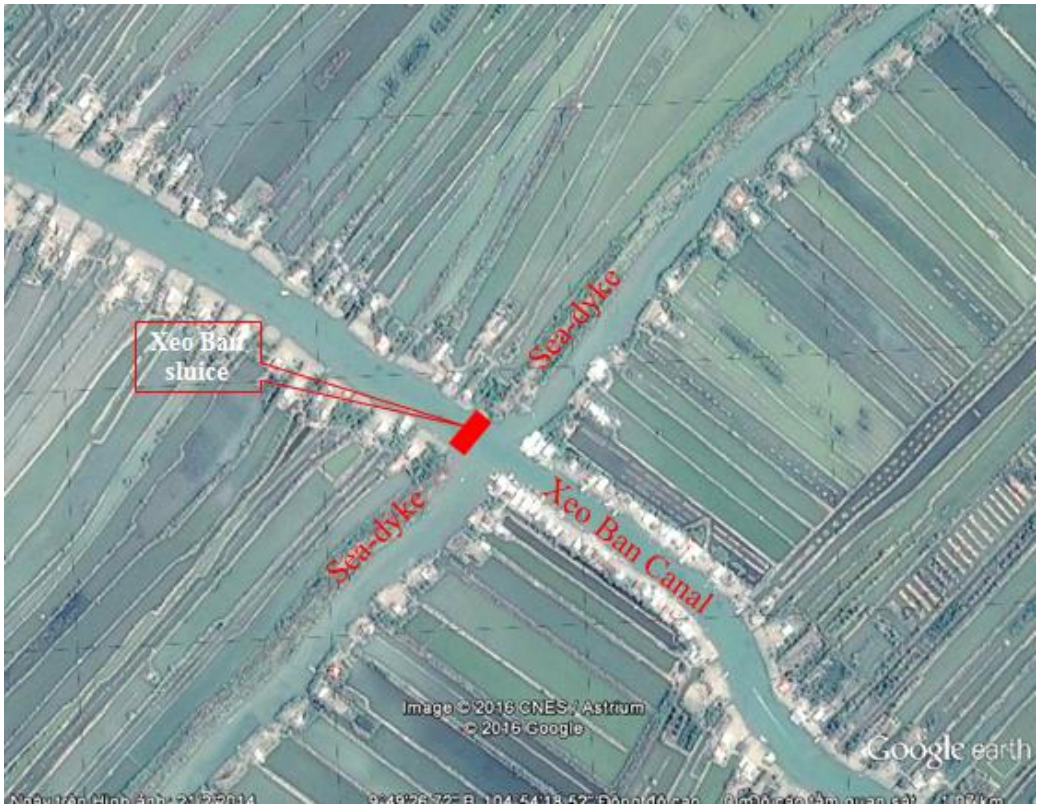


Figure 34: Location of Xeo Ban sluice

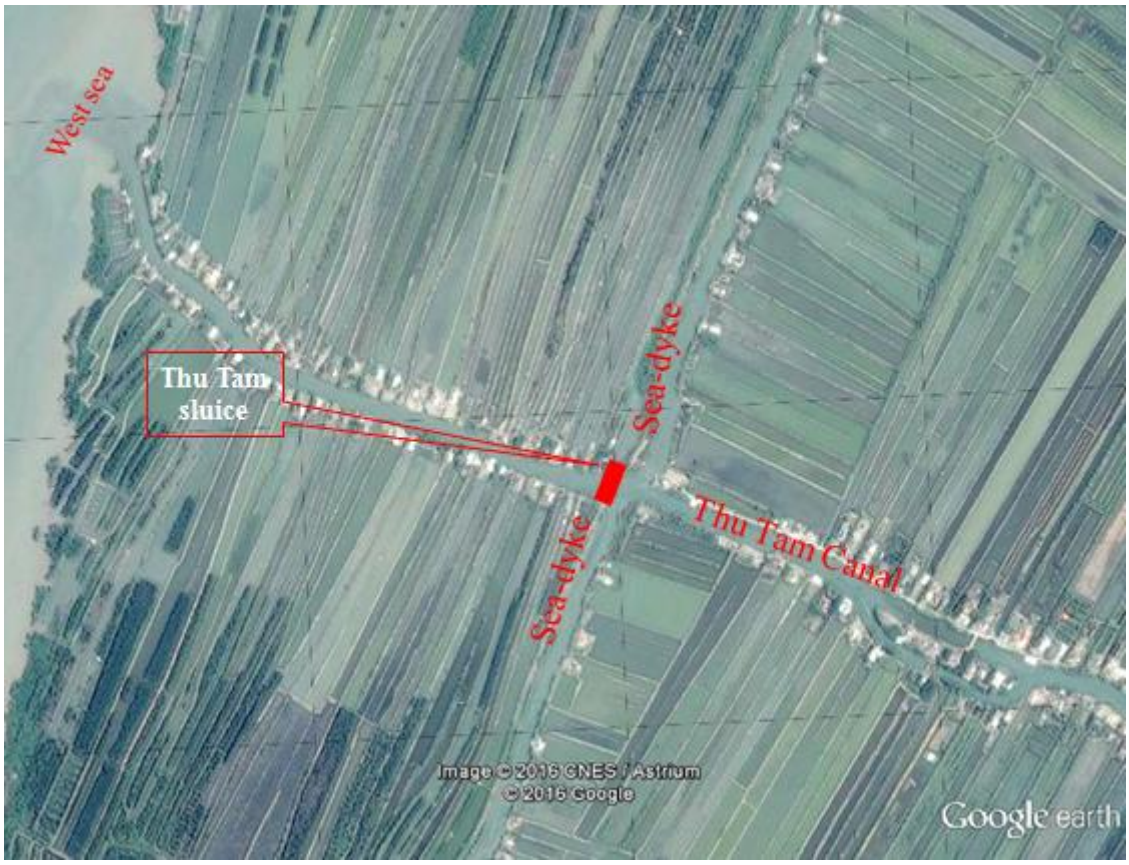


Figure 35: Location of Thu Tam sluice

2.3.8. Thu Chin Sluice gate

The sluice gate will be built on Thu Chin canal with the width of 10m (*Figure 36*). The location of the sluice gate is 500m away from the western sea.

The residential people density in the sluice gate construction regions is few. Within 50 meters from the sewer location, there are only 4 households living.

At the same time, the sluice gate will be built entirely on the channel, the bridge will be built on the sea dike so the clearance and land acquisition to build the sluice gate is negligible.

There are not any cultural works, public and religious near sluice location.

Rice farming and aquaculture activities: Inside the sluice gate, residential people mostly harvest the extensive shrimp aquaculture farming. Outside the dike, at the channel's gate location, people gradually changed from forest shrimp aquaculture farming to extensive shrimp aquaculture farming.

Figure 36: Location of Thu Chin sluice

2.3.9. Thu Muoi Sluice gate

The sluice gate will be built on Thu Muoi canal with the width of 10m (*Figure 37*). The location of the sluice gate is 310m away from the western sea where there is no forest belt. The width of the canal at the construction location is 35m. The location of the sluice gate is 800m away from the temperary earth dam on Thu Muoi canal.

The residential people density in the sluice gate construction regions is few and concentrated mainly in the inner dikes, which are separated by channels along the Quoc Phong dyke. Within

a radius of 50 meters from the building location of the sluice gate, there are only 2 households living.

At the same time, the sluice gate will be built entirely on the channel, the bridge will be built on the sea dike so the clearance and land acquisition to build the sluice gate is negligible.

There are not any cultural works, public and religious near sluice location.

Rice farming and aquaculture activities: The outer location of the sluice gate, it is the forest shrimp aquaculture harvest production; while the inner location of the sluice gate, people have extensive shrimp aquaculture harvest production.

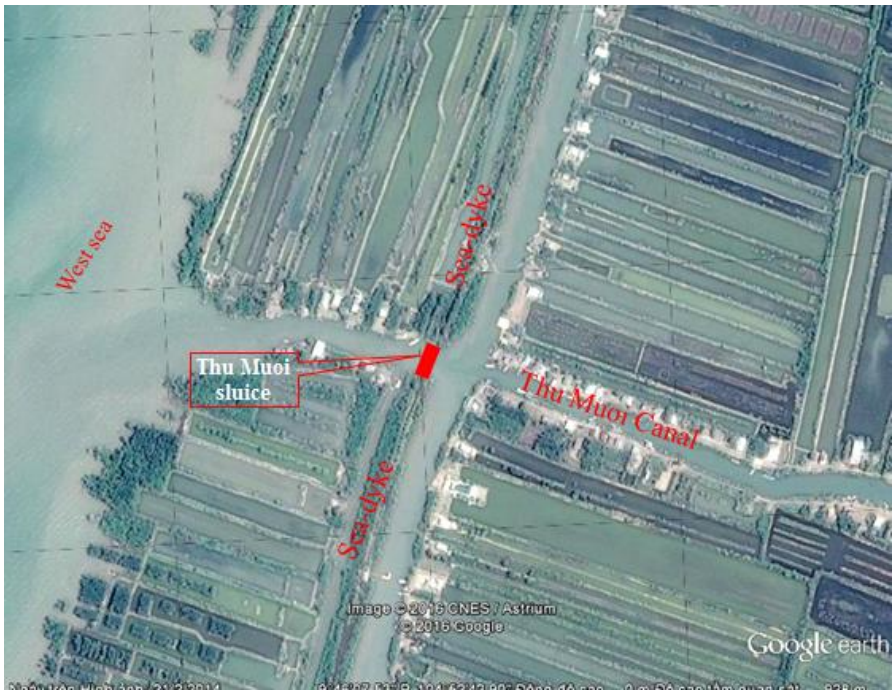


Figure 37: Location of Thu Muoi sluice

2.4. Description of mangrove forest restoration

Coastal protection mangrove forest will be restored and recovered with the area of 150ha, stretching from Rach Dua channel area to Muoi Than channel with the length of about 10km (*Figure 38*). This area is currently eroded very quickly and currently has no primary forest belt. The remaining forest belt is very thin and sparse with only 150-200m, where the residential people combine aquaculture production activities under the forest canopy.

Figure 38: Location of the restoration area of 150ha coastal mangroves

CHAPER 3. ANALYSIS OF ALTERNATIVES

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 (the Project) for the estuary and coastal 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 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 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 4 of the 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 installing water/salinity control structures in the estuary and peninsula.

- The subproject involve the construction/ rehabilitation of coastal dikes in erosion areas and the modification of water control infrastructure along the coastal zone to adapt to changing salinity levels. High historic rates of coastal erosion in Kien Giang which are projected to continue increasing indicate that the business-as-usual approach to coastal protection is not working and a new approach is needed to protect coastlines, ecosystems and valuable agriculture and aquaculture areas.
- The traditional approach to protecting the coastline in Vietnam consists of constructing sea dikes, many of them armed with rocks and/or concrete. Previously, water control infrastructure was constructed in coastal provinces to control salinity intrusion into the estuaries. 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. Where sluices exist, this creates conflicts between the freshwater needs of agriculture and the brackish water needs for aquaculture. To manage conflicting water uses zones will need to be established for saline, brackish and freshwater farming areas. The operation of sluices and farming zones would need to be flexible to consider salinity intrusion in wet, average, dry years and future sea level rise.

- Recently, the function of salinity-control structures has been modified from a control oriented to adaption-oriented approach. For instance, shrimp culture relying on saline water in the dry season is followed by rice culture depending on rainwater in the wet season through proper adjustments in the design and operation of existing water structures and additional investments in small-scale infrastructure. The MD-ICRSL project (the Project) builds on this approach and the infrastructure will support the transition to more sustainable brackish water activities such as mangrove-shrimp, rice shrimp and other aquaculture activities, adapting to further challenges of salinity intrusion.
- The issue of surface water quality and operation of sluices needs to be managed. Surface water pollution comes from the residues of agro-chemicals (i.e. pesticides and fertilisers) and organic matter from agriculture and aquaculture when flushing water from canals and embankments. Potential impacts would be mainly local, and mitigation measures can be implemented at the subproject level. The operation of sluices also needs to consider the impacts to local waterway transportation for fishers and farmers. The operating rules of sluice gates should be developed in consultation with all stakeholders, including local waterway users.

(b) Impacts of new 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 as households 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 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. fertilisers, 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.
- The Project would support a study contributing to the improvement of current water management practices for shrimp aquaculture. In particular, the study would cover the following aspects: (a) developing a categorized inventory of the current farms; (b) analyzing the current use of fertilizers and antibiotics; (c) identifying areas with acute environmental issues; and (d) establishing and disseminating best practices. Wastewater treatment systems are required for aquaculture and shrimp farming to reduce surface water pollution. Increasingly, groundwater is being used an additional source of fresh water to control salinity levels in shrimp farming and enable the diversification of production into vegetables (both in rice and shrimp areas). The transition to sustainable shrimp farming will reduce groundwater abstraction.

(d) Impacts of protecting mangrove forests in coastal areas

- To adapt to saline intrusion and prevent coastal erosion in Kien Giang, 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 in 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) programme is supporting Vietnam to manage its coastal ecosystems in order to strengthen resilience to climate change.
- 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 Alternative analyses for the implementation of the subproject

The content of this part is aimed at analyzing environmental and social impacts in the context of "with" and "without" sub-projeect:

- In the context of "without" subproject: it means that all the environmental and social issues are the same as current condition, for example: fresh water supply providing for the domestic utilization is rare, high tide, saline intrusion causing damange and loss of rice crop, high concentration of saline decline the growth of shrimps, the transportation is restricted, cost for temporary dam is high, impacted by the climate change, etc
- In the context of "with" subproject: it means that the investment items of the subproject are considered, including 9 sluice gates along the West coast, planting 150ha mangrove forest, 250ha forest inside the shrimp aquacultural farm, providing domestic fresh water for 5 communes in An Bien district, and sustainable livelihood models or patterns are presented to the local residents.

Details regarding the analysis of environmental and social impacts of "with" and "without" the subproject is presented in the *Table 53*below.

Table 53: Compre the environmental and social impacts in the context of "with" and "without"subproject

No.	Issue	Options	
		"Without" subproject	**"With" subproject**
1	**Environmental aspect**		
1.1	Impact on the water source quality	Environmental pollution at the interior area of the temporary dams (it is impossible to do the water exchange when observing the pollution).	Reduce the water pollution im comparison with the temporary dams (due to the controlled sluice gate can open when pollution occurs in the field side)
1.2	Impact on the soil environment	Deacidification and washing the aluminum are difficult due to the water irrigation and drainage is not proactive	Pro-active irrigation and drainage the water therefore improve the deacidification and washing aluminum
1.3	Impact on air quality		Improve the environmental condition thanks to the more and larger forest area.
1.4	Impact on biodiversity	Temporary dams causing the separation for a long time then it restricts the movement of species inside and outside (interior and exterior) of the dams.	The controlled sluice gate only restricts the movement of species during the closing time; when the controlled sluice gate opens, the movement of species will be maintained as normal condition. The more mangrove forest area planted will be the

No.	Issue	Options	
		"Without" subproject	**"With" subproject**
			habitat, reproductive area of many natural species, this mangrove forest will also be the habitat of the bird and animals.
1.5	Response to climate change sea level rise	Sea level rise will increase the possibility and also the risk of flooding when the tide is at the peak, especially from October to December.	Proactively moderate and regulate the water source when the tide is high, control and prevent the flood due to tide.
1.6	Flooding condition	The temporary dams are not possible to operate when the rain is heavy causing partial flood due to tide.	When there is still heavy rain in the local area, actively open the sluice gate to drain the rain water.
2	**Social aspects**		
2.1	Pro-Active production	The water source regulation is dependent and positive therefore aquaculture cropping production is lost and damaged due to environmental pollution; the saline concentration is out of control or being positive.	Actively regulate water resource for aquaculture
2.2	Improve the transportation infrastructure	The road transportation is still separated by canal. The temporary dams totally restrict the water-way transportation for boats; especially the cargo boat or ships transportation could not pass through.	Connect the transportation of the coastal route. The controlled sluice gates may operate so that the boats even the cargo boats or ships can pass through
	Impacts on the waterway transportation	Significant impact on waterway traffic. Only boats passing through ports which are installed by people. Large boats/ ships can not go through.	Impact on waterway traffic when closing the sluice gates. However, all boats/ ships (large boat/ ship) can pass through when the sluice gates open.
2.3	Economic loss	The loss in agricultural production and aquacultural cultivation is huge.	Reduce the damage and loss in agricultural production and aquacultural cultivation thank to the the actively regulate of water source.

No.	Issue	Options	
		"Without" subproject	**"With" subproject**
2.4	Development of sustainable livelihood models or patterns	The production models arespontaneous, self-learning and without orientation	The production models are orientated, compliance with the planning and suitable with the water resource condition, especially match with the climate change and sea level rise condition
2.5	Protect the infrastructure and residents when having high tide	Positive in protection of the infrastructure and the residents when the tide is high.	Actively regulate the water level to protect the residents when the tide is high.
2.6	Products with better quality	The quality of the fishery products is not controlled (some aqua farmers still utilize the antibiotic, forbidden chemicals in aquaculture) which result in the redundant of the forbidden chemicals inside the products.	Organic rice crop cultivation production without herbticides; aquacultural cultivation production following VietGap model which secures the quality of the fishery products and meet the requirements for export.
2.7	Improve the competitiveness and increase the product value	The products are without brand-name/trademark therefore the price is not secured and stable; the price is low.	Develop the products brandname and trademark to improve and enhance the reputation of the product and contribute to the good price of the product, also increase the income for the producers and farmers.

3.1. Assess the selected alternatives regarding technical aspects of the subproject

When developing the subproject, the two components of development of livelihood models or patterns and the non-structural solutions have no different selection. For the component of construction of sluice gates, there are two alternatives proposed as illustrated in*Figure 39* and *Table54*:

- Alternative 1: Construction of nine sluice gates along the coastal dike An Minh – An Bien
- Alternative 2: Change the construction location of nine sluice gates from the coastal dike backto the Chong My channel system.

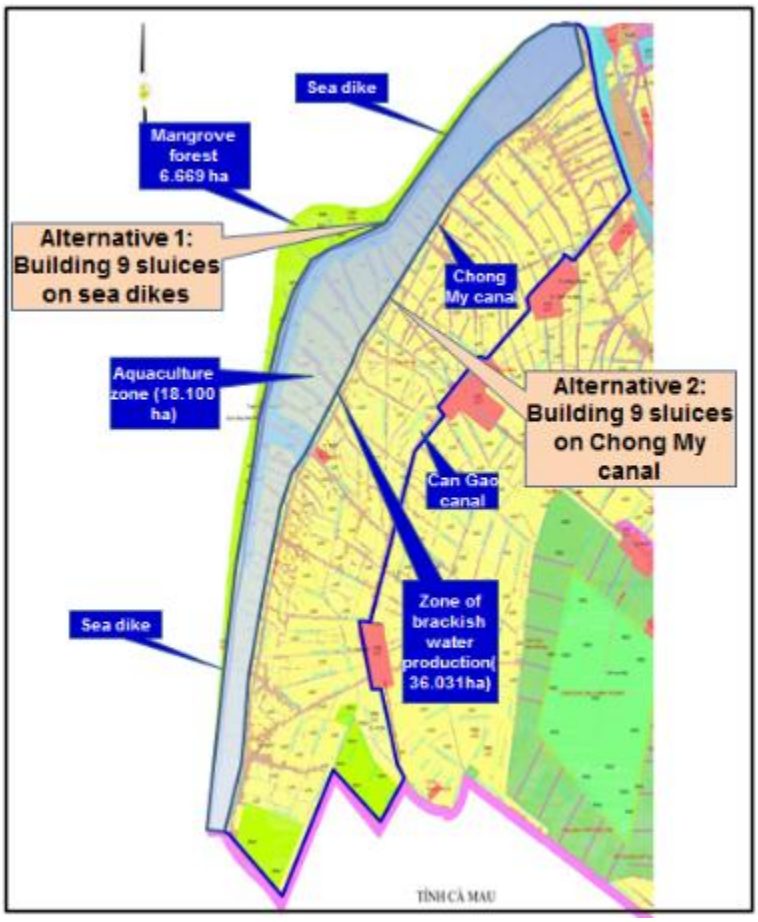


Figure 39: Options to construction the tidal prevention sluice gate system, regulate the water source

Table54:Option to construct the high tide prevention system, regulate the water source

Issues	**Alternative 1**	**Alternative 2**
The protection scope due to high tide	Possible to protect the comprehensive area inside the defense dike system 54,131ha	The production and residential activities of the area outside of Chong My channel (24,100ha) will be affected seriously when the sea level rises.
Land acquisition	The population density of this area is still low therefore the compensation cost and resettlement expense will not be much.	The population density of this area is quite high therefore the compensation cost and resettlement expense is much higher.
The stability of the structural system	If the protection of the mangrove forest is not well, then when the coastal zone is eroded, it will be the possibility and risk of impacts on the stability of the sluice gates.	Lying 2-6km away from the coastal line therefore, when the coastal zone is eroded, the possibility and risk of impacts on the sluice gate is disappeared.
Diversification of the livelihood patterns	Actively diversify the livelihood patterns thanks to the active regulate of the water source.	It is difficult to diversify the livelihood patterns outside of the Chong My channel due to positive regulate of the water source.

Issues	**Alternative 1**	**Alternative 2**
Impacts on the Socio-Economic condition	Improve the transportation of the coastal area where the transporation condition is really difficult.	Support to develop the transportation at the Chong My channel area.

In the analyse of the alternatives of sluice gates presented above, it is reflected that Alternative 1 is the selected, which is optimum regarding economic, suitable with the natural condition and have the environmental and social impacts at the acceptable level.

CHAPER 4. ANALYSIS OF ENVIRONMENTAL AND SOCIAL IMPACTS

Implementation of the subproject will also create some negative impacts (temporal and permanent impacts) on the local environment and local communities. This chapter analyzes in details the positive and negative impacts that may occur during the entire subproject implementation.

It is noted that although the potential negative impacts of works (sluice gates and protection of coastal erosion) to be conducted under Components 1 and 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 4.2.2. 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 (Componement 3). 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 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.

LowImpact (L).

- Noticeable changes for less than 2 years, significant changes for less than 6 months.
- 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 of the Subproject

4.2.1. Positive impacts on the socio-economic condition

Construction of the proposed 9 new sluices when completed, it will bring many benefits to the residents, specifically:

- Actively regulate the water source therefore the local farmers can actively arrange the farming timetable or schedule suitable with the water source condition in the region.
- Diversify the aquaculture to meet the food demand of the society, create jobs, increase the income of the local people.
- Reduce the impacts of the harzards or calamity, impacts of the climate change in the subproject area.
- Actively regulating the water source contributes to the improvement of the water environment, protect the production in condition of climate change and sea level rise.
- Improve access to road traffic condition for the coastal area.
- Increase the non-agricultural production, business based on agricultural development.
- Develop and increase the mangrove forest area to contribute to the protection of the coastal line at the same time improve the biodiversity, maintain and sustain the fishery breeds resources in the nature.
- Improve the environment thanks to the more environmental friendly production activities (VietGap model of fishery and aquaculture farming).

4.2.2. Positive impacts on the environment

- Actively deacidification and desalination, control the saline intrusion into the complete fresh production area.
- Improve significant water quality due to un-blocked water flow by constructing the temprorary dykes in dry season.
- Improve the fish migration (if have) due to un-blocked water flow by slucie operation.
- Improve the environment thanks to the more environmental friendly production activities (VietGap model of fishery and aquaculture cultivation, organic rice crop cultivation production, reduce the utilization of herbticides, fertilizer in rice crop cultivation production, etc).
- The Integrated Pest Management (IPM) and the "One Must Five Reductions" programs applied for rice – shrimp model will help to reduce pestiside and fertilizer.
- The Coastal forest will be rehabitated and extended, which is habitate for many oragnism specieces and contributes to reduce green house gas and mitigate the climate change impacts and sea level rise.

4.2.3. Positive overall impacts

- Operation of the proposed 9 sluices to be constructed under the subproject will help increase ability of Kien Giang 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 that will seriously affect 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 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. At present there are 9 existing sluices in operations while selection of the additional 9 sluices have been designed to facilitate the separation of waer supply from drainage that could be used to facilitate the demonstration of the livelihood Model 2 (shrimp farming) and Model 3 (shrimp-crab/fish farming). More details are discussed in Section 4.3
- Construction of the structure to reduce wave energy and protection of the embankment foundation (Component 2) will not only create positive impacts on deposition of sediment and plantation of mangrover forest in the target area but will also help preventing land slide 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 area.
- Implementation of the 5 livelihood models (Component 3) will enhance opportunity for the local farmers to upgrade their knowledge and experience on implementation of appropriate technology that could be friendly to the local environment as well as bring them more income. Nontheless, an appropriate training program and a social survey will have to be made to ensure that farmers have knowledge and aware of the tehnical and financial risks,while the Kien Gian 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 uncontrol development of inappropriate scalling of these models.

4.3. Potential Negative Impacts of the subproject

Based on the actual production condition of the local area, based on the natural condition, the construction schedule of the subproject and actual construction status of other subprojects' items of work, the environmental impacts may arise from the activities of the subproject are shown in *Table 55* to *Table 57*:

Table 55: Potential Negative Impacts 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 9 new sluice gates (Component 1) --see site –specific assessment in Table 56											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Protection of coastal erosion (Component 2)											
Pre-construction	N	N	N	N	N	N	N	N	N	N	N
Construction	L	L	L	N	L	N	N	N	N	L	L
Operation	N	L	L	N	N	N	N	N	N	L	L
Five livelihood models implementation (Component 3) --see site –specific assessment in Table 57											
Detailed design of the models	N	N	N	N	N	N	N	N	N	N	N
Construction of the small facilities for the models	L	M	M	N	N	N	N	N	L	L	M
Operation of the models	N	M	M	N	L	L	N	N	L	L	M

Table 56: Potential Negative Impacts of the 9 Sluice Gates (Component 1)

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 Thu Nhat (NT1)— Thu Nhat canal (20 m wide); has a permanent dam; Gate width 10m; Location -230 m away from the West sea and 160 m from forest belt; **Hot spots:** some HH living on the dyke near the site (50m radius);Tay Yen primary schools (80 m away, Tay Yen church (250m away); **Land/water uses:** inner for 2 crops rice production and outer for forest shrimp aquaculture											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Hai (TH2) – Thu Hai Canal (14 m wide); has a permanent dam; Gate width 8m; Location -220 m away from the West sea and 110 m from forest belt; **Hot spots:** no HH near the site (some HH in100 m radius); **Land/water uses:** inner for 2 crops rice production and rice shrimp and outer for forest shrimp aquaculture											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Ba (TB3) - Thu Ba Canal (70 m wide); Gate width 30m; **Location** -290 m away from the West sea and 270 m from forest belt; **Hot spots:** 3 HH near the site (50 m raddius); **Land/water uses:** inner for extensive shrimp aquaculture and outer for forest shrimp aquaculture											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Nam (TN4) -- Thu Nam Canal (30 m wide); Gate width 20m; **Location** -240 m away from the West sea and 160 m from forest belt; **Hot spots: 1** HH near the site (50 m radius); **Land/water uses:** inner for extensive shrimp aquaculture and outer for forest shrimp aquaculture											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L

Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Sau (TS5) -- Thu Sau Canal (88 m wide); Gate width 30m; **Location** -650 m away from the West sea and 420 m from forest belt; **Hot spots: 0** HH near the site (50 m radius); **Land/water uses:** inner for extensive shrimp aquaculture and outer for forest shrimp aquaculture. There is a HH with intensive shrimp farming (2.36 ha) located near the gate about 180 m away.											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Xeo Ban (XB6) – Xeo Bau Canal (50 m wide); Gate width 10m; **Location** -1,780 m from forest belt; **Hot spots: 1** HH living on the dyke near the site (50 m radius); **Land/water uses:** inner for extensive shrimp aquaculture and outer for extensive shrimp aquaculture.											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Tham (TT7)-- – Thu Tham Canal (45 m wide); Gate width 15m; **Location** -1,250 m from West sea –No forest belt; **Hot spots: 2** HH living on the dyke near the site (50 m radius); **Land/water uses:** inner and outer is extensive shrimp aquaculture.											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Chin (TC8) – **Thu Chin** Canal (xx m wide); Gate width 10m; **Location** -500 m from West sea –No forest belt; **Hot spots: 4** HH living on the dyke near the site (50 m radius); **Land/water uses:** inner is extensive shrimp aquaculture while outside is changing from forest-shrimp farming to extensive shrimp farming.											
Pre-construction	L	N	N	N	N	M	N	N	L	N	L
Construction	L	L	L	L	L	N	N	L	L	L	M
Operation	L	L	L	N	L	N	L	L	M	M	M
Construction of the Thu Muoi (TM9) -- **Thu Muoi** Canal (35 m wide); 800 m away from a temporary dam; Gate width 10m; **Location** -310 m from West sea –No forest belt; **Hot spots: 2** HH living on the dyke near the site (50 m radius); **Land/water uses:** inner is extensive shrimp aquaculture while outside is forest-shrimp farming.											

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

Table 57: Potential Negative Impacts of the 5 Livelihood Models (Component 3)

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		
Implementation of Model 1 (Raising Blood Cockle): Location: Zone 1 (outside the sea dike -mangrove belt/coastal); Apply Biosafety method (no chemicals); 3 demonstration sites (0.3 ha/site); **Production Area:** 1200 ha of which 500 ha in An Bien and 700ha in An Minh; **Production calendar:** Feeding model during Nov-July; seasonal transition from dry to rainy seas Aug-Oct;**Implementation time:** 2016-2018; in 2016 the subproject will support 100% cost of 9 ha; in 2017-2018 will support 50% cost of 1,200ha; **Profit** -100MVND/ha/year.												The subproject may support only 25%
Detailed design of the models	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	N	L	L	N	L	N	N	N	M	L	M	
Implementation of Model 2 (Mono Culture for Shrimp Zone): *Panaeus Monodon* (7 lavae/m^2); **Location:** Zone 2 (inside sea dyke –Chong May canal –Saline water); **Production:** shrimp 2 crops/year; Monodon (7 lavae/m2); 20 demonstration sites (0.3 ha/site); **Production Area:** 4,000 ha of which 1,500 ha in An Bien and 2,500 ha in An Minh; Calendar: None: **Implementation time:** 2016-2018; in 2016 the subproject will support 100% cost of 9 ha; in 2017-2018 will support 50% cost of 1200ha.; **Profit** –135 MND/ha/year.												The subproject may support only 25%
Detailed design of the models	N	N	N	N	N	N	N	N	N	N	N	Need consultation
Construction of the small facilities for the models	L	M	M	N	N	N	N	N	L	L	M	May need onfarm improvement

Operation of the models	N	S	S	N	L	L	N	N	L	L	M	
Implementation of Model 3 (Polyculture of Shrimp): *Penaeus Monodon* with crab-fish, etc; **Location:** Zone 2 (inside sea dyke –Chong May canal – Saline water); **Production:** shrimp 2 crops/year; Biosafety (no chemicals); Stocking (5 lavae/m^2); 10 demonstration sites (0.3 ha/site); **Production Area:** 1,000 ha of which 400ha in An Bien and 600ha in An Minh; Calendar: None: **Implementation time:** 2016-2018; in 2016 the subproject will support 100% cost of about 30ha; in 2017-2018 will support 50% cost of 1,000ha; **profit** -30-40MVND/Ha/Year.											The subproject may support only 25%
Detailed design of the models	N	N	N	N	N	N	N	N	N	N	N	Need consultation
Construction of the small facilities for the models	L	M	M	N	N	N	N	N	L	L	M	May need on-farm improvement
Operation of the models	N	S	S	N	L	L	N	N	L	L	M	
Implementation of Model 4 (Shrimp-Rice Culture): *Penaeus Monodon*(3-5 lavae/m^2)**; Location:** Zone 2 (inside sea dyke –Chong May canal –Brackish water); **Production:** shrimp 2 crops/year; Biosafety (no chemicals); Stocking (5 lavae/m^2); 9 demonstration sites (40 ha/site); **Production Area:** 2,000 ha of which 1,000 ha in An Bien and 1,000ha in An Minh; **Calendar:** shrimp production Jan-June (6months), salt washing July, rice cultivation Aug-Nov (4months); **Implementation time:** 2016-2018; in 2016 the subproject will support 100% cost of about 30ha; in 2017-2018 will support 50% cost of 1,000ha; **profit** is about 60MVND/ha/year.											
Detailed design of the models	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	No construction
Operation of the models	N	M	M	N	L	L	N	N	L	L	M	
Implementation of Model 5 (Poly culture Shrimp-Rice-Prawn): *Penaeus Monodon*(3-5 lavae/m^2)**; Location:**Zone 2 (inside sea dyke –Chong My canal –Brackish water); **Production:** shrimp 2 crops/year; Biosafety (no chemicals); Stocking (5 lavae/m^2); 3 demonstration sites (3ha/site); **Production Area:** 500 ha of which 300 ha in An Bien and 200ha in An Minh; **Calendar:** monodon in dry season (6 months in Jan-June), salt washing in July, and rice with Macrobrachium (3-5 lavae/m^2) in rainy season (4 months Aug-Nov); **Implementation time:** 2016-2018; in 2016 the subproject will support 100% cost of about 9ha; in 2017-2018 will support 50% cost of 500ha; **profit** is about 212MVND/ha/year.											

Detailed design of the models	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	No construction
Operation of the models	N	M	M	N	L	L	N	N	L	L	M	

4.4. Impact assessment for construction of 9 sluice gates(Component 1)

4.4.1. During pre-construction phase

4.4.1.1. Impacts due to land acquisition

To have space for constructing structures, main activities in the site pre-construction phase are mainly including: the land acquisition, compensation, site clearance and resettlement.

About 7.23ha will be permanently acquired for the construction of sluice gates and protection corridor; meanwhile the temporary land acquisition is 3.63ha (for worker camps, equipments and facilities storage areas, construction machines storage yard, construction material stock, etc) and 67 households need to be physically relocated (*Table 58*).

Table 58: Land acquisition for the subproject and the affected objects

No	Sluice gate	Permanent land acquisition (ha)	Temporary land acquisition (ha)	Corrugated house	Leaf house	Metal-roof houses	Tree
1	Thu Nhat	0.85	0.26	0	9	3	97
2	Thu Hai	0.72	0.32	1	1	0	35
3	Thu Ba	1.20	0.90	6	6	3	172
4	Thu Nam	0.64	0.21	0	0	0	107
5	Thu Sau	1.20	0.85	1	1	1	115
6	Xeo Ban	0.64	0.27	0	1	5	92
7	Thu Tam	0.60	0.31	7	7	1	92
8	Thu Chin	0.70	0.28	0	5	3	92
9	Thu Muoi	0.68	0.24	0	5	1	124
	Total	**7.23**	**3.63**	**15**	**35**	**17**	**926**

Source: FS report

Among of 7.23 ha of permanent land acquisition, only 20% (about 1.4 ha) is belongs to local households and local residents, i.e. about 0.16 ha/sluice or about 1-8 households affected. The temporary land acquisition is used for stockpiles and will be returned to land owners after ultility, about 2 years.They are mostly canal, garden land and aquaculture cultivation area.

4.4.1.2. Impacts on the land use, resettlement and household income

a). Loss of house and properties

The survey results in Table 56 indecate the number of relocated household is 58.No household lost more than 20% of land. During the FS, the alternative options on the location of sluice have been studied to minimize the land and properties loss.

About 926 trees will be totally lost; they are mostly the fruit trees or local trees, which can be re-planted in other areas.

b). Impacts on the land use and household income

As discussed above, the impacts on land use is not much and not serious. Most of the affected households will be relocated to other place following the resettlement of Vietnamese regulation.

c). Psychological impacts on the residents

At present, the residents expect this subproject for a long time. During the past years, the agricultural production in thesubproject areais facing with many difficulties especially lost of paddy rice crop due to salinity intrusion and shortage of fresh water during flowering. In the last winter –spring rice crop in 2016, Kien Giang province DARD has to prepare to declare the food disaster because of serious completed loss of 7,400 ha in An Bien District, 8,400 ha in Vinh Thuan district and especially An Minh 14,400 ha of rice before harvesting.

Annually, the local government has spent about 4 to 10billion VND/year to build and maintain the temporary dykes. Both resident and local autorities very expect the structures which are able to control well the fresh water source and water regimesfor production demand.

However, some affected households concerned on their loss, which could be managed due to reasonable and transparency compensation program, introduced later by subproject implementation.

4.4.1.3. Impacts on the public works utilities; religious, cultural and historical sites

a). Impacts on the religious, cultural and historical sites

Since there is no relic, cultural and historic sites in the subproject area, therefore, the impacts on such sites caused by this subproject do not take place.

b). Impacts on the public works utilities

The investment items of the subproject lying at the canals and basic infrastructure, therefore, there is no public works utilities affected.

Most of constructed sluices will be connected with sea dyke. Therefore, the subproject also helps to improve the public works utilities due to construct the sluices and bridge over sluices, which help to improve the transportation roads.

4.4.1.4. Impacts on the forest and vegetation cover

Most of the constructing land of thesubproject is the water surface area. The riparian banks near the constructing sluices are residential land. The borrow pit area is inside land; therefore the activities of the subproject only remove 960 trees (*Table 59*).Construction of the wave underground dyke can affect the existing forest during the construction.

Table 59: Amount / Volume of site clearance

No.	Content	Unit	Quantity
1	Clearance of fruit trees (fruit trees)	Tree	926
2	House relocation	Household	67

4.4.1.5. Impacts during clearance phase

a). Impacts on the air environment

The house demolition and tree clearance can create the construction waste, biomass and dust which could affect the air quality. The cut down trees can be reused as fuel for local residents. The solid waste generated by houses removal is not much (67 houses), which is spreaded widely over the construction sites of nine sluice gates. The afftected houses are classified as level 4 corrugated metal-roof houses, therefore the impacts caused by house demolition activities on the air quality environment is partial and short time (several days only). Moreover, the construction site is the coastal rural area then the impacts on air quality is low.

b). Impacts on water environment

The construction site for each sluice gate is not large, from two to four ha. The cutting down trees, levelling and grounding, demoliting housecan create the suspension materials and soil/dust erosion in the run-offs and could affect on water quality.Potential imapcts is consider low. However, due to the dispersal condition of this source of solid waste, the volume of waste is not much then the risk of impacts on the water quality is low, partial and can be mitigated and controlled.

c). Impacts on soil environment

Waste from house demolittion and site clearnace, used oils from equipments can affect soil environment if not dispose properly.

However, due to the dispersal condition of this source of solid waste, the volume of waste is not much then the risk of impacts on the soil is low, partial and can be mitigated and controlled.

d). Impacts due to the UXO (Unexplored Ordnance)

Because the subproject is located in an area that was affected by military operations during the war period, it is necessary to clear any remaining UXO to avoid the potential threat to the structures and safety for local people and workers. For the subproject components, UXO needs to be carefully considered and removed before construction activities can commence.

Conclusions: The impacts of UXO in the subproject area represent moderate negative impacts if mitigation measures are not applied, with high risk to human health, life, and also infrastructure. UXO removal must be completed before starting civil works.

e). Impacts on the ecosystem and biodiversity

The site clearance seems not have adverse impacts on the natural environment. The cutting down trees mosty are planted trees, orchards. The scope of construction site is low therefore the impacts caused by the site clearance on biodiversity is considered negligible.

In conclusion: The negative impacts possibly occur during the pre-construction phaseis the land acquisition, the relocation of houses by the residents, the psychological impacts on the residents especially the direct subproject affected people due to the house relocation and loss partial of the production land. The impacts are considered to be low, partial and not long-term when the subproject owner having suitable and appropriate solution, mitigation measures.

4.4.2. During construction phase

4.4.2.1. Determine the sources of impacts

Main activities in the subproject which are possible to have impacts on the environment during the construction phaseare the construction of 9 sluice gates for regulating the water source at the existing canals locations. All the construction materials providing to the construction of the sluice gates will be bought from other places therefore the transportation during the construction stage include (*Table 60*):

- Transport of construction materials, equipment, facilities, construction machines.
- Construction of works items: including the excavation of soil, sand, concrete, construction of bridge pier abutments, installation of bridge structural equipment, sluice gates, etc.

Table 60: The activities and sources of impacts on the environment during the construction stage

No.	Activities	Scope of Impact	Source of impact related to waste	Source of impact not related to waste
1	Construction of the controlled sluice gates and transportation bridge	Low to moderate impacts at the sluice gate construction location	- Dust generated from the construction machines - Dust generated from the construction materials especially dust from the concrete mixing - Waste generated from the construction machines. - Oil/ grease leakage from the construction machines, - Waste soil excavated from the foundation pits of the construction works, - Leakage water from the foundation pits	- Causing noise from the construction machines - Impacts on the labor safety, - Fire, explosion incidents / accidents, UXO - Impacts on the water-way traffic
2	Construction of auxiliary facilities worksincluding small management office	Low to moderate impacts at the construction location	- Dust generated from the construction machines - Dust generated from the construction materials especially dust from the concrete mixing. - Waste generated from the construction machines and quipment - Oil/ grease leakages from the construction machines and equipment	- Causing noise from the construction machines - Impacts on the labor safety, - Fire, explosion incidents / accidents, UXO - Impacts on the water-way traffic

Objects, scope of the impacts during the construction stage is presented in *Table61*:

Table61:Objects, scope of the impacts during the construction stage

No.	Impacted Object	Scope of the impact
1	Air environment at the construction site	Air environment in the construction site, it is expected to be low to moderate, not possible to disperse, scope of the impact is within the distance of 50m, maximum 100m away.
2	Water environment	At the construction site, mainly at the construction location of the nine sluice gates. The distance of impacts is within the distance of 100-200m. The impact mainly has short and temporary when implementing the sheetpile of the foundation pit when constructing the sluice gate piers.
3	Aquatic organisms	The wastes generated during construction and the use of inappropriate construction methods may have adverse impacts on the aquatic organisms in and around the constrution sites, and coastal and estuary organisms.

No.	Impacted Object	Scope of the impact
4	Aquaculture and agriclture activities	Construction activities can cause pollution to the argicultural land and aquaculture ponds due to disposals of waste, water pollution, and sedimentation
5	Soil environment	At the location of construction of the sluice gates, the locationn of construction along two (02) sides of the sluice gates' body, sluice gate piers and sluice gate pier pits.
6	Safety of water-way traffic	Waterway traffic flow of the boats and ships at the construction location of the sluice gate which may frequent occur during the construction time and construction materials.
7	Socio – Economy	Some households living near the sluice gate construction area. Labor workers involve with the contruction activities.

4.4.2.2. Impacts not related to waste

a). Noise

During the construction phase, noise sources and vibration mainly include: noise generated from the concrete piling machine, concrete mixing machine (concrete mixer). The level as well as the scope of impact of noise during the construction of works items depend on the techinical specification, time duration and frequency of the operation of the machines, equipment as well as the direction and the distance to the receivers.The time of construction of the subproject is mainly at day time. The reference data shows that the noise from the source of 1m, 20m and 50m away from the construction machines are presented in *Table62*.

Table62: Maximal noise level of some construction machines and equipment

No.	Equipment	Noise level 1m away from the source (dBA)(1)		Noise level 20m away (dBA)(2)	Noise level 50m away (dBA)(2)
		The range	Averaage		
1	Bucket excavator	72.0 - 84.0	78.0	52.0	44.0
2	Bulldozer	-	93.0	67.0	59.0
3	Compressor	72.0-74.0	73.0	47.0	39.0
4	Scraper, grader	80.0-93.0	86.5	60.5	52.5
5	Truck	82.0-94.0	88.0	62.0	54.0
6	Concrete mixer	75.0 - 88.0	81.5	55.5	47.5
7	Concrete pump	81 – 84	82.5	56.0	48.0
8	Piling	81-115	98	82.4	65.6
9	Welding machine	71 – 82	76.5	48.5	40.0
10	Compactor	74 – 77	75.5	48.0	39.5
QCVN 26:2010/BTNMT at normal place from 6-21h		**70 dBA**			

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

Applying the dispersement calculation equation to calculate the noise dispersement in the air:

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

Where: r_1:the distance which measures the noise level at the preliminary time; r_2: is the distance from the calculation point to the noisesource (m); a: the coefficient which takes into account the noise absorb capacity of the land surface.

*Table62*shows that most of the noise generated from the construction machines and equipment within the distance of 20m away from the noise source is under the acceptable standard (QCVN 26:2010 BTNMT). Except for the piling machine, in the distance of 20m away from the noise source, the noise level is still 82.4dB.

The result of noise calculation of the concrete piling machines based on the distance is illustrated in *Figure 40*.

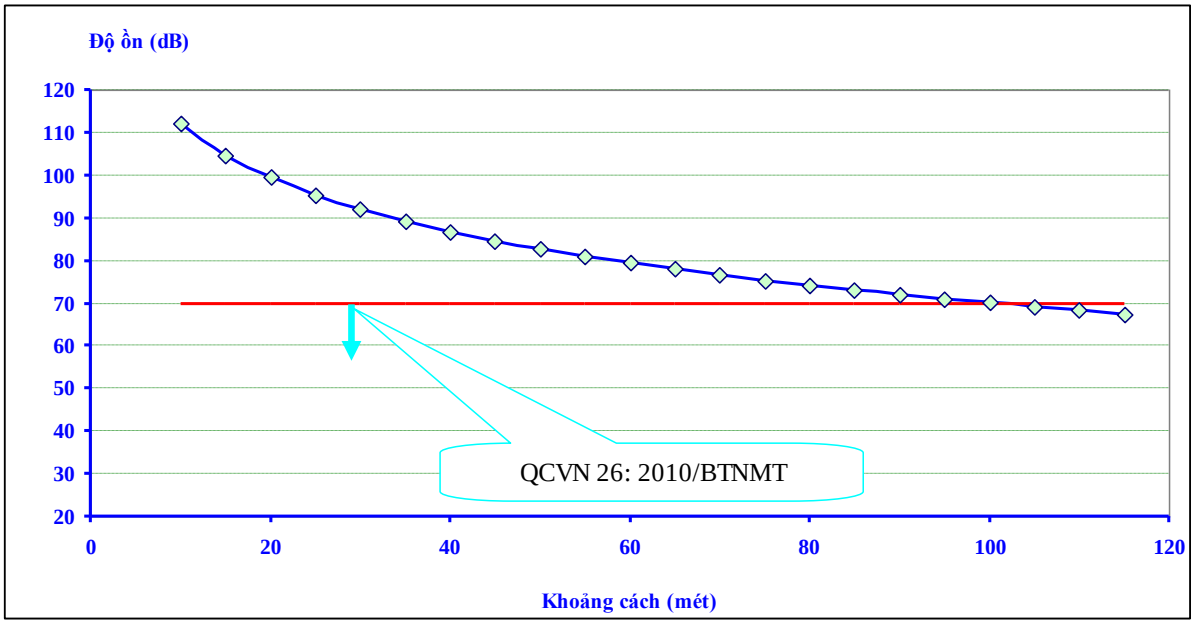


Figure 40: The reduction of noise level from the piling machine along the distance

*Figure 40*shows that the maximal noise level of the concrete piling machine is 115dB at 100m away from piling machine and meets the acceptable standard according to the Vietnam law and regulations. From the result, it also shows that the scope of impact caused by noise during the construction on the environment is within the radius of 100m.

In fact, the piling activities mainly occur inand nearby water way, which is at least 50m away from the residential area.However, the construction site is not much, the duration of piling for each sluice gate lastsfrom one to two months long. Therefore, the impacts caused by noise generated from the construction machines and equipment of the sluice gate construction is determined to be low, and it is also temporary. It will stop when the piling activities finished.

As mentioned in section *4.4.2.4a* about the list of sensitive facilities, which the contractors should be awared on and set up the construction plan which can minimize the impacts and apply the mitigation measures.

The material calculation indicates that the amount of material needed for constructing a sluice gate is not very large, about 38,968m^3. If the contractors use the 50-ton ferry to transport constructing materials, they need only 0.24 trip/day/sluice gate. Thus, the noise impacts from the ferry on riparian residents are low, which only occur along the transportation route locally and last about 1-2 minutes at one location.

b). Impacts on navigation

All the sluice gates will be constructed on the canals and they using the shape steel cofferdams and steel piles *(Figure 14*), which will not block the navigation routes but may affect them when the boat and ship pass the construction sites.

It will need about 173 transportation trips of 50 ton ferry for construting one sluice gate in two years. Therefore it will not affect the traffic much but may increase the risks of incident or accident during the transportation.

c). Impacts on the biological environment

The construction activities occur within the small area, the radius is about 50 -100 m, and mostly on the canal. The complete construction process will not block the flow entirely but applying the shape steel cofferdams and steel piles; therefore, the impacts caused by the

construction of sluice gates on the biological environment is low, temporary and can be mitigated.

d). Impacts on the socio-economic condition

During the construction, the subproject may brought the positive impacts on the local social economic such as create 10 jobs for 5-10 workers per a sluice gate. However, it may also causeconflict among staffs, workers and the local residents in terms of benefits, behaviours and life style; increase the risk of social disorders and evils such as drinking, gambling, etc. In this case, the close cooperation between the contractors and the local authority to manage and supervise them is neccesary and important.

In the poor sanitation conditions of the construction sites, risks of occurrence of infectious diseases such as dengue, diarrhea might emerge and they might spread out from the construction sites to the residential areas.

e). Impacts on the production activities and water supply

Impacts on the domestic water supply activities: Residents do not use canal water for domestic use therefore the construction activities will not affect the domestic water supply activities of the local residents.

Impact on the production: The transportation of construction materials, the soil may leak to the canal. The excavation and embankment activities during the construction will increase the turbidity at the construction site, at the same time, the rain causing erosion and run-offs through the construction site may carry the soil, sand and oil/ grease to the water body. However, the impacts are partial, shorterm; the impacts are low and mitigatable.

The sluice construction sites are nearby the semi intensive shrimp farms or shrimp –forest model locations. The unproper waste discharge may affect on intake water quality for them. The scale of impacts depends on the amount and type of waste generated (oils or organic waste). This is medium scale impacts, therefore the constructors must concern and establish the mitigate measures to control the waste or pollutant disperse to surrounding environment. All waste will be collected, treated and disposed properly.

f). Impacts on the hydrological regime

The selected costruction method is direct construction on the canal applying the steel sheetpile without preventing the flow; therefore, the impact caused by the construction activities on the water flow is low.

However, in few locations this impact will become moderate if the water diversion is needed.

g). Impacts on the erosion – sedimentation

The construction activities will not change the flow as well as no increase in the sand and soil sedimented into the canal in the local area therefore the construction of sluice gates will not affect the sedimentation and erosion of the local area.

h). Impacts on the landscape, religiuos, cultural and historical sites

The constructing activities mostly occur on water canal therefore there are no impacts on religious, cultural and historial sites as well as school. Within the radius of 500m away from the construction sites of sluice gates, there is limited number of them as listed in Table 59.

4.4.2.3. Impacts related to waste

a). Impacts on the air environment

During the construction, the sources generated to pollute the air environment include:

- Dust generated from the excavation and embankment, transportation of construction materials;
- Dust and SO_2, NO_x, CO, THC gases generated from the automobile construction machines and equipment, piling machines, concrete mixer, vibrator/compactor, water way construction materials transportation may cause the risk of air pollution for the surrounding area;

During the construction phase of sluice gates and bridge, the waste in the form of dust, emission/exhaust gases generated mostly from the construction material transportation activities, especially dust generated from the concrete mixing activities to build the sluice gates is the source which may cause negative impacts on the air environment.

Dust – emission/exhaust gases generated from the construction machines, equipment and construction materials during the construction of bridge, sluice gates:

The transportation of construction materials for the subproject is totally by using the barges therefore the waste in the form of dust generated from this activity seems not to have impacts on the air environment when it is covered carefully. According to the amount and volume of construction materials needed (*Table 10*) for the construction of sluice gates is about 38,968m^3 (28,154m^3 concrete) then the quantity of barges, ships for the transportation of construction materials in and out of the subproject area is 173 trips /sluice gate (calculted for the 50ton-25m^3 barges). The construction materials are bought from the construction material ports along Xeo Ro canal and be transported to the sluice gates with the distance of about 9 – 10km. With emission coefficient of the ship and barge operated by diesel engine illustrated in the *Table63*then the exhaust gases/emission generated from the transportation of construction materials into the air environment is calculated as shown in *Table 64*.

Table63: Emission coefficient by ship and barge operated by diesel engine

Pollutant	**Dust**	**SO_2**	**NO_x**	**CO**	**VOC**
Emission coefficient (kg/1000km)	6,8	136S	90,7	0,036	4,1

Source: World Health Organization (WHO), 1993.

Notice: S – Concentration or content of sulfur in the diesel, taken equal to 0.25%.

Table 64: Pollutant load from the construction materials transportation

Parameter	**Dust**	**SO_2**	**NO_x**	**CO**	**VOC**
Pollution load (kg/day)	0.1472	0.0074	1.9636	0.0008	0.0888
Daily pollution load (kg/day/sluice gate)	0.0164	0.0008	0.2182	0.0001	0.0099

With the pollution load mentioned above, it is considered and determined to be not much in the condition of the construction site is the rural area, then then impacts caused by the mentioned activities on the air environment is not possible. In fact, it is shown that the construction materials transportation for the construction only increase the water way traffic

flow of ships and barges of 0.24 trip therefore the impacts of the activity is only the same as 1 small-sized ship transportation on the canal.

Dust – Emission/Exhaust gases generated from the construction of bridge, sluice gates

Dust is generated from the excavation activities and the operation of the construction machines and equipment, the construction material storage stock yard. According to the Environmental Impact Assessment (EIA) guidebook issued by WB (Environmental assessment sourcebook, volume II, sectoral guidelines, environment, World Bank, Washington D.C8/1991), the dispersement level of dust generated from the excavation of the topsoil based on pollution coefficient (E) is as follows:

$$E = k \times 0.0016 \times (U/2,2)^{1,4}/(M/2)^{1,3}, \text{ kg/ton.}$$

Where:

E : Pollution coefficient, kg dust/ton of soil;

k : Structure of the grain / particles with the average value of 0,35;

U: Average wind velocity in the subproject area 3,6m/s;

M: Average humidity of the construction materials, about 20%.

$$\text{Then } E = 0.35x\ 0{,}0016x\left(\frac{3.6}{2.2}\right)^{1.4}/(\frac{0,2}{2})^{1.3} = \mathbf{0.0188}\text{kg dust/ton of soil}$$

The amount or volume of dust generated from the excavation and embankment for each construction items of the subproject is calculated by applying the equation below:

$W = E \times Q \times d$

Where:

W: Average amount / volume of dust generation (kg);

E: Pollution coefficient (kg dust/ton of soil);

Q: Amount/ volume of excavated and embanked soil (m^3);

d: Density of the excavated and embanked soil (d = 1.5 ton/m^3).

With the total amount/ volume of excavation – embankment of the subproject which is about **101,749 m^3**and it will occur in the period of time of about four (02) years. Therefore, predict the volume of dust generation in the construction stage is calculated in *Table65*.

Table65: Predict the dust pollution load in the local area due to the excavation and embankment activities (during the construction period of 4 years)

Pollution/Emission source	**Average daily Emission load (kg/day)**	**Average daily Emission load per sluice gate (kg/day/sluice gate)**
101,749x 1.5 x 0.0188	1.99	0.211

In fact, the actual dust volume generated will not be the same as the shown figure above since the soil in this local area is high humidity (30 – 40%) therefore the possibility of dust dispersement in fact is only 50% in comparison with the calculation by applying the negative condition (humidity is only 20%). With the disperment of the construction items (9 sluice gates), the dispersement area is the rural area, few residents therefore, the impacts caused by dust generated from the excavation and embankment is determined to be partial, with the level of impacts is negligible.

Dusst generated from the concrete mixing activity

The cement dust generated from the concrete mixing activity is determined to possibly have impacts on the environment. According to the design, total volume of concrete utilization for the subproject is 28,154 m^3. The emission coefficient for the concrete mixing activity is 0.5 – 5 g/m^3 therefore the total cement dust generated into the air environment is about 14-140kg dust. However, the concrete mixing activity only occur in the location adjacent to the sluice gate and far away from the residential area as well as it will disperse at nine sluice gates locations then the impacts caused by cement dust is determined to be low.

Since the concrete mixing method is by using the small mixer (500 litre) therefore the dust will only have impacts within the scope of the concrete mixing area with the radius of 5 – 10m, and the impacts caused by dust is mainly on the direct workers who assigned to do the task.

For the direct worker who assigned the concrete mixing activity, he will have quite long time facing with dust. Since the cement dust is small and fine particles/ grain, if without the control and prevention method and solutions then after a long time, it may directly causes impacts on the human health. Therefore, the contractors must equip the personal protective equipment (PPE) for the workers who do the concrete mixing activity as well as the contractors have the responsibility to train the workers how to reduce the dust, or how to select the sitting position suitably during the mixing time duration so that the workers can minimize the breath in/ taken of dispersed dust emission.

b). Impacts on water environment

Wastewater resulted from the activities of workers on the construction site

The average water use of construction worker on the site is about 45 litres/person/day, maximum number of workers on a sluice contruction site is 20 people therefore maximum wastewater flow discharges to the environment is 45 l/person/day x 20 people = 0,9m^3/day. The concentrations of typical pollutants in domestic wastewater are presented from *Table66*and pollutant loads resulted from the subproject implementation are presented in *Table67*.

Table66: Typical compositions of domestic wastewater

No.	Pollutants	Unit	Pollutant concentration (untreated)	QCVN 14:2008/BTNMT column B (k=1.2)
1	BOD_5	mg/l	563 - 675	60
2	COD	mg/l	900 – 1,275	-
3	Suspended solids	mg/l	875 – 1,813	120
4	Non-mineral grease	mg/l	125 - 375	24
5	Nitrates (as total N)	mg/l	75 - 150	-
6	Amonia	mg/l	30 - 60	12
7	Total P	mg/l	10 - 50	11
8	Coliform	MPN/100ml	106,000– 109,000	6,000

Source: Hoang Hue, 2002

As seen from the above table, concentrations of pollutants in domestic wastewater are many times higher than the acceptable discharge limits (QCVN 14:2008/BTNMT column B)

Based on the pollutant conversion factors established by the World Health Organization and the number of workers at each sluice construction site of approximately 20 people, pollutant loads of the wastewater of the site are calculated and presented in *Table67*.

Table67:Pollutant loads of the domestic wastewater

No.	Pollutants	Conversion factor WHO (g/capitaxday)	Load (kg/day)
1	BOD_5	45 - 54	0.9 – 1.08
2	COD	72 - 102	1.44 – 2.04
3	Suspended solids (SS)	70 - 145	1.4 – 2.9
4	Non mineral grease	10 - 30	0.2 – 0.6
5	Nitrates (as total N)	6 - 12	0.12 – 0.24
6	Amonia (N-NH3)	2.4 – 4.8	0.048 – 0.096
7	Phosphorus (as total P)	0.8 – 4.0	0.016 – 0.08

Source: Rapid Environmental Assessment, WHO, 1995

The above calculation shows that the wastewater loads resulted from the workers' activities at 1 construction site are not at a great amount (equivalent to the amount of wastewater discharged from 4-5 households along a canal); if this wastewater is discharged to the environment its impact affects locally at the discharging point but not to a broader scale. In addition, the locations of the sluice construction sites are apart from each other thus their impacts are not added up and accumulated. Levels of impacts is low and will be ended when the construction finish.

However, in order to ensure the environment and sanitation, the construction contractors have to meet the sanitation and environmental requirements of which the worker camps are to be equipped with a latrine and a domestic wastewater treatment facility for construction workers.

Storm water runoff

Storm runoff: By nature, rainwater is considered clean water, however if it flows through the soil spillage area, containing waste, oil diesel, household waste it will affect the receiving water. Some affected acid soil area while being disturbed might trigger the alum transformation and the alum being washed by the rainwater runoff is also at the risk of causing serious impacts to the aquatic environment.

Results from the soil survey (*Table 23*) show that the soil in this area is acid sulfatesoil (Moderately acid and slightly acid). The soil in the area will be disturbed highly by excavating activities and therefore risks of acide transformation are imminent.

The area for a sluice construction site is about 2.4 ha however there is only about 20% (0.48ha) of the area is exposed soil the remaining area is saved for camps, workers, material storage, etc. limiting the effects of acide transformation.

The impact due to storm water runoff is quantified based on the following parameters: surfacial area F = 0.48 ha. Amount of precipitation for each rain: W_0 = S x M/1000 (S is cachtment area – m^2; M highest rainfall 50mm)

W_0 = 4800 x 50/1000 =240m^3

Rain at the beginning of the season highly penetrates down into the soil surface so that about 40-60% of the storm water flowing down the canals, for approximately 140m^3

In the early season's rains, the water flushing through the highly acidic soil has pH value ranging from 2-3. However water on the canals is still saline therefore it can neutralize the acidic water. With the amount of likely acidic water from 140 up to the maximum of 240 m^3 entering the canals, the impact scale is not big, extending only about 20 – 30 m from the receiving point therefore the impact of acide wash from the construction site is low and localized and it occurs only after 2-3 rains at the beginning of the season. However to avoid the storm water runoff, the contractors should have technical solutions for minimizing acide transformation or neutralizing the acide once it is transformed.

Besides, grease or waste if dropped on site could be washed away with stormwater as part of contamination sources affecting the receiving water body.

Wastewater from construction execution

After each working shift the concrete mixing equipment must be cleaned. Dirt in the wash water is mostly cement powder and sand still stuck in the rotating drum. The amount of wash water is less than 30 - 50 liters / equipment / time. This wash water source if poured directly into canals may affect low aquatic system at the receiving point. With the negligible pollutant composition, this small amount of water can be dumped directly into the unused part of the site especially to the acidic soil area to neutralize the soil and reduce the negative effects of acidic soil to the water environment.

Overall Assessment: The above analysis and assessment show that negative impacts to surface water quality in the construction phase of the subproject are low, temporary and localized. These effects are completely under control when the construction contractors to fully implement working protocols and measures for environmental pollution control.

c). Impacts of solid wastes

Construction solid wastes resulted from the sluice construction:

In water regulating construction work, solid waste is not much, composing mostly of the used cement bags and disposed slabs supporting formwork.

On average, each sluice construction will require about 2,800m3 of concrete in equivalence to about 28,000 bags of cement and therefore the used cement bags considered as waste would be about 20,000-26,000 packages. Notably the packages are usually very difficult to degrade or it takes decades for the waste to be decomposed. This type of waste has negative impacts on the environment if being discarded into the canals or production land areas.

Currently the majority of the construction company uses the iron or plastic formwork, very few construction units using wooden formwork. Metal or plastic formworks are usually collected completely as they can be sold for recycling. Wooden formwork can also be reused for heating purposes but if discarded into the environment (in canals or underground) they would impact negatively on the environment. The extent of this impact is considered as low and only localized.

These construction units should implement measures to manage this source of waste to limit its effects to the natural environment.

Domestic waste resulted from workers' activities in the construction site

It is estimated that each worker working at the construction on average generates 0.4 kg of domestic waste daily and this solid waste contains 60-70% organic matters and easy degradable materials (except for the packages, nylon bags, plastic bottles…). The amount of solid waste from each sluice is 8 kg/day (0.4 kg/person/day * 20 persons = 8 kg/each sluice constructed/day)

The environmental impact brought from 8 kg of solid waste (garbage) at one construction site is small, localized and unable to affect on a large scale. However, domestic waste is often easily degradable so if released to the environment around the camp ground it will create unpleasant smells attracting fliers and insects which are sources for transmitting infection diseases on the site. If leaked into canals this waste will pollute the water.

To limit the impacts, the construction units should implement required solutions for collecting and treatment of waste, reducing negative impact on the environment.

d). Impacts of the hazardous waste

Hazardous waste is generated from activities, including oil replacement, equipment maintanance with the composition of oil contaminated rags (rags used for cleaning oil, grease or covering the equipment) and some small amount of other types such as light bulbs, batteries.The frequency of oil replacement for each equipment is one per every 3 – 6 months.There is rarely light bulbs and batteries.

Although this waste is small and rarely discharged but once released into the environment it has big impact, especially with machine's oils/ grease. It is completely possible to control this source of waste relying on the awareness of workers, especially of the operators of waterway transporting vehicles.

Impacts of used oil and grease: Although the oil residues are not much (7 liter/recharge) however if leaked into the environment its harmful impact on the environment is really huge. Assuming a spillage of the 7 liters of lubricant oil onto the environment, due to the light density of oil and its low degradation, once an oil spill occurs, the affected surface area would be tens of thousands squares meter. When the oil floats on the surface water it blocks air water interface, causing oxygen deficiency in the water and directly affecting the aquatic species. The oil spill can also stick on the aquatic species and it can cause them to deaths when the amount is big enough. This is the point where the construction units need to pay special attention to control the oil residues avoiding any leakage into the environment under any circumstances.

The possibility of oil/diesel leakage/spillage from the construction equipment to the environment should be monitored. For construction machinery, its leaked fuels will penetrate into soil and be in contact with water following rainwater runoff, affecting aquatic environment and aquatic fauna. This risk will not be high due to the limited quantity of equipment being used in the construction, the machinery must also be ensured for the compliance with the technical standard requirements and furthermore if there's leakage the fuel cost of the construction unit will be directly impacted.

Equipment cleaning rags: This source of waste mainly contains oil and grease. This is not much in quantity and only available upon equipment repairs or maintenance. Once the workers are aware of the risk of waste discharge then the control of this is not difficult and the impact on the environment is low.

With the spread of the subproject, the non concentration of construction machineries and the major activities happen inland so the impacts from oil residues are not much especially when there are measures to control the sources then the impact from the used oil residues from construction equipment are considered insignificant.

e). Impacts on the aquaculture and mariculture

During construction water quality could be changed due to increase suspended materials and therefore, organic matters and iron contented in the water could be increased, which may effect on downstream aquaculture and mariculture.There are very few shrimp farms at downstream of sea dyke and they will be informed to take water from the other canals not from constructed

canal temporary. Thus, this impact could be mitigated and controlled.The farm of blood cookle (nearby mariculture) is far away the construction sites and it will not be affected during construction.

4.4.2.4. Impacts of sluice gates construction to sensitive facilities

a). Sensitive facilities nearby sluices

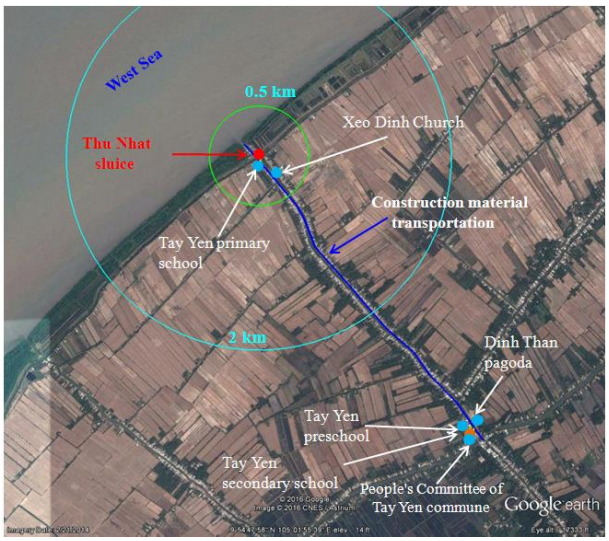
Table 68 summarizes sensitive areas that could be affected during construction of sluices but the impacts are expected to be low since most of them are due to potential increase on noise and/or vibration due to transportation of construction materials. Nontheless measure will be conducted to ensure that the contractor pay due attention to reduce and/or avoid the impacts.

Table 68: List of sensitive facilities which could be affected during sluices construction

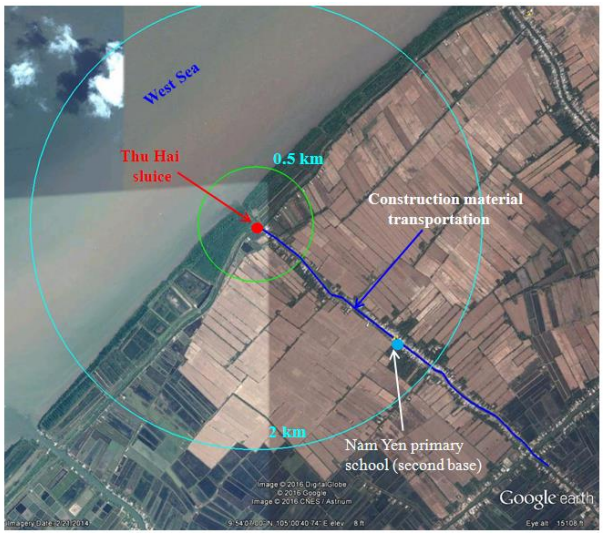
No.	Name of sensitive facilities	Location	L*	Impact sources and levels
1.	**Thu Nhat sluice gate**			
1.1	Forest – shrimp farm	Nearby sluice	40m	Low impacts (L) due to waste and water pollution
1.2	Local resident	On material transportation routes	>50m	Low impacts (L) due to noise of transportation boats
1.3	Tay Yen Prelimary school	Near the Thu Nhat canal end	80m	Low impacts (L) due to noise of pilling
1.4	Xeo Dinh Church	Near the Thu Nhat canal end	250m	Low impacts (L) due to noise of transportation boats and pilling
2.	**Thu Hai sluice gate**			
2.1	Forest – shrimp farm	Nearby sluice	40m	Low impacts (L) due to waste and water pollution
2.2	Local resident	On material transportation routes	>50m	Low impacts (L) due to noise (locate on transportation routes)
3.	**Thu Ba sluice gate**			
3.1	Forest – shrimp farm	Nearby sluice	40m	Low impacts (L) due to waste and water pollution
3.2	Local resident	On material transportation routes	>50m	Low impacts (L) due to noise (locate on transportation routes)
4.	**Thu Nam sluice gate**			
4.1	Forest – shrimp farm	Nearby sluice	20m	Low impacts (L) due to waste and water pollution
4.2	Local resident	On material transportation routes	>40m	Low impacts (L) due to noise (locate on transportation routes)
5.	**Thu Sau sluice gate**			
5.1	Forest – shrimp farm	Nearby sluice	20m	Low impacts (L) due to waste and water pollution
5.2	Local resident	On material transportation routes	>40m	Low impacts (L) due to noise (locate on transportation routes)

No.	Name of sensitive facilities	Location	L*	Impact sources and levels
6.	**Xeo Ban sluice gate**			
6.1	Semi intensive shrimp farm	Nearby sluice	70m	Low impacts (L) due to waste and water pollution
6.2	Local resident	On material transportation routes	>50m	Low impacts (L) due to noise (locate on transportation routes)
6.3	Blood Cockle farms	Located offshore	>1 km	Low impacts (L) due to water quality issue and sedimentation
7.	**Thu Tam sluice gate**			
7.1	Semi intensive shrimp farm	Nearby sluice	20m	Low impacts (L) due to waste and water pollution
7.2	Local resident	On material transportation routes	>40m	Low impacts (L) due to noise (locate on transportation routes)
8.	**Thu Chin sluice gate**			
8.1	Semi intensive shrimp farm	Nearby sluice	60m	Low impacts (L) due to waste and water pollution
8.2	Local resident	On material transportation routes	>50m	Low impacts (L) due to noise (locate on transportation routes)
9.	**Thu Muoi sluice gate**			
9.1	Semi intensive shrimp farm	Nearby sluice	60m	Low impacts (L) due to waste and water pollution
9.2	Local resident	On material transportation routes	>50m	Low impacts (L) due to noise (locate on transportation routes)

Note: L*: distance from the sensitive facilities



Thu Nhat sluice gate



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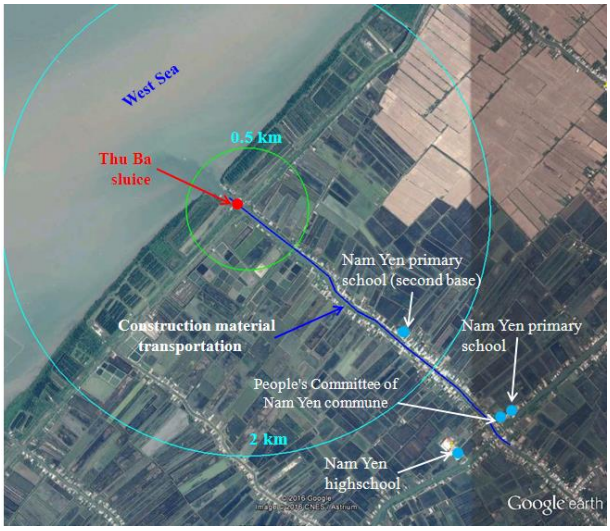
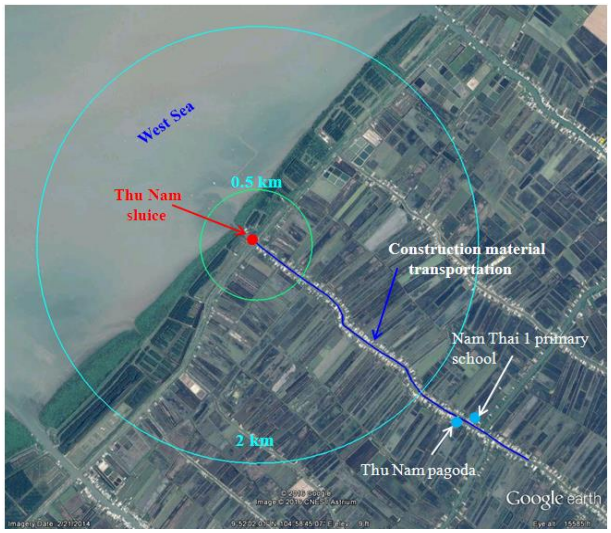
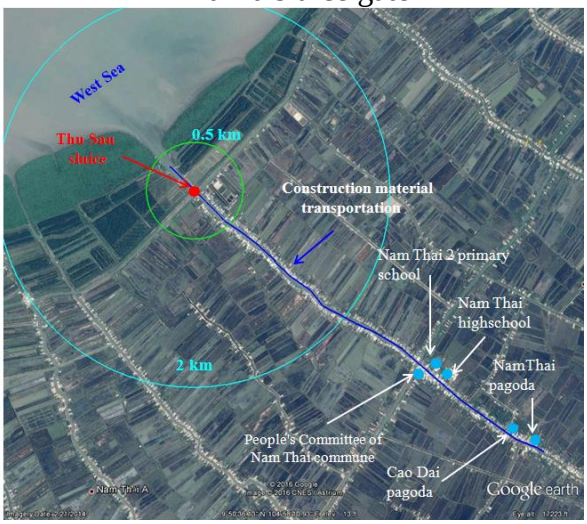


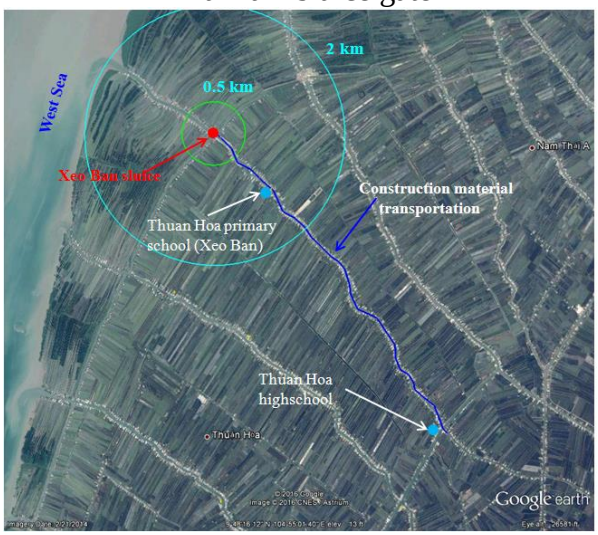
Thu Ba sluice gate



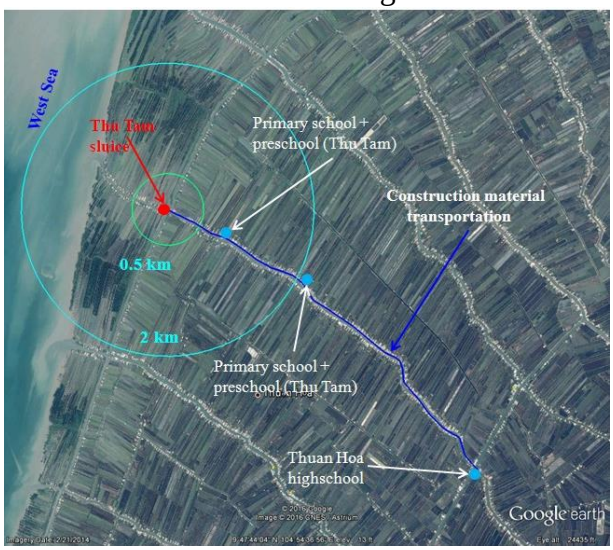
Thu Nam sluice gate



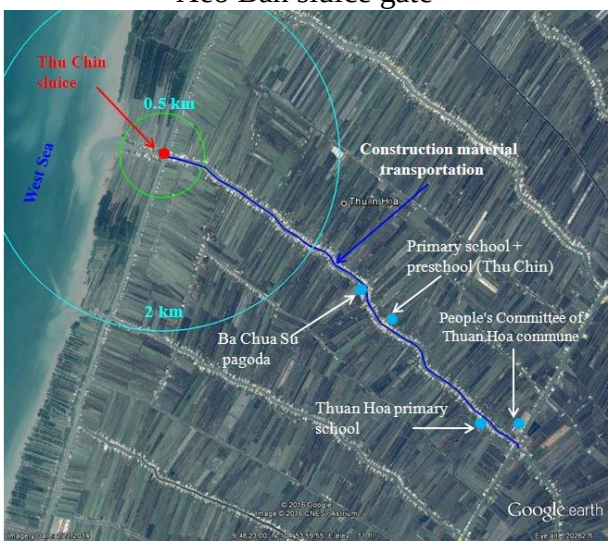
Thu Sau sluice gate



Xeo Ban sluice gate



Thu Tam sluice gate



Thu Chin sluice gate

Thu Muoi sluice gate

Figure 41: Sensitive facilities/sites at 9 sluices

b). Aquaculture cultivation on the sea

Along the coastal line from An Minh to An Bien (1km away from the coastal beach, the residents operate the blood cockle cultivation activities (Figure 42), especially, at the locations near the canals and estuaries. If the management of water environment at these locations is not good, it will have negative impacts on the aquaculture cultivation production at these areas.

4.4.3. During operation phase

The environment impact during operation phase is related to the operational activities of the sluice gate system, which is regulated as follows: In the rainy seasons, the sluice gates will operate to reduce fresh water flowing from inner field to the sea and reduce saltwater intrusion into the fresh production regions. In the dry seasons, the sluice gates will operate mainly to prevent tidal surges and then open for water circulation to serve saltwater aquaculture.

Operation of these sluice gates may have some impacts on water quality and water transportation; however, the effects can be varied from one location to another but considered low to moderate in general.

4.4.3.1. Impact on road traffic

Building sluice gates will contribute to developing road on canal sides which people can go and it creates conditions for the development of the coastal traffic on the dike. So negative impacts from the sluice gates construction on road are negligible.

4.4.3.2. Impact on waterway transport

In the areas where the sluice gates will be constructed to replace the temparary earth dams which usually are closed for a long period impeding waterway transport. During operation the sluice gates will open most of the time, facilitating more convenient waterway traffic than before. However, there are still times when they are closed. Therefore, this impact can be assessed as moderate.

4.4.3.3. Impact of sluice gates on tidal patterns, salinity, and water quality

Water flow pattern resulting from operation of the sluice gates: Coastal areas are a highly dynamic interface between the coastal area and the sea. Large-scale structure such as seawalls, groins, jetties and other shoreline stabilization structures along high energy sea shorelines have been reported to have significant impacts on the sea waves, currents, and sediment movement, resulting in down-coast erosion problems with associated costs that have greatly exceeded the construction cost of the structure. The 9 sluice gates will be contructed at a long distance of more than 20 km of Kien Giang coast line. The sluice gates would be located at 300m – 2,000m from the coast, and along a low energy sea shoreline which is evidenced by the stable coast line. The current practice of operation sluice gates in similar locations would only result in changes in water flow within 20-50m of the sluice location, and these location would be reinforced by concrete to avoid erosion. Observation at Kim Quy sluice gate constructed and in operation for 15 years, indicates that there is no erosion and within the sluice area reninding of insignificant change in water flow pattern. Similar observation could be made at the site of the sluice gate T 29 constructed in 2005 on Ca Mau coast, about 20km from the subproject area. All these evidences and the fact that the sluice gates will open most of the time suggests that the effects on the water flow pattern in the coastal area would be low.

Water quality: In the areas where the sluice gate is constructed to replace the temparary earth dam, the impacts will be positive since water quality will be improved due to more circulation.

4.4.3.4. Impact on water and aquatic environments

These impacts are varied depending on locations. Currently when temporary dams are built for about 20 days, the inner water is not circulated and there are signs of slight water pollution. The creatures inside and outside the sluice gates are also divided during that time.When the sluice gates are built, it can be operated to avoid water pollution. The sluice gates opening also facilitates the movement of aquatic species including fish passage in and out of the sluice gates.

4.4.3.5. Impacts on aquaculture and mariculture

In the area that there is no need for a temporary dam, operation of the sluice gate will change the water flow pattern in the canal but the impacts are considered moderate and can be mitigated through proper planning and consultation as well as an agreement on the operation manual of the sluices. Since the Cockle farming area (Figure 42) are located farm from the sluice gate (about 1k far), the impact of the sluice gate on this sensitive receptor could be considered low. However, to ensure that change in water quality due to the sluice gate will not have serious impacts on the aquaculture farming in coastal and offshore areas, especially the area near Xeo Ban sluice, a water quality monitoring program will be conducted during the implementation of the subproject to monitor the impact on cockle cultivation areas.

Figure 42: Blood cockle cultivation area located 1km from Xeo Ban sluice gate on the sea

4.5. Impact assessment for protection of coastal erosion (Component 2)

4.5.1. During pre-construction phase

The sea wave breaker embankment is built entirely on the sea 200m from the shoreline to attenuate the wave energy and trap sediment for mangrove restoration. Therefore there will be no land acquisition and site clearance. This effect is determined negligible.

4.5.2. During construction phase

4.5.2.1. Impacts on the Marine Environment within the loading area

The soft embankment is simple (*Figure 9*), just dropping prefabricated components down the seabed which help reduce sea-waves hitting the mangroves and create sediment deposition inside the embankment. All construction activities are on barge at the sea.

Impacts of hydrocarbon wastes discharged by the tugboats and cranes: During the performance of operations, there may be undesired discharges into the sea due to an operating error or a failure in these pieces of equipment. Dropping of the prefabricated components down and driving soft bamboo piles on the coatal seabedwill bring about turbidity during a relatively short period of time.

Flora: This area was seriously eroded and from 30 to 80m of protective mangrove forest was lost within 10 years (*Figure 43*).Due to thehighly disturbed shoreline bottom because of strong waves in this area, there is limited flora adhered to the substratum in this area. The sea current the presence of which is only occasional, associated with rough waters, drags along existing flora. There is no sea grass presence in the area due to high water turbidity level. Therfore, low impacts are expected upon the flora.

Fauna: Due to severe erosion, bottom substrate in the area disturbed by the waves leading to poor communities of zoobenthos in this area in terms of species abundance and diversity (see

Table 69). The fauna is scarce in a heavily disturbed coastal shallow water environment due to strong waves. Landing structures down the bottom may cause deaths of benthic species at the landing locations, however, the survey on the regional zoobenthos shows no endemic species which belong to the groups that can regenerate after about 1-2 months. The area of landing of prefabricated structures is extremely small (20 segments, 500m long and 1m wide, 60m between each segment) compared to the vast water surface, so after the landing, benthic

species around will reach into the structures immediately. As regards the benthos community, which is directly affected by the construction of the wave breaker, the impact will only be temporary, until construction work is completed. In addition, there are no marine protected areas, fish spawning habitats, or other important habitats around this site. Therefore, the impacts of building wave breakers on the aquatic fauna can be assessed as low.

Figure 43: Coastal line erosion in the subproject area

Table 69: Zoobenthos in the coastal area of An Minh district

Zoobenthos	**Site**			
	1	**2**	**3**	**4**
POLYGOCHAETA				
Potamilla leptochaeta	*	*		*
Myriochella picta	*	*		*
Nereis sp	*	*		
Prionospio sp	*			
Nephtys oligobranchia		*	*	*
Polydora sp		*		*
MOLLUSCA				
BIVALVIA				
Paphia undulata	*	*		*
Paphia textile	*			
Anadara granosa		*		*
ARTHROPODA				
CRUSTACEA				
Upogebia sp	*			
Alpheus pubescens		*		
Ogyrides striaticauda		*		
Total (species/ site)	**7**	**9**	**1**	**6**

4.5.2.2. Impact of domestic solid waste on the environment

The construction is completely implemented by barges with the construction teams of 4-6 workers.For workers, the environment affection is domestic waste.The daily waste of 6 workers living in bargesthat is less than 2.4kg, need however to be collected but exhausted to the sea that causes water resource pollution as well as damages to coastal mangroves.

Though it employs few machines for this item construction (barges and a crane), their emission such as maintenance fuels cause negative impacts to the environment. If these types of waste are not duly managed, they may affect the environment especially in each time of changing oil

for machines. Typically about 3 to 6 months, oil machine will be replaced. For small construction equipment, the replacement of oil amount is about 7 liters each. If this amount is not collected and treated but discharged outside, it would have been negative impact to the aquatic environment particularly to the aquaculture in the coastal areas. However, the discharge of oil into the environment is insignificant (as workers are trained) but if oil is discharged into the environment, the impact is significant. The risk of fuel exhaust in constructions and in maintenance needs to be considered. When fuels exhausted to barges floor can be rinsed directly to the sea. Though the risk is low and the impacts remain local within a low scale, it is however necessary that the construction units manage carefully to avoid the exhaust to the water environment. The impact of this activity on the environment is determined as low.

4.5.2.3. Impacts on marine dynamics and the coastal profile

As regards marine dynamics (waves, currents and tides), no impacts are expected from the construction of the sea wave breaker, which will be built on soft components and are transparent to the action of the sea. During the construction phase, no impacts are expected on the coastal profile. This impact is considered low.

4.5.2.4. Impacts on the transit of vessels and fishermen

There is no waterway transit for vessels and fishermen in this area.

4.5.2.5. Impacts on fishery activities

The field surveys and consultations with the local communities showed that the area does not support abundant fish stock, and there are no fishing activities in the wave breakerconstruction area.

4.5.3. During operation phase

4.5.3.1. Impacts on biodiversity and aquatic species

When being used, embankment will take effective to protect shore from waves and protect coastal protective forests. Embankments will create depositing inside that makes grounds for development of mangroves. The growth of mangroves will be the habitats for many aquatic species which contributes to improving the biodiversity and sustaining aquatic species. In addition, in this phase, negative impact will not appear that affects the environment.

4.5.3.2. Impacts on marine dynamics and the coastal profile

The impact of the wave breaker on the marine dynamics and coatal profile is complicated and merit a detailed study during implementation of in component. A Technical assistance will be sought to conduct this study focusing on the changes in costal sedimentation budget and erosion northward along the coast due to operation of the wave breaker. A monitoring program is also needed to address this issue.

Figure 44: Under-water wave breaker for U Minh (Ca Mau) mangroves reforestation

4.5.3.3. Aesthetical impacts

The construction of the wave breaker, with modern infrastructure, will have a slight impact on the natural landscape, for which reason every possible effort will be made to have colors harmonize as much as possible with the surrounding environment. The impact is considered low.

4.6. Impact assessment for the livelihoood models (Component 3)

As presented in Chapter 1 (subproject description) that of the 5 proposed livelihood model there is only 1 model (Model 1 –raise blood cockle) is located outside the sea dyke and biosafety methodology will be demonstrated while other remaining 4 models (all related to shrimp farmig) will be located in the inner side of the seadyke and several demonstration sites will be selected for these models. Background information in Chapter 2 (2.2.3 Current livelihood models) suggested that at present there are existing farming systems in the subproject area as follows:

- Blackish water zone (comprising double rice cropping, alternating rice shrimp, freshwater aquaculture, and freshwater capture fisheries);
- Saline water zone (alternating shrimp-rice, saline crab farming, and saline water capture fish);
- Saline water zone (year round improved extensive shrimp and saline water capture fisheries in the canals, intensive shrimp pond; and
- Mangrove zone (mangrove-aquaculture covering around 40% of the area).

Although the proposed livelihood models will have many positive impacts for the environment and can increase farmer's income, theycan also create some risks on the local environment and local population. The nature and extent of the risks/impacts will depend on type and location of the activities as well as on on-farm management and financial capacity of farmers while the financial risks and benefits to farmers could be high.

4.6.1. Potential positive impacts of the subproject on socio-economic

The implementation of economic models will create the additional incomes for residents. The production activities will be created and developed in association with the master plan of production areas and products. The technology transfer via model application is aimed to reduce the cost, increase the product quality and product types, therefore, constribute into incomes increase.

In the production model No. 4 and 5, there includes organic rice farming activities. The rice production in this model is oriented towards organic rice production, restricting the use of herbicides and fertilizers, technical solutions applied to rice production including applicable measures of Integrated Pest Management (IPM), applicable solutions of "one must - five reduce" in rice production. This is the condition for the development of production models reducing production costs, reducing the use of fertilizers and pestisidesand bringing economic benefits to the people as well as reducing waste disposals into the environment.

Experience in implementing the "1 Must 5 Reductions" program began in Kien Giang in 2009 (*Table 70*).

Table 70: The benefits from model one Must five Reductions in Summer-Autumn rice at Kien Giang in 2009

	Unit	**Model "one Must five Reductions"**	**Nomal production**	**Difference**
Rice seeds	kg/ha	125	149.5	24.5
Fertilizer				
+ Urea	kg/ha	110.6	117.5	6.5
+ Phosphate	kg/ha	58.0	66.4	8.4
+ Potassium	kg/ha	53.3	53.6	0.3
Pesticides				
+ Pesticides	Times of crop	0.9	3.3	2.4
+ Fungicide	Times of crop	2.5	3.8	1.3
Pumping water	Times of crop	5.8	7.8	2.0
The falling rate		8.5%	20.0 %	11.5
Yield	Ton/ha	5.66	5. 47	0.19
Profit	**(VND/ha)**	**11,508,000**	**7,768,000**	**3,740,000**

Source: DARD Kien Giang, 2009

Farming 1 hectare of rice has a positive yield by decreasing the following; 24.5 kg of rice seeds, 6.5 kg of urea, 8.4 kg of phosphate, 0.3 kg potassium, 2.4 applications of the pesticides per crop, of 1.3 sprays of fungicide per crop, 2.0 times of pumping water /crop and 11.5% of the falling rate and an increase of 190 kg of rice in yield and a profit of 3.74 million dong/ha compared with normal farming practices of the people.

Thus only 50% of the land's production in the area of subproject (18.000ha) is applying a good practice of the "One Must 5 Reductions" in their rice production. The one-year operating profit from their production will be 67 billion dong. This operation can reduce 11.7 tons of urea fertilizer, 15,3 tons of phosphate, and 0,54 tons of potassium, decreasing all that waste discharge into the environment.

Regarding pestisides, because each chemical applies a different dosage e.g. the hoppers insecticide in powder form is usually applied about 30-150 g/ha/time or the liquid form is applied from 0.25 to 2 liters/ha/time depending on the type. However, if calculating only the powder pesticides with an average of 50 grams/ha/application then in 1 year alone the threee communes on the East side of the Hau River could reduce 220 kgs of pesticide and 120 kg of fungicides. This is a significant number that needs special attention and concern for the environment, and for the health of all people, farmers, and consumers.

4.6.2. Potential negative impacts during construction

Implementation of the proposed Model 2 (mono culture shrimp) and Model 3 (polyculture shrimp) may require some improvement of on-farm systems to ensure achievement of good production practices. However, potential impacts of these works will be low, localized, and limited to each farm and it will be made with technical assistance to be provided by the subproject to ensure that the system has the right design to implement the demonstration activities. It is not expected that improvement of on-farm systems will be required for other proposed models (Models 4 and 5 which involve shrimp-rice and shrimp-rice-prawn). *Table 57* provides results of an impact assement of these models while details are discussed below.

4.6.3. Potential negative impacts during operation

Recognizing the potential negative impacts of these livelihood activities on mangrove destruction could be serious, the subproject has been designed carefully to select the existing farms that could be used to demonstrate good agriculture practices, biosecurity, and/or other environmental friendly technologies. Therefore, the negative impact on mangrove due to site clearance for construction of new ponds/farms will not occur. Main impacts on local environment will be limited to management of wastewater and bottom sediment to be discharged from the farm during operations.

4.6.3.1. Negative effects are not related to wastes

It has been demonstrated worldwide that while production of shrimp could bring large amount of profits it could also bring large amount of debtsto farmers as well. Therefore,operations of these models may have serious impacts on livelihood and income of poor farmers and care must be undertaken to provide adequate knowledge and understanding on the technical, management, and financial aspects of these models.*Table 71*summarizes the potential risks of these models.

Table 71: Potential risks of livelihoods models

Livelihood Models	***Technical Risk (see discussion below)***	***Financial Risk***	***Remarks***
1. Raise blood cockle under mangrove canopy	Lowif the water quality is not very turbid	Low	Production area can be control by the government to avoid over expansion of the model.
2. Monoculture of shrimp (Monodon)	Very high especially if water quality is not clean	Very high, especially for the poor	Shrimp farming is considered a high risk-high profit business and it has to be regulated and monitored closely to minize potential neagative impacts on water quality, soil, and mangrove area. High quality of shrimp products for exprt has become the driver for the application

			of many certification efforts, but this only the beginning in Vietnam. It is necessary for the local authority to effectively control the expansion of new farms in mangrove area.
3. Shrimp-crab/fish	High	High	Need training for poor farmers
4. Shrimp-rice	Moderate	Moderate	Need training for poor farmers
5. Shrimp-rice-prawn	Moderate	Moderate	Need training for poor farmers

4.6.3.2. The negative impact related to waste

a). Wastes from aquaculture cultivation

All proposed models have aquaculture activities; however, each model may have different aquacultural methods, scales and technologies. Thus, their impacts on environment may be different.

Model 1: Raise Andara granosa under forest canopy

This model is completedly maintaining the natural conditions without using any kind of food, chemicals or drugs. Rasing the Andara granosa will not create waste to environment, in constrast, it helps to treat water and improve water quality.Nonetheless, harvesting of blood cockle could increase the level of suspended solid in water colume but it will be temporary and settledown. The impact is considered low.

Model 2:Mono cultureshrimp(2 crops/year)

Currently, there have many methods of shrimp farming, but concentrating into 3 main methods:

- Traditional or extensive method of culture operation: stocking density of 0.3-0.5 fry/m^2. (about 3,000–5,000 fry per hectare). No need to feed them entire farming and water exchange by tide fluctuation so impacts of this method on environment is low.
- Improved traditional or semi-intensive method culture operation: stocking density of 2-7 fry/m^2, using small amount of food for them so impacts of this method on environment is low.
- Intensive method of culture operation: stocking density of 15-50 fry/m^2, fed daily with artifical foods. Due to high stocking density leading to high amount of waste generation and impacts on environment of this method is also high.

There have been a lot of studies related to impacts of shrimp farming on environment (as soil, water pollution, aquatic life) and decrease of mangrove forest area, in which the intensive method is considerated as highest impacts.

The wastes from shrimp ponds consist of: (a) solid matter, a mixture of uneaten food, feces, phytoplankton, and colonising bacteria, and (b) dissolved matter such as ammonia, urea, carbon dioxide, and phosphorus (Macintosh and Phillips 1992). The wastes include amino acids, proteins, fats, carbohydrates, fiber, minerals, and bacteria (Boyd 1989).

Table 72: The relationship of FCR to waste production fer tone of shrimp

FCR	***Organic matter (kg)***	***Nitrogen (kg)***	***Phosphorus (kg)***
1,0	500	26	13
1,5	875	56	21
2,0	1250	87	28
2,5	1625	117	38

Source: Lin 1995

Table 73: Waste load of shrimp pond effluent and other types of wastewaters

Type of wastewater	***Unit***	***Shrimp pond effluent***	***Untreated sewage***	***Primary-treated sewage***	***Biologically treated sewage***
BOD	mg/l	4,0–10,2	300	200	30
TN	mg/l	0,03–3,40	75	60	40
TP	mg/l	0,01–2,02	20	15	12
Solids	mg/l	30–225	500		15

Source: Beveridge, Phillips, Mackintosh, 1997

Aquaculture wastes not only affect on water quality due to risk of pollution from feeds and waste but also from chemical application to prevent and control the desease for raised animals, mange the quality of feeding water and soil and create the favourable conditions for raising and harvesting. The potential used chemicals are listed as following:

- Soil and water treatment (EDTA, lime, Zeolite);
- Disinfection chemicals (Natrium or Cansium hypochloric, chloramine, Benzalkonium chloride (BKC), Formalin, Iốt, Ozone);
- Pesticides and herbicides (Saponin, Sotenone, Amoniakhan, Gusathion, Sevin, Organophosphates, Organotins);
- Antibiotics (Nitrofuran, Erythromycin, Chloramphenicol, Oxolinic axit, Sulphonamides, Oxytetracycline);
- Others (Formalin, Acriflavine, Green or Blue Malachite,Kali permanganat, Trifluralin);
- Feed indegrients (Immunostimulants, protective and conservative chemicals and anti-oxidants and feed attractive components, Vitamin);
- Thus, if the aquacultural activities are not managed well enough, it will cause significant environmental pollution. Those impacts must be controled and mitigated during the operation by applying the environmental management plan to ensure that the aquaculture do not pollute or has adverse impacts on environment.

In the production Model 2: Shrimps culture proposal is the improved traditional model. The density is not high about 7 fry/m^2. The evaluated productivity is about 1.2 – 1.5 ton/ha.

Cause the shrimps cultures rely on the nature that bring them foods, the feed conversion ratio (FRC) remains low at about 1. The waste quantity could be then estimated for 1 ha shrimps culture as in *Table 74*.

Table 74:Wasted quantity of shrimp's culture under improved traditional model

Parameters	**Unit**	**Value**
Yield	Ton/ha	1.3
Feed conversion ratio- FRC	-	1.0
Waste		
Organic matter	Kg/ha	650
Nitrogen	Kg/ha	33.8

Phosphorus	Kg/ha	16.9

*Table 74*shows that 1ha shrimps raising induces wastes of 650 kg organics; 33.8 kg nitrogen and 16.9 kg phosphorus per each crop.

For 650 kg organics/10,000.m^2, the organic quantity is then 0,065kg/m^2 within a period of 4 months, not significant that micro-organisms treatment process can limit considerably impacts to the environment.

Compared to the rice production that needs 100kg N; 30 kg phosphorus, this model generates low wastes from nitrogen and phosphorus. The raising ponds can auto-regulate naturally then pollutes less to the environment. As analyzed above on this model, the impacts of wastes deterioration from shrimp food remain low to the environment.

In fact, in the subproject area, there have some areas of intensive shrimp (20ha), so the risk of increasing the area of intensive shrimp will happen during the subproject implementation.

Table 75:Forecast of waste from 1 ha intensive shrimp farming

Parameters	**Unit**	**Value**
Yield	Ton/ha	4
Feed conversion ratio (FRC)	-	1,5
Waste		
Organic matter	Kg/ha	3500
Nitrogen	Kg/ha	224
Phosphorus	Kg/ha	84

*Table 75*shows thewaste generatedfrom fooddue to intensive shrimp farmingoperationsof1hais high: 3,500kgof organic matter, 224 kg of nitrogen (N) and84kg of phosphorous (P). The wastes of P and N from intensive shrimp are 2.2 and 2.8times, respectively higher than these in rice farming in the same condition. So the subproject's owner needsto pay attention when increasing the area for intensive shrimp farming and waste from intensive shrimp farming must be treated before discharging into the environment.

The previous studies also showed this activity will cause high negativeimpactstothe areaof coastalmangroves. However, in the subproject area, shrimp ponds have been developed about10-20years and shrimp farming model funded in the subproject will be developed in the existing ponds so no impacts of this activity on the mangrove area.

The impact from the sludge after the shrimp harvesting

After each shrimp crop, farmers usually have to renovate ponds for the next crop in which dredging is the most important activity. Due to low awareness and low area for shrimp, farmers pump directly mud from dredging their ponds into canals. This causes increasing suspended solids content and sedimentation and pollution of canal water. There have no separately canals for water supply and drainage in the subproject area, so this waste from pond will impact on other ponds. These are problems that occur in many other shrimp farming areas, so the subproject should have good management measures to ensure the operation of sludge from shrimp ponds must be managed and handled properly defined, is not discharged directly into waterways causing environmental pollution.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.

Model 3: Culture shrimp(*Penaeus monodon)*with other targeted animals (fish, crab,etc.)

This model is a similar to Model 2in which low stocking density of shrimp (5 frys/m^2) will be applied whileaddingcrabsand fish.

Dueto thelower stocking density than Model 2, impacts of this model on environment are lower than the Model 2. Adding crabs and fish in this model will generatecontinuousfood chainin the pond. Thewastefromthe shrimpwill be thesource offood for fishandfishinthis casecontributepartially treatedwastefromshrimp. The impact ofthis modelon the environmentis considered moderate.

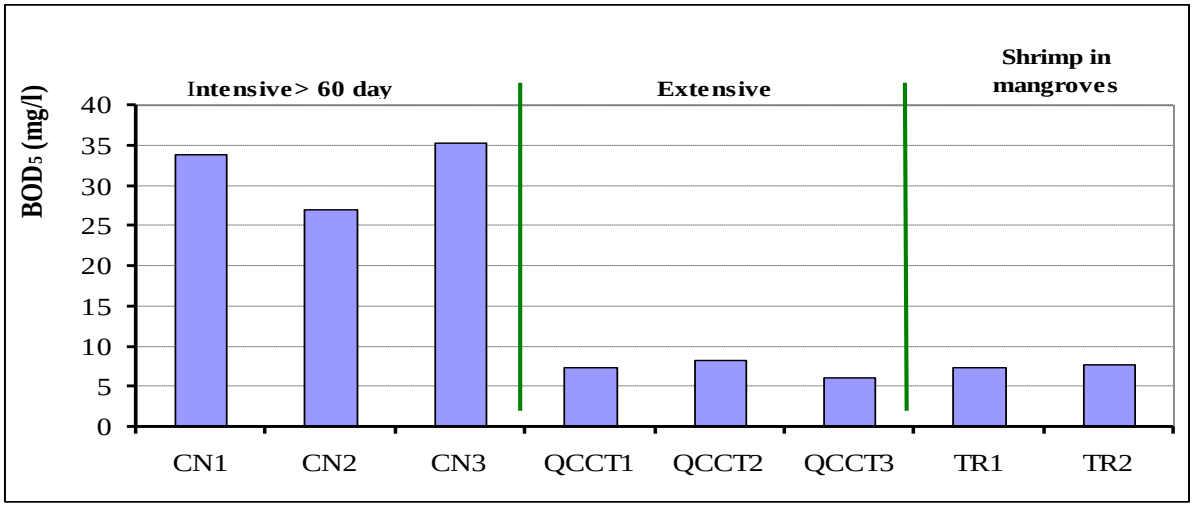
Model 4: Shrimp – Ricerotation

In the shrimp/rice rotation systems, the 3-4 month shrimp crop is cultured in the dry seasonat low stocking densities (3 to 5 prawns per square meter) and rice is planted during the rainy season. Due to enhanced soil fertility after the shrimp crop, very limited fertilizer is used for rice cultivation.

Due to the lower density so the negative impact from shrimp farming activities on the environment is considered low.

Model 5: Shrimp (Penaenus mondon) – Rice + Shrimp (*Macrobrachium rosenbergii*)

This model is similar to Model 4, however, Giant freshwater prawns(*Macrobrachium rosenbergii*) are also normally stocked during rice cultivation at low stocking densities (3 to 5 prawns per square meter). Due to low density of *Macrobrachium rosenbergii* raised and they mostly use the natural food in water field without feeding, therefore, theis impacts on enviromenta are less significant and controlable.The impact is considered low.



Source: SIWRR, 2013

Figure 45: Comparision of BOD_5 concentrations due to different methods of shrimp farming in the Mekong Delta

b). Waste from rice cultivation

Rice culture normally relies considerably on fertilizers and pesticides. The previous researchs showed the impacts of rice culture to the environment. The most negative one is the use of pesticides. On the market, there a plenty of commercialized pesticides, most of which contain these 6 active substances (*Table 76*).

The active substances also impact shrimp cultures. The local experiences shows that in the rice areas handled pesticides, the shrimps culture is not efficient, low living percentage, slow

growth. In An Giang prawnraisers choose only fields without pesticides for shrimp culture. If the pesticides are used in productions, the risk of its residue in soil is high that affects shrimps raises.

Table 76:Classification of pesticides by active substances

No.	*Pesticides*	Class **(WHO)**
1	Fenobucard	II
2	Isoprocard	II
3	Buprofezin	III
4	Etofenprox	-
5	Imidacloprid	II
6	Thiamethoxam	III

Note: II. Moderately hazardous; III. Slightly hazardousb

Source: The WHO recommended classification of pesticides by hazard and guidelines to classification: 2004.

Conscious of the issues, farmers do not use pesticide for production on rice fields that combine with shrimps raising. Moreover the rice culture is not continuous, because of the 4 months rainy season (from August to November) that is followed by shrimp. The alter activities induces similar impacts like pesticide without using the chemical one.

The rice culture on shrimp fields reduces the need of fertilizers, i.e. Do Van Xe, 2010. The quantity of fertilizers used in rice-shrimps combined model equal to 78% to normal rice culture model. It indicates that the reduction of fertilizers in combined rice shrimps model contributes to lower impacts of fertilizers used in rice culture to the environment.

In fact, shrimps output represents 70 – 90 % of the profit of the combined rice-shrimps model, rice production then represents 10 – 30%. The objective of rice culture is therefore not only for productivity itself, but also for conditioning shrimps fields. The rice culture creates interrupted periods of pests development in the environment, then reduces damages caused by pests. The rice roots produce organics for soil that supports the development of vi sinh vật as well as natural foods for shrimps that reduces the need of industrial foods for shrimps culture.

In conclusion, the rice production in the combined rice-shrimps model that does not use pesticides, reduce fertilizers and rice scale, minimize the negative impacts to the environment and commercialize the organic rice, compared to traditional rice culture model.

4.7. Induced impacts due to implementation of the livelihoods models

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 (i) changes in landuse from rice cultivation to intensive shrimp farming, (ii) degradation of mangrove areas, and (iii) 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 address comprehensively at the provincial and local levels.

4.8. Impacts due to safety risks and accidents in construction of sluice gates

4.8.1. During preconstruction phase

The significant potential risks of the subproject can be:

- Explosion during the ground preparation: explosive material exploration and disposal is one of the tasks belongs to ground preparation areas. In order to ensure safety for people, equipment and machine as well as of the whole subproject, the Board of Project Management will be in charge of this task. The explosive material exploration and disposal task is conducted at the same time with the subproject execution. This is a very dangerous and difficult task with specialized operational procedures which will only be performed by the competent Divisions of the Ministry of Defense.
- Difficulties in finding new job, new income, and dispirited psychology arise due to the land reclaimed and moving to the new residents.
- Due to the above mention disagreement, the ground clearance progression may be delayed.

4.8.2. During construction phase

a). Accident at work

In general, accident can be happened anytime during the subproject construction. The causes of accidents at work are:

- Unconcentration of workers during the materials transportation, execution, and installation can cause incidents or traffic accidents.
- Accidents caused by the lack of personal protective equuipment (PPE) or by workers not following safety rules and negligent at works.
- Loss of life due to unsafe electric cables at the construction site.

This is assessed as the most concern matter at any construction site. The subprojct owner should strictly monitor to ensure that the contractors have a safety plan in place and perform strong commitment during the construction time. These impactswillbe minimizedandcontrolledinthe environmental managementplan.

b). Explosion, material leaking

Explosion can be happened during fuel transportation and storage or due to unsafe temporary power supply system which can cause damage to people and properties during construction. The root causes can be identified as following:

- Temporary fuel/material tankers such as gas, oil, etc are the source of explosion. Explosion due to this type of source can cause fatality and significant impacts to the economic and society as well as to the subproject progression.
- Equipment and machinery temporary power supply system can cause electric shock, short circuit, fire and explosion, etc. which will lead to fatality of workers and surrounding residents and damage to the properties and economic.

The subproject owner shall have strict requirements for the contractors in fire and explosion control, electric system, and fuel management, etc. The fire prevention plan will be implemented regularly, therefore, the risk of fire accident will be low, and the potential impact will be insignificant.

c). Waterway accidents

Because almost all the materials will be transported by waterway, the accident can occur due to the boats are collided during the transportation to the work sites. This incidents can cause serious impacts to the environment, especially to the water surface such as the turbidity of water river, on the surface of water rivers and water canals.

4.8.3. During operation phase

As analyzed above, safety risks and accidents may arise during the subproject implementation. Risks and accidents happening during operation are mainly derived from subjective causes; sometimes there are objective reasons. The reasons that might lead to safety risks and accidents are:

- The technical quality of the works is not guaranteed from the beginning;
- Operation of work is not carried out according to regulation;
- Regular maintenance activities do not comply with regulation;
- Not comply with processes in repair and maintenance of sluicegates.
- People lacking awareness of protection of the works;
- Creatures stick to the sluicegate causing difficulties for operation, even causing damage to the sluicegate.

4.6 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 Table 77. Most of the regional impacts of the subproject are positive including: Reduced coastal erosion; Reduced damage from storm surges and sea level rise; Improved resilience of farmers; 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 rise; Establish mangrove-clam farming systems. The REA indicates that the subproject may have negative regional impacts due to construction of the infrastructure to prevent coastal erosion and to support aquaculture production in An Minh and An Bien districts of Kien Giang province and implementation of the livelihood models. The key regional adverse impacts include:

- ***Installing water/salinity control structures in the delta estuary and peninsula:*** Salinity intrusion affects existing freshwater agriculture areas; Barrier to fish migration and ecosystem connectivity; Conflict between freshwater and aquaculture water uses; Surface water quality impacts when opening sluice gates; Groundwater aquifers impacted by salinity intrusion;
- ***Development of livelihood models in delta estuary and peninsula:*** Surface water quality issues of aquaculture and shrimp farming; Livelihood programs not provided to vulnerable groups, ethnic minorities people, 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 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 77: Summary of regional impacts for Components 3 of the MDICRSL Project

Activity	**Demand on natural resources**	**Significant impacts**	**Impact**
		Intensity/Extent/Duration	**Rating**
Installing water/salinity control structures in the delta estuary and peninsula	Changes hydrological flow and land use.	• Salinity intrusion affects existing freshwater agriculture areas ***M/Sr/Lt***	**Moderate**
		• Barrier to fish migration and ecosystem connectivity ***H/R/Lt***	**Minor**
		• Conflict between freshwater and aquaculture water uses ***M/Sr/Mt***	**Moderate**
		• Surface water quality impacts when opening sluice gates ***M/Lo/St***	**Minor**
		• Groundwater aquifers impacted by salinity intrusion ***M/Sr/Lt***	**Moderate**
		• Reduced coastal erosion ***H/R/Lt***	**Moderate**
		• Reduced damage from storm surges and sea level rise ***M/Sr/Mt***	**Moderate**
		• Improved resilience of farmers ***H/Lo/Mt***	**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

4.7 ASSESSMENT OF DETAIL AND REALIABILITY OF ABOVE ASSESSMENTS

4.7.2 Assessment of reliability of the method used in the ESIA report

- Statistical and comparative methods: In completing the ESIA the Environment Team has taken many observation, data collection in subproject corridor, Those data has been updated and for series of years. Therefore, such methods could give reliable and accurate results.
- Field observation, measurement and sampling, sample analysis in laboratory and social survey are methods used in this ESIA, People, who are trained, experienced, and working in such technique for years, conducted those activities. The data from such methods could ensure accurately and reliability about environmental quality.
- Environmental rapid assessment method: the application follows guideline of WHO in quantifying pollutions that depends on pollution coefficients. This method could quickly give outputs that are used for other assessments.
- Integrated analysis and assessment methods: this method used to synthesize environmental impacts caused by subproject then propose the mitigation measures. Though these methods are subjective assessments it is still reliable if it is done by environmental experts who experience with those impacts. The impacts will be assessed depending on realities of local contexts as well as subproject designs before propose mitigation measures that should be appropriate and feasible.
- The characteristics of impacts were identified according to experiences of experts, secondary data as well as quantification of impacts that are caused by subproject activities. The impacts were quantified through used materials, emission coefficients from reliable sources such as Assessment of Sources of Air, Water and Land pollution by WHO (1993), Environmental Impact Assessment by Larry W. Canter (1997).
- Determining the spatial scale and time scale of impacts carried based on expert consultation method, analyzing the current characteristics in terms of scale, scope and construction plans in considerations of local climate conditions, infrastructures as well as environmental management regulations.
- Impacts assessments considered to the scale of impacts, spatial scale, time scale as well as sensitivity of recipients. The actual experiences are very important in assessing the impactsand proposed the mitigation measures. It requires understanding local social and environmental context as well as local environmental regulations.
- The assessments were details enough that allow proposing mitigation measures, in later section, to mitigate negative impacts as well as have feasible preparedness and response plans for emergencies.

4.7.3 Reliability of the assessment

- All impact assessments were conducted by experienced experts as well as useful tools that give reliable and accurate results. Impacts type and impacts scope were assessed for different phases of subproject implementation so that they reflect reality. Therefore, investor has committed to mitigate negative impacts as well as pollution control, which are detailed in later sections.

- The quantifying pollutions assessed based on the fuel consumption and emission norms documents. For example, the application of emission norms of vehicle WHO 1993; or calculation of noise level applied guideline of Pham Ngoc Dang 1997.
- The assessments were analyzed by experts who experience in practices and scientific researches as well as participate in many ESIAs therefore their opinions or analyses and solutions that are determined.

CHAPER 5. IMPACT PREVENTION AND MITIGATION MEASURES

The impact analysis conducted in Chapter 4 suggested that the potential negative impacts of the subproject 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 measures is presented in Chapter 6.

5.1. Measures to mitigate site–specific impacts for the 9 sluice gates (Component 1)

5.1.1. Pre-construction phase

As discussed in Section4.4.1, key site-specific impacts for the subproject during preconstruction phase are: (i) Impact on households whose land is acquired permanently and temporarily; (ii) Impact from landmines and explosives which still persist in the ground; and (iii) construction site clearance in additiona to the general requirements described in ECOP. To prevent and/or mitigate these impacts, the subproject owner will perform the following tasks:

5.1.1.1. Organization of compensation for households whose land and houses are lost and support for their livelihood restoration

- Get local community opinions on the land acquisition and resettlement plan for residents who give land for the construction of the subproject works and complete the compensation plan to meet the aspirations of people.
- Organize and pay compensation for households whose land and houses are lost according to the Resettlement Action Plan (RAP) that has been prepared for the subproject and approved by the World Bank (WB) and the Ministry of Agriculture and Rural Development (MARD). Basic principles and procedures for compensation will follow those described in the RPF that has been approved by WB and MARD.

5.1.1.2. Mitigation measures for safety risks of unexploded ordnances (UXOs)

To address safety risks associated with UXOs, the subproject will allocate fund for UXO clearance of all the construction areas. The subproject owner will sign a contract with the specialized military unit in Kien Giang province to carry out an 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.

5.1.1.3. Construction site clearance

- Gathering and collection of wastes due to demolition of works, structures and clearance of trees around the construction sites.
- Providing regulation on demolition time and transport of demolished materials to avoid the resting time of local communities (allowed time is from 6AM to 6PM).

- Measuring accurately the scope of site clearance to minimize the number of trees to be cut down;
- It is strictly forbidden for the contractor to dispose waste including waste soil, plant materials into the flow, especially the 9 canals where sluice gates will be built.

5.1.2. Construction phase

As discussed in Chapter 4, construction of sluice gatescan increase the level of air, noise, vibration, local traffic, wastes, water pollution, etc. and these impacts could be mitigated through the application of ECOP in general.However, in order to minimize negative impacts, the subproject ownerwillalso require the contractor to implement the following site specific measures:

5.1.2.1. Minimize social negative impacts

In order to minimize social negative impacts, the subproject owner and the contractor will:

- Inform transparently to government and local people about the subproject plan before constructions.
- Declare temporary residency of workers coming from other regions.
- Control wastes and residues disposal and treatment in zones near gardens, fields, ponds raising fisheries and other water resources.
- Respect local culture and religion.

5.1.2.2. Minimise noise impacts

- The construction noise mainly comes from hammer piling and movements of transport vehicles.In order to minimize impacts to the environment, the constractor hasto deploy the following solutions: (i) The transport vehicles satisfied noise standard by the responsible authority can be used for project; (ii) Control operational time of material transport, concrete mixing, piling within the day time,no construction will be allowed at night time to ensure the people's sleeping time; (iii) When the construction vehicles make noises that exceed the authorized standards, they need to stop working for maintenance; and (iv) In the construction site of sluice gates, there is electricity, it would be better to use machines like concrete mixer and compactor to reduce construction noises.
- Noise analysis presented in *Table 68*suggested that most of sluices locations are quite far from sensitive receptors, except the first sluice location which is about 50 m from school and 250m fromXeo Dinh church. The contractor needs therefore to implement appropriate solutions to minimize the noise impacts as follows: (i) No piling during school time, the most appropriated piling time is summer holidays. It is possible to use the bored piling technology; (ii) The churchs organize the masses on Saturday and Sunday that requires to reduce noises. The construction units need to avoid piling on Saturday and Sunday, and avoid constructions implemented during mass times.
- *Table54* show that on the road transporting materials for sluices, there are some residencial areas where noises and vibration from vehicles may affect local residents especially increase road safety risks. In order to minimize the negative impacts as the following measures will be employed: (i) No material transport at night (ii) the transport that crosses schools need to respect the authorized timing and noise level.All equipment that participate to the transport

need to have validated controlled certificate for noise standard. Stop immediately the transport due to reactions of people living in these susceptible zones.

5.1.2.3. Minimize the impact of air pollution

- Use the appropriated fuel following engine design: diesel that contain less than 0.25% sulfure.
- Ensure a control and regular maintenance of equipment to improve engines productivity.
- All equipments used in the construction phrase need to satisfy Vietnam Standard of engine air emissions (QCVN 05:2009/BTNMT). Prior to the implementation, a list of equipments emissions controlled document need to be sent to investors for approval.
- Do not burn wastes in construction sites, avoid spreading emissions fromburning undetermined origines materials as well as minimize explosion risk.
- Manage wastes induced in the construction sites to avoid the deterioration that causes polluted smell in air.
- Install mobile toilets that meet hygene standard on sites for workers.

5.1.2.4. Minimize the environmental pollution

As analyzed in Chapter 4, the constructions impacts to water resource remain low and moderate. The wastes are mainly from fuelused during the sluices construction process and daily workers activity disposals then diluted by rains. The measures to minimize water resource pollution are as following:

- Do not dischargeoil/fuels to the environment in any case. Used oil/fuels need to be collected as toxic wastes. Fuel cleaned rag also need to be collected and treated following the regulation.
- The transport vehicles (land and water) need to be covered to avoid dust dispersion to the environment.
- Clean construction sites as regulated and ensure daily life water supply.
- Domestic wastes from construction workers need to be collected and no direct isposal into canals and cause water pollution or left on construction site that can cause water pollution when raining.
- All cement bags and other construction wastes need to be collected and disposed off properly; no disposal into the canals.
- For the materials depot areas that risk erosions, it needs to build embankments to avoid wastes, dusts eroded by rains to channels.
- For the areas with acid soil, the contractor needs to work with expert to prepare a plan to limit the impactsof acid leaching in the beginning of rainy season. At the area with acid sulfate soil (soil pH 5-6), lime should be used for neutralization. At the area with serious acid sulfate soil (pH <5), the alkali soil will be used for covering to constrain acid sulfate.
- Create wastewater drainage to an area that can be further treated so that wastewater cannot flow directly to the canals.

Special attention*:* *Table 68*suggested that there are some aquaculter farms located nearby the contruction sites at Thu Nhat sluice gate and Xeo Ban sluice gate, the subproject owner and contractor will pay special attention on the following:

- Ensure that there will be no discharge of any wastes/pollution from the construction site that could affect quality of water supply to the nearby aquaculture ponds/farms;
- Consult with the farm owners to ensure that the construction time will not have any impacts on the farming activities; and Coordinate with local people. If accident that can affect water quality occur, alerting people and local authorities and taking actions to prevent water flows into the nearby aquacutlture ponds/farms.

Environmental monitoring: To ensure that the construction of sluice gates will not create significant impacts on local environment and local people/activities, an environmental monitoring program (air, noise, vibration, water quality) will be conducted at the construction site as well as at critical location that may have significant impacts and details are presented in Chapter 6.

5.1.2.5. Methods to minimize impacts on water transportation

As suggested in Chapter 4 that the impacts on water transport will be low, however to reduce the accident risks to the people that may passing through the construction sites, the following measures will be implemented:

- Install navigation traffic signs throughout construction sites. Traffic lights signal construction means to raise attention of passengers particularly at night.
- The contractor should be required to assign a person to be responsible for planning and management of water transporation of construction materials and provide guidance on water traffic so that people can find alternatives for their navigations.
- Coordinate with local authorities to inform about the construction plan, process, and other transportation security issues in order to minimize safety risks and potential negative impacts on local residents.

5.1.3. Operation phase

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 the fact that there are existing 9 sluice gates under operations and that the new 9 sluices will not be constructed at the same time. 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 such as blood cockle farm near Xeo Ban sluice. 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.

- During implementation a Technial Assistance (TA) will be implemented to support for real time operation of hydrolics system monitoring in the MD. The purpose of this monitoring system is to enhance the reliability and proactive real-time prediction of water information supporting to operation of hydraulic structures in the MD to improve the effectives of irrigation systems in managing the water, mitigating flood risks, water supply, drought and salinity intrusion control. The subproject will be benefit from this TA for optimal operation of the sluices.

5.2. Measures to mitigate site–specific impacts for the protection of coastal erosion (Component 2)

As suggested in Chapter 4 (Section4.5) that the negative impacts of this component during pre-construction, construction, and operation will be low and may be limited to safety risks. In order to minimize negative impacts, the following actions will be undertaken by the subproject owner:

- During preconstruction and constraction, the contractor will be required to (i) inform and consult with local authority and local people about the site preparation and construction plan; (ii) organize collecting lubricate for each changing time and sent to recycling storage as properly defined in Circular No.36; all lubricate and fuel containers must be collected as regulated for hazardous waste treatment and must not be discharged directly into the environment as well as sold as scraps; (iii) all barges at sea must have toilets for workers to ensure sanitary conditions; and (iv) install proper traffic and navigation sign must especially for night time.
- During operation, the agency responsible for the mangrove plantation and management of the area will ensure that proper navigation sign is installed and maintained, especially for night time. Effort should be made to engage local communities to participate in the mangrove plantation and maintenance.

5.3. Measures to mitigate site–specific impacts for the livelihood models (Component 3)

5.3.1. Mitigation measures not involving waste

- As discussed in Chapter 4 (Section4.6.3.1)that implementation of this component could create both positive and negative impacts on socio-economic and financial conditions of local farmers depending on many uncontrollable factors including various technical risks. However, to minimize the potetntial negative effects the Subproject Owner and the concerned authorities of Kien Giang province should implement the following comprehensive measures:*Provide technical assistance to promote development and expansion of trade for aquaculture products* by: (i) Developinga market forecasts for such products as *Andara granosa, Penaeus monodon, Macrobrachium rosenbergii,* organic rice to meet the demand of the consumption market; (ii) Developing brand for such products as *Andara granosa, Macrobrachium rosenbergii, Penaeus monodon,* organic rice as the impetus for this production development; and (iii) Finding out ways to establish stable market for *Andara granosa, Macrobrachium rosenbergii, Penaeus monodon,* organic rice through promotion of product introduction on the domestic and international fairs.
- *Provide in-depth knowledge on technical aspects on production by* applying the Field Farming School (FFS) approach with local farmers on technical knowledge as well as hand-

on training on ways to convert to new livelihood models. Key activities will include, but not limited to, (i) undertaking a series of technical workshops to provide basic knowledge on technical issues related to on-farm management as well as clear explanation on ways to convert to the new models; (ii) setting up a group of qualified agricultural/aquacultural extension officers who can provide direct guidance to local famers when they require through a "Training-of-Trainer or TOT" program including preparation of technical guidelines and/or manual that could be used to equip local farmers people enough knowledge and techniques when new models are introduced in the area; and (iii) establishing farmer networks through a series of study visits to appropriate areas so that farmers could have opportunities to exchange knowledge and implementation experience that could help enhancing quality of the model application.

- *Conduct socioeconomic survey*: This should be done to assess the potential impacts on socioeconomic of poor farmers to evaluate the effectiveness of the sustainable livelihood models in relation to poverty reduction in the subproject area. The findings of the survey will be the inputs to the design and adjustment of the models. If needed appropriate actions could be carried out during the implementation of the subproject.

5.3.2. Mitigation measures related to waste

5.3.2.1. Wastes from aquaculture operations

As discussed in Chapter 4 Section, only 1 farming Model No2 (intensive shrimp) is at risk of causing negative impact to the aquatic environment especially the intensive farming scale. To reduce impact farming intensive shrimp on the environment, the following range of measures must be taken by the farmers in pond systems to (i) reduce the amount of contamination of the effluent; (ii) prevent pond effluent from entering surrounding water bodies; and (iii) treat the effluent before its release into the receiving waters to reduce contaminant levels. The following management measures should be implemented to prevent the contamination of effluent:

Feed:

- Ensure that pellet feed has a minimum amount of "fines" or feed dust. Fines are not consumed and add to the nutrient load in the water;
- Match the pellet size to the species' life-cycle stage (e.g. smaller pellets should be fed to fry or juvenile animals to reduce the unconsumed fraction);
- Regularly monitor feed uptake to determine whether it is being consumed and adjust feeding rates accordingly. Feed may be wasted due to overfeeding or not feeding at the right time of day;
- Where feasible, use floating or extruded feed pellets as they allow for observation during feeding time;
- Store feed in cool, dry facilities and ideally for no longer than 30 days to avoid reduction in vitamin contents. Moldy feed should never be used as it may cause disease;
- Spread feed as evenly as possible throughout the culture system, ensuring that as many animals as possible have access to the feed. Some species are highly territorial, and uneaten feed adds to the nutrient load;
- Feed several times a day, especially when animals are young, allowing better access to food, better feed conversion ratios and less waste;

- Halt feeding at a suitable interval before harvest to eliminate the presence of food and/or fecal material in the animal's gut;
- During harvesting, contain and disinfect blood water and effluent to reduce the risk of disease spread and to contain effluent matter.

Suspended solids:

- Avoid discharging waters from ponds while they are being harvested with nets, as this will add to the suspended solids in the effluent drainage;
- If feasible, use partial draining techniques to empty ponds that have been harvested. The last 10–15% of pond water contains the highest quantities of dissolved nutrients, suspended solids, and organic matter. After harvest, hold the remaining water in the pond for a number of days before discharge, or transfer to a separate treatment facility.

Fertilizers:

- Plan the rate and mode of application of fertilizers to maximize utilization and prevent over-application, taking into account predicted consumption rates;
- Increase the efficiency of application and dispersion through such practices as dilution of liquid fertilizers or solution of granulated fertilizers prior to application. Other options include the use of powdered fertilizers or the placement of powdered fertilizer bags in shallow water to allow solution and dispersion;
- Consider the use of time-released fertilizer in which resin coated granules release nutrients into the pond water, with the rate of release corresponding to water temperature and movement;
- Avoid the use of fertilizers containing ammonia or ammonium in water with pH of 8 or above to avoid the formation of toxic unionized ammonia (NH3);
- Depending on the system (e.g., freshwater aquaculture), grow organic fertilizer (e.g. natural grass) in the pond basin after harvest;
- Initiate pond fertilization only in static ponds with no pond water overflow that can impact downstream waters and watersheds;
- Conduct pond fertilization to avoid or minimize consequences of potential runoff due to floods or heavy rain and avoid application to overflowing ponds.

Chemicals:

- Design the pond depth to reduce the need for chemical control of aquatic weeds and reduce thermal stratification;
- Do not use antifoulants to treat cages and pens. The chemically active substances used in antifouling agents are very poisonous and highly stable in an aquatic environment. Clean nets manually or in a net washing machine.

The following management measures can be taken in pondbased systems to prevent pond effluent from entering surrounding water bodies:

- Avoid automatic drainage of ponds at the end of the production cycle as the same pond water may be used to cultivate several crop rotations of certain species;
- Reuse water from harvested ponds by pumping it into adjacent ponds to help complement their primary productivity, provided that the level of BOD is controlled;

- Consider the hydrology of the region in the design of the pond system and ensure that the pond embankments are high enough to contain the pond water and prevent loss of effluent during periods of increased rainfall and potential flooding;
- Ensure that the ponds effluent meet the following standards (*Table 78*):

Table 78: Requirement of ponds effluent

No.	*Parameter*	*Unit*	*Allowable limit*
1	pH		5,5 – 9
2	$BOD_5(20^0C)$	mg/l	≤ 50
3	COD	mg/l	≤ 150
4	Total suspended solids	mg/l	≤ 100
5	Coliform	MPN /100ml	≤ 5.000

The following measures should be implemented by the local authorities:

- Transfer antibiotics technology in improved traditionaland imtensive shrimp farming for local people;
- Develop and promote implementation of the Vietnam Good Acquaculture God Practice (VietGap) for organic shrimps raising models;
- Monitor and supervise the use of medicals, disinfection chemicalsin aquacultural against the use of forbidden ones;
- Local authorities and communities to closely monitor implementation of the pond dredging. Strictly prohibition of pumping dredging sludge into canals;
- Enforce implementation of QCVN 02-19/2014/BNNPTNT on national technical regulation on blackish water shrimp culture farm - conditions for veterinary hygiene, environmental protection and food Safety.

5.3.2.2. Waste from rice planting

As discussed in Section 4.6.3.2 (b)the rice growing of the livelihood models mainly produce organic rice. However, to ensure the proper operation as expected, which reduce pesticides, fertilizers in agricultural production, the Subproject Owner - the Department of Agriculture and Rural Development of Kien Giang province must fully implement the following solutions:

- Organize widely agriculture extension classes to introduce people the integrated pest management measures (IPM) and "One Must, Five Reductions" program so that people understand as well as practice in reality.The IPM program is conducted in 4 steps as: (i) Step 1: Set up a preventive threshold, the point where pest populations or environmental conditions indicate that it is necessary to carry out pest control measures. The degree that pests become an economic threat is the threshold to make pest management decisions; (ii) Step 2: Monitor and identify types of pests. Do not destroy all insects or weeds. Many species do not cause harm and even some species benefit. This will preclude the use of pesticides; (iii) Step 3: Implement preventive measures such as crop rotation, selecting breeding varieties etc. which are high tolerant to pests and diseases. These measures bring more effective, cost less and are less hazardous to human health and environment; and (iv) Step 4: Prevent and identify pests. When the preventive threshold points out that it is necessary to have pest management measures (IPM). The IPMs will evaluate and select appropriate solutions on both validity and

level of risk. The effective, less risky solutions will be selected first like pheromones that kill males, making traps, field sanitation etc. The "*one must - five reductions*" program is based on the "*Three Reductions, Three Gains*" program the Department of Crops Production recognized as the new technical advance in the rice production in Vietnam. Accordingly, "*one must*" means using certified seeds, "*five reductions*" means reducing amount of seed, reducing surplus nitrogen fertilizer, reducing pesticides, reducing watering, and reducing post-harvest losses.

- Apply the organic rice production for Models 4 and 5.

5.3.3. Mitigation measures for induced impacts of livelihood models

From the environmental and social perspectives, implementation of Model 2 of monoculture may trigger induced impacts which include (i) changes in landuse from rice cultivation to intensive shrimp farming, (ii) degradation of mangrove areas, and (iii) 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. The following measures should be implemented by the provincial authority:

- Develop and implement spatial planning and management for the pilot and model sale up area which include zoning, site selection, and designation and management of an aquaculture management area;
- Develop and promote implementation of the Vietnam Good Acquaculture God Practice (VietGap) for organic shrimps raising models;
- Enforce application of government standards and/or promotion of good practices which could benefit all the farmers;
- Establish an effective regulations and/or control mechanism including providing incentives (via technical assistance) to ensure that future expansion of aquaculture farmings and/or the proposed models will be properly managed;
- Provide technical assistance to increase technical and management capacity of farmers through the FFS approach (see Section 5.3.1) as well as assist the agency in establishing a registration system for aquaculture farming.

5.4. Measures to manage, prevent and respond to safety risks and accidents

5.4.1. The subproject's measures to manage, prevent and respond to safety risks and accidents in the construction stage

The implementation of measures to manage, prevent the breakdown of labor safety and health of workers during sluice contruction are all committed by the Subproject owner, including:

For human:

- All officers and workers are health checked and trained about labor safety - sanitation as stipulated in Circular No.37/2005/TT –BLDTBXH dated 29/12/2005 of the Ministry of Labor - Invalids and Social Affairs and labor safety measures as stipulated in TCVN 5308 - 91. The training includes local people to be involved in the construction. After the training is completed, the list of labor safety cards are made to grant for each employee.
- All laborers working on construction sites are obliged to comply with the labor safety regulations as stipulated in TCVN 5308-91 on safety technical specifications in

construction.

- Equip adequate safety tools as anti-dust masks, boots, gloves, helmets on working to meet TCVN 2287-78.
- Workers are strictly forbidden to leave equipment when it is operating.
- Provide adequate sanitation water for workers on construction sites.
- Practice to cope and handle bad situations of labor safety on construction sites, means of rescue, first aid etc.

For construction equipment:

- All construction equipment on sites must meet Standard 2290-78 - Manufacturing Equipment.
- Construction machinery and facilities are registered and are calibrated by the competent authorities.
- The salvage activities for sunken boats, barges and materials, goods which are on boards, barges must not obstruct waterways. The rescue to chemical leaks must be under the national regulation: QCVN 17: 2011/BGTVT - National Technical Standard on Regulations for Pollution Prevention by Inland Waterway Vessels.
- Transport regulation must be arranged at two ends of construction sites; signboards in incident areas and forbidden areas must be plugged. Regulatory stations are required to guide vessels run safely through fairways.

Minimize and rescue waterway accidents:

- Equipment involved in material transport must meet the technical requirements.
- Material transporters must survey canal before shipping to arrange suitable means of transport on fairways.
- Organize to fully install traffic guidance signs in waterways.
- Transport at night is prohibited.

Minimize fires and explosions:During the construction process, if fires and explosions happen, the rescue must be implemented immediately in hazardous areas: proactively isolate hotspots/fires by available facilities on site (water, fire extinguishers etc.); organize workers to participate in fire fighting under the guidance of the functional units (which can be in remote contact) until the authorities appear at site; coordinate with local authorities to establish safety belt around hazardous areas; check fire safety conditions at site; ensure incidents do not continue; suspend the construction.

Finding cultural, archaeological artifacts: the contractors are required to protect the construction status and report to the construction supervisors and PMU, local museums and local Department of Culture and Information; deliver artifacts for local museums or cultural management authorities; consider whether the excavation is continued or stopped for the survey. The Director of the local Department of Culture and Information will be responsible for managing artifacts under Article 21 of Decree 92/2002 - Executable Instructions for Cultural Heritage Law.

When graves are found in excavation area: the subproject owner will require the Contractors to protect the status quo and notify local authorities; determine how to resolve and duties of involved individuals, relocation time and exhumation site (if available); implement proposed measures.

5.4.2. Management measures for prevention and response to the safety risks and accidents during the operational stage

There are concerns regarding the safety risks and accidents during operation phase of the subproject. The concerns on safety risks due to transportation (bridges and waterways) related to the sluice operations (Component 1)will be mitigated during the design, construction, and operations of Component 1.Installation of navigation safey sign will be made to mitigate potential risk during operation of Component 2.

To mitigate the potential risk of Component 3, the Department of Agriculture and Rural Development (DARD) of Kien Giang province and the local veterinary offices must organize tight control of variety sources of *Penaeus monodon*, *Macrobrachium rosenbergiiAndara granosa* to be traded in the region.When disease virus is detected, immediately destroy diseased shrimps to cut off the spread of infection. Establishment of the database for aquaculture farming in the subproject and nearby area (Section 5.3.2.1 above) could also help addressing the risks related to diseases that may occur.

CHAPER 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 Kien Giang 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 Kien Giang will be responsible for implementation of the mitigation measures during the operation phase 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

6.2.1.1. Positive impacts on the socio-economic condition

When the subproject is implemented, it will bring many benefits to the local residents, as follow:

- Actively regulate the water source therefore the residents can actively arrange the cultivation timetable or schedule suitable with the water source condition in the region.

- Diversify the cultivation objects and aquaculture objects meeting the food demand of the society, create jobs, increase the income of the residents.
- Reduce the impacts of natural disasters, impacts of the climate change on the region.
- Actively regualting the water source contributes to the improvement of the water environment, protect the production in climate change condition, rising sea level.
- Develop the road traffic condition for the coastal zone.
- Increase the non-agricultural production, business based on agricultural development.
- Develop and increase the mangrove forest area to contribute to the protection of the coastal line at the same time improve the biodiversity, maintain and sustain the fishery breeds resources in the nature.

6.2.1.2. Positive impacts on the environment

Positive impacts on the environment of the subproject can be listed as follows:

- Actively deacidification and desalination, control the saline intrusion into the complete fresh production area.
- Improve the environment thanks to the more environmental friendly production activities (VietGap model of fishery and aquaculture cultivation, organic rice crop cultivation production, reduce the utilization of herbticides, fertilizer in rice crop cultivation production, etc).
- The Integrated Pest Management (IPM) and the "One Must 5 Reductions" programs applied for rice will help to reduce pestisidesand fertilizer usages in production.

6.2.2. Negative impact

During pre-construction, potential negative impacts would mainly cause land acquisition, land clearance and UXO residues.

During construction, potential negative impacts on the local environment and the community will include increases in air pollution, noise, vibration, water pollution, waste generation, land and waterway transport, safety risks, and potential disturbance to local residents and other social impacts. Main sources of impacts will be due to preparation of land (clearance and land filling); excavation of soil, rock and concrete; construction of piers; transportation of materials and construction equipment; installation of a structural bridge and sluice gate; and activities of officers and workers at the work site and/or work camp.

During operation, potential negative impacts may include disruption to waterway transportation, increased sedimentation and water pollution near the sluice gate, a change in water quality and ecology, flood management due to sluice operations and road safety issues due to bridge operation.

The negative impacts of the subproject could be summarized in *Table 79*.

Table 79: Potential Negative Impacts of the Subproject

No.	Impacts/ Issues	Impact Description	Location / Affected Object	Level of impacts	Impact duration
A	***Construction of 9 sluice gates (Component 1)***				
A (I)	**Pre-construction phase**				
1	Land aquisition	The permanent land acquisition is 7,23ha, but only 20% of the permanent land acquisition is private land and 80% is surface water; and the temporary land acquisition is 3,63 ha. The number of households to be relocated is 67 households	- Local people of Tay Yen, Nam Yen, Nam Thai communes in An Bien and Thuan Hoa commune in An Minh commune	Low	Long-term
2	Land clearance	The construction sites for the sluice gates construction are mostly the water surface area, at the two canal banks, there are brushes/ shrubs, on the land there are some residential households and area for aquaculture and garden. The dust generation and exhausted gases sources in this stage is mostly due to the clearance, the relocation of houses out of the construction site. The number of affected house is 58 houses however; it is divided and spreaded widely over the nine sluice gates locations and in the coastal area. These houses are all level 4 corrugated metal-roof houses therefore the impacts caused by this house demolition activities on the air environment will only be low. The site clearance seems to have no impacts on the natural environment even the water surface, the cutting down of trees in the area is low; most of the trees are human planted trees.	- 67 affected households in the construction area of 9 sluice gates - Workers at the construction site.	Low	Short-term
3	Worker and public safety	Kien Giang was bombed heavily during the war period, UXO removal is important so as to avoid any potential threat to works and safety for local people and workers.	- Resident surrounds the construction area of 9 sluice gates - Workers at the construction sites.	Moderate	Short-term
A (II)	**Construction phase** (9 sluice gates)				
1	Dust generation/ Air pollution	Embankment and excavation activities the 9 sluice gates will generate dust.	- Local people in the surrounding area of the construction area of 9 sluice gates - Workers at the construction sites.	Low	Short-term

		The total volume of excavation – embankment of the subproject is about 101,749 m^3 and it will occur in the period of time of about four years. The construction site is the rural area with high humidity (30 – 40%), few residents, over 2 districts therefore, the impacts caused by dust generation from the excavation and embankment is low.			
		The construction of 9 sluice gates will use 66,600 m^3 of material (including 28,154m^3 of concrete) and will bring to the construction site by barges and boat from the construction material ports along Xeo Ro canal (9-10km far away from construction sites). Materials transportation via waterway navigation will be lesser dust generation and air pollution than via by roads and will be in rural area and sparsely people. The impacts will be low	- Local people surrounds the construction area of 9 sluice gates - Resident and sensitive receptors along the transportation route - Workers at the construction sites.	Low	Short-term
		The cement dust generated from the concrete mixing activity: total volume of concrete for the subproject is 28,154 m^3. The emission coefficient for the concrete mixing activity is 0.5 – 5 g/m^3 therefore the total cement dust generation is about 14-140kg dust. However, the concrete mixing activity only occur in the location adjacent to the sluice gates and far away from the residential clusters as well as it will disperse at 9 sluice gates locations then the impacts is low.	- Local people surrounds the construction area of 9 sluice gates - Workers at the construction sites.	Low	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. The piling activity mainly is in-canal and at least 50m away from the residential area and number of people live surrounding construction sites is not so many and time for pilling for each sluice gate is one to two months long. Therefore, the is low However, there only have 2 sensitive receptors in the construction sites (Tay Yen primary school - 80m from the construction site and Xeo Dinh church - 250m from the construction site). There need to pay attention to the 2 sensitive receptors during operation.	- Sensitive receptors in the construction sites (Tay Yen primary school and Xeo Dinh church) - Local peole surrounding the construction sites of 9 sluice gates - Workers at the construction sites.	Low	Short-term

		Noise from material transportation: the volume of material for each sluice gate is 11,600m^3, using 50-ton barges to bring this amout to construction site during 2 years will increase traffic density of 0.37 barge/day and this source is linear, time duration of the impact at one point on the transportation route lasts only in 1-2 minutes. This impact will be low.	Local people and sensitive receptors along the materials transportation route	Low	Short-term
3	Surface water pollution from excavation and backfilling activities, worker's camp and construction equipment.	- Wastewater from construction is mainly from concrete mixing station. The amount of wash water is about 30 - 50 liters/equipment/time. If this wastewater discharge directly into canals may affect aquatic life at the receiving point. However, this dicharges directly into the unused part of the site especially to the acid sulfate soil area and it can be neutral negative effects of acidic soil to the water environment. - Rain water run-off: In the construction site, 20% of construction site is acid sulphate soil but most of all is for workers' camp and construction yard. With 240 m3 of rainwater, about 140 m3 with acidity will be enter the canals and extending about 20 – 30 m from the receiving point, therefore the impact of flushing acidity from the construction site is low and locally and it occurs only after 2-3 rains at the beginning of the season so the impact is low - Wastewater from workers: 20 workers will be used for each sluice gate building, it means that 0.9 m3/day (equivalent to the amount of wastewater discharged from 4-5 households along a canal) of wasterwater contains organics easy to decompose, so if this kind of wastewater is directly discharged into the environment it would make the receiving water sources polluted.	- Thu Nhat, Thu Hai, Thu Ba, Thu Nam, Thu Sau, Thu Tam, Thu Chin, Thu Muoi and Xeo Ban canals - Local people around the construction sites - Workers in construction sites	Low	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.	- Thu Nhat, Thu Hai, Thu Ba, Thu Nam, Thu Sau, Thu Tam, Thu Chin, Thu Muoi and Xeo Ban canals - Local people around the construction sites	Low	Short-term
5	Solid waste	- Domestic waste: 8kg of domestic will be generated in each sluice gate and this is often contains organic matters and	- At the construction sites and worker's camps.	Low	Short-term

		easy degradable materials (except for the packages, nylon bags, plastic bottles. 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 - Construction solid wastes:Currently the majority of the construction company uses the iron or plastic formwork, very few construction units using wooden formwork. Metal or plastic formworks are usually collected completely as they can be sold for recycling. Wooden formwork can also be reused for heating purposes but if discarded into the environment (in canals or underground) they would impact negatively on the environment			
6	Hazardous wastes	Hazardous wastes as used oil and lubricant residue, oily rags. The amount of oil discharged each time is 07 litters with a frequency of 3-6 months/oil change/time. 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, equipment maintenance.	Low	Short-term
7	Interruption of waterway navigation	All the sluice gates will be constructed in the canals. When doing the construction of the sluice gate the steel sheet pile cofferdams will be applied then the construction of piers will be done therefore it will not disturb or restrict the waterway traffic on the canal. However, it may affect the transportation of boat and ship crossing the construction site.	In the construction sections of 9 canals	Low	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
9	Traffic safety	All the sluice gates are lying on the coastal area which there is no road therefore all the construction materials and fuel, construction machines and equipment will be transported to the construction site by water way. About 0.37 trip/day will be add in the transportation route. The possibility of causing impacts on the water way is only maybe the incident or accident by ships collision during the transportation.	Along transportation route	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 in the construction area of 9 sluice gates	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 9 sluice gates	Low	
12	Cultural impacts	- Within 500m away from the construction sites of sluice gates, there is no relic, cultural and historial sites as well as school; therefore, the activities of the subproject will not have any impacts on the landscape, relic, cultural and historical 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.	Low	Short-term
13	Fire and explosive incident during construction phase	Fire and explosion incidents could occur during transporting and storing fuel, or because of unsafe use of the temporary electric generation system, causing loss of life and property during construction. The reasons of fire and explosion are as following: - The temporary material storages serving the construction, machinery and technical equipment (paint, gasoline, DO oil, FO oil, etc.) are the source of fire and explosion. When the incident occurs, it can cause damage to people, economy and environment; - Using the temporary power supply systems for machinery, construction equipment can cause electric shock, electrical leakage, fire, explosion, causing economic damage or accident at work;	In the whole of construction area	Moderate	Short-term

		– Using of heating equipment could cause fire, burns or accidents if no preventive measures.			
14	Impacts on the hydrological regime	Using steel sheet pile coffer dam will not impede the canals flow; therefore the impacts caused by the construction activities on the flow is low	Thu Nhat, Thu Hai, Thu Ba, Thu Nam, Thu Sau, Thu Tam, Thu Chin, Thu Muoi and Xeo Ban canals	Low	Short-term
15	Impacts on domestic water supply	local people do not use the canal water for the domestic use therefore the construction activities will not affect the domestic water supply activities of the local residents.	Local people around the construction sites	No	
16	Impact of local production	The excavation and backfilling activities during the construction will increase the turbidity at the construction site, at the same time, the rain causing run-off through the construction site may carry the soil, sand and oil/ grease to the water body at the construction site. However, the impacts are partial; in short time therefore the impacts are determined to be low.	Local people around the construction sites	Low	Short-term
A (III)	**Operation phase** (9 sluice gates)				
1	Dust and exhaust gases generation	The operation of the 9 bridges over the sluice gates could increase air pollutant concentration, however, still be under thresholds of technical regulations.	Along the 9 bridges over the sluice gates	Low	Long-term
2	Traffic safety	Increase in traffic-related accidents in the locality. Road safety facilities have been incorporated in the subproject design at both preparatory and detailed design phase	Along the 9 bridges over the sluice gates	Moderate	Long-term
5	Risks and incidents	– Traffic accidents can cause losses of properties and lives. The reasons for traffic accidents can be many, including transport vehicles do not meet technical standards; driver fatigue or distraction; and non-compliance with traffic safety regulations. When the bridges over the 9sluicegates are completed, the traffic volume is projected to increase. – Damage of sluice gates can impact of local production	Local peole who using the bridges and sluice gates	Moderate	Long-term
6	Possible impacts due to sluice operations	– This may have both positive and negative impacts on water quality and movement of aquaculture. It is important to ensure that the sluice operation plan is developed through consultation with key stakeholders and	Canals in the subproject areas and nearby coastal area	Moderate	

		the final plan and its updated is publically disclosed. Monitoring of water quality and selected biota will also be necessary to ensure that actions could be undertaken to mitigate potential impacts as required. Consultation with water users and key stakeholders should be made periodically as part of the sluice operational plan			
B	**Construction of protection of coastal erosion**				
	Impacts/ Issues	**Impact Description**	**Location / Affected Object**	**Significance of impacts**	**Impact duration**
B (I)	In pre-construction phase	The embankment is built entirely on the sea without land acquisition and site clearance. This effect is determined to be low. Nonetheless installation of navigationa signs and safety measure will be made to reduce possible risk for local navigation, especially at night time.	Residents surrounds the waver breaker construction site	Low	Long term
B (II)	In construction phase	The soft embankment is simple, just dropping prefabricated components down the seabed which help reduce sea-waves hitting the mangroves and create sediment deposition inside the embankment. All construction activities are on barge at sea, the environment impact in this case is low. Nonetheless installation of navigationa signs and safety measure will be made to reduce possible risk for local navigation, especially at night time.	Residents surrounds the waver breaker construction site	Low	Short term
B (III)	In operation phase	When being used, the wave breaker will take effective to protect shore from waves and protect coastal protective forests. The wave breaker will create depositing inside that makes grounds for saline forest development of mangroves. The growth of mangroves will be the habitats for many aquatic species which contributes to improving the biodiversity and sustaining aquatic species. Negative impact will be limited to safety on local navigation. Installation of navigationa signs and safety measure will be made to reduce possible risk for local navigation, especially at night time.	Residents surrounds the waver breaker construction site	Low	Long term
C	**Impacts of livelihoods models (Component 3)**				

C (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	Low	Long - term
C (II)	In construction phase	All thedemonstration sitesare located inthe existing ponds, however Model 2 and 3 may require some adjustment or construction of new ponds, ditch, and/or cleaning or taking out the mud layer on the bottom of the ponds,however works will be very small and limited within the site area. The work will be made under supervision of the technical assistance to be provided as part of the demonstration model and the activities will not create significant impacts on local environment and local people. The impacts are considered low.	Aquaculture ponds using for demonstrations	Low	Short- term
C (III)	**In operation phase**				
1	Wastes from intensive shimp farming	This model is professional aquacultural and creates waste and residual of use chemicals which may harm to the environment significantly. Not only affect on water quality due to risk of pollution from feeds and waste but also from chemical application to prevent and control the desease for raised animals, mange the quality of feeding water and soil and create the favourable conditions for raising and harvesting	Aquaculture ponds using for demonstrations	Moderate	Long - term
2	Psychological impact on farmers	The famers have been accustomed to rice production farming for many years with that technical expertise. When shifting to new farming models, an inadequate technical guidance can lead to unsuccessful production, limiting the model to scale up to the broader scale. The risk of this impact is considered to be low and can completely control through the training schedule for residential people.	In the demonstration sites	Low	Psychological impact on farmers
3	Impact of expanding area of demonstration site	The development of large product outputs while not having a market may negatively impact the livelihood models of subprojects. If not forecast the needs of the market well and not well supported consumption for products, the risk of producers produce over demand which could lead to devaluation. The risk of this impact appears at average level	In the demonstration sites and expanding area	Moderate	Long term

		and the level of social impact will be at a low level but for the producers, the impact will be moderate.			
4	Impacts on socio-economic conditions of poor farmers due to risks associate with technical and management at on-farm level as well as financial capacity of farmers.	This may cause degration of mangrove area and/or change in land use which may later create potential conflict in land and water uses. This is possible if there are no regaultory measures and means to apply them effectively.	Farmers who participate in the pilot models and nearby areas who may apply them by theself.	Moderate	Can be short or long term
5	Induced impacts due to possible expansion of the models in the subproject and nearby area without proper control and management	This may cause degration of mangrove area and/or change in land use which may later create potential conflict in land and water uses. This is possible if there are no regaultory measures and means to apply them effectively.	In the subproject and nearby areas	Moderate	Long term

6.3. Mitigation measures

This section presents the measures to be carried out by the subproject owner (Kien Giang 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 80*) presents the potential negative impacts of the subproject activities (3 components) considered as general impacts and they could be mitigated through ECOP while Section 6.3.2 (*Table 81*) presents site-specific impacts that require special attention. Nonetheless it is noted that if the contract for Component 2 is implemented through different contractor, the simplified ECOP shown in Annex 2will be applied.

For works of Components 1 and 2, during the preparation of bidding documents, the Kien Giang 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 contruction, the contractor will be required to prepare and implement a Contractor Environmental and Social Management Plan (CESMP) in line with these requirements. The Kien Giang 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 (Kien Giang DARD) will be responsible for ensuring that the responsible agencies of the province will take actions to implement the activities identified in ECOP (*Table 80*) as well as those identified under the site-specific requirements (*Table 81*). One technical assitance will be provide for safeguard training as well as ensuring that the sluice operation procesure 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. General Impacts and Mitigation Measures

The mitigation measures of general impacts during pre-construction, construction, and operation phases, the environmental code of practices, related to the general construction activities of the nine sluice gates are presented in*Table 80.*

6.3.2. Site-Specific Impacts and Mitigation Measures

*Table 81*presents site-specific impacts and mitigation measures that could not addressed through the application of the ECOP. This may be because the impacts are very site-specific in nature and thus require very site-specific mitigation measures.

Table 80: Mitigation Measures of General Impacts (ECOP) related to Subproject's Activities

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
A. For 9 sluice gates				
A (I). During pre-construction				
1. Complaints due to subproject implementation	– Prior to commencement of site works, the contractor will develop a grievance redress mechanism (GRM) or system that will allow for receiving/recording and immediate response to and resolution of construction-related complaints. The GRM shall be consistent with the GRM described in the ESIA. – The Contractor will inform the communities along the alignment and other stakeholders affected by the subroject about the GRM in place to handle complaints and concerns about the subproject. – The Contractor will also install notice boards at the construction sites to publicize the name and telephone numbers of the representatives of the Contractor, DDIS and PPMU who are designated to receive and document complaints.	– Law on Land No. 45/2013/QH13 – Law on Environmental Protection No. 55/2014/QH13	– Contractor – PPMU	– Supervision reports of CSC – Supervision and monitoring reports of PPMU Kien Giang
2.Inadequate disclosure of subproject information prior to construction	– Prior to site preparation and commencement of site works, the Contractor will meet stakeholders such as district and local authorities, e.g. DONRE; officers in charge of irrigation, navigation and transport; owners of utilities (water, electricity, communication, etc.) and community leaders in affected communities to provide relevant subproject information (e.g. activities, schedules, etc.) and to ensure that various concerns that may affect stakeholders are discussed and addressed.	– Law on Land No. 45/2013/QH13 – Law on Environmental Protection No. 55/2014/QH13	– Contractor	– Supervision reports of CSC – Supervision and monitoring reports of PPMU Kien Giang
A (II). During construction of the 9 sluice gates				

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
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: Road vehicles. Maximum permitted emission limits of exhaust gas. - No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection; - QCVN 05:2013/BTNMT: National technical regulation on ambient air quality.	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine 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: National technical regulation on noise QCVN 27:2010/BTNMT: National technical regulation on vibration	Contractor	- Supervision reports of CSC Supervision and monitoring reports of PPMU Kien Giang
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.	- QCVN 09:2008/BTNMT: National Technical Standard on underground water Quality; - QCVN14:2008/BTNMT: National technical regulation on domestic wastewater; - QCVN 40: 2011/BTNMT: National technical	Contractor	- Supervision reports of CSC Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.	regulation on industrial wastewater; - TCVN 7222: 2002		
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. - 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 plansor 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	- TCVN 4447: 2012: Earth works-Codes for construction; - Decree No. 22/2010/TT-BXD on regulation of construction safety; - QCVN 08-MT:2015/BTNMT: National technical regulation on quality of surface water	- Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	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. Management of stockpiles, quarries, and borrow pits	- Large scale borrow pits or 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 landowners are affected by use of their areas for stockpiles or borrow pits, they must be included in the subproject resettlement plan. - 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.	- Decree No. 59/2015/ND-CP - Decree No. 38/2015/NĐ-CP	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- 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.			
6. Solid waste	- Before construction, a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by the Contractors and it must be carefully followed during construction activities. - Before construction, all necessary waste disposal permits or licenses must be obtained. - Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. 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 through a licensed waste collector. - 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	- Decree No. 38/2015/ND-CP on solid waste management - Circular No. 36/2015/TT-BTNMT on management of hazardous substance	- Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	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.			
7. Chemical or hazardous wastes	- Chemical waste of any kind shall be disposed of at an approved appropriate landfill site and in accordance with local legislative requirements. The Contractor shall obtain needed disposal certificates. - The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. - Used oil and grease shall be removed from site and sold to an approved used oil recycling company. - 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. - Used oil or oil-contaminated materials that could potentially contain PCBs shall be securely stored to avoid any leakage or affecting workers. Kien Giang DONRE must be contacted for further guidance. - Unused or rejected tar or bituminous products shall be returned to the supplier's production plant. - Relevant agencies shall be promptly informed of any accidental spill or incident.	Circular No.36/2015/TT-BTNMT on management of hazardous substance	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- Store chemicals appropriately and with appropriate labeling - Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards - Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions.		Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang
8. Management of excavated soil	- Characteristics of excavated soil should be determined by sampling and analysis if not already fully evaluated during the ESIA. Excavated soil that is heavily contaminated would require measures that go beyond the scope of these ECOPs. - Collected excavated soil has to be processed, as per Vietnamese regulations on waste collection, to ensure safe and environmentally secure transportation, storage, treatment and management.	- Decree No. 38/2015/ND-CP on solid waste management - Circular No. 36/2015/TT-BTNMT on management of hazardous substance	- Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang
9. Disruption of vegetative cover and ecological resources	- The Contractor shall prepare a Clearance, Revegetation and Restoration Management 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 Kien Giang DARD.	- Law on Environment protectionNo. 55/2014/QH13		

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- 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.			
10. 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 necessary, to ensure safe traffic circulation.	- Law on traffic and transportation No. 23/2008/QH12 - Law on construction No. 50/2014/QH13 - Circular No.22/2010/TT-	- Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warnings. - Employ safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. - Avoid material transportation for construction during rush hours. - Passageways for pedestrians and vehicles within and outside construction areas should be segregated and provide for easy, safe, and appropriate access. Signposts shall be installed appropriately in both water-ways and roads where necessary.	BDX dated 03 Dec., 2010 on labor safety duringthe construction of civil works		
11. Interruption of utility services	- Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance). - 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.	- Decree No. 73/2010/NDCP on administrative penalization security and society issues	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang
12. 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.	- Law on Environment protection No. 55/2014/QH13		

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- 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.			
13. 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 dated 03 December 2010 on regulation of construction safety - Directive No. 02/2008/CT-BXD on safety and sanitation issues in construction agencies - TCVN 5308-91: Technical regulation on safety in construction	- Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- 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. - Contractors' contracts to include conditions to ensure occupational health and safety; do not differentiate payment between women and men, and those who belong to local ethnic Khmer groups, 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.	- Decision No. 96/2006/QD-TTg dated 04 May 2006 on management and implementation of bomb mine explosive material disposal.		
14. 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.	- Decree No. 73/2010/ND-CP on administrative penalization security and society issues - Law on Environment protection No. 55/2014/QH13	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- 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.			

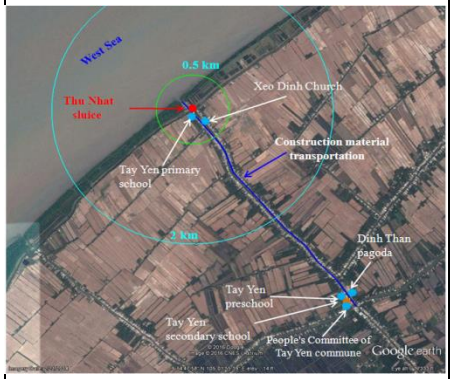
Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
15. Chance find procedures	- If the Contractor discovers archeological sites, historical sites, remains and objects, including graveyards and/or individual graves 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.	- Law onCultural Heritage 32/2009/QH12 - Decree No. 98/2010/ND-CP	- Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

Environmental – social issues	Mitigation measure	Vietnam code/regulation	Responsibility	Verification to determine effectiveness of measures
	- 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.			
A (III). During operation phase of the sluice gates				
Dust and exhaust gases generation	- There is a measurable link between traffic noise and speed. Speed control is the most direct and economic way to reduce traffic noise. - Encourage the use of less noisy vehicles and periodic maintenance of vehicles	- QCVN 06:2009/BTNMT. - TCVN 6438-2005 - Decision No. 249/2005/QĐ-TTg	Local government and traffic authorities	- Supervision reports of CSC - Supervision and monitoring reports of Kien Giang DARD
Traffic safety	- Road safety facilities have been incorporated in the subproject design at both preparatory and detailed design phases. These include traffic separation medians, pedestrian and light vehicle underpasses, lighting at intersections and bridges longer than 100 m and signs and pavement markings complying with Vietnamese standards. These will be put in place by the Contractors during construction and will be maintained by the subproject owner during the subproject's service life. - Using environmentally friendly vehicles - Old vehicles will be checked 6-monthly and maintained in good order	- Law on traffic and transportation No. 23/2008/QH12 - Circular No. 22/2010/TT-BXD	Local government and traffic authorities	Supervision reports of CSC Supervision and monitoring reports of Kien Giang DARD
B Construction of the protection of coastal erosion (Component 2)				
B (I). During site clearance and construction	- Apply the simplified ECOP (Annex 3)	- Law on Environment protection No. 55/2014/QH13	Contractor	CSC and PPMU

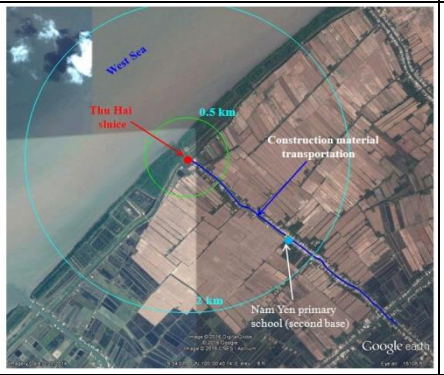
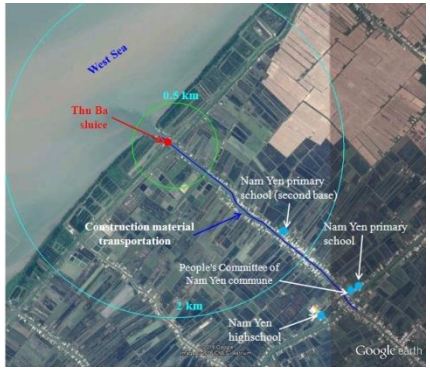
Environmental – social issues	**Mitigation measure**	**Vietnam code/regulation**	**Responsibility**	**Verification to determine effectiveness of measures**
B (II) During operation	- Install and maintain navigation safety signs especially for nightime	- Law on Environment protection No. 55/2014/QH13 - Law No. 48/2014/QH13on amending and supplementing a number of articles of law on inland waterway transport	Traffic police	Kian Giang DARD and local communties

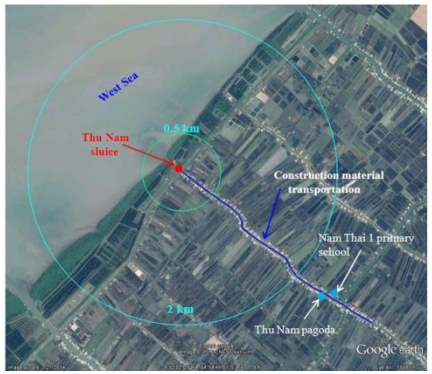
Table 81: Site -specific Mitigation Measures

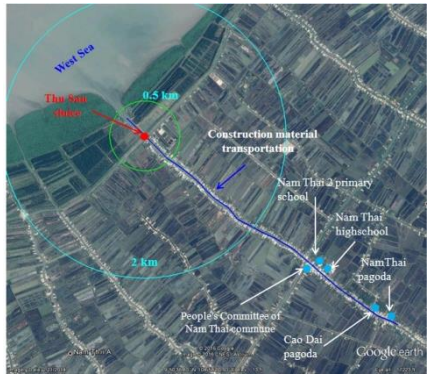
No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
A	***For 9 sluice gates***				
A (I). During pre-construction phase					
1	**Land acquisition and resettlement**	Land acquisition and resettlement will comply with approval Resettlement Policy Framework (RPF) of the MDICRSL project and Resettlement Action Plan (RAP) of this subproject, specifically: - Compensate for all losses at replacement costs and provide replacement land within their village or commune satisfactory to them so that their cultural and social cohesion could be maintained. - Support to relocating HHs to restore their livelihood and living conditions. - To be recruited for the subproject.	- Law on Land No. 45/2013/QH13; - Decree No. 43/2014/ND-CP; - Decree No. 44/2014/ND-CP; - Decree No. 47/2014/NĐ-CP; - Circular No. 36/2014/TT-BTNMT; - Circular No. 37/2014/TT-BTNMT; - Decision No.52/2012/QD-TT;	- Compensation, support and resettlement councils of Kien Giang - PPMU Kien Giang	Supervision reports of PPMU Kien Giang and Independent resettlement monitoring consultant
2	**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 Kien Giang 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. - 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 emoving/destroying UXO - PPMU Kien Giang	- Implementation report - Supervision reports of the PPMU Kien Giang
A (II)	***During construction phase*(9 sluice gates)**				
1	***Sensitive receptor***				

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
1.1	***Thu Nhat sluice gate***				
	- Forest - shrimp (40m from the sluice gate) - Tay Yen Prelimary school (80m from the sluice gate) - Xẻo Dinh Church (250m from the sluice gate)  	*<u>Mitigation measures at Tay Yen Preliminary school:</u>* - Spray sufficient water during dry days to avoid dust around the school. - Prohibit use of construction methods that cause noise during school learning hours. - Ensure traffic safety by installing safety fence and warning sign, providing traffic instruction when school children go to and leave the school around construction area. - Provide good drainage avoid water run-off to the school area. - Prohibit construction of workers camps within 2 km from the school. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Immediately address any issue/complaint raised by the school. *<u>Mitigations measures to avoid impacts on Xeo Dinh Church:</u>* - Inform the temple management of the construction activities and their potential impacts of construction activities such as dust and noise one month before start of the construction. - Use axial compressive load pile driving method instead of using pile driving hammer. - Spray sufficient water to suppress dust during dry and windy days. - Pay special attention to the above mitigation measures during religious events every first and 15th days of the lunar month and during festival days.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

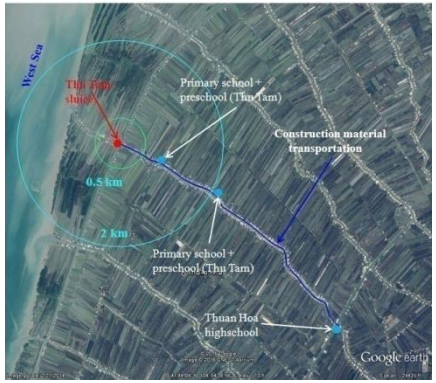
No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		- Immediately addess any issue/problem caused by the construction activities and raised by the temple. *Mitigation measures to address impacts on forest – shrimp*: - Inform the forest-shrimp owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Arrange drainage at the construction site to ensure no soil erosion and sedimentation to the forest-shrimp area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spill. - Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Spray sufficient water during dry days to avoid dust to the around area. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes.			
1.2	**Thu Hai canal sluice**				
	- Forest - shrimp (40m from the sluice gate)	*Mitigation measures to address impacts on forest – shrimp*: - Inform the forest-shrimp owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Arrange drainage at the construction site to ensure no soil erosion and sedimentation to the forest-shrimp area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spill.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		- Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Spray sufficient water during dry days to avoid dust to the around area. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes.			
1.3	**Thu Ba canal sluice**				
	- Forest - shrimp (40m from the sluice gate) - Resident on the material transportation routes (above 50m from the route) 	*Mitigation measures to address impacts on forest – shrimp*: - Inform the forest-shrimp owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Provide drainage at the construction site to ensure no soil erosion and sedimentation to the forest-shrimp area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spill. - Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Spray sufficient water during dry days to avoid dust to the around area. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes. *Mitigation measures for impacts on residents on the material transportation routes:*	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		- Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm. - Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. - Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. - Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
1.4	**Thu Nam canal sluice**				
	- Forest - shrimp (20 m from the sluice gate) - Resident on the material transportation routes (above 40m from the route) 	*Mitigation measures to address impacts on forest – shrimp*: - Inform the forest-shrimp owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Provide drainage at the construction site to ensure no soil erosion and sedimentation to the forest-shrimp area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spill. - Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Spray sufficient water during dry days to avoid dust to the around area. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes. *Mitigation measures for impacts on residents on the material transportation routes:* - Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		– Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. – Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. – Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
1.5	**Thu Sau canal sluice**				
	– Forest - shrimp (20 m from the sluice gate) – Resident on the material transportation routes (above 40m from the route) 	*Mitigation measures to address impacts on forest – shrimp*: – Inform the forest-shrimp owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. – Provide drainage at the construction site to ensure no soil erosion and sedimentation to the forest-shrimp area. – Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spill. – Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. – Spray sufficient water during dry days to avoid dust to the around area. – Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes. *Mitigation measures for impacts on residents on the material transportation routes:* – Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm.	– QCVN 05:2013/BTNMT – QCVN 06:2008/BTNMT – QCVN 08-MT:2015/BTNMT – QCVN 19: 2009/BTNMT – QCVN 26:2010/BTNMT – QCVN 27:2010/BTNMT – Circular 36/2015/BTNMT	Contractor	– Supervision reports of CSC – Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		- Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. - Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. - Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
1.6	**Xeo Ban sluice**				
	- Semi intensive shrimp farm (70 m from the sluice gate) - Resident on the material transportation routes (above 50m from the route) 	*Mitigation measures to address impacts on shrimp farm*: - Inform the semi intensive shrimp farm owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Provide drainage at the construction site to ensure no soil erosion and sedimentation to the shrimp farming area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spills. - Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes. - Spray sufficient water during dry days to avoid dust to the around area. - Immediately address any related problem raised by the shrimp farm owners. *Mitigation measures for impacts on residents on the material transportation routes:*	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		- Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm. - Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. - Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. - Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
1.7	**Thu Tam canal sluice**				
	- Semi intensive shrimp farm (20 m from the sluice gate) - Resident on the material transportation routes (above 40m from the route) 	*Mitigation measures to address impacts on shrimp farm*: - Inform the semi intensive shrimp farm owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Provide drainage at the construction site to ensure no soil erosion and sedimentation to the shrimp farming area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spills. - Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes. - Spray sufficient water during dry days to avoid dust to the around area. - Immediately address any related problem raised by the shrimp farm owners.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		Mitigation measures for impacts on residents on the material transportation routes: - Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm. - Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. - Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. - Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
1.8	**Thu Chin canal sluice**				
	- Semi intensive shrimp farm (60 m from the sluice gate) - Resident on the material transportation routes (above 50m from the route) 	*Mitigation measures to address impacts on shrimp farm*: - Inform the semi intensive shrimp farm owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. - Provide drainage at the construction site to ensure no soil erosion and sedimentation to the shrimp farming area. - Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spills. - Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. - Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes. - Spray sufficient water during dry days to avoid dust to the around area.	- QCVN 05:2013/BTNMT - QCVN 06:2008/BTNMT - QCVN 08-MT:2015/BTNMT - QCVN 19: 2009/BTNMT - QCVN 26:2010/BTNMT - QCVN 27:2010/BTNMT - Circular 36/2015/BTNMT	Contractor	- Supervision reports of CSC - Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		– Immediately address any related problem raised by the shrimp farm owners. *Mitigation measures for impacts on residents on the material transportation routes:* – Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm. – Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. – Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. – Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
1.9	**Thu Muoi canal sluice**				
	– Semi intensive shrimp farm (60 m from the sluice gate) – Resident on the material transportation routes (above 50m from the route) 	*Mitigation measures to address impacts on shrimp farm*: – Inform the semi intensive shrimp farm owners of the construction activities and their potential impacts of construction activities such as increased suspended solids in the water, wastewater, domestic wates and construction spoils one month before start of the construction. – Provide drainage at the construction site to ensure no soil erosion and sedimentation to the shrimp farming area. – Arrange a speedboat to regulate, control, and guide waterway traffic to avoid oil and hazardous spills. – Put the floating pontoon surrounded rigs to facilitate the collection of solid waste, floating objects accidentally falling flow. – Arrange 2 different trash containers on each floating rigs for containing oil rags and other solid wastes.	– QCVN 05:2013/BTNMT – QCVN 06:2008/BTNMT – QCVN 08-MT:2015/BTNMT – QCVN 19: 2009/BTNMT – QCVN 26:2010/BTNMT – QCVN 27:2010/BTNMT – Circular 36/2015/BTNMT	Contractor	– Supervision reports of CSC – Supervision and monitoring reports of PPMU Kien Giang

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		- Spray sufficient water during dry days to avoid dust to the around area. - Immediately address any related problem raised by the shrimp farm owners. *Mitigation measures for impacts on residents on the material transportation routes:* - Do not allow transportation of construction materials to the construction site before 6:30 am and after 8:00 pm. - Ensure waterway traffic safety by installing safety warning signs, and waterway traffic instruction around the affected residential area. - Prohibit discharge of waterwater and domestic wastes from the transportation boats to the canal. - Hold monthly meeting with the affected community on construction progress and issues and immediately address any issue/complaint raised by the community.			
A (III)	***During operation of the sluice gates***				
1	**Air pollution and road safety on the bridges**	- Road safety facilities have been incorporated in the subproject design at both preparatory and detailed design phases. These include traffic separation medians, pedestrian and light vehicle underpasses, lighting at intersections and bridges longer than 100 m and signs and pavement markings complying with Vietnamese standards. These will be put in place by the Contractors during construction and will be maintained by the subproject owner during the subproject's service life. - Using environmentally friendly vehicles - Old vehicles will be checked 6-monthly and maintained in good order	- Law on traffic and transportation No. 23/2008/QH12 - Circular No. 22/2010/TT-BXD ated on December 03, 2010 of MOC on labor safety in work construction	Local government and traffic authorities	- Supervision reports of CSC - Supervision and monitoring reports of Kien Giang DARD
2	Possible impacts on water users and other key staekhoders due to operation of sluice gates	- Development of the sluice operational plan through close consultation with water users and key stakeholder	- Law No. 48/2014/QH13on amending and	Kieng Giang DARD	Subproject progress report

No	Sensitive Area or Activity	Mitigation Measures	Vietnam code/regulation	Responsibility	Verification effectiveness of measures
		(starting 2017) so that the final plan acceptable to staekholders will be finalized by end of 2019.	supplementing a number of articles of law on inland waterway transport - Law on water resources No. 17/2012/QH13		
B (I)	**Protection of coastal erosion (Component 2)**				
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 Kien Giang province - Kien Giang PPMU	- Supervision reports of CSC - Supervision and monitoring reports of Kien Giang DARD

2	Ensure safety for local navigation	Install navigation safety sign especially for night time and inform local people	- Law on traffic and transportation No. 23/2008/QH12	- The agency responsible for maintenance of the areas (Kian Giang DARD)	- Supervision reports of CSC - Supervision and monitoring reports of Kien Giang DARD
C (I)	**Implementation of 5 Livelihood Models (Component 3)**				
1.	Ensure adequate measures to mitigate potential negative impacts on poor farmers dur to implementation of the 5 livelihood models	Provide technical assistant to brand development and expansion of trade for products: - Organize market forecasts for such products as *Andara granosa, Penaeus monodon, Macrobrachium rosenbergii*, organic rice to meet the demand of the consumption market; - Develop brand for such products as *Andara granosa, Macrobrachium rosenbergii, Penaeus monodon,* organic rice as the impetus for this production development; - Find out stable output for *Andara granosa, Macrobrachium rosenbergii, Penaeus monodon,* organic rice through product introduction on the domestic and international fairs. - In-depth technical guidance for production: Organize field farming school to guide people to convert to new livelihood patterns through the introduction of theory, models and sending agricultural/aquacultural extension offices who directly guide people on site when they require. The guidelines must ensure to equip people enough knowledge and techniques when new models are introduced in the area. - Zone planning for intensive shrimp farming	- Law on fisheries No. 17/2003/QH11 - Decision No. 3824/QĐ-BNN-TCTS - Decision No. 4835/QĐ-BNN-TCTS	- Division of Aquaculture of Kien Giang province - Agriculture and Fishery Extension Center of Kien Giang province - Kien Giang PPMU	- Supervision reports of CSC - Supervision and monitoring reports of Kien Giang DARD

		- Treatment sludge and wastewater before discharging into the canals - Control fertilizer, pepticides, chemicals for farming - Applying IMP. - Conduct socio-economic survery; - Developother measures to improve knowledge of farmers including building farmer networks.			
2	Reduce potential negative impacts due to possible expansion of aquculture farming and/or the models	Provide technical assistance to establish a registration system for aquaculture farming.	- Law on fisheries No. 17/2003/QH11 - Decision No. 3824/QĐ-BNN-TCTS - Decision No. 4835/QĐ-BNN-TCTS	- Division of Aquaculture of Kien Giang province - Agriculture and Fishery Extension Center of Kien Giang province - Kien Giang PPMU	- Supervision reports of CSC - Supervision and monitoring reports of Kien Giang DARD

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 Kien Giang PPMU. 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 Kien Giang PPMU and the WB.
- Community monitoring: Monitoring by local communities will be conducted following the Government practices with the technical and management support from the ICMB10.

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:

- 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.

*Table 82*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 4years), 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 82: Scope of environmental monitoring for the subproject

No	Contents	Specific requirements	Applied standard
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 at 5 sluice location	
c	Frequency	03 months/time x 48 months	
2	Water + micro organism + aquatic life		QCVN 08-MT:2015/BTNMT
a	Parameters	pH, Tur., Salinity, DO, TSS, BOD_5, TN, TP, oil & grease, coliform, phytoplankton, zooplankton, zoobenthos	
b	Locations	15 stations, in which 9 stations on scanal at sluice gate location and 6 stations at aquaculture area	
c	Frequency	03 months/time x 48 months	
3	Sediment - Soil		QCVN 03:2008/BTNMT; QCVN 43:2012/BTNMT;
a	Parameters	pH_{KCl}, salinity, Cu, Pb, Zn, Cd, As, TP, TN, TC	
b	Locations	15 stations, in which 9 stations on scanal at sluice gate location and 6 stations at aquaculture area	
c	Frequency	03 months/time x 48 months	
II	**Operation phase**		
1	Water + micro organism + aquatic organism		QCVN 08-MT:2015/BTNMT
a	Parameters	pH, Tur., Salinity, DO, TSS, BOD_5, TN, TP, oil & grease, coliform, phytoplankton, zooplankton, zoobenthos	
b	Locations	15 stations, in which 9 stations on scanal at sluice gate location and 6 stations at aquaculture area	
c	Frequency	03 months/time during the first 2 years of operation	
2	Sediment- Soil		QCVN 03:2008/BTNMT; QCVN 43:2012/BTNMT;
a	Parameters	pH_{KCl}, salinity, Cu, Pb, Zn, Cd, As, TP, TN, TC	
b	Locations	15 stations, in which 9 stations on scanal at sluice gate location and 6 stations at aquaculture area	
c	Frequency	03 months/time during the first 2 years of operation	

Figure 46: Environmental monitoring site during construction and operation phase

(note: N: surface water; TT: sediment; D-TT: sediment/soil; KK: air; final statiosn and parameters may be adjusted as needed)

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 No. 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, investors, project management unit, contractors and project-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 DMMP; (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 ICMB10 and the WB. Cost for the monitoring will be part of the ICMB10 cost.

6.5. Role and responsibilities for esmp implementation

6.5.1. Implementation arrangement

Role and responsibilities for ESMP implementation are described in Figure 47andTable83.

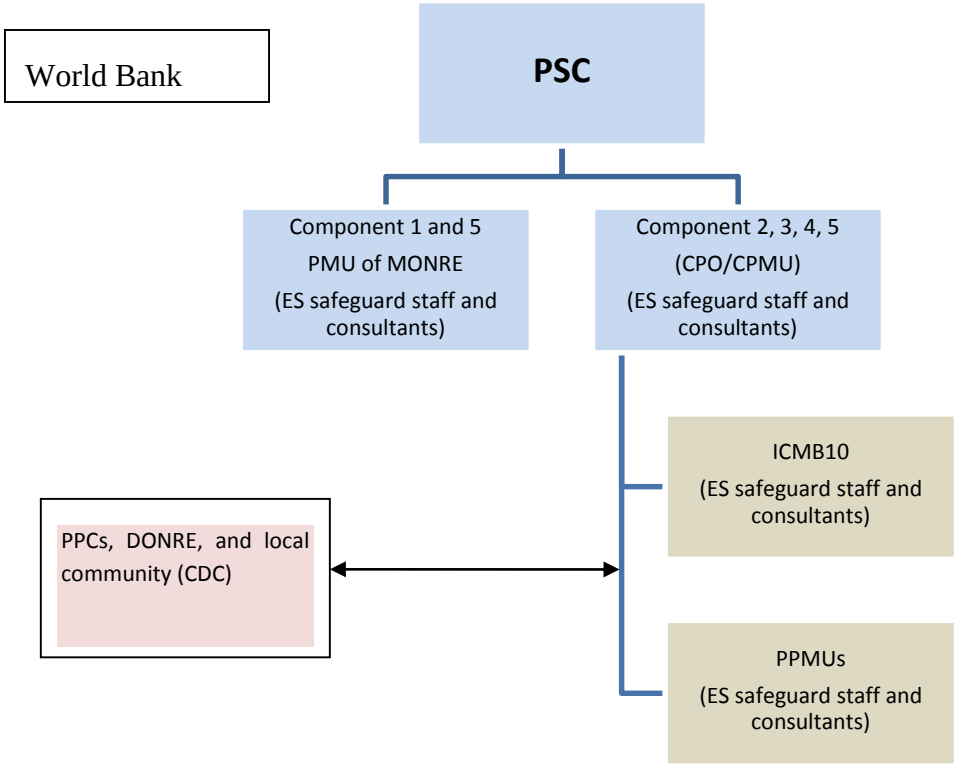


Figure 47: Organization structure for safeguard monitoring

Table83: 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 PPMUs of the provinces)	- 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 phases 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 Forestry of Kien Giang province DARD is responsible for forest management - Division of Aquaculture of Kien Giang province DARD and Agriculture and Fishery Extension Center of Kien Giang 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 phases. 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 phases.

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 phase 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 phases of the Project. Environmental quality monitoring will be report periodically to PPMU (every 06 months in construction phase and in operation phase).
- IEMC will also supply specialized assistance to CPMU and ECO in environmental matters.

6.5.2.4. Environmental Supervision during Construction

During construction phase, 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 phase; 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 84*.

Table 84: Regular Reporting Requirements

No.	Report Prepared by	Submitted to	Frequency of Reporting
1	Contractor to the Employer	PPMU Kien Giang	Once before construction commences and monthly thereafter
2	Construction Supervision consultant (CSC)	PPMU Kien Giang	Weekly and monthly
4	Community Monitoring	PPMU Kien Giang	When the community has any complaint about the subproject safeguards implementation

5	PPMU Kien Giang	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 PPMUs staff indicates the staff has 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 PPMUs 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 thatwould 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)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 85below 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 PMU training. The PMU/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 PPMUs, 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 85*):

- 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 85: 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 costwill 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 86.

- 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 will be part of the construction supervision contracts.
- Cost for the EMC and monitoring of environmental quality during construction is included in the subproject cost (Table 86).
- Costs for PPMU operations related to the ESMP 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 5 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 ESMP implementation cost (excluding those to be included in civil works contract and CSC contract and RAP) will be about 2,074,800,000 VND (94,000USD**)**+US$300,000over a 6 years period. Estimation cost for ESMP is shown in*Table 86*.

Table 86: Cost for ESMP in the entire subproject (VND)

Activity	Source of fund	Total cost (VND)
(a) Resettlement and land acquisition	Part of subproject cost	44,200,000,000
(b) Mitigation measures during the construction phase	Part of contract cost	
(c) Safety monitoring during the construction phase (48months x 5 millions VND/months)	Part of subproject cost	240,000,000
(d) PPMU environmental staff	Part of subproject cost	240,000,000
(e) Environmental monitoring in the entire subproject (see in*Table 87*)	Part of subproject cost	1,354,800,000
(f) Environmental monitoring consultant (EMC)	Part of subproject cost	240,000,000
(g) Technical assistance (national consultant) for development and consultation of the operation plan for the sluice gates including meetings and workshops for 2 years during 2017-2020	Part of subproject cost	US$100,000
(h) Technical assistance (national consultant) for (i) planning and undertaking socio-economic survey for the farmers in the pilot sites and nearby areas for 3 years during (2017-2020) to evaluate effectiveness of the pilot livelihood models, (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)	Part of subproject cost	US$200,000

Table 87:Cost for environmental monitoring in the entire subproject

TT	Activities	Unit	Quantity	Unit price (VND)	Total (VND)

I	**Construction phase**				**920,640,000**
1	Total of sampling (48 months x 3 months/time = 16 times)	Time	16		
2	Air/noise (5 stations x 16 times)	Sample	80	654,000	52,320,000
3	Water + micro organism + aquatic life (15 stations x 1samples/station) x 16 times	Sample	240	2,247,000	539,280,000
4	Sediment - Soil (15 stations /time x 16 times)	Sample	240	1,371,000	329,040,000
II	**Operation phase** (before operation and 1 year after operation **)**				**434,160,000**
1	Total of sampling (24 months x 3 months/time)	Time	8		
2	Water + micro organism + aquatic life (15 stations x 1 samples/station) x 8 times	Sample	120	2,247,000	269,640,000
3	Sediment - Soil (15 stations /time x 8 times)	Sample	120	1,371,000	164,520,000
	Total= I+II				**1,354,800,000**

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 alog 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. Project 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.

CHAPER 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 ssessment, 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 EMP 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 project is implemented;
- State responsibilities and awareness of stakeholders, beneficiary people in the project site during the project implementation;
- Encourage the community participation in determining the environmental impacts of the project.
- 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 phase.

7.2. Implementation methods

The MDICRSL project is a Category A project, thus it was required by Bank safeguard policy to carry out the public consultation at least twice during the ESIA process. The 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.

The first consultation was held at the meeting room of An Minh DPC on 18 September 2015 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.

For the secon round, the subproject owner organized consultation meetings with the subproject districts and communes and affected people at the meeting room of An Minh DPC on 26 January 2016. All the feedbacks and comments from the consultations have been considered and incorporated in the subproject design and the final ESIA.

7.3. Public consultation results

7.3.1. The first consultation

- The local authorities and people are unanimous with the subproject implementation.
- Although subproject investment is necessary but must be compensated for land and livelihood support to people stabilize production.
- Avoid spreading investment and quick construction, timely for people living and production.
- A lot of sluice gates will be built under the subproject but subproject area are sparsely populated, the subproject impacts are mainly on production so avoiding a series of embankments up for long period affect the quality of the environment and people's production.

7.3.2. The second consultation

- All participants agreed with the subproject implementation
- Beside the required structural measures, it needs to implement the work uniformly with construction time constraints to avoid affecting the environment.
- Before the construction, it needs the accurate inventory of land acquisition, adequate compensation and support to avoid the adjustment which costs time and affects the subproject progress.
- For the maintenance of the forest belt: this is a very necessary, important issue.
- The construction schedule must be rapid and timely to let people live and manage their production.
- If there is no cofferdam method for the foundation pits, diversion canals should be built.

7.4. Environmental information disclosure

The subproject draft ESIA in Vietnamese was disclosed in January 2016 at the CPO office, PPMU office, the project provincial and district offices, and the subproject communities as required by the government EA regulation and the Bank safeguard policies and the policy on access to information. The ESIA report in English was also disclosed at the Bank’s InfoShop in January 2016. The final ESIA will be disclosed locally and at the InfoShop in February 2016.

CONCLUSIONS, RECOMMENDATIONS AND COMMITMENTS

1. Conclusions

Based on the above analysis and evaluation, impacts of subproject on the local people and environment can be identifiedas follows:

The positive impacts of the subproject include:

- Actively regulate the water source therefore the local people can actively arrange the farming timetable or schedule suitable with the water source condition in the region.
- Diversify the auaculture objects meeting the food demand of the society, create jobs, increase the income of the local people.
- Reduce the impacts of the harzards or calamity, impacts of the climate change in the subproject area.
- Actively regualting the water source contributes to the improvement of the water environment, protect the production in condition of climate change and sea level rise.
- Develop the road traffic condition for the coastal area.
- Increase the non-agricultural production, business based on agricultural development.
- Develop and increase the mangrove forest area to contribute to the protection of the coastal line at the same time improve the biodiversity, maintain and sustain the fishery breeds resources in the nature.
- Improve the environment thanks to the more environmental friendly production activities (VietGap model of aquaculture farming).

The negative impacts include:

During the subproject preparation phase, some negative impacts will affect the local environment and local populations in the subproject area. Land acquisition and resettlement of subproject affected households will be required. There are no cultural or historical works or indigenous people in the subproject area. A Resettlement Action Plan (RAP) has been prepared in line with the Resettlement Policy Framework (RPF) developed for MD-ICRSL project. The RAP will be submitted to WB for review. Implementation and monitoring of the RAP will be made in line with the safeguard arrangement for the MD-ICRSL project. The CPMU, assisted by the Social Safeguard Coordinator (SSC) and the RAP Independent Monitoring Consultant (IMC) will undertake monitoring and compliance reporting. Periodic consultation and information disclosure to the local community will be closely monitored.

During the construction phase, there will be negative impacts including vehicle and equipment exhaust emissions, dust and noise from construction equipment during the construction of roads and sluices, wastewater from construction workers and construction activities, construction solid waste, and some contaminated waste, among others. These have been identified in the ESMP and included in ECOP. These impacts can be mitigated by ensuring that the subproject contractors comply with the provisions of their contracts, including those which relate to environmental impacts. The PPMU and their CSC and EMC will be responsible for ensuring that this compliance occurs. In accordance with their contracts, contractors will be required to prepare the Contract Specific Environmental Plan (CSEP) describing detailed environmental safeguard actions. The CSEP will be approved by PPMUs and supervised by CSCs prior to the work commencing. Periodic monitoring reports will be prepared by the EMC and the results will be submitted to CPMU and the World Bank (as needed).

During the operation phase, potential negative impacts may include road safety issues due to bridge operation, risk due to bridges and sluice gates operations and disease spreadingin

aquaculture. Most of these impacts are considered low and/or moderate and can be mitigated through proper operations and apply IPM in aquaculture.

In addition, environmental monitoring will be carried out to ensure that the subproject activities do not create adverse impacts. The monitoring results will be periodically reported to CPMU and the World Bank (as needed).

2. Commitments

- General Commitments:
  - The Client and PPMU commit to complying with Vietnam Laws on Environmental protection: Law on Environmental protection 2014, Laws and legal documents (Decree No. 18/2015/ND-CP dated 14 February 2015 of the Government on environmental protection assessment, strategic environmental assessment, environmental impact assessment and environmental protection plan; Decree No. 38/2015/ND-CP dated 24 April 2015 on management of waste and scrubs); and WB's safeguard policies during the project implementation.
  - The Client commits to complying with the mitigation measures of adverse impacts of the subproject on environment during the pre-constructioon, construction and operation according to contents as mentioned in Chapter 5 of this Report.
  - Subproject's activities shall be under the inspection of the competent authorities in charge of environmental management of DONRE of Kien Giang and relevant functional agencies to ensure the subproject development and environmental protection
  - The Client commits to disclose contents of approved ESIA report approved at the subproject locality to monitor the compliance with environmental protection commitments in the approved ESIA report.
- Commitment to complying with environmental standards and regulations: the Client commits to complying strictly with environmental standards and regulations:
  - Exhaust gas: In accordance with Vietnam standard (QCVN 19:2009/BTNMT: National Technical Regulation on Industrial Emission of Inorganic Substances and Dusts;
  - Waste water: Commit to implementing mitigation measures and operation of waste water treatment system to ensure waste water treatment according to QCVN 14:2008/BTNMT (column B): National technical regulations on domestic waste water quality;
  - Noise: Control noise in accordance with QCVN 26:2010/BTNMT – National technical regulation on noise.
  - Solid waste: Solid waste will be collected and treated properly to ensure not drop down and exposure to ambient environment to ensure requirements for environmental sanitation and regulations in Decree No. 38/2015/NĐ-CP of the Government dated 24 April 2015 on solid waste management.
  - Hazardous waste: Commit to complying with 36/2015/TT-BTNMT of 30 June 2015 of MONRE on hazardous waste management.
- Commitment to management and control of environmental pollution:
  - The environmental management and control of environmental pollution will be given top priority during the construction and operation.
  - During the operation, the Client commits to implementing the environmental pollution management and control program in the project area as mentioned in this report and periodically reporting to the DONRE ofKien Giangprovince.
  - The Client commits for compensation and remedy of environmental pollution in case of environmental incidents and risks due to the subproject implementation.

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ANNEX 1: ANALYSIS RESULTS OF EXISTING ENVIRONMENTAL QUALITY

A.1.1.Analysis results of air quality

No.	Locations	Analysis indicators							
		Temp.	**Humidity**	**Wind speed**	**Noise**	**Dust**	**SO_2**	**NO_2**	**CO**
		^oC	**(%)**	**m/s**	**dBA**	**mg/m^3**	**mg/m^3**	**mg/m^3**	**mg/m^3**
1	**KK1**	29.0	85	2.4	42 - 64	0.09	0.018	0.022	0.16
2	**KK2**	30.0	84	1.2	45 - 67	0.11	0.021	0.024	0.24
3	**KK3**	30.5	84	1.5	44 - 68	0.1	0.017	0.033	0.32
4	**KK4**	31.0	83	1.4	43 - 74	0.12	0.016	0.041	0.41
5	**KK5**	31.2	81	1.4	52 - 76	0.18	0.023	0.048	0.54

A.1.2. Analysis results of soil quality

No	Locations	Layer	pH_{H2O} (1:5)	pH_{KCl} (1:5)	EC	Sanility	TC	TP	TN	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	Fe_{TS}	Acid
					µS/cm	*‰*	*%*			*mg/100g*					*meq/100g*
1	**Đ1**	T1	6.17	5.48	2.91	1.50	2.29	0.050	0.167	83.00	100.50	475.40	146.46	484.17	0.10
2		T2	5.95	4.30	3.00	1.58	2.13	0.047	0.164	68.20	101.13	535.10	149.83	600.20	0.26
3		T3	5.80	4.25	3.02	1.62	2.10	0.040	0.161	67.30	101.56	543.50	152.70	578.30	0.29
4	**Đ2**	T1	6.21	5.07	2.04	1.08	2.49	0.055	0.183	60.03	106.13	291.33	145.67	385.53	0.10
5		T2	6.06	4.78	2.17	1.11	2.06	0.045	0.173	69.90	111.09	345.98	165.40	319.14	0.21
6		T3	6.00	4.70	2.19	1.15	2.01	0.041	0.168	68.90	111.73	352.88	168.30	311.37	0.28
7	**Đ3**	T1	5.77	4.23	1.98	1.05	2.49	0.055	0.180	79.28	105.49	291.44	149.30	378.27	0.36
8		T2	4.95	4.02	2.01	1.03	2.34	0.052	0.195	69.21	109.74	317.86	158.93	286.71	0.39
9		T3	4.90	4.00	2.10	1.08	2.32	0.050	0.195	69.11	109.94	324.70	164.73	255.84	0.41
10	**Đ4**	T1	5.59	4.89	2.12	1.13	3.02	0.066	0.186	84.88	87.59	268.59	158.95	383.97	0.21
11		T2	5.34	4.17	2.29	1.23	1.45	0.032	0.184	95.29	98.91	343.97	144.87	381.17	0.36
12		T3	5.24	4.09	2.32	1.29	1.40	0.028	0.174	94.39	99.02	352.55	147.27	378.32	0.44
13	**Đ5**	T1	5.73	4.95	2.09	1.11	3.29	0.072	0.308	91.00	123.83	186.12	310.72	299.00	0.21
14		T2	5.23	4.22	2.14	1.12	2.43	0.053	0.237	71.37	206.43	220.77	276.98	238.17	0.36
15		T3	5.21	4.12	2.19	1.18	2.22	0.051	0.221	70.32	207.44	225.38	278.58	234.56	0.44
16	**Đ6**	T1	5.35	4.78	1.35	0.72	2.24	0.049	0.166	35.92	67.70	180.86	150.26	150.44	0.21
17		T2	5.20	4.62	1.47	0.79	2.15	0.047	0.174	50.59	80.63	238.47	119.24	133.36	0.21
18		T3	5.15	4.57	1.52	0.82	2.10	0.045	0.169	52.32	81.75	258.52	122.14	132.27	0.25
19	**Đ7**	T1	5.69	5.27	1.34	0.71	2.57	0.057	0.180	33.57	73.43	178.33	142.66	168.00	0.10
20		T2	5.27	4.82	1.47	0.75	2.07	0.046	0.176	30.86	83.42	241.64	120.82	216.05	0.21
21		T3	5.10	4.75	1.54	0.78	2.01	0.043	0.178	31.70	85.41	262.44	118.74	219.45	0.33

No.	Locations	Layer	Cd	Hg	Pb	As	Cu	Zn
			mg/kg					
1	**Đ1**	**T1**	0.024	KPH	0.53	0.26	7.2	48
2		**T2**	0.041	KPH	0.38	0.24	5.9	64
3		**T3**	0.034	KPH	0.24	0.31	6.3	73
4	**Đ2**	**T1**	0.021	KPH	0.68	0.56	3.6	46
5		**T2**	0.017	KPH	0.52	0.27	4.4	29
6		**T3**	0.033	KPH	0.61	0.38	5.9	41
7	**Đ3**	**T1**	0.019	KPH	0.55	0.21	7.2	34
8		**T2**	0.022	KPH	0.37	0.64	3.8	71
9		**T3**	0.017	KPH	0.64	0.54	6.2	52
10	**Đ4**	**T1**	0.037	KPH	0.24	0.41	8.6	64
11		**T2**	0.041	KPH	0.61	0.56	5.7	27
12		**T3**	0.054	KPH	0.53	0.42	9.2	35
13	**Đ5**	**T1**	0.021	KPH	0.68	0.56	3.6	46
14		**T2**	0.017	KPH	0.52	0.27	4.4	29
15		**T3**	0.033	KPH	0.61	0.38	5.9	41
16	**Đ6**	**T1**	0.028	KPH	0.61	0.27	7.4	34
17		**T2**	0.013	KPH	0.55	0.34	6.8	26
18		**T3**	0.007	KPH	0.81	0.24	7.4	51
19	**Đ7**	**T1**	0.037	KPH	0.24	0.41	8.6	64
20		**T2**	0.041	KPH	0.61	0.56	5.7	27
21		**T3**	0.054	KPH	0.53	0.42	9.2	35

ANNEX 1.3: ANALYSIS RESULTS OF SURFACE WATER QUALITY

No.	Locations	Tide	pH	EC	Salinity	Turb.	SS	DO	BOD_5	TOC	TN	$N\text{-}NH_4^+$	$N\text{-}NO_2^-$	$N\text{-}NO_3^-$	$P\text{-}PO_4^{3-}$
				µS/cm	‰	*NTU*	*mg/l*	mgO_2/l		*mg/l*					
1	**N1**	Low	7.81	14900	8.65	43.7	72.6	5.3	9.2	4.84	0.998	0.102	0.010	0.830	0.045
2		High	7.28	15100	8.79	36.4	56.8	5.7	8.5	4.46	0.885	0.050	<0.01	0.781	0.044
3	**N2**	Low	7.40	21400	13.20	24.9	40.0	5.4	8.1	4.13	0.973	0.101	0.031	0.802	0.032
4		High	7.05	21600	13.50	20.6	31.6	5.8	8.0	4.23	0.884	0.053	0.018	0.769	0.036
5	**N3**	Low	7.37	21000	12.80	26.2	41.5	5.1	10.3	5.33	0.896	0.062	0.010	0.790	0.028
6		High	7.14	21500	13.30	23.6	39.5	5.0	9.2	4.61	0.889	0.031	<0.01	0.836	0.018
7	**N4**	Low	7.87	19100	11.60	39.6	69.0	5.5	7.5	3.81	1.481	0.456	0.059	0.872	0.076
8		High	7.55	19500	11.90	36.2	62.0	5.7	6.6	3.27	1.369	0.336	0.041	0.857	0.110
9	**N5**	Low	5.73	15800	9.30	6.2	8.5	7.5	3.6	2.368	1.150	0.430	0.010	0.682	0.023
10		High	6.57	16300	9.80	5.6	7.1	6.4	5.5	4.08	0.949	0.280	0.010	0.637	0.018
11	**N6**	Low	6.54	21200	12.80	93.2	142.6	5.1	9.5	5.62	1.079	0.230	0.029	0.765	0.045
12		High	6.25	21400	13.10	86.8	127.8	5.5	8.7	5.14	1.007	0.207	0.025	0.736	0.032
13	**N7**	Low	7.99	6900	3.97	31.6	55.3	5.4	10.3	5.20	1.396	0.367	0.081	0.873	0.061
14		High	7.12	7160	4.13	25.5	42.3	5.8	11.1	5.75	1.186	0.235	0.063	0.829	0.048
15	**N8**	Low	7.03	7140	4.12	29.0	45.6	5.6	7.6	4.29	1.092	0.155	0.095	0.786	0.046
16		High	6.56	7620	4.39	32.8	50.3	5.4	7.9	4.36	0.952	0.074	0.066	0.767	0.037
17	**N9**	Low	7.60	7420	4.28	9.4	18.5	5.4	9.0	4.81	1.691	0.577	0.080	0.979	0.045
18		High	7.41	8020	4.62	26.9	43.5	5.4	8.1	4.35	1.232	0.304	0.055	0.808	0.053
19	**N10**	Low	6.41	5708	3.14	20.0	34.7	6.0	7.0	3.70	1.264	0.302	0.050	0.866	0.038

No.	Locations	Tide	pH	EC	Salinity	Turb.	SS	DO	BOD_5	TOC	TN	$N\text{-}NH_4^+$	$N\text{-}NO_2^-$	$N\text{-}NO_3^-$	$P\text{-}PO_4^{3-}$
				µS/cm	‰	*NTU*	*mg/l*	*mgO_2/l*		*mg/l*					
20		High	6.34	6410	3.63	17.9	27.4	6.1	5.8	3.48	1.116	0.254	0.041	0.766	0.045

A1.3.1. Analysis results of surface water quality (continuous)

No.	Locations	Tide	Total hardness	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Fe_{TS}	Cl^-	K^+	Na^+	Acid	Al^{3+}	Total Coliform	Facal Coliform
			$mgCaCO_3/l$			*mg/l*					*meq/l*		*10^2*MPN/100 ml*	
1	**N1**	Low	1458.0	106.44	286.06	341.0	0.729	4881.6	107.4	2634.9	KPH	KPH	32	9.3
2		High	1477.6	107.87	289.90	346.9	0.719	4947.2	111.2	2694.9	KPH	KPH	17	0
3	**N2**	Low	2094.1	152.88	410.85	516.8	1.582	6925.2	155.5	3686.2	KPH	KPH	64	22
4		High	2113.7	154.31	414.69	538.8	1.486	7106.8	160.9	4015.6	KPH	KPH	52	11
5	**N3**	Low	2054.9	150.02	403.17	506.2	1.847	6880.2	153.7	3725.4	KPH	KPH	29	4.9
6		High	2103.9	153.59	412.77	535.3	1.806	7044.0	160.8	3836.1	KPH	KPH	20	3.2
7	**N4**	Low	1869.0	136.45	366.70	453.8	0.581	6257.7	158.4	3392.2	KPH	KPH	27	9.3
8		High	1908.2	139.31	374.37	429.6	1.793	6388.7	142.5	3463.5	KPH	KPH	54	20
9	**N5**	Low	1546.1	112.87	303.339	315.4	0.528	5176.5	111.9	2764.2	0.087	0.136	95	40
10		High	1595.0	116.45	312.9	386.7	0.432	5340.3	118.4	2886.0	0.088	0.106	130	28
11	**N6**	Low	2074.5	151.45	407.0	527.9	0.516	6945.7	155.5	3772.0	0.049	0.068	13	0
12		High	2094.1	152.88	410.9	517.6	0.368	7011.2	158.1	3785.6	0.060	0.071	11	0
13	**N7**	Low	726.1	53.01	142.45	169.5	0.939	2162.3	52.0	1182.8	KPH	KPH	11	0
14		High	784.8	57.29	153.97	183.0	0.884	2307.7	55.2	1315.0	KPH	KPH	19	0
15	**N8**	Low	558.5	40.78	109.58	131.1	0.533	2089.7	37.1	721.2	0.040	0.054	24	9

No.	Locations	Tide	Total hardness	Ca^{2+}	Mg^{2+}	SO_4^{2-}	Fe_{TS}	Cl^-	K^+	Na^+	Acid	Al^{3+}	Total Coliform	Facal Coliform
			$mgCaCO_3/l$			*mg/l*					*meq/l*		*10^2*MPN/100 ml*	
16		High	627.2	45.79	123.06	143.6	0.349	2168.4	42.7	779.5	0.061	0.068	33	11
17	**N9**	Low	698.7	51.01	137.08	160.8	0.490	2247.1	50.3	1022.4	KPH	KPH	32	7.8
18		High	745.6	54.44	146.29	173.9	0.591	2428.8	52.3	1232.0	0.060	0.050	16	2
19	**N10**	Low	675.2	49.29	132.47	166.1	1.116	1728.6	46.1	1002.1	KPH	KPH	59	14
20		High	700.6	51.15	137.46	157.4	0.955	1941.3	51.3	1116.2	KPH	KPH	7.4	0

A1.3.1. Analysis results of surface water quality (continuous)

No.	Locations	Tide	Cd	Hg	Pb	As	Cu	Zn	Mineral oil	Chlorinated pesticides	Phosphorus Pesticides
			mg/L								
1	**N1**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
2		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
3	**N2**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
4		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
5	**N3**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
6		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
7	**N4**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
8		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
9	**N5**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
10		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
11	**N6**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH

No.	Locations	Tide	Cd	Hg	Pb	As	Cu	Zn	Mineral oil	Chlorinated pesticides	Phosphorus Pesticides
			mg/L								
12		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
13	**N7**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
14		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
15	**N8**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
16		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
17	**N9**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
18		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
19	**N10**	Low	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH
20		High	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH	KPH

A.1.4.Analysis results of groundwater quality

No.	Parameter	Unit	Symbol		
			GK1	**GK2**	**GK3**
1	pH	-	6.67	6.53	6.7
5	Turbidity	NTU	1.34	5.62	1.41
6	EC	µS/cm	1469	5730	967
7	Salinity	‰	0.70	3.30	0.40
8	DO	mg/l	3.20	3.80	4.50
9	TOC	mg/l	2.07	0.89	1.33
10	Total alkalinity	$mgCaCO_3/l$	300	420	240
11	TSS	mg/l	5	11	0
12	TN	mg/l	0.44	1.19	0.83
13	$N\text{-}NH_4^+$	mg/l	0.20	0.21	0.68
14	$N\text{-}NO_2^-$	mg/l	0	0	0
15	$N\text{-}NO_3^-$	mg/l	0.20	0.98	0.08
16	Cl^-	mg/l	44.90	1587.00	37.49
17	Ca^{2+}	mg/l	33.91	115.61	16.96
18	Mg^{2+}	mg/l	18.38	196.31	19.63
19	$P\text{-}PO_4^{3-}$	mg/l	0.11	0.05	0.10
20	Na_+	mg/l	230.17	1036.61	161.92
21	K^+	mg/l	8.84	37.19	6.30
22	SO_4^{2-}	mg/l	13.85	9.82	5.83
23	Fe_{TS}	mg/l	0.54	0.79	0.65
24	Pb	µg/l	KPH	0.005	0.01
25	Zn	µg/l	KPH	KPH	KPH
26	Hg	µg/l	KPH	KPH	KPH
27	As	µg/l	0.064	0.042	0.058
28	E. Coli	MPN/100 mL	0	0	0
29	Total Coliform	MPN/100 mL	0	0	0

A1.5. Analysis results of wastewater quality

Parameter	Unit	Domestic wastewater		
		NT1	**NT2**	**NT3**
pH		6.76	6.5	6.8
EC	µgs/cm	710	640	580
Color	Pt-Co	60	50	45
DO	mg/l	1.87	1.9	1.5
SO_4^{2-}	mg/l	26.1	22.4	18.4
Cl^-	mg/l	23.4	21.1	17.4
TN	mg/l	12.6	14.3	18.5
$N\text{-}NH_4^+$	mg/l	10.7	8.4	12.1
$N\text{-}NO_2^-$	mg/l	0.046	0.0	0.1
$N\text{-}NO_3^-$	mg/l	1.17	0.7	2.9
TP	mg/l	0.97	1.1	0.8
$P\text{-}PO_4^{3-}$	mg/l	0.68	0.8	0.5
TSS	mg/l	129	172.0	195.8
TDS	mg/l	371	350.0	327.0
BOD_5	mg/l	128.58	125.6	138.6
COD	mg/l	241	247.0	264.0
H_2S	mg/l	0.34	0.2	0.2
Fe_{Ts}	mg/l	0.521	0.4	0.2
Cu	mg/l	KPH	KPH	KPH
Pb	mg/l	KPH	KPH	KPH
Zn	mg/l	KPH	KPH	KPH
Cd	mg/l	KPH	KPH	KPH
As	mg/l	KPH	KPH	KPH
Hg	mg/l	KPH	KPH	KPH
Total coliform	MPN/100 ml	11.000	5.200	79.000
Fecal coliform	MPN/100 ml	4.800	2.300	6.500

A1.6.1: Analytical result of phytoplankton (from site 1 to 5)

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
I	***BACILLARIOPHYTA***										
2	*Actinoptychus roperi*	*								*	
3	*Amphiprora alata*			*							
4	*Amphiprora gigantea*				*						
5	*Amphora lineolata*						*				
6	*Amphora quadrata*			*					*		
7	*Biddulphia mobiliensis*		*								
8	*Biddulphia regia*						*				
9	*Biddulphia sinensis*	*			*						*
10	*Chaetoceros abnormis*								*		
11	*Chaetoceros diversus*		*								
12	*Chaetoceros lorenzianus*					*				*	
13	*Chaetoceros peruvianus f. robusta*			*							
14	*Climacodium frauenfeldianum*	*						*			*
15	*Coscinodiscus astromphalus*										
16	*Coscinodiscus bipartitus*			*							
17	*Coscinodiscus excentricus*								*		
18	*Coscinodiscus gigas*						*				
19	*Coscinodiscus janisschii*	*			*						

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
20	*Coscinodiscus jonessianus*		*								*
21	*Coscinodiscus lineatus*									*	
22	*Coscinodiscus marginatus*				*		*		*		
23	*Coscinodiscus radiatus*					*					
24	*Coscinodiscus subtilis*		*							*	
25	*Cyclotella comta*							*			
26	*Cyclotella glomerata*	*									
27	*Cyclotella striata*			*							
28	*Ditylum sol*										*
29	*Ditylum sol*		*						*		
30	*Fragilaria longissima*						*				
31	*Fragilaria virescens*			*							
32	*Gomphonema sp*					*					
33	*Grammatophora angulosa*	*							*		
34	*Guinadia flaccida*										
35	*Gyrosigma acuminata*			*							
36	*Gyrosigma balticum*						*				
37	*Gyrosigma macrum*									*	
38	*Gyrosigma sp.*							*			*
II	***CYANOPHYTA***										
39	*Anabaena variabilis*	*									

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
40	*Ceratium furca*								*		
41	*Ceratium macroceros*			*	*						
42	*Ceratium trichoceros*					*				*	
43	*Gloeocapsa minima*							*			
44	*Oscillatoria acuta*										*
45	*Oscillatoria formosa*		*								
46	*Oscillatoria geitlariana*									*	
47	*Oscillatoria limosa*			*			*				
48	*Oscillatoria princeps*	*									
49	*Oscillatoria subbrevis*					*					
50	*Oscillatoria tenuis*								*		
51	*Oscillatoria limosa*			*							
III	***DINOPHYTA***										
52	*Ceratium hirumdinella*		*								
53	*Glenodinium sp.*						*				
54	*Gonyaulax turbynei*									*	
55	*Noctiluca scintilans*					*					
56	*Peridinium conicum*	*									
IV	***EUGLENOPHYTA***										
57	*Ceratium hirumdinella*			*							
58	*Euglena acus*								*		

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
59	*Euglena caudata*						*				
60	*Euglena oxyuris*									*	
61	*Euglena sanguinea*				*						
62	*Euglena spinogyra*		*					*			
63	*Euglena tripteros*			*							
64	*Glenodinium sp.*					*					
65	*Gonyaulax turbynei*		*								
66	*Noctiluca scintilans*				*				*		
67	*Peridinium conicum*							*			
68	*Peridinium latum*						*			*	
69	*Peridinium remotum*		*								
70	*Peridinium remotum*				*						
71	*Peridinium sinaicum*						*				*
V	***CHLOROPHYTA***										
72	*Ankistrodesmus angustus*	*									
73	*Ankistrodesmus falcatus*					*					
74	*Bulbochaete varians*			*					*		
75	*Chlorella vulgaris*		*								
76	*Chodatella subsalsa*				*						*
77	*Closterium gracile*									*	
78	*Closterium kuetzingii*		*								

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
79	*Coelastrum microporum*					*		*			
80	*coelastrum sphaericum*	*									
81	*Hyalotheca mucosa*			*						*	
82	*Kirchneriella subsalsa*						*				
83	*Pachycladon umbrinus*								*		
Quantity (species/site)		11	12	14	9	9	12	7	12	12	8
Density (Cell/m^3)		70	96	84	79	71	110	89	127	94	88

A1.6.2. Analytical result of phytoplankton (from site 6 to 10)

No.	Name of specices	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
I	***BACILLARIOPHYTA***										
2	*Actinoptychus roperi*		*								
3	*Amphiprora alata*				*					*	
4	*Amphiprora gigantea*							*			
5	*Amphora lineolata*										
6	*Amphora quadrata*					*					*
7	*Biddulphia mobiliensis*	*								*	
8	*Biddulphia regia*						*				
9	*Biddulphia sinensis*			*							
10	*Chaetoceros abnormis*					*		*		*	
11	*Chaetoceros diversus*		*								
12	*Chaetoceros lorenzianus*				*						*
13	*Chaetoceros peruvianus*						*				
14	*Climacodium frauenfeldianum*	*							*		
15	*Coscinodiscus astromphalus*				*						*
16	*Coscinodiscus bipartitus*										
17	*Coscinodiscus excentricus*		*								
18	*Coscinodiscus gigas*						*		*		
19	*Coscinodiscus janisschii*	*									
20	*Coscinodiscus jonessianus*			*							
21	*Coscinodiscus lineatus*					*					

No.	Name of specices	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
22	*Coscinodiscus marginatus*							*			*
23	*Coscinodiscus radiatus*		*						*		
24	*Coscinodiscus subtilis*				*						
25	*Cyclotella comta*	*								*	
26	*Cyclotella glomerata*		*								
27	*Cyclotella striata*										
28	*Ditylum sol*				*			*			
29	*Ditylum sol*										
30	*Fragilaria longissima*					*				*	
31	*Fragilaria virescens*										*
32	*Gomphonema sp*		*								
33	*Grammatophora angulosa*					*		*			
34	*Guinadia flaccida*										
35	*Gyrosigma acuminata*		*		*						
36	*Gyrosigma balticum*								*		
37	*Gyrosigma macrum*						*				
38	*Gyrosigma sp.*	*									*
II	***CYANOPHYTA***										
39	*Anabaena variabilis*		*								
40	*Ceratium furca*				*						*
41	*Ceratium macroceros*							*			

No.	Name of specices	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
42	*Ceratium trichoceros*										
43	*Gloeocapsa minima*			*							
44	*Oscillatoria acuta*					*				*	
45	*Oscillatoria formosa*							*			
46	*Oscillatoria geitlariana*										
47	*Oscillatoria limosa*	*									
48	*Oscillatoria princeps*			*							
49	*Oscillatoria subbrevis*								*		
50	*Oscillatoria tenuis*						*				
51	*Oscillatoria limosa*		*								
III	***DINOPHYTA***										
52	*Ceratium hirumdinella*		*					*			
53	*Glenodinium sp.*					*					*
54	*Gonyaulax turbynei*										*
55	*Noctiluca scintilans*			*					*		
56	*Peridinium conicum*	*									
IV	***EUGLENOPHYTA***										
57	*Ceratium hirumdinella*		*								
58	*Euglena acus*				*			*			
59	*Euglena caudata*									*	
60	*Euglena oxyuris*	*									

No.	Name of specices	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
61	*Euglena sanguinea*						*				
62	*Euglena spinogyra*										
63	*Euglena tripteros*		*		*				*		
64	*Glenodinium sp.*		*								
65	*Gonyaulax turbynei*					*		*			
66	*Noctiluca scintilans*									*	
67	*Peridinium conicum*							*			
68	*Peridinium latum*	*			*						
69	*Peridinium remotum*		*								
70	*Peridinium remotum*							*		*	
71	*Peridinium sinaicum*					*					
V	***CHLOROPHYTA***										
72	*Ankistrodesmus angustus*		*								
73	*Ankistrodesmus falcatus*								*		
74	*Bulbochaete varians*						*			*	
75	*Chlorella vulgaris*			*							
76	*Chodatella subsalsa*					*					
77	*Closterium gracile*		*								
78	*Closterium kuetzingii*							*			*
79	*Coelastrum microporum*				*						
80	*coelastrum sphaericum*	*									

No.	Name of specices	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
81	*Hyalotheca mucosa*			*							
82	*Kirchneriella subsalsa*									*	
83	*Pachycladon umbrinus*					*					
Quantity (species/site)		10	16	7	11	11	7	13	8	11	10
Density (Cell/m^3)		87	145	54	99	107	81	128	83	99	104

A1.7.1.Analytical result of zooplankton (from site 1 to 5)

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		High	Low	High	Low	High	Low	High	Low	High	Low
I	***CLADOCERA***										
1	*Alona davidi*	*		*		*		*			
2	*Alona rectangula*			*						*	
3	*Biaperturakarua*										
4	*Bosmina longirostris*		*				*				
5	*Bosminopsis deitersi*										*
6	*Ceriodaphnia laticaudata*					*		*		*	
7	*Ceriodaphnia megalops*			*							
8	*Ceriodaphnia reticulate*	*				*					
II	***COPEPODA***										
1	*Allodiaptomus gladiolus*	*			*	*				*	
2	*Dentodiaptomus javanus*							*			
3	*Eodiaptomus dracosinignvomi*		*								*
4	*Eodiaptomus lumboltzi*				*						
5	*Eucyclops serruatus*								*		
6	*Heliodiaptomus serratu*	*									
7	*Limnoithona sinensis*						*		*		*
8	*Limoncaea genuine*			*							
9	*Mesocyclops leuckarti*	*				*					

No.	Species	Sites									
		N1		N2		N3		N4		N5	
		High	Low	High	Low	High	Low	High	Low	High	Low
10	*Mongolodiaptomus formosanus*		*						*		
11	*Neodiaptomus botulifer*				*						*
12	*Neodiaptomus handeli*	*					*				
13	*Neodiaptomus visnu*								*		
14	*Paracyclops serrulatus*			*			*				
	Quantity (species/site)	***6***	***3***	***5***	***3***	***5***	***4***	***3***	***4***	***3***	***4***
	Density (invidual/m^3)	**1100**	**590**	**902**	**660**	**890**	**700**	**621**	**786**	**588**	**864**

A.1.7.2: Analytical result of zooplankton (from site 6 to 10)

No.	Species	Sites									
		N6		N7		N8		N9		N10	
		High	Low	High	Low	High	Low	High	Low	High	Low
I	***CLADOCERA***	*								*	
1	*Alona davidi*										
2	*Alona rectangula*						*			*	
3	*Biaperturakarua*										
4	*Bosmina longirostris*			*					*		
5	*Bosminopsis deitersi*				*						
6	*Ceriodaphnia laticaudata*						*				*
7	*Ceriodaphnia megalops*		*							*	

No.	Species	Sites									
		N6		N7		N8		N9		N10	
		High	Low	High	Low	High	Low	High	Low	High	Low
8	*Ceriodaphnia reticulate*			*							
II	***COPEPODA***										
1	*Allodiaptomus gladiolus*		*					*			
2	*Dentodiaptomus javanus*			*							
3	*Eodiaptomus dracosinignvomi*					*					
4	*Eodiaptomus lumboltzi*								*		*
5	*Eucyclops serruatus*	*									
6	*Heliodiaptomus serratu*			*		*					
7	*Limnoithona sinensis*							*			
8	*Limoncaea genuine*		*		*						
9	*Mesocyclops leuckarti*	*								*	
10	*Mongolodiaptomus formosanus*			*			*				
11	*Neodiaptomus botulifer*				*				*		*
12	*Neodiaptomus handeli*		*					*			
13	*Neodiaptomus visnu*			*						*	
14	*Paracyclops serrulatus*	*					*				
	Quantity (species/site)	***3***	***4***	***6***	***3***	***2***	***4***	***3***	***3***	***4***	***3***
	Density (invidual/m^3)	**430**	**542**	**1004**	**503**	**325**	**589**	**442**	**476**	**534**	**482**

A1.8.1: Analytical result of zoobenthos (from site 1 to 5)

No.	Name of species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
1	**POLYCHAETA**										
2	*Ammotripane dubia*		*								
3	*Bispira polymorpha*						*			*	
4	*Glicinde oligodon*				*			*			
5	*Lumbrinereis sp*	*									
6	*Marphysa bifurcata*					*		*			*
7	*Neanthes caudata*		*								
8	*Neanthes meggitti*			*					*		
II	**GASTROPODA**										
9	*Antimelania swinhoei*	*								*	
10	*Bellamya filosa*						*				
11	*Filopaludina filosa*		*							*	
12	*Melanoides tuberculatus*						*				*
13	*Sinotaria reevei*			*					*		
III	**BIVALVIA**										
14	*Corbicula leviuscula*	*	*								*
15	*Corbicula baudoni*				*			*			
16	*Corbicula cyreniformis*					*				*	
IV	**CRUSTACEA**										
17	*Macrobrachium mammilodactylus*			*				*			
18	*Macrobrachium pilimanus*	*								*	
19	*Macrobrachium rosenbergii*				*		*		*		

No.	Name of species	Sites									
		N1		N2		N3		N4		N5	
		Low	High	Low	High	Low	High	Low	High	Low	High
20	*Penaeus monodon*	*									*
21	*Fenneropenaeus merquiensis*						*			*	
22	*Fenneropenaeus indicus*			*							
	Quantity (species/site)	5	4	4	3	2	5	4	3	6	4
	Density (invidual/m^2)	58	66	49	42	25	70	59	43	81	55

A1.8.2. Analytical result of zoobenthos (from site 6 to 10)

No.	Name of species	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
1	**POLYCHAETA**										
2	*Ammotripane dubia*					*			*		
3	*Bispira polymorpha*		*								
4	*Glicinde oligodon*	*			*						*
5	*Lumbrinereis sp*	*						*			
6	*Marphysa bifurcata*						*				
7	*Neanthes caudata*		*							*	
8	*Neanthes meggitti*				*				*		
II	**GASTROPODA**										
6	*Antimelania swinhoei*				*			*		*	
7	*Bellamya filosa*		*								
8	*Filopaludina filosa*						*		*		*
9	*Melanoides tuberculatus*	*		*							
10	*Sinotaria reevei*				*			*			
III	**BIVALVIA**										
13	*Corbicula leviuscula*		*				*			*	
14	*Corbicula baudoni*				*				*		
15	*Corbicula cyreniformis*	*				*			*		
IV	**CRUSTACEA**										
17	*Macrobrachium mammilodactylus*			*					*		*
18	*Macrobrachium pilimanus*	*				*					
19	*Macrobrachium rosenbergii*				*			*			

No.	Name of species	Sites									
		N6		N7		N8		N9		N10	
		Low	High	Low	High	Low	High	Low	High	Low	High
20	*Penaeus monodon*		*	*		*	*			*	
21	*Fenneropenaeus merquiensis*	*						*			
22	*Fenneropenaeus indicus*					*					*
	Quantity (species/site)	6	5	3	6	5	4	5	6	4	4
	Density (invidual/m^2)	66	61	38	68	55	49	42	60	45	42

ANNEX 2: 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 (Kien Giang 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 (Kien Giang 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) Kien Giang 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

Issues/Risks	Mitigation Measure
	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. • 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.

Issues/Risks	Mitigation Measure
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.
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;

Issues/Risks	Mitigation Measure
	• 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; • 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	• 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

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	• 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.

ANNEX 3: SOME PICTURES OF PUBLIC CONSULTATIONS



KÉM, DÂN VẬN KHÉO THÌ VIỆC GÌ CŨNG THÀNH CÔNG

ĐẢNG CỘNG SẢN VIỆT NAM QUANG VINH MUÔN NĂM



KÉM THÌ VIỆC GÌ CŨNG KÉM, DÂN VẬN KHÉO THÌ VIỆC GÌ CŨNG

ANNEX 4: LOCATIONS OF SAMPLING SITES

A3.1. Location of sampling for environmental status

Table 1: Coordinates of surface water sampling location

No	Locations	Coordinates		Description of sampling sites
		Latitude	Longitude	
1	N1	9°55'23.49" N	105° 1'43.27"E	at Thu Nhat sluice
2	N2	9°53'16.36" N	104°59'28.75"E	at Thu Ba sluice
3	N3	9°51'1.99"N	104°57'34.85"E	at Thu Sau sluice
4	N4	9°49'23.80" N	104°54'19.07"E	at Xeo Ban sluice
5	N5	9°45'59.16" N	104°52'44.89"E	at Thu Muoi sluice
6	N6	9°39'1.37"N	104°51'6.60"E	at Chu Vang canal, intersection with sea dyke
7	N7	9°38'13.91" N	104°56'23.47"E	at Can Gao canal, section near Chu Vang canal
8	N8	9°45'13.04" N	104°57'11.86"E	at Thu Tam, section near Kiem Lam canal
9	N9	9°49'1.23"N	105° 0'12.13"E	at Thu Sau canal, section near Kiem Lam canal
10	N10	9°50'15.92" N	105° 5'10.31"E	at Xeo Ro canal, section near Thu Nhat canal

Table 2: Coordinates of groundwater sampling location

No	Locations	Coordinates		Description of sampling sites
		Latitude	Longitude	
1	GK1	9°52'37.38"N	105° 0'14.50"E	at residential area along Thu Ba canal
2	GK2	9°50'57.76"N	104°57'42.40"E	residential area at head of Thu Sau canal
3	GK3	9°47'6.59"N	104°53'8.46"E	residential area at head of Thu Chin canal

Table 3: Coordinates of wastewater sampling location

No	Locations	Coordinates		Description of sampling sites
		Latitude	Longitude	
1	NT1	9°55'20.91" N	105° 1'45.44"E	residential area at head of Thu Nhat canal
2	NT2	9°50'58.47" N	104°57'41.69"E	residential area at head of Thu Sau canal
3	NT3	9°47'8.46"N	104°53'11.70"E	residential area at head of Thu Chin canal

Table 4: Coordinates of soil sampling location

No.	Locations	Coordinates		Description of sampling sites
		Latitude	Longitude	
1	Đ1	9°55'26.67"N	105° 1'39.94"E	at Thu Nhat sluice
2	Đ2	9°50'59.25"N	104°57'36.68"E	at Thu Sau sluice

3	Đ3	9°48'10.58"N	104°53'30.09"E	at Thu Tam sluice
4	Đ4	9°46'2.77"N	104°52'45.21"E	at Thu Muoi sluice
5	Đ5	9°37'18.00"N	104°55'12.85"E	Infield of KT1 canal area
6	Đ6	9°44'34.67"N	104°57'13.75"E	Infield of Kiem Lam canal area
7	Đ7	9°49'1.80"N	105° 2'44.23"E	Infield of Thay Cai canal area

Table 5: Coordinates sediment sampling location

No	**Locations**	**Coordinates**		**Description of sampling Sites**
		Latitude	**Longitude**	
1	TT1	9°55'26.91"N	105° 1'37.64"E	at Thu Nhat canal
2	TT2	9°54'18.44"N	105° 0'28.80"E	at Thu Hai canal
3	TT3	9°53'11.36"N	104°59'31.85"E	at Thu Ba canal
4	TT4	9°52'8.51"N	104°58'30.84"E	at Thu Nam canal
5	TT5	9°50'59.47"N	104°57'37.74"E	at Thu Sau canal
6	TT6	9°49'23.74"N	104°54'18.85"E	at Xeo Ban canal
7	TT7	9°48'13.83"N	104°53'33.19"E	at Thu Tam canal
8	TT8	9°47'8.19"N	104°53'6.15"E	at Thu Chin canal
9	TT9	9°46'6.07"N	104°52'44.82"E	at Thu Muoi canal
10	TT10	9°46'54.47"N	104°56'17.08"E	at intersections of Chong My - Xeo Ban canal

Table 6: Coordinates of air sampling location

No	**Locations**	**Coordinates**		**Description of sampling Sites**
		Latitude	**Longitude**	
1	KK1	9°55'23.87"N	105° 1'40.47"E	at residential area near Thu Nhat sluice
2	KK2	9°53'12.53"N	104°59'33.05"E	at residential area near Thu Ba sluice
3	KK3	9°50'57.47"N	104°57'33.66"E	at residential area near Thu Sau sluice
4	KK4	9°49'21.30"N	104°54'18.47"E	at residential area near Xeo Ban sluice
5	KK5	9°46'1.42"N	104°52'45.23"E	at residential area near Thu Muoi sluice

A3.2. Locations of environmental monitoring sites

Table 1: Coordinates of surface water sampling location

No	Locations	Coordinates		Description of sampling location
		Latitude	Longitude	
1	N1	9°55'22.46"N	105° 1'42.66"E	at Thu Nhat sluice
2	N2	9°54'17.88"N	105° 0'29.24"E	at Thu Hai sluice
3	N3	9°53'12.48"N	104°59'30.19"E	at Thu Ba sluice
4	N4	9°52'8.42"N	104°58'30.76"E	at Thu Nam sluice
5	N5	9°50'59.10"N	104°57'38.16"E	at Thu Sau sluice
6	N6	9°49'23.63"N	104°54'18.88"E	at Xeo Ban sluice
7	N7	9°48'13.07"N	104°53'33.08"E	at Thu Tam sluice
8	N8	9°47'7.86"N	104°53'5.74"E	at Thu Chin sluice
9	N9	9°45'57.57"N	104°52'58.01"E	at Thu Muoi sluice
10	N10	9°55'5.22"N	105° 4'14.59"E	infield of Dai canal area
11	N11	9°52'34.55"N	104°59'41.60"E	infield of aquaculture area near Thu Ba canal
12	N12	9°49'43.48"N	104°58'18.57"E	Infield of aquaculture area near Thu Sau canal
13	N13	9°44'54.73"N	104°53'50.55"E	Infield of aquaculture area near Thu Muoi canal
14	N14	9°40'19.90"N	104°52'25.29"E	Infield of aquaculture area near Ro Ghe canal
15	N15	9°36'24.53"N	104°55'26.83"E	Infield of Cho canal area

Table 2: Coordinates sediment sampling location

No	Locations	Coordinates		Description of sampling location
		Latitude	Longitude	
1	TT1	9°55'26.91"N	105° 1'37.64"E	at Thu Nhat canal
2	TT2	9°54'18.44"N	105° 0'28.80"E	at Thu Hai canal
3	TT3	9°53'11.36"N	104°59'31.85"E	at Thu Ba canal
4	TT4	9°52'8.51"N	104°58'30.84"E	at Thu Nam canal
5	TT5	9°50'59.47"N	104°57'37.74"E	at Thu Sau canal
6	TT6	9°49'23.74"N	104°54'18.85"E	at Xeo Ban canal
7	TT7	9°48'13.83"N	104°53'33.19"E	at Thu Tam canal
8	TT8	9°47'8.19"N	104°53'6.15"E	at Thu Chin canal
9	TT9	9°46'6.07"N	104°52'44.82"E	at Thu Muoi canal
10	D-TT10	9°40'27.90"N	104°52'21.97"E	infield of Dai canal area
11	D-TT11	9°36'30.31"N	104°55'21.36"E	infield of aquaculture area near Thu Ba canal
12	D-TT12	9°44'48.66"N	104°53'58.75"E	Infield of aquaculture area near Thu Sau canal
13	D-TT13	9°49'41.91"N	104°58'21.20"E	Infield of aquaculture area near Thu Muoi canal
14	D-TT14	9°52'25.76"N	104°59'51.05"E	Infield of aquaculture area near Ro Ghe canal
15	D-TT15	9°55'2.12"N	105° 4'9.59"E	Infield of Cho canal area

Table 3: Coordinates of air sampling location

No	Locations	Coordinates		Description of sampling location
		Latitude	Longitude	
1	KK1	9°55'23.87"N	105° 1'40.47"E	at residential area near Thu Nhat sluice
2	KK2	9°53'12.53"N	104°59'33.05"E	at residential area near Thu Ba sluice
3	KK3	9°50'58.50"N	104°57'41.34"E	at residential area near Thu Sau sluice
4	KK4	9°49'21.46"N	104°54'17.26"E	at residential area near Xeo Ban sluice
5	KK5	9°46'5.11"N	104°52'45.40"E	at residential area near Thu Muoi sluice