CHAPTER 4 LAND USE PLANNING

4.1 Introduction

In this chapter, agricultural land use plan is formulated given the climate change scenarios simulated in the Project. In a course of planning process, four major issues were concerned, namely 1) profitability of major commodities (paddy, shrimp, and fruits crops), 2) stability of major commodities in an economic term, 3) adaptability or suitability of major commodities to different types of environment, and 4) issues and constraints need to be considered for planning. After all, three land use plans were established for the projected years of 2020, 2030 and 2050.

First of all, as described in the main report of the Project, a series of simulation analysis had been carried out based on a couple of development scenarios: A1, A2, B1 and B2 scenarios, which are summarized in Table 4.1.1. Particularly, two major issues of climate change, flood and saline intrusion were simulated along with the development scenarios. As a result, various levels of saline intrusions were drawn by time series with several cases of water discharge, sea level rise, and development scenarios.

In the land use planning, saline intrusions of average projected-discharges of 2011-2020, 2021-2030, and 2041-2050 for each year of 2020, 2030 and 2050 were taken based on B2 scenario, in which sustainable development is to be pursued within a scope of regional development.

Table 4.1.1 Contents of Four Development Scenarios

Scenario		A	B
		Puts more emphasis on economic growth	Pursues sustainable development along with environment conservation
1	Promotes globalization by narrowing regional disparity	A1: **Pro-dev. and Globalize**	B1: **Sus-Dev. and Globalize**
2	Promotes uniqueness of the region	A2: **Pro-Dev. and Regionalize**	B2: **Sus-Dev. and Regionalize**

4.2 Characteristics of Main Commodities Prevailing in the Area

4.2.1 Profitability of Major Commodities

Based on a series of questionnaire surveys organized in the Project, expected profitability has been estimated for the major commodities: paddy, shrimp, coconuts, and fruit crops. Outlines and detailed results of each questionnaire survey are summarized in the previous chapters (CHAPTER 1 to CHAPTER 3). Based on the findings derived from the questionnaire surveys, it was found that the profit of paddy cultivation is far lower than other crops even if paddy is cultivated twice a year.

The most profitable crop was found fruit crops conceiving a net income of 94,733,000VND/ha although it is still a provisional value, which is followed by coconut with a net income of 56,680,000VND/ha. Note that the price of coconut for the year surveyed was quite high as compared to the recent years and had dropped to be 30% of it in the following year. Therefore, it is safer to consider that presented value is the maximum case.

Brackish shrimp culture comes to the third ranked, still higher than two cropping of paddy cultivation. Taking a series of interviews made to some shrimp farmers into account, the resulted income level seems a little understated. It may be because the results included a lot numbers of samples for extensive, extensive under rotation between shrimp-paddy, and semi-extensive cultures.

To be sure, manageable size of land area also needs to be considered. Average size of production area for shrimp culture was considerably bigger than that of other commodities. Given the bigger size of manageable areas, higher income per household can be expected from brackish shrimp culture.

Thus, as far as profitability of average year is concerned, fruit crops and shrimp culture maintain more economic potential than paddy. When land use is concerned, those commodities would be more preferable to the beneficial people in the area.

Table 4.2.1 Profitability of Major Commodities (000VND/ha)

Commodity	Gross Income	Cost	Net Income	Area/ Household	Source
Paddy (1 cropping)	30,780	17,658	13,122	0.74ha	Agriculture and aquaculture questionnaire survey
Paddy (2 cropping)	61,560	35,316	26,244	0.74ha	Agriculture and aquaculture questionnaire survey
Brackish Shrimp	64,968	28,246	36,722	2.00ha	Shrimp culture questionnaire survey
Coconut	65,233	8,553	56,680	0.48ha	Agriculture and aquaculture questionnaire survey
Fruit Crops	140,586	46,153	94,433	0.64ha	Fruit production questionnaire survey

Source: JICA Project Team (2012) from a different set of questionnaire surveys.
Note: For the target year of coconut production, price was the highest in the recent years, which dropped to be around 30% in the next year (early 2012). Therefore, it is safer to consider the net income of coconut roughly half of it.

In addition to above mentioned statistical data, it has been confirmed that profitability of fruit crops are generally higher than that of paddy (interview to Southern Horticultural Research Institute: SOFRI, 2012). For example, expected average income of mandarin and orange are 200-300 million VND/ha per year, which sometimes reaches even 500 million VND/ha per year in maximum despite some risk of loss to be 10 million VND or total loss as a minimum case due to disease.

Mango and longan, for another example, would bring average benefit of approximately 100 million VND/ha, ranging from 50 up to 200 million VND/ha, while expected average income of paddy is around 30 million/ha per year from two times of cropping, which also ranges from 30 to 50 million VND/ha.

4.2.2 Economic Stability of Major Commodities

In addition to the profitability of each commodity, stability of those commodities should be also considered. For example, productivity of paddy may easily change due to the fluctuation in temperature or in amount/ timing of rainfall in a particular season or a year. For another example, shrimp cultivation is often exposed to a certain risk of loss by an occurrence of diseases.

According to some interviews made to shrimp farmers, they sometimes experience an occurrence of shrimp diseases that would reduce the production of shrimps or sometimes loose total shrimps in the pond—shrimp culture is definitely associated with a certain risk higher than other commodities. Fruits production is not an exception. Recently, “greening disease” transmitted by a type of flying insect had become pandemic for citrus fruits, which causes the significant loss of fruits.

Moreover, market price is also a subject that determines the level of income from particular commodity; even if higher production is conceivable, it does not guarantee higher income. Price fluctuation is significant when the commodity is marketed to an international market. Even the local prices are heavily influenced by the fundamentals in the international market unless price of that commodity is regulated by the government authorities.

In conclusion, there are two major factors that have decisive influence on the economic stability of agricultural and aquacultural commodities: 1) fluctuation of market price, and 2) fluctuation of production. Then, the fluctuation of production itself attributes to various factors such as amount of inputs, technical level, availability of human and natural resources, and then climate condition.

In addition, required period of time for production and required amount of investment are of big concern for small-scale households, although those are not exactly the risk attached to the commodity

itself but a risk associated with the cash flow enabled by households. When the economic tolerance of farmer households is considerably low, those commodities that required high investment cost and longer period of time for production would not be better choices.

In this section, then, risk factors of major commodities are summarized to see comparative advantages and disadvantages of the commodities in terms of the stability of income levels. Risks to major commodities can be summarized as shown in Table 4.2.2. For example, risk of income reduction caused by temperature change is evaluated "middle" for paddy and shrimp and "low" for coconut and fruit crops. On the other hand, conceivable risk associated with saline water is "high" for paddy and fruits, "low" for coconut, and "no" noticeable risk for shrimp.

Table 4.2.2 Risk Factors and Their Impact on Major Commodities

Risk Factor	Paddy	Shrimp	Coconut	Fruits	Remark
1. Production Factors					
Temperature change	Mid	Mid	Low	Low	Quality of products is also affected
Saline water	High	Low (no)	Low	High	Ditto
Degree of technology	Low	High	Low	High	Ditto
Disease	Mid	High	Low	High	Ditto
Flood	Mid	Mid	Low	High	Ditto
2. Price Factors					
Price fluctuation	Low	High	High	High	
3. Other Factors					
High investment cost	Low	High	Low	Mid	
Length to first harvest	Low (short)	Low (short)	High (long)	High (long)	
Manageable size	Mid	Low (large)	Mid	Mid	Clarification of data needed
Count of High Risk	1	4	2	6	5 point/high risk
Count of Middle Risk	4	2	1	2	3 point/ middle risk
Count of Low Risk	4	3	6	1	1 point/ low risk
Total Score of Risk	21	29	19	37	

Source: JICA Project Team (2012) from a different set of questionnaire surveys.
Note: Evaluation of the risk was based on a discussion with SIWRP counterparts (no particular foundations to prove)

Total risk was then concluded through a simple evaluation of risk factor by giving different scores to each level of risk (5 point for high risk, 3 point for middle risk and 1 point for low risk). Note that no weight factor was considered among the risk factors given no particular scientific foundation available for that. After all, total score was the highest (37 points), the most risky, for fruit crops despite the higher income level, which is followed by shrimp (29 points).

On the other hand, paddy and coconut were scored about the same: 21 points and 19 points respectively. This simple trial implied that, considering the economic stability of the production, the most preferable crops are paddy and coconut, while shrimp and fruit crops entail a certain level of risks associated with production factors, price factors and other conceivable factors.

4.2.3 Suitability of Major Commodities

As for land use planning, suitability and adaptability of major commodities to various types of agro-ecological environment should be clearly understood so that appropriate commodities can be recommended suitable to particular areas. As a bottom line, minimum requirement of the commodities or threshold for biologically and economically acceptable for the commodities, should be identified. The following gives some descriptive notes. The detailed information on environmental tolerance of major crops and expected degree of damages to be caused by climate change in the future is precisely discussed and quantitatively evaluated in APPENDIX II "Climate Change and Vulnerability."

1) Paddy

Salinity tolerance of paddy may vary according to the variety, growth stage and conditions of other environmental factors such as water temperature, water quality and fertility of the land. Generally, it is said that salinity contents should be kept less than 0.4% for paddy production (Interview to Cuu Long Rice Research Institute, 2011), which is considered the threshold for the salt tolerant varieties.

In reality, however, salinity should be kept much lower than that for the economic production of paddy. For an example of a research in Japan, it is reported that effect of salinity starts at the salinity content of 500 ppm for the early stage (3 weeks after transplanting), by reduction of number of tillers[20]. At the point of 1,000 ppm, effect of salinity appears as a reduction of number of panicles.

In practice, furthermore, geospatial arrangement of farm plots also counts. There are farm areas where shrimp culture and paddy cultivation are mosaicked at the same season, by which paddy cultivation is exposed to a higher risk of saline contamination derived from water management or gate operation for shrimp culture.

2) Shrimp

Shrimp cultivation has been given lots of popularity and total cultivated areas and production of shrimp has ever increased. The factor that drove shrimp farmers run into the shrimp culture is high level of its income. However, shrimp culture is also associated with a risk of disease as described in the previous subsection.

Furthermore, water salinity also plays an important role in shrimp culture. According to the Research Institute for Aquaculture No.2, salinity contents adaptable for shrimp are 8-40 ppt for black tiger shrimp and 2-40 ppt for white leg shrimp, of which those species best fit to ranges of 18-25 ppt for black tiger shrimp and 25-30 ppt for white leg shrimp.

That is, white leg shrimp can adapt to a wider ranges of salinity but, for better production, range of targeted salinity is quite narrow (within 5 ppt points). Contrary, an adaptable range of salinity for white black tiger shrimp is narrower than white shrimp but the targeted range of salinity level is wider (within 7 ppt points).

In a view of cultivating shrimp with less salinity level, or with higher risk of flood or fresh water contamination, white leg shrimp is relatively adaptable.

Table 4.2.3 Suitable Salinity Contents for Shrimp Culture

Type of Shrimp	Best Fits	Adaptable	Remarks
Black Tiger Shrimp	18-25PPT	8-40 PPT	Best-fit range is wider but minimum salinity level is higher.
White Leg Shrimp	25-30PPT	2-40 PPT	Best-fit range is narrow but the adaptable at lower salinity content

Source: Research Institute for Aquaculture No.2 (2011)

3) Fruit Crops

In general, fruit crops are not truly suitable in such agro-ecological characteristics prevailing in the Mekong delta: acid sulphate soils, saline soils, heavy clay soils, and flooded areas. However, there are a large block of fruit areas in the Mekong Delta where small-scale farmers who maintain far less than 1.0 ha per household have traditionally cultivated various kinds of fruit crops such as mango, longan, citrus (mandarin, orange, and lemon), durian, rambutan, dragon fruit, pineapple, and banana.

To do fruit production, those farmers have selected relatively preferable locations or improved soil conditions. As a result, accumulated land area for fruits production reached around 38% of the total

[20] http://www.pref.tottori.lg.jp/secure/563190/48-3-2.pdf (in Japanese)

fruits production areas in the nation. One of the advantages of this area is that fruits can be produced in the off season due mainly to abundant water available throughout the year.

Those farmers went for fruits production notwithstanding the fact that physical condition does not necessarily fit to fruit production. The reason can be found only for the higher profitability of fruits than paddy, as mentioned in section 4.2. In fact, it was reported that some farmers in Tien Gian province continues planting citrus trees even after having significant loss by severe diseases.

Therefore, it is assumed that current areas for fruit production would be kept even in the future unless climate change make the production more difficult or profit profile is transformed due to significant change in market trend or pandemic of severe diseases.

In terms of tolerance fruit crops to salinity, mango, longan and citrus like mandarin orange are relatively strong than other fruit crops, while durian is prone to salinity. Actually, new varieties of some fruit crops have been newly developed by the Southern Fruit Research Institute (SOFRI) and ready for the extension. In any case, however, tolerance of fruit crops to salinity (500-600 ppm) is generally lower than that of paddy (1,000-4,000 ppm) and thus they cannot be a good alternative to paddy for adaptation to salinity increment.

As far as flooding or inundation is concerned, furthermore, fruit crops are relatively prone to water. Among all, banana, papaya, mango, and jackfruit are quite weak; they would die down with only a week of inundation. Today, water-tolerant varieties of mango and citrus have been developed by SOFRI; those varieties can grow even after two months of inundation (SOFRI, 2012). However, again, this level of water tolerance cannot be attractive as an alternative to the other crops like paddy.

In the principle of land-use planning, therefore, fruits are not seen as strategic crops for adaptation to the forthcoming climate change: saline intrusion and flood. Instead, it should be recommended where sandy soil prevails and water resources are relatively scarce so that water conservation philosophy can be holistically pursued in case water becomes scarce due to climate change or excessive development of water resources upstream the Mekong River.

4) Gap Between Commodities Suitable and Actually Produced

Note that however agricultural commodities are not necessarily and exactly produced where those commodities best fit. There are some areas where saline water comes up and brings about some problems to the growth of paddy. Even in such areas, farmers plant paddy by appreciating the pros of paddy cultivation such as improvement effects of environmental quality for fresh water shrimp (an example of Bac Lieu). Others would cultivate paddy by modifying their

In any cases, there are always some gaps between the commodities recommended and the commodities actually produced in particular areas. It fundamentally suggests that environmental characteristics alone cannot define the land use plan. Thus, in this chapter, current status of this gap was analyzed and shown in section 4.4.

4.3 Issues and Constraints Considered

For a rational planning of land use plan, some constraints should be taken into consideration, which may include negative impact to environment, policy framework, and marketability of the commodities produced in the area. That is, even if one particular commodity is suitable to a certain area in terms mainly of physical conditions of the area such as soil type, availability of fresh/brackish water and thus considerably low risk of losses, it may not be recommended due to upper level reasons mentioned above. Considering all the potential constraints, the Project proposes four major principles applied in the planning process:

1) Self sufficiency of rice should be more than satisfied per province (political reason)
2) Existing mangrove forest and protection forest should be conserved (environmental reason)
3) Pace of change should be kept moderate (social consideration)

1) Political Consideration

As of a restriction in the re-arrangement of land use, current policy should be carefully and thoroughly considered. One of the most important policy settings can be seen in the master plan to agriculture product development up to 2020 and vision to 2030 (Decision No. 124/QĐ-TTg, as of February 2, 2012). In this decision, area for aquaculture production is targeted to be 790,000 ha in the nation, which is 99,700 ha or 14.4% of increment from the current land use.

To this end, the Mekong delta is expected to contribute 70% of this increment, that is, approximately 70,000 ha of shrimp culture area need to be newly developed in the Mekong delta. Considering the fact that shrimp culture is essentially only possible in the coastal areas, this projection should be applied to the project area.

Additionally, it was decided to maintain 3,812 thousand ha of paddy field in the country, of which 3,200 thousand ha is to be cultivated under the two-cropping system, producing 41-43 million tons in 2020 and 44 million tons in 2030 both for self-consumption and exportation. This clause can be interpreted to a general direction that current paddy area should be kept as it is. In fact, it was reported that a small-scale pilot project on fruits production in Tieng Gian was rejected as it was in a “paddy” area—policy of land use, especially for paddy production, is strictly enforced by the government.

Hence, in this land use planning, utmost attention is given to paddy production area; current paddy area should be kept unless the area is to be negatively affected by the climate change. For the area where climate change would make it difficult to carry out paddy production any more, the plan is to suggest changing the types of land use from paddy to others without hesitation.

2) Environmental Consideration

Environmental consideration should be given higher priority before setting a needs-based land use plan. As known as tragedy of commons, without proper regulatory arrangement, individual’s rational behavior sometimes causes devastating loss of environmental resources. Most famously in this regard, destruction of mangrove forest along the coastal areas of Thailand in the 1990’s had earned a national and international notoriety. It was concluded that such arrangement is not sustainable at all. To be comprehensively rational, therefore, mangrove forest and also conservation forest, of course, should be disregarded from the target areas of shrimp culture development in the land use plan.

3) Social Consideration

Particularly, for the social consideration listed as number 4, the Project tentatively set the limit of change not more than 20% of the size of area in the current land use for the projected year of 2020 and 30% for the year 2030 and also 2050. Because it is believed that the significant change of land use in a shorter time should cause some confusion to the farmers and fish farmers concerned.

For example, if so many numbers of farmers rushed to change their commodity from paddy to shrimp, those who used to purchase the paddy from that area are forced to change their strategies on the one hand. That may sometimes force rice milers to close the factories or consumers to purchase paddy from other places at relatively higher cost.

On the other hand, shrimps farmers who newly shifted from paddy production to shrimp cultivation themselves may face some difficulty in preparing their new lines of production. For example, due to insufficient numbers of construction machineries, new shrimp farmers may have to wait for long time

before starting the actual cultivation. Also, prices of inputs such as shrimp larvae, quality feed and aeration equipment may hike up due to rapidly increased demand and thus they cannot achieve the expected profit. And more, common resources, i.e. water, could become scarce as fundamental infrastructure is yet ready for such a rapid change.

4.4 Land Use Planning and Mapping

4.4.1 Principles and Procedure

1) Basic Principles of Land Use Planning and Mapping

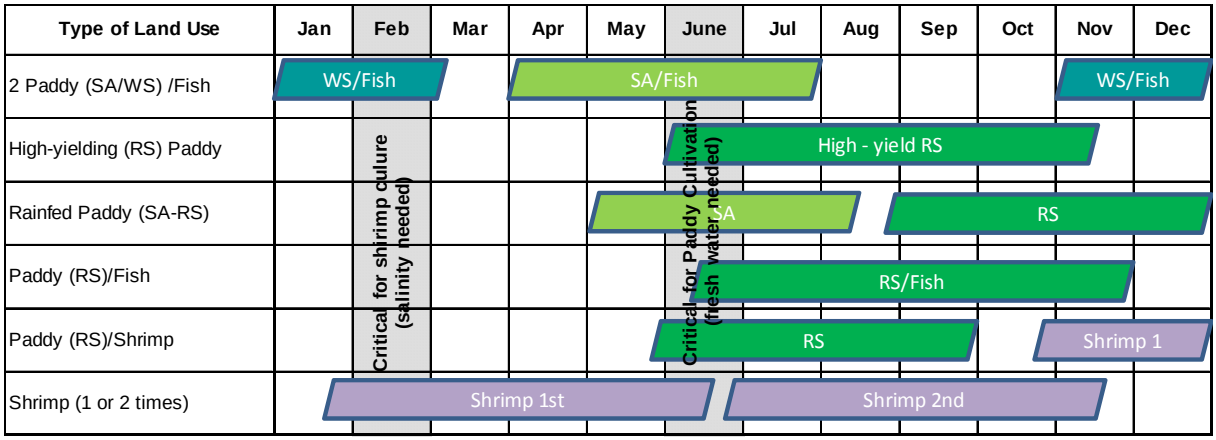
Land use map was prepared based on a series of simulation results. In general, the most considerable effect of climate change among others was the increased saline intrusion coupled with elevated sea level and decreased river discharge in the targeted years of 2020, 2030 and 2050. Precisely, results from the simulation were composed of different types of issues and time series in each targeted year.

To be a basis of meaningful land use plan, therefore, only relevant information was first extracted from a volume of simulation results. Prepared that the increase of saline intrusion would threaten production of paddy and other crops, the timing when the saline water brings about the most significant impact on the cultivation of paddy was chosen.

As shown in Table 4.4.1, Summer-Autumn (SA) paddy production in the saline-prone areas starts in and around May, beginning of rainy season. For the cropping system of paddy-shrimp rotation, May is usually a time for leaching salinity with a help of rainwater. To do proper cultivation of paddy, it is essential to start cultivation by June without any residual salinity in the field. In other word, such areas where saline water remains at a certain level even in June, it would become quite difficult to manage paddy production.

Thus, the first criterion in re-examining the land use plan is to see where there is certain amount of salinity in June. Paddy can be recommended in the area where less salinity is expected in June but the other commodities should be considered for the area where salinity is more than the certain level. Generally, it is know that paddy cannot grow well at a salinity level of 1,000 ppm and incurs severe damage at around 4,000 ppm. Consequently, the threshold was set at 4.0 g/l for decision making whether or not paddy is recommendable (in the simulation, salinity level was set in ranges of 0-0.5, 0.5-1.0, 1.0-2.5, 2.5-4.0, 4.0-10, 10-20 g/littler).

Table 4.4.1 Typical Cropping Calendar in the Saline-Prone Areas



Source: SIWRP (2012). Note: SA: Summer-Autumn crop; WS: Winter-Spring; RS: Rainy Season crop

Note that paddy can be cultivated even during Autumn-Winter season. However, the most productive season of paddy is in Summer-Autumn season and thus there is no reason to keep recommending paddy in such areas where Summer-Autumn is not manageable or where two times of cropping cannot fully managed.

Next, another criterion was considered to decide where shrimp cultivation can be sustainably operated. As shown as Table 4.4.1, shrimp culture, especially under intensive or semi-intensive system, commonly starts in late January or February. It is known that shrimp cannot usually grow in such environment where mean water temperature is 25 degrees Celsius or below. In January, daily mean air temperature sometimes go below 25 degree, thus, it is not actually recommendable to start shrimp culture in January (except preparation). To set the threshold for shrimp culture, therefore, salinity level of February was taken. That is, where the simulated saline content of February is 10 ppt or less, shrimp culture would not be suitable.

In conclusion, two criteria were employed to evaluate the suitable location of paddy and shrimp, one for salinity level of June and another for salinity level of February. Note that saline intrusion is usually the greatest in and around March and April, but the most important seasons for decision making are those two months.

Yet, there are some areas where both paddy and shrimp are not suitable, that is, saline contents of February is significantly lower than what is needed for shrimp culture (less than 10 ppt) but the salinity of June is considerably high (more than 4 ppt). In such cases, current paddy production area should be protected in accordance with the government's policy. The criteria applied in the land use planning are conceptualized as Figure 4.4.1 and summarized in Table 4.4.2 specifically for the consideration of paddy and shrimp.

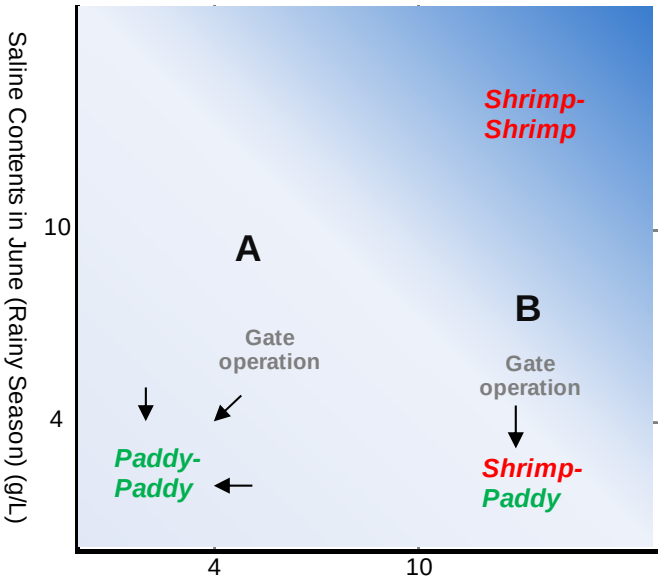


Figure 4.4.1 Concept of Land Use Criteria for Paddy-Shrimp Conversion

Note: Cropping pattern shows the combination between dry season and rainy season

In the figure, X-axis shows the saline content in February (dry season) and Y-axis indicates the one in June (rainy season). paddy-paddy (dry season- rainy season) can be managed in such an environment in which saline content is not more than 4 g/L both in February and June (bottom left), while shrimp-shrimp can be conducted where saline contents exceed 10g/L both season (up right). Also, shrimp-paddy can be organized where saline content exceed 10g/L in February and reduced less than 4g/L in June (bottom right). Meanwhile, there are some cases wherein saline contents of two seasons may not match to any of those cropping patterns. For example, saline contents in area "A" of the figure are not suitable both for paddy and shrimp. In such area, salinity should be controlled by gate operation to be suited to "paddy-paddy" pattern. Furthermore, saline content in area "B" is also difficult for paddy cultivation during rainy season. Thus, salinity control is required to enable "shrimp-paddy" pattern.

Based on this concept, concrete criteria are prepared as Table 4.4.2. In general, "paddy-paddy" pattern is applied where saline content is less than 10g/L both season, provided that salinity control is to be properly carried out at canal and on-farm levels. Then, shrimp-paddy pattern is applied where saline content exceeds 10g/L in February while it is less than 10g/L in June. Lastly, shrimp-shrimp pattern is applied where saline content exceeds 10g/L both seasons.

Table 4.4.2 Criteria for the Land Use Planning for Paddy and Shrimp

Criteria			Saline Intrusion in June		
			(A) 4g/L or less	(B) 4-10g/L	(C) 10g/L or more
			Suitable for paddy	Not suitable both for paddy and shrimp	Suitable for shrimp
Saline Intrusion in February	(D) 4g/L or less	Suitable for paddy	[AD] Paddy-Paddy (No Change)	[BD] Paddy-[Paddy]	[CD] Paddy-[Paddy]
	(E) 4-10g/L	Not suitable both for paddy and shrimp	[AE] [Paddy]-Paddy	[BE] [Paddy]-[Paddy]	[CE] [Paddy]-[Paddy]
	(F) 10g/L or more	Suitable for shrimp	[AF] Shrimp-Paddy	[BF] Shrimp-[Paddy]	[CF] Shrimp-Shrimp

Note: 1) Such condition is not likely that saline content in rainy season is higher than dry season (shown by sloped line)
2) Where saline content level is not suitable both for paddy and shrimp, paddy is given higher priority in accordance with the national policy.
3) For the cropping pattern where marked by [ ], infrastructural measurement is required to protect paddy (risk is considerably high).

To be sure, 10g/L is applied as a salinity threshold to classify the area between paddy cultivation and brackish aquaculture. It was set based on an understanding that saline content may differ between canal water and water in paddy field—in fact, the salinity shown in the simulation analysis is based on the saline content in canal water. In addition, in rainy season, rainfall supply tremendous amount of freshwater in paddy field. Thus, as rather strict criteria to change the land use pattern, 10g/L was assigned.

2) Particular Procedure of Land Use Planning and Mapping

In this sub-section, particular procedure of the mapping process is explained. First, based on the existing land use map for the year of 2009, a GIS base map was prepared for the geospatial analysis. In the preparation process, duplication of layers and polygon data were first removed and geometric errors were corrected.

Then, two isometric maps were prepared: one for the saline intrusion of June as to identify the area not suited for paddy production (more than 10g/L) and another for saline intrusion of February as to identify the area not suited for shrimp cultivation (less than 10g/L). Those two maps were originally obtained as TIF files having the geographic coordinates but no attributes of saline contents. Therefore, based on color data of the picture files (RGB format), GIS data are newly created.

Using the geospatial information of those two saline intrusion maps, paddy-related land uses on the original land uses map (2009) were further categorized into several suitability zones as shown in Table 4.4.2: 1) suitable for paddy production, 2) not suitable for paddy but suitable for shrimp, and 3) not suitable both for paddy and shrimp. Thereafter, those zones are categorized into: 1) paddy-paddy area, 2) shrimp-paddy area, and 3) shrimp area. In so doing, saline-prone area for paddy cultivation was separately identified where saline intrusion in either rainy season (June) or dry season (Feb) is higher than 4g/L.

Finally, newly categorized land uses are applied to the original land use map, to be the projected plan for the target year of 2020, 2030 and 2050.

(1) Current Land Use

Basis for land use planning and mapping

(2) Saline Intrusion of June

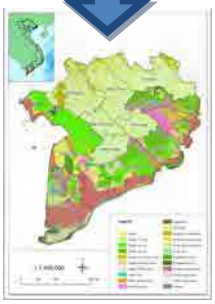
Justification of area not suited for paddy cultivation (more than 10g/L)

(3) Saline Intrusion of February

Justification of area not suited for shrimp cultivation (less than 10g/L)

(4) Identification of Area for the conversion

1) Convert from paddy to shrimp where salinity is considerably high for paddy
2) Protect paddy area where salinity is high but still manageable for paddy



(5) Land Use Plan

Reflect the consideration on conversion of the commodities onto the current land use, which is to be the plan of the target year.

Figure 4.4.2 Procedure of Land Use Planning and Mapping

4.4.2 Projected Land Use Maps of Target Years upon Saline Intrusion

1) Current Land Use

Current situation of provincial agricultural land use in the Mekong Delta was made available by the Sub-national Institute of Agricultural Planning and Projection (Sub-NIAPP) for the year 2009 (see Figure 4.4.4). Based on the original GIS database, provincial data have been extracted and elaborated to be the basis of land use planning. Specifically, categories of land use were integrated into a fewer numbers of items as shown in Table 4.4.3.

Table 4.4.4 shows the current land use pattern by province for the year of 2009 based on new category set by the Project team. At large, brackish aquaculture shares the biggest (23.3% of a total of 21 items), which is followed by double cropping of paddy (21.6%), and triple cropping of paddy (11.9%).

For easier understanding, this land use was further aggregated and simplified. As shown in Table 4.4.5, paddy shares 44.0% of the total land use area (excepting "others") which is actually composed of single, double and triple cropping of paddy. From the table, it is understood that nearly half of land use of the Project area (seven provinces) is shared by paddy production.

The compositions of land use types totally differ among the provinces. As shown in Figure 4.4.3, "paddy" shares more than 50% in Kien Giang, Soc Trang, Tien Giang, and Tra Vinh, while "brackish aquaculture" shares about half in Bac Lieu and Ca Mau. On the other hand, "perennial crops" shares nearly half in Ben Tre.

Table 4.4.3 Re-arrangement of Land Use Category

No.	Major Category	Land Use	No.	Major Category	Land Use
1	Paddy	Other paddy land	18	Protected forest	Land for cultivation of protective forest
		Paddy+farming			Natural protective forest
		Paddy-farming			Planted protective forest
2	Paddy (1 crop)	1 crop paddy			Protective forest
3	Paddy (2 crop)	2 crop paddy	19	Brackish aquaculture	Brackish aquaculture
4	Paddy (3 crop)	3 crop paddy	20	Fresh aquaculture	Fresh aquaculture land
5	Paddy and annual crops	Other paddy and other annual crop	21	Other aquaculture	Clam
6	Paddy-Brackish aqua	Other paddy and brackish aquaculture			Krill
		Paddy+brackish aquaculture	22	Others	Land for irrigation
7	Paddy-Fresh aqua	Paddy+fresh aquaculture			Rivers/canals
8	Paddy-Fish	Paddy-fish			Special used water surface
9	Other annual crops	Other annual cop land			0
		Other flat annual cop land			Belief land
		Other flat annual cop land and rural homestead land			Building material and ceramic land
		Other flat annual farming land			Cemetery
10	Perennial fruits	Other perennial fruit land and urban homestead land			Defence land
		Perennial fruit land			Industrial zone
		Perennial fruit land and rural homestead land			Land for cultural facilities
		Perennial fruit land and urban homestead land			Land for education facilities
11	Sugarcane	Sugarcane			Land for energy and communication transport
12	Pineapple	Perennial fruit land (pine apple)			Land for health facilities
13	Sugarcane-pineapple	Sugarcane-Pineapple			Land for historical and landscape places
14	Other perennial crops	Other perennial crop land			Land for markets
		Perennial industrial and rural homstead land			Land for minning activities
		Perennial industrial and urban homestead land			Land for non-agricultural production and business
		Perennial industrial land			Land for salt production
15	Other agricultural land	Land for cultivation of productive cultivation			Land for sport facilities
		Other agricultural land			Land for transportation
		Other upland annual cop land			Land of agricultural service in the cities
16	Grass land	Land for grass cultivation			Land used by non-profit agencies
		Natural grass improved by human			Land used by offices
17	Productive forest	Land for cultivation of special used forest			Landfill, waste treatment places
		Land for recovery of special used forest			Non tree rocky mountain
		Natural productive forest			Private land for non-commercial
		Natural special used forest			Religious land
		Planted productive forest			Rural homestead land
		Planted productive forest (bufferzone)			Security land
		Planted special used forest			Special used land
		Productive forest			Unused flat land
					Urban homestead land

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.4 Current Land Use by Province for the Year of 2009

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	Share
1	Paddy	21,168	0	977	43,850	13,317	0	7,735	87,048	4.5%
2	Paddy (1 crop)	10,208	18,082	43,483	41,183	0	0	0	112,956	5.8%
3	Paddy (2 crop)	11,157	1,928	29,304	235,611	93,910	19,144	31,237	422,291	21.6%
4	Paddy (3 crop)	22,314	21,040	0	6,729	38,084	83,797	59,555	231,519	11.9%
5	Paddy and annual crops	0	0	0	0	0	0	4,845	4,845	0.2%
6	Paddy-Brackish aqua	20,753	0	0	12,073	0	0	14,687	47,513	2.4%
7	Paddy-Fresh aqua	13	0	0	0	17,311	0	4	17,327	0.9%
8	Paddy-Fish	7,015	0	8,213	803	0	0	454	16,484	0.8%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10	Perennial fruits	159	59,828	0	10,352	9,581	25,912	8,642	114,475	5.9%
11	Sugarcane	0	5,368	0	0	0	0	0	5,368	0.3%
12	Pineapple	0	0	0	0	0	10,140	0	10,140	0.5%
13	Sugarcane-pineapple	0	0	0	1,262	0	0	0	1,262	0.1%
14	Other perennial crops	4,865	32,364	6,275	47,643	5,276	9,643	199	106,265	5.4%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16	Grass land	6	49	11	0	0	0	13	79	0.0%
17	Productive forest	118	0	75,787	49,860	10	14,824	13,983	154,582	7.9%
18	Protected forest	4,630	5,540	23,070	17,422	5,442	1,496	3,778	61,379	3.1%
19	Brackish aquaculture	102,700	36,834	184,340	64,476	45,875	4,351	16,734	455,309	23.3%
20	Fresh aquaculture	0	0	0	0	0	68	0	68	0.0%
21	Other aquaculture	1,121	0	0	0	0	0	2,877	3,998	0.2%
	Total of Above	**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
	Share in the Total	**83%**	**80%**	**79%**	**85%**	**76%**	**70%**	**73%**	**79%**	
22	**Others**	**42,770**	**48,045**	**109,404**	**93,492**	**80,270**	**74,058**	**62,882**	**510,921**	
	Total Land Area	**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)
Note: Based on the GIS data for the entire Mekong Delta region, provincial data were extracted by the Project Team.

Table 4.4.5 Current Land Use by Province for the Year of 2009 (Abstract)

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	Share
1-5	Paddy	64,848	41,049	73,765	327,373	145,312	102,941	103,372	858,659	44.0%
6	Paddy-Brackish aqua	20,753	0	0	12,073	0	0	14,687	47,513	2.4%
7-8	Paddy-Fresh aqua	7,027	0	8,213	803	17,311	0	458	33,812	1.7%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10-14	Perennial crops	5,024	97,561	6,275	59,257	14,857	45,695	8,841	237,510	12.2%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16-18	Grass land and forest	4,755	5,590	98,868	67,282	5,452	16,320	17,774	216,041	11.1%
19	Brackish aquaculture	102,700	36,834	184,340	64,476	45,875	4,351	16,734	455,309	23.3%
20-21	Other aquaculture	1,121	0	0	0	0	68	2,877	4,066	0.2%
	Total of Above	**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
	Share in the Total	**83%**	**80%**	**79%**	**85%**	**76%**	**70%**	**73%**	**79%**	
22	**Others**	**42,770**	**48,045**	**109,404**	**93,492**	**80,270**	**74,058**	**62,882**	**510,921**	
	Total Land Area	**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)
Note: Based on the GIS data for the entire Mekong Delta region, provincial data were extracted by the Project Team.

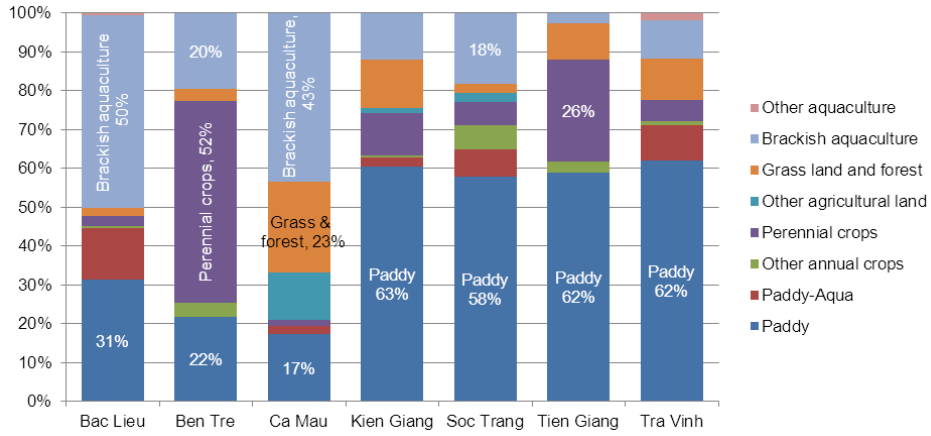


Figure 4.4.3 Composition of Current Land Use by Province
Source: JICA Project Team based on Sub-NIAP (2012)

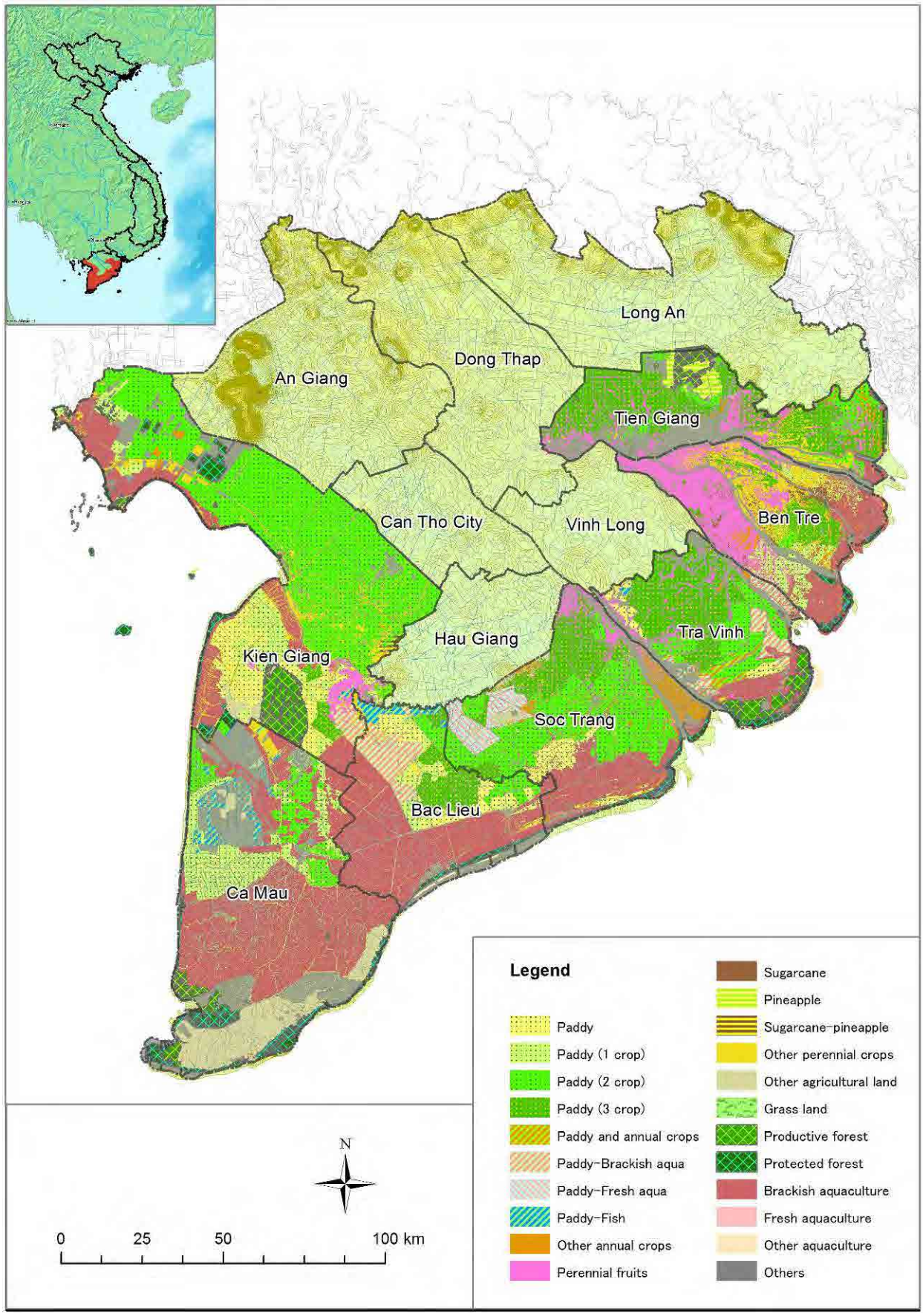


Figure 4.4.4 Land Use Map for the Year 2009

Source: JICA Project Team based on Sub-NIAP (2012)

2) Land Use Projected for the Year 2020 (Short Term Target)

Based on the principle mentioned in the previous section, land use plan for the target year of 2020 was formulated. First, suitability areas of paddy and shrimp production were identified based on the salinity level. As shown in Table 4.4.6, area suitable for paddy cultivation is estimated 766,838 ha or 86% of the total paddy areas currently cultivated. Of the areas, 168,968 ha or 22% is classified as saline-prone area, where saline content in either February or June reaches at a level between 4-10g/L.

Of the total area not suitable for paddy cultivation (125,632 ha or 14% of total paddy area currently cultivated), 1,096 ha (1% points) are categorized as suitable area for the double cropping of shrimp culture (dry season) and paddy (rainy season). In addition, 124,536 ha (99% points) are categorized suitable for shrimp cultivation. Furthermore, other two categories of land use were assessed based on the salinity: "paddy-brackish aquaculture" and "fresh aquaculture." As shown at the bottom of the table, 21,761 ha of current "paddy-brackish aquaculture" is identified too salty (more than 10g/L) to continue the same cropping pattern. Also, 13 ha of existing "fresh aquaculture" area is also categorized into high-salinity zone (more than 10g/L in both seasons).

Based on the result, thus, it was suggested that 125,632 ha or 14% of current paddy-oriented areas should be converted to other land use either "brackish-paddy" or "brackish aquaculture." In consideration with the existing "paddy-brackish aquaculture" and "fresh aquaculture," furthermore, a total of 20,666 ha of current "paddy-brackish aquaculture" area should be converted to "brackish aquaculture." As a result, a total of 146,311 ha of area should be converted to "brackish aquaculture" to be suitable for the simulated saline condition in 2020.

Table 4.4.6 Conversion Areas from Paddy to Other Land Use (2020)

Land Use	No Change			Change to			Grand Total
	Without Risk	With Risk	Total	Bracksih-Paddy	Brackish Aqua	Total	
	< 4g/L both in Feb&Jun	4-10g/L in either Feb or Jun		>10g/L in Feb <10g/L in Jun	>10g/L both in Feb & Jun		
Paddy	28,063	21,490	49,554	125	37,369	37,494	87,048
Paddy (1 crop)	43,786	31,299	75,085	258	37,613	37,871	112,956
Paddy (2 crop)	316,146	62,605	378,751	654	42,886	43,540	422,291
Paddy (3 crop)	178,042	49,080	227,122	34	4,363	4,397	231,519
Paddy and annual crops	661	1,854	2,515	25	2,305	2,330	4,845
Paddy-Fresh aqua	17,233	94	17,327	0	0	0	17,327
Paddy-Fish	13,939	2,545	16,484	0	0	0	16,484
Paddy Total	**597,870**	**168,968**	**766,838**	**1,096**	**124,536**	**125,632**	**892,471**
	78%	22%	100%	1%	99%	100%	
	67%	**19%**	**86%**	**0%**	**14%**	**14%**	**100%**
Other factors considered for the conversion to either brackish-paddy or brackish aquaculture							
Paddy-Brackish aqua*				-21,761	21,761		
Fresh aquaculture	44	*12*	55		13	13	68
Total				**-20,666**	**146,311**		

Source: JICA Project Team based on Sub-NIAP (2012)

Upon the suggestions, land use map for the year 2020 was formulated (Figure 4.4.6), in which existing paddy areas located in high-saline area were converted into "brackish-paddy" area or "brackish aquaculture" areas. As for other land uses, no change was generally made as forest area should be conserved and perennial fruits area should be also worth protected as it generate much higher income than other commodities.

The detailed land use is summarized in Table 4.4.7 for abstract and Table 4.4.8 for complete list. In addition, conversion areas from current to the target year are indicated in Table 4.4.9 and Figure 4.4.5 (all). The change ratio of brackish aquaculture resulted in 32% of increase, suggesting quite challenging to achieve in a short period of time by 2020.

Table 4.4.7 Land Use for the Year 2020 (Abstract)

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	Share
1-5	Paddy	54,884	31,110	32,849	299,169	128,378	95,678	90,959	733,027	37.5%
6	Paddy-Brackish aqua	13,370	26	117	7,961	98	52	5,224	26,847	1.4%
7-8	Paddy-Fresh aqua	7,027	0	8,213	803	17,311	0	458	33,812	1.7%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10-14	Perennial crops	5,024	97,561	6,275	59,257	14,857	45,695	8,841	237,510	12.2%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16-18	Grass land and forest	4,755	5,590	98,868	67,282	5,452	16,320	17,774	216,041	11.1%
19	Brackish aquaculture	120,046	46,748	225,138	96,792	62,711	11,574	38,611	601,620	30.8%
20-21	Other aquaculture	1,121	0	0	0	0	55	2,877	4,053	0.2%
	Sub Total	**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		83%	**80%**	**79%**	**85%**	**76%**	**70%**	**73%**	**79%**	
22	Others	42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
	Total Land Area	**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.8 Land Use for the Year 2020 (All Items)

No	Land Use	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	%
1	Paddy	17,680	0	767	22,829	3,396	0	4,882	49,554	2.5%
2	Paddy (1 crop)	6,360	10,962	22,030	35,733	0	0	0	75,085	3.8%
3	Paddy (2 crop)	8,649	1,861	10,051	233,878	86,897	13,407	24,007	378,751	19.4%
4	Paddy (3 crop)	22,195	18,287	0	6,729	38,084	82,271	59,555	227,122	11.6%
5	Paddy and annual crops	0	0	0	0	0	0	2,515	2,515	0.1%
6	Paddy-Brackish aqua	13,370	26	117	7,961	98	52	5,224	26,847	1.4%
7	Paddy-Fresh aqua	13	0	0	0	17,311	0	4	17,327	0.9%
8	Paddy-Fish	7,015	0	8,213	803	0	0	454	16,484	0.8%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10	Perennial fruits	159	59,828	0	10,352	9,581	25,912	8,642	114,475	5.9%
11	Sugarcane	0	5,368	0	0	0	0	0	5,368	0.3%
12	Pineapple	0	0	0	0	0	10,140	0	10,140	0.5%
13	Sugarcane-pineapple	0	0	0	1,262	0	0	0	1,262	0.1%
14	Other perennial crops	4,865	32,364	6,275	47,643	5,276	9,643	199	106,265	5.4%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16	Grass land	6	49	11	0	0	0	13	79	0.0%
17	Productive forest	118	0	75,787	49,860	10	14,824	13,983	154,582	7.9%
18	Protected forest	4,630	5,540	23,070	17,422	5,442	1,496	3,778	61,379	3.1%
19	Brackish aquaculture	120,046	46,748	225,138	96,792	62,711	11,574	38,611	601,620	30.8%
20	Fresh aquaculture	0	0	0	0	0	55	0	55	0.0%
21	Other aquaculture	1,121	0	0	0	0	0	2,877	3,998	0.2%
Sub Total		**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		11%	10%	22%	28%	13%	9%	9%	100%	
Others		42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
Total Land Area		**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.9 Change in Land Use from 2009 to 2020

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total
1-5	Paddy	-9,963	-9,939	-40,916	-28,204	-16,934	-7,263	-12,413	-125,632
6	Paddy-Brackish aqua	-7,384	26	117	-4,112	98	52	-9,463	-20,666
7-8	Paddy-Fresh aqua	0	0	0	0	0	0	0	0
9	Other annual crops	0	0	0	0	0	0	0	0
10-14	Perennial crops	0	0	0	0	0	0	0	0
15	Other agricultural land	0	0	0	0	0	0	0	0
16-18	Grass land and forest	0	0	0	0	0	0	0	0
19	Brackish aquaculture	17,347	9,914	40,799	32,315	16,836	7,224	21,876	146,311
20-21	Other aquaculture	0	0	0	0	0	-13	0	-13
Change in Paddy		**-15%**	**-24%**	**-55%**	**-9%**	**-12%**	**-7%**	**-12%**	**-15%**
Change in Paddy-Brackish Aqua		**-36%**	**-**	**-**	**-34%**	**-**	**-**	**-64%**	**-43%**
Change in Brackish aquaculture		**17%**	**27%**	**22%**	**50%**	**37%**	**166%**	**131%**	**32%**

Source: JICA Project Team based on Sub-NIAP (2012)

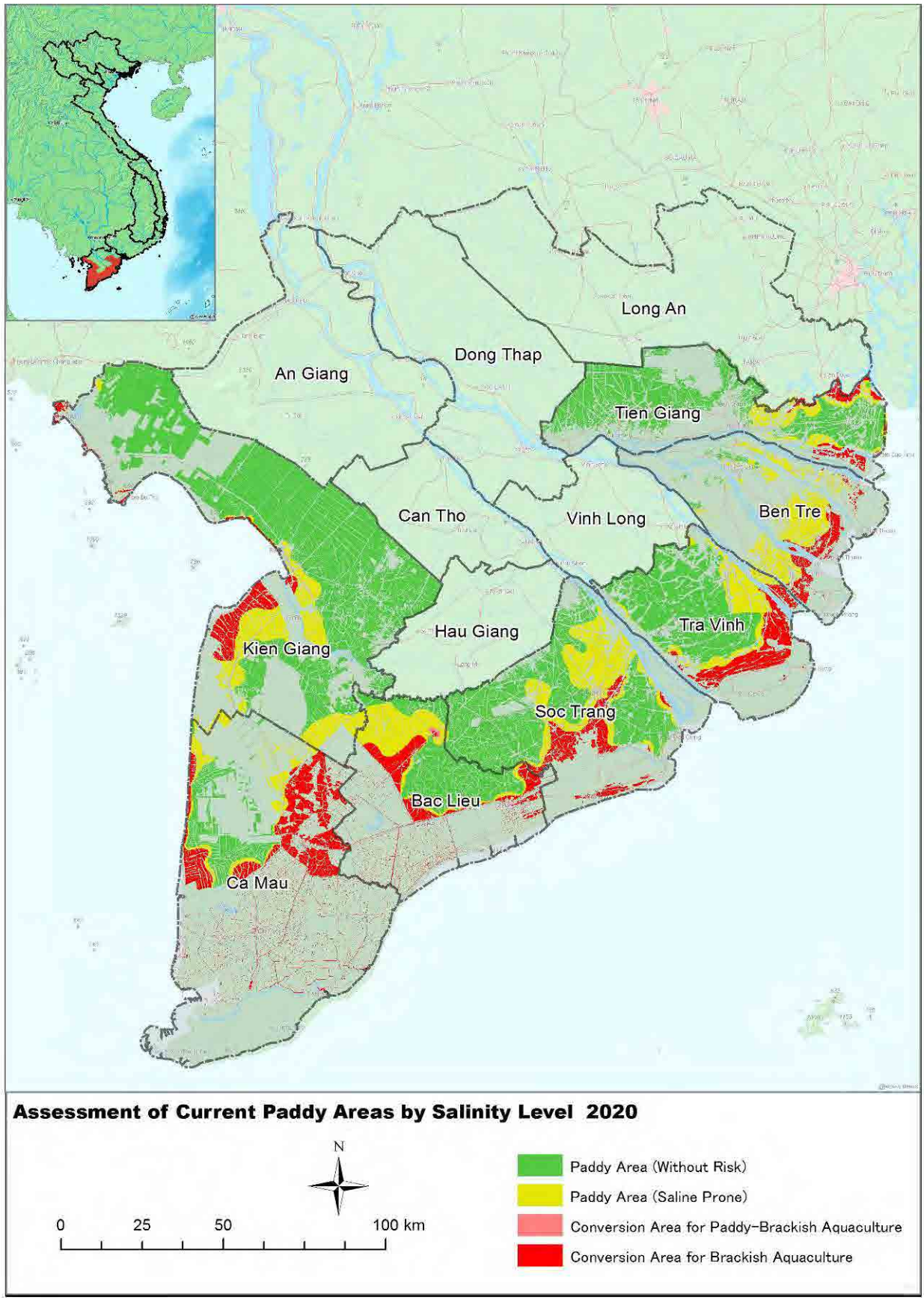


Figure 4.4.5 Assessment of Current Paddy Area by Salinity Level (2020)

Source: JICA Project Team based on Sub-NIAP (2012)

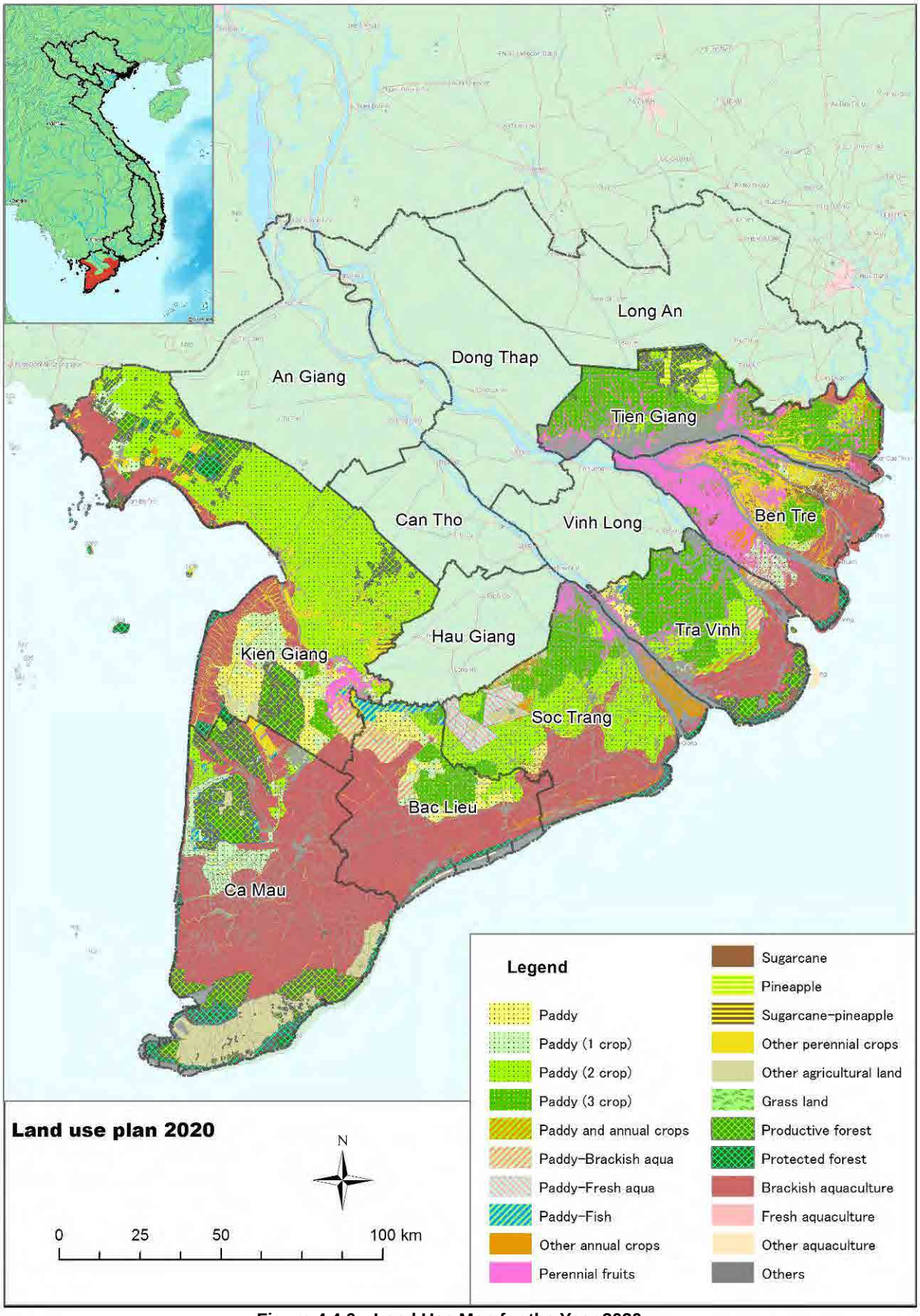


Figure 4.4.6 Land Use Map for the Year 2020

Source: JICA Project Team based on Sub-NIAP (2012)

3) Land Use Projected for the Year 2030 (Mid Term Target)

As for the mid-term land use plan, the plan for the target year of 2020 was formulated. First, suitability areas of paddy and shrimp production were identified based on the salinity. As shown in Table 4.4.10, area suitable for paddy cultivation is estimated 768,333 ha or 86% of the total paddy areas currently cultivated. Of the areas, 106,217 ha or 14% is classified as saline-prone area, where saline content level in either February or June is between 4-10g/L.

Of the total area not suitable for paddy cultivation (124,137 ha or 14% of total paddy area currently cultivated), 40,789 ha (33% points) are categorized as suitable area for double cropping of shrimp culture (dry season) and paddy (rainy season). Furthermore, 83,349 ha (67% points) are categorized suitable for shrimp cultivation. Other two land uses were also assessed based on the salinity, which are "paddy-brackish aquaculture" and "fresh aquaculture." As shown at the bottom of the table, 11,510 ha of current "paddy-brackish aquaculture" is identified too salty (more than 10g/L) to continue it. Also, 11 ha of existing "fresh aquaculture" area are also categorized into high-salinity zone (more than 10g/L in both seasons).

Based on the result, it was suggested that 124,137 ha or 14% of current paddy-oriented areas should be converted to either "brackish aquaculture-paddy" or "brackish aquaculture." Considering the existing "paddy-brackish aquaculture" and "fresh aquaculture," furthermore, a total of 29,278 ha should be converted to "paddy-brackish aquaculture" and another 94,870 ha should be converted to "brackish aquaculture" mainly from paddy-oriented cultivations, which are to be suitable for the simulated saline condition in 2020.

Table 4.4.10 Suitability Areas for Paddy and Shrimp Production (2030)

Land Use	No Change			Change to			Grand Total
	Without Risk	With Risk	Total	Bracksih-Paddy	Brackish Aqua	Total	
	< 4g/L both in Feb&Jun	4-10g/L in either Feb or Jun		>10g/L in Feb <10g/L in Jun	>10g/L both in Feb & Jun		
Paddy	30,012	19,866	49,878	9,451	27,719	37,169	87,048
Paddy (1 crop)	49,521	26,106	75,628	15,721	21,607	37,328	112,956
Paddy (2 crop)	337,156	42,170	379,326	11,050	31,914	42,965	422,291
Paddy (3 crop)	213,334	13,806	227,140	2,511	1,868	4,379	231,519
Paddy and annual crops	781	1,769	2,550	2,056	240	2,295	4,845
Paddy-Fresh aqua	17,138	189	17,327	0	0	0	17,327
Paddy-Fish	14,175	2,309	16,484	0	0	0	16,484
Paddy Total	**662,116**	**106,217**	**768,333**	**40,789**	**83,349**	**124,137**	**892,471**
	86%	14%	100%	33%	67%	100%	
	74%	**12%**	**86%**	**5%**	**9%**	**14%**	**100%**
Other factors considered for the conversion to either brackish-paddy or brackish aquaculture							
Paddy-Brackish aqua*				-11,510	11,510		
Fresh aquaculture	55	2	58		11	11	68
Total				**29,278**	**94,870**		

Source: JICA Project Team based on Sub-NIAP (2012)

Upon the suggestions derived from the above, land use map for the year 2030 was formulated (Figure 4.4.8), in which existing paddy area in high-saline zones were converted into "brackish-paddy" or "brackish aquaculture" areas. As for other land uses, no change was made as forest area should be conserved and perennial fruits area should be also worth protected as it generate much higher income than other commodities.

The detailed land use is summarized in Table 4.4.11 for abstract and Table 4.4.12 for complete list. In addition, conversion area from current to the target year is indicated in Table 4.4.13 and Figure 4.4.7. The change rate of brackish aquaculture resulted in 21% increase.

Table 4.4.11 Land Use for the Year 2030 (Abstract)

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	Share
1-5	Paddy	55,040	31,284	32,820	299,737	128,785	95,807	91,048	734,522	37.6%
6	Paddy-Brackish aqua	17,364	7,439	5,224	23,268	487	2,960	20,049	76,791	3.9%
7-8	Paddy-Fresh aqua	7,027	0	8,213	803	17,311	0	458	33,812	1.7%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10-14	Perennial crops	5,024	97,561	6,275	59,257	14,857	45,695	8,841	237,510	12.2%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16-18	Grass land and forest	4,755	5,590	98,868	67,282	5,452	16,320	17,774	216,041	11.1%
19	Brackish aquaculture	115,896	39,160	220,060	80,916	61,915	8,534	23,697	550,179	28.2%
20-21	Other aquaculture	1,121	0	0	0	0	58	2,877	4,056	0.2%
	Sub Total	**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		83%	**80%**	**79%**	**85%**	**76%**	**70%**	**73%**	**79%**	
22	Others	42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
	Total Land Area	**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.12 Land Use for the Year 2030 (All Items)

No	Land Use	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	%
1	Paddy	17,724	0	767	23,070	3,429	0	4,888	49,878	2.6%
2	Paddy (1 crop)	6,386	11,145	22,053	36,044	0	0	0	75,628	3.9%
3	Paddy (2 crop)	8,746	1,893	10,000	233,894	87,272	13,467	24,055	379,326	19.4%
4	Paddy (3 crop)	22,184	18,246	0	6,729	38,084	82,341	59,555	227,140	11.6%
5	Paddy and annual crops	0	0	0	0	0	0	2,550	2,550	0.1%
6	Paddy-Brackish aqua	17,364	7,439	5,224	23,268	487	2,960	20,049	76,791	3.9%
7	Paddy-Fresh aqua	13	0	0	0	17,311	0	4	17,327	0.9%
8	Paddy-Fish	7,015	0	8,213	803	0	0	454	16,484	0.8%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10	Perennial fruits	159	59,828	0	10,352	9,581	25,912	8,642	114,475	5.9%
11	Sugarcane	0	5,368	0	0	0	0	0	5,368	0.3%
12	Pineapple	0	0	0	0	0	10,140	0	10,140	0.5%
13	Sugarcane-pineapple	0	0	0	1,262	0	0	0	1,262	0.1%
14	Other perennial crops	4,865	32,364	6,275	47,643	5,276	9,643	199	106,265	5.4%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16	Grass land	6	49	11	0	0	0	13	79	0.0%
17	Productive forest	118	0	75,787	49,860	10	14,824	13,983	154,582	7.9%
18	Protected forest	4,630	5,540	23,070	17,422	5,442	1,496	3,778	61,379	3.1%
19	Brackish aquaculture	115,896	39,160	220,060	80,916	61,915	8,534	23,697	550,179	28.2%
20	Fresh aquaculture	0	0	0	0	0	58	0	58	0.0%
21	Other aquaculture	1,121	0	0	0	0	0	2,877	3,998	0.2%
Sub Total		**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		11%	10%	22%	28%	13%	9%	9%	100%	
Others		42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
Total Land Area		**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.13 Change in Land Use from 2009 to 2030

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total
1-5	Paddy	-9,807	-9,765	-40,944	-27,636	-16,527	-7,133	-12,324	-124,137
6	Paddy-Brackish aqua	-3,389	7,439	5,224	11,196	487	2,960	5,362	29,278
7-8	Paddy-Fresh aqua	0	0	0	0	0	0	0	0
9	Other annual crops	0	0	0	0	0	0	0	0
10-14	Perennial crops	0	0	0	0	0	0	0	0
15	Other agricultural land	0	0	0	0	0	0	0	0
16-18	Grass land and forest	0	0	0	0	0	0	0	0
19	Brackish aquaculture	13,197	2,326	35,721	16,440	16,040	4,184	6,962	94,870
20-21	Other aquaculture	0	0	0	0	0	-11	0	-11
Change in Paddy		**-15%**	**-24%**	**-56%**	**-8%**	**-11%**	**-7%**	**-12%**	**-14%**
Change in Paddy-Brackish Aqua		**-16%**	**-**	**-**	**93%**	**-**	**-**	**37%**	**62%**
Change in Brackish aquaculture		**13%**	**6%**	**19%**	**25%**	**35%**	**96%**	**42%**	**21%**

Source: JICA Project Team based on Sub-NIAP (2012)

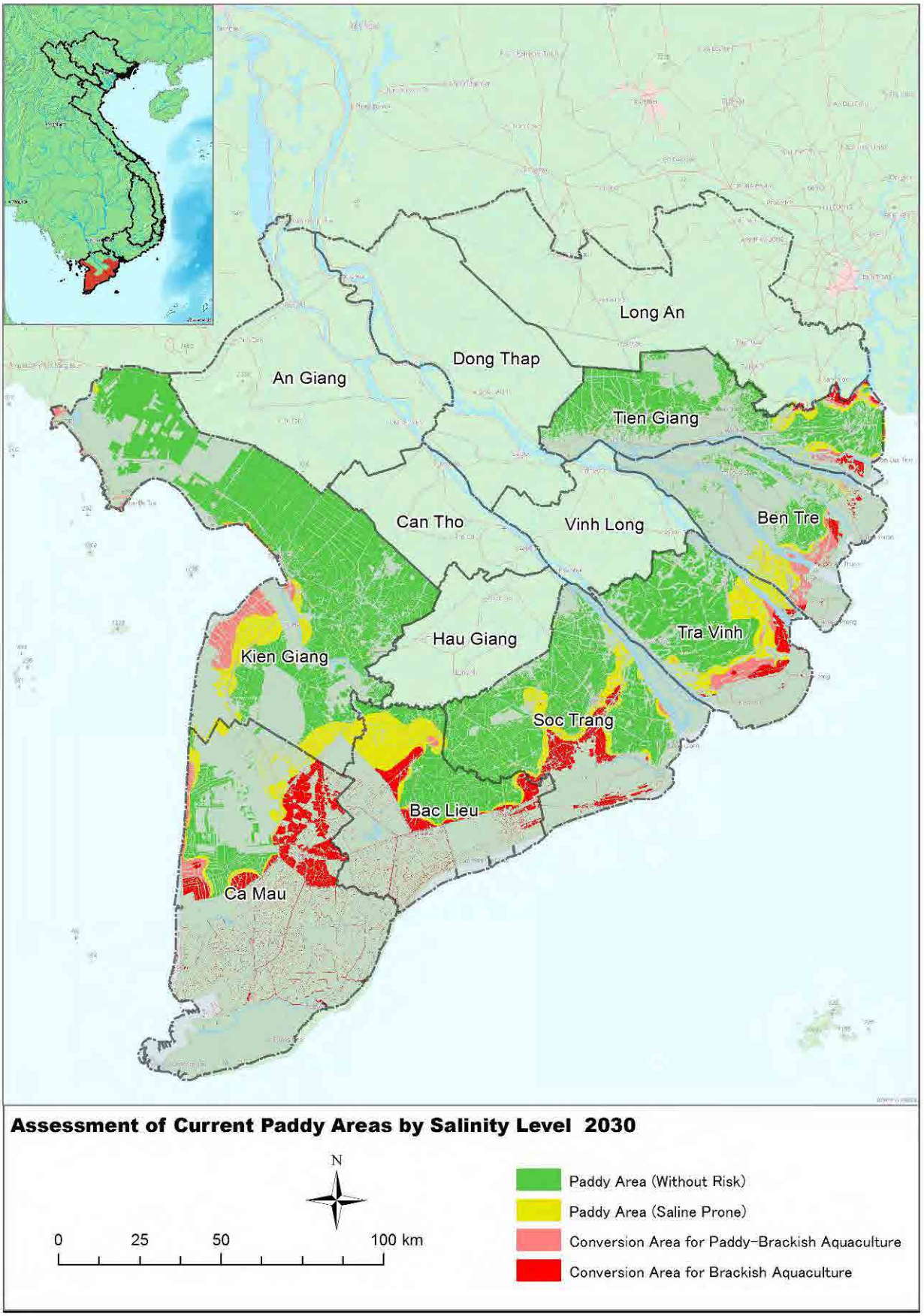


Figure 4.4.7 Assessment of Current Paddy Area by Salinity Level (2030)

Source: JICA Project Team based on Sub-NIAP (2012)

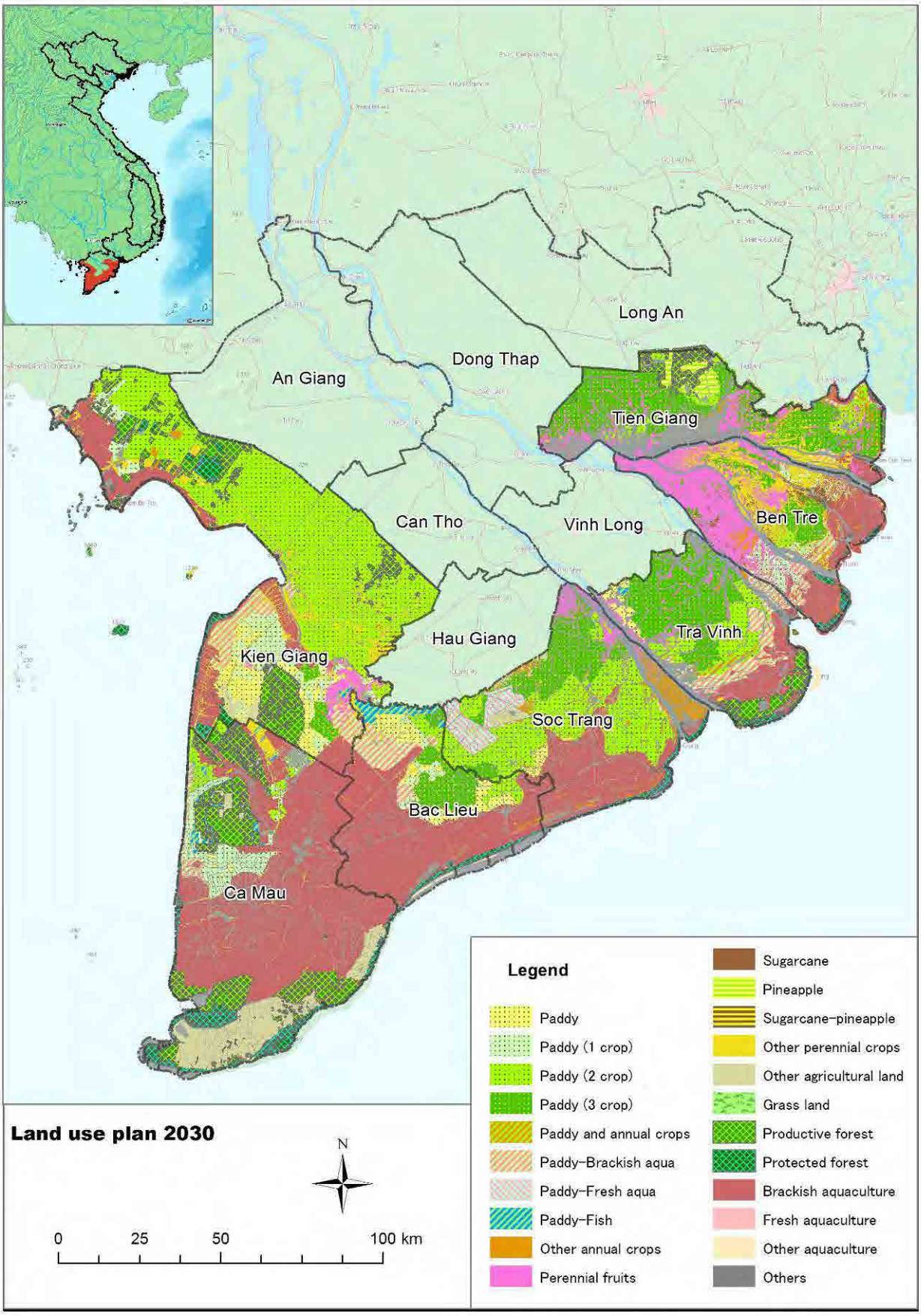


Figure 4.4.8 Land Use Map for the Year 2030

Source: JICA Project Team based on Sub-NIAP (2012)

4) Land Use Projected for the Year 2050 (Long Term Target)

As for the long-term land use plan, the plan for the target year of 2050 was formulated. First, suitability areas of paddy and shrimp production were identified. As shown in Table 4.4.18, area suitable for paddy cultivation is estimated 766,303 ha or 86% of the total paddy areas currently cultivated, which was assessed based only on the simulated salinity contents in the target months of the target year. Of the areas, 117,031 ha or 15% is actually classified as saline-prone area, where saline content level in either February or June reaches at a level between 4-10g/L.

Of the total area not suitable for paddy cultivation (126,168 ha or 14% of the total paddy area currently cultivated), 30,616 ha (24% points) are categorized as suitable area for the combination of shrimp culture (dry season) and paddy (rainy season). In addition, 95,552 ha (76% points) are categorized suitable for shrimp cultivation. Furthermore, other two categories of land use were assessed based on the salinity: "paddy-brackish aquaculture" and "fresh aquaculture." As shown at the bottom of the table, 15,990 ha of current "paddy-brackish aquaculture" is identified too salty (more than 10g/L) to continue the same. Also, 11 ha of existing "fresh aquaculture" area are also categorized into high-salinity zone (more than 10g/L in both seasons).

Based on the result, thus, it was suggested that 126,168 ha of current paddy area should be converted into either "brackish-paddy" or "brackish aquaculture." Considering the existing "paddy-brackish aquaculture" and "fresh aquaculture," as a result, a total of 14,627 ha should be converted to "paddy-brackish aquaculture" area and 111,552 ha to "brackish aquaculture" to be suitable for the simulated saline condition in 2020.

Table 4.4.14 Suitability Areas for Paddy and Shrimp Production (2050)

Land Use	No Change			Change to			Grand Total
	Without Risk	With Risk	Total	Bracksih-Paddy	Brackish Aqua	Total	
	< 4g/L both in Feb&Jun	4-10g/L in either Feb or Jun		>10g/L in Feb <10g/L in Jun	>10g/L both in Feb & Jun		
Paddy	28,768	21,257	50,025	8,801	28,221	37,022	87,048
Paddy (1 crop)	47,722	27,365	75,087	12,535	25,334	37,869	112,956
Paddy (2 crop)	333,068	45,053	378,121	7,815	36,355	44,170	422,291
Paddy (3 crop)	207,820	18,931	226,750	1,455	3,314	4,769	231,519
Paddy and annual crops	741	1,767	2,508	10	2,327	2,337	4,845
Paddy-Fresh aqua	17,236	91	17,327	0	0	0	17,327
Paddy-Fish	13,918	2,567	16,484	0	0	0	16,484
Paddy Total	**649,272**	**117,031**	**766,303**	**30,616**	**95,552**	**126,168**	**892,471**
	85%	15%	100%	24%	76%	100%	
	73%	**13%**	**86%**	**3%**	**11%**	**14%**	**100%**
Other factors considered for the conversion to either brackish-paddy or brackish aquaculture							
Paddy-Brackish aqua*				-15,990	15,990		
Fresh aquaculture	55	*2*	58		11	11	68
Total				**14,627**	**111,552**		

Source: JICA Project Team based on Sub-NIAP (2012)

Upon the suggestions derived from the above discussion, land use map for the year 2050 was formulated (Figure 4.4.10), in which existing paddy areas in high-saline zones were converted into "brackish- paddy" or "brackish aquaculture" areas. As for other land uses, no change was, in principle, made as forest area should be conserved and perennial fruits area should be also worth protected as it generate much higher income than other commodities.

The detailed land use is summarized in Table 4.4.15 for abstract and Table 4.4.16 for complete list. Change from current land use to the target year is indicated in Table 4.4.17 and Figure 4.4.9. The change rate of brackish aquaculture resulted in 25% increase.

Table 4.4.15 Land Use for the Year 2050 (Abstract)

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	Share
1-5	Paddy	54,903	30,706	32,871	299,715	129,226	95,335	89,735	732,491	37.5%
6	Paddy-Brackish aqua	16,557	3,512	5,107	23,277	344	2,957	10,385	62,139	3.2%
7-8	Paddy-Fresh aqua	7,027	0	8,213	803	17,311	0	458	33,812	1.7%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10-14	Perennial crops	5,024	97,561	6,275	59,257	14,857	45,695	8,841	237,510	12.2%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16-18	Grass land and forest	4,755	5,590	98,868	67,282	5,452	16,320	17,774	216,041	11.1%
19	Brackish aquaculture	116,840	43,666	220,126	80,929	61,618	9,010	34,674	566,861	29.0%
20-21	Other aquaculture	1,121	0	0	0	0	58	2,877	4,056	0.2%
	Sub Total	**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		83%	**80%**	**79%**	**85%**	**76%**	**70%**	**73%**	**79%**	
22	Others	42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
	Total Land Area	**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.16 Land Use for the Year 2050 (All Items)

No	Land Use	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	%
1	Paddy	17,685	0	767	23,068	3,623	0	4,882	50,025	2.6%
2	Paddy (1 crop)	6,355	10,605	22,101	36,026	0	0	0	75,087	3.8%
3	Paddy (2 crop)	8,690	1,848	10,003	233,891	87,518	13,370	22,800	378,121	19.4%
4	Paddy (3 crop)	22,174	18,253	0	6,729	38,084	81,965	59,545	226,750	11.6%
5	Paddy and annual crops	0	0	0	0	0	0	2,508	2,508	0.1%
6	Paddy-Brackish aqua	16,557	3,512	5,107	23,277	344	2,957	10,385	62,139	3.2%
7	Paddy-Fresh aqua	13	0	0	0	17,311	0	4	17,327	0.9%
8	Paddy-Fish	7,015	0	8,213	803	0	0	454	16,484	0.8%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10	Perennial fruits	159	59,828	0	10,352	9,581	25,912	8,642	114,475	5.9%
11	Sugarcane	0	5,368	0	0	0	0	0	5,368	0.3%
12	Pineapple	0	0	0	0	0	10,140	0	10,140	0.5%
13	Sugarcane-pineapple	0	0	0	1,262	0	0	0	1,262	0.1%
14	Other perennial crops	4,865	32,364	6,275	47,643	5,276	9,643	199	106,265	5.4%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16	Grass land	6	49	11	0	0	0	13	79	0.0%
17	Productive forest	118	0	75,787	49,860	10	14,824	13,983	154,582	7.9%
18	Protected forest	4,630	5,540	23,070	17,422	5,442	1,496	3,778	61,379	3.1%
19	Brackish aquaculture	116,840	43,666	220,126	80,929	61,618	9,010	34,674	566,861	29.0%
20	Fresh aquaculture	0	0	0	0	0	58	0	58	0.0%
21	Other aquaculture	1,121	0	0	0	0	0	2,877	3,998	0.2%
Sub Total		**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		11%	10%	22%	28%	13%	9%	9%	100%	
Others		42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
Total Land Area		**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.17 Change in Land Use from 2009 to 2050

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total
1-5	Paddy	-9,944	-10,343	-40,893	-27,658	-16,086	-7,605	-13,638	-126,168
6	Paddy-Brackish aqua	-4,196	3,512	5,107	11,205	344	2,957	-4,302	14,627
7-8	Paddy-Fresh aqua	0	0	0	0	0	0	0	0
9	Other annual crops	0	0	0	0	0	0	0	0
10-14	Perennial crops	0	0	0	0	0	0	0	0
15	Other agricultural land	0	0	0	0	0	0	0	0
16-18	Grass land and forest	0	0	0	0	0	0	0	0
19	Brackish aquaculture	14,140	6,832	35,786	16,453	15,743	4,659	17,939	111,552
20-21	Other aquaculture	0	0	0	0	0	-11	0	-11
Change in Paddy		**-15%**	**-25%**	**-55%**	**-8%**	**-11%**	**-7%**	**-13%**	**-15%**
Change in Paddy-Brackish Aqua		**-20%**	**-**	**-**	**93%**	**-**	**-**	**-29%**	**31%**
Change in Brackish aquaculture		**14%**	**19%**	**19%**	**26%**	**34%**	**107%**	**107%**	**25%**

Source: JICA Project Team based on Sub-NIAP (2012)

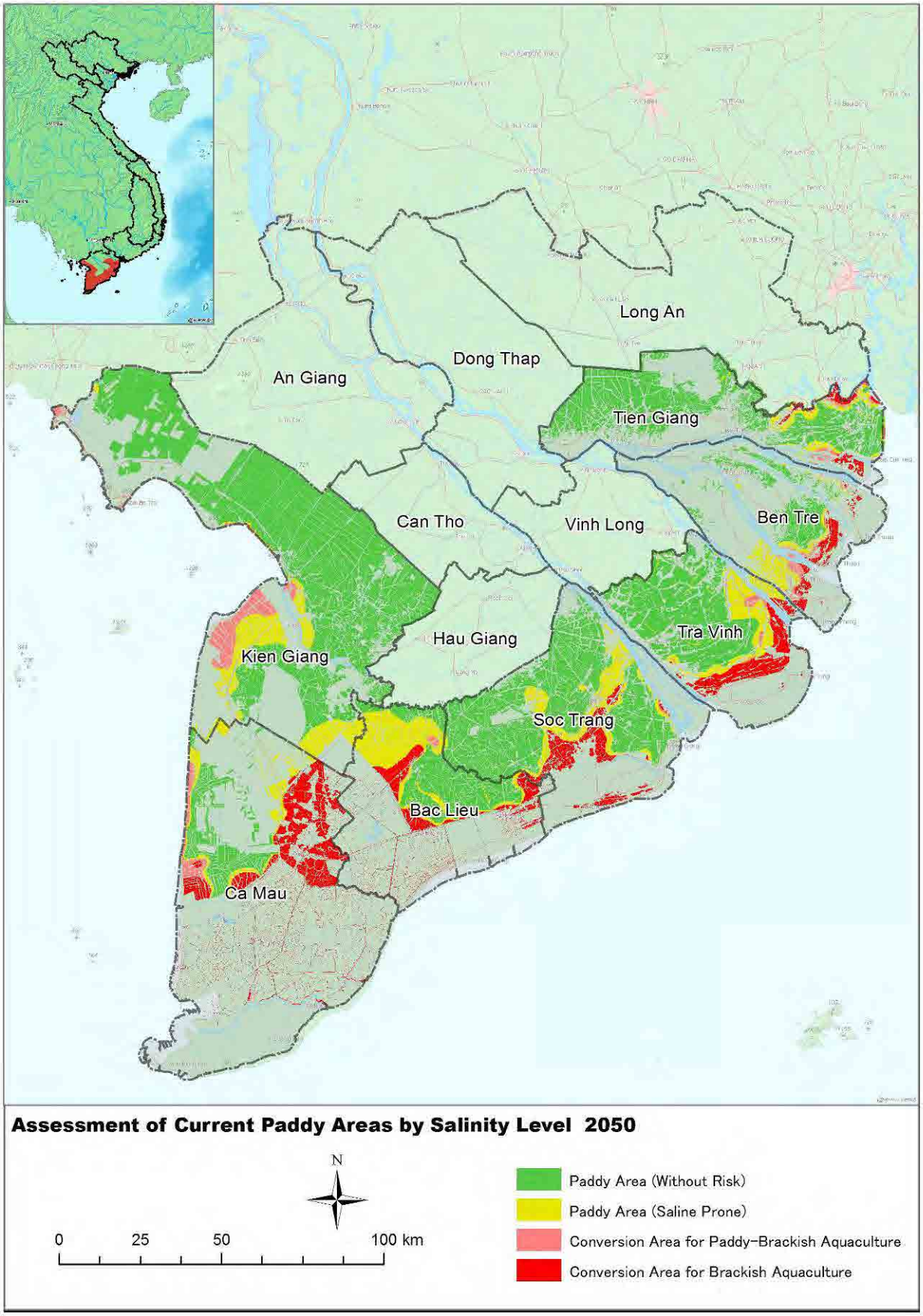


Figure 4.4.9 Assessment of Current Paddy Area by Salinity Level (2050)

Source: JICA Project Team based on Sub-NIAP (2012)

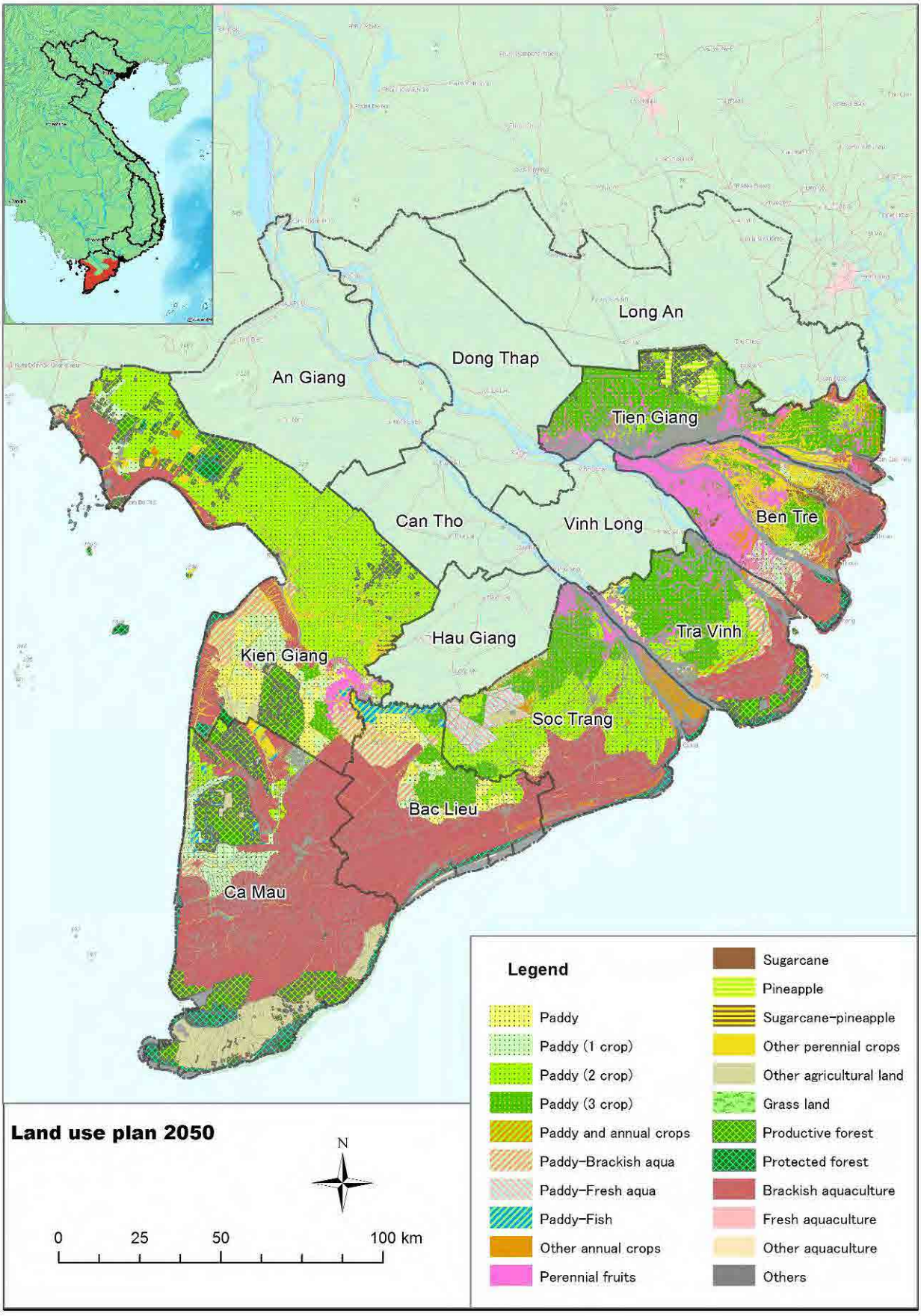


Figure 4.4.10 Land Use Map for the Year 2050

Source: JICA Project Team based on Sub-NIAP (2012)

5) Change in Conversion Area and Protection Area in the Three Target Years

As presented, three land use maps were projected based on the current land use pattern and simulated saline intrusion for the time series of year 2020, 2030 and 2050. As a summary, Table 4.4.18 shows areas for protection of paddy-oriented land use as saline prone area and also area for conversion from paddy-oriented area to "paddy-brackish aquaculture" and "brackish aquaculture."

As shown in the table, saline-prone area where paddy-oriented cultivation can be continued under a certain risk (4-10g/L in either rainy season or dry season) shares 19% in 2020 but gradually reduces as time goes. That is, even after converting a certain areas of paddy field to other commodities, there remain a lot of areas at risk of saline intrusion. To deal with it, any structural measures should be implemented to control the salinity at the level paddy can grow.

Area necessary to convert from paddy-oriented pattern to "paddy-brackish aquaculture" stays 5% or below throughout the period (0% in 2020, 5% in 2030 and 3% in 2050). On the other hand, area necessary to concert to "brackish aquaculture" once reach 14% in 2020 and then becomes lower 9% in 2020 and 11% in 2050.

Projected "conversion areas" for shrimp culture already reached 15% in the year 2020, the short-term target year—this fact suggest that saline intrusion would come up almost to the maximum level in the short term. That is, necessary size of area for the conversion from paddy to brackish aquaculture, such as shrimp culture, it should be achieved as early as the year 2020.

Table 4.4.18 Summary of Protection Area and Conversion Area (2020, 2030 and 2050)

Category	Current Land Use	Area for Protection of Paddy (Saline Prone)			Area for Conversion to Paddy-Brackish Aquaculure			Area for Conversion to Brackish Aquaculure		
		2020	2030	2050	2020	2030	2050	2020	2030	2050
Paddy	87,048	21,490	19,866	21,257	125	9,451	8,801	37,369	27,719	28,221
Paddy (1 crop)	112,956	31,299	26,106	27,365	258	15,721	12,535	37,613	21,607	25,334
Paddy (2 crop)	422,291	62,605	42,170	45,053	654	11,050	7,815	42,886	31,914	36,355
Paddy (3 crop)	231,519	49,080	13,806	18,931	34	2,511	1,455	4,363	1,868	3,314
Paddy & annual crops	4,845	1,854	1,769	1,767	25	2,056	10	2,305	240	2,327
Paddy-Fresh aqua	17,327	94	189	91	0	0	0	0	0	0
Paddy-Fish	16,484	2,545	2,309	2,567	0	0	0	0	0	0
Total	**892,471**	**168,968**	**106,217**	**117,031**	**1,096**	**40,789**	**30,616**	**124,536**	**83,349**	**95,552**
	100%	**19%**	**12%**	**13%**	**0%**	**5%**	**3%**	**14%**	**9%**	**11%**

Source: JICA Project Team based on Sub-NIAP (2012)

4.4.3 Saline-Prone Area for Paddy Cultivation

1) Saline-Prone Areas for Paddy Cultivation in Each of Three Target Years

As discussed in section 4.4.1, land use planning in this report employs criteria that focus on the salinity level of February and June in the target years of 2020, 2030 and 2050. In this regard, saline level at 4-10g/L was categorized as to keep the existing cropping patterns that are oriented to paddy-based systems such as paddy, paddy-paddy, and paddy-annual crops. Yet, the saline content level more than 4g/L is actually not suitable for paddy cultivation and therefore they should be regarded as saline-prone areas, where any countermeasures to keep the salinity at lower level should be taken. Those countermeasures may include construction of sluice gate.

In this concern, Table 4.4.19 to Table 4.4.21 summarizes the risks of salinity in paddy areas (category number 1-5 and 7-8 in the land use plans). For example, in the year 2020 (Table 4.4.19), a total of 168,797 ha or 22% of the paddy-based areas are categorized as saline-prone areas either any of the months or the both. Moreover, 12% of the area is regarded as risk area both in February and June.

The risk area is the biggest in 2020 (22%), which is followed by 2050 (21%) and then 2030 (13%). That is, projected risk areas would once decrease in and around the year 2030 and then increase again toward the year 2050. Even after converting the cropping patterns as suggested as the land use plan of each target year, still remains are the risk of saline water for paddy-based cropping patterns.

Those areas are also shown as maps as Figure 4.4.11 to Figure 4.4.13.

Table 4.4.19 Saline Prone Area for 2020

Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	
At risk only in February	3,924	0	48	659	212	27	183	5,052	1%
At risk only in June	685	22,502	1,946	12,440	24,627	5,326	4,379	71,905	9%
At risk both in February and June	11,884	5,934	12,864	25,456	16,410	7,622	11,670	91,840	12%
Total of Above	**16,492**	**28,436**	**14,858**	**38,554**	**41,249**	**12,976**	**16,233**	**168,797**	**22%**
No significant saline risk	45,419	2,675	26,204	261,418	104,440	82,702	75,184	598,041	78%
Paddy-Based Areas (No.1-5, 7-8)	**61,912**	**31,110**	**41,062**	**299,971**	**145,689**	**95,678**	**91,417**	**766,838**	**100%**

Note: Paddy-based area is based on the land use plan of the target year, not the current land use.
Risk is defined as the saline content level is at 4-10g/L in particular season(s).

Table 4.4.20 Saline Prone Area for 2030

Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	
At risk only in February	11,504	1,589	3,503	10,075	3,837	2,971	2,309	35,788	5%
At risk only in June	145	3,770	233	317	4,902	56	427	9,850	1%
At risk both in February and June	4,461	3,917	9,436	16,349	11,568	4,561	7,677	57,968	8%
Total of Above	**16,110**	**9,276**	**13,172**	**26,740**	**20,306**	**7,588**	**10,412**	**103,605**	**13%**
No significant saline risk	45,958	22,008	27,861	273,799	125,790	88,220	81,093	664,729	87%
Paddy-Based Areas (No.1-5, 7-8)	**62,068**	**31,284**	**41,033**	**300,539**	**146,096**	**95,807**	**91,506**	**768,333**	**100%**

Note: Paddy-based area is based on the land use plan of the target year, not the current land use.
Risk is defined as the saline content level is at 4-10g/L in particular season(s).

Table 4.4.21 Saline Prone Area for 2050

Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	
At risk only in February	11,331	130	3,310	11,102	2,864	1,331	1,075	31,144	4%
At risk only in June	11,378	6,287	5,122	13,449	5,782	3,239	9,953	55,209	7%
At risk both in February and June	5,730	6,773	9,684	18,117	15,236	6,189	9,518	71,247	9%
Total of Above	**28,439**	**13,190**	**18,116**	**42,667**	**23,883**	**10,759**	**20,546**	**157,599**	**21%**
No significant saline risk	178,942	174,784	405,641	498,471	227,027	163,603	146,082	1,794,550	234%
Paddy-Based Areas (No.1-5, 7-8)	**61,931**	**30,706**	**41,084**	**300,518**	**146,537**	**95,335**	**90,192**	**766,303**	**100%**

Note: Paddy-based area is based on the land use plan of the target year, not the current land use.
Risk is defined as the saline content level is at 4-10g/L in particular season(s).

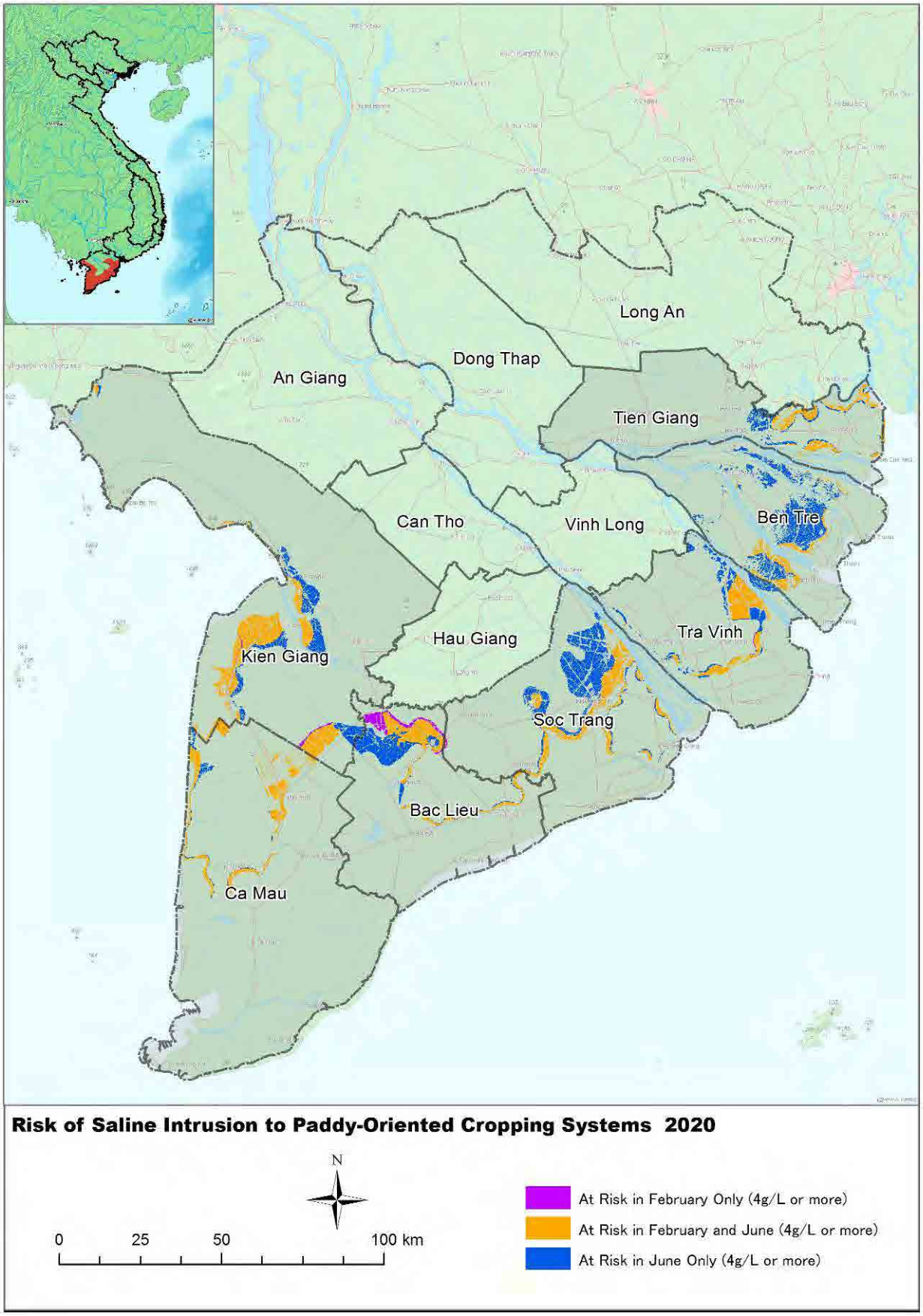


Figure 4.4.11 Risk of Saline Intrusion to Paddy-based Cropping Systems (2020)
Source: JICA Project Team based on Sub-NIAP (2012)

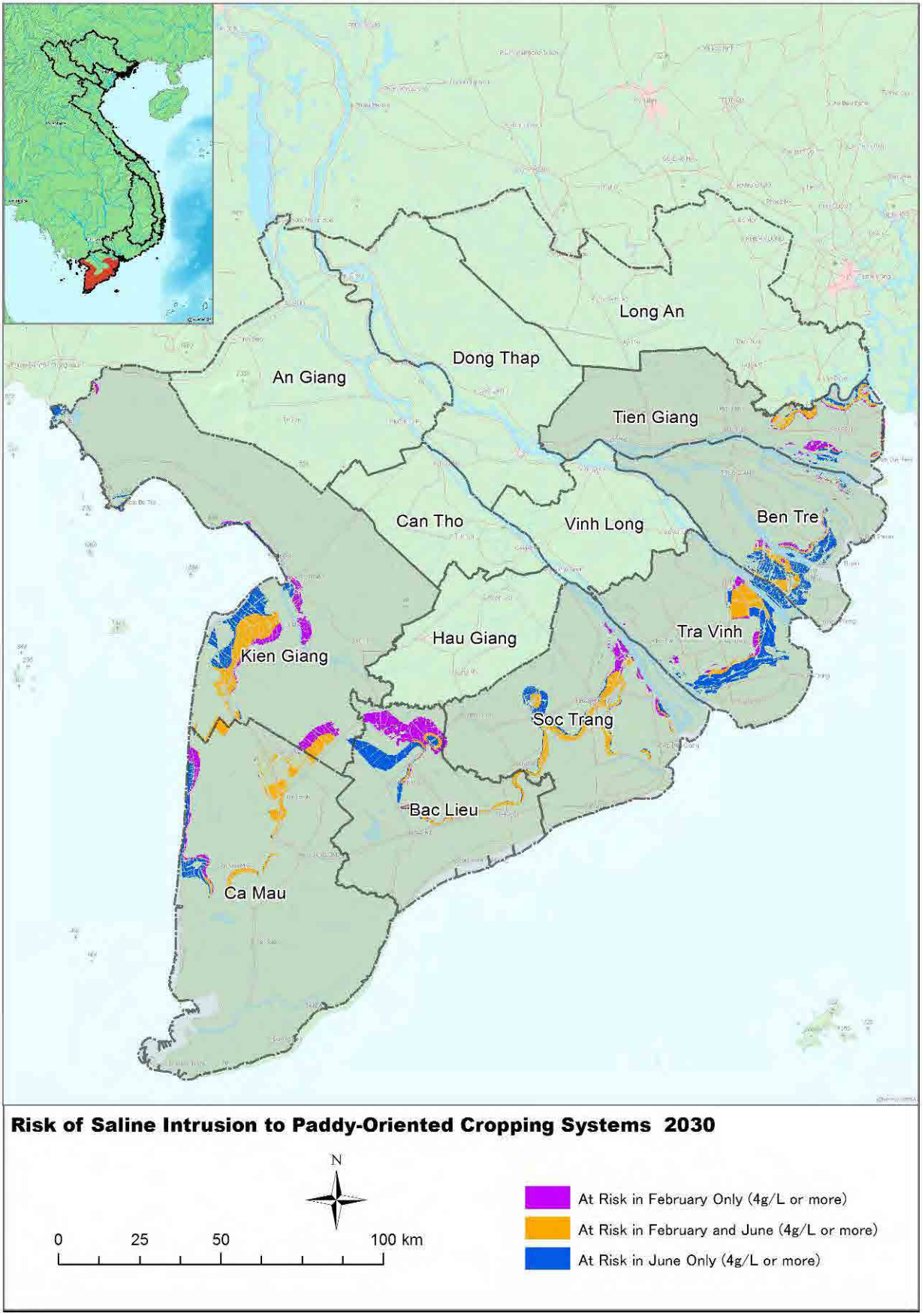


Figure 4.4.12 Risk of Saline Intrusion to Paddy-based Cropping Systems (2030)
Source: JICA Project Team based on Sub-NIAP (2012)

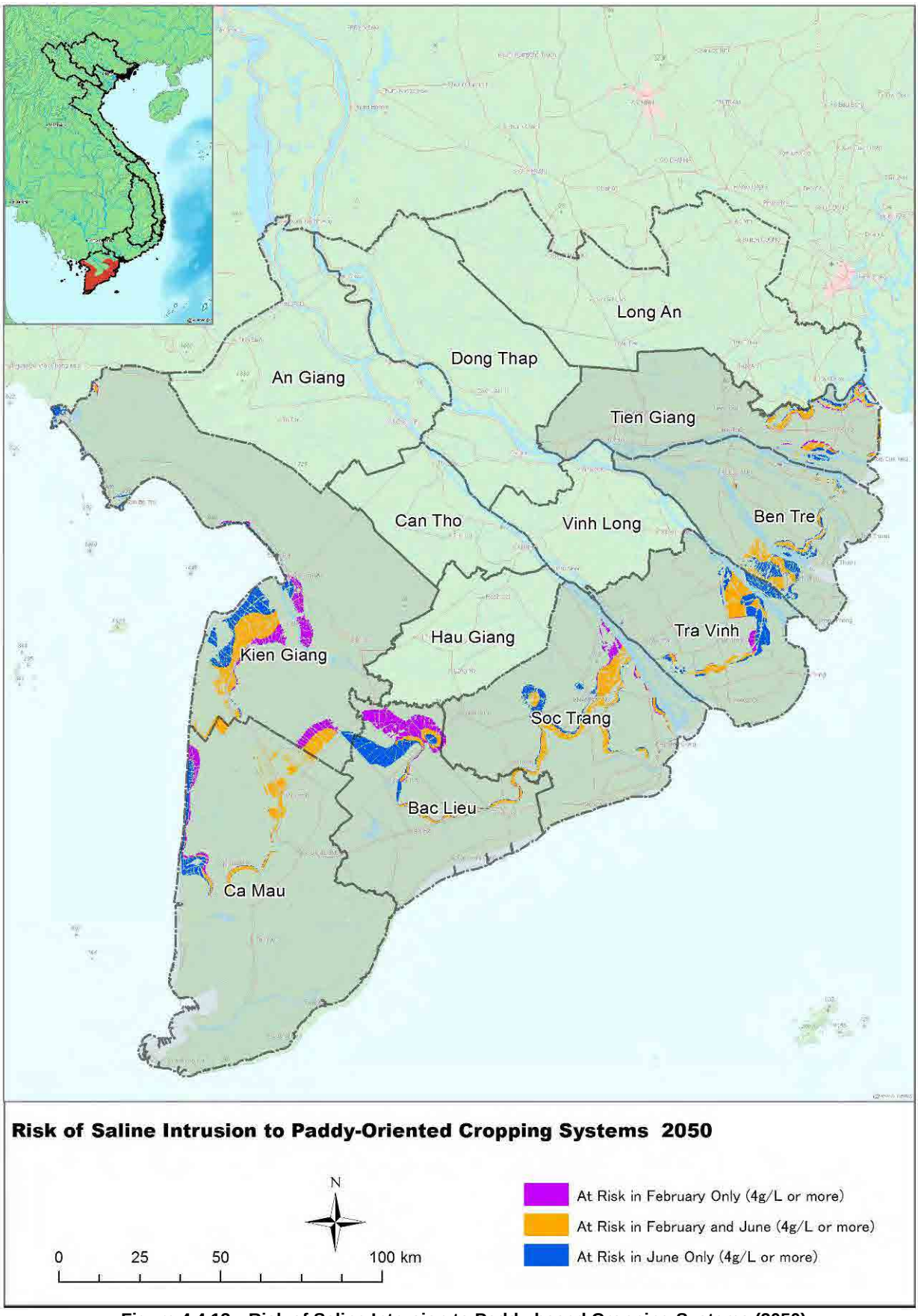


Figure 4.4.13 Risk of Saline Intrusion to Paddy-based Cropping Systems (2050)

Source: JICA Project Team based on Sub-NIAP (2012)

4.4.4 Land Use Plan Concluded for the Target Year 2050

In conclusion, land use plan is finalized for the target year of 2050. To be the basis of the land use plan, projected land use of 2050 was chosen with three major reasons: 1) it is better to present the ultimate picture of the adaptation endeavor to the simulated climate change; 2) size of estimated land areas necessary for conversion from paddy to shrimp are about the same among the three target years; and 3) fluctuation in the saline-prone area for paddy cultivation does not affect the land use planning as it is defined as “paddy” area.

In addition, two issues were taken into account. First, conversion from paddy cultivation to brackish aquaculture is restricted in Ben Tre province due to the fact that the self-sufficiency of paddy production is considerably lower than other provinces (295kg/capita as compared to 1,260kg/capita on an average of Mekong Delta for the year 2010, Table 2.2.4). Although production per capita is enough for self-consumption, this level of production should be maintained by any means, considering the government’s policy favored to paddy production. As a result, originally projected areas as “conversion” area are replaced to “paddy” areas.

Second, coastal area of Tieng Gian province is converted to the area for brackish aquaculture. According to DARD of Tieng Gian province, farmers on the east coast of the province are willing to start shrimp culture given abundant brackish water. In fact, there is a plan to set back the seashore embankment about several hundred meters so that newly opened area can be utilized as shrimp culture area. As a result, small band areas along the coastal line are planned as “brackish aquaculture.”

After all, finalized land use plan for the target year of 2050 is presented as Figure 4.4.14 and summarized in Table 4.4.22 and Table 4.4.23. As also shown in Table 4.4.24, it is planned to convert a total of 116,401 ha of paddy areas to either brackish aquaculture or paddy-brackish aquaculture, which accounts for 14% of decrease in the area of paddy cultivation. Of the paddy-oriented areas, 11,115 ha is to be converted to paddy-brackish aquaculture and 105,297 ha to brackish aquaculture, which accounts for 23% and 23% of increase from original size of its areas, respectively.

As per province, Ca Mau has the biggest areas to decrease from paddy to other commodities: 40,893 ha, accounting for 55% of original paddy area. In terms of the change rate, Tieng Giang projects 120% of increase in brackish aquaculture, although the targeted size of area itself is the smallest (except Ben Tre where no change is planned): 5,235 ha. Of the total area projected for Tien Giang province, 576 ha is additionally projected along the coastal area based on the needs assessment as described above.

For Ben Tre province, no change was planned, following the government’s policy toward self-sufficiency of paddy. Yet, it actually means that a lot of efforts are required to keep the current paddy area to be cultivated in the future too. Because, as once projected in Table 4.4.21, 157,599 ha is expected as saline-prone areas where brackish aquaculture will be much more suitable by the target 2050, given no particular implementation of infrastructural projects. In other word, to realize this plan, infrastructure-oriented project is needed.

Lastly, projected increase of area in brackish aquaculture (105,297ha) is, in fact, about 50% bigger than the government’s current plan—approximately 70,000ha (see 4.3). That is, if forthcoming climate change—in terms of the increase in saline water intrusion—is considered, much more significant adaptation strategies should be taken.

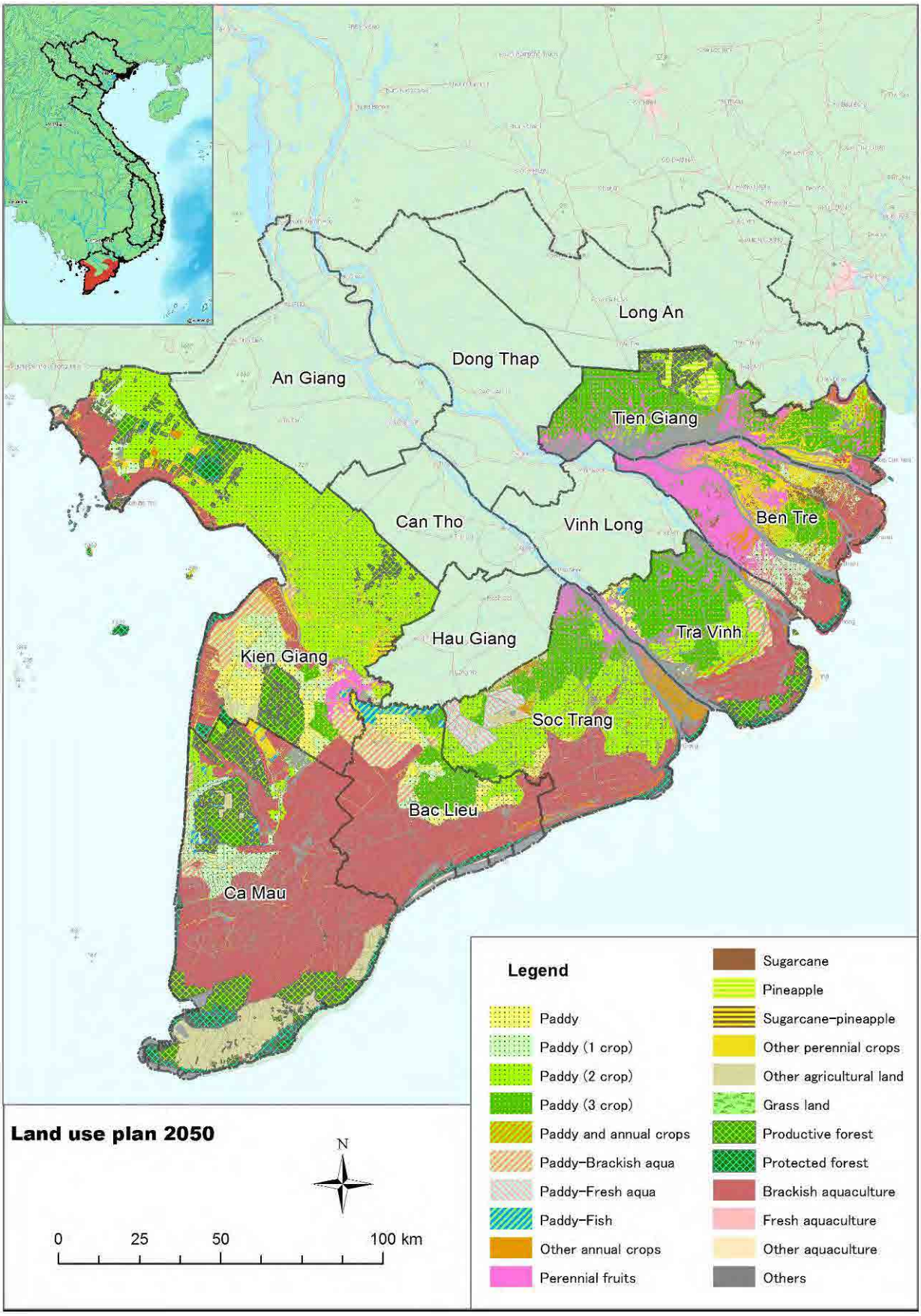


Figure 4.4.14 Land Use Map for the Year 2050 (FINAL)
Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.22 Land Use Plan for the Year 2050 (Abstract: FINAL)

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	Share
1-5	Paddy	54,903	41,049	32,871	299,715	129,226	94,759	89,735	742,258	38.0%
6	Paddy-Brackish aqua	16,557	0	5,107	23,277	344	2,957	10,385	58,628	3.0%
7-8	Paddy-Fresh aqua	7,027	0	8,213	803	17,311	0	458	33,812	1.7%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10-14	Perennial crops	5,024	97,561	6,275	59,257	14,857	45,695	8,841	237,510	12.2%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16-18	Grass land and forest	4,755	5,590	98,868	67,282	5,452	16,320	17,774	216,041	11.1%
19	Brackish aquaculture	116,840	36,834	220,126	80,929	61,618	9,586	34,674	560,606	28.7%
20-21	Other aquaculture	1,121	0	0	0	0	58	2,877	4,056	0.2%
	Sub Total	**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		83%	**80%**	**79%**	**85%**	**76%**	**70%**	**73%**	**79%**	
22	Others	42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
	Total Land Area	**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012)

Table 4.4.23 Land Use Plan for the Year 2050 (Complete: FINAL)

No	Land Use	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total	%
1	Paddy	17,685	0	767	23,068	3,623	0	4,882	50,025	2.6%
2	Paddy (1 crop)	6,355	18,082	22,101	36,026	0	0	0	82,563	4.2%
3	Paddy (2 crop)	8,690	1,928	10,003	233,891	87,518	13,370	22,800	378,201	19.4%
4	Paddy (3 crop)	22,174	21,040	0	6,729	38,084	81,389	59,545	228,961	11.7%
5	Paddy and annual crops	0	0	0	0	0	0	2,508	2,508	0.1%
6	Paddy-Brackish aqua	16,557	0	5,107	23,277	344	2,957	10,385	58,628	3.0%
7	Paddy-Fresh aqua	13	0	0	0	17,311	0	4	17,327	0.9%
8	Paddy-Fish	7,015	0	8,213	803	0	0	454	16,484	0.8%
9	Other annual crops	1,153	6,940	318	2,861	15,697	4,874	1,884	33,728	1.7%
10	Perennial fruits	159	59,828	0	10,352	9,581	25,912	8,642	114,475	5.9%
11	Sugarcane	0	5,368	0	0	0	0	0	5,368	0.3%
12	Pineapple	0	0	0	0	0	10,140	0	10,140	0.5%
13	Sugarcane-pineapple	0	0	0	1,262	0	0	0	1,262	0.1%
14	Other perennial crops	4,865	32,364	6,275	47,643	5,276	9,643	199	106,265	5.4%
15	Other agricultural land	0	0	51,979	7,013	6,405	114	0	65,511	3.4%
16	Grass land	6	49	11	0	0	0	13	79	0.0%
17	Productive forest	118	0	75,787	49,860	10	14,824	13,983	154,582	7.9%
18	Protected forest	4,630	5,540	23,070	17,422	5,442	1,496	3,778	61,379	3.1%
19	Brackish aquaculture	116,840	36,834	220,126	80,929	61,618	9,586	34,674	560,606	28.7%
20	Fresh aquaculture	0	0	0	0	0	58	0	58	0.0%
21	Other aquaculture	1,121	0	0	0	0	0	2,877	3,998	0.2%
Sub Total		**207,380**	**187,975**	**423,756**	**541,138**	**250,910**	**174,362**	**166,628**	**1,952,149**	**100.0%**
		11%	10%	22%	28%	13%	9%	9%	100%	
Others		42,770	48,045	109,404	93,492	80,270	74,058	62,882	510,921	
Total Land Area		**250,150**	**236,020**	**533,160**	**634,630**	**331,180**	**248,420**	**229,510**	**2,463,070**	

Source: JICA Project Team based on Sub-NIAP (2012) Note: Colored cells show adjusted areas.

Table 4.4.24 Change in Land Use from 2009 to 2050 (FINAL)

No.	Category	Bac Lieu	Ben Tre	Ca Mau	Kien Giang	Soc Trang	Tien Giang	Tra Vinh	Total
1-5	Paddy	-9,944	0	-40,893	-27,658	-16,086	-8,182	-13,638	-116,401
6	Paddy-Brackish aqua	-4,196	0	5,107	11,205	344	2,957	-4,302	11,115
7-8	Paddy-Fresh aqua	0	0	0	0	0	0	0	0
9	Other annual crops	0	0	0	0	0	0	0	0
10-14	Perennial crops	0	0	0	0	0	0	0	0
15	Other agricultural land	0	0	0	0	0	0	0	0
16-18	Grass land and forest	0	0	0	0	0	0	0	0
19	Brackish aquaculture	14,140	0	35,786	16,453	15,743	5,235	17,939	105,297
20-21	Other aquaculture	0	0	0	0	0	-11	0	-11
Change in Paddy		**-15%**	**0%**	**-55%**	**-8%**	**-11%**	**-8%**	**-13%**	**-14%**
Change in Paddy-Brackish Aqua		**-20%**	**-**	**-**	**93%**	**-**	**-**	**-29%**	**23%**
Change in Brackish aquaculture		**14%**	**0%**	**19%**	**26%**	**34%**	**120%**	**107%**	**23%**

Source: JICA Project Team based on Sub-NIAP (2012)

APPENDIX-IV

AQUACULTURE

APPENDIX IV: AQUACULTURE

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CHAPTER 1 AQUACULTURE DEVELOPMENT PLAN IN VIETNAM

1.1 Administrative Organization

Ministry of Agriculture and Rural Development (MARD) is the responsible ministry for aquaculture in Vietnam, and Department of Aquaculture, Directorate of Fisheries in MARD is the competent authority for aquaculture. Directorate of Fisheries also has the Research Institute on Aquaculture No.2 which does research activities on aquaculture including seed production, feed composition, biological products, diseases, environmental issues in Southern Vietnam. Department of Animal Health (DAH) takes the responsibility for diseases and drags for aquaculture. Aquaculture extension is conducted by National Centre for Agriculture and Aquaculture Extension at the national level.

In the province, aquaculture division under the Department of Agriculture and Rural Development (DARD) takes responsibility for the aquaculture activities and Provincial Centre for Agriculture and Aquaculture Extension is in charge of the responsibility of extension activities. Under the Provincial Centre for Agriculture and Aquaculture Extension, district extension station is allocated at each district, and one to two extension official(s) is assigned in each commune.

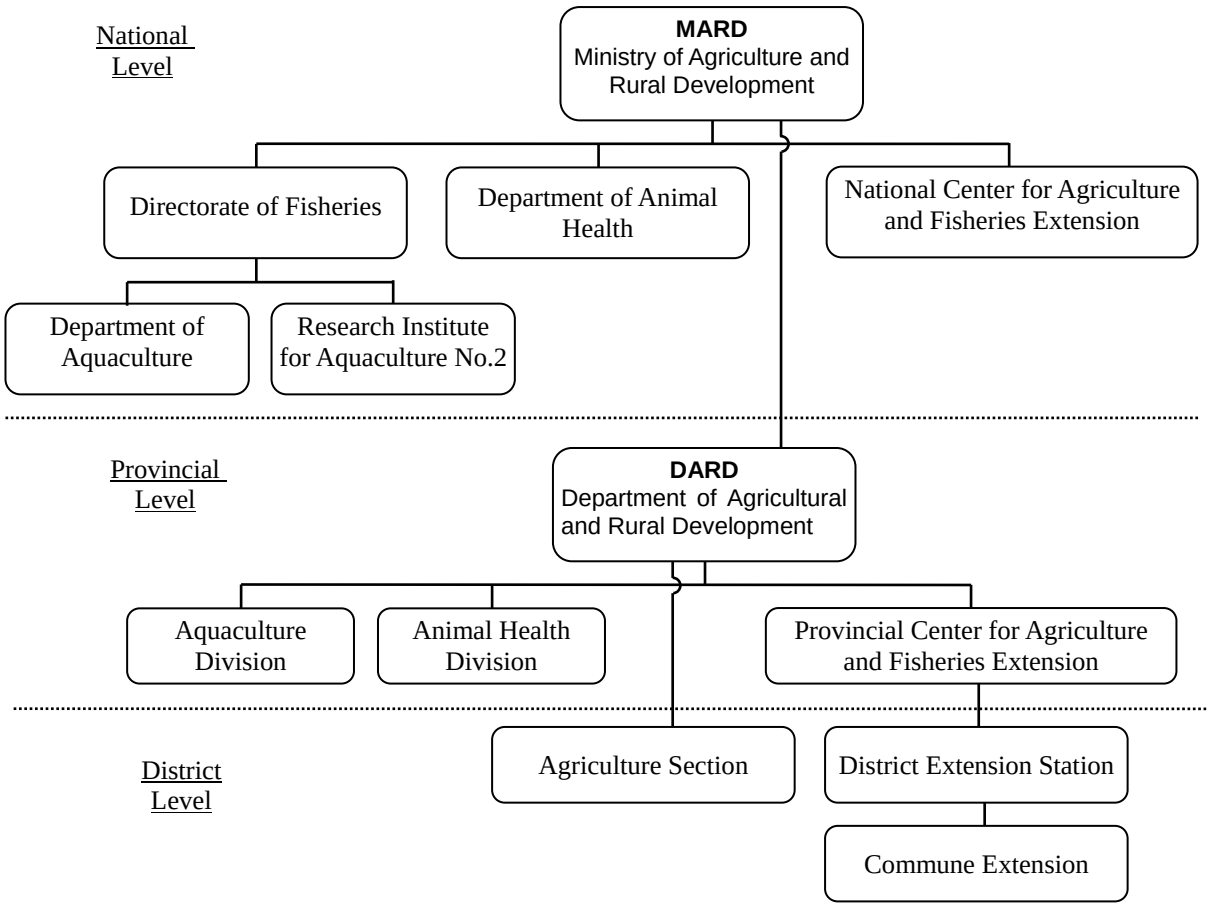


Figure 1.1.1 Responsible Agencies for Aquaculture in Mekong Delta Area

1.2 National Aquaculture Development Plan

Aquaculture development plan is prepared at national level and provincial level. The National Master Plan for Aquaculture Development to 2020 and Vision to 2030 prepared by Fisheries Directorate in June 2012 sets up the following development targets.

- In 2015, aquaculture production reaches 3.60 million ton, on an area of 1.1 million ha; export turnover of 3.5 – 4.0 billion USD, create jobs for 3.0 million labors.
- In 2020, aquaculture farming production reaches 4.5 million ton, on an area of 1.2 million ha; export turnover of 5.0 – 5.5 billion USD, create jobs for 3.5 million labors.

  In which:

  - Shark catfish production from 1.8 to 2 million ton, average growth of 4.8%/year.
  - Brackish shrimp production reaches 700,000 ton, average growth of 5.76%/year.
  - Mollusks production reaches 400,000 ton, average growth of 16.0%/year.
  - Sea fish production reaches 200,000 ton, average growth of 14.9%/ year.
  - Tilapia production reaches 150,000 ton, average growth of 7.9%/year.
  - Seaweed production reaches 100,000 ton, average growth of 17.9%/year.
  - Giant prawn production reaches 60,000 ton, average growth of 11.6%/year

Besides, USD 11 billion of export turnover from aquaculture sector is targeted in the Decision No: 124/QD-TTg on 2nd February 2012, "Approval of Master Plan to Agriculture Product Development up to 2020 and Vision to 2030". The master plan also targets to increase 99.7 thousand ha of aquaculture area comparing to 2010; in which the area for cultivation in the Mekong Delta occupies 70%.

1.3 Provincial Aquaculture Development Plan

As mentioned in the Table 1.3.1, MARD sets up the target area of shrimp farming in Mekong Delta by 2015 and 2020 in the "Aquaculture Development Plan in Mekong Delta to 2015 and Orientation to 2020" by MARD in April 2009. There are three options studied in the plan. First option is the case which prioritizes the black tiger (*Penaeus monodon*) culture and reducing share of white leg shrimp (*Litopenaeus vannamei*) culture, second one is to prioritize aquaculture of black tiger, freshwater giant prawn (*Macrobrachium rozenbergii*) and Pangasiius, and third option is to prioritize intensive / semi-intensive culture of white leg shrimp.

In consideration of development rate, market tendency and amount of investment required, the Plan selected option 2 since option 3 required large amount of investment. It is planned to develop 546,000 ha for black tiger and 14,000 ha for white leg shrimp by 2015 and 543,950ha for black tiger and 20,800 ha for white leg shrimp by 2020. It means that 2,050 ha of black tiger culture area will be decreased from 2015 to 2020. All areas are located in target provinces of the Project.

Target area for shrimp farming in the Aquaculture Development Plan in Mekong Delta to 2015 and Orientation to 2020" was also updated in the National Master Plan for Aquaculture Development to 2020 and Vision to 2030 although provincial target is not specified in the National Master Plan. Targets in both plan are shown in Table 1.3.1.

Table 1.3.1 Target Area for shrimp farming development by 2015 and 2020 Unit: ha

Province	Target area by 2015			Target area by 2020		
	P. monodon	*L. vanamei*	Total	*P. monodon*	*L. vanamei*	Total
Targets sat up in the Aquaculture Development Plan in Mekong Delta in 2009						
Long An	3,300	300	3,600	1,650	300	1,950
Tiền Giang	4,100	700	4,800	3,000	1,700	4,700
Bến Tre	29,500	1,000	30,500	29,200	2,000	31,200
Trà Vinh	31,700	1,000	32,700	35,000	1,800	36,800
Sóc Trăng	53,900	1,000	54,900	52,400	2,000	54,400
Bạc Liêu	111,500	5,000	116,500	110,000	6,000	116,000
Cà Mau	235,500	4,000	239,500	232,500	5,000	237,500
Kiên Giang	76,500	1,000	77,500	80,200	2,000	82,200
An Giang	-	-	-	-	-	-
Dồng Tháp	-	-	-	-	-	-
Hậu Giang	-	-	-	-	-	-
Cần Thơ	-	-	-	-	-	-
Vĩnh Long	-	-	-	-	-	-
Total	546,000	14,000	560,000	543,950	20,800	564,750
Targets sat up in the National Master Plan in 2012						
Total	541,500	18,500	560,000	528,400	33,200	561,600

Source: Aquaculture Development Plan in Mekong Delta to 2015 and Orientation to 2020 prepared in 2009 and National Master Plan for Aquaculture Development to 2020 and Vision to 2030 prepared in 2012

As shown in Table 1.3.2, there is not so much difference in the share of areas by culture categories in 2015 and 2020. Improved extensive culture covers 53 to 55% of total area, and paddy-shrimp culture covers 25 to 26%, intensive / semi-intensive covers 14 to 15% only.

Table 1.3.2 Target Area for shrimp farming development by Culture Category Unit: ha

		Aquaculture Development Plan in Mekong Delta in 2009									National Master Plan in 2012
		Long An	Tiền Giang	Bến Tre	Trà Vinh	Sóc Trăng	Bạc Liêu	Cà Mau	Kiên Giang	Total	
Target in 2015	**P. monodon**	**3,300**	**4,100**	**29,500**	**31,700**	**53,900**	**111,500**	**235,500**	**76,500**	**546,000**	**541,500**
	Intensive / semi-intensive	1,200	2,700	6,000	12,500	23,000	14,000	10,000	4,500	73,900	73,900
	Improved extensive	2,100	1,400	13,900	11,400	20,900	79,500	149,700	19,000	297,900	297,900
	Paddy- shrimp			7,600	5,300	10,000	18,000	45,300	53,000	139,200	175,200
	Garden-shrimp							10,000		10,000	
	Forest-shrimp			2,000	2,500			20,500		25,000	
	L. vannamei	300	700	1,000	1,000	1,000	5,000	4,000	1,000	**14,000**	**18,500**
Target in 2020	**P. monodon**	**1,650**	**3,000**	**29,200**	**35,000**	**52,400**	**110,000**	**232,500**	**80,200**	**543,950**	**528,400**
	Intensive / semi-intensive	1,200	2,000	5,700	13,900	22,000	14,000	11,400	9,000	79,200	80,000
	Improved extensive	450	1,000	13,900	12,300	20,400	78,000	145,300	18,200	289,550	272,400
	Paddy- shrimp			7,600	6,300	10,000	18,000	45,300	53,000	140,200	176,000
	Garden-shrimp							10,000		10,000	
	Forest-shrimp			2,000	2,500			20,500		25,000	
	L. vannamei	300	1,700	2,000	1,800	2,000	6,000	5,000	2,000	**20,800**	**33,200**

Source: Aquaculture Development Plan in Mekong Delta to 2015 and Orientation to 2020 prepared in 2009 and National Master Plan for Aquaculture Development to 2020 and Vision to 2030 prepared in 2012

Beside the development plan aforementioned, DARD in each province prepares provincial aquaculture development plan. The Project could correct the shrimp culture development plan from some provinces. Target water surface area of shrimp farming is shown in Table 1.3.3.

Table 1.3.3 Targeted Water Surface Area of Shrimp Farming by Province Unit: ha

		2010	2020	Note
Ca Mau	Intensive / semi-intensive	1,752	N.A	-
	Traditional extensive	206,643	N.A	
	Improved extensive	3,500	N.A	
	Shrimp−paddy	36,997	N.A	
	Shrimp−Mangrove	17,700	N.A	
	Total	**266,592**	N.A	
Bac Lieu	Intensive / semi intensive	9,340	17,000	Aquaculture development plan up to 2020 was already approved in Bac Lieu.
	Extensive (including improved extensive)	2,802	67,500	
	Shrimp-paddy	29,000	35,000	
	Total	**41,142**	**119,500**	
Ben Tre	Tiger shrimp			Aquaculture development plan up to 2020 was already approved in Ben Tre.
	Intensive / semi-intensive	4,350	4,500	
	Improved extensive	16,290	13,351	
	Shrimp−paddy	6,600	8,900	
	Shrimp−Mangrove	3,359	3,400	
	Sub-total	30,599	30,151	
	White leg shrimp	500	2,000	
	Total	**31,099**	**32,151**	

Source: Results of interview survey by JICA Project

CHAPTER 2 AQUACULTURE IN THE MEKONG DELTA AREA

Aquaculture in the Mekong Delta has been a common aspect of daily life of the people, and in addition commercial aquaculture started rapidly developing in the mid to late 1980's with the introduction of Doi Moi. In the 1990's, the rapid expansion of shrimp farming received much attention from overseas but in recent years, various types of aquaculture system have developed for both the domestic and oversea markets.

2.1 Aquaculture Production

Overall coastal areas of the Delta are characterized as brackish shrimp (*Penaeus monodon*) cultivation area under the condition that saline water intrusion takes place. In the coastal areas nearer to Ho Chi Minh (HCM) city, various types of cultivation systems are in operation. In Ben Tre and Tien Giang provinces, for example, the cultivation of mollusks such as clams (*Meretrix spp*) and blood cockle (*Anadara sp*) are becoming very significance.

On the other hand, freshwater aquaculture has flourished in the mid and upper parts of Mekong Delta. The upper parts of the Hau and Tien Rivers are becoming Pangasius cultivation areas. Initially in An Giang and Dong Thap provinces, the cultivation of *Pangasius spp* was started in the late 1990's for export. The central parts of the Delta, such as Can Tho province, are introducing this export-oriented Pangasius cultivation but the areas placed under heavy floods still depend on other freshwater fish mostly for the domestic markets.

Table 2.1.1 summarizes the aquaculture production in the Mekong Delta as compared with other parts of the Country, and Figure 2.1.1 illustrates per-capita aquaculture production of fish and Figure 2.5.2 depicts the brackish shrimp aquaculture production. As is well illustrated, the aquaculture production of the Mekong Delta by far surpasses the production of other regions. In fact, the overall aquaculture production by Mekong Delta (1,940,181 tons) shares as much as 72% of the national production (2,706,752 tons).

With regards to the aquaculture production of fish, the intensive production areas can be seen in the upper-mid parts of Mekong Delta, and yet the Project area still produces total 530,612 tons of cultured fish. Per-capita production of cultured fish in the Project area is estimated at 59 kg as shown in the Figure 2.1.1, which is far bigger than the national per-capita production of 24 kg only. Note that the population employed in estimating the per-capita production is the total number of people in the respective provinces or regions (not the population engaged in the aquaculture).

As is well known, the cultured shrimp production in the Project area by far exceeds those of other regions including mid-upper parts of Mekong Delta. The total production of cultured shrimp in 2010 was 331,760 tons while that of national level was 450,364 tons. It means the Project area produced as much as 76%, three-quarters of the national production. Per-capita production of the cultured shrimp arrives at 36.8 kg while those of other provinces and regions remain less than 5 kg per capita only.

Table 2.1.1 Aquaculture Production (2010) in the Mekong Delta as Compared with Other Regions

Province/ Region	Aquaculture Production, ton	Per-capita Aquaculture Production, kg	Production of Cultured Fin Fish, ton	Per-capita Production of Cultured Fin Fish, kg	Production of Cultured Shrimp, ton	Per-capita Production of Cultured Shrimp, kg
Tien Giang	120,188	72	87,925	52	12,833	7.7
Ben Tre	168,148	134	122,150	97	30,485	24.3
Tra Vinh	82,777	82	53,824	54	20,944	20.8
Soc Trang	98,493	76	37,490	29	60,830	46.8
Bac Lieu	143,725	166	65,370	75	68,003	78.4
Ca Mau	235,550	194	117,216	97	103,900	85.7
Kien Giang	97,673	57	46,637	27	34,765	20.4
Project Area	946,554	105	530,612	59	331,760	36.8
An Giang	279,773	130	276,941	129	916	0.4
Can Tho	172,360	144	172,331	144	22	0.0
Hau Giang	44,430	59	43,482	57	15	0.0
Vinh Long	135,181	132	135,089	132	16	0.0
Dong Thap	331,373	198	327,757	196	1,727	1.0
Long An	30,510	21	23,751	16	6,661	4.6
Mekong Delta	1,940,181	112	1,509,963	87	341,117	19.7
Red River Delta	406,280	21	309,573	16	16,422	0.8
N. Midlands & Mountain	67,909	6	65,673	6	367	0.0
N. Central & Central Coastal	177,397	9	86,725	5	71,292	3.8
Central Highlands	20,603	4	20,252	4	68	0.0
South East	94,382	5	67,379	4	21,030	1.2
Whole Country	2,706,752	31	2,058,465	24	450,364	5.2

Source: Statistical Year Book of Vietnam (2011)

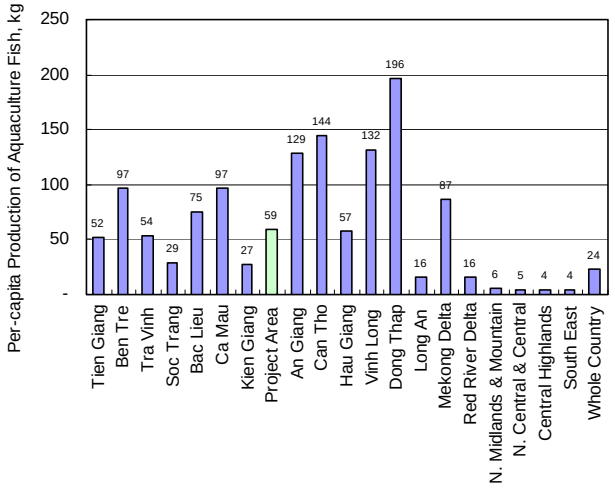


Figure 2.1.1 Per-capita Production of cultured Fin Fish (2010)

Source: Statistical Year Book of Vietnam 2010, GSO

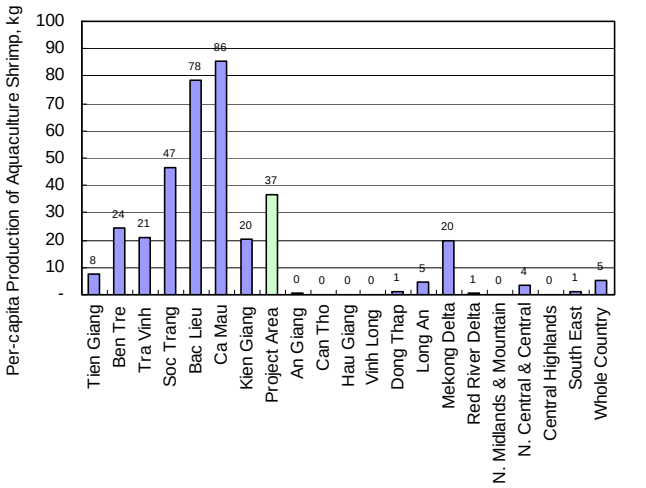


Figure 2.1.2 Per-capita Production of cultured Shrimp (2010)

Source: Statistical Year Book of Vietnam 2010, GSO

In the coastal area of Mekong Delta, a lot number of shrimp firms can be seen. Shrimp culture had started in the early 1970's in brackish water area. At that time, however, production per unit was said to be only about 100 kg/ha with extensive farming method[1]. The shrimp production in Vietnam started increasing rapidly in 2000's in contrast to the black tiger shrimp (*Penaeus monodon*) production in Thailand.

In Thailand, black tiger shrimp culture had become popular in mid 1980's, and in the 1990's the production had reached a peak. However, due to deterioration of coastal environment, annual

[1] R. E. Turner (1977); "Intertidal Vegetation and Commercial Yield of Penaeid Shrimp", Transactions of the American.

production declined in 1996 as a result of viral disease problems in eastern and southern Thailand. Thus some shrimp farms relocated their farming area from coastal area to inland area. These farms succeeded shrimp farming in inland area with introduction of low-salinity culture techniques. This success led large number of rice farmers in central Thailand to convert irrigated paddy fields into shrimp ponds during the latter half of the 1990s.

However, with devastative negative impacts on the natural environment, the Thai government had restricted the brackish shrimp farming in inland area. Consequently, 30% of the total shrimp farming area that was located in freshwater areas of the country was affected by this decree. For continuing the shrimp farming in inland area, white leg shrimp (*Litopenaeus vannamei*) which could grow up in the freshwater without any introduction of saline water was introduced by the private sector in late 1999.

As the production of Thai black tiger shrimp had decreased, the production of the black tiger in Vietnam started increasing on the contrary. The production of the black tiger shrimp in Vietnam started increasing since early 2000s as indicated in Figure 2.1.3. The production of black tiger shrimp in Vietnam has come to around 300,000 tons per annum in year 2008. Most of the production came from the coastal areas of Mekong Delta, which is the Project area. In recent years, white leg shrimp is cultivated in Vietnam but still the black tiger shrimp is the major species, unlike the trend in Thailand.

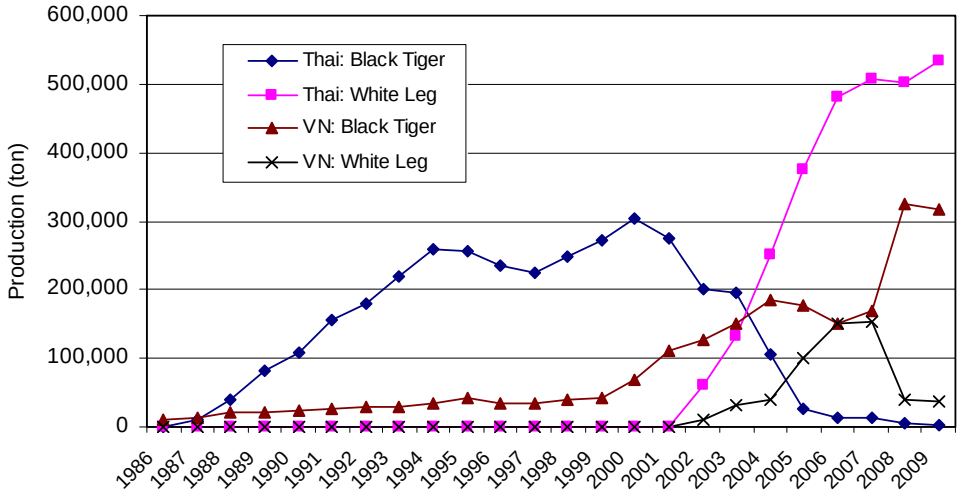


Figure 2.1.3 Trend of Shrimp Production in Vietnam and Thailand
Source: FAOSTAT (2011)

2.2 Shrimp farm management

Shrimp culture in Vietnam is divided into two major categories: intensive and extensive, and those may further be divided into four: intensive, semi-intensive, improved-extensive and extensive, although they have some variations. In the coastal Mekong Delta, intensive shrimp culture shares only 10% in terms of the area cultivated as indicated in Figure 2.2.1; remaining one are all for extensive systems according to Research Institute for Aquaculture No.2[2].

[2] The Status, Challenge and Perspective of Black Tiger Shrimp (*Penaeus monodon*) Farming in the Mekong Delta, Vietnam, Research Institute for Aquaculture No.2, MARD, 2008

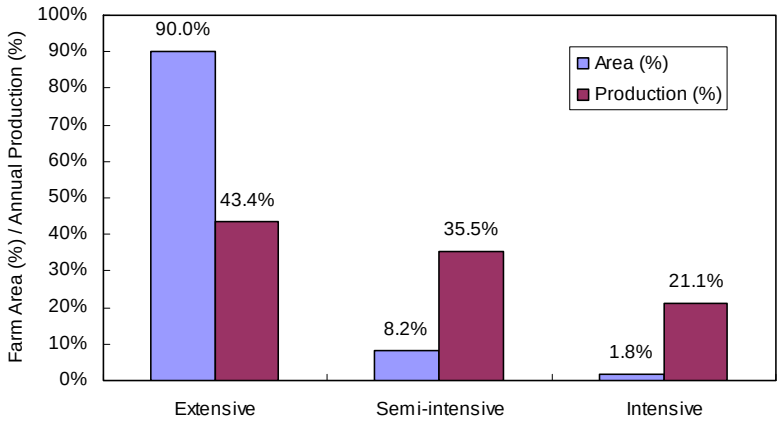


Figure 2.2.1 Shares in Area Cultivated and Production of Shrimp by Category

Source: The Status, Challenge and Perspective of Black Tiger Shrimp (*Penaeus monodon*) Farming in the Mekong Delta, Vietnam, Research Institute for Aquaculture No.2, MARD, 2008

Extensive system has less impact to environment, although it on the other hand results in quite low productivity. According to records by Research Institute for Aquaculture No.2[3], annual yield of the shrimp production under the extensive system is estimated at around 200-300kg/ha. On the other hand, production of the semi-intensive system reaches 1.5-3.0 ton/ha and the intensive system comes to as high as 5.0-7.0 ton/ha and even more.

As shown above, while the extensive system shares 90% of the total cultivated area in the Mekong Delta, it shares only 43% in terms of the production. On contrast, the semi-intensive system, which shares only 8.2% of the area, produces 35.5% of the production. Similarly, while the intensive system shares only 1.8% of the area, it produces 21.1% of the total production, that is, "intensive" systems produce nearly half of the production with only 10% of the land.

Rice-shrimp farming and Shrimp-Mangrove farming are categorized as a kind of extensive system. Rice - shrimp farming cultivates paddy in rainy season and cultivate shrimp in dry season. Shrimp pond is conditioned through the decomposition of detritus sedimented on the bottom of shrimp pond during the paddy cultivation period, and running cost is saved since no pesticide is used for paddy cultivation. On the other hand, Shrimp-Mangrove culture has been promoted as a part of Five Million Hectare Reforestation Program (Project 661) which started in 1998 for mangrove conservation. In the program, the Government provides participants with not only technical support but also financial support for starting Shrimp-Mangrove farm such as low rental fee of land and loan with low interest from the Government bank.

2.2.1 Extensive Shrimp Culture

In the extensive system, larva are released at a low density of about 1-2 shrimp only per square meter. There is no clear production cycle for the extensive system. Instead, shrimp is periodically harvested, once a month for example, and, at this time, small shrimps are released back to the pond. Post larvae are also released periodically to supplement the deficit caused by the harvest. As those arrangements are done periodically and with no concrete measurement, actual population density is hardly monitored.

As mentioned above, extensive shrimp cultivation system is sometimes combined with paddy production. In this kind of system, shrimp is cultivated only in the dry season when saline intrusion takes place. In this system, as the period available for shrimp culture is limited, post larvae are

[3] The Status, Challenge and Perspective of Black Tiger Shrimp (*Penaeus monodon*) Farming in the Mekong Delta, Vietnam, Research Institute for Aquaculture No.2, MARD, 2008

released only one time at the beginning of the dry season in most cases. After they have harvested the shrimp at end of dry season, they usually leave the farm land for two to two and half months during the early rainy season. The farm plots where salt has been accumulated with shrimp culture are therefore washed by rainfall, becoming ready for paddy cultivation.

According to some interviews made to shrimp farmers[4], costs of fertilizer and post larvae shares a range of about 30% of the total expenditure. By subtracting the cost from the sale, farmers can fetch net profit of about 20 million VND to 40 million VND per ha from this extensive shrimp culture. This net profit of 20 to 40 million VND is about the same to twice as much as what one hectare of paddy cultivation can fetch in net profit. Thus, if no disease occurs, shrimp culture even if it is extensive one can be more profitable than paddy production.

Shrimp-Mangrove culture pond is composed of 70% of mangrove area and 30% of shrimp cultivation area. Shrimp cultivation is continuously implemented throughout year. Shrimp is harvested 2 times / month at spring tide cycle and post larvae of Black Tiger Shrimp are released every month. Juveniles of other shrimps and crabs caught at sea are also released in some cases. As same as other type of extensive culture, Shrimp-Mangrove culture also does not feed any diet but using some fertilizer.

There is no clear definition between extensive and improved extensive culture but higher density of PL were released and diets also are fed supplementary in the improved extensive culture system.

2.2.2 Intensive and Semi-intensive Shrimp Culture

As for the intensive shrimp culture systems, it is recommended by Research Institute for Aquaculture No.2 to do only one time cultivation per year. However, it was revealed that many shrimp farmers do twice per year for more income earning. According to the Institute, the intensive culture requires quite a high investment for infrastructure construction, feeds and purification of polluted water, and thus more farmers run for the semi-intensive system, which require relatively low investment.

Typical profiles of semi-intensive and intensive systems are summarized in Table 2.2.1 in comparison with those of extensive shrimp culture. As shown in the table, for the intensive systems, investment cost shares 40-60% of gross income, in which the cost of feed shares the most (usually a range of about 70% of total cost). The net profits for the semi-intensive and intensive are in fact quite high as exampled by a comparison with the net profit of extensive culture; about 3 times more for the case of semi-intensive and more than 10 times or even over 30 times in case of intensive culture depending on the level of the intensiveness.

Intensive and semi-intensive culture feature a use of aeration and/or waterwheel for oxygen supply.

Table 2.2.1 Typical Profile of Semi-Intensive and Intensive Systems

Category	Initial Population Density	Average Yield	Gross Income, VND/ha	Net Profit, VND/ha
Semi-Intensive	10 – 15 shrimps/m^2	1.5 – 3.0 ton/ha	175 – 500 million	75 – 100 million
Intensive	20 – 30 shrimps/m^2	5.0 – 7.0 ton/ha	600 – 1,200 million	325 – 650 million
Extensive	1 – 2 shrimps/m^2	200 – 300 kg/ha	30 – 60 million	20 – 40 million

Source: The Status, Challenge and Perspective of Black tiger shrimp (Penaeus monodon) Farming in the Mekong Delta, Vietnam, Research Institute for Aquaculture No.2, MARD, 2008, Interviews to Shrimp Culture Farmers

[4] The interviewees were conducted in August and September in 2011 to 20 shrimp culture farmers in Ca Mau, Bac Lieu, Soc Trang, Ben Tre provinces.

Mangrove-Shrimp Culture in Mekong Delta Area

In 1943, Vietnam had 14.3 million ha of natural forests, covering 43% of the total land area of the country. However, forest area has fallen rapidly and by 1990 was just 9.18 million ha or 27.2% of the total land area.

With the support of international organizations, Vietnam has invested in many national programs and projects including Program 327 and the Five Million Hectare Reforestation Program (Program 661), which help to improve forest area and quality. In 1990, the forest area of Vietnam was 9.1 million ha, by 2000 it was 10.9 million ha and by 2006 it was 12.9 million ha, covering 38% of the total land area of the country.

In 1999, zoning of mangrove area in Mekong Delta was announced under the Decision 116/1999/QD-TTg by the Prime Minister. Mangrove area in the Mekong Delta divided into three zones: (i) Full Protection zone; (ii) buffer zone; and, (iii) Economic zone. The full protection zone is for coastal protection and the buffer zone is for controlled economic activities 40% by area, but the remaining 60% forest cover is the economic zone where there are no forest conservation restrictions. The Government has also enacted a 500 - 1000 m wide green belt for full protection zone along the Mekong Delta for storm and flood protection.

As a part of the Program 327, mangrove-shrimp culture has been promoted from 1992. Although the Program 327 was terminated in 1998, it was replaced to Program 661 and promotion of mangrove-shrimp culture has been continued.

Maximum allocated area for mangrove-shrimp culture is 20 ha for households and 30 to 50 ha for other organizations depending on the approval of the authority. The actual average farm area is 4.7 ha/household.

According to DRAD Bac Lieu, person who started the mangrove-shrimp culture under this program can receive following supports from the Government.

- Technical training
- Land lease with low rental fee
- Loan with the condition of ;
  interest 0.2 to 0.3 % per year
  repayment period 3 years
  loan ceiling 30 million VND

2.3 Marketing

Since production volume from an extensive farm is small, extensive farms sell their products to middleman. Then the middleman sells accumulated shrimps to processing factories. Basically, there is no credit tied between middleman and shrimp farmers. In case of intensive farms, they sell their products to the processing factories directly. An intensive farm in Ca Mau is a member of shrimp farmers' cooperative, and they do cooperative shipment. There is also intensive farm that makes contract with processing factories. The shrimp farm receives financial support from the processing factories in terms of seed, feed, and other kinds of materials, and the shrimp farm is obligated to sell their products to the processing factory.

Since all products are exported to international market, a processing factory interviewed by the Project introduced Global GAP for quality control, and shrimp farms making contract with the processing factory also should follow the Global GAP procedure.

Due to insufficient supply of shrimp from the shrimp farms, many processing factories use imported shrimp which price is lower than farm gate price of local shrimp in the Mekong Delta. Accordingly, farm gate price of shrimp has been decreased due to price competition between shrimp farms in Mekong Delta Area and imported shrimp from Thailand and India, etc.

2.4 Shrimp Diseases

2.4.1 Diseases Outbreak in Mekong Delta Area

According to Network of Aquaculture Centres in Asia-Pacific (NACA)[5], white spot disease (WSD) and acute hepatopancreatic degenerative necrotic syndrome (AHDNS) were reported every month from October 2011 and June 2012 by the shrimp farms in Mekong Delta Area. WSD shows medium to high mortality rate, 100% within 10 days in some cases. Early harvest or disposal of cultured shrimp and sterilization of ponds using $CaCO_3$ or $CaCl_2$ is only the effective countermeasures of WSD. WSD cases were reported from Ca Mau only during the fourth quarter of 2011, but it was spread to Ben Tre, Tien Gang, Kien Gang and Ca Mau provinces in the first quarter of 2012.

AHDNS is a disease causing mass mortality at 20 to 30 days post stocking in both black tiger shrimp and white leg shrimp under intensive and semi-intensive farming system. AHDNS has been epidemic in the Mekong Delta Area since March 2011 but pathogen(s) have not been confirmed yet as of end 2012. According to NACA, AHDNS cases were also reported from main China (2009), Malaysia (2011) and Thailand (2012).

In Mekong Delta Area of Vietnam, Department of Animal Health reported in June 2011 that mass mortality of black tiger shrimp and white led shrimp occurred in 51,928 ha of shrimp farming area out of 566,189 ha (total shrimp farming area of 7 coastal provinces of Mekong Delta i.e. Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu and Kien Giang). WSD cases reported in 621 ha out of 51,928 ha, and remaining areas were infected with AHDNS. It is also reported that 19,349 ha out of 25,447ha shrimp farming area (76%) was damaged in Soc Trang province. As same as WSD, there is no countermeasure for AHDNS. Shrimp firms had harvested or disposed all shrimps when they found AHDNS and sterilized ponds.

The Project carried out a interview survey for confirming the disease situation in Ca Mau, Soc Trang, Bac Lieu and Ben Tre in November 2012. According to DARD Ca Mau, shrimp farms in Ca Mau did not have serious damages by AHDNS since most of shrimp farms in Ca Mau are extensive farms. In contrast, it was reported mass mortality of shrimp in Bac Lieu and Ben Tre. An intensive shrimp farm in Bac Lieu explained that their annual production volume was reduced to 30% in 2012.

Thus, many intensive farms have postponed activities due to lack of funds for reinvestment. An intensive In Ben Tre also explained that their annual production in 2011 was dropped to 50%, and production in 2012 is worse than 2011. Since many shrimps were harvested in early stages when disease was observed, these shrimp could be sold to local market but not for processing companies due to smaller size. Therefore, the farm gate price was also lower than the case selling to the processing factories.

Due to serious damages in shrimp culture sector in South East Asia, a conference about AHDNS was held at Bangkok, Thailand on 10th August 2012 in cooperation with NACA and Australian Department of Agriculture, Fisheries and Forestry. Number of shrimp culture experts and regional agencies participated the conference but the conference was closed without any conclusion about pathogen of AHDNS.

[5] Quarterly Aquatic Animal Disease Report (Asia and Pacific Region), October –December 2011, January – March 2012, and April – June 2012, NACA & FAO

2.4.2 Capacity of DARD Laboratories

All hatcheries are obligated to pass the disease test by DARD laboratories before selling the seed. Laboratories under DARD check 6 virus (White Spot Syndrome Virus: WSSV, Yellow head virus / gill-associated virus: YHV/GAV, Monodon Bacuro Virus: MBV, Infectious Hypodermal and Hematopoietic Necrosis Virus: IHHNV, Infectious myonecrosis virus: IMNV, and Taura syndrome virus: TSV) which made serious damages in the area.

Table 2.4.1 Number of Disease Investigation Laboratories and Hatcheries in the Provinces

Province	Nos. of laboratories	Nos. of hatcheries	Note
Ca Mau	3	867	N.A.
Bac Lieu	2	196	Analytical capacity of laboratory is about 200 sample / day. The laboratories provide services based on the farmer7s requests, but could not cover the seed check from hatcheries.
Soc Trang	2	100	Analytical capacity of laboratory is about 200 sample / day.
Ben Tre	2	59	Analytical capacity of 2 laboratories is 8,000 sample / year.

Source: Results of field survey, JICA Project Team (2012)

As the results of household survey shown in “3.1”, 240 interviewees out of 273 (88%) purchased seed from private companies and 182 interviewees out of 240 purchased certified seed. But 58 interviewees (28%) purchased seed without the certificate of DARD laboratories. In total, 74 interviewees out of 240 (27%) purchased non certified seed from the seed suppliers (see Table 2.5.2).

Table 2.4.2 Type of Seed supplier and Quality of Seed

Unit: Nos. of interviewees

Type of supplier	Certified	Not certified	Total
Private company	182	58	240
Cooperative	10	3	13
Public organization	4		4
NGO			0
Other farmers	2	9	11
Others	1	4	5
Total	199	74	273

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

Actually, some small scale shrimp farmers purchase seed from retail shops / middleman nearby their farms. In this case, the middleman purchases post larvae (PL) 10 from hatchery and sell PL 14-18 after keeping the seed for few days in the nursling ponds. Since disease investigation certificate is valid for 2 days only, shrimp farmers need additional disease investigation of seed for ensure the seed condition when they purchase seed from the retail shops / middleman. Thus, workload of DARD laboratories (necessary number of investigation) is increased if shrimp farmers purchase seed from retail shops / middleman

Analytical capacity of DARD laboratories is also different among provinces. DARD in Ben Tre announced the results of disease investigation with the name of hatcheries, date of investigation, expired date of the certificate, amount of seed certified, etc. on their internet home page. DARD in Ben Tre also conducted disease investigation for retail seed shop and the results are also announced on their home page.

In contrast, some provinces reported that they conducted disease investigation mainly by visual due to

budget limitation. Although some viral disease such as white spot, yellow head, Taura could not be investigated by visual investigation, certificate was issued from the DARD. Shrimp farmers can request DARD laboratories to conduct PCR test for viral investigation. But shrimp farmers have to pay the cost for this service.

Although there are gaps in terms of service quality and analytical capacity of the laboratories among provinces, disease inspection of seed contributes to improve the seed quality. In case of Bac Lieu province, there were about 5,739 million seeds produced in the province and another 22,362 million seeds (including 2,362 million of nauplius) transported from outside of the province investigated by the DARD laboratories during 1st January 2012 to 28th October 2012. As a result, 27.5 million post larvae were detected to have parasite infection and luminous bacteria disease, 18.7 million post larvae were treated and 8.8 million post-larvae infected with luminous bacteria were disposed.

Therefore, these gaps should be rectified through the improvement of disease investigation system in the provinces for ensuring the sustainable development of shrimp culture.

Although it was not pointed out by Vietnamese stakeholders during the interview survey, it was confirmed that no appropriate institute exists in the area for checking drag resistance bacteria as a part of disease control system. An intensive shrimp farm in Ben Tre dosed antibiotics in line with manual but without any test for drag resistance. Drag resistance test is in fact required before dosage the drags for avoiding generation of drag resistance strains and utilizing medicines appropriately. However, DARD laboratories in Mekong Delta Area do not provide any service for drag resistance test since the laboratories do not have enough capacity for providing drag resistance test for shrimp farms in the area.

CHAPTER 3 SHRIMP CULTURE HOUSEHOLD SURVEY

The Project carried out household surveys twice. First survey which covered all sectors including agriculture, aquaculture and livestock was held from November 11 to 17, 2011, and second survey for shrimp culture was conducted from March 5 to 7, 2012.

3.1 Household survey in 2011

3.1.1 Outline of the Survey

1) Surveyed Area

The surveyed areas are summarized in Table 3.1.1. As shrimp production areas, Soc Trang and Ca Mau provinces have been covered. Bac Lieu province was seen as shrimp production and area for the combination of shrimp-paddy production.

Table 3.1.1 Surveyed Area and Number of Survey Samples by District

Province	District	Commune	No. of Samples	Major Feature	Date of Interview	Sample ID
Ben Tre	Ba Tri	An Binh Tay	38	Paddy	Nov.11	1-38
Ben Tre	Giong Trom	Thuan Dien	42	Fruits	Nov.10	39-80
Tra Vinh	Cang Long	Huyen Hoi	30	Paddy	Nov.12	81-110
Soc Trang	Vinh Chau	Vinh Hai	21	Shrimp	Nov.17	111-132
Bac Lieu	Phuoc Long	Phuoc Long	41	Shrimp/ Shrimp-Paddy	Nov.16	133-173
Ca Mau	Cai Nuoc	Tran Thoi	39	Shrimp	Nov.15	174-212
Total			211			

Source: Questionnaire Household Survey, JICA Project Team (2012)

2) Years of Experience in Shrimp Culture

There were a total of 96 valid responses to the year of experiences in shrimp culture except Ba Tri and Cang Long (Ben Tre) where shrimp culture is not done. On average, the respondents have 10 years of experiences ranging from one year up to 28 years (Table 3.1.2). This tendency is quite the same among the listed four districts: 10-11 years of experiences on average.

Table 3.1.2 Years of Experience in Shrimp Culture

Distric	No. of Responses	Average	Max	Min
Ba Tri				
Cai Nuoc	39	11.1	28	1
Cang Long				
Giong Trom	18	10.1	12	4
Phuoc Long	17	10.1	12	4
Vinh Chau	22	11.5	28	2
Grand Total	**96**	**10.8**	**28**	**1**

Source: Questionnaire Household Survey, JICA Project Team (2012)

To clarify, frequency of responses by years of experience in shrimp culture is shown in Figure 3.1.1. Among a total of 96 responses, 55 responses were within a range of 11-15 years, which was followed by 6-10 years with 26 responses. This result is in line with the trend of shrimp production in the nation; as summarized in Figure 2.1.3, the production of shrimp had increased since the late 90's.

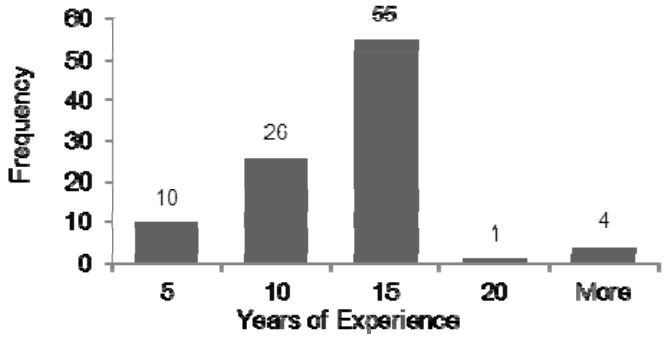


Figure 3,1,1 Frequency of Responses to the Years of Experience in Shrimp Culture
Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- An average year of experience in shrimp culture was 10.8 years, ranging from one to 28 years.
- The most frequent year of experience was in a range of 11-15 years having 55 responses, which is in line with the national trend of shrimp production that had increased since the late 90's.

3.1.2 Intensity of Shrimp Culture

Table 3.1.3 summarizes the number of responses to each of four types of intensities in shrimp culture: extensive, semi-extensive, semi-intensive, and intensive cultures. Of a total of 80 responses, 45 respondents or 56% of the total responses do extensive culture, which is followed by intensive culture with 17 responses (21%), and then semi-intensive culture (12 responses, 15%). By district, 30 out of 38 (79%) respondents were doing extensive culture in Cai Nuoc (Ca Mau), while the respondents in other districts were scattered to different systems (data size quite limited though).

Table 3.1.3 Years of Experience in Shrimp Culture

Distric	Extensive	Semi-extensive	Semi-intensive	Intensive	Total
Cai Nuoc	30	1	0	7	38
Phuoc Long	8	0	6	1	15
Vinh Chau	7	5	6	9	27
Total	**45**	**6**	**12**	**17**	**80**
	56%	**8%**	**15%**	**21%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: For the districts not listed in the table, there were no data available.

Short Summary

- On average, 56% of the respondents are doing extensive culture and 21% are for intensive culture.
- In Cai Nuoc (Ca Mau), 79% of respondents were concentrated to extensive system.

3.1.3 Types of Aquaculture Commodities by District

Table 3.1.4 shows types of aquaculture commodities by district derived from the result of the questionnaire. There were a total of 70 valid responses for brackish culture, of which 35 responses were given to brackish shrimp and 27 to prawn. Generally, brackish shrimp is the major commodity in Cai Nuoc (Ca Mau), while prawn shares the majority in Vinh Chau (Soc Trang).

For fresh water culture, on the other hand, there were only nine responses in Phuoc Long and Vinh Chau together. There were three types of commodities listed: crayfish, freshwater shrimp and green foot shrimp. However, as the numbers of responses were limited, no clear trend of production was observed.

Note: Following answers were collected through the free-answer questions and the names of commodities are based on the answers from respondents; there is a possibility that "shrimp" and "prawn" listed here are essentially the same.

Table 3.1.4 Types of Aquaculture Commodities by District

District	Brackish Culure				Freshwater Culture				
	B-shrimp	prawn	Others	Total	Crayfish	F-shrimp	Green foot	Others	Total
Cai Nuoc	31	8		39					
Phuoc Long		3	8	11	1		1	5	7
Vinh Chau	4	16		20		2			2
Grand Total	**35**	**27**	**8**	**70**	**1**	**2**	**1**	**5**	**9**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Crustaceans (both brackishwater shrimp and prawn) is the major commodity in Cai Nuoc and Vinh Chau.
- No clear trend was confirmed for freshwater aquaculture due to the limited number of responses.

3.1.4 Number of Harvest

The numbers of harvests per cultivation and per year are summarized from Table 3.1.5 to Table 3.1.7 for shrimp culture in brackish water environment. First, Table 3.1.5 shows the number of harvest per cultivation by commodity. On an average of a total of 61 valid responses, shrimp are harvested 9.7 times per cultivation, ranging from 5.6 times for intensive to 13.3 times for semi-extensive. This result showed a tendency that the more extensive the system is, the more the number of harvest per cultivation. Among the type of shrimps, number of harvest per cultivation is significantly higher for the category of “brackish shrimp” (14.6 times) as compared to prawn (6.2) and others (not specified)[6].

Table 3.1.5 Number of Harvest per Cultivation by Commodity (Brackish)

Unit: Number

Intensity	B-shrimp		Prawn		Not Specified		Total	
	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples
Extensive	16.5	17	15.0	7	2.2	6	12.0	30
Improved-Extensive	1.0	1	6.8	4			13.3	5
Semi-intensive	1.0	2	1.4	5	5.0	1	7.9	8
Intensive	16.0	7	1.3	8	5.0	1	5.6	16
Total	**14.6**	**27**	**6.2**	**24**	**2.9**	**8**	**9.7**	**59**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: The data for “not specified” are separately calculated based, by which the resulted total-average became slightly different between the tables here and below.

Table 3.1.6 summarizes the number of harvest per cultivation by district. First of all, there was a significant difference between Cai Nuoc district and other districts; the numbers of harvest in Cai Nuoc reached 17.3 times, while they were only 2.8 times and 1.2 times for Phuoc Long and Vinh Chau respectively. It is in line with the above result that the number of harvest for brackish shrimp is a lot more than the others (Table 3.1.5) and the brackish shrimp was dominant in Cai Nuoc (Table 3.1.4).

[6] Note, however, that the numbers for both extensive and intensive culture for brackish shrimp were extremely higher than other two categories, implying respondents’ potential misunderstanding of the question. Thus, the figures described in this section need to be further clarified by an independent survey.

Table 3.1.6 Number of Harvest per Cultivation by District (Brackish)

Unit: Number

Intensity	B-shrimp		Prawn		Not Specified		Total	
	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples
Extensive	17.4	22	2.2	6	1.5	2	13.3	30
Improved-Extensive	24.0	1			1.0	4	5.6	5
Semi-intensive			3.5	2	1.2	6	1.8	8
Intensive	16.0	7	5.0	1	1.3	8	7.9	16
Total	**17.3**	**30**	**2.8**	**9**	**1.2**	**20**	**9.6**	**59**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Lastly, number of harvest per year was estimated based on the number of harvest per cultivation and the number of cultivation per year, which is summarized in. Basically, as the number of harvest per cultivation for brackish shrimp was far big, number of harvest per year also resulted in big amount, 90.7 times. On average of all the commodities, then, the number of harvest per year reached 55.7 times based on a total of 56 valid responses.

Table 3.1.7 Number of Harvest per Year by Commodity (Brackish)

Unit: Number

Intensity	B-shrimp		Prawn		Not Specified		Total	
	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples
Extensive	101.1	17	86.1	7	5.3	4	83.7	28
Improved-Extensive	1.0	1	1.0	3			1.0	4
Semi-intensive	1.0	2	2.2	5	10.0	1	2.9	8
Intensive	104.0	7	1.5	8	10.0	1	46.9	16
Total	**90.7**	**27**	**27.3**	**23**	**6.8**	**6**	**55.7**	**56**

Source: Questionnaire Household Survey, JICA Project Team (2012)

In addition, the numbers of harvest per cultivation and per year for freshwater culture are summarized as tables below only for reference, as the number of responses to each item is quite limited.

Table 3.1.8 Number of Harvest per Cultivation by Commodity (Freshwater)

Unit: Number

Intensity	F-shrimp		Green foot shrimp		Not Specified		Total	
	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples
Extensive					18.5	2	18.5	2
Improved-Extensive	1.0	1					1.0	2
Semi-Intensive	1.0	1			3.5	2	1.0	1
Intensive			1.0	1	1.0	1	2.7	3
Total	**1.0**	**2**	**1.0**	**1**	**9.0**	**5**	**6.0**	**8**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Table 3.1.9 Number of Harvest per Cultivation by District (Freshwater)

Unit: Number

Intensity	Phuoc Long		Vinh Chau		Total	
	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples
Extensive	18.5	2			18.5	2
Improved-Extensive			1.0	1	1.0	1
Semi-intensive	2.7	3			2.7	3
Intensive			1.0	2	1.0	2
Total	**9.0**	**5**	**1.0**	**3**	**6.0**	**8**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Table 3.1.10 Number of Harvest per Year by Commodity (Freshwater)

Unit: Number

Intensity	F-shrimp		Green foot shrimp		Not Specified		Total	
	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples	Average	No. of Samples
Extensive					37.0	3	37.0	3
Improved-Extensive	1.0	1					1.0	1
Semi-Intensive	1.0		1.0	1	6.0	2	4.3	3
Intensive		1					1.0	1
Total	**1.0**	**2**	**1.0**	**1**	**21.5**	**5**	**12.7**	**8**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- The result in averaged numbers of harvest per cultivation and per year seemed far bigger than what was interviewed through unstructured interviews by the Project team. Therefore, independent survey is required for clarification.
- With that condition, an average number of harvest per cultivation was 9.7 times, of which it was significantly big for brackish shrimp culture especially in Cai Nuoc of Ca Mau.
- For freshwater culture, no clear trend was observed as the number of sample is too small.

3.1.5 Intensity of Post Larvae Released in the Pond

Intensity of post larvae released to the shrimp pond is summarized by the intensity of shrimp culture as shown in Table 3.1.11. On an overall average, 9.5 post larvae per square meter are released in the pond, ranging from 1.7 for "not specified" to 16.6 for semi-intensive culture. According to the Research Institute for Aquaculture No.2, 10 to 20 post larvae per square meter is recommended for intensive culture of black tiger, and it is also well known that around four post larvae per square meter is prevailing in the Mekong Delta—the result is almost in the range of those common practices: 5.6 post larvae for extensive and around 15 for semi-extensive to intensive cultures.

Data on the number of post larvae releasing per year became also available with a total of 74 valid responses. On an overall average, post larvae are released 4.8 times per year, ranging from 2.8 for semi-extensive to 6.3 times for extensive. According to the output, the number of releasing for extensive culture is relatively larger than others.

Table 3.1.11 Intensity of Post Larvae Released and Number of Release per Year

Intensity	Average Intensity (No./m2)	No. of Samples	No. per Year (times/year)	No. of Samples
Extensive	5.6	36	6.3	37
Improved-Extensive	15.8	6	2.8	6
Semi-intensive	16.6	8	2.3	11
Intensive	13.4	17	3.8	17
Not Specified	1.7	3	5.3	3
Total	**9.5**	**70**	**4.8**	**74**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Note: Basically, large size shrimps are harvested by trap intermittently (once or twice per month) and then post larvae are released into ponds in case of extensive and improved-extensive culture. Post larvae are released almost every month and shrimps are kept in the pond through the year. In contrast, intensive and semi-intensive culture harvest all shrimp at the end of culture period although large size shrimps may be thinned out during culture period. In this case, post larvae are released into pond only one time when shrimp culture started.

Considering the above, thus, result summarized in this table does not probably reflect the actual

situation, attributing to misunderstanding of the question or inapplicability of the question across the types of cultivation method.

3.1.6 Institutions Where to Obtain Post Larvae

As shown in Table 3.1.12, 56 respondents, 67% of the total number of valid responses (84), obtain post larvae from private company (shops), 17% from other farmers, and 14% from cooperative. There were no respondents who obtain it from either public organization or NGOs. According to the Research Institute for Aquaculture No.2, the institute recommends fish folks to purchase relatively a large quantity of post larvae by group and share them among the group members so that the group can ask public institutes for inspection of the post larvae, by which infected post larvae can be avoided. Given the fact, the item of "other farmers" may reflect the group purchasing of post larvae. To be sure, all the responses for freshwater culture were given to "private company" too (eight responses).

Table 3.1.12 Institutions where to Obtain Post Larvae (Brackish)

Intensity	Private Company	Other farmers	Cooperative	Public organization	NGO	Others	Total
Extensive	26	9	12			2	49
Improved-Extensive	4	1					5
Semi-Intensive	12						12
Intensive	12	4					16
Not Specified	2						2
Total	**56**	**14**	**12**			**2**	**84**
	67%	**17%**	**14%**			**2%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

3.1.7 Frequency of Renewing Post Larvae

The respondents renew post larvae once in a while. As shown in Table 3.1.13, the most common frequency in renewing post larvae was every time of cultivation with 37 responses or 51% of a total of 73 valid responses. As Table 3.1.12 suggests, post larvae are released on average 4.8 times a year. Thus, it is reasonable to believe that majority of the respondents renew, or newly purchase, post larvae and release them. However, there were also some respondents who had not renewed their post larvae in the past five years, implying that they continue using offspring of the shrimps they cultivate[7].

Table 3.1.13 Frequency of Renewing Post Larvae

Intensity	Every culture	Every 1-2 year	Every 3-5 years	No in last 5 years	Total
Extensive	16	9		13	38
Improved-Extensive	2			3	5
Semi-Intensive	5		1	4	10
Intensive	11	2		4	17
Not Specified	3				3
Total	**37**	**11**	**1**	**24**	**73**
	51%	**15%**	**1%**	**33%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Note: As mentioned in "3.1.5", answers about frequensy / number of releasing post larvae do not prpbably reflect the actual situation.

3.1.8 Trend of Shrimp Price

Figure 3.1.2 shows the trend in the average price of shrimp from year 2002 to 2010 both as nominal

[7] Some inconsistency is observed in the numbers among cultivations, harvests, and renewal of larvae.

value of each year and as the value of year 2000 adjusted by the national inflation rate for consumer price index[8]. As shown in the figure, nominal price has remained the same level since 2002 and hiked up in 2010 and 2011, which generally shows slightly increasing trend as a whole.

However, with the adjusted price with the value of year 2000, the price has continued decreasing except the year 2010 when the average price increased from 61,388 VND/kg to 83,075VND/kg. Thus, the overall actual price of shrimp experienced basically a decreasing trend.

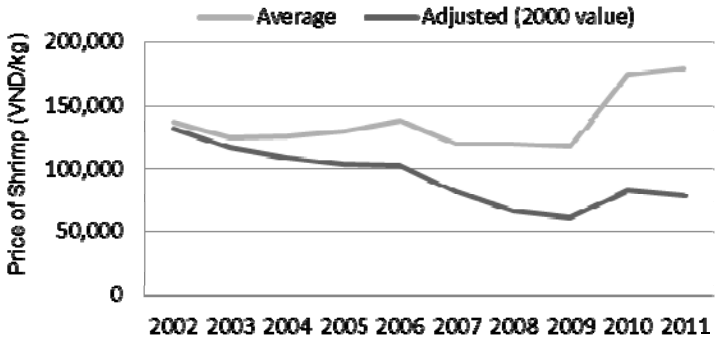


Figure 3.1.2 Trend of Shrimp Price (2002-2011)

Source: Questionnaire Household Survey, JICA Project Team (2012)

The frequency of the responses to the price data is also summarized in Table 3.1.14 in which the largest frequency is colored in each year. In the table, average price, median price, and actual price with the value of year 2000 are also indicated. As the table summarizes, the most frequent value has once increased (lowered in the table) during the mid 2000's, decreased (raised in the table) during 2007-2009, and then increased again in 2010. The period of decrease in 2008 is the time of financial crisis in the US and Europe, and therefore the decrease seemed to have been caused by the lack of demand.

Table 3.1.14 Frequency of Responses to Price of Shrimp

Range	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
50,000	0	0	1	1	0	0	0	0	0	0
75,000	2	0	0	0	1	2	5	3	0	0
100,000	4	4	2	1	0	3	4	7	5	2
125,000	2	1	1	1	0	4	0	4	7	1
150,000	3	3	3	4	4	2	4	3	9	6
175,000	2	1	1	1	2	0	0	0	2	4
200,000	4	1	1	1	1	3	3	3	16	19
225,000	0	0	0	0	0	0	0	1	3	2
250,000	1	0	0	0	0	0	1	0	8	5
More	0	0	0	0	0	0	0	0	3	0
Average	136,944	125,000	125,556	130,000	138,375	119,429	120,000	117,762	174,038	179,590
Median	135,000	120,000	130,000	140,000	140,000	115,000	100,000	105,000	180,000	180,000
No. of sample	18	10	9	9	8	14	17	21	53	39
Inflation Rate	4.08	3.30	7.90	8.39	7.50	8.35	23.12	6.72	9.21	9.21
Value of 2000	131,987	116,623	108,569	103,707	102,684	81,795	66,756	61,388	83,075	78,498

Source: Questionnaire Household Survey, JICA Project Team (2012)

The price of shrimp changes monthly too. As shown in Table 3.1.15, average price of shrimp hits the bottom during January-February and reaches the highest during May-June. Setting January-February as 100, the price during May-June is at a level of 104. To see the trend of demand-supply, the number of samples given to each month is shown in Table 3.1.16. Although this result does not necessarily reflect the exact intensity of the trade in each season, number of responses in each month could

[8] http://www.indexmundi.com/vietnam/inflation_rate_(consumer_prices).html

somehow imply the significance of marketing shrimps in each month.

In this regard, the number of responses reached the highest (185) in November-December when the level of price remains still the 102 point. After that, the level of price decreased to 100 due probably to the increased supply. Therefore, for the fish folks who sell shrimps in January-February, it is difficult to enjoy the high price.

Table 3.1.15 Average Price of Shrimp by Month

Type of Shrimp	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec
B-shrimp	180,263	185,000	184,643	189,643	191,467	190,586
prawn	184,875	193,333	223,333	189,375	182,000	183,313
Not Specified	185,000	200,000	170,000	175,000	174,000	181,875
Total	**182,242**	**187,222**	**189,211**	**188,333**	**186,080**	**186,393**
	100	**103**	**104**	**103**	**102**	**102**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Table 3.1.16 Number of Samples for the Price of Shrimp by Month

Type of Shrimp	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec
B-shrimp	19	14	14	14	15	29
prawn	8	3	3	8	5	16
Not Specified	6	1	2	2	5	16
Total	**33**	**18**	**19**	**24**	**25**	**61**
	100	**55**	**58**	**73**	**76**	**185**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Note: There are 2 major species cultured in Vietnam i.e. Black Tiger and White Leg Shrimp. Basically, farm gate price depends on the species and size of shrimps. However, as mentioned on "3.1.3", species were not clarified from their answers. In addition, shrimp size against the farm gate price was also not collected. Thus, data was analyzed without consideration of species and size of shrimps. The data is presented to show only the trend of price.

3.1.9 Trend in Size of Shrimp Pond

Table 3.1.17 summarizes the trend in size of shrimp pond per household from 2002 to 2011. The average size of the pond is generally larger for intensive system (more than five hectares) as compared to other systems (less than five hectares). On a simple average for the said period, size of pond for intensive culture resulted 9.12 ha, which is followed by semi-intensive (3.27), extensive (2.18), and semi-extensive (1.14). Also, while the sizes of the pond for other systems have remained at the same level, one for the intensive system has fluctuated a lot: once reached 14.24 ha/household in 2003 and then decreased to 5.07 ha/household in 2011. It probably reflects the "boom" of shrimp culture in Vietnam at the early 2000's.

Table 3.1.17 Size of shrimp Pond per Household

(ha/household)

Intensity	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Ave
Extensive	1.98	2.52	2.59	2.59	1.91	1.90	1.81	2.42	2.02	2.10	2.18
Semi-Extensive	1.07					1.00	1.41	1.26	1.06	1.06	1.14
Semi-Intensive	2.67	3.64	3.64	3.64	3.64	3.64	3.42	2.81	2.81	2.81	3.27
Intensive	5.12	14.24	11.98	11.53	13.00	8.14	8.14	8.14	5.82	5.07	9.12
Total	**2.74**	**6.03**	**5.95**	**5.80**	**5.58**	**4.70**	**4.08**	**3.86**	**3.05**	**2.98**	**4.48**

Source: Questionnaire Household Survey, JICA Project Team (2012)

3.1.10 Trend in the Loss of Shrimp by Type of Cause

Figure 3.1.3 and Table 3.1.18 summarize a trend in the loss of shrimp by types of causes: disease, low quality of post larvae, drought, saline, and flood. As shown in the figure, disease and low quality of post larvae share a considerable percentage of the causes, ranging from 68.0% of 2005 to 97.2% of 2008 and 2009 (Table 3.1.18). Based on this underlying trend of two major causes of losses, some other factor sometimes became pronounced. For example, drought shared 30.6% in 2005 despite the trend of lower share (less than 10%) in the rest of year.

Note that "low quality of post larvae" also appears as a form of infection of disease, implying that up to 77% of the loss would be possibly related to disease.

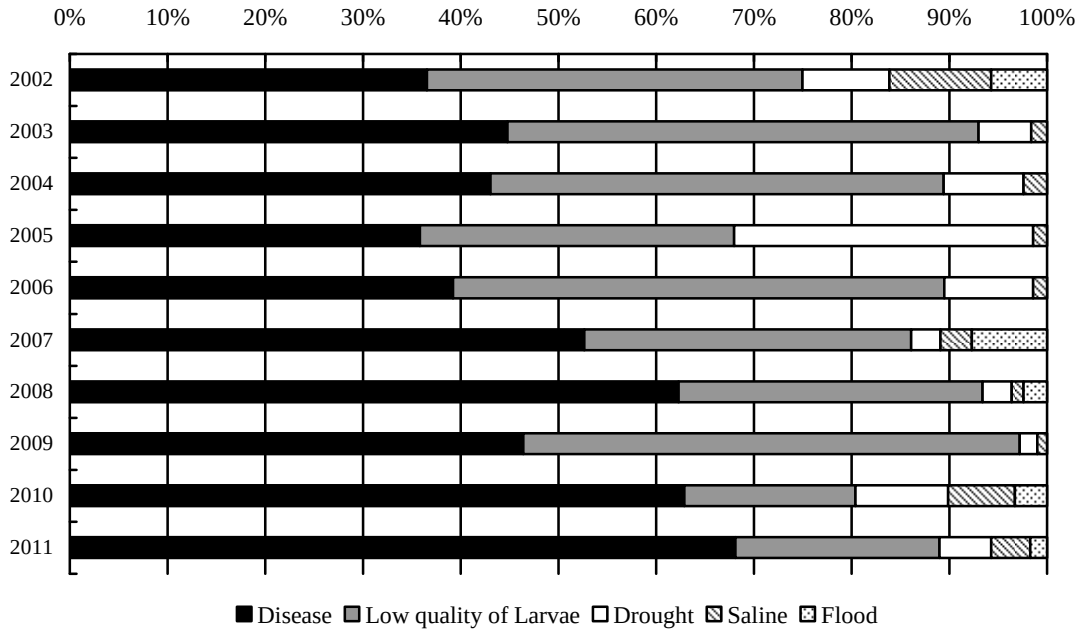


Figure 3.1.3 Trend in the Loss of Shrimp by Cause
Source: Questionnaire Household Survey, JICA Project Team (2012)

On the other hand, saline water kept lower share on average 3.1%, which marked more than 10% (10.4%) one time in 2002. There were also some incidents of loss by flood but only five times in the past 10 years. Thus, it is concluded that disease and low quality of post larvae are the most problematic problems in shrimp culture in the surveyed areas.

Table 3.1.18 Trend in the Loss of Shrimp by Cause (Share in %)

Years	Disease	Low quality of Larvae	Drought	Saline	Flood	Total	Disease+ Larvae
2002	36.5	38.4	8.9	10.4	5.7	100.0	74.9
2003	44.8	48.2	5.4	1.6	0.0	100.0	93.0
2004	43.1	46.4	8.2	2.4	0.0	100.0	89.5
2005	35.8	32.1	30.6	1.4	0.0	100.0	68.0
2006	39.2	50.3	9.1	1.4	0.0	100.0	89.5
2007	52.7	33.5	3.0	3.2	7.7	100.0	86.1
2008	62.3	31.1	3.0	1.2	2.4	100.0	93.4
2009	46.4	50.8	1.8	1.0	0.0	100.0	97.2
2010	62.9	17.5	9.5	6.8	3.3	100.0	80.4
2011	68.1	20.9	5.3	4.0	1.7	100.0	89.0
Average	**49.2**	**36.9**	**8.5**	**3.3**	**2.1**	**100.0**	**86.1**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Each figure shows the average of concerned households, in the year, who claimed any losses by percent, in which sum of losses of the household was set as 100% It means, each figure does not reflect the volume of losses each household incurred.

As background information, number of valid responses given to each factor is summarized in Table 3.1.19. Respondents who claimed "disease" reached 135 in total of 10 years, which accounts for 45% of all the responses, which is followed by low quality of post larvae (32%), and drought (15%). The least number was given to flood (10 responses). Except special case, flood is not a major cause of loss, but it should be noted that even flood occurs along coastal provinces if the conditions are met.

Table 3.1.19 Trend in the Loss of Shrimp by Cause (Share in %)

Years	Disease	Low quality of Larvae	Drought	Saline	Flood	Total
2002	19	17	10	6	4	52
2003	6	6	2	1	0	15
2004	4	4	2	1	0	11
2005	5	5	5	1	0	16
2006	6	7	3	1	0	17
2007	9	7	2	2	1	20
2008	10	7	2	1	1	20
2009	10	11	2	1	0	24
2010	29	14	9	4	2	56
2011	37	18	9	5	2	69
Average	**14**	**10**	**5**	**2**	**1**	**30**
Total	**135**	**96**	**46**	**23**	**10**	**300**
	45%	**32%**	**15%**	**8%**	**3%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

3.2 Household survey in 2012

3.2.1 Outline of the Survey

A household questionnaire survey had been carried out specifically for shrimp culture in a total of six villages (communes) of three provinces namely Ca Mau, Bac Lieu, and Soc Trang). Those locations were selected based on the suggestion from DARD of each province. The survey, hereinafter referred to as the "shrimp survey," had been carried out from March 5 to 7, 2012 and gained a total of 281 samples using a pre-structured questionnaire form. Particularly, the samples are composed of three major types of shrimp culture: 90 samples for extensive, 101 samples for semi-intensive, and 90 samples for paddy-shrimp rotation culture under an extension system. Outline of the survey is summarized in Table 3.2.1. The questionnaire format is attached as Attachment IV -A.

Figure 3.2.1 Location Map of Shrimp Survey
Source: JICA Project Team (2012)

Table 3.2.1 Outline of the Shrimp Survey (Interviewed)

Province	District	Village/	Type of Culture	System	Samples
Ca Mau	Phu Tan,	Phu Tan	Shrimp	Extensive	30
				Semi-intensive	40
		Phu My	Paddy-shrimp	Extensive	30
Bac Lieu	Gia Ra	Tan Phong	Shrimp	Extensive	30
				Semi-intensive	31
		Phong Thanh Ai	Paddy-shrimp	Extensive	30
Soc Trang	My Xuyen,	Ngoc Dong	Shrimp	Extensive	20
				Semi-intensive	30
		Hoa Tu 1	Paddy-shrimp	Extensive	30
			Shrimp	Extensive	10

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)
Note: Number of samples shows the originally counted numbers. There are actually some changes of categories after detailed data checking).

The number of samples obtained in the survey is shown in Table 3.2.2. After the detailed data check, the valid number of samples decreased to be a total of 270, composing of 90 for extensive, 89 for extensive (shrimp-paddy: SP), 30 for improved-extensive, 59 for semi-intensive, and 2 for semi-intensive (SP). As the number of semi-intensive (SP) was only two samples, this category is omitted from the forthcoming analysis discussed in this chapter.

Table 3.2.2 Number of Valid Samples by Intensity of Culture

Category	Shrimp	Shrimp & Paddy	Total
Extensive	90	0	90
Extensive (SP)	0	89	89
Improved Extensive	30	0	30
Semi Intensive	59	0	59
Semi Intensive (SP)	0	2	2
Total	**179**	**91**	**270**

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

3.2.2 Shrimp Production per Household

1) Area Cultured

To obtain area data for aquaculture, three types of questions were asked to the interviewees: 1) area of

farmland for aquaculture, 2) size of pond for aquaculture, and 3) size of pond assigned for the rotation of shrimp and paddy culture. First, Table 3.2.3 summarizes average sizes of farmland dedicated for shrimp culture per household by type of aquaculture. There were a total of 147 valid responses that maintained complete data for both farmland area and cost of production. As an overall average of all types of culture, area per household reached 2.1 ha/ha.

Of the total responses, 137 responses were given to brackish shrimp culture with the average size of 2.1 ha/household. For freshwater shrimp culture and the rotation of brackish and fresh cultures, responses were only three (1.7 ha/household) and seven (2.3 ha/household) respectively, suggesting that brackish shrimp culture is the most common system of shrimp culture in the surveyed area.

Table 3.2.3 Area of Farmland per Household by Type of Aquaculture

Category	Brackish		Fresh		Brackish and Fresh		Total Average	
	Area (ha/HH)	No. of Samples	Area (ha/HH)	No. of Samples	Area (ha/HH)	No. of Samples	Area (ha/HH)	No. of Samples
Extensive	4.5	14					4.5	14
Extensive (SP)	1.6	38	1.7	3	2.3	6	1.7	47
Improved Extensive	1.9	30					1.9	30
Semi Intensive	1.8	55			1.8	1	1.8	56
Average	**2.1**	**137**	**1.7**	**3**	**2.3**	**7**	**2.1**	**147**

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)
Note: Samples were selected only the ones which have cost data.

Then, Table 3.2.4 shows average sizes of shrimp pond, or size of net production area, used for brackish and freshwater shrimp culture. In fact, there was no significant difference between the size of farmland and the size of shrimp pond: the former was 2.1 ha/household, while the latter was 2.0 ha/household (96%). The biggest difference was found in freshwater shrimp culture (78%), which was followed by rotation of brackish and fresh water shrimp culture (87%). Yet, the size of pond for brackish culture reached 97% (2.0 ha/household), even implying misunderstanding of the question.

If “farmland” includes the dead space necessary for the proper management of shrimp culture, such as embankment of the pond, and “shrimp pond” is purely the size of water surface, there should be a certain differences between the two. As the lot percentage of freshwater culture was 78% and brackish-fresh culture was 87%, actual lot percentage can be assumed to be around 80%.

To be more precise, there were some differences among the different intensities of the culture. The biggest average size of pond was recorded for extensive culture, having 3.8 ha/household, although the number of responses was only 14 responses. On the other hand, size of shrimp pond for extensive under the shrimp-paddy rotation system was the smallest in the category of brackish culture: 1.5 ha/household with a total of 38 responses. Note that the size of shrimp pond is much bigger than the average size of farmland surveyed through another set of questionnaire survey (1.57 ha/household, see ANNEX III Agriculture and land Use). As for the data of pond size specifically asked for “shrimp-paddy” culture, no valid data was obtained and thus omitted from the analysis.

Table 3.2.4 Area of Shrimp Pond per Household by Type of Aquaculture

Category	Brackish		Fresh		Brackish and Fresh		Total Average	
	Area (ha/HH)	No. of Samples	Area (ha/HH)	No. of Samples	Area (ha/HH)	No. of Samples	Area (ha/HH)	No. of Samples
Extensive	3.8	14					3.8	14
Extensive (SP)	1.5	38	1.3	3	2.0	6	1.6	47
Improved Extensive	1.9	30					1.9	30
Semi Intensive	1.7	55					1.7	56
Average	**2.0**	**137**	**1.3**	**3**	**1.8**	**1**	**2.0**	**147**
Lot Percentage	**97%**		**78%**		**87%**		**96%**	

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)
Note: Samples were selected only the ones which have cost data, which is to be the basis of cost and benefit per area.

2) Gross Income from Shrimp Culture

Amount of production and gross income from shrimp culture became available for brackish culture (for fresh culture, however, enough number of responses was not obtained). As shown in Table 3.2.5, an average production of shrimp was found 768 kg/household with a total of 126 valid responses, ranging from 307kg/household for extensive (SP) to 1,030kg/household for semi-intensive cultures.

An average unit price was 158,000VND/kg, which ranges from 144,000VND/kg for semi-intensive to 183,000VND/kg for extensive cultures; the price for extensive system was higher than semi-intensive system. It was partly, if not all, caused by the size of shrimp. For extensive system, average number of shrimp per kg was 31 shrimps as compared to 40 shrimps for semi-intensive—size of individual shrimps is bigger than that of semi-intensive. Then, an average size of shrimp was found 35 shrimp/kg.

As a result, an average gross income reached 129,778,000VND/household (2.0ha/household) with a total of 126 valid responses, which actually ranges from 54,202,000VND/household for extensive (SP) to 187,057,000VND/household. Although the level of gross income for extensive culture is bigger than other categories, it basically attribute do the bigger size of its shrimp pond, 3.8 ha/household. In fact, an average gross income per hectare was for extensive system was not so much higher than the others. Instead, it was the highest for semi-intensive culture, 101,642,000VND/ha. As a total average of all categories, an average gross income per hectare reached 64,968,000VND/ha.

Table 3.2.5 Production and Gross Income from Brackish Shrimp Culture

Category	Brackish						
	Production (kg)	Unit Price (000VND/kg)	Size (shrimp/kg)	Gross Income (000VND)	No. of Samples	Area of Shrimp Pond (ha/HH)	Gross Income Per ha (000VND)
Extensive	981	183	31	187,057	14	3.8	48,950
Extensive (SP)	307	163	33	54,202	38	1.5	36,486
Improved Extensive	867	156	31	141,088	30	1.9	73,791
Semi Intensive	1,030	144	40	169,112	44	1.7	101,642
Total/Average	768	158	35	129,778	126	2.0	64,968

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

Another set of data is also available for those who are doing “unstructured” system in which shrimps are not harvested on schedule but small numbers of shrimps are frequently and occasionally harvested. In fact, this type of arrangement was considered as “extensive” system when the questionnaire was prepared. But, there were a number of respondents who answered both to the above mentioned question items (Table 3.2.5) and the question items shown as Table 3.2.6 for reference.

As shown in the table, frequency of harvest was recorded to be an average of 27 times per year for extensive culture, yet the number shown in extensive (SP) system was not available due to low data

validity. The size of shrimp was averaged to be 37 shrimp/ kg, fairly same level as the ones shown in. Table 3.2.6.Then, an average gross income reached 86,617,000VND/household, which accounts for 67% of the gross income under a more structured management system summarized in Table 3.2.6.

Table 3.2.6 Gross Income from Brackish Shrimp Culture (Unstructured System)

Category	Gross Income of Extensive Brackish Shrimp Culure						
	Frequency (times)	Unit Price (000VND/kg)	Size (shrimp/kg)	Gross Income (VND)	No. of Samples	Area of Shrimp Pond (ha/HH)	Gross Income Per ha (000VND)
Extensive	27	158	34	85,771	69	3.8	22,445
Extensive (SP)		157	41	87,859	47	1.5	59,142
Total/Average		**158**	**37**	**86,617**	**116**	**1.5**	**58,306**

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

3) Production Cost

Cost of brackish shrimp culture is summarized in Table 3.2.7. As shown in the table, an average cost of shrimp production was found 56,424,000VND/household for a pond size of 2.0 ha/household. It actually ranged from 15,506,000VND/household for extensive (SP) to 82,543,000VND/household for semi-intensive culture. Among all the main cost items, the biggest portion was shared by food, which was followed by seed (post larvae) and others (20%). Note that, however, a couple of samples accounted all the cost for "others" as some shrimp farmers could not specify the cost items, leading the average cost of "others" to be bigger than it actually is.

In terms of the cost per unit area, the total average reached 28,246,000VND/ha, ranging from 10,438,000VND/ha for extensive (SP) to 49,611,000VND/ha for semi-intensive. In general, the more the intensity of the system is, the higher the cost of production is.

Table 3.2.7 Cost of Production for Brackish Shrimp Culture

Category	Cost of Extensive Brackish Shrimp Culture (000VND)										
	Seed	Medicine	Food	$CaCO_3$	Labor	Fertilizer	Others	Total	No. of Sample	Shrimp Pond (ha/HH)	Cost Per ha
Extensive	9,400	10,471	42,979	1,807	6,514	1,271	2,171	74,614	14	3.8	19,525
Extensive(SP)	7,028	716	3,113	1,259	1,559	1,057	775	15,506	44	1.5	10,438
Improved-extensive	13,303	2,867	32,183	2,237	5,633	1,400	1,567	59,191	30	1.9	30,957
Semi-Intensive	12,853	18,944	19,503	1,316	1,500	2,043	26,384	82,543	56	1.7	49,611
Total/Average	10,831	9,201	19,419	1,538	2,867	1,533	11,035	56,424	144	2.0	28,246
	19%	16%	34%	3%	5%	3%	20%	100%			

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

Same as gross income, another set of data is available specifically for the extensive system. As shown in Table 3.2,8, an average cost of brackish shrimp production under extensive systems was 38,037,000VND/household. Different from the above table, cost of extensive (SP) was higher than extensive culture, to which medicine attributed a lot.

Table 3.2.8 Cost of Production for Extensive Brackish Shrimp Culture

Category	Cost of Extensive Brackish Shrimp Culture (000VND)										
	Seed	Medicine	Food	$CaCO_3$	Labor	Fertilizer	Others	Total	No. of Sample	Shrimp Pond (ha/HH)	Cost Per ha
Extensive	10,834	2,801	12,360	2,523	1,745	728	1,543	32,534	75	3.8	8,514
Extensive(SP)	10,203	14,563	14,496	4,800	1,489	1,748	118	47,417	44	1.5	31,919
Total/Average	10,601	7,150	13,150	3,365	1,650	1,105	1,016	38,037	119	1.5	25,605
	28%	19%	35%	9%	4%	3%	3%	100%			

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

3) Net Income from Shrimp Culture

Based on average gross income and cost of production for brackish shrimp culture, net income is

estimated (Table 3.2.9). First, net income per household is summarized on the left side of the table, and net income per hectare is shown on the right side of the table. An averaged net income per household was found 73,354,000VND/household (2.0ha/household), which account for US$3,540 at a current exchange rate of 20,721.22VND/US$.

The net income was ranging from 38,696,000VND/household (US$1,867) for extensive (SP) culture to 112,443,000VND/household (US$5,426) for extensive culture. Since the net income of extensive (SP) is just a part of total income (additional income is expected from paddy cultivation), it is natural to be lower than the others.

In terms of net income per hectare, the total average reached 36,722,000VND/ha, or US$1,772/ha. It ranged from 26,048,000VND/ha (US$1,257) for extensive (SP) to 52,031,000VND/ha (US$2,511). Furthermore, real benefit of brackish shrimp culture was estimated as a simulation: benefit per land area in consideration with the loss of land area for embankment. Assuming the lot percentage of 80% (see Table 3.2.9 for the discussion of this ground), real net income can be expected to be 29,378,000VND/ha or US$1,418/ha.

Table 3.2.9 Net Income from Brackish Shrimp Culture

Category	Net Income per Household (000VND)				Net Income per Hectare (000VND)				(With Lot 80%)	
	Gross Income	Total Cost	Net Income	US$	Gross Income	Total Cost	Net Income	US$	Net Income	US$
Extensive	187,057	74,614	112,443	$5,426	48,950	19,525	29,425	$1,420	23,540	$1,136
Extensive (SP)	54,202	15,506	38,696	$1,867	36,486	10,438	26,048	$1,257	20,838	$1,006
Improved Extensive	141,088	59,191	81,897	$3,952	73,791	30,957	42,834	$2,067	34,267	$1,654
Semi Intensive	169,112	82,543	86,569	$4,178	101,642	49,611	52,031	$2,511	41,625	$2,009
Average	**129,778**	**56,424**	**73,354**	**$3,540**	**64,968**	**28,246**	**36,722**	**$1,772**	**29,378**	**$1,418**
	US$6,263	**US$2,723**	**US$3,540**		**US$3,135**	**US$1,363**	**US$1,772**			
Exchange Rate(VND/US$)		**20,721.22**								

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

Based on the gross income and production cost for the extensive system separately aggregated, net income of brackish shrimp culture was also estimated. As shown in Table 3.2.10, net income per household was averaged to be 48,580,000VND/household (US$2,344), which was composed of 40,442,000VND/household for extensive (SP) and 53,237,000VND/household (US$2,569). As per hectare, the average net income was estimated to be 32,701,000VND/ha or US$1,263—slightly lower than the total average estimated in Table 3.2.10.

Table 3.2.10 Net Income from Brackish Shrimp Culture (Extensive System)

Category	Net Inome per Household (000VND)				Net Inome per Hectare (000VND)				(With Lot 80%)	
	Gross Income	Total Cost	Net Income	US$	Gross Income	Total Cost	Net Income	US$	Net Income	US$
Extensive	85,771	32,534	53,237	$2,569	22,445	8,514	13,931	$672	11,145	$538
Extensive (SP)	87,859	47,417	40,442	$1,952	59,142	31,919	27,223	$1,314	21,778	$1,051
Average	**86,617**	**38,037**	**48,580**	**$2,344**	**58,306**	**25,605**	**32,701**	**$1,578**	**26,161**	**$1,263**
	US$4,180	**US$1,836**	**US$2,344**		**US$2,814**	**US$1,236**	**US$1,578**			
Exchange Rate (VND/US$)		**20,721.22**								

Source: Questionnaire Shrimp Survey, JICA Project Team (2012)

CHAPTER 4 DEVELOPMENT CONSTRAINTS

According to the stakeholders of shrimp farming in Ben Tre, Soc Trang and Bac Lieu province, following issues were listed up as development constraints for shrimp farming in Mekong Delta area.

4.1 Major Identified Constraints

4.1.1 Mass Mortality of Shrimps Due to Diseases

As mentioned in "2.4", many shrimp farms have been influenced by WSD and AHDNS since 2011 although the statistics prepared by General Statistics Office of Vietnam shows that production volume of cultured shrimp in 2011 was increased in each province located along the coastal area in Mekong Delta. Table 4.1.1 shows affected area of shrimp farms based on the information from DARD in each province.

Table 4.1.1 Affected area of shrimp farms by Province

Unit: ha

		2010	2011	2012[*1]
Ca Mau	Total affected area	16,335	21,527	17,593
	Mass mortality areas of intensive farms	237	491	930
Bac Lieu	Total affected area	N.A.	29,480[*2]	16,066
	Mass mortality areas of intensive farms	383[*3]	9,730[*2]	6,162
Ben Tre	Total affected area	N.A.	N.A.	N.A.
	Mass mortality areas of intensive farms	515	1,250	2,301
Soc Trang	Damaged area (Black Tiger)	8.092	31,070	N.A.
	Damaged area (White leg shrimp)	11	710	N.A.

Note: *1 Data up to October 2012
*2 Data on July 2010
*3 Data on June 2011

As the results of disease forecasting model in 2011 and 2012 in Bac Lieu, shrimp farming damaged due to white spot and yellow head disease accounted for very low percentage (2011: 14.3% of samples infected with white spot virus; 1.4% of samples infected with yellow head virus; 2012: 18.8% of samples infected with white spot virus; 5.4% of samples infected with yellow head virus), while acute hepatopancreas necrosis caused over 75% total area of damage. In addition, the results of tests implemented at people's request showed that 43.9% out of 23,951 test samples were MBV, 0.3% were white spot virus and 6.6% were yellow head virus.

In 2012, a total number of samples tested is 19.184, in which 41.6% has MBV, 17.7% has white spot virus and 1.1% has yellow head virus.

4.1.2 Downslide of Farm Gate Price

According to DARD, many processing factories were established in 2011 and 2012. However, shrimp production volume has not been increased so much due to epidemic of diseases. Therefore, some processing factories in Mekong Delta have imported inexpensive frozen shrimps as processing materials from neighboring countries such as Thailand and India. These factories also beat the farm gate price when they purchase shrimp from shrimp farms in Mekong Delta Area.

An intensive shrimp farm in Bac Lieu explained that farm gate price of White Leg Shrimp in 2012 was 134,000 to 139,000VND/kg (for 35 shrimp/kg) although they sold same size of White Leg Shrimp

with 165,000VND/kg in 2011. Paddy-shrimp farmers in Soc Trang also reported that farm gate price of Black Tiger (30 shrimp/kg) was decreased from 230,000 VND in 2011 to 120,000VND in 2012.

4.1.3 Insufficient Supply of Shrimp Seeds

According to RIA No.2, only 50% of shrimp seed consumed in Mekong Delta is produced at hatcheries in Mekong Delta Area, and remaining is transported from hatcheries in Central Vietnam such as Nhatrang, Bina Thuan and Ninh Thuan province.

DARDs in Ca Mau, Bac Lieu, Soc Trang and Ben Tre also explained that production capacity of hatcheries in the province could not meet demand of the seed. Therefore, some portion of seed is purchased from the hatcheries in Central Vietnam. Particularly, hatcheries in Ben Tre cover only 20% of seed demand in the province. So shrimp farms purchased seed from the hatcheries outside of the province. However, an intensive shrimp farm in Ben Tre explained that 10 to 20 % of seed from the Central Vietnam is dead before receiving since it takes 10 to 12 hours from the hatcheries in Central Vietnam to shrimp farms in Mekong Delta Area. Although the seed produced in Mekong Delta Area is more vigorous than the seed transported from Central Vietnam , they do not have any other alternative supply sources.

DARD Bac Lieu plans to establish 3 industrial zone for shrimp hatcheries for increasing seed production capacity in the province. DARD Ben Tre also prepared a land use plan for hatchery areas for promoting investment from private sector. The plan was already approved by the provincial government of Ben Tre. Thus, seed production capacity in terms of quality and quantity is need to be improved.

4.1.4 Inappropriate Design of Water Canals

Most of shrimp farms use irrigation canals for water intake and discharge. In consideration of water management and disease control, it is desirable to set up canals for water intake and water discharge separately. However, DARD explained that renovation of canals is very difficult due to non availability of land for expansion. DARD Bac Lieu also pointed out mass sedimentation in canals from sea. According to DARD Bac Lieu, they have to dredge the canals twice a year due to the mass sedimentation.

4.2 Constraints possibly happened due to Climate Change

A study for evaluation of the impact of climate change to shrimp culture in Vietnam namely “ECONOMICS OF ADAPTATION TO CLIMATE CHANGE, VIETNAM” was carried out in 2010 by the World Bank Group. As shown in the Table 4.2.1, the study estimated expected impacts by factors influenced by climate change.

Table 4.2.1 Expected Impacts on Shrimp Culture Sector by Climate Change

Factors	Expected impacts
Temperature rise and salinity intrusion	➢ Increasing of air temperature without rainfall in dry season will result in higher water losses from ponds, especially the larger extensive-scale shrimp ponds, hence increasing water salinity in the ponds. This may require the addition of freshwater to ponds during the dry season, when there will likely be competing demands for freshwater from other sectors (agricultural, industrial, and domestic). ➢ Temperature rise also increase organic decomposition rates causing decreasing dissolved oxygen in rearing water particularly in intensive culture ponds.
Sea level rise	➢ Replacement or upgrading of pond embankment is required to reduce the extent of flooding.

It is concluded that production cost of shrimp will be increased due to: 1) investment for replacement or upgrading of pond embankment is required for both intensive / semi-intensive farms and extensive farms, and 2) increasing cost of water pumping in intensive / semi-intensive culture for adjusting salinity level of rearing water is expected.

CHAPTER 5 NECESSARY ACTIONS TO BE TAKEN FOR SECURING SUSTAINABLE SHRIMP CULTURE

5.1 Outline

Fast of all, there are three categories of shrimp culture in Mekong Delta Area i.e. intensive, semi intensive and extensive. Since intensive and semi-intensive culture are carried out by companies and investors, the Project focuses on the strengthening of extensive culture which mainly conducted by artisanal farmer and fishers.

Development constraints of shrimp culture in Mekong Delta are divided into two categories. One is constraints possibly happened due to climate change and the others are existing constraints that have already happened.

Table 5.1.1 Constraints that possibly happened and Identified

Constraints possibly happened	Temperature rise, salinity intrusion and sea level rise, etc
Major identified constraints	Diseases (WSD, AHDNS), insufficient seed supply, low market price, etc.

Actually, as described in "3.1", shrimp culture sector in Mekong Delta Area has been facing very serious problems. It seems that the private sector does not have much interest on shrimp farm development due to low profitability of shrimp culture caused by outbreak of unknown decease and decreasing of farm gate price.

In consideration of present situation, it may be difficult to guide the farmers to convert their paddy fields to shrimp farms although their lands will be influenced by climate change, e.g. saline water intrusion. Therefore, preparation of countermeasures for existing constraints is important for accelerating farmers to convert their paddy fields to shrimp ponds. Since effects of climate change have not been realizing, and countermeasures for these constraints will be able to develop through the technology improvement and increase of financial investment (see Table 5.1.2).

Table 5.1.2 Basic Strategies against the Constraints

Constraints	Basic strategies	Priority
Temperature rise Salinity intrusion Sea level rise	➢ Models of extensive shrimp culture considering the affect of climate change will be developed through the pilot projects. Rice-shrimp farming model and Shrimp-Mangrove farming model will be developed if necessary. ➢ Training system including manuals also will be developed for paddy farmers who will convert their paddy fields to shrimp ponds.	High
Diseases	➢ No action will be proposed for studying AHDNS since has already started in cooperation with research institutes in Vietnam and foreign institutes. ➢ Strengthening disease investigation capacity of DARD laboratories is proposed for ensuring qualified sees supply and avoiding generation of drag resistance strains, etc.	High
Insufficient supply of seed	➢ Seed production depends on the private sector, and Governments plans to prepare industrial zone for hatcheries and/or strategies for promoting more investment from private sector for strengthening seed production. ➢ The Project will contribute to strengthen the seed supply chain through the strengthening of disease investigation for seeds as mentioned above.	Moderate
Low market price	➢ It depends on the international market price of shrimps. No action	-

	will be proposed.	
Inappropriate design of water canals	➢ No action will be proposed due to uncertain availability of lands for expansion of canals, .	-

The Project recommends to prioritize such measures as; 1) to develop the conversion plan of paddy field to shrimp farm including improvement of extensive culture methods considering the effect of climate change, and 2) to strengthen the disease investigation capacity of DARD laboratories contributing to smooth conversion of paddy farmer to shrimp farming.

In addition, promotion of shrimp farmers' organization and strengthening of the cooperative works are also important issue for smooth conversion and effective works of shrimp farmers. The developed models aforementioned and knowledge and techniques of diseases control will have to be disseminated more effectively among shrimp farmers through the shrimp farmers' cooperatives.

5.2 Development of the conversion plan from paddy field to shrimp pond in consideration of effect of climate change

The Project predicts that a part of paddy farming area in Mekong Delta Area will face fresh water supply problem due to decease of fresh water supply and increased saline intrusion. Farmers who work on these areas have to convert their job to other business such as shrimp farming which is suitable for new environment conditions.

In addition, it is expected that natural conditions i.e. temperature, salinity level of rearing water, sea level, rainfall, etc will be changed due to impacts of climate change and it would influence the rearing condition in the shrimp ponds. Therefore, new extensive culture methods should be developed in consideration of natural environments change. Then, land use plan should be revised based on the applicability of the new extensive method. Following activities are therefore needed for smooth conversion from paddy field to shrimp pond.

- Developing appropriate shrimp farming models in consideration of increase of temperature, salinity intrusion and sea level rise.
- Preparation of training courses and technical manual for shrimp farming for farmers who have convert paddy field to shrimp farm.
- Implementation of training for shrimp farming including rice-shrimp culture and Shrimp-Mangrove culture.
- Development of monitoring system by DARD's extension officials for shrimp farms which were converted from paddy field.
- Existing land use plan should be revised based on the applicability of the new extensive culture methods.

Regarding the farming model development, some trials have already been started in the field. Most of the pond bottom in the area is now flat. Since environmental condition in the pond is almost same, shrimp is easily influenced by affect of temperature. Actually, conditions of rearing water can be changed easily. For example, in dry season, it is known that sudden wind in night cools down not only air temperature but also water surface temperature. Sudden change of the temperature gave stress to shrimps, and remote causes of diseases. Therefore, some farmers dig canals on the pond bottom for avoiding the effect of temperature change. Shrimp can stay at the deeper area of pond bottom when temperature becomes lower or higher. This improvement can be applied not only for extensive shrimp cultivation but also for paddy-shrimp farming.

Initial density of seed is from 1 to 2 seed (post larvae) per square meter. Since size of seed is about 1.5 cm when it is released into pond, it is difficult to monitor the seed condition in early stage of shrimp farming. Therefore, some farmers made nursling pond for initial stage of the cultivation. Seed is kept with higher density (i.e. 5 to 6 seeds per square meter). The advantage of this arrangement is that larva affected by virus does not affect adult shrimp because they can separate each other. However, this method cannot be applied to shrimp and paddy rotation because paddy cultivation requires shallow farm land.

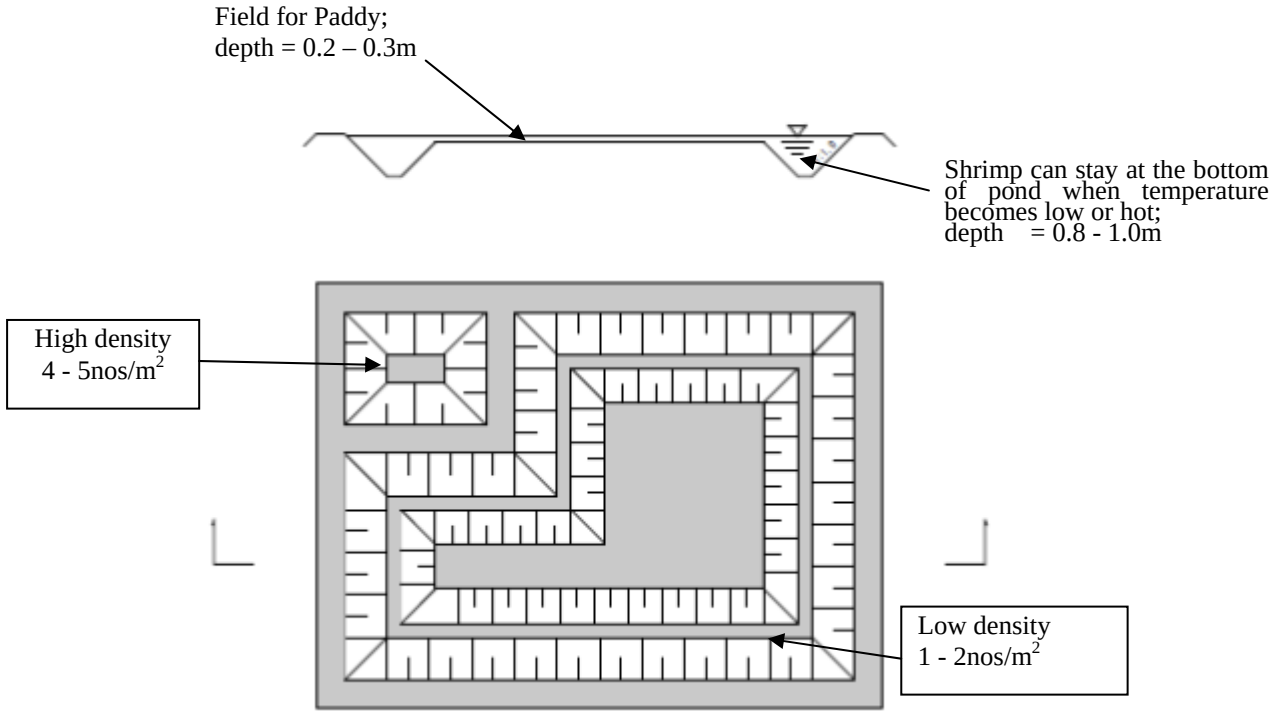


Figure 5.2.1 Typical Cross Section for Improved Extensive Shrimp Farming (up) and Plan (below)
Source: RIAq2 and Study Team

Activities aforementioned are listed up for developing extension models of extensive shrimp culture in Mekong Delta. Additional costs will be required for actual extension works of the developed models. Provincial governments need budgets for strengthening the extension works for farmers who convert paddy field to shrimp pond. Farmers also should invest following items for converting paddy field to shrimp pond, and some of them need financial support from Government.

- Construction cost for embankment and sluice gate, and
- Procurement cost for materials, shrimp seed and miscellaneous

These expenses for actual extension works should be borne by the Vietnamese Government, and cost estimation will have to be done during a pilot project period with the support of pilot project.

5.3 Strengthening the disease investigation capacity of DARD laboratories

Since international agencies such as FAO, NACA and Australian Department of Agriculture, Fisheries and Forestry already started studies on AHDNS, the Project would not propose any study for this particular disease for avoiding duplication of activities. Instead, the Project proposes to strengthen the comprehensive structure of shrimp disease control by DARD in the Mekong Delta Area. Main activities are as follows:

- Strengthening the seed quality monitoring system including the PCR tests at hatchery level through the strengthening of disease investigation capacity of DARD laboratories.
- Strengthening the disease diagnostic system including drag resistance test through the of disease diagnosis capacity of DARD laboratories.
- Developing referral system among DARD laboratories, universities concerned and RIA No2.
- Strengthening the extension works on disease control for shrimp farmers.

5.4 Promotion of shrimp farmers' organization

Most of the shrimp farmers in Mekong Delta Area are not well organized. Although some cooperatives are organized by intensive farmers and some groups by extensive farmers, most of shrimp farmers work individually. Therefore, DARD has promoted to organize shrimp farmers for easier access to the Government support in each province.

In consideration of the situation aforementioned, it is recommended to develop models of shrimp farmers' cooperative which realize 1) cooperative purchase of seed which is certified by the DARD laboratories, 2) cooperative shipment of the product in better conditions (i.e. selling the products under the contract between cooperative and processing factories) and 3) information shearing about shrimp rearing technologies, diseases, etc among members.

Detail actions for developing the cooperative models are as follows:

- Fixing mandate and functions of the shrimp farmers' cooperative.
- Establishing shrimp farmers' cooperative and selecting board members of the cooperative.
- Starting group purchasing of seed and materials, water drainage management and cooperative shipment of products.
- Sharing the information about diseases, market price, new culture techniques etc through the cooperative.
- Government supports such as trainings / workshops, loans, etc will be provided through the cooperative.

Attachment IV-A: Questionnaire for Shrimp Farmers

Interviewer's Name: _____ Date:_____

Interviewee's Profile

Name: Mobile No.:

Address: Hamlet, Commune

District, Province

Type of Culture Please tick the following.

( ) Shrimp Culture, ( ) Shrimp and Paddy Culture

PART 1: FAMILY STRUCTURE

1.1 Family Structure: All the household members.

Member	Interviewee (Tick one)	Age	Sex		Educational Level
			Male	Female	
Husband					
Wife					
Children Total No. of children incl. independent ( )					
Parents (who are living together)					
Others (living together) ( )					
( )					

PART 2: ESTABLISHMENT OF SHRIMP FARM

2.1 How many years have you cultivated shrimp for? _____Years or Since_____

2.2 How many year have you cultivated both shrimp and paddy in a same plot for?

_____Years or Since_____

2.3 How much area of total farm land (use right) do you have?

( ) cong: <Cong>: 1,300m^2/cong ( ) or 1,000m^2/cong ( )

2.4 How much area do you use for shrimp farm?

(_____) cong: <Cong>: 1,300m^2/cong (___) or 1,000m^2/cong (___)

2.5 How much area do you use for combination of shrimp and paddy cultivation?

(_____) cong: <Cong>: 1,300m^2/cong (___) or 1,000m^2/cong (___)

2.6 What is the type (intensity) of your shrimp culture?

Please select and tick one from the list and explain the definition of the selected category.

Extensive ( ) Your Definition_____

Semi-extensive ( ) Your Definition_____

Semi-Intensive ( ) Your Definition_____

2.7 How much does it cost for establishment of shrimp farm?

Type	Cost (VND)*	Frequency of Maintenance or Renewal per year	Annual cost of maintenance (VND)
Civil Works			
Excavation of Pond and Ridge (payment year)			
Excavation of Canal (payment year)			
Facilities			
Pump			
Net			
Total			

2.8 How did you get the capital for Shrimp farm establishment? Please tick where applicable and fill in the detail.

( ) **Own money:** Amount (_____ VND)

( ) **Banks**: (Name of bank: _____) Amount(_____ VND)

( ) **Other Financial Institutions**: (Name of institution: _____)

Amount(_____ VND)

( ) **Relatives/Family members**: Amount(_____ VND)

( ) **Others**: (Please be specific: _____) Amount(_____ VND)

2.9 What is your farming system last year?

Please describe the cropping calendar

Month / Area	1	2	3	4	5	6	7	8	9	10	11	12
Plot A (area:)												
Plot B (area:)												
Plot C (area:)												
Examples												
Example1 (area: 400m^2)	**Shrimp (semi-extensive)**				**Shrimp (extensive)**			**Paddy**				
Example2 (area: 500m^2)	**Shrimp (semi-extensive)**							**Fresh shrimp + Paddy**				
Example3 (area: 600m^2)	**Shrimp (extensive)**											

PART 3: INCOME AND EXPENDITUREOF SHRIMP

3.1 Shrimp Production in each cultivation in the Past One Year [SHRIMP]

Shrimp	No. of Harvest	Season (month)	Production (ton/ area)	Unit Price (VND/kg)	Size (shrimp/kg)	Gross Income (VND)
Pond A: Area ( ) Cong Combined with Paddy→ Yes ( )/ No ( )						
1st Cultivation Brackish ( ) Fresh ( )	1					
	2					
	3					
2nd Cultivation Brackish ( ) Fresh ( )	1					
	2					
	3					
Extensive Brackish ( )	Frequency ( )			Average	Average	
Pond B: Area ( ) Cong Combined with Paddy→ Yes ( )/ No ( )						
1st Cultivation Brackish ( ) Fresh ( )	1					
	2					
	3					
2nd Cultivation Brackish ( ) Fresh ( )	1					
	2					
	3					
Extensive Brackish ( )	Frequency ( )			Average	Average	
Pond C: Area ( ) Cong Combined with Paddy→ Yes ( )/ No ( )						
1st Cultivation Brackish ( ) Fresh ( )	1					
	2					
	3					
2nd Cultivation Brackish ( ) Fresh ( )	1					
	2					
	3					
Extensive Brackish ( )	Frequency ( )			Average	Average	
Total						(A)

3.2 How much does it cost for each input/labor per Year? Unit: (VND)

Items	Baby/ egg	Medicine	Food	$CaCO_3$	Labor	Fertilizer	Others ( )	Total
Pond A:								
1st Cultivation Brackish ( ) Fresh ( )								
2nd Cultivation Brackish ( ) Fresh ( )								
Extensive Brackish								
Pond B:								
1st Cultivation Brackish ( ) Fresh ( )								
2nd Cultivation Brackish ( ) Fresh ( )								
Extensive Brackish								
Pond C:								
1st Cultivation Brackish ( ) Fresh ( )								
2nd Cultivation Brackish ( ) Fresh ( )								
Extensive Brackish								
Total								(B)

3.3 Net Income of aquaculture (VND)

Gross Income from Shrimp(A)	Cost (B)	**Net Income (A)-(B)**	**Total Area of Ponds (m2)**

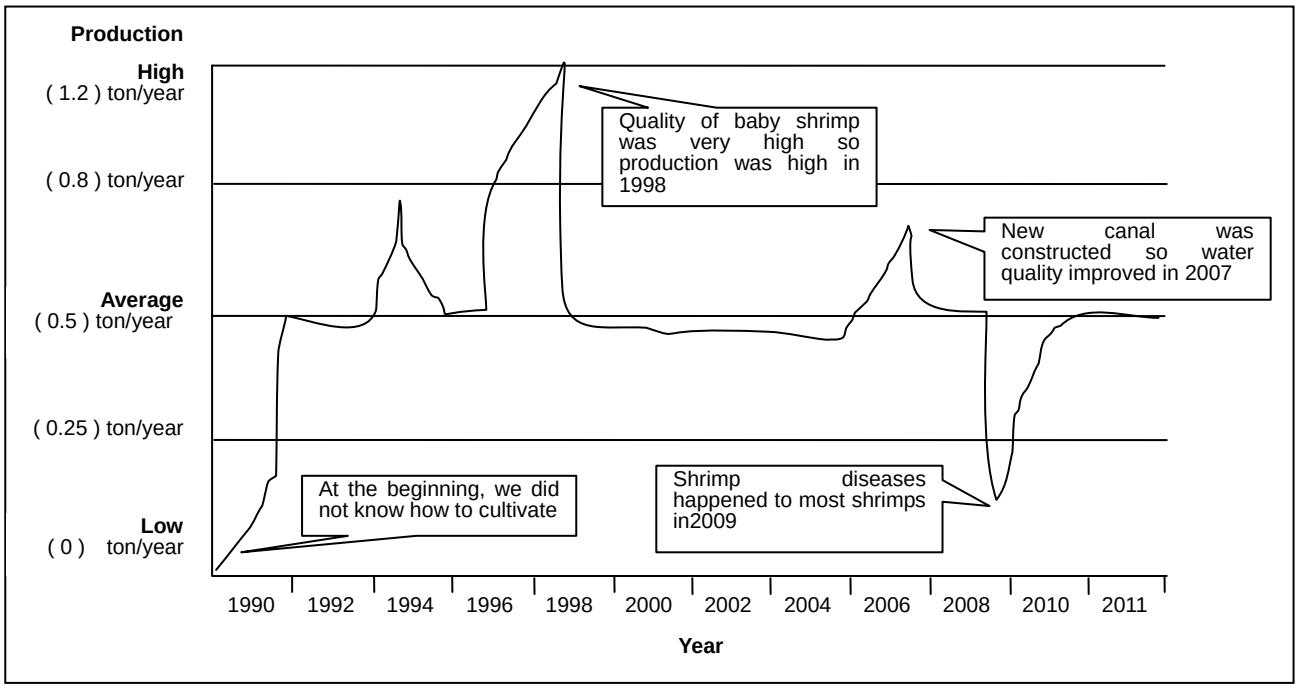
PART4: PRODUCTION TREND

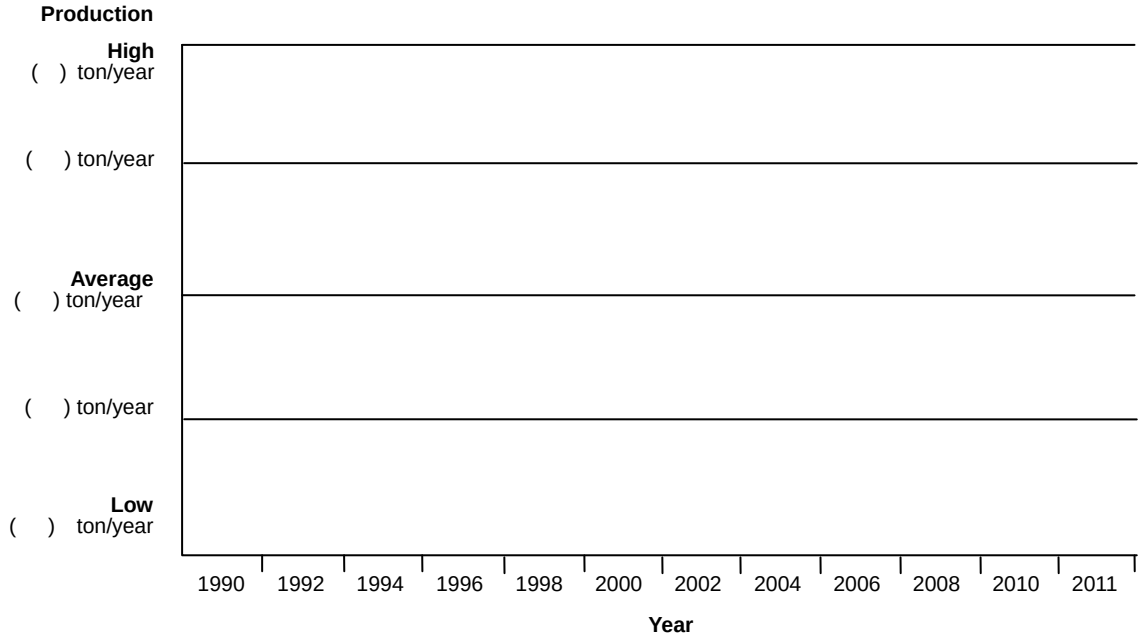
4.1 Shrimp Production Trend.

This question is only for farmers who have experience of shrimp culture <u>more than 10 years.</u>

Please describe the trend of shrimp production since 1990 and explain the reasons for high and low production years.

[EXAMPLE]





Please explain the reasons for each fluctuation.

4.2 Detail of the production trend since 2000.

*** Definition the number of Level of water quality is: 1. Very bad, 2. Bad, 3 Good, 4. Very good**

This question is only for farmers who start shrimp culture after 2000

		Total Production (tons)	With paddy (Y or N)	Area of ponds (m2)	production level (High/Average/ Low)	Level of water quality (1 to 4)*	Disposal of waste (Y or N)	Frequency of water exchange (times/year)	Variety of shrimp (Name)	Size of shrimp (shrimp/kg)	Disease occurrence (Y or N)	Intensity of baby shrimp (shrimps/_m2)	Using certified baby shrimp, (Y or N)	Where did you get baby shrimp	Type of medicine	Amount of medicine (ml or g)	Urea (50kg bag)	CaCO3 (kg)	Others Inputs	Amount of other input Unit: ( )	Kind of Food and its amount Unit: ( )
2011	(B)																				
	(F)																				
2010	(B)																				
	(F)																				
2009	(B)																				
	(F)																				
2008	(B)																				
	(F)																				
2007	(B)																				
	(F)																				
2006	(B)																				
	(F)																				
2005	(B)																				
	(F)																				
2004	(B)																				
	(F)																				
2003	(B)																				
	(F)																				
2002	(B)																				
	(F)																				
2001	(B)																				
	(F)																				
2000	(B)																				
	(F)																				

*** (B) means Brackish shrimp and (F) means Fresh shrimp**

NOTICE: This section is only for farmers who produce paddy in the same plot of shrimp farm.

PART 5: INCOME AND EXPENDITURE OF PADDY

5.1 Size of Farmland (m^2) or (cong)

5.2 How much were the agriculture gross profit by rice last year?

Crop	Area planted	Area harvested	Production (A)	Home consum-ption	Seed for the next season	Selling (B)	Farm gate price (C)	Gross Cash Income (B) x (C)
Unit	( )	( )	( )	( )	( )	( )	( )	VND
Paddy (Rainy season1)								
Paddy (Rainy season2)								
Total								(A)

5.3 How much does it cost for each input?

Paddy	Urea	Compound	Compost	Pesticide / Fungicide	Herbicides	TOTAL
Paddy (Rainy season1)						
Paddy (Rainy season2)						
Total						(B)

5.4 How much does it cost for paddy farming per one cropping? (VND)

Item	Farm labor	Rental Machine	Others	TOTAL
Paddy: Rainy season1				
Land Cleaning				
Plowing				
Saline Leaching				
Soil Pudding				
Seeding (broadcast)				
Seeding (in row)				

Transplanting				
Fertilizer Application				
Pesticide/fungicide Application				
Herbicide Application				
Weeding				
Harvesting				
Threshing				
Transporting (farm to dry yard)				
Drying/Packing				
Transporting (dry yard to market)				
Water Fee				
Land Tax				
Subtotal (VND)				
Paddy: Rainy season2				
Land Cleaning				
Plowing				
Saline Leaching				
Soil Pudding				
Seeding (broadcast)				
Seeding (in row)				
Transplanting				
Fertilizer Application				
Pesticide/fungicide Application				
Herbicide Application				
Weeding				
Harvesting				
Threshing				

Transporting (farm to dry yard)				
Drying/Packing				
Transporting (dry yard to market)				
Water Fee				
Land Tax				
Land Cleaning				
Subtotal (VND)				
TOTAL				(C)

Please answer only to the items applicable.

5.5 Net Income of Paddy (VND)

Gross Income (A)	Cost of Input (B)	Cost of Labors (C)	**Net Income (A)-(B)-(C)**	**Total Area of Farmland (m2)**

PART 6: OTHERS

6.1 How do you get the information about shrimp farming such as baby shrimp and diseases? Please tick the following.

( ) TV/Radio

( ) Other farmers

( ) Extension officers

( ) Others: Please be specific

6.2 How did you acquire techniques of shrimp farming?

Year	From who or which organization	Contents

6.3 Where do you usually obtain baby shrimp?

Location	Brackish	Certified or not
1. Private company		
2. Cooperative		
3. Public organization		
4. NGO		
5. Other farmers		
6. Others		

6.4 Water Sources for Shrimp Culture

Type of Source	Level of Water Quality (please describe)	Water flow/ circulation of water (please describe)	Distances from the field (km)

6.5 Please list up the main reasons for water quality degradation.

Important reasons	Detail
1.	
2.	
3.	
4.	

6.6 Please list up the main reasons for occurrence of shrimp diseases.

Important reasons	Detail
1.	
2.	
3.	
4.	

6.7 How do you dispose wastes of shrimp farm? Please explain.

6.8 How do you usually deal with shrimps with disease? Please explain.

6.9 What measures have you taken to prevent shrimp diseases?

Thank you very much for your cooperation!

APPENDIX-V

VILLAGE LEVEL WORKSHOP RESULTS

APPENDIX V: VILLAGE LEVEL WORKSHOP RESULTS

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V.1 Problem Analysis

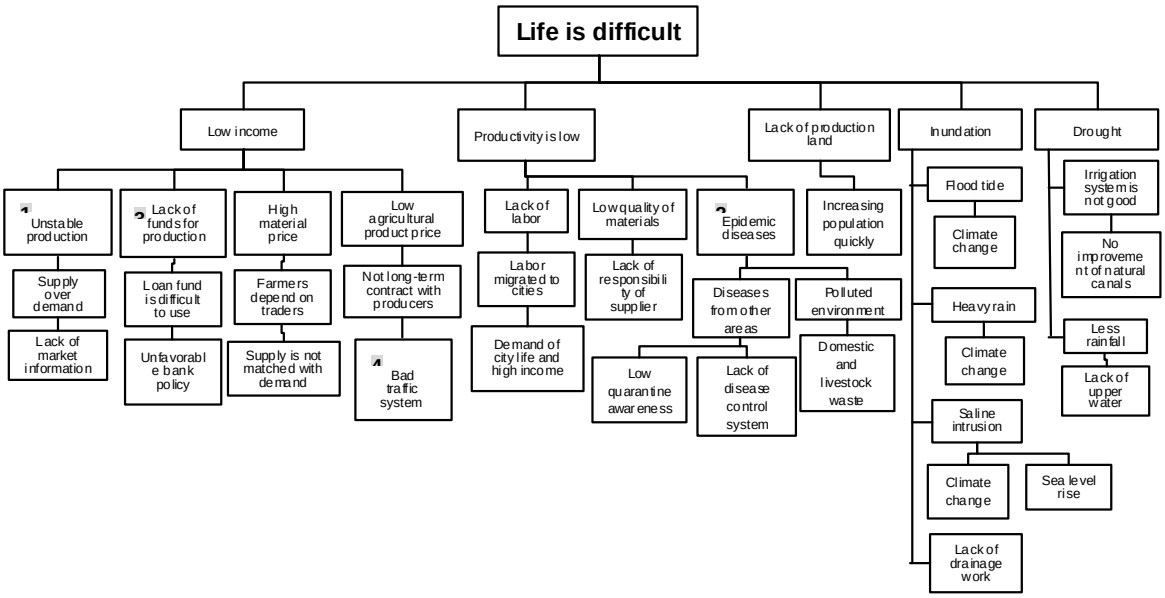

Figure 1.1.1 Problem Analysis in Thuan Dien Commune, Ben Tre Province

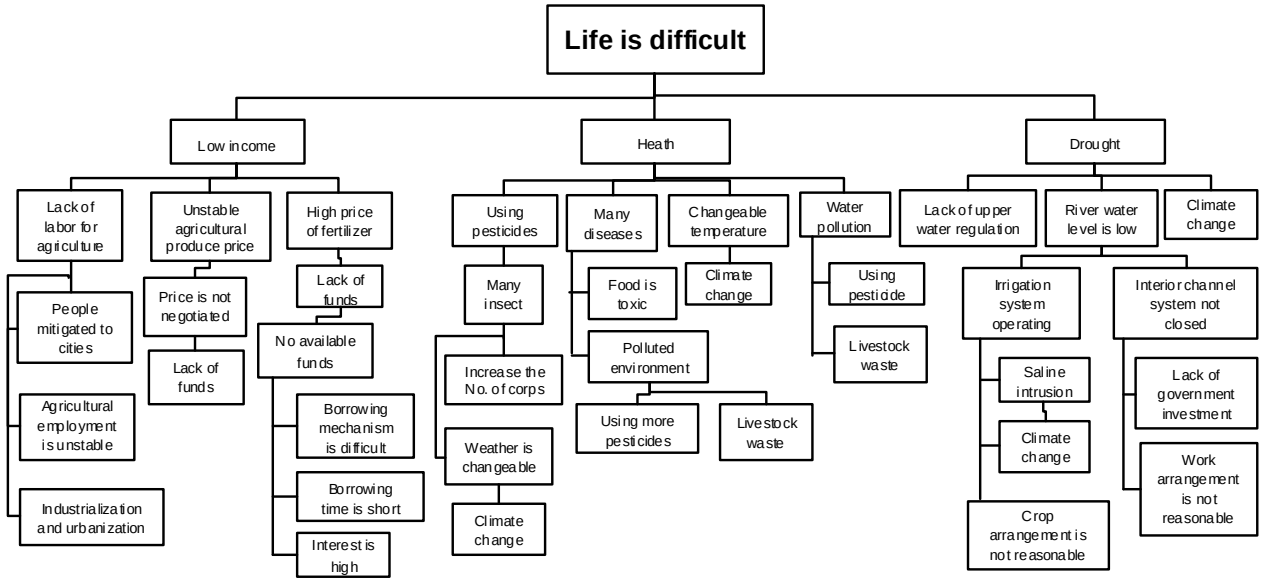

Figure 1.1.2 Problem Analysis in An Binh Tay Commune, Ben Tre Province

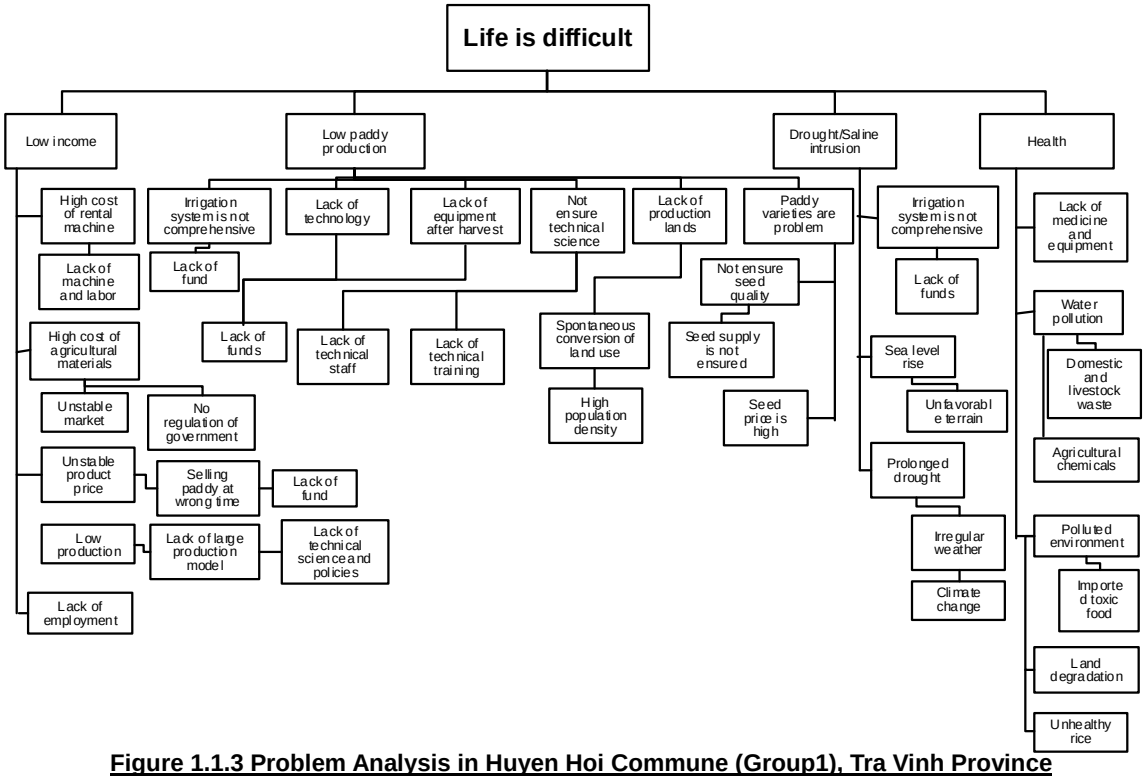

Figure 1.1.3 Problem Analysis in Huyen Hoi Commune (Group1), Tra Vinh Province

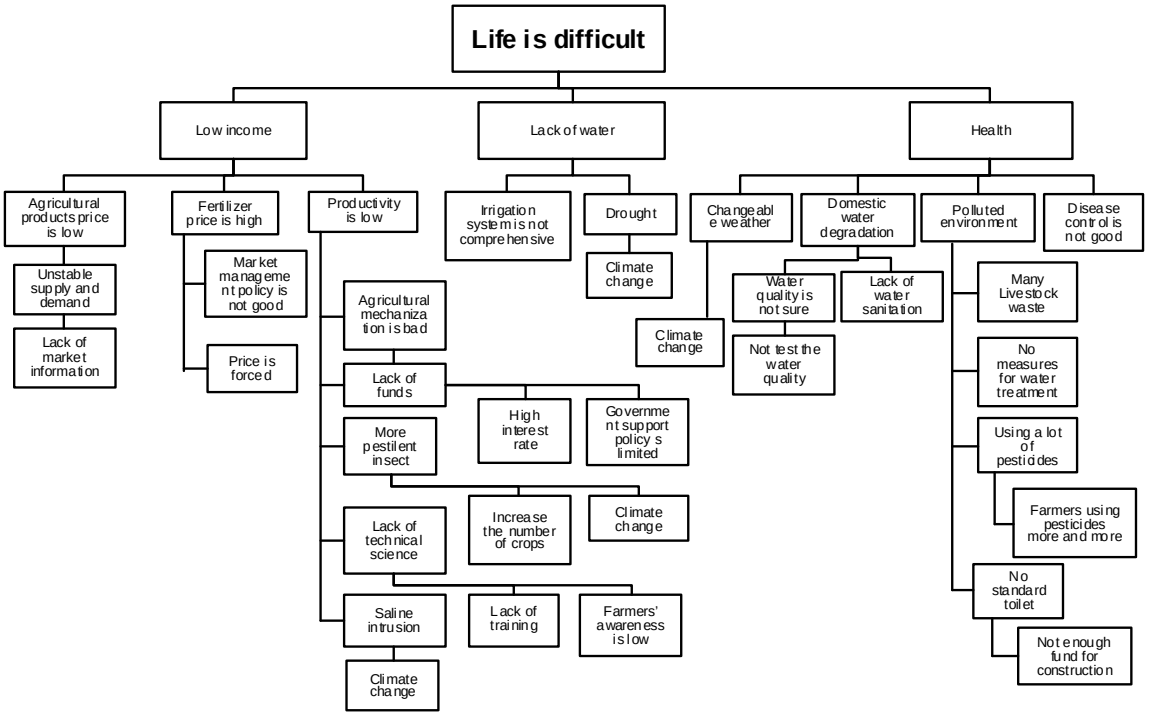

Figure 1.1.4 Problem Analysis in Huyen Hoi Commune (Group2), Tra Vinh Province

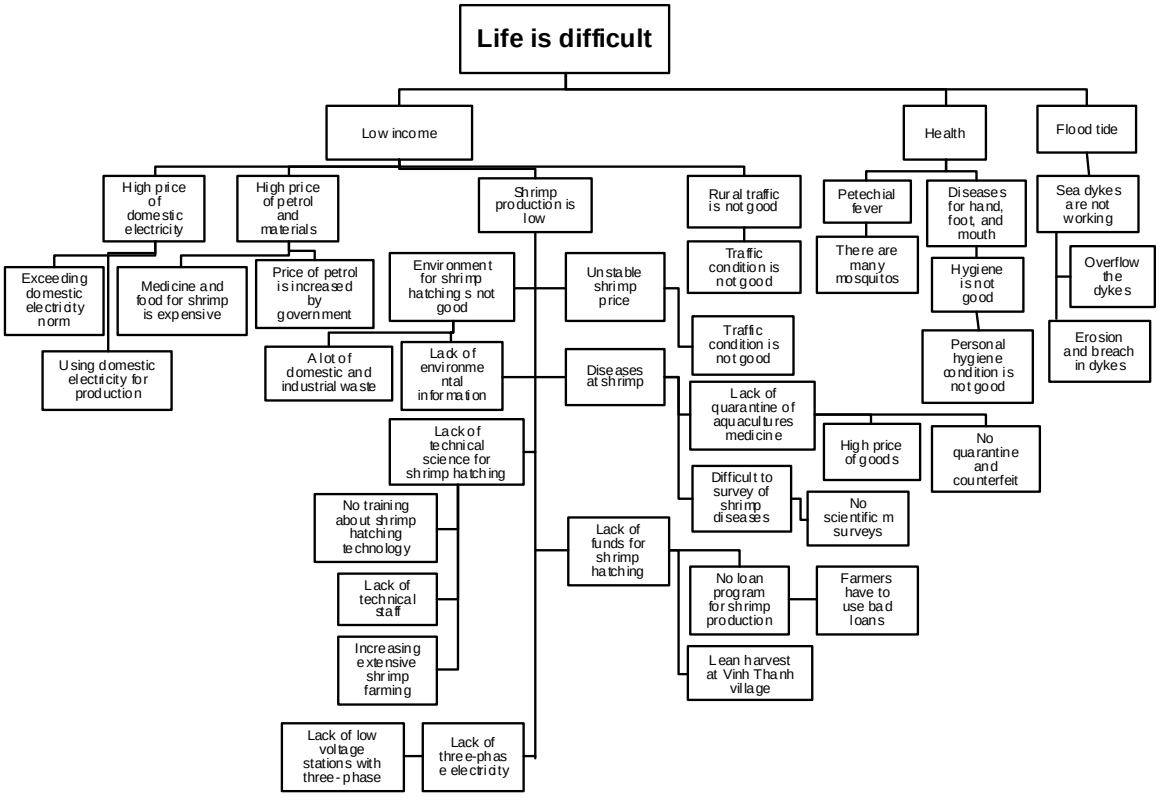

Figure 1.1.5 Problem Analysis in Vinh Hai Commune (Group1), Soc Trang Province

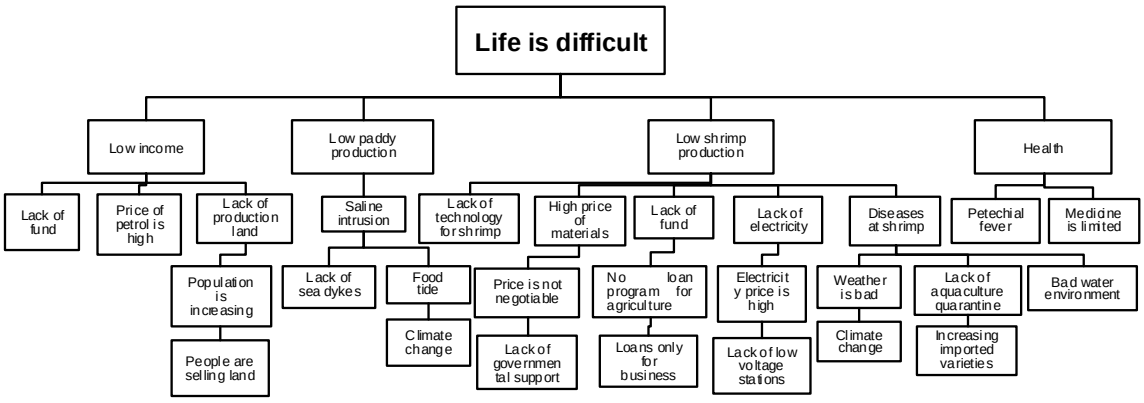

Figure 1.1.6 Problem Analysis in Vinh Hai Commune (Group2), Soc Trang Province

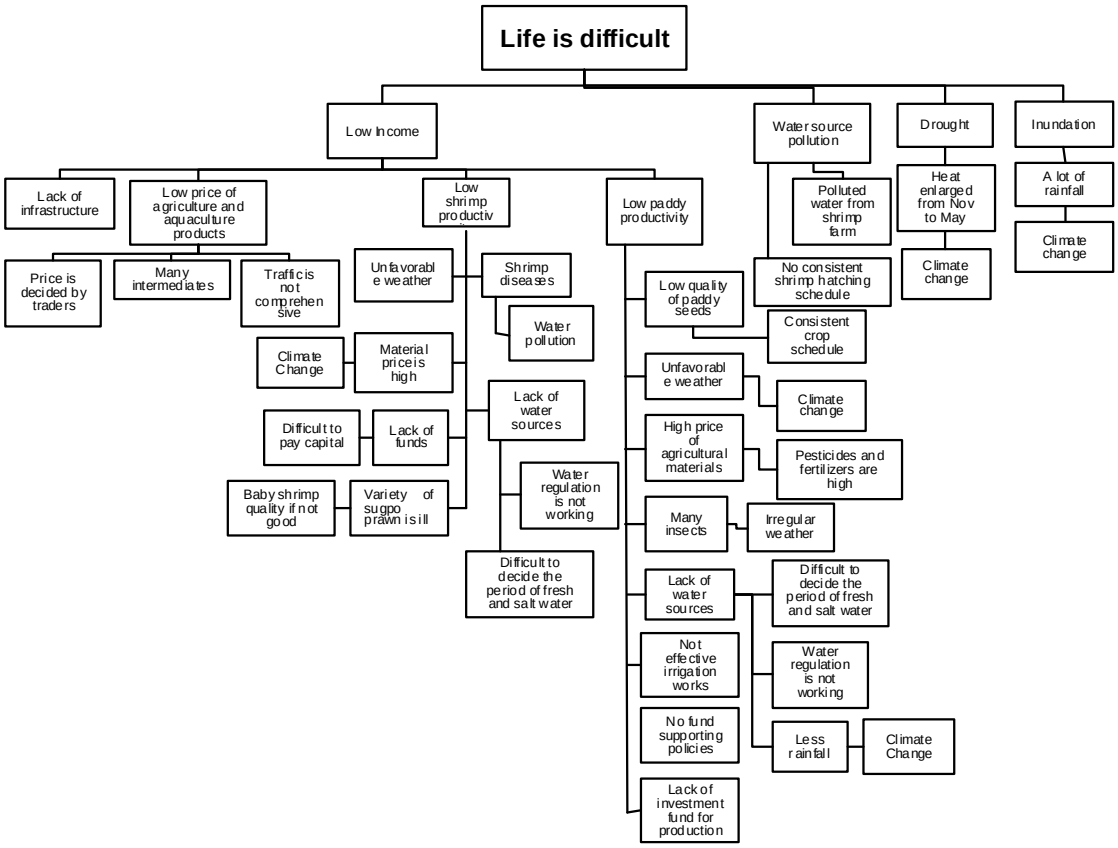

Figure 1.1.7 Problem Analysis in Phuoc Long Commune (Group1), Bac Lieu Province

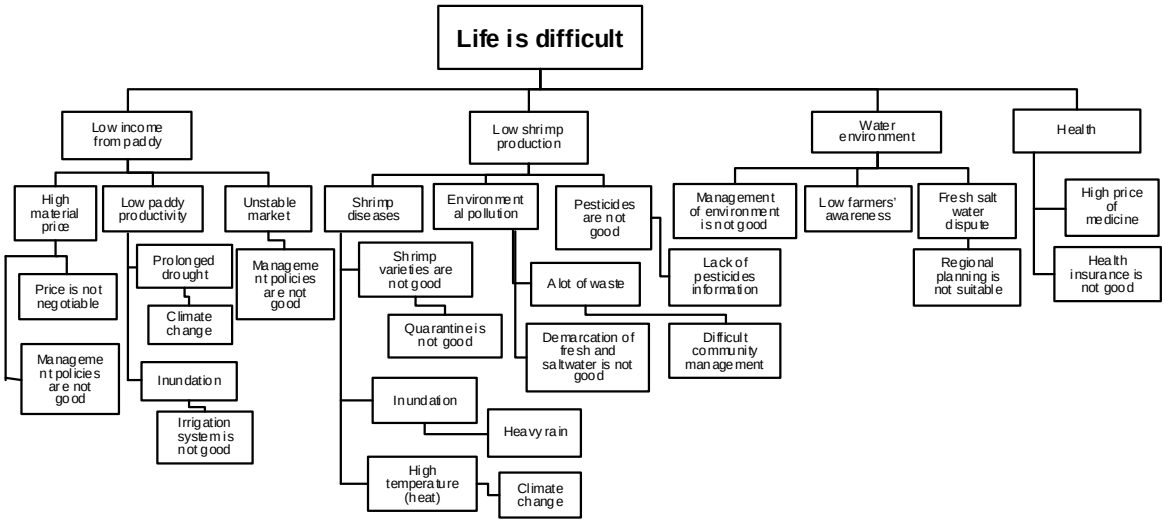

Figure 1.1.8 Problem Analysis in Phuoc Long Commune (Group2), Bac Lieu Province

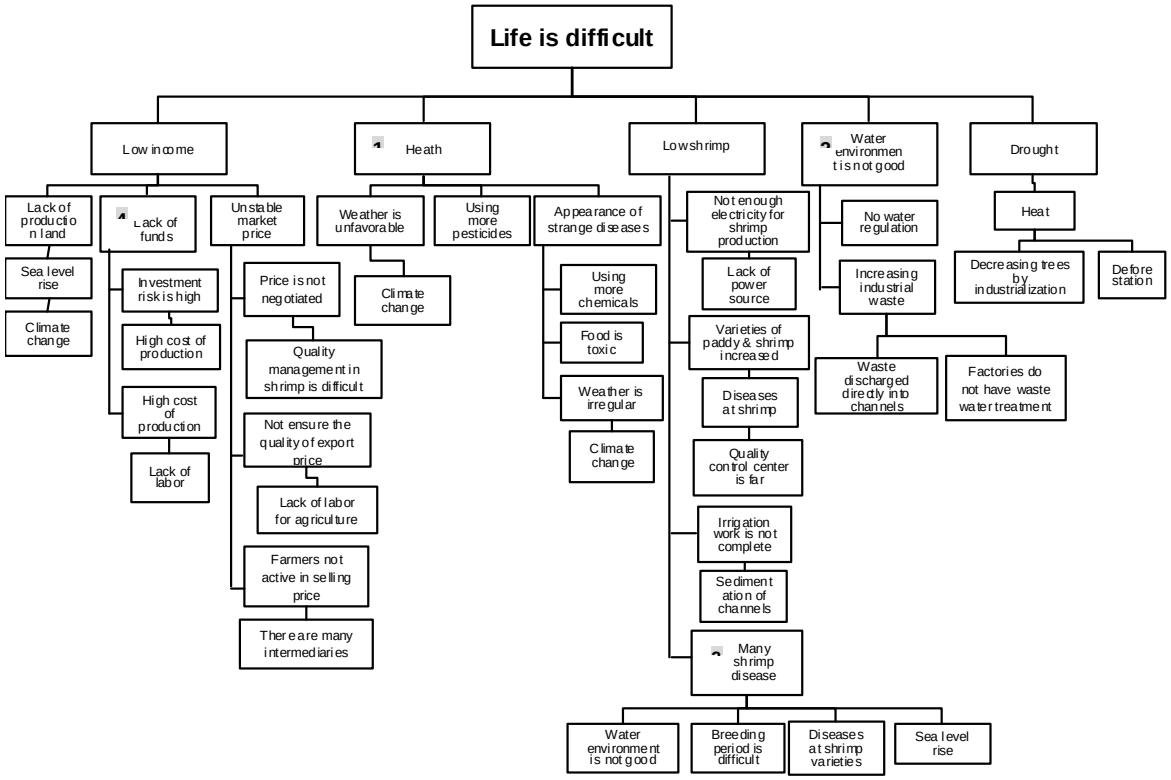

Figure 1.1.9 Problem Analysis in Tran Thoi Commune, Ca Mau Province

V.2 Trend Analysis

V.2.1 Comments on Trend Analysis from participants

Table 1.2.1 Major comments on Each Time Scale

Place	1986-1995	1996-2000	2001-2005	2006-Present
Thuan Dien (Ben Tre)	· Start using pesticides and chemicals	· Start development of irrigation · Start using word "Climate Change" · From 2000, saline intrusion was increased		· Rapid growth of coconut production
An Binh Tay (Ben Tre)	· Prolonged drought for 3 months (Apr, May, June)	· Low price of paddy · Start using pesticides and chemicals · Construction of drilled and digging wells and appeared strange diseases	· Young people move to city to look for jobs · Awareness of water pollution	
Huyen Hoi (Tra Vinh)	· Paddy diseases epidemic · Start development of irrigation	· No irrigation system before start shrimp · Start irrigation development		· Paddy price is high · Start exporting paddy · Paddy disease spread out · Increasing paddy varieties
Tran Thoi (Ca Mau)	· No irrigation work	· Paddy production increased because of irrigation · Start shifting to shrimp · Serious damage of flood in Sep to Nov · Prolonged drought affected production from Feb to Aug,	· Shift to shrimp · Income was the highest · Increasing domestic waste · Increasing agricultural toxic food · Government started investing shrimp farm	· Income decreased because polluted water environment · Increasing waste from domestic garbage, waste of shrimp farm, and waste of industrial zones · Revenue from shrimp production was low

Place	1986-1995	1996-2000	2001-2005	2006-Present
Phuoc Long (Bac Lieu)	· Specialized in paddy · Prolonged drought from Nov to Dec, but not serious damage · Start development of irrigation	· No rural traffic system · Before 2000, cultivated only paddy and onion · Start using electricity · Start using drilled wells	· High income but unstable prices · Epidemic shrimp diseases happened · Paddy was damaged by flood and shrimp was damaged by diseases · From 2005, climate change started · Serious damage of flood in June to Oct	· Very high income · Paddy was damaged by flooding and shrimp was damaged by diseases · Industrial waste was increasing rapidly · Large scale farmers use pesticides and chemicals more and more
Vinh Hai (Soc Trang)	· In 1995, 2,000ha of paddy field was damaged by a storm in 6 costal hamlets		· Start shrimp production · Income was the highest · The number of drilled wells were increasing	· Epidemic diseases at shrimp · Harvest was bad · Inundation at 6 hamlets, 2 weeks and 50 centimeters level · Price of electricity increased rapidly · Lack of fresh water and wells are salted

V.2.2 Results of the Trend Analysis

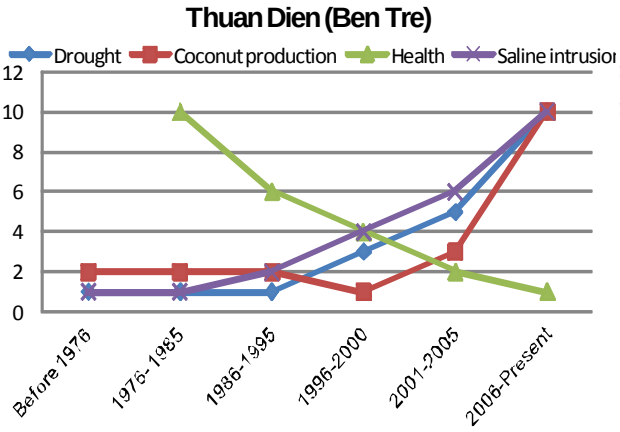

Figure 1.2.1 Trend Analysis in Thuan Dien

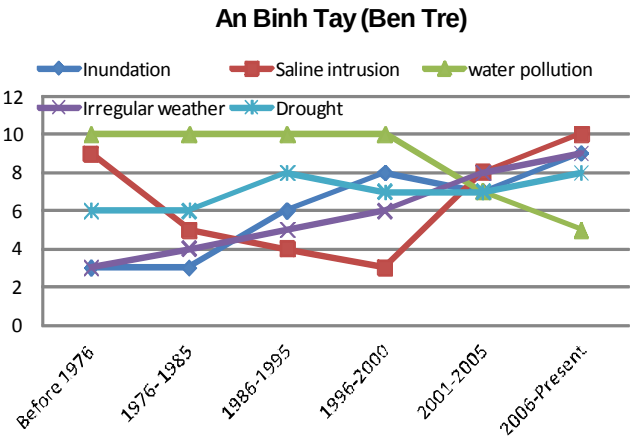

Figure 1.2.2 Trend Analysis in An Binh Tay

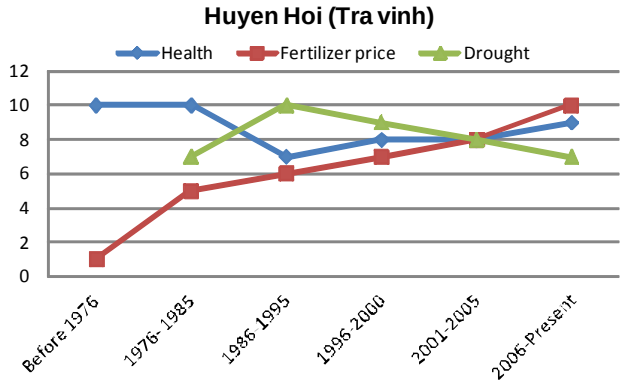

Figure 1.2.3 Trend Analysis in Huhen Hoi

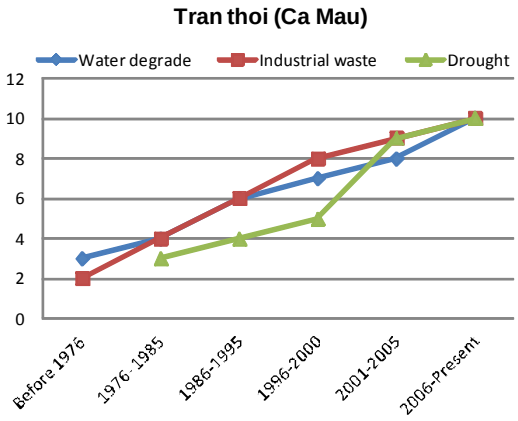

Figure 1.2.4 Trend Analysis in Tran Thoi

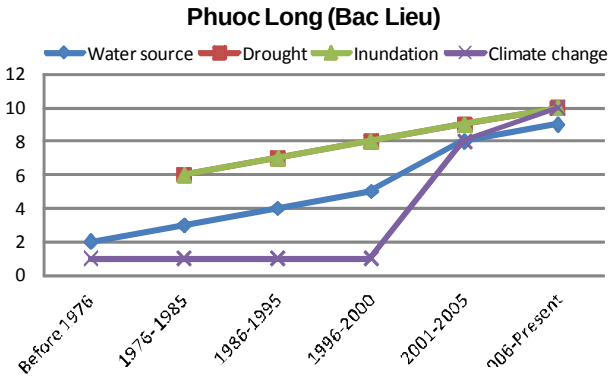

Figure 1.2.5 Trend Analysis in Phuoc Long

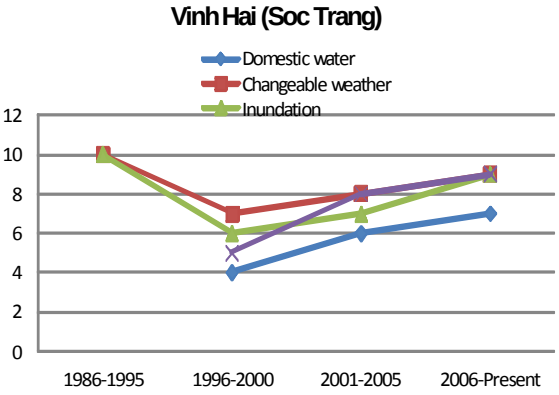

Figure 1.2.6 Trend Analysis in Vinh Hai

V.3 Issues Identification Associated with the Climate Change

Table 1.3.1 Climate Change Issues in An Binh Tay

An Binh Tay Commune, Ben Tre Province			
Issues	**Current situation**	**Future prediction**	**How to cope with**
Flood-tide	· Salinity intrusion from February to April increasing failure of WS crop in all communes.	· More serious and prolonged	· Protective forestation and solid embankment
Inundation	· Lowland influenced, loss of about 80% of AW crop in 2010, 3/6 hamlets of commune was flooded · (hamlet 3, 4,5)	· To prolong inundation area (maybe all commune)	· Need to have drainage pump system, embankment for water prevention, and close drainage sewer system.
Irregular weather	· WS crop influenced by rain in wrong time. · Less rainfall than in previous years	· Unseasonal rains occur more commonly · Rainfall is more and more decreasing	· To recommend producing 2 paddy crops, avoiding FW crop.
Prolonged heat	· Heat enlarged from October to May of following year. Temperature increased highly · Influenced negatively on cultivation and breeding: plants and domestic animals dead, or decreased yield, · Influenced on farmers' health: creasing many diseases.	· Heat time may extend from October to July of following year · To bring about more difficulties for agricultural production	· Forestation to improve living environment. · Construction of complete irrigational system to store water for agricultural production in months of water shortage · using varieties with the ability to cope with current climate · The support to prevent diseases, cattle and domestic fowls breeding is better
Drought	· Time: From May to July · Range: occurring in all communes. · Influenced on paddy and vegetables: lack of producing water, late crop, decreasing productivity, plants dead completely in term of prolonged drought · influenced on cattle and domestic fowls breeding · lack of domestic water · Influenced on farmers' health, especially children	· Time: maybe more prolonged in next years · Range: all of 6 hamlets · Caused many difficulties, damage to agricultural production of farmers.	· To complete irrigation channel system from upstream to supply for plants, domestic animals and farmers' life in the drought months · Expansion of clean water plants · To invest health equipments for farmers · To supply medicine to prevent diseases · To research new varieties with the ability of high drought resistance

Salinity intrusion	· Time: from February to April · Area of salinity intrusion: >100 ha, focusing on hamlets 6, 1, 5 · Bad impact on rice (WS rice), so decreasing paddy yield. · Bad impact on fruit-trees: to fall fruit, increase fertilizer cost due to extending developing time · Bad impact on farmers' life: water source pollution, lack of clean water for activities, lack of fresh water for production, appearance many diseases, and polluted environment. · Bad impact on cattle and domestic fowls: creasing many diseases, difficulty for cattle food	· Level and time of salinity intrusion increase highly and prolong due to climate change · Influenced on SF paddy crop	· To construct embankment to prevent salinity intrusion in fields · Mangrove forestation for embankment protection not erosion · To construct irrigation channel system from upstream to serve production in months of water shortage · To have seawall · To build pump stations for clean water supply in rural · To develop health care program for farmers. · To popularize knowledge, experience of cultivation, breeding and disease prevention for farmers.

Table 1.3.2 Climate Change Issues in Thuan Dien

Thuan Dien Commune, Ben Tre Province			
Issues	**Current situation**	**Future prediction**	**How to cope with**
Decreasing plant productivity	· Coconuts: To fall fruits. · Fruit trees (having segments): No flowers · Livestock: bad productivity and reproduction · Shrimp and fish diseased	· Ratio of fruit falling more than. · Plants: be shed leaves and dead. · Sea level rise, salinity intrusion, inundation due to heavy rain and storm. · Livestock dead due to lack of water · Fishes dead due to much saltwater	· Application of technical science in production. · To build embankment to prevent saltwater, to limit inundation. · To plant trees to prevent wind and heat. · To find other freshwater sources.
Heavy rain	· Fields submerged from September to December, with level ò 20÷50cm	· Longer time and higher level	· To build solid embankment and use drainage pumps.
Heat	· From December to April, temperature of 32-37°C · Influenced on agricultural production, decreasing plants productivity · Impact on farmers' health, to appear epidemic disease	· more and more higher temperature · Bad impact on agricultural production, farmers' health, more and more increasing	· To plant green trees to incline covering level · To select appropriate varieties · Training program of cultivation methods of new varieties to get high efficiency. · Program to protect farmers' health. · To give measures to minimize the impact of environmental degradation.
Inundation	· To happen from September to December (lunar calendar)	· Will happen in longer time, with higher level	· To build embankment, to clear sewers and use draining pumps
Flood-tide	· Flood-tide reaches the peak of 20-50cm from September to December (lunar calendar)	· Longer time and higher level	· To dam up.
Salinity intrusion Drought	· Time: From February to April · Range: 7 hamlets of commune · Salinity: 5ä · Fruit trees (having segments) decrease productivity · Cattle and livestock diseased by saltwater. · Domestic water is difficult to use · Freshwater shrimp and fish diseased, declining productivity	· Time: to prolong, from February to June · Range: 7 hamlets of commune · Fruit trees (having segments) and coconuts decrease productivity · Cattle and livestock diseased or dead by lack of water	· To embanks and build sewers at channel top to prevent saltwater · conversion of production · To cultivate plants with the ability of saltwater resistance · To dig wells, to store rainwater · To desalt by using rainwater

		・ Domestic water not use due to salted ・ Shrimps and Fishes diseased or dead by salted lake water	

Table 1.3.3 Climate Change Issues in Huyen Hoi

Huyen Hoi Commune, Tra Vinh Province			
Issues	**Current situation**	**Future prediction**	**How to cope with**
Insect	・ Bag-roller (3 crops) ・ Brown plant hopper (3 crops, all commune) ・ Tree borer.	・ The ability of appearance in more than much density if much heat or rain and high humidity.	・ To use varieties resisting insect ・ To have producing schedule avoiding insect ・ To localize for quarantine ・ To use pesticide: right pesticide, right dose, right object, right time. ・ Appropriate cultivated methods (water regulation) ・ To cultivate short-day varieties
Drought	・ Time: From February to March ・ Average temperature: 35-37C. ・ over 40% of area dead ・ Domestic animal also dead ・ Lack of water for coconut, fruit falling ・ Developing time of plants prolongs, so high care cost	・ Temperature continues to rise, drought time also extends, rainfall declines.	・ To plant green trees ・ To crease water source
Salinity intrusion	・ Time: From February to March (Lunar calendar) ・ In Spring crop (from April to May), paddy is empty, decreases productivity from 70-100%, such as 2009 ・ In WS, paddy also may be empty and decreased productivity if late seeding	・ Not serious due to Lang The and Cai Hoan culverts.	・ To conform to crop schedule ・ active freshwater source ・ To dredge interior channels
Diseases	・ Farmers: petechial fever; hand, foot, and mouth diseases; cirrhosis of liver...accounting for about 10% ・ Domestic animals: cholera, Blue ear pig disease, ulcerated mouth and loose hooves,...accounting for about 20-30% (in 2011) and about 50% (in 2010) ・ Plants: leaves falling and twisting disease, diseased by insect,... accounting for about 30% (in 2011). Coconut decreasing productivity due to insect	・ Appearance of many new diseases. ・ more and more complicated level	・ To have propagandizing methods and prevention of diseases having spreading danger. ・ the medical stations should instruct farmers how to prevent immediately upon detection of disease, and prompt treatment of infected people for epidemic disease to not spread ・ To use appropriate pesticides ・ To preserve environmental sanitation ・ To improve technical science to find good drugs.
Weather change	・ More heavy rain causing local inundation influencing on plants, domestic animals and more difficult farmers' life due to environmental pollution. ・ Prolonged hot weather, high temperature causing drought influencing badly on plants, increasing the development time of plants, care cost and decreasing productivity. ・ Food source for cattle, more and	・ weather changes with more than complex and irregular level	・ To build finished embankment system, drainage system to avoid inundation in a long time. ・ To plant green trees to increase covering density to resist drought, hot weather and erosion. ・ To mobilize farmers not to burn or throw garbage away living environment. ・ To have information equipment system to warn farmers timely when there are any abnormal

	more scarce, appearance of many diseases (blue ear pig disease, ulcerating mouth and loose hooves, flu epidemic) ・ Drought creasing lack of domestic water for farmers, increasing cost to buy fans, diseases such as high blood pressure, cardiovascular disease. ・ Tornados damaged houses, infrastructure		weather changes

Table 1.3.4 Climate Change Issues in Tran Thoi

Tran Thoi Commune, Ca Mau Province			
Issues	**Current situation**	**Future prediction**	**How to cope with**
Channel accumulation	・ Due to tidal rise, alluvium given into channels influenced agricultural production ・ High cost for dredging of accumulated small channels and shrimp hatching fields ・ lack of water from March to April in 12 hamlets, so water intake for shrimp hatching fields difficultly	・ Channels will be more than accumulated, influenced shrimp hatching of hamlets.	・ Regular channel dredging to overcome accumulation.
Drought	・ Influenced on health of farmers, plants and domestic animals. ・ happening from October to April of following year. ・ Increasing salinity (from 25-30%) due to little rainfall, influenced all commune.	・ In next time, more serious influence of farmers' life ・ Influenced on aquaculture ・ in next time, more prolonged drought	・ To plant green trees to crease shapes and forest protection ・ Application of technical scientific measures in life.
Health and illness	・ Appearance of hand, foot, and mouth diseases. ・ malnutrition at children ・ diabetes, high blood pressure	・ Immeasurable development of epidemic diseases	・ Planting green trees to protect living environment; clearing sewerage system. ・ Development of health network from Central government to hamlets in communes
Heat	・ appearance of many prolonged heats ・ average temperature: 34-37 C ・ The hottest time of the year is from February to May. ・ 12/12 hamlets influenced by many hot spells ・ Influenced on health of farmers, cattle, domestic fowls and shrimp ・ Causing prolonged drought influenced domestic and production water. ・ High cost of fertilizer due to enlarge the development time of plants and domestic animal.	・ Hot level continues to rise ・ appearance of strange diseases ・ Decreasing productivity of plants and domestic animal ・ Lack of domestic water	・ To mobilize farmers for planting green trees around living and producing area. ・ To have measures for waste treatment, shouldn't burn garbage causing greenhouse effect. ・ Need to have care program for farmers' health. ・ Using new varieties appropriating climate change. ・ To have proper measures for treatment of domestic and production water sources
Epidemic disease at shrimp	・ In 2011, shrimp production is loss of revenue compared with previous years ・ Cause: irregular weather influenced living environment of shrimp, not clear shrimp variety origin and not strict quarantine ・ The time of diseased shrimp is from April to July.	・ Appearance of many other shrimp diseases	・ Government agencies need to have close checking measures of diseases and shrimp varieties ・ the quick supply of prevention and cure drugs for shrimp before and immediately after shrimp diseased

	· common diseases: black gills, red body, rickets, white spots, ...		
Irregular weather	· Irregular sun and rain, prolonged dry season, late rain season, rain in wrong time.	· Prediction of prolonged heat and drought in the next years. · Sea level more and more rising. · Salinity intrusion in larger area · Appearance of many tornados.	· To plant green trees. · Construction and improvement of embankment system to against sea level rise and salinity intrusion.
Sea level rise	· From October to November underwent sea level rise inundating 50 cm of all commune that influenced farmers' living environment. · Influenced on domestic and production water (due to sea level rise caused salinity intrusion) · Influenced on plants, cattle and aquaculture	· Sea level is rising in the next years due to the long spell of climate change. · Causing salinity pollution of domestic water source of farmers and the influence of farmers' health.	· Must have closed embankment system for prevention of input of sea level rise. · To set drainage pump system · To need mangrove forests to protect coastal embankment system. · To select appropriate varieties · To have the care program of farmers' health.

Table 1.3.5 Climate Change Issues in Phoc Long

Phoc Long Commune, Bac Lieu Province			
Issues	**Current situation**	**Future prediction**	**How to cope with**
Fresh water source	· Lack of freshwater made trouble in agricultural production · Polluted freshwater source · Appearance of strange diseases due to lack of freshwater	· Lack of freshwater increasing due to socio-economic development and prolonged heat (because of climate change) · Polluted freshwater source due to the farmers' habit of direct discharge waste water into channel and rivers.	· To dredge channels to store fresh water · To plant more trees to keep moisture · To raise awareness of farmers by training and workshop
Salt water source	· Not enough saltwater source for aquaculture · Polluted saltwater source influenced on shrimp productivity and the ability of capital revoking of farmers · The time which lack of saltwater is from January to May	· More and more difficult situation · To need the support of government and scientists	· To have comprehensive water regulation system · To have the demarcation between saline and fresh water clearly to product effectively
Healthy	· Good health due to the use of fresh and seft-supplying food source · Only light fever · No epidemic disease · No livestock influenza due to less herd breeding	· If using food from other places, will not guarantee · safety healthy · May occur large quantity of fever if there are toxic wind in October · May catc epidemic disease	· Quarantine in hamlet, commune · To use veterinary medicine · To prevent epidemic disease

Water environment	・ Polluted water, high salinity and alum influenced on shrimp production ・ white-spots, red-body diseases in shrimp killed 90% of shrimp quantity ・ Loss of 50-60% of revenue	・ Disease and pollution tends to increase ・ Maintained paddy-shrimp model	・ Shrimp production and paddy crop are cultivated at the same time ・ Raising awareness of people about discharging water from diseased ponds ・ To regulate water in proper time and production crop ・ To improve soil and water environment for production ・ Application of technical scientific achievements for creating new varieties with the ability of adaptation of the most adverse conditions ・ Price control of government.
Heavy rain	・ Rain is out of season, not steady. ・ In 2010, from July to October, 9 hamlets of commune flooded about 50-60 cm compared with current situation.	・ No prediction because maybe more complicated	・ Need to have a closed area to serve farmers' life and production
Heat	・ Heat affects healthy of people and causes many difficulties for production ・ In 2010, heat extended to July that cause salt and aluminous pollution and lack of producting water	・ More and more complicated due to climate change	・ Need to have planning about residential and production - business areas to repair damange quickly when occurs problems.
Shrimp Productivity	・ Decreasing 50 -100 kg/ ha/ year because of prolonged heat and changeable weather and polluted water environment	・ More and more decreasing	・ Need to have good variety source, saline and fresh water source in proper time and place
Paddy Productivity	・ increasing 1 ÷ 2 ton/ha ・ because of good variety and right care technique ・ and convenient weather	・ Paddy productivity will increase ・ because selecting variety of high productivity, using fertilizer and pesticide in time	・ Using short time variety with the ability of drought-salinity-alum resistance and high productivity ・ To ensure freshwater ・ To use fertilizer and pesticide having good quality ・ Application of technical scientific achievements
Pestilent insects of paddy	・ When paddy is 50 days old, ruined by insects, so decreasing paddy productivity (Paddy crop from August to December in lunar calendar)	・ Climate change make heat prolonged, rain out of season, so happening more pestilent insects and low paddy productivity	・ Using pesticide when appears pestilent insects
Shrimp Disease	・ From 2003 to present, red - body and white spots diseases damage 80% of shrimp yield. ・ In 2000, from January - April, shrimps develop normally, but from July to September, there are diseases. ・ Now, production consists of 2 shrimp crops and 1 paddy crop. (1st crop: January-April, 2nd crop: April-August)	・ After 2010, more and more ruining	・ To improve pond before started another crop

Table 1.3.6 Climate Change Issues in Vinh Hai

Vinh Hai Commune, Soc Trang Province			
Issues	**Current situation**	**Future prediction**	**How to cope with**
Shrimp production environment	・ Irregular weather ・ Salinity changes suddenly ・ Polluted water source more and more increasing due to dredging pond and then discharge down the channels ・ To occur primarily in 3 hamlets: Huynh Ky, Vinh Thanh A, Vinh Thanh B due to industrial shrimp hatching	・ Changeable weather (can't predict) ・ Polluted water source more and more increasing	・ Planting more trees ・ waste treatment ・ To change the water
Disease at shrimp	・ Heat is prolonged ・ Shrimp died but not know the reason ・ White spots, red-body	・ If the weather is not sustainable, disease and shrimp production condition ・ will be affected and a mass of shrimp will die	・ Considering the weather to shrimp production in time ・ To improve ponds ・ Used rightly medicines ・ To test ・ To have training courses to guide technique of shrimp hatching for farmers.
Shrimp productivity	・ In 2011, climate change, harvest losses 98% ・ Disease occurs all 8 hamlets, 1 month-old shrimp died	・ Maybe occurs a number of strange diseases against last years ・ Shrimp productivity in future will loss because disease is irregular	・ Ponds treated by supervising to annihilate bacterium ・ Need to have 3-phase electricity ・ Application advance of science and technique ・ Need to have good medicine, technique
Poor household	・ Now, about 20% - 30% of poor household in commune, the most is Au Tho A, Vinh Thanh B, Tra Set because of no producting land, lack of capital and bad harvest	・ The poor household number will increase in future ・ No job and lack of capital	・ There are capital supporting policies of government for production. ・ To create jobs and open vocational training classes. ・ Poverty-alleviation program
Income	・ Unstable ・ Many bad harvests, a mass of shrimps died in many years, the price is unstable ・ Cost of variety and care are very high	・ In future, many good harvests, ・ the price will be stable ・ Income of farmer increases	・ Stabilization of prices ・ Training technical for shrimp and farm production ・ Policy of loans are much more support ・ To ensure productivity of shrimp and farm production
Climate change	・ Heat is prolonged (from November to April) ・ Impacted on life of people, affected fisheries, crops ・ caused many diseases like neuropathy, hypertension ・ Much rain causes flood (from May to October) ・ and impacts on life of people and farm production ・ in 2010, there is flooded in 6 hamlets in 3 days and make purple onion died ・ Caused hand, foot and mouth disease , malaria disease,…	・ Hotter and hotter ・ more and more flooded ・ Changeable weather	・ Planting trees to make cover ・ Need to have methods to prevent deforestation ・ Healthy community programs ・ Need to have methods to prevent deforest ・ Need to have completed dykes system ・ Need to have drainage pumping stations

Flood tide	・ Sea level rise overflows dykes due to flood-tide, which make part of dykes broken, affected farmers' life ・ There are 6 hamlets : Au Tho B, Au Tho A, Tra Set, Giong Noi, Huynh Ky, My Thanh which affected by that (flooded level of about 50cm)	・ More and more increased by climate change ・ with disadvantage trends	・ To need renovations and upgrade the sea dyke system to cope with climate change and flood-tide. ・ Forestation for protection of coastal area ・ Need to have training classed for farmers to know climate change, disaster and prevention
Domestic water	・ Lack of domestic water for daily life in February and March ・ Most people use well-water which is not hygienic, salt and aluminous (approximately 70m of depth)	・ Heat is prolonged, so not enough water to use ・ Lack of domestic water in February, March, April	・ To ensure enough water to use ・ To use boiled and filtered water, and bottle drinking water.
Health	・ Occurred many diseases, such as hand, foot, and mouth disease, petechial fever, and heart disease	・ If heat extends, disease will increase and many strange diseases will appear	・ Promoted propaganda for farmers to know ・ more effective disease preventing ways

V.4 Success Story and Village History

Table 1.4.1 Success Story in Thuan Dien

***SUCSSESS STORY (*Thuan Dien Commune, Ben Tre Province)**	
Year	**Achievements**
1975- 1985	To improve fields and gardens to gather production to overcome war's consequence.
1986-1996	To renovate the structure of agricultural production
1995	There was electricity for all hamlets in the commune. Government and people worked together
1997	Coconuts and fruit trees were planted to develop
1997-2000	Rural roads were paved. The Government provided capital and village people helped to construct.
2001-2005	There were concrete roads in the hamlets. The Government provided capital and village people helped to construct.
2006	Built inter-communal road and Mrs. Tran An Nhien provided capital.
2006-2007	Built three concrete bridges and Mrs. Tran An Nhien provided capital.
2008	To build house of culture in commune
2006	Established clean water factory because the Government invested funds.
2008-2009	Built secondary school.
2009	There were no more rope bridges in the village.

Table 1.4.2 Village History in Thuan Dien

***VILLAGE HISTORY (*Thuan Dien Commune, Ben Tre Province)**	
Year	**Events**
1977	Establishment of secondary school and medical station
1980	Market established in the commune
1995	Electricity came to the commune
1996	Got the title of the people's armed force heroic commune
1998	Got the title of labor heroic commune
1999	Built inter-hamlet road and inter-communal road paved
2003	Constructed pagoda of worship
2006	Constructed bridges which were funded by village people
	Constructed a temple
2007	Establishment of the kindergarten that reach the national standard
2008	Got the title of cultural commune

Table 1.4.3 Success Story in An Binh Tay

Year	*VILLAGE HISTORY (An Binh Tay Commune, Ben Tre Province)* Events
1976	Got the title of cultural commune by the government
1978 - 1980	Established co-operative -Production corporation
1986	Started to construct the land for farmers
1997	Some hamlets had domestic electricity
2002	An Thuan hamlet was established
2005	An Thuan hamlet got the title of cultural hamlet
2009	Commune got the title of cultural commune Storm no. 9 had come and swept roofs, and more than 500 houses collapsed Established An Binh Tay market

Table 1.4.4 Village History in An Binh Tay

Year	*SUCCESS STORY (An Binh Tay Commune, Ben Tre Province)* Achievements
1976	Got the title of heroic commune
1997	Some of the hamlets had domestic electricity.
2000	Hamlet 4 was recognized as the first cultural hamlet in the commune
2001	Inter-communal road was paved. The Government provided capital and village people helped to construct.
2002	Electricity reached 100% in the commune.
2005	Communal medical stations took care of farmers' health very much.
2008	Constructed inter-communal road system. The Government provided 70% of the total funds and farmers provided rest of 30%.
2009	Established the communal market in An Binh Tay Got the title of cultural commune.
2010	Doctors have been staying in the communal medical station.

Table 1.4.5 Success Story in Huyen Hoi

SUCCESS STORY (Huyen Hoi Commune, Tra Vinh Province)	
Year	**Achievements**
1997	The electricity has come The Government supported to construct houses
2000	inter-provincial road was paved The concrete bridge was improved. Got the title of cultural hamlet
2003	Rural was constructed. The Government provided 65% of the total investment capital and villager provided the rest of 35%.
2009	Constructed kindergarten, elementary and secondary school

Table 1.4.6 Village History in Huyen Hoi

Year	*VILLAGE HISTORY (Huyen Hoi Commune, Tra Vinh Province)*
	Events
1968	Got the title of the people's armed force Heroic commune
	Huyen Hoi commune has 9 hamlets: Tra On, Giong Ben, Ap Soc Giong Moi, Luu Tu, Kinh H, Kinh B, Binh Hoi
1975 -1985	Total household: 2734 Total population:13040 Commune constructed new committee head office and the medical station Establishment of elementary and secondary school
1989-1999	Total of population: 15020
1997	Storm No.5 hit the commune. 70 houses and 2300 ha of farm production and paddy were damaged.
1999 to now	Total of population: 16069, about 3000 household
2009	Storm No.9 hit the commune, 45 houses and 3900ha of farm land were damaged. A secondary school has been recognized as national level school
2010	Ap Soc pagoda has been recognized as national-level historical monument Ap Soc hamlet has been poor hamlet of commune B secondary school has been recognized as national level school
2011	C secondary school has been recognized as national level school

Table 1.4.7 Success Story in Tran Thoi

Year	*SUCCESS STORY (Tran Thoi Commune, Ca Mau Province)*
	Achievements
1980	Added Viet Thang commune
1993	Constructed medical station in the commune
1999	Constructed inter-communal road. The Government supported 60% of the total capital.
2001	Had national Grid to the rural area Changing from paddy production to shrimp hatching
2003	Got the title of cultural hamlet
2008	Constructed bridges. Constructed basic schools Awarded the Merit of economic-social development in the first position of district
2009	Constructed Đam Cung bridge. Capital provided by Ministry of Transport
1997-2000	Completed a part of Highway 1A
2000-2001	Completed Highway 1A
2004-2011	Completed 90% of rural roads
2009-2011	Established basic schools in 12 hamlets
2010-2011	Constructed bridges in 12 hamlets

Table 1.4.8 Village History in Tran Thoi

Year	*SUCCESS STORY (Tran Thoi Commune, Ca Mau Province)* *Events*
30/4/1975	The Southern area was liberated
1987	Constructed the head office of communal people's committee
1996	Many hamlets had electricity for daily life
1997	Strom No.5 hit the commune and many houses were damaged.
2001	Shifted from paddy production to aquaculture to give good results, life and income of people in commune improved
2003	Many schools were built basically. Công Trung hamlet was the first cultural hamlet in commune
2001-2009	Constructed many inter-hamlet roads, to transport easily.

Table 1.4.9 Success Story in Phuoc Long

Year	*SUCCESS STORY (Phuoc Long Commune, Bac Lieu Province)* **Achievement**
1984	Communal medical station was founded
1996	Shifted from inefficient paddy production to aquaculture with high economic growth
2005	All hamlets in commune got the title of cultural hamlet
2006	To be awarded the title of the people's armed force heroic commune Established medical station Had domestic electricity for commune and hamlets Constructed paved inter-communal road for cars into hamlets in the commune.
2007	Commune achieves criteria about the comprehensive development commune on district plan of comprehensive development oriented rural in 2006-2010 period
2008	Established three schools in the commune to reach the national standard
2010	Nine hamlets get cultural title and five hamlets get cultural hamlet in 5 year continuously

Table 1.4.10 Village History in Phuoc Long

Year	*VILLAGE HISTORY (Phuoc Long Commune, Bac Lieu Province)* **Events**
1975/4/30	Phuoc Long is liberated completely
1980/6/20	Renamed Phuoc Long to Phuoc Tay commune
1987/6/20	Renamed Phuoc Tay to Phuoc Long commune
1997/5/10	The 5th storm damaged about 64 houses and about 40% of paddy area
2006	Recognized as heroic commune
2006-2010	Recognized as the comprehensive developing commune

Table 1.4.11 Success Story in Vinh Hai

Year	*SUCCESS STORY (Vinh Hai Commune, Soc Trang Province)* Achievements
1990	Constructed communal medical station
1995	Hamlets had electricity
2000	Clean water for hamlets Started to build inter-communal road
2002	Set up the first cell of Vinh Chau district
2004	Established high school
2005	Built the communal cultural house. The Government supported capital.
2006	Establishment of memorial wall of shooting down AD6 airplane Paved inter-communal road.
2007	Built the community house in all level.
2008	Shifted to extensive shrimp production
2009	Recognized as the cultural commune
2010	Good crop of violet onion Good shrimp production The inauguration ceremony of My Thanh 2 bridge

Table 1.4.12 Village History in Vinh Hai

Year	*VILLAGE HISTORY (Vinh Hai Commune, Soc Trang Province)* Events
1931	Set up the first cell of Vinh Chau district
1975- 1982	Established the new commune named Vinh Hai commune
1993-1996	Established the memorial wall of the establishment of the cell of Huynh Ky hamlet Set up memorial wall of shooting down AD6 airplane in Huynh Ky and Vinh Thanh A hamlets
1995	Government invested funds for the construction of sea dyke.
1996	Connected the electricity up to the rural area.
1997	The 5th storm and tornado damaged about 600 houses collapsed and farm production
2000	Government invested funds for the construction of road of Southern Bassac river
2010	The inauguration ceremony of My Thanh 2 bridge in Huynh Ky hamlet

APPENDIX-VI

DESIGNING AND SURVEYS FOR FACILITIES

APPENDIX VI: DESIGNING AND SURVEYS FOR FACILITIES

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VI.1 BILL OF QUANTITIES AND COST ESTIMATION FOR THREE SLUICES IN TRA VINH

CALCULATION EXPLANATION

-Volume: Based on Draft Design Drawing of Vung Liem,Bong Bot ,Tan Dinh
2-Construction method :By machine + manually
3-Materials price: According to published materials 09/2012 of the Department of Finance Building in Vinh Long Province No. 231/CB.LS 28/09/2012, materials not included in the notice of the base priceConstruction of the quotation by the manufacturers or the market price.

4-Legal basis, norms, prices:

- Circular number 04/2010/TT-BXD dated 26/05/2010 by Ministry of Construction to regulate the establishment & management of construction investment cost management.
- Decree 70/2011/ND-CP dated 22/8/2011 regulating minimum wage for working labor in companies, enterprises, cooperatives, farm, household, individuals & other organizations in Vietnam.
- Official documents number 1730/BXD-KTXD dated 20/10/2011 guiding the adjustment of cost estimate for construction according to new minimum wage from 01/10/2011 under the provisions of Decree No. 70/2011/ND-CP
- Circular number 129/2008/TT-BTC dated 26/12/2008 guiding the implementation of a number of items in Value Added Tax Law and the implementation of Decree No. 123/2008/ND-CP dated December 8th 2003 by the Government regulate details and implementation of
- Circular 33/2007/TT-BTC dated 9/4/2007 by Ministry of Finance to guide cost finalization for national budget project.
- Construction insurance cost is according to Decision number 33/2004/QD-BTC-TCNH dated 12/04/2004 by Ministry of Finance
- Circular number 176/2011/TT-BTC dated 06/11/2011 by Ministry of Finance guiding collection, payment & usage of appraisal fees for construction investment project
- Cost norms of project management and investment consulting for construction issued together with Decision number 957/QD-BXD dated 29/09/2009 by Ministry of Construction.
- Construction cost estimation norm for construction part issued together with the official documents number 1776/BXD-VP dated 16/8/2007
- Construction cost estimation norm for installation part issued together with the official documents number 1777/BXD-VP dated 16/8/2007
- Materials loading and unloading norms issued with the official documents number 1778/BXD-VP on 16/8/2007
- Materials norms for basic construction issued with the official document number 1784/BXD-VP on
- Decision no 4892/UBXD-TMXDCB by Ben Tre PPC dated 14/12/2007 on issuance of construction price – for works in Ben Tre province
- Decision no 4892/UBXD-TMXDCB by Ben Tre PPC dated 14/12/2007 on issuance of construction price – for installation part in Ben Tre province
- Price for basic construction in Ben Tre province issued with decision number 1662/2006/QD-UBXD of Ben
- Decision number 2212/2006/QD-UBND on issuance of waterway transport fee of Ben Tre PPC on
- Decision number 4891/UBND-TMXDCB on issuance of price for horizontal transport at construction site in Ben Tre province by Ben Tre PPC on 14/12/2007.
- Machine shift & construction equipment price table for construction in Ben Tre province issued together with official documents number 1001/UBND-TCDT dated 17/03/2011 by the People's Committee on issuance of machine shift & construction equipment in B
- Official documents of the Ben Tre People's Committee number 5708/UBND-TCDT issued on 09/12/2011 regulating adjustment of cost estimation according to the new minimum wage from 01/10/2011.

Decision No. 30/2011/QD-UBND dated 28/12/2011 by Ben Tre People's Committee promulgating regulations on prices of land type in the province of Ben Tre in 2012.

Decision no 18/2011/QD-UBND dated 27/07/2011 by People's Committee of Ben Tre province on issuance of houses and structures price table applied in the province of Ben Tre.

Decision no 14/2010/QD-UBND dated 12/05/2010 of People's Committee of Ben Tre on issuance of supporting policies in cases the government recovers land in the province of Ben Tre.

-Pursuant to Instruction No. 1126/SXD-KTTH 20-12-2011 Construction of the facility Vinh Long on the adjustment cost of labor and construction machines in construction estimates

-Construction estimates have been prepared in accordance with unit prices of construction documents dated 25/12/2007 Construction of the facility

+ Text No. 203/SXD 25/12/2007 "on the announcement of the construction - The installation of electrical systems in the work

+ Text No. 204/SXD 25/12/2007 "on the announcement of the construction - The construction of the province of Vinh Long".

+ Text No. 205/SXD 25/12/2007 "on the announcement of the construction - The construction survey in the province of Vinh Long"

+ Decision No. 20/2009-UBND 5/11/2009 provincial People's Committee of Vinh Long on: promulgate regulations on compensation, support and resettlement when the State recovers land for use for purposes of national defense, security, national interests, public interests, the purpose of economic development and responsible handling of organizations and citizens in the compensation, support and resettlement the province

+ Decision No. 27/2011 dated 20/12/2011 of the provincial People's Committee of Vinh Long: Regulation of land prices in 2012 in the province of Vinh Long.

CONSTRUCTION COST ESTIMATION TABLE

WORKS: 3 SLUICE GATES OF NAM MANG THIT AREA

WORKS: VUNG LIEM, BONG BOT, TAN DINH SLUICE GATE

Unit: dong

No	COST	ĐMTL	CALCULATION METHOD	COST BEFORE TAX	VAT	COST AFTER TAX
1	**Construction cost (GXD)**		(1.1)+(1.2)	**542,013,867,903**	**54,201,386,790**	**596,215,254,694**
1.1	**Construction cost**		**calculation sheet**	**536,647,393,964**	**53,664,739,396**	**590,312,133,360**
	a. Vung Liem Sluice Gate			226,912,513,344	22,691,251,334	249,603,764,679
	b. Bong Bot Sluice Gate			140,101,806,708	14,010,180,671	154,111,987,379
	c. Tan Dinh Sluice Gate			169,633,073,911	16,963,307,391	186,596,381,302
1.2	**Temporary house for accomodation**		**calculation sheet**	**5,366,473,940**	**536,647,394**	**5,903,121,334**
	a. Vung Liem Sluice Gate			2,269,125,133	226,912,513	2,496,037,647
	b. Bong Bot Sluice Gate			1,401,018,067	140,101,807	1,541,119,874
	c. Tan Dinh Sluice Gate			1,696,330,739	169,633,074	1,865,963,813
2	**Compensation, financial support and resettlement cost**		calculation sheet	**25,553,610,600**		**25,553,610,600**
	a. Vung Liem Sluice Gate			8,953,497,000		8,953,497,000
	b. Bong Bot Sluice Gate			7,408,476,600		7,408,476,600
	c. Tan Dinh Sluice Gate			9,191,637,000		9,191,637,000
3	**Project Management cost (G_{QLDA})**		ĐMTL*(G_{XD}+G_{TB})	**7,395,115,633**	**739,511,563**	**8,134,627,196**
	a. Vung Liem Sluice Gate	1.345%		3,051,973,304	305,197,330	3,357,170,635
	b. Bong Bot Sluice Gate	1.417%		1,985,242,603	198,524,260	2,183,766,861
	c. Tan Dinh Sluice Gate	1.390%		2,357,899,727	235,789,973	2,593,689,700
4	**Construction Investment Cost (G_{TV})**			**23,915,718,163**	**2,391,571,816**	**26,307,289,979**
5	**Other cost (G_K)**			**1,505,916,719**	**126,925,522**	**1,632,842,241**
6	**Confingency (G_{DP})**		G_{DP1} + G_{DP2}	**152,423,720,902**	**14,587,616,511**	**167,011,337,413**
	Total:		(1)+(2)+(3)+(4)+(5)+(6)	**752,807,949,919**	**72,047,012,203**	**824,854,962,122**
	ROUND (GXDCT):			**752,807,950,000**	**72,047,012,000**	**824,854,962,000**

CONSULTATION COST SUMMARY TABLE

WORKS: 3 SLUICE GATES OF NAM MANG THIT AREA

WORKS: VUNG LIEM, BONG BOT, TAN DINH SLUICE GATE

Unit: dong

No	COST	ĐMTL	CALCULATION METHOD	COST BEFORE TAX	VAT	COST AFTER TAX
I	***Investment project establishment***					
1	Construction project establishment cost		ĐMTL*(G_{XD}+G_{TB})	1,302,710,681	130,271,068	1,432,981,749
	- Vung Liem Sluice Gate	0.222%		503,745,780	50,374,578	554,120,358
	- Bong Bot Sluice Gate	0.270%		378,274,878	37,827,488	416,102,366
	- Tan Dinh Sluice Gate	0.248%		420,690,023	42,069,002	462,759,026
2	Geological Survey		Estimated	1,500,000,000	150,000,000	1,650,000,000
3	Topographical survey		Estimated	1,200,000,000	120,000,000	1,320,000,000
4	Environmental Impact Assessment		Estimated	150,000,000	15,000,000	165,000,000
5	compensation and resettlement Report		Estimated	150,000,000	15,000,000	165,000,000
6	Cost for evaluation of investment efficiency	0.037%		198,559,536	19,855,954	218,415,489
II	***Establishment of technical design***					
1	Geological Survey		Estimated	2,400,000,000	240,000,000	2,640,000,000
2	Topographical survey		Estimated	900,000,000	90,000,000	990,000,000
3	Survey monitoring	0.0249%	TT	133,625,201	13,362,520	146,987,721
4	Cost for hydraulic model experiments	0.1066%	TT	572,066,122	57,206,612	629,272,734
5	[illegible]	1.288%		6,912,018,434	691,201,843	7,603,220,278
6	[illegible]	0.065%		348,820,806	34,882,081	383,702,887
7	Inspection of cost works estimates	0.063%		338,087,858	33,808,786	371,896,644
8	Establishment of construction price norms	0.0269%	TT	144,358,149	14,435,815	158,793,964
9	[illegible]	0.055%		295,156,067	29,515,607	324,671,673
10	Construction supervision	1.056%		5,666,996,480	566,699,648	6,233,696,128
11	Cost of works quality control	0.189%	TT	1,014,263,575	101,426,357	1,115,689,932
12	Foreign consultants hiring cost	0.0311%	TT	166,897,340	16,689,734	183,587,073
13	Conversion of construction investment capital	0.0423%	TT	227,001,848	22,700,185	249,702,032
14	Establishment of bidding documents	0.055%	TT	295,156,067	29,515,607	324,671,673
15	Costs of other consultation works		Separate cost estimate			
	Total:			**23,915,718,163**	**2,391,571,816**	**26,307,289,979**
	ROUND (GTV)					

OTHER COST & CONTINGENCY SUMMARY TABLE

WORKS: 3 SLUICE GATES OF NAM MANG THIT AREA

WORKS: VUNG LIEM, BONG BOT, TAN DINH SLUICE GATE

Unit: dong

No	COST	ĐMTL	CALCULATION METHOD	COST BEFORE TAX	VAT	COST AFTER TAX
I	OTHER COST			1,505,916,719	126,925,522	1,632,842,241
1	Inspection of investment project			119,136	11,914	131,049
2	Fee for inspection for investment	0.011%		59,031,213		59,031,213
3	Fee for inspection of technical design	0.017%	ĐMTL*TMĐT	91,230,057		91,230,057
4	Fee for inspection of cost estimate	0.016%	ĐMTL*TMĐT	85,865,583		85,865,583
5	Fee for construction license		As regulated			
6	Fee for inspection of bidding results			536,647		536,647
7	Fee for ensuring waterway			7,792,120	779,212	8,571,332
8	Insurance cost			34,881,544	3,488,154	38,369,698
9	Acceptance and handover of works		TT	60,000,000	6,000,000	66,000,000
10	Training for operation manager		TT	120,000,000	12,000,000	132,000,000
11	Audit fee	0.055%		295,156,067	29,515,607	324,671,673
12	Fee for approval of investment	0.140%		751,306,352	75,130,635	826,436,987
II	CONTINGENCY			152,423,720,902	14,587,616,511	167,011,337,413
	- Contingency for quality			60,038,422,902	5,745,939,569	65,784,362,471
	- Contingency for inflation			92,385,298,000	8,841,676,942	101,226,974,942
	Total:			153,929,637,621	14,714,542,033	168,644,179,653
	ROUND (GK)			153,929,638,000	14,714,542,000	168,644,180,000

CONSTRUCTION COST SUMMARY TABLE

WORKS: VUNG LIEM SLUICE GATE

ITEM: CONSTRUCTION OF SLUICE GATE

Unit: Dong

No	ITEM	CALCULATION METHOD	VALUE	CODE
	COST ACCORDING TO PRICE			
	Materials cost		75,511,240,191	A
	Materials difference		79,883,933,607	CLVT
	Manpower cost		5,238,576,247	B
	Construction machine cost		14,124,514,175	C
	Construction machine difference			CLM
I	DIRECT COST			
1	Materials cost	(A + CLVT) * 1	155,395,173,798	VL
2	Manpower cost	B*1*3.602	18,869,351,643	NC
3	Construction machine cost	C*1*1.744+CLM	24,633,152,720	M
4	Other direct cost	(VL+NC+M)*2.5%	4,972,441,954	TT
	Direct cost	VL+NC+M+TT	203,870,120,115	T
II	GENERAL COST	T * 5.5%	11,212,856,606	C
III	TAXABLE INCOME PRECALCULATED	(T+C) * 5.5%	11,829,563,720	TL
	Construction cost before tax	T+C+TL	**226,912,540,441**	G
IV	VALUE ADDED TAX	G * 10%	22,691,254,044	GTGT
	Construction cost after tax	G + GTGT	**249,603,794,485**	G^{XD}
V	CONSTRUCTION OF TEMPORARY HOUSE AND CONSTRUCTION MANAGEMENT HOUSE	G*1%*(1+10%)	2,496,037,945	G_{XDNT}
	TOTAL	$G^{XD} - G_{XDNT}$	**252,099,832,430**	G_{XD}
	ROUND		**252,099,832,000**	

CONSTRUCTION COST ESTIMATE TABLE

WORKS: VUNG LIEM SLUICE GATE

ITEM: SLUICE GATE CONSTRUCTION

Unit: dong

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		Site clearance								
1	AA.11111	Clear forest grade 1 manually, standard tree density100m2 : 0 tree	100m²	309.1		37,363			11,548,530	
2	AA.12111	Cutting down trees in flat ground Dtree <=20cm	tree	2,000.0		4,719			9,438,000	
3	AA.13111	Digging tree stumps Dtree <=20cm	stump	2,000.0		7,866			15,732,000	
4	AA.13212	Digging bush of water coconut. Dbush <=30cm	bush	200.0		29,497			5,899,400	
5	AB.13214	Embankments g =1.60	m³	511.6		31,856			16,296,255	
6	AB.31312	Soil Excavation for embankment or to dump site - Soil Grade II	m³	613.9		24,384			14,968,655	
7	AB.22131	Digging and transporting organic soil in a distance <= 50m, Bulldozer <= 110CV, Soil Grade I	100m³	19.0			257,712			4,908,640
8	AB.13312	Embankment in combination with service roads, K=0.9	m³	1,077.5		28,317			30,512,021	
9	AB.64112	Embankment of service roads using compressor 9T K=0.9	100m³	25.1		68,432	311,889		1,720,520	7,841,526
10	AB.24122	Digging soil for embankment by excavators <=0.8m3 + buzzdozer 110 CV, Soil grade II	100m³	43.1		25,564	322,737		1,101,835	13,910,171
11	AB.41112	Transporting soil by dump trucks Distance <= 300m, truck 5T,Soil grade II	100m³	35.9			426,800			15,329,461

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
12	AB.13312	manual embankment of service roads K=0.9	m³	1,120.5		28,317			31,729,199	
13	AB.64112	Embankment of site area, compressor 9T, K=0.9	100m³	26.1		68,432	311,889		1,789,155	8,154,338
14	AB.24122	Digging soil for embankment by excavators <=0.8m3 + buzzdozer 110 CV	100m³	37.4		25,564	322,737		954,815	12,054,227
15	AB.41112	Transporting soil by dump trucks 5T Distance <= 300m, soil grade II	100m³	37.4			426,800			15,940,980
16	AB.31512	Digging dramage ditches B<=3m, H<=1m, Soil grade II	m³	135.0		35,789			4,831,515	
17	AD.21228	Embankment with aggregate with thickness of 20 cm for service roads	100m²	13.6	616,896	128,224	690,066	8,392,870	1,744,488	9,388,348
18	BB.11208	Installation of concrete pipes D500mm, for 1m pipe use brick	100m	2.0	28,387,182	4,449,648	2,218,277	56,774,364	8,899,296	4,436,554
19	AB.22122	Land levelling as the previous condition of site ground, distance <=50m, Bulldozer <= 110CV, Soil Grade II	100m²	37.4			317,375			11,853,956
20	GTT1	Material loading and unloading terminals	piece							
		**Bored piles for ground treatment:*								
		+ Pile casting yard								
21	AB.22122	Leveling to restore construction site, buzzdozer <= 110cv, distance <= 50m, soil grade II	100m²	37.4			317,375			11,853,956
		Driving pile for foundation								
		+ pile casting yard								
22	AB.22122	Leveling for pile casting yard by buzzdozer <= 110cv, distance <= 50m, soil grade II	100m²	165.0			317,375			52,366,875

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
23	AK.41114	Smoothen floor of yard with 2cm layer of M75 mortar	m²	500.0	6,925	3,124	175	3,462,500	1,562,000	87,500
24	AF.11121	Concrete for subase width > 250cm stone 4x6 M100	m³	25.0	294,928	46,408	12,382	7,373,200	1,160,200	309,550
		+ Preparation to install pile								
		a. Floor embankment								
25	AB.62111	Compact by compactor 9T. K = 0.85	100m³	6.4		29,103	191,952		187,132	1,234,251
26	AB.24122	Digging soil for embankment by excavators <=0.8m3 – buzzdozer 110 CV	100m³	7.7		25,564	322,737		197,252	2,490,239
27	AB.41112	Transporting soil by dump trucks 5T Distance <= 300m, soil grade II	100m³	7.7			426,800			3,293,189
28	AB.66112	Sand embankment by compactor 9T, K = 0.90	100m³	6.4	1,626,626	58,994	289,017	10,459,205	379,331	1,858,379
29	AD.21228	Aggregate of scaffold with thickness of 20cm	100m²	6.4	616,896	128,224	690,066	3,968,698	824,908	4,439,425
30	AD.21223	Aggregate of scaffold with thickness of 10cm	100m²	6.4	308,448	88,405	329,507	1,984,349	568,739	2,119,828
		b. Fabrication								
31	AG.11115	Production of pre-casted concrete pile stone 1x2 M300	m³	1,574.4	477,906	71,972	19,353	752,400,869	113,310,558	30,468,783
32	AG.13121	Fabricate and erect precast concrete pile diameter <=18mm	ton	393.6	7,481,619	533,421	145,813	2,944,709,126	131,232,005	57,390,903
33	AI.13151	Fabricate steel structure inside concrete, pile connection box weight >100kg/components	ton	93.0	9,157,065	1,216,218	374,097	851,607,045	113,108,274	34,791,021
34	AI.11131	Manufacture pile by steel profile	ton	2.8	8,767,247	436,468	749,308	24,548,292	1,222,110	2,098,062
35	AG.31121	Production, erection and dismantling of pile formwork	100m²	205.6	274,109	1,129,136		56,366,656	232,190,918	
		c. Pile driving								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
36	AG.41141	Erection of precast concrete pile > 7T	cái	1,488.0	98,698	77,645	147,690	146,862,624	115,535,760	219,762,720
37	AC.15223	Driving reinforced plumb piles 35x35 on ground, hammer <=2.5T, length <= 24m, soil grade 2	100m	1.4	25,116,175	269,466	4,415,727	35,413,807	379,947	6,226,175
38	AC.18112	Driving reinforced piles 35x35 above water, hammer <=2.5T, length <= 24m	100m	112.6	25,239,900	277,141	9,336,944	2,841,760,341	31,203,305	1,051,246,525
39	AC.18112	Driving inclined reinforced piles 35x35 above water, hammer <=2.5T, length <= 24m	100m	2.0	25,239,900	277,141	9,336,944	49,975,002	548,739	18,487,149
40	AC.15223	Driving reinforced vertical piles 35x35 length > 24m on ground, hammer <=2.5T, soil grade II	100m	10.6	25,116,175	269,466	4,415,727	265,226,808	2,845,561	46,630,077
41	AC.15223	Driving reinforced inclined piles 35x35 length > 24m on ground, hammer <=2.5T, soil grade II	100m	2.0	25,116,175	269,466	4,415,727	49,730,027	533,543	8,743,139
42	AC.23110	Dismantling driving piles	100m	2.0		122,211	2,473,435		244,422	4,946,870
43	AA.21241	Pile head breaking	m³	30.4		234,504			7,128,922	
44	AB.22121	Production, erection and dismantling of pile formwork	shift	30.0			257,712			7,731,360
		Foundation hole, channel connection and works finishing								
45	AB.22122	Leveling fishbone road by buzzdozer = 110 cv, distance <=50m	100m³	1.3			317,575			412,588
46	AD.21228	Embankment with aggregate with thickness of 20 cm for service roads	100m²	0.8	616,896	128,224	690,066	481,179	100,015	538,251

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
47	AD.21223	Aggregate of scaffold with thickness of 10cm	100m²	0.8	308,448	88,405	329,507	240,589	68,956	257,015
48	AB.25412	Digging foundation > 20m by excavators <= 0.8m3, soil grade II	100m³	180.0		55,926	369,909		10,066,680	66,583,620
49	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	180.0			426,800			76,824,000
50	AB.22122	Land levelling as the previous condition of site ground, distance <=50m	100m²	54.0			317,375			17,138,250
51	AB.71150	Dredging depth <=6m by suction vessel capacity <= 1000CV, h discharge pipe <=3m, l discharge pipe <=300 m	100m³	238.0		294,683	5,031,568		70,134,554	1,197,513,184
52	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzdozer 110CV, distance 30m	100m³	9.0		19,665	271,398		176,985	2,442,582
53	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	9.0			426,800			3,841,200
54	AB.64113	Soil embankment for wing wall by compressor 9T K=0.95	100m³	7.5		68,432	436,645		513,240	3,274,838
55	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzdozer 110CV, distance 30m	100m³	126.0		19,665	271,398		2,477,790	34,196,148
56	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	126.0			426,800			53,776,800
57	AB.63113	Embankment for channel top by compactor 9T, weight <= 1.8T/m3	100m³	103.0		58,207	370,175		6,111,735	38,868,375

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
58	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzdozer 110CV, distance 30m	100m³	16.8		19,665	271,398		330,372	4,559,486
59	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	16.8			426,800			7,170,240
60	AB.65130	Embankment by jumping compactor, K = 0,95	100m³	1,400.0		467,710	266,115		654,794,000	372,561,000
		Frame fabrication								
61	AC.22622	Driving steel I300 piles above the water surface, pile length > 10m, soil grade II (depreciation 30%)	100m	54.8	6,181,200	740,617	16,831,019	338,611,081	40,571,592	922,016,686
62	AI.11911	Production of fixed frame system (depreciation 30%)	ton	17.6	2,571,395	1,217,516	990,170	45,205,121	21,403,931	17,407,189
63	AI.63321	Erection of steel structure under water	ton	17.6	181,860	528,356	898,609	3,197,093	9,288,498	15,797,546
64	AC.23120	Nhổ cọc thép hình, làm khung dẫn định vị, thao tác under water	100m	54.8		261,881	4,437,407		14,346,051	244,180,521
65	AC.22222	Driving steel sheet piles (Larsen pile) above the water surface, pile length > 12m soil grade II (depreciation 30%)	100m	273.9	20,532,150	843,532	21,288,936	5,622,852,470	231,006,299	5,830,102,857
66	AI.11911	Production of Larsen fixed frame system (depreciation 30%)	ton	12.0	2,571,395	1,217,516	990,170	30,753,882	14,561,491	11,842,433
67	AI.63321	Erection of Larsen pile structure under water	ton	12.0	181,860	528,356	898,609	2,175,046	6,319,138	10,747,364
68	AC.23220	Dismantling Larsen wooden pile underwater	100m	273.9		396,497	8,551,421		108,583,082	2,341,857,949
		Excavation works inside frame								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
69	AB.71150	Dredging soil inside frame, silt, depth <=6m by suction vessel capacity <= 1000CV, h discharge pipe <=3m, l discharge pipe <=300	100m³	128.1		294,683	5,031,568		37,736,516	644,332,535
70	GT12	Water pumping inside frame	shift	28.0						
		Road connecting sluice gate and dyke								
71	AB.22121	Digging and transporting organic soil in a distance <= 50m by buzzdozer <= 110 cv, distance <= 50m, soil grade I	100m³	14.1			257,712			3,627,554
72	AB.34121	Soil digging on trucks by excavator 0.8m3 + buzzdozer 110CV, distance 30m	100m³	65.2		19,665	271,398		1,282,613	17,701,434
73	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	65.2			426,800			27,837,228
74	AB.65130	Embankment by jumping compactor, K = 0.95	100m³	54.4		467,710	266,115		25,421,255	14,464,042
75	AB.66113	Sand embankment compactor, K = 0.95	100m³	36.2	1,626,626	58,994	355,554	58,940,793	2,137,648	12,883,499
76	AD.11222	Stone aggregate	100m³	7.5	20,022,000	202,154	1,146,995	150,309,158	1,517,611	8,610,721
77	AG.11922	Fabricate precast concrete block to prevent wave stone 1x2 M150	m³	120.1	360,216	88,212	14,297	43,272,748	10,596,908	1,717,499
78	AG.42111	Install concrete component weight <=50kg manually	cái	6,673.9	915	6,892		6,106,608	45,996,442	
79	AF.11223	Concrete at foot of block, width > 250cm stone 1x2 M200	m³	16.5	445,240	77,478	12,606	7,333,103	1,276,063	207,621
80	AF.61110	Fabricate and erect reinforcement at block foot diameter <=10mm	ton	1.3	7,159,379	482,651	23,853	9,435,198	635,941	31,429
81	AK.41124	Lining mortar of 3cm thick M75	m²	164.7	9,695	4,870	234	1,596,476	801,943	38,533

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
82	AD.21314	Stone road surface with asphalt emulsion of acid base, surface thickness 12cm	100m²	25.0	4,861,732	810,956	762,103	121,659,982	20,293,363	19,070,865
		Sluice gate paving:								
		bottom slabs:								
		a. bottom slabs of side column								
83	AF.11223	Concrete for bottom of foundation width > 250cm stone 1x2 M200	m³	466.3	445,240	77,478	12,606	207,624,317	36,129,541	5,878,430
84	AF.11121	Foundation concrete width > 250cm stone 4x6 M100	m³	798.0	294,928	46,408	12,382	235,343,696	37,032,192	9,880,465
85	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	949.29	519,113	77,478	12,606	492,786,703	73,548,781	11,966,699
86	AF.61120	Fabricate and erect reinforcement of foundation diameter <=18mm	ton	75.9	7,481,259	355,593	144,359	568,148,354	27,004,757	10,963,038
87	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	4.9	2,335,418	580,290		11,350,131	2,820,209	
		b. Middle plate column								
88	AF.11223	Bottom seal concrete width > 250cm stone 1x2 M200	m³	522.0	445,240	77,478	12,606	232,415,280	40,443,516	6,580,332
89	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	798.0	294,928	46,408	12,382	235,343,696	37,032,192	9,880,465
90	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	806.61	519,113	77,478	12,606	418,721,737	62,494,530	10,168,126
91	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	64.5	7,481,259	355,593	144,359	482,756,666	22,945,990	9,315,313
92	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	4.9	2,335,418	580,290		11,350,131	2,820,209	
		c. Double wall bottom slab								
93	AF.11223	Bottom concrete of foundation width > 250cm stone 1x2 M200	m³	396.7	445,240	77,478	12,606	176,635,613	30,737,072	5,001,052
94	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	678.9	294,928	46,408	12,382	200,217,771	31,504,999	8,405,768

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
95	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B> 250cm	m³	913.6	519,113	77,478	12,606	474,275,134	70,785,915	11,517,169
96	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	73.1	7,481,259	355,593	144,359	546,805,819	25,990,321	10,551,211
97	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	5.1	2,333,418	580,290		11,854,582	2,945,552	
		d. Bottom slab between 2 column								
98	AF.11223	Bottom concrete of foundation width > 250cm stone 1x2 M200	m³	1,224.1	445,240	77,478	12,606	545,009,379	94,839,270	15,430,752
99	AF.11225	stone-lined concrete 4x6 M100, width > 25cm	m³	2,617.8	519,113	77,478	12,606	1,358,958,929	202,825,627	33,000,592
100	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	209.4	7,481,259	355,593	144,359	1,566,783,913	74,471,074	30,232,794
101	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	5.3	2,333,418	580,290		12,387,057	3,077,858	
		Side column of sluice gate								
		a. Side column								
102	AF.12145	Wall concrete of thickness > 45cm h> =16m stone 1x2 M300	m³	881.7	534,204	168,416	31,344	471,023,693	148,497,440	27,636,945
103	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h> =16m	ton	70.5	7,481,259	520,171	152,546	527,716,040	36,692,030	10,746,243
104	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork >45cm	100m²	11.8	2,695,831	1,498,234		31,897,072	17,727,105	
		b. Column								
105	AF.12145	Wall concrete of thickness > 45cm h> =16m stone 1x2 M300	m³	881.7	534,204	168,416	31,344	471,023,693	148,497,440	27,636,945
106	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h> =16m	ton	70.5	7,481,259	520,171	152,546	527,716,040	36,692,030	10,746,243

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
107	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork >45cm	100m²	11.8	2,695,831	1,498,234		31,897,072	17,727,105	
		c. Double column								
108	AF.12145	Wall concrete of thickness > 45cm h> =16m stone 1x2 M300	m³	881.7	534,204	168,416	31,344	471,023,693	148,497,440	27,636,945
109	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h> =16m	ton	70.5	7,481,259	520,171	152,546	527,716,040	36,692,030	10,746,243
110	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork >45cm	100m²	11.8	2,695,831	1,498,234		31,897,072	17,727,105	
		Turning wall								
		a. Component 1								
111	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	14.4	294,928	46,408	12,382	4,246,963	668,275	178,301
112	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B> 250cm	m³	57.6	519,113	77,478	12,606	29,900,909	4,462,733	726,106
113	AF.12125	Wall concrete of thickness > =45cm h> =16m stone 1x2 M300	m³	284.2	599,314	179,928	31,344	170,337,025	51,139,136	8,908,592
114	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.6	7,481,259	355,593	144,359	34,473,641	1,638,573	665,206
115	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h> =16m	ton	22.7	7,481,259	520,171	152,546	170,105,875	11,827,440	3,463,982
116	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	14.2	2,519,916	1,276,324		35,810,526	18,137,840	
		b. Component 2								
117	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	14.8	294,928	46,408	12,382	4,364,934	686,838	183,254
118	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B> 250cm	m³	59.2	519,113	77,478	12,606	30,731,490	4,586,698	746,275

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
119	AF.12125	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	195.720	599,314	179,928	31,344	117,297,736	35,215,508	6,134,648
120	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.736	7,481,259	355,593	144,359	35,431,243	1,684,088	683,684
121	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	15.658	7,481,259	520,171	152,346	117,138,561	8,144,629	2,385,373
122	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	9.8	2,519,916	1,276,324		24,569,181	12,444,159	
		c. Components 3								
123	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	14.8	294,928	46,408	12,382	4,364,934	686,838	183,254
124	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	59.2	519,113	77,478	12,606	30,731,490	4,586,698	746,275
125	AF.12125	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	110.9	599,314	179,928	31,344	66,475,909	19,957,614	3,476,676
126	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.7	7,481,259	355,593	144,359	35,431,243	1,684,088	683,684
127	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	8.9	7,481,259	520,171	152,346	66,385,700	4,615,789	1,351,857
128	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	5.5	2,519,916	1,276,324		13,972,934	7,077,217	
		Back yard								
		a. To the field								
129	AL.15111	Fabricate and drop Fabricate and drop gabion basket 2x1x1m under water	piece	820.0	242,729	179,075		199,037,780	146,841,500	
130	AL.15121	Fabricate and drop gabion basket 2x1x0.5m under water	piece	1,032.2	160,001	108,298		165,159,432	111,789,528	

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		b. To the river								
131	AL.15111	Fabricate and drop gabion basket 2x1x1m under water	piece	820.0	242,729	179,075		199,037,780	146,841,500	
132	AL.15121	Fabricate and drop gabion basket 2x1x0.5m under water	piece	1,032.2	160,001	108,298		165,159,432	111,789,528	
		Valve framework								
		a. Sluice gate body								
133	AF.12245	Column concrete cross section > 0.1m2 h<=16m stone 1x2 M300	m³	36.7	528,967	172,680	32,440	19,398,278	6,332,521	1,189,640
134	AF.12315	Beam, bracing concrete stone 1x2 M300	m³	201.8	485,025	151,788	31,344	97,867,574	30,627,479	6,324,530
135	AF.12415	Roof concrete stone 1x2 M300	m³	35.5	485,025	105,740	26,357	17,136,370	3,735,889	931,217
136	AF.61422	Fabricate and erect column reinforcement diameter <=18mm h<=16m	ton	3.7	7,481,259	434,471	152,346	27,435,273	1,593,292	558,683
137	AF.61522	Fabricate and erect Beam, bracing reinforcement diameter <=18mm h<=16m	ton	20.2	7,481,619	443,851	153,829	150,962,612	8,955,937	3,103,931
138	AF.61711	Fabricate and erect roof reinforcement diameter <=10mm h<=16m	ton	3.5	7,159,379	623,779	24,350	25,294,730	2,203,867	85,960
139	AF.81132	Fabricate and erect, dismantle formwork	100m²	44.8	2,524,401	1,465,614		113,065,240	65,643,295	
		b. External sluice body								
140	AF.12245	Column concrete cross section > 0.1m2 h<=16m stone 1x2 M300	m³	30.9	528,967	172,680	32,440	16,351,428	5,337,884	1,002,785
141	AF.12315	Beam, bracing concrete stone 1x2 M300	m³	79.9	485,025	151,788	31,344	38,758,348	12,129,379	2,504,699
142	AF.12415	Roof concrete stone 1x2 M300	m³	16.0	485,025	105,740	26,357	7,745,316	1,688,551	420,892
143	AF.61422	Fabricate and erect column reinforcement diameter <=18mm h<=16m	ton	3.1	7,481,259	434,471	152,346	23,126,068	1,343,037	470,932

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
144	AF.61522	Fabricate and erect Beam, bracing reinforcement diameter <=18mm h<=16m	ton	8.0	7,481,619	443,851	153,829	59,785,617	3,546,813	1,229,248
145	AF.61711	Fabricate and erect roof reinforcement diameter <=10mm h<=16m	ton	1.6	7,159,379	623,779	24,330	11,432,741	996,106	38,852
146	AF.81132	Fabricate and erect, dismantle rectangular formwork	100m²	20.8	2,524,401	1,465,614		52,385,372	30,413,842	
147	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	11.0	294,928	46,408	12,382	3,239,462	508,168	135,583
148	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	21.9	519,113	77,478	12,606	11,368,575	1,696,768	276,071
149	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	1.8	7,481,259	355,593	144,359	13,107,166	622,999	252,917
		Transport bridge								
		a. Span								
150	GT13	Concrete beam L=24.34m	piece	10.0	67,272,727			672,727,270		
151	AG.41141	Erection of precast concrete column > 15T	piece	10.0	98,698	77,645	147,690	986,980	776,450	1,476,900
152	AG.52322	Erect habor port weight > 15T	piece	10.0	24,000	433,738	733,030	240,000	4,337,380	7,330,300
153	AF.12315	Concrete for bridge surface, beam, bracing stone 1x2 M300	m³	207.6	485,025	151,788	31,344	100,667,909	31,503,903	6,505,510
154	AF.61522	Fabricate and erect different reinforcement diameter <=18mm h<=16m	piece	16.6	7,481,619	443,851	153,829	124,225,999	7,369,773	2,554,201
155	AF.81141	Fabricate and erect, dismantle formwork	100m²	6.9	2,935,675	1,579,555		20,310,174	10,927,993	
		b. Middle span								
156	GT14	Concrete beam L=16,96m	piece	36.0	46,493,295			1,673,758,606		
157	AG.41141	Erection of precast concrete column > 15T	piece	36.0	98,698	77,645	147,690	3,553,128	2,795,220	5,316,840
158	AG.52322	Erect habor port weight > 15T	piece	36.0	24,000	433,738	733,030	864,000	15,614,568	26,389,080

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
159	AF.12315	Concrete for bridge surface, beam, bracing stone 1x2 M300	m³	206.2	485,025	151,788	31,344	100,031,356	31,304,757	6,464,387
160	AF.61522	Fabricate and erect different reinforcement diameter <=18mm h<=16m	ton	16.5	7,481,619	443,851	153,829	123,440,728	7,323,186	2,538,055
161	AF.81141	Fabricate and erect, dismantle formwork	100m²	6.9	2,935,675	1,579,555		20,181,787	10,858,914	
		Abutment								
162	AF.12125	Abutment concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	220.9	599,314	179,928	31,344	132,368,096	39,739,981	6,922,824
163	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	17.7	7,481,259	520,171	152,346	132,188,470	9,191,048	2,691,844
164	AG.11113	Fabricate precast concrete for sign post stone 1x2 M200	m³	6.9	405,095	71,972	19,353	2,789,079	495,537	133,245
165	AG.13111	Fabricate and erect reinforced concrete for sign post diameter <=10mm	ton	5.5	7,159,379	607,577	23,853	39,433,860	3,346,534	131,382
166	AG.42111	Manual erection of precast concrete component weight <=50kg	piece	206.0	915	6,892		188,490	1,419,752	
167	AF.11111	Foundation lining concrete width <=250cm stone 4x6 M100	m³	2.3	294,928	55,847	12,382	663,588	125,656	27,860
168	AF.81132	Fabricate and erect, dismantle bridge abutment formwork	100m²	2.3	2,524,401	1,465,614		5,806,122	3,370,912	
		Roofing upstream and downstream gate by gabion mattress thickness 30cm								
169	AL.15121	Fabricate and drop gabion basket 2x1x0.5m under water	piece	3,487.5	160,001	108,298		558,003,488	377,689,275	
		Paving								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
170	AF.11223	Concrete for paving width > 250cm stone 1x2 M200	m³	429.9	445,240	77,478	12,606	191,413,128	33,308,567	5,419,445
171	AF.61110	Fabricate and erect reinforcement for concrete diameter <=10mm	ton	34.4	7,159,379	482,651	23,853	246,231,090	16,599,719	820,371
172	AF.81111	Fabricate and erect, dismantle formwork	100m²	14.3	2,335,418	580,290		33,467,318	8,315,749	
		Waterway signs	system	1.0				150,000,000		
		Works fence	system	1.0				400,000,000		
		Landscaping	system	1.0				2,000,000,000		
		Management house	system	1.0				300,000,000		
		Anti lightning system	system	1.0				300,000,000		
		Water and electricity system	system	1.0				500,000,000		
		Mechanical: Valve gate and equipment	set	4.0				39,835,221,000		
		TOTAL						**75,511,240,191**	**5,238,576,247**	**14,124,514,175**
								A	B	C

CONSTRUCTION COST SUMMARY TABLE

WORKS: BONG BOT SLUICE GATE

ITEM: CONSTRUCTION OF SLUICE GATE

Unit: Dong

No	ITEM	CALCULATION METHOD	VALUE	CODE
	COST ACCORDING TO PRICE			
	Materials cost		49,661,966,348	A
	Materials difference		48,220,490,256	CLVT
	Manpower cost		2,992,069,415	B
	Construction machine cost		8,110,549,776	C
	Construction machine difference			CLM
I	DIRECT COST			
1	Materials cost	(A + CLVT) * 1	97,882,456,604	VL
2	Manpower cost	B*1*3.602	10,777,434,033	NC
3	Construction machine cost	C*1*1.744+CLM	14,144,798,810	M
4	Other direct cost	(VL+NC+M)*2.5%	3,070,117,236	TT
	Direct cost	VL+NC+M+TT	125,874,806,683	T
II	GENERAL COST	T * 5.5%	6,923,114,368	C
III	TAXABLE INCOME PRECALCULATED	(T+C) * 5.5%	7,303,885,658	TL
	Construction cost before tax	T+C+TL	**140,101,806,708**	G
IV	VALUE ADDED TAX	G * 10%	14,010,180,671	GTGT
	Construction cost after tax	G + GTGT	**154,111,987,379**	G^{XD}
V	CONSTRUCTION OF TEMPORARY HOUSE AND CONSTRUCTION MANAGEMENT HOUSE	G*1%*(1+10%)	1,541,119,874	G_{XDNT}
	TOTAL	$G^{XD} + G_{XDNT}$	**155,653,107,253**	G_{XD}
	ROUND		**155,653,107,000**	

CONSTRUCTION COST ESTIMATE TABLE

WORKS: BONG BOT SLUICE GATE

ITEM: SLUICE GATE CONSTRUCTION

Unit: đồng

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		Site clearance								
1	AA.11111	Clear forest grade 1 manually, standard tree density/100m2 : 0 tree	100m²	258.8		37,363			9,670,292	
2	AA.12111	Cutting down trees in flat ground Dtree <=20cm	tree	800.0		4,719			3,775,200	
3	AA.13111	Digging tree stumps Dtree <=20cm	stump	800.0		7,866			6,292,800	
4	AA.13212	Digging bush of water coconut, Dbush <=30cm	bush	100.0		29,497			2,949,700	
5	AB.13214	Embankments g<=1.60	m³	824.0		31,856			26,250,618	
6	AB.11212	Soil Excavation for embankment or to dump site - Soil Grade II	m³	988.8		24,384			34,112,070	
7	AB.22121	Digging and transporting organic soil in a distance <= 50m. Bulldozer <= 110CV, Soil Grade I	100m²	14.6			257,712			3,772,131
8	AB.13312	Embankment in combination with service roads, K=0.9	m³	1,137.5		28,317			32,210,701	
9	AB.64112	Embankment of service roads using compressor 9T K=0.9	100m²	26.5		68,432	311,889		1,816,306	8,278,083
10	AB.24122	Digging soil for embankment by excavators <=0.8m3 + buzzdozer 110 CV, Soil grade II	100m³	45.3		25,564	322,737		1,163,166	14,684,585
11	AB.41112	Transporting soil by dump trucks: Distance <= 300m, truck 5T,Soil grade II	100m³	37.9			426,800			16,182,890
12	AB.13312	manual embankment of service roads K=0.9	m³	765.0		28,317			21,662,505	

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
13	AB.64112	Embankment of site area, compressor 9T, K=0.9	100m³	17.9		68,432	311,889		1,221,511	5,567,219
14	AB.24122	Digging soil for embankment by excavators <=0.8m3 + buzzdozer 110 CV	100m³	25.5		25,564	322,737		651,882	8,229,794
15	AB.41112	Transporting soil by dump trucks 5T,Distance <=300m, soil grade II	100m³	25.5			426,800			10,883,400
16	AB.11512	Digging drainage ditches B<=3m, H<=1m, Soil grade II	m³	148.5		35,789			5,314,667	
17	AD.21228	Embankment with aggregate with thickness of 20 cm for service roads	100m²	10.5	616,896	128,224	690,066	6,449,648	1,340,582	7,214,640
18	BB.11208	Installation of concrete pipes D500mm, for 1m pipe use brick	100m	1.2	28,387,182	4,449,648	2,218,277	34,064,618	5,339,578	2,661,932
19	AB.22122	Land levelling as the previous condition of site ground, distance <=50m, Bulldozer <= 110CV, Soil Grade II	100m²	25.5			317,375			8,093,063
20	GTT1	Material loading and unloading terminals	piece							
		"Bored piles for ground treatment"								
		+ Pile casting yard								
21	AB.22122	Leveling to restore construction site, buzzdozer <= 110cv, distance <= 50m, soil grade II	100m²	25.5			317,375			8,093,063
		Driving pile for foundation								
		+ pile casting yard								
22	AB.22122	Leveling for pile casting yard by buzzdozer <= 110cv, distance <= 50m, soil grade II	100m²	1.4			317,375			457,020
23	AK.41134	Smoothen floor of yard with 2cm layer of M75 mortar	m²	500.0	6,925	3,124	175	3,462,500	1,562,000	87,500
24	AF.11421	Concrete for subase width > 250cm stone 4x6 M100	m³	25.0	294,928	46,406	12,382	7,373,200	1,160,200	309,550

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		+ Preparation to install pile								
		a. Floor embankment								
25	AB.62111	Compact by compactor 9T, K = 0,85	100m³	6.4		29.103	191.952		187.132	1.234.251
26	AB.24122	Digging soil for embankment by excavators <=0.8m3 + buzzdozer 110 CV	100m³	7.7		25.564	322.737		197.252	2.490.239
27	AB.41112	Transporting soil by dump trucks 5T Distance <= 300m, soil grade II	100m³	7.7			426.800			3.295.189
28	AB.66112	Sand embankment by compactor 9T, K = 0,90	100m³	6.4	1.626.626	58.994	289.017	10.459.205	379.331	1.858.379
29	AD.21228	Aggregate of scaffold with thickness of 20cm	100m²	6.4	616.896	128.224	690.066	3.968.698	824.908	4.439.425
30	AD.21223	Aggregate of scaffold with thickness of 10cm	100m²	6.4	308.448	88.405	329.507	1.984.349	568.739	2.119.828
		b. Fabrication								
31	AG.11115	Production of pre-casted concrete pile stone 1x2 M300	m³	843.9	477.906	71.972	19.353	403.306.068	60.737.351	16.332.045
32	AG.13121	Fabricate and erect precast concrete pile diameter <=18mm	ton	211.0	7.483.619	333.421	145.813	1.578.439.245	70.343.704	30.762.989
33	AI.73151	Fabricate steel structure inside concrete, pile connection box weight > 100kg/components	ton	50.8	9,157.065	1,216.218	374,097	465.094.840	61.772.710	19.000.693
34	AI.71131	Mamufacture pile by steel profile	ton	2.8	8.767.247	436.468	749.308	24.548.292	1.222.110	2.098.062
35	AG.31121	Production, erection and dismantling of pile formwork	100m²	110.2	274.109	1.129.136		30.213.390	124.457.886	
		c. Pile driving								
36	AG.41141	Erection of precast concrete pile <=7T	piece	813.0	98,698	77.645	147.690	80.241.474	63.125.385	120.071.970
37	AC.15223	Driving reinforced plumb piles 35x35 on ground, hammer <=2.5T, length <= 24m, soil grade 2	100m	1.3	25.116.175	269.466	4.415.727	31.395.219	336.833	5.519.659

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
38	AC.18112	Driving reinforced piles 35x35 above water, hammer <=2.5T length <= 24m	100m	54.7	25.239.900	277.141	9.336.944	1.379.865.333	15,151,298	510,450,728
39	AC.18112	Driving inclined reinforced piles 35x35 above water, hammer <=2.5T, length <= 24m	100m	1.5	25,239,900	277,141	9,336,944	37.859.850	415.712	14.005.416
40	AC.15223	Driving reinforced vertical piles 35x35 length > 24m on ground, hammer <=2.5T, soil grade II	100m	10.0	25,116,175	269,466	4,415,727	250.408.265	2.686.576	44.024.798
41	AC.15223	Driving reinforced inclined piles 35x35 length > 24m on ground, hammer <=2.5T, soil grade II	100m	1.5	25,116,175	269,466	4,415,727	37.674.263	404.199	6.623.591
42	AC.23110	Dismantling driving piles	100m	2.0		122.211	2,473,435		244.422	4.946.870
43	AA.21241	Pile head breaking	m³	16.6		234.504			3,892,473	
44	AB.22121	Production, erection and dismantling of pile formwork	ca	20.0			257.702			5,154,240
		Foundation hole, channel connection and works finishing								
45	AB.22122	Leveling fishbone road by buzzdozer = 110 cv, distance <=50m	100m²	1.5			317.275			476.063
46	AD.21228	Embankment with aggregate with thickness of 20 cm for service roads	100m²	0.9	616,896	128.224	690.066	555.206	115.402	621.059
47	AD.21223	Aggregate of scaffold with thickness of 10cm	100m²	0.9	308,448	88,405	329,507	277,603	79,565	296,556
48	AB.25412	Digging foundation > 20m by excavators <= 0.8m3, soil grade II	100m³	287.7		55.926	369,909		16.091.598	106.433.917
49	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	287.7			426,800			122.803.164

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
50	AB.22122	Land levelling as the previous condition of site ground, distance <=50m	100m²	86.3			317,375			27,395,493
51	AB.71150	Dredging depth <=6m by suction vessel capacity <= 1000CV, h discharge pipe <=3m, l discharge pipe >300 m	100m³	145.3		294,683	5,031,568		42,802,706	730,835,252
52	AB.24121	Soil digging on trucks by excavator 0,8m3 + buzzdozer 110CV, distance 30m	100m³	9.0		19,665	271,398		176,985	2,442,582
53	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	9.0			426,800			3,841,200
54	AB.64113	Soil embankment for wing wall by compressor 9T K=0,95	100m³	7.5		68,432	436,645		513,240	3,274,838
55	AB.24121	Soil digging on trucks by excavator 0,8m3 + buzzdozer 110CV, distance 30m	100m³	112.5		19,665	271,398		2,212,313	30,532,575
56	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	112.5			426,800			48,015,000
57	AB.63113	Embankment for channel top by compactor 9T, weight <= 1,8T/m3	100m³	93.8		58,207	370,175		5,456,906	34,703,906
58	AB.24121	Soil digging on trucks by excavator 0,8m3 + buzzdozer 110CV, distance 30m	100m³	15.6		19,665	271,398		306,774	4,233,809
59	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	15.6			426,800			6,658,080
60	AB.65130	Embankment by jumping compactor, K = 0,95	100m³	13.0		467,710	266,115		6,080,230	3,459,495
		Frame fabricator								
61	AC.22622	Driving steel I300 piles above the water surface, pile length > 10m, soil grade II (depreciation 30%)	100m	31.1	6,181,200	740,617	16,891,019	192,279,825	23,038,521	525,565,874

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
62	AI.11911	Production of fixed frame system (depreciation 30%)	ton	10.1	2,571,395	1,217,516	990,170	25,994,909	12,308,191	10,009,890
63	AI.63321	Erection of steel structure under water	ton	10.1	181,860	528,356	898,609	1,838,471	5,341,290	9,084,276
64	AC.23120	Nhổ cọc thép hình, tấm khung đã định vị, thao tác under water	100m	31.1		261,881	4,457,407		8,146,385	138,657,451
65	AC.22220	Driving steel sheet piles (Larsen pile) above the water surface, pile length > 12m soil grade II (depreciation 30%)	100m	155.5	20,532,150	843,332	21,288,936	3,192,502,939	131,159,104	3,310,174,081
66	AI.11911	Production of Larsen fixed frame system (depreciation 30%)	ton	8.2	2,571,395	1,217,516	990,170	21,137,112	10,008,098	8,139,292
67	AI.63321	Erection of Larsen pile structure under water	ton	8.2	181,860	528,356	898,609	1,494,907	4,343,137	7,386,652
68	AC.23220	Dismantling Larsen wooden pile underwater	100m	155.5		396,497	8,551,421		61,650,526	1,329,643,348
		Excavation works inside frame								
69	AB.71150	Dredging soil inside frame, silt, depth <=6m by suction vessel capacity >= 1000CV, h discharge pipe <=3m, l discharge pipe <=300	100m³	74.2		294,683	5,031,568		21,857,227	373,201,462
70	GTT2	Water pumping inside frame	Ca	19.0			184,109			3,498,071
		Road connecting sluice gate and dyke								
71	AB.22121	Digging and transporting organic soil in a distance <= 50m by buzzdozer <= 110 cv, distance <= 50m, soil grade I	100m³	13.1			257,712			3,372,419
72	AB.24121	Soil digging on trucks by excavator 0,8m3 + buzzdozer 110CV, distance 30m	100m³	54.1		19,665	271,398		1,064,131	14,686,142
73	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	54.1			426,800			23,095,401

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
74	AB.65130	Embankment by jumping compactor, K = 0,95	100m³	45.1		467,710	266,115		21,090,967	12,000,220
75	AB.66118	Sand embankment compactor, K = 0,95	100m³	30.1	1,626,626	58,994	355,554	48,900,837	1,773,521	10,688,928
76	AD.11222	Stone aggregate	100m³	7.0	20,022,000	202,154	1,146,995	139,737,542	1,410,873	8,005,108
77	AG.11922	Fabricate precast concrete block to prevent wave stone 1x2 M150	m³	157.0	360,216	88,212	14,297	56,556,035	13,849,804	2,244,713
78	AG.42111	Install concrete component weight <=50kg manually	piece	8,722.5	915	6,892		7,981,133	60,115,812	
79	AF.11223	Concrete at foot of block, width > 250cm stone 1x2 M200	m³	23.0	445,240	77,478	12,606	10,258,330	1,785,093	290,442
80	AF.61110	Fabricate and erect reinforcement at block foot diameter <=10mm	ton	1.8	7,159,379	482,651	23,853	13,196,167	889,622	43,966
81	AK.41124	Lining mortar of 3cm thick M75	m²	230.4	9,695	4,870	234	2,233,728	1,122,048	53,914
82	AD.21314	Stone road surface with asphalt emulsion of acid base, surface thickness 12cm	100m²	23.3	4,861,732	810,956	762,103	113,103,333	18,866,080	17,729,564
		Sluice gate paving								
		bottom slabs								
		a. bottom slabs of side column								
83	AF.11223	Concrete for bottom of foundation width > 250cm stone 1x2 M200	m³	699.5	445,240	77,478	12,606	311,436,475	54,194,311	8,817,645
84	AF.11121	Foundation concrete width> 250cm stone 4x6 M100	m³	798.0	294,928	46,408	12,382	235,343,696	37,032,192	9,880,465
85	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	949.29	519,113	77,478	12,606	492,786,703	73,548,781	11,966,699
86	AF.61120	Fabricate and erect reinforcement of foundation diameter >=18mm	ton	75.9	7,481,259	355,593	144,359	568,148,354	27,004,757	10,963,058
87	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	4.9	2,335,418	580,290		11,350,131	2,820,209	
		b. Middle plate column								
88	AF.11223	Bottom seal concrete width > 250cm stone 1x2 M200	m³	391.5	445,240	77,478	12,606	174,311,460	30,332,637	4,935,249

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
89	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	399.0	294,928	46,408	12,382	117,671,848	18,516,096	4,940,232
90	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	403.31	519,113	77,478	12,606	209,360,868	31,247,265	5,084,063
91	AF.61120	Fabricate and erect reinforcement for foundation diameter >=18mm	ton	52.3	7,481,259	355,593	144,359	241,319,333	11,472,995	4,657,657
92	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	4.9	2,335,418	580,290		11,350,131	2,820,209	
		d. Bottom slab between 2 column								
93	AF.11223	Bottom concrete of foundation width > 250cm stone 1x2 M200	m³	1,336.3	445,240	77,478	12,606	594,983,117	103,535,401	16,845,650
94	AF.11225	stone-lined concrete 4x6 M100, width > 25cm	m³	1,880.8	519,113	77,478	12,606	976,339,425	145,719,383	23,709,163
95	AF.61120	Fabricate and erect reinforcement for foundation diameter >=18mm	ton	150.5	7,481,259	355,593	144,359	1,125,650,578	53,503,490	21,720,648
96	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	5.1	2,335,418	580,290		11,854,582	2,945,552	
		Side column of sluice gate								
		a. Side column								
97	AF.12145	Wall concrete of thickness> 45cm h>=16m stone 1x2 M300	m³	829.5	534,204	168,416	51,344	443,138,244	139,706,124	26,000,788
98	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h >=16m	ton	66.4	7,481,259	520,171	152,346	496,474,302	34,519,796	10,110,046
99	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork >45cm	100m²	11.8	2,695,831	1,498,234		31,897,072	17,727,105	
		b. Column								
100	AF.12145	Wall concrete of thickness> 45cm h>=16m stone 1x2 M300	m³	414.8	534,204	168,416	51,344	221,569,122	69,853,062	13,000,394
101	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h >=16m	ton	33.2	7,481,259	520,171	152,346	248,237,151	17,259,898	5,055,023

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
102	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	11.8	2,695,831	1,498,234		31,897,072	17,727,165	
		Turning wall								
		a. Component 1								
103	AF.11121	stone-lined concrete 4x6 M100, width >25cm	m³	14.4	294,928	46,408	12,382	4,246,963	668,275	178,301
104	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	57.6	519,113	77,478	12,606	29,900,909	4,462,733	726,106
105	AF.12126	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	284.2	599,314	179,928	31,344	170,337,025	51,139,136	8,908,592
106	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.6	7,481,259	355,593	144,359	34,473,641	1,638,573	665,206
107	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	22.7	7,481,259	520,171	152,346	170,105,875	11,827,440	3,463,982
108	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	14.2	2,519,916	1,276,324		35,810,526	18,137,840	
		b. Component 2								
109	AF.11121	stone-lined concrete 4x6 M100, width >25cm	m³	14.8	294,928	46,408	12,382	4,364,934	686,838	183,254
110	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	59.2	519,113	77,478	12,606	30,731,490	4,586,698	746,275
111	AF.12126	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	195.720	599,314	179,928	31,344	117,297,736	35,215,508	6,134,648
112	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.736	7,481,259	355,593	144,359	35,431,243	1,684,088	683,684
113	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	15.658	7,481,259	520,171	152,346	117,138,561	8,144,629	2,385,373
114	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	9.8	2,519,916	1,276,324		24,569,181	12,444,159	

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		c. Components 3								
115	AF.11121	stone-lined concrete 4x6 M100, width >25cm	m³	14.8	294,928	46,408	12,382	4,364,934	686,838	183,254
116	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	59.2	519,113	77,478	12,606	30,731,490	4,586,698	746,275
117	AF.12125	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	110.9	599,314	179,928	31,344	66,475,909	19,957,614	3,476,676
118	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.7	7,481,259	355,593	144,359	35,431,243	1,684,088	683,684
119	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	8.9	7,481,259	520,171	152,346	66,385,700	4,613,789	1,351,857
120	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	5.5	2,519,916	1,276,324		13,972,934	7,077,217	
		Back yard								
		a. To the field								
121	AL.15117	Fabricate and drop Fabricate and drop gabion basket 2x1x1m under water	piece	498.0	242,729	179,075		120,879,042	89,179,350	
122	AL.15121	Fabricate and drop gabion basket 2x1x0.5m under water	piece	315.0	160,001	108,298		50,397,915	34,112,246	
		b. To the river								
123	AL.15111	Fabricate and drop gabion basket 2x1x1m under water	piece	498.0	242,729	179,075		120,879,042	89,179,350	
124	AL.15121	Fabricate and drop gabion basket 2x1x0.5m under water	piece	315.0	160,001	108,298		50,397,915	34,112,246	
		Valve framework								
		a. Sluice gate body								
125	AF.12245	Column concrete cross section <=0.1m2 h<=16m stone 1x2 M300	m³	12.7	528,967	172,680	32,440	6,728,460	2,196,490	412,637
126	AF.12315	Beam, bracing concrete stone 1x2 M300	m³	95.6	485,035	151,786	31,344	46,360,872	14,508,580	2,996,001
127	AF.12415	Roof concrete stone 1x2 M300	m³	23.5	485,035	105,740	26,357	11,416,046	2,488,805	620,365

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
128	AF.61422	Fabricate and erect column reinforcement diameter <=18mm h<=16m	ton	1.3	7,481,259	434,471	152,346	9,516,161	552,647	193,784
129	AF.61522	Fabricate and erect Beam, bracing reinforcement diameter <=18mm h<=16m	ton	9.6	7,481,619	443,851	153,829	71,512,681	4,242,528	1,470,367
130	AF.61711	Fabricate and erect roof reinforcement diameter <=10mm h<=16m	ton	2.4	7,159,379	623,779	24,330	16,851,048	1,468,190	57,266
131	AF.81132	Fabricate and erect, dismantle formwork	100m²	21.4	2,524,401	1,465,614		54,055,458	31,383,460	
		b. External sluice body								
132	AF.12245	Column concrete cross section > 0.1m2 h<=16m stone 1x2 M300	m³	9.9	528,967	172,680	32,440	5,247,353	1,712,986	321,805
133	AF.12315	Beam, bracing concrete stone 1x2 M300	m³	75.9	485,025	151,788	31,344	36,790,359	11,513,499	2,377,521
134	AF.12415	Roof concrete stone 1x2 M300	m³	19.1	485,025	105,740	26,357	9,275,085	2,022,055	504,022
135	AF.61422	Fabricate and erect column reinforcement diameter <=18mm h<=16m	ton	1.0	7,481,259	434,471	152,346	7,421,409	430,995	151,127
136	AF.61522	Fabricate and erect Beam, bracing reinforcement diameter <=18mm h<=16m	ton	7.6	7,481,619	443,851	153,829	56,749,951	3,366,721	1,166,831
137	AF.61711	Fabricate and erect roof reinforcement diameter <=10mm h<=16m	ton	1.9	7,159,379	623,779	24,330	13,690,809	1,192,846	46,526
138	AF.81132	Fabricate and erect, dismantle rectangular formwork	100m²	17.0	2,524,401	1,465,614		42,983,631	24,955,390	
139	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	12.8	294,928	46,408	12,382	3,760,332	591,702	157,871
140	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	25.5	519,113	77,478	12,606	13,237,382	1,975,689	321,453
141	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	2.0	7,481,259	355,593	144,359	15,261,768	725,410	294,492
		Transport bridge								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		a. Span								
142	GTT3	Concrete beam L=24.54m	piece	10.0	67,272,727			672,727,270		
143	AG.41141	Erection of precast concrete column > 15T	piece	10.0	98,698	77,645	147,690	986,980	776,450	1,476,900
144	AG.52322	Erect habor port weight > 15T	piece	10.0	24,000	433,738	733,030	240,000	4,337,380	7,330,300
145	AF.12315	Concrete for bridge surface, beam, bracing stone 1x2 M300	m³	207.6	485,025	151,788	31,344	100,667,909	31,503,903	6,505,510
146	AF.61522	Fabricate and erect different reinforcement diameter <=18mm h<=16m	ton	16.6	7,481,619	443,851	153,829	124,225,999	7,369,773	2,554,201
147	AF.81141	Fabricate and erect, dismantle formwork	100m²	6.9	2,935,675	1,579,555		20,310,174	10,927,993	
		b. Middle span								
148	GTT4	Concrete beam L=16.96m	piece	36.0	46,493,295			1,673,758,606		
149	AG.41141	Erection of precast concrete column > 15T	piece	36.0	98,698	77,645	147,690	3,553,128	2,795,220	5,316,840
150	AG.52322	Erect habor port weight > 15T	piece	36.0	24,000	433,738	733,030	864,000	15,614,568	26,389,080
151	AF.12315	Concrete for bridge surface, beam, bracing stone 1x2 M300	m³	130.5	485,025	151,788	31,344	63,284,510	19,804,813	4,089,665
152	AF.61522	Fabricate and erect different reinforcement diameter <=18mm h<=16m	ton	10.4	7,481,619	443,851	153,829	78,094,216	4,632,981	1,605,689
153	AF.81141	Fabricate and erect, dismantle formwork	100m²	4.3	2,935,675	1,579,555		12,767,916	6,869,843	
		Abutment								
154	AF.12125	Abutment concrete of thickness >=45cm h<=16m stone 1x2 M300	m³	220.9	599,314	179,928	31,344	132,368,096	39,739,981	6,923,824
155	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	17.7	7,481,259	520,171	152,346	132,188,470	9,191,048	2,691,844
156	AG.17113	Fabricate precast concrete for sign post stone 1x2 M200	m³	6.9	405,095	71,972	19,353	2,789,079	495,527	133,245

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
157	AG.1311	Fabricate and erect reinforced concrete for sign post diameter <=10mm	ton	0.6	7,159,379	607,577	23,853	3,943,386	334,653	13,138
158	AG.42111	Manual erection of precast concrete component weight <=50kg	piece	206.0	915	6,892		188,490	1,419,752	
159	AF.11111	Foundation lining concrete width <=250cm stone 4x6 M100	m³	2.3	294,928	55,847	12,382	663,588	125,656	27,860
160	AF.81132	Fabricate and erect, dismantle bridge abutment formwork	100m²	2.3	2,524,401	1,465,614		5,806,122	3,370,912	
		Roofing upstream and downstream gate by gabion mattress thickness 30cm								
161	AL.1512	Fabricate and drop gabion basket 2x1x0.5m under water	piece	2,956.6	160,001	108,298		473,055,021	320,191,203	
		Paving								
162	AF.11223	Concrete for paving width <=250cm stone 1x2 M200	m³	390.1	445,240	77,478	12,606	173,673,876	30,221,689	4,917,197
163	AF.81110	Fabricate and erect reinforcement for concrete diameter <=10mm	ton	31.2	7,159,379	482,651	23,853	223,411,572	15,061,337	744,343
164	AF.81111	Fabricate and erect, dismantle formwork	100m²	13.0	2,335,418	580,290		30,365,728	7,543,085	
		Waterway stem	system	1.0				150,000,000		
		Works fence	system	1.0				400,000,000		
		Landscaping	system	1.0				1,000,000,000		
		Management house	system	1.0				300,000,000		
		Anti lightning system	system	1.0				300,000,000		
		Water and electricity system	system	1.0				500,000,000		
		Mechanical: Valve gate and equipment	set	4.0				26,556,814,000		
		TOTAL						49,661,966,348	2,992,069,415	8,110,549,776
								A	B	C

CONSTRUCTION COST SUMMARY TABLE

WORKS: TAN DINH SLUICE GATE

ITEM: CONSTRUCTION OF SLUICE GATE

Unit: Dong

No	ITEM	CALCULATION METHOD	VALUE	CODE
	COST ACCORDING TO PRICE			
	Materials cost		60,669,052,235	A
	Materials difference		58,392,960,701	CLVT
	Manpower cost		3,440,443,638	B
	Construction machine cost		9,882,743,257	C
	Construction machine difference			CLM
I	DIRECT COST			
1	Materials cost	(A + CLVT) * 1	119,062,012,936	VL
2	Manpower cost	B*1*3.602	12,392,477,985	NC
3	Construction machine cost	C*1*1.744+CLM	17,235,504,240	M
4	Other direct cost	(VL+NC+M)*2.5%	3,717,249,879	TT
	Direct cost	VL+NC+M+TT	152,407,245,040	T
II	GENERAL COST	T * 5.5%	8,382,398,477	C
III	TAXABLE INCOME PRECALCULATED	(T+C) * 5.5%	8,843,430,393	TL
	Construction cost before tax	T+C+TL	**169,633,073,911**	G
IV	VALUE ADDED TAX	G * 10%	16,963,307,391	GTGT
	Construction cost after tax	G + GTGT	**186,596,381,302**	G^{XD}
V	CONSTRUCTION OF TEMPORARY HOUSE AND CONSTRUCTION MANAGEMENT HOUSE	G*1%*(1+10%)	1,865,963,813	G_{XDNT}
	TOTAL	$G^{XD} + G_{XDNT}$	**188,462,345,115**	G_{XD}
	ROUND		**188,462,345,000**	

CONSTRUCTION COST ESTIMATE TABLE

WORKS: TAN DINH SLUICE GATE

ITEM: SLUICE GATE CONSTRUCTION

Đơn vị tính: đồng

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		Site clearance								
1	AA.11111	Clear forest grade 1 manually standard tree density/100m2 : 0 tree	100m²	226.4		37,363			8,457,113	
2	AA.12111	Cutting down trees in flat ground Dtree <=20cm	tree	1,000.0		4,719			4,719,000	
3	AA.13111	Digging tree stumps Dtree <=20cm	stump	1,000.0		7,866			7,866,000	
4	AA.13212	Digging bush of water coconut Dbush <=30cm	bush	120.0		29,497			3,539,640	
5	AB.13214	Embankments g<=1.60	m³	564.0		31,856			17,966,784	
6	AB.11212	Soil Excavation for embankment or to dump site - Soil Grade II	m³	676.8		24,384			16,503,091	
7	AB.22121	Digging and transporting organic soil in a distance <= 50m, Bulldozer <= 110CV, Soil Grade I	100m²	8.8			257,712			2,273,020
8	AB.13312	Embankment in combination with service roads, K=0.9	m³	685.4		28,317			19,409,604	
9	AB.64112	Embankment of service roads using compressor 9T K=0,9	100m²	16.0		68,432	311,889		1,094,474	4,988,228
10	AB.24122	Digging soil for embankment by excavators >=0.8m3 + buzzdozer 110 CV, Soil grade II	100m²	27.4		25,564	322,737		700,904	8,848,674
11	AB.41112	Transporting soil by dump trucks Distance <= 300m, truck 5T,Soil grade II	100m²	22.8			426,800			9,731,526

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
12	AB.13312	manual embankment of service roads K=0.9	m³	864.0		28,317			24,465,888	
13	AB.64112	Embankment of site area, compressor 9T, K=0,9	100m²	20.2		68,432	311,889		1,379,589	6,297,682
14	AB.24122	Digging soil for embankment by excavators >=0.8m3 + buzzdozer 110 CV	100m²	28.8		25,564	322,737		736,243	9,294,826
15	AB.41112	Transporting soil by dump trucks 5T Distance <= 300m, soil grade II	100m²	28.8			426,800			12,291,840
16	AB.11512	Digging drainage ditches B<=3m, H<=1m, Soil grade II	m³	140.5		35,789			5,028,355	
17	AD.21228	Embankment with aggregate with thickness of 20 cm for service roads	100m²	6.3	616,896	128,224	690,066	3,886,445	807,811	4,347,416
18	BB.11208	Installation of concrete pipes D500mm, for 1m pipe use brick	100m	1.0	28,387,182	4,449,648	2,218,277	28,387,182	4,449,648	2,218,277
19	AB.22122	Land levelling as the previous condition of site ground, distance <=50m, Bulldozer <= 110CV, Soil Grade II	100m²	28.8			317,375			9,140,400
20	GTT1	Material loading and unloading terminals	piece							
		**Bored piles for ground treatment:*								
		+ Pile casting yard								
21	AB.22122	Leveling to restore construction site, buzzdozer <=110cv, distance <= 50m, soil grade II	100m²	28.8			317,375			9,140,400
		Driving pile for foundation								
		+ pile casting yard								
22	AB.22122	Leveling for pile casting yard by buzzdozer <= 110cv, distance <= 50m, soil grade II	100m²	150.0			317,375			47,606,250

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
23	AK.41114	Smoothen floor of yard with 2cm layer of M75 mortar	m²	500.0	6,925	3,124	175	3,462,500	1,562,000	87,500
24	AF.11121	Concrete for subase width 250cm stone 4x6 M100	m³	25.0	294,928	46,408	12,382	7,373,200	1,160,200	309,550
		+ Preparation to install pile								
		a. Floor embankment								
25	AB.62111	Compact by compactor 9T, K = 0.85	100m²	6.4		29,103	191,952		187,132	1,234,251
26	AB.34122	Digging soil for embankment by excavators <=0.8m3 + buzzdozer 110 CV	100m³	7.7		25,564	322,737		197,252	2,490,239
27	AB.41112	Transporting soil by dump trucks 5T Distance <= 300m, soil grade II	100m³	7.7			426,800			3,293,189
28	AB.66112	Sand embankment by compactor 9T, K = 0.90	100m³	6.4	1,626,626	58,994	289,017	10,459,205	379,331	1,858,379
29	AD.21228	Aggregate of scaffold with thickness of 20cm	100m²	6.4	616,896	128,224	690,066	3,968,698	824,908	4,439,425
30	AD.21223	Aggregate of scaffold with thickness of 10cm	100m²	6.4	308,448	88,405	329,507	1,984,349	568,739	2,119,828
		b. Fabrication								
31	AG.13115	Production of pre-casted concrete pile stone 1x2 M300	m³	1,036.8	477,906	71,972	19,353	495,512,057	74,623,448	20,065,965
32	AG.13121	Fabricate and erect precast concrete pile diameter <=18mm	ton	259.2	7,481,619	333,421	145,813	1,939,310,461	86,426,057	37,796,188
33	AI.13151	Fabricate steel structure inside concrete, pile connection box weight > 100kg/components	ton	62.6	9,157,065	1,216,218	374,097	573,216,519	76,133,155	23,417,829
34	AI.11131	Manufacture pile by steel profile	ton	2.8	8,767,247	436,468	749,308	24,548,292	1,222,110	2,098,062
35	AG.31121	Production, erection and dismantling of pile formwork	100m²	135.4	274,109	1,129,136		37,120,937	152,912,114	
		c. Pile driving								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
36	AG.41141	Erection of precast concrete pile <=7T	piece	1,002.0	98,698	77,645	147,690	98,895,396	77,800,290	147,985,380
37	AC.16223	Driving reinforced plumb piles 35x35 on ground, hammer <=2.5T, length <= 24m, soil grade 2	100m	1.3	25,116,175	269,466	4,415,727	31,395,219	336,833	5,519,659
38	AC.18112	Driving reinforced piles 35x35 above water, hammer <=2.5T, length <= 24m	100m	47.3	25,239,900	277,141	9,336,944	1,192,585,275	13,094,912	441,170,604
39	AC.18112	Driving inclined reinforced piles 35x35 above water, hammer <=2.5T, length <= 24m	100m		25,239,900	277,141	9,336,944			
40	AC.16223	Driving reinforced vertical piles 35x35 length > 24m on ground, hammer <=2.5T, soil grade II	100m	33.1	25,116,175	269,466	4,415,727	832,350,040	8,930,103	146,137,193
41	AC.16223	Driving reinforced inclined piles 35x35 length > 24m on ground, hammer <=2.5T, soil grade II	100m	3.0	25,116,175	269,466	4,415,727	75,348,525	808,398	13,247,181
42	AC.23110	Dismantling driving piles	100m			122,211	2,473,435			
43	AA.21241	Pile head breaking	m³	20.5		234,504			4,797,366	
44	AB.22121	Production, erection and dismantling of pile formwork	shift	20.0			257,712			5,154,240
		Foundation hole, channel connection and works finishing								
45	AB.22122	Leveling fishbone road by buzzdozer = 110 cv, distance <=50m	100m²	0.8			317,375			253,900
46	AD.21228	Embankment with aggregate with thickness of 20 cm for service roads	100m²	0.5	616,896	138,224	690,066	296,110	61,548	331,239

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
47	AD.21223	Aggregate of scaffold with thickness of 10cm	100m²	0.5	308,448	88,405	329,507	148,055	42,434	158,163
48	AB.25412	Digging foundation > 20m by excavators <= 0.8m3, soil grade II	100m³	388.8		55,936	369,909		21,744,039	143,820,619
49	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	388.8			426,800			165,939,840
50	AB.22122	Land levelling as the previous condition of site ground, distance <=50m	100m²	116.6			317,375			37,018,620
51	AB.71150	Dredging depth <=6m by suction vessel capacity <= 1000CV, h discharge pipe <=3m, l discharge pipe >300 m	100m³	189.0		294,683	5,031,568		55,695,087	950,966,352
52	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzlozer 110CV, distance 30m	100m³	9.0		19,665	271,398		176,985	2,442,582
53	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	9.0			426,800			3,841,200
54	AB.64113	Soil embankment for wing wall by compressor 9T K=0.95	100m³	7.5		68,432	436,645		513,240	3,274,838
55	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzlozer 110CV, distance 30m	100m³	69.0		19,665	271,398		1,356,885	18,726,462
56	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	69.0			426,800			29,449,200
57	AB.63113	Embankment for channel top by compactor 9T, weight <= 1.8T/m3	100m³	57.5		58,207	370,175		3,346,903	21,285,063

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
58	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzlozer 110CV, distance 30m	100m³	16.8		19,665	271,398		330,372	4,559,486
59	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	16.8			426,800			7,170,240
60	AB.66130	Embankment by jumping compactor, K = 0.95	100m³	14.0		467,710	266,115		6,547,940	3,725,610
		Frame fabrication								
61	AC.22622	Driving steel I300 piles above the water surface, pile length > 10m, soil grade II (depreciation 30%)	100m	39.0	6,181,200	740,617	16,831,019	241,056,910	28,883,878	656,382,811
62	AI.11911	Production of fixed frame system (depreciation 30%)	tấn	12.6	2,571,395	1,217,516	990,170	32,397,970	15,339,942	12,475,524
63	AI.63321	Erection of steel structure under water	tấn	12.6	181,860	528,356	898,609	2,291,323	6,656,956	11,321,913
64	AC.23120	Nhổ cọc thep hình, làm khung đà n định vị, thao tác under water	100m	39.0		261,881	4,457,407		10,213,940	173,831,741
65	AC.22222	Driving steel sheet piles (Larsen pile) above the water surface, pile length > 12m soil grade II (depreciation 30%)	100m	194.9	20,532,150	843,532	21,288,936	4,002,619,450	164,441,502	4,150,150,340
66	AI.11911	Production of Larsen fixed frame system (depreciation 30%)	ton	9.5	2,571,395	1,217,516	990,170	24,338,643	11,523,974	9,372,110
67	AI.63321	Erection of Larsen pile structure under water	ton	9.5	181,860	528,356	898,609	1,721,333	5,000,970	8,505,471
68	AC.23220	Dismantling Larsen wooden pile underwater	100m	194.9		396,497	8,551,421		77,294,711	1,667,048,215
		Excavation works inside frame								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
69	AB.71150	Dredging soil inside frame, silt, depth <=6m by suction vessel capacity <= 1000CV, h discharge pipe <=3m, l discharge pipe <=300	100m³	85.4		294,683	5,031,568		25,157,677	429,555,023
70	GTT2	Water pumping inside frame	shift	22.0			184,109			4,050,398
		Road connecting sluice gate and dyke								
71	AB.22121	Digging and transporting organic soil in a distance <= 50m by buzzdozer <= 110 cv, distance <= 50m, soil grade I	100m³	8.4			257,712			2,157,049
72	AB.24121	Soil digging on trucks by excavator 0.8m3 + buzzdozer 110CV, distance 30m	100m³	15.0		19,665	271,398		294,163	4,059,767
73	AB.41112	Transporting soil by dump trucks 5T distance <= 300m, soil grade II	100m³	15.0			426,800			6,384,382
74	AB.65130	Embankment by jumping compactor, K = 0.95	100m³	12.5		467,710	266,115		5,830,286	3,317,283
75	AB.68113	Sand embankment compactor, K = 0.95	100m³	8.3	1,626,626	58,994	355,554	13,517,913	490,264	2,954,796
76	AD.11222	Stone aggregate	100m³	4.5	20,022,000	202,154	1,146,995	89,378,208	902,415	5,120,186
77	AG.11922	Fabricate precast concrete block to prevent wave stone 1x2 M150	m³	157.8	360,216	88,212	14,297	56,827,676	13,916,325	2,255,495
78	AG.42111	Install concrete component weight <=50kg manually	cái	8,764.4	915	6,892		8,019,467	60,404,551	
79	AF.11223	Concrete at foot of block, width > 250cm stone 1x2 M200	m³	24.0	445,240	77,478	12,606	10,685,760	1,859,472	302,544
80	AF.81110	Fabricate and erect reinforcement at block foot diameter <=10mm	ton	1.9	7,159,379	482,651	23,853	13,746,008	926,690	45,798
81	AK.41124	Lining mortar of 3cm thick M75	m²	240.0	9,695	4,870	234	2,326,800	1,168,800	56,160

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
82	AD.21314	Stone road surface with asphalt emulsion of acid base, surface thickness 12cm	100m²	14.9	4,861,732	810,956	762,103	72,342,572	12,067,025	11,340,093
		Sluice gate paving								
		bottom slabs:								
		a. bottom slabs of side column								
83	AF.11223	Concrete for bottom of foundation width > 250cm stone 1x2 M200	m³	699.5	445,240	77,478	12,606	311,436,475	54,194,311	8,817,645
84	AF.11121	Foundation concrete width > 250cm stone 4x6 M100	m³	798.0	294,928	46,408	12,382	235,343,696	37,032,192	9,880,465
85	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	949.29	519,113	77,478	12,606	492,786,703	73,548,781	11,966,699
86	AF.81120	Fabricate and erect reinforcement of foundation diameter <=18mm	ton	75.9	7,481,259	355,593	144,359	568,148,354	27,004,737	10,963,038
87	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	4.9	2,333,418	580,290		11,350,131	2,820,209	
		b. Middle plate column								
88	AF.11223	Bottom seal concrete width > 250cm stone 1x2 M200	m³	783.0	445,240	77,478	12,606	348,622,920	60,665,274	9,870,498
89	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	798.0	294,928	46,408	12,382	235,343,696	37,032,192	9,880,465
90	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	806.61	519,113	77,478	12,606	418,721,737	62,494,530	10,168,136
91	AF.81120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	64.5	7,481,259	355,593	144,359	482,756,666	22,945,990	9,315,313
92	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	4.9	2,333,418	580,290		11,350,131	2,820,209	
		c. Double wall bottom slab								
93	AF.11223	Bottom concrete of foundation width > 250cm stone 1x2 M200	m³	1,023.1	445,240	77,478	12,606	455,533,949	79,269,291	12,897,451
94	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	1,499.5	519,113	77,478	12,606	778,432,784	116,181,670	18,903,252

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
95	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	120.0	7,481,259	355,593	144,359	897,478,164	42,658,188	17,317,814
96	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	5.1	2,335,418	580,290		11,854,582	2,945,552	
		d. Bottom slab between 2 column								
97	AF.11223	Bottom concrete of foundation width > 250cm stone 1x2 M200	m³	574.2	445,240	77,478	12,606	255,656,808	44,487,868	7,238,365
98	AF.11225	stone-lined concrete 4x6 M100, width > 25cm	m³	826.0	519,113	77,478	12,606	428,797,720	63,998,378	10,413,808
99	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	66.1	7,481,259	355,593	144,359	494,373,565	23,498,154	9,539,474
100	AF.81111	Fabricate and erect, dismantle foundation formwork	100m²	5.3	2,335,418	580,290		12,387,057	3,077,858	
		Side column of sluice gate								
		a. Side column								
101	AF.12145	Wall concrete of thickness > 45cm h<=16m stone 1x2 M300	m³	829.5	534,204	168,416	31,344	443,138,244	139,706,124	26,000,788
102	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	66.4	7,481,259	520,171	152,346	496,474,302	34,519,796	10,110,046
103	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork > 45cm	100m²	11.8	2,695,831	1,498,234		31,897,072	17,727,105	
		b. Column								
104	AF.12145	Wall concrete of thickness > 45cm h<=16m stone 1x2 M300	m³	829.5	534,204	168,416	31,344	443,138,244	139,706,124	26,000,788
105	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	66.4	7,481,259	520,171	152,346	496,474,302	34,519,796	10,110,046
106	AF.81312	Fabricate and erect, dismantle straight and thick wall formwork > 45cm	100m²		2,695,831	1,498,234				
		Turning wall								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		a. Component 1								
107	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	14.4	294,928	46,408	12,382	4,246,963	668,275	178,301
108	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	57.6	519,113	77,478	12,606	29,900,909	4,462,733	726,106
109	AF.12125	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	284.2	599,314	179,928	31,344	170,337,025	51,139,136	8,908,592
110	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.6	7,481,259	355,593	144,359	34,473,641	1,638,573	665,206
111	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	22.7	7,481,259	520,171	152,346	170,105,875	11,827,440	3,463,982
112	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	14.2	2,519,916	1,276,324		35,810,526	18,137,840	
		b. Component 2								
113	AF.11121	stone-lined concrete 4x6 M100, width > 25cm	m³	14.8	294,928	46,408	12,382	4,364,934	686,838	183,254
114	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	59.2	519,113	77,478	12,606	30,731,490	4,586,698	746,275
115	AF.12125	Wall concrete of thickness <=45cm h<=16m stone 1x2 M300	m³	195.720	599,314	179,928	31,344	117,297,736	35,215,508	6,134,648
116	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.736	7,481,259	355,593	144,359	35,431,243	1,684,088	683,684
117	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	15.658	7,481,259	520,171	152,346	117,138,561	8,144,629	2,385,373
118	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	9.8	2,519,916	1,276,324		24,569,181	12,444,159	
		c. Components 3								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
119	AF.11121	stone-lined concrete 4x6 M100, width >25cm	m³	14.8	294,928	46,408	12,382	4,364,934	686,838	183,254
120	AF.11225	Concrete of bottom slabs with stone 1x2 M300 B >250cm	m³	59.2	519,113	77,478	12,606	30,731,490	4,586,698	746,275
121	AF.12125	Wall concrete of thickness <=45cm h <=16m stone 1x2 M300	m³	110.9	599,314	179,928	31,344	66,475,909	19,957,614	3,476,676
122	AF.61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	4.7	7,481,259	355,593	144,359	35,431,243	1,684,088	683,684
123	AF.61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	8.9	7,481,259	520,171	152,346	66,385,700	4,615,789	1,351,857
124	AF.81311	Fabricate and erect, dismantle straight and thick wall formwork <=45cm	100m²	5.5	2,519,916	1,376,324		13,972,934	7,077,217	
		Back yard								
		a. To the field								
125	AL.15111	Fabricate and drop Fabricate and drop gabion basket 2x1x1m under water	piece	648.0	242,729	179,075		157,288,392	116,040,600	
126	AL.15121	Fabricate and drop gabion basket 2x1x0,5m under water	piece	409.9	160,001	108,298		65,578,010	44,387,018	
		b. To the river								
127	AL.15111	Fabricate and drop gabion basket 2x1x1m under water	piece	648.0	242,729	179,075		157,288,392	116,040,600	
128	AL.15121	Fabricate and drop gabion basket 2x1x0,5m under water	piece	409.9	160,001	108,298		65,578,010	44,387,018	
		Valve framework								
		a. Sluice gate body								
129	AF.12245	Column concrete cross section >0,1m2 h<=16m stone 1x2 M300	m³	17.0	528,967	172,680	32,440	8,971,280	2,928,633	550,182
130	AF.12315	Beam, bracing concrete stone 1x2 M300	m³	120.9	485,025	151,788	31,344	58,623,739	18,346,236	3,788,471

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
131	AF.12415	Roof concrete stone 1x2 M300	m³	29.3	485,025	105,740	26,357	14,205,861	3,097,011	771,968
132	AF.61422	Fabricate and erect column reinforcement diameter <=18mm h<=16m	ton	1.7	7,481,259	434,471	152,346	12,688,215	736,863	258,379
133	AF.61522	Fabricate and erect Beam, bracing reinforcement diameter <=18mm h<=16m	ton	12.1	7,481,619	443,851	153,829	90,428,458	5,364,716	1,859,293
134	AF.61711	Fabricate and erect roof reinforcement diameter <=10mm h<=16m	ton	2.9	7,159,379	623,779	24,330	20,969,051	1,826,982	71,260
135	AF.81132	Fabricate and erect, dismantle formwork	100m²	27.2	2,524,401	1,465,614		68,551,074	39,799,308	
		b. External sluice body								
136	AF.12245	Column concrete cross section >0,1m2 h<=16m stone 1x2 M300	m³	9.9	528,967	172,680	32,440	5,247,353	1,712,986	321,805
137	AF.12315	Beam, bracing concrete stone 1x2 M300	m³	66.1	485,025	151,788	31,344	32,046,814	10,029,013	2,070,976
138	AF.12415	Roof concrete stone 1x2 M300	m³	16.4	485,025	105,740	26,357	7,966,002	1,736,663	432,885
139	AF.61422	Fabricate and erect column reinforcement diameter <=18mm h<=16m	ton	1.0	7,481,259	434,471	152,346	7,421,409	430,995	151,127
140	AF.61522	Fabricate and erect Beam, bracing reinforcement diameter <=18mm h<=16m	ton	6.6	7,481,619	443,851	153,829	49,432,927	2,932,635	1,016,387
141	AF.61711	Fabricate and erect roof reinforcement diameter <=10mm h<=16m	ton	1.6	7,159,379	623,779	24,330	11,758,493	1,024,488	39,959
142	AF.81132	Fabricate and erect, dismantle rectangular formwork	100m²	15.0	2,524,401	1,465,614		37,895,520	22,001,340	
143	AF.11121	stone-lined concrete 4x6 M100, width >25cm	m³	11.0	294,928	46,408	12,382	3,229,462	508,168	135,583

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
144	AF 11225	Concrete of bottom slabs with stone 1x2 M300 B>250cm	m³	21.9	519,115	77,478	12,606	11,368,575	1,696,768	276,071
145	AF 61120	Fabricate and erect reinforcement for foundation diameter <=18mm	ton	1.8	7,481,259	355,593	144,359	13,107,166	622,999	252,917
		Transport bridge								
		a. Span								
146	GTT3	Concrete beam L=24.34m	piece	10.0	67,272,727			672,727,270		
147	AG.45141	Erection of precast concrete column > 15T	piece	10.0	98,698	77,645	147,690	986,980	776,450	1,476,900
148	AG.52322	Erect habor port weight > 15T	piece	10.0	24,000	433,738	733,030	240,000	4,337,380	7,330,300
149	AF 12315	Concrete for bridge surface, beam, bracing stone 1x2 M300	m³	207.6	485,025	151,788	31,344	100,667,909	31,503,903	6,505,510
150	AF 61522	Fabricate and erect different reinforcement diameter <=18mm h<=16m	ton	16.6	7,481,619	443,851	153,829	124,225,999	7,369,773	2,554,201
151	AF 61141	Fabricate and erect, dismantle formwork	100m²	6.9	2,935,675	1,579,555		20,310,174	10,927,993	
		b. Middle span								
152	GTT4	Concrete beam L=16.96m	piece	36.0	46,493,295			1,673,758,606		
153	AG.41141	Erection of precast concrete column > 15T	piece	36.0	98,698	77,645	147,690	3,553,128	2,795,220	5,316,840
154	AG.52322	Erect habor port weight > 15T	piece	36.0	24,000	433,738	733,030	864,000	15,614,568	26,389,080
155	AF 12315	Concrete for bridge surface, beam, bracing stone 1x2 M300	m³	168.4	485,025	151,788	31,344	81,636,481	25,554,399	5,276,935
156	AF 61522	Fabricate and erect different reinforcement diameter <=18mm h<=16m	ton	13.5	7,481,619	443,851	153,829	100,765,557	5,977,970	2,071,833
157	AF 61141	Fabricate and erect, dismantle formwork	100m²	5.6	2,935,675	1,579,555		16,474,538	8,864,210	
		Abutment								

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
158	AF 12125	Abutment concrete of thickness >=45cm h<=16m stone 1x2 M300	m³	220.9	599,314	179,928	31,344	132,368,096	39,739,981	6,922,824
159	AF 61322	Fabricate and erect wall reinforcement diameter <=18mm h<=16m	ton	17.7	7,481,259	520,171	152,346	132,188,470	9,191,048	2,691,844
160	AG.11113	Fabricate precast concrete for sign post stone 1x2 M200	m³	6.9	405,095	71,972	19,353	2,789,079	495,537	133,245
161	AG.13111	Fabricate and erect reinforced concrete for sign post diameter <=10mm	ton	0.6	7,159,379	607,577	23,853	3,943,386	334,653	13,138
162	AG.42111	Manual erection of precast concrete component weight <=50kg	piece	206.0	915	6,892		188,490	1,419,752	
163	AF 11111	Foundation lining concrete width >=250cm stone 4x6 M100	m³	2.3	294,928	55,847	12,382	663,588	125,656	27,860
164	AF 61132	Fabricate and erect, dismantle bridge abutment formwork	100m²	2.3	2,524,401	1,465,614		5,806,122	3,370,912	
		Roofing upstream and downstream gate by gabion mattress thickness 30cm								
165	AL.15121	Fabricate and drop gabion basket 2x1x0.5m under water	piece	2,956.6	160,001	108,298		473,055,021	320,191,203	
		Paving								
166	AF 11223	Concrete for paving width >250cm stone 1x2 M200	m³	390.1	445,240	77,478	12,606	173,673,876	30,221,689	4,917,197
167	AF 61110	Fabricate and erect reinforcement for concrete diameter <=10mm	ton	31.2	7,159,379	482,651	23,853	223,411,572	15,061,337	744,345
168	AF 61111	Fabricate and erect, dismantle formwork	100m²	13.0	2,335,418	580,290		30,365,728	7,545,085	
		Waterway signs	system	1.0				150,000,000		
		Works fence	system	1.0				400,000,000		
		Landscaping	system	1.0				1,000,000,000		
		Management house	system	1.0				300,000,000		

No	CODE PRICE	ITEM	UNIT	VOLUME	PRICE			AMOUNT		
					MATERIALS	MANPOWER	MACHINE	MATERIALS	MANPOWER	MACHINE
		Anti lightning system	system	1.0				300,000,000		
		Water and electricity system	system	1.0				500,000,000		
		Mechanical: Valve gate and equipment	set	4.0				33,859,937,850		
		TOTAL						60,669,052,235	3,440,443,638	9,882,743,257
								A	B	C

COMPENSATION AND RESETTLEMENT SUMMARY TABLE
VUNG LIEM SLUICE GATE
VINH LONG PROVINCE

NO	ITEM	UNIT	Unit price	Number	Quantity	Amount
I	**Homes**					
1	Leaf house	m2	484,000	1	60.00	29,040,000
2	Brick house	m2	2,482,000	7	420.00	1,042,440,000
3	Tile house	m2	2,000,000	-	-	-
4	Steel house	m2	655,000	4	240.00	157,200,000
5	Rewards policy	5%				-
6	Support to moving house	household	4,000,000		11.00	44,000,000
7	Grant stable life	individual	3,960,000		66.00	261,360,000
8	Support for changing jobs & create job	m2	140,000		29,500.00	4,130,000,000
9	The cost for dispersion resettlement	household				-
10	The cost for constructing resettlement area	tt			-	-
11	Other architectural objects	tt				
II	**Other type**	tree				
1	Paddy	m2	1,500		-	-
2	Grave	piece	3,000,000			-
3	Temple	piece	20,000,000		1.00	20,000,000
4	Move to pole	piece	15,000,000		3.00	45,000,000
5	coconut	tree	290,000		1,000.00	290,000,000
6	Nipa palm	m2	3,000		200.00	600,000
7	Other tree	tree	150,000		1,000.00	150,000,000
III	**Land**					
1	**The temporary land loss**	**m2**			-	-
2	**The permanent land loss**	**m2**			31,000.00	-
*	Land cultivation paddy	m2	35,000			-
*	Garden land	m2	70,000		29,500.00	2,065,000,000
*	Indigenous rural residential land	m2	195,000		1,500	292,500,000
*	Indigenous town residential land	m2	105,000			-
	Total: (I+II+III)					**8,527,140,000**
IV	Cost for compensation, site clearance board (5%)					426,357,000
	TOTAL					**8,953,497,000**

COMPENSATION AND RESETTLEMENT SUMMARY TABLE
TAN DINH SLUICE GATE
VINH LONG & TRA VINH PROVINCE

NO	ITEM	UNIT	Unit price	Number	Quantity	Amount
I	**Homes**					
1	Leaf house	m2	484,000	8	480.00	232,320,000
2	Brick house	m2	2,482,000	8	480.00	1,191,360,000
3	Tile house	m2			-	-
4	Steel house	m2	655,000	2	120.00	78,600,000
5	Rewards policy	5%				-
6	Support to moving house	household	4,000,000		16.00	64,000,000
7	Grant stable life	individual	3,960,000		96.00	380,160,000
8	Support for changing jobs & create job	m2	170,000		23,400.00	3,978,000,000
9	The cost for dispersion resettlement	household				
10	The cost for constructing resettlement area	tt				
11	Other architectural objects	tt				
II	**Other type**	tree				
1	Paddy	m2			-	
2	Grave	piece				-
3	Temple	piece			-	-
4	Move to pole	piece	15,000,000		9.00	135,000,000
5	coconut	tree	290,000		100.00	29,000,000
6	Nipa palm	m2				
7	Other tree	tree	150,000		1,000.00	150,000,000
III	**Land**					
1	**The temporary land loss**	**m2**			-	-
2	**The permanent land loss**	**m2**			26,100.00	-
*	Land cultivation paddy	m2	35,000			-
*	Garden land	m2	85,000		23,400.00	1,989,000,000
*	Indigenous rural residential land	m2	195,000		2,700	526,500,000
*	Indigenous town residential land	m2	105,000			-
	Total: (I+II+III)					**8,753,940,000**
IV	Cost for compensation, site clearance board (5%)					437,697,000
	TOTAL					**9,191,637,000**

COMPENSATION AND RESETTLEMENT SUMMARY TABLE
BONG BOT SLUICE GATE
VINH LONG PROVINCE

NO	ITEM	UNIT	Unit price	Number	Quantity	Amount
I	**Homes**					
1	Leaf house	m2	724,400	3	180.00	130,392,000
2	Brick house	m2	3,142,000	6	360.00	1,131,120,000
3	Tile house	m2	2,000,000	–	-	-
4	Steel house	m2	600,000	–	–	–
5	Rewards policy	5%				–
6	Support to moving house	household	3,000,000		8.00	24,000,000
7	Grant stable life	individual	3,960,000		48.00	190,080,000
8	Support for changing jobs & create job	m2	140,000		24,550.00	3,437,000,000
9	The cost for dispersion resettlement	household				
10	The cost for constructing resettlement area	tt				
11	Other architectural objects	tt				
II	**Other type**	tree				
1	Paddy	m2				
2	Grave	piece				
3	Temple	piece				
4	Move to pole	piece	15,000,000		2.00	30,000,000
5	coconut	tree	200,000		500.00	100,000,000
6	Nipa palm	m2	3,000		200.00	600,000
7	Other tree	tree	120,000		200.00	24,000,000
III	**Land**					
1	**The temporary land loss**	**m2**			-	-
2	**The permanent land loss**	**m2**			25,900.00	–
*	Land cultivation paddy	m2	35,000		–	–
*	Garden land	m2	70,000		24,550.00	1,718,500,000
*	Indigenous rural residential land	m2	200,000		1,350	270,000,000
–	Indigenous town residential land	m2	105,000			–
	Total: (I+II+III)					**7,055,692,000**
IV	Cost for compensation, site clearance board (5%)					352,784,600
	TOTAL					**7,408,476,600**