



# BDP

The MRC Basin Development Plan

**Sub-area Report**

**Delta Sub-area (SA10V)**

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# Acronyms and Abbreviations

MRC	: Mekong River Commission
NMCs	: National Mekong Committees
BDP	: Basin Development Planning
DANIDA	: Danish International Development Agency.
DARD	: Department of Agricultural and Rural Development
DSF	: Decision-making Supporting Frame
VEN	: Vietnam Electricity Corporation
FIPI	: Forestry Investigation and Planning Institute
GDP	: Gross Domestic Products
GSO	: General Office of Statistics
ISD	: Institute of Strategy Development
IWARP	: Institute of Water Resource Planning
JICA	: Japan International Cooperation Agency
MARD	: Ministry of Agricultural and Rural Development
MOFI	: Ministry of Fishery
MRC	: Mekong River Commission
NIAPP	: National Institute of Agricultural Planning and Projection
VND	: Vietnamese Dong
VNMC	: Vietnam National Mekong Committee
EP	: Environment Programme
	:



# EXECUTIVE SUMMARY

## BACKGROUND

The Basin Development Plan (BDP) formulation started on 1<sup>st</sup> October 2001, as one of the three core programmes of the Mekong River Commission (MRC). The formulation involves the National Mekong Committees (NMCs) in each country, national planning and line agencies, and a wide range of other government, private sector and civil society actors. The work is supervised by the MRC Joint Committee and by National Sub-Committees.

The BDP seeks to develop both an *initial plan* as a framework for the basin-wide water and water-related resources development and a sustainable *planning process* in the four member states of the MRC, including Cambodia, Lao PDR, Thailand and Vietnam.

The BDP team in each country has been initiating studies and analysis in a number of Sub-areas making up the Lower Mekong Basin (LMB). This is the first stage of the BDP development process. Five Sub-areas have been delineated in the Cambodian part of the Mekong Basin (MB).

In Vietnam, the Vietnam National Mekong Committee (VNMC) is leading the efforts on the BDP. The overall process involves reviewing, collecting, analyzing relevant data and information and conducting forums at regional, national and provincial levels. Background study is being finalized at national level through sub/sectoral reviews by Technical Officials from line agencies involved.

The work in the Sub-areas is being divided into two components as following:

- **Component A: Review and Analysis**
  - Review of provincial and sector plans/data and insight collection; and
  - Analysis.
- **Component B: Scenario and Strategy Development**
  - Scenario development; and
  - Strategy development.

The Sub-area review and analysis will provide the basis for formulating the scenarios and strategies for water use in the Sub-areas and subsequently in the region. It will therefore be essential that *the level of detail be tailored and targeted to facilitate macro thinking and analysis and the promotion of suitable oversight and vision in the subsequent stages*. The outcomes for each Sub-area analysis will therefore be:

- Summary of present conditions and context for development;
- Summary of water availability, ecological demands and present water uses;
- Identification of opportunities, concerns and risks; and

- Formulation of development objectives.

## PROCESS OF SUB-AREA STUDY AND ANALYSIS

Sub-area studies involve:

- ***Preliminary review:*** Review of available information at regional, national and Sub-area levels to provide overviews of keys issues, review of development plans/programmes (either already prepared or under preparation) and preparation of GIS and related information from MRC data sets;
- ***Identification of key issues and sectors;***
- ***Information collection:*** Identify information gaps, collate or collect required information (particularly from national and provincial agencies);
- ***Analysis:*** Identify Sub-area development objectives, formulate scenarios and strategies and identify potential projects/programmes; and
- ***Public consultation:*** Include local knowledge and opinions.

It is proposed that the process of Sub-area study and analysis should be orientated around two forums. The process can then be broken down into a number of steps as follows:

- ***Review:*** Mainly through activities coordinated at MRC Secretariat;
- ***Forum 1:*** A multi-stakeholder forum within the Sub-area to consider Sub-area information, identify key issues and information gaps, and prepare a work plan for further study and analysis;
- ***Implementation of work plan:*** Mainly collection of further information as defined at Forum 1; and
- ***Forum 2:*** A second multi-stakeholder forum to agree on Sub-area development objectives, scenarios and strategies and to identify potential projects/programmes.

## DEVELOPMENT OF SCENARIOS AND STRATEGIES

According to the BDP, scenarios are not about predicting the future; rather they are about perceiving the future in the present. A scenario is a hypothetical combination of events and physical conditions, describing a possible future situation. Development scenarios will be formulated in order to illustrate anticipated limits to the long-term basin development, as well as the significance of external driving forces and uncertainties about applied key assumptions.

Development strategies will be drafted as a tool for identification and assessment of development projects and programmes. Development and management strategies will be formulated for each Sub-area and each relevant water related sector. This will be done in a close dialogue with the stakeholders, and drawing on related MRC programmes.

The strategies need to be justified in terms of: (i) socio-economic implications; (ii) environmental implications; (iii) human resources development implications; and (iv) national priorities, strategies and plans.

## **IMPORTANCE OF THE REPORT**

The report might also be useful for governmental institutions, external support agencies, project evaluation teams, investors and technical specialists in helping them understand:

- The current condition of various development sectors at provincial levels around Delta Sub-area;
- The trends within and future plans of the sectors within the Delta Sub-area;
- The linkages between one sector and another;
- The cross-cutting themes: socio-economic, environment, public participation and human resources aspects; and
- The Trans-boundary issues within the Delta Sub-area.

## **OVERVIEW OF THE SUB-AREA 10V**

### **Baseline Description**

The Cuu Long Delta Sub-area (Sub-area 10V) is located in the southernmost Vietnam bordered with the border of Vietnam and Cambodia and Ho Chi Minh City in the north, the East Sea in the east and the south, the West Sea in the west. It covers provinces including Long An, Tien Giang, Dong Thap, Vinh Long, Tra Vinh, Can Tho, Soc Trang, Ben Tre, An Giang, Kien Giang, Bac Lieu and Ca Mau with a land of about 3.97 million ha.

Population of the sub-area 10V in 2002 was about 16.76 million, including 13.7 million rural people (sharing 82.9%) and 3.04 million urban people. The number of people in each household was 5.4 people rather higher than the average of the nation. The growth rate was about 1.55%/year, with an average density 423 people/km<sup>2</sup>, and unevenly distributed over the area. The highest population density was concentrated in provinces along the Mekong River and the Bassac River, and the lowest is located in provinces, which are far from freshwater-sources like Ca Mau, Bac Lieu, Kien Giang and Long An. The population in labour age was about 9.7 million people. Communities living in the sub-area include Kinh people, Khmer, Hoa (Chinese). Of that, the Kinh people were about 88%.

Sources of the economy of the sub-area 10V, in general, and of the inundation areas, in particular, are mainly agriculture, and in addition, fishery, forestry, industry of exploitation of materials, agricultural and fishery processing industries, and services. Recently, the economy of the Cuu Long Delta and of the inundation area has developed remarkably. In the year 2000, rice production reached 11,742,808 tons; GDP per person was about 300 USD/person/year. Strong investment in water resources development and infrastructure from the government, in combination with reasonable frameworks, and policies, has created dynamic for production.

Water resources in the Cuu Long Delta: Annually average water availability in the Cuu Long Delta to the sea is about 471 billion m<sup>3</sup>, of which 23 billion m<sup>3</sup> are caused by rainfall in the field of Cuu Long Delta and 448 billion m<sup>3</sup> are from outside (upstream). Annually average water

volume in Mekong Delta is near 59% of total water volume in Vietnam. Specific discharge of the Mekong River and the Bassac River is 30 l/s.km<sup>2</sup> and that of Ca Mau peninsula is 20 l/s.km<sup>2</sup>.

The rainfall in the Cuu Long Delta is not evenly distributed in time and space. Western zone of the sub-area 10V has the highest rainfall, about 1800-2400 mm per year. Rainfall in eastern zone of the sub-area 10V is approximate 1600-1800 mm. The central zone (from Chau Doc – Long Xuyen – Can Tho – Cao Lanh to Tra Vinh- Go Cong) has the smallest rainfall, about 1,200-1,600 mm per year. About 90% of yearly rainfall falls in wet season while about 10% in the dry season.

### **Priority Development Policies**

Based on the conditions of the sub-area, in particular, and the conditions of the nation, in general, the Government of Vietnam has launched the priority development policies for regional development, specially the Decision Nos. 01/1998/QĐ-TTg, 99/QĐ-TTg and 173/QĐ-TTg for development activities and programs for the sub-area by 2010, as well as policies on changes in movement of economic structures, economic development of all sectors in order to improve the living condition of the local people, particularly the minority communities of the sub-area 10V. These policies include:

- Encouraging non-state enterprises and local people to invest into agriculture, fishery development, agriculture, fishery production processing industries with a priority on development of dominant production in the sub-area such as rice, fishery production, and fruit.
- Forming, extending agro-commodity production areas and industrial trees, which have potential for export.
- Prioritizing to licensing land use right and to give the land use license for farming owners, which give them the ways to loan from the banks.
- Prioritizing the settlement, sustainable cultivation, construction of transportation, power supply, and culture activities in the remote areas (program 135 – hunger clearance and poverty reduction).
- Prioritizing reasonable state budgets in combination with ODA loans for investment on transportation and water resources development in the sub-area.
- Exempting from or reduce or income tax, VAT for projects, which invest on processing industry; and industries, which servers for agriculture development. Exempting agriculture land use tax for extremely difficult households.
- Implementing priority policies for national and international investment, reducing renting land prices, and reducing income tax in the beginning period.

### **Development Objectives**

#### ***Short-term Objectives (2010):***

- GDP will be double in comparison with 2000. The shares of GDP are 16-17%, 40-41% and 42-43% for agriculture, industry and service respectively;

- Change economic patterns, reduce rice production, and promote aquaculture/fishery/livestock. Promote strongly production; improve quality for commercial foods, vegetable, fruits, livestock, and fishery. Agricultural development towards diversification, sustainable. The processing industry and mechanism are given priorities to serve for agriculture development. Promote navigation development;
- The priority is given to infrastructure, residential areas, agricultural production conform to flood migration strategies. Stabilize resident in flooded areas including housing and land allocated. The priority is given to poverty alleviation;
- Bio-technologies and processing technologies are promoted. Apply information technology in sector development; and
- Combine socio-economic development in combination with security, national defence and country's sovereignty protection.

### ***Long Objectives (2020):***

- Socio-economic development through changing economic patterns toward agricultural and rural industrialization and modernization aim at poverty alleviation, improving living standards and human resources development;
- Reasonable development and utilization for natural resources based on the view of sustainable development, taking water resources as the centre; and
- Enhance the international cooperation with neighbouring countries.

## **TOOLS AND METHODOLOGY**

### **Methodology**

The analysis is conducted through the following tasks:

- Document review and analysis
- Stakeholders consultation; and
- Analysis of the outcomes of the informal Working Group session and the outcomes of Forum 1 and Forum 2.

### **Organization**

A study team of Sub-Institute for Water Resources Planning was established to implement the Study on Analysis of Sub-area 10V. The Team has relation with and consults the National Mekong River Committee of Vietnam to implement the above-mentioned works. The Sub-Institute of Water Resources Planning are responsible for the study and joined-study organizations include Sub-NIAPP, Sub-Institute for Forestry Planning, Fishery Planning Institute, Ministry of Plan and Investment, local departments (Provincial Department of Agriculture and Rural Development, Departments of Science and Technology, Departments of Plan and Investment) of 12 provinces including Long An, Tien Giang, Dong Thap, Vinh Long, Tra Vinh, Can Tho, Soc Trang, Ben Tre, An Giang, Kien Giang, Bac Lieu and Ca Mau. Specially,

the implementation of the study has been guided, and monitored by the Vietnam National Mekong Committee.

The study team includes 8 specialists from SIWRP as follows:

1. To Van Truong – Director of SIWRP
2. Luong Quang Xo – Water resources expert, Team Leader
3. Ho Trong Tien – Irrigation expert, member
4. Nguyen Huu Tan – Hydraulic works expert, member
5. Tran Duc Dong – Hydraulic model expert, member
6. Tran Minh Khoi – Environment expert, member
7. Nguyen Dinh Tien – Hydrology expert, member
8. Nguyen Tan Ha – Database expert, member

The project of BDP will contribute to strengthen the cooperation among sub-areas by establishment of a planning process and a reasonable framework for investment and sustainable development. BDP will establish a framework for water resources plan aiming at efficient use of water resources, protection of the environment, and promotion of the society equitableness.

1. Overview of  
the National  
and Cuu Long  
Delta  
Economy

## 1.1. Economic Growth and Structures

During the last five years, the economy of the world and the Southeast Asia countries has grown slowly, while Vietnam has a growth rate of economy rather high. For instance, GDP reached a rate of 7.04% in 2002 and 7.2% in year 2003, ranking the second in the region after China. The Cuu Long Delta has a progress of improving economy frame at a low level and unstable in comparison with other areas of the nation. The rate of agriculture, forestry and fishery production decreases from 62.1% in 1995 to 50.9% in 2002. Correspondingly, the rate of the industry and the construction increases from 14.1% to 19.8% at the same time, and the service production from 23.8% to 29.3%. The service sectors, particularly agriculture, forestry and fishery services are still weak. The rate in terms of “content of science” in each product is still low. Urbanization rate of the sub-area 10V increased from 15.7% in 1995 to 18.1% year 2001 is quite lower than that of the whole nation (from 20.7% to 24.8% at the same time).

Table 1: Growth Rate and Economic Structure

Index	Growth Rate %		Economic Structure %	
	1996 - 2000	2002	1995	2002
Nation	6.82	7.04	100	100
Agriculture, forestry and fishery	4.0	4.1	36.1	24.6
Industry-Construction	10.5	9.4	26.9	39.2
Services	5.7	6.5	37.0	36.2
Sub-area 10V	5.5	6.34	100	100
Agriculture, forestry and fishery	3.8	4.35	62.1	50.9
Industry-Construction	9.1	11.56	14.1	19.8
Services	5.6	6.48	23.8	29.3

Source: Institute of Strategy Plan – Ministry of Plan and Investment.

The above table shows that the growth rate of the Sub-area 10V is lower than that of the nation but in comparison with itself from 1996 to 2000, the sub-area has increased in all three sectors as follows:

- Agriculture, Forestry and Fishery:** The value of the sector production in 2001 and 2002 has grown at high rate due to changes of agriculture cultivation to fishery culture. In economic structure aspect, GDP of agriculture, forestry and fishery sectors still has contributed to a high rate. Recently, decreasing Catfish (Basa) consumption as well as no consumption markets for agriculture and fishery products has obstructed the progress of development of the sub-area. In the year 2003, GDP of agriculture, forestry and fishery sectors is shared of 73.5%, 1.5% and 25% respectively.
- Industry and Construction:** The production value of industry and construction sectors has increased only at a rate of 11.56%, at the same time, GDP of industry production shared only 19.8 %. In comparison with



that of the nation, this growth rate is still low. The increase is mainly due to the effort applying the law of business and policies of mobilization of interior investment capital.

- **Services:** In year 2002, the service sector has prosperity. The value of trade, hotel, restaurant, transportation, telecommunication, tourism has increased at rather high rate (6.48%). Particularly, GDP of service sector has reached a rate of 29.3%. However, this is still low in comparison with that of the nation. It is necessary to speed up urbanization and kind of ecological tourism in near future.

## 1.2. Economic Sector

### 1.2.1. Agriculture

Agriculture production of the sub-area 10V has developed rapidly and steadily in trend of diversification of cropping. It shares a high rate in terms of agricultural products in comparison with that of the nation as follows:

- Yearly agriculture GDP reached 5.8% in period of from 1990 to 2000 and 5.18% from 1996 to 2000.
- Economic structure of the sub-area, particularly in recent years, has changed in trend of increasing fishery production. Within the agriculture sector, the cultivation has decreased from 77% in 1995 to 73% in 2000 (and 73.7% in 2003), the breeding increased from 19.6% in 1995 to 21.3% in 2000 (and 20.4% in 2003), and service from 3.5% to 5.7% (5.9% in 2003).
- Having formed specialized cultivation areas, where have high potential in comparison with other areas of the nation, and shared high rates in terms of agriculture products such as over 50% rice production, over 60% of fruit and coconut, about 40% of sugarcane, 20% of meat production and 60% value of fishery production.

However, agriculture production has encountered a number of difficulties in terms of consumption markets, particularly changes in export markets. While agriculture production of the Cuu Long Delta has carried out at small farming scales with the limited possibility of support of the economy to exported agriculture product.

The sub-area 10V produces a diversified agriculture product sharing about 40% the value of the agriculture-forestry-fishery production of the nation. Of that value, rice production (17.4 million tons of rice in 2002) took over 50% the total production and 90% exported value of rice of the nation; fishery shared 55% in terms of production and 61% in terms of the exported value of the nation.

The change in agriculture structure was in trend of decrease of agricultural weight, increase weight of the value of the breeding and service sectors, although the target has gained at a low rate. In comparison with that of the nation, yield of cultivated crops and the value of agriculture production in each land unit have increased. Income of agriculture labour has increased correspondingly (from 6.95 to 10.83

million VND /labour /year). A number of specializing crop areas like special rice, sugarcane, fruit, etc. have been formed initiating an important basic condition for development of commercial agriculture production in connection with processing industry, improving local people's lives.

Table 2: Cropping Areas in 2002

Crop	2002 (1000 ha)		Ratio (%)
	Sub-area 10V	Nation	
Rice	3814	7,484.6	50.9
Maize	25.8	726.9	3.5
Cotton	0.4	27.3	1.4
Fruit	223.2		

However, a number of potentials of the sub-area 10V in terms of agriculture production are not yet explored reasonably. Rate of area of high quality rice, which needs for export, is still at low, and post-harvesting technology needs to be improved. In the sub-area 10V, the growth rate of pigs and poultry averages to 4.5 – 4.8%/year, cattle decreases at rate of about 11%/year that needs to be improved. On the other hand, due to slow improvement of socio- economic, and culture situations, a number of ecosystem problems have occurred at a extremely rate. Particularly, change of mangrove forest for shrimp culture in the coastal area affecting to the coastal ecosystem, water pollution, salinity, acidization, etc. needs to be studied in the plan.

### 1.2.2. Forestry

The sub-area 10V is the rice bow of Vietnam but often affected by floods and salinity. In this area, forestry sector shares a low rate in compare with other economic sectors and is in trend of decrease. The area of forest has decreased from 348,700 ha in 1990 to 273,000 ha in 1998 and slightly increased to 333,800 ha in 2002 due to the policy of reforestation of bared land and hills. The coverage rate at this time is about 8.4%. Due to fire disasters at the beginning 2002, there remain only 51400 ha of the natural forest. The reason of decrease of the forest area is due to lack of synchronous development policy such as reclaim policy, a policy on encouraging food crop cultivation, fishery culture.

Table 3: Forest Area in 2002 (1,000ha)

Forest	Nation	Sub-area 10V	Rate %
Total area	11,523.8	333.8	2.9
Natural forest	9,586.5	51.4	0.5
Replanted forest	1,946.3	282.4	14.5
Un-used land	7,699.4	247.3	3.2

Source: Sub-Institute of Forestry Investigation and Planning No 2.

### 1.2.3. Fishery

Fishery capture: In 2002, 8 coastal provinces in the sub-area 10V had captured 1,035,388 tons sharing 65.3 % of the total capture production of the nation. Inland

production of fish capture of the sub-area was 50,000 tons/year, of that figure; river fish was about 30,000 tons/year.

Aquaculture: Aquaculture area in the sub-area 10V is about 571,700 ha sharing 70% of the aquaculture area of the nation. It is different from traditional ways of fishery capture in large lakes, pond aquaculture, and cage fishery, which limit to supply for inner/local needs of the Central Highland area, the potential of large water surface area of the Sub-area 10V has been used efficiently for a decade ago. The fishery production of the sub-area 10V in 2002 was 1,327,437 tons, increasing 2.7 times, and sharing over 60% of the exported fishery production of the nation.

Particularly, there was a change of rice cultivation to shrimp/fish culture (about 200,000 ha) in year 2000 and 2001. Main product was catfish with high value contributing to the export.

Table 4: Present situation of fishery production

Items	Nation	Sub-area 10V	
		Production/Area (ton/ha)	Rate Compared with that of the Nation (%)
<b>Total production in 2002 (ton)</b>	<b>2,578,500</b>	<b>1,327,437</b>	<b>51.4</b>
Marine fishery capture	1,797,100	848,651	47.2
Aquaculture	781,400	478,786	61.2
of which: Shrimp	186,700	144,849	77.6
<b>Aquaculture Area, ha</b>	<b>819,800</b>	<b>571,700</b>	<b>69.7</b>

Source: Sub-Institute of Economy and Fishery Planning

Owing to large fishery production and developed infrastructure for fishery processing, the total fishery export value of the sub-area 10V has contributed 51.4% to the national export fishery value. However, situation of uncontrolled fishery development in the sub-area is a reason, which affects to the fishery environment such as degradation natural sources for fishery, pollution of aquaculture environment, degradation of aquatic environment.

#### 1.2.4. Electricity

Total installation capacity of all power stations in Vietnam is about 8,750 MW. Of which, hydropower is about 48.8%, thermal power 20.4% and gas turbine and diesel power 30.8%. Over the last 10 years, power production of Vietnam has increased at a rate of about 12% and production scale has increased 3.5 times and annually power generation is about 26,594.10<sup>6</sup> KWh. The average power consumption per person has increased from 113 to 341 KWh/year. Structure of sources of power generation has changed dramatically such as power generation by gas turbine increased from 5.4% to 23%, power generation by hydropower decreased from 61.9% to 54.7% and by thermal decreased from 32.7% to 22.3%. The sub-area 10V only has potential for development of gas turbine and thermal power plants. The potential of these powers in the sub-area 10V is estimated at

2070 MW with 3 power plants such as O Mon I (600 MW), Ca Mau (720 MW) operated after 2005 and O Mon II (750 MW) after 2010.

### 1.2.5. Navigation

Vietnam is the nation with high potential for water transportation. River networks of the Red River Delta in the North and the Mekong Delta in the South cover almost fields of economic, political, culture, science, and population of the nation, creating a favourable navigation system for socio-economic development.

Table 5: Main Navigation Routes of the Sub-area 10V

Navigation Line	Length (km)
National Lines (Ship 300 DWT, Barge 1000DWT)	
Ho Chi Minh City – Ca Mau	356
Ho Chi Minh City – Kien Luong	319
Ho Chi Minh City – Plain of Reeds – Long Xuyen Quadrant	288
Line in Mekong River and Bassac River (ship 3000-5000 DWT)	
Mekong River from Tieu River Mouth to Vietnam – Cambodia border	227
Bassac River from Dinh An River Mouth to Vietnam – Cambodia border	228
Lines linked with harbours	
Line linked Kien Giang with Ca Mau	
Line linked Dai Ngai – Bac Lieu - Ca mau	
Line linked Quan lo - Phung Hiep	

Source: Southern Transportation and Construction Consultation Company

Navigation network of the Sub-area 10V is the most enormous and diversification one of the nation with an approximately 13,000km, which can be used for transportation (of which about 5000Km for ship/boat of about 30 - 50T). At present, about 2,312 km of the Mekong River, the Bassac River and main routes from Ho Chi Minh City to Ca Mau, Kien Luong sharing 20% of the total length of the whole sub-area are managed by the central government.

Because of under developed road network; without railways, and due to high potential for navigation, investment for development of navigation network of the sub-area during the past years has shared a high rate in transportation development. In year 2002, transportation volume of the river transportation of the sub-area was 21,385 thousand tons/km.

Together with navigation network, system of harbours and stations has been developed and diversified in terms structures, but still in poor condition in terms of

technical facilities. The group of harbour system in the Mekong River, the Bassac River with Can Tho port considered as the centre, is the most important. In addition, there are some other harbours such as My Thoi harbour located in the right bank of the Bassac River (1.2 million ton/year for ship 2000 DWT); Vinh Thai harbour in the right bank of the Co Chien River (0.3 million ton/year, for ship 1000-2000 DWT); My Tho harbour in the left bank of the Mekong River (0.7-1.0 mil T/year, for ship 1000-3000 DWT); Cao Lanh harbour in the left bank of the Mekong River (0.3 million ton/year, for ship 1000 DWT) and a number of local harbours such as Ca Mau , Dai Ngai ( Soc Trang ), Nam Can, Ong Doc, Hon Chong (Kien Giang), etc.

Table 6: Comparison Volume of Freight of Water Transport with Total Volume of Freight in the Sub-area 10V

Items	1994		1995		1996		1997	
	1,000T	Mil.T.Km	1,000T	Mil.T.Km	1,000T	Mil.T.Km	1,000T	Mil.T.Km
Volume of freight	11997	1274	13406	1472.5	14831	1636	16299	1769
Of that, water transport	7433	954.6	8247	1096	9150	1193	10102	1318
Rate (%)	62	74.9	61.5	74.4	62	72.9	62	73

Source: Southern Transportation and Construction Consultation Company

However, in the water transportation in the sub-area has encountered number difficulties as follows:

- Although there are a number of navigation routes, most of these are used naturally, depending on topography of river channels, water levels (large difference by seasons), and sedimentation regime;
- A number of obstacles like sunk ships, bridge pillars, underwater reefs and fail river embankment, and even structures that encroach river banks (such as houses, fish cages) are not fully controlled and managed that caused a number of problems for the navigation and polluted the environment. There are a number of low free-broad and old bridges, which have narrow width and low clearance that also limit the navigation;
- Facilities and infrastructure of harbours are in out of date condition. Ships are transported at a low speed due to capacity and limited engines. Investment for harbour development was not corresponding to the potential, which the sub-area has (about 2% of total investment of the transportation sector);
- Rate of un-educated human resources is rather high. People, who involve in navigation activities, are mainly poor people living based on rivers with low education. Therefore, their knowledge on law and technical and science are limited;
- There are many harbour and station systems but spontaneous development. They have been built but not following any integrated plan, small capacity, mainly manual loading and unloading. Therefore, management and coordination in production are difficult. On the other hand, due to not

having reasonable investment yet, there is a lack of equipment for loading and unloading;

- Transportation equipment (wood skin sharing 40-45%, steel skin of about 50%), is limited to capacity, un-safety and low speed.
- Management: At present, about 18-20% is managed by central government organizations, the remaining are managed by local authorities; therefore the management is still in poor state. In the flood season, when large inundation happens, transportation equipment could not identify routes causing difficulty for transportation and loading unloading; and
- Activities of water transportation, in fact, have caused pollution for the environment such as dirty dust, chemical substance spill/scatter, oil spreading, odour, waste waters at harbour areas; accidents like oil/chemical spreading; disorder of heavy metals during dredging, which also caused problems for fauna/flora existence.

#### 1.2.6. Tourism

The Cuu Long Delta is one of cradles of the culture of the Vietnamese communities, with many valuable cultural and historical heritages, which contribute to the sources of the diversified tourism of the area. The tourism of the area is mainly cultural, ecological and historical tourism such as ecological tourism in mangrove forest (Ca Mau), marine ecological area, coral ecology (Phu Quoc Island), swampy/wetland ecology, and famous natural beauty areas. However, tourism infrastructures, particularly hotels, restaurants, tourist services, etc., are limited. There are about 500 hotels with about 13,750 rooms in over the Sub-area 10V (sharing about 18% total hotel rooms of the nation); restaurant systems have just developed in recent years, and did not qualify to serve for high requirement tourists. Tourist services are not diversification; services activities with community participation are in poor arrangement, monotonous and un-attractive.

In order to develop the tourism of the sub-area taking advantage of the famous river and canal networks, the tourism sectors of the sub-area have implemented many studies and developed step by step. On the other hand, owing to the assistance from the government in terms of funds and technical aspect, the tourism, in fact, has become an important sector in contributing to the gross production and creating jobs for local people.

#### 1.2.7. Domestic and Industrial Water Supply

Up to date, 61 towns and cities have water supply systems consisting of about 241 water plants with a total capacity of 2.96 million m<sup>3</sup>/day. Rate of clean water supply is estimated at about 50-60% (60-80litter/person/day). During the last some years, the Government has invested to construction of urban water supply system by the national funds, ODA, and other international donors. However, due to the characteristics of water sources and the water losses during the operation, there is still a lack of water supply during the dry season. At present, all cities, towns in the sub-area have about 53 water supply systems with a total capacity of about 242 000 m<sup>3</sup>/day.

The issue on drainage of wastewater and environment sanitation of urban areas in the sub-area 10V has solved reasonably. However, the state of untreated wastewater causing pollution is rather popular. Specially, there are about 40% of urban areas, where wastewater from tank latrines, two-section latrines and public toilets are not treated.

Table 7: Existing Situation of Water Supply

Region	No. Plants	Capacity 10 <sup>6</sup> m <sup>3</sup> /day	Standard l/person/day	Rate of Accessed (%)	Sources
Nation	241	2.96	60-80	50-60	Surface and GW
Sub-area 10V	53	0.241	60-70	40-60	Surface and GW

Rural population in the sub-area 10V is mainly used water from rivers, canals for domestic uses; rate of accessed clean water is very low.

### 1.2.8. Flood Control

Eight among 12 provinces of the Cuu Long Delta have affected by floods from the Mekong River. The hydrological regime in the inundation areas has strongly affected by flows from the Mekong River, tides from the East Sea, the West Sea and inland water level regime. The flood season of the sub-area is almost the same as rainy season (from July to December). Flood flows in the sub-area originate from two sides; one from inundation areas in the Cambodia territory (about 10-15%), the other from the Mekong River and the Bassac River (85 - 90%). Most of floodwater flows out the East Sea; the remaining debouches into the West Seas and Vam Co River.

The trend of the floods from Cambodia to Long Xuyen Quadrant and Plain of Reeds has increased in terms of flow discharge but the characteristic of these floods is low in the main river and higher in the farm field. Particularly, due to the flows from Cambodia side higher than the rich-sedimentation flows from the Mekong River and the Bassac River, therefore, the sedimentation, which contributes to fertilizer for soils in this area, is reduced.

Floods flowing into the Mekong Delta bring a number of benefits such as sedimentation, extending the coastal area of the Delta into the seaside, contributing fertilizer for soil, supplying more fishery sources, improving the environment, field sanitation and aquaculture. However, floods cause a number of constraints in exploitation of land and urbanization of the rural areas, development of rural areas in trend of civilization, and modernization. Therefore, flood control plan for the Cuu Long Delta has closely related to strategies of water resources development of the Mekong River basin and the Mekong Delta. Hence, plan of water resources development and protection has to be developed in close coordination with other plans such as transportation plan, construction plan, fishery and agriculture aiming at civilization rural areas. The key point of the flood control plan is to find reasonable measures to drain floods from the upstream into the seas, the Vam Co River, to bring back to the Mekong River and Bassac River, and to reduce effects/impacts to the production, the population and the environment. During the floods in year 2000, the damage of properties of the whole Cuu Long Delta was estimated at about 2,000 billion. VND and hundreds of people died.

Table 8: Damages caused by High Floods

Item	Unit	1978	1984	1991	1994	1995	1996
<b>I. Human/housing</b>							
1. No. of death	Person	87	105	158	407	199	217
2. Damaged house	H.Hold	66,010	50,504	197,477	505,906	28,240	78,859
3. Resettlement household	H.Hold	245,500	10,744	15,600	20,125	11,431	38,735
4. Household needed to be supported	H.Hold					59,262	175,441
<b>II. Production</b>							
1. Rice area inundated reduced yield	Ha	113,600	111,879	88,837	202,189	62,399	107,707
- Not harvested	Ha	307,100	175,628	171,898	26,868	11,101	43,249
2. Upland crop area inundated reduced yield	Ha						50
- Not harvested	Ha						17,466
3. Inundated fruit	Ha						76,396
4. Fish pond	Pond					16,336	69,505
5. Death Poultry/Cattle	Head					242	18,965
<b>III. Infrastructure</b>							
1. School classes	Room						11,093
2. Pupils has to be absent	Pupil					217,412	905,302
3. Medical aid station inundated	Station					156	509
4. Canal inundated	m <sup>3</sup>					5,512,226	4,431,000
5. Damaged Bridges, sluices						2,722	24,478
6. Inundated stores, offices, ...						372	2,411
<b>IV. Erosion land</b>							
Eroded areas	m <sup>2</sup>					506,880	356,935
1. Effected household	Household						5,543
<b>Total</b>	<b>10<sup>9</sup> VND</b>	<b>2,469</b>	<b>2,492</b>	<b>2,217</b>	<b>2,284</b>	<b>700,544</b>	<b>2,182</b>

Source: Provincial reports



***General Analysis on Development Situation and Issues:***

- The problem of products consumption is not yet solved resulting in difficulties for farmers in selling their production and causing loss for farmers due to price reduction from merchants.
- The forecast of products consumption capacity is not yet well implemented resulting in unstable development and production, and causing large amount of losses. Sometime, there is no product for consumption. And sometimes; product could not be sold.
- Management task is not yet carried out well including the management of natural resources such as land, water resources, biological resources and the management of socio-economic sector, resulting in dramatically destroy of forest, exhausted fishery resources, and that policies are not fully functioned.
- Slow development of industry sector, particularly processing industry for agriculture production, which result in limitation of products consumption of farmers and consequently reduce the income of farmers because of production in raw state and having low price.

***Issues:***

- Road systems are under developed. This issue affects largely to rural development including economy, culture and society.
- Living conditions of the local people are still in difficult situation due to poor environment; lack of clean water, power for domestic uses; inundation in long period of time. In annually inundated areas, a large amount of damage still happens. In high flood years, hundred of thousand households have to resettle, therefore, no sustainable living condition are existed.
- Lack of investment capital.
- Difficulty in production consumption.



## 2. Baseline Description of the Sub-area

## 2.1. Geographical Features

### 2.1.1. Coverage

The Cuu Long Delta Sub-area (Sub-area 10V) is located in the southernmost Vietnam bordered with the border of Vietnam and Cambodia and Ho Chi Minh City in the north, the East Sea in the east and the south, the West Sea in the west. It covers provinces including Long An, Tien Giang, Dong Thap, Vinh Long, Tra Vinh, Can Tho, Soc Trang, Ben Tre, An Giang, Kien Giang, Bac Lieu and Ca Mau with a land of about 3.97 million ha.

### 2.1.2. Topography

The Cuu Long Delta is rather flat with the elevation from 0.8 to 1.2 m (above m.s.l.). The highest area is located (3.0 – 4.0 m above MSL) is along the border of Vietnam and Cambodia with elevation of about 3.0 to 4.0 m (in the left bank of the Mekong River); 2.0-3.0m (the area in between Mekong and Bassac rivers). Land elevation gradually is lower downstream direction, as from 1.0-1.5 m in central zones, 0.5-0.8 m in the coastal area. Along both side of the Mekong River and Bassac River, the high elevation land strips are formed (with the elevation of 1.5-2.0 m, isolated 2.5 m) naturally formed river banks, which can protect rice fields against small and medium floods. Sand bars in coastal zone usually are established by interactions of East Sea short & long shore currents, river sedimentation and wind. The downstream of the West Vam Co River, , the lowland zones in Cai Lon – Cai Be catchments, and Southern Ca Mau cape are the lowest area with elevation of about 0.3-0.7 m, and always inundated due to high tides, rainfall, and floodwaters.

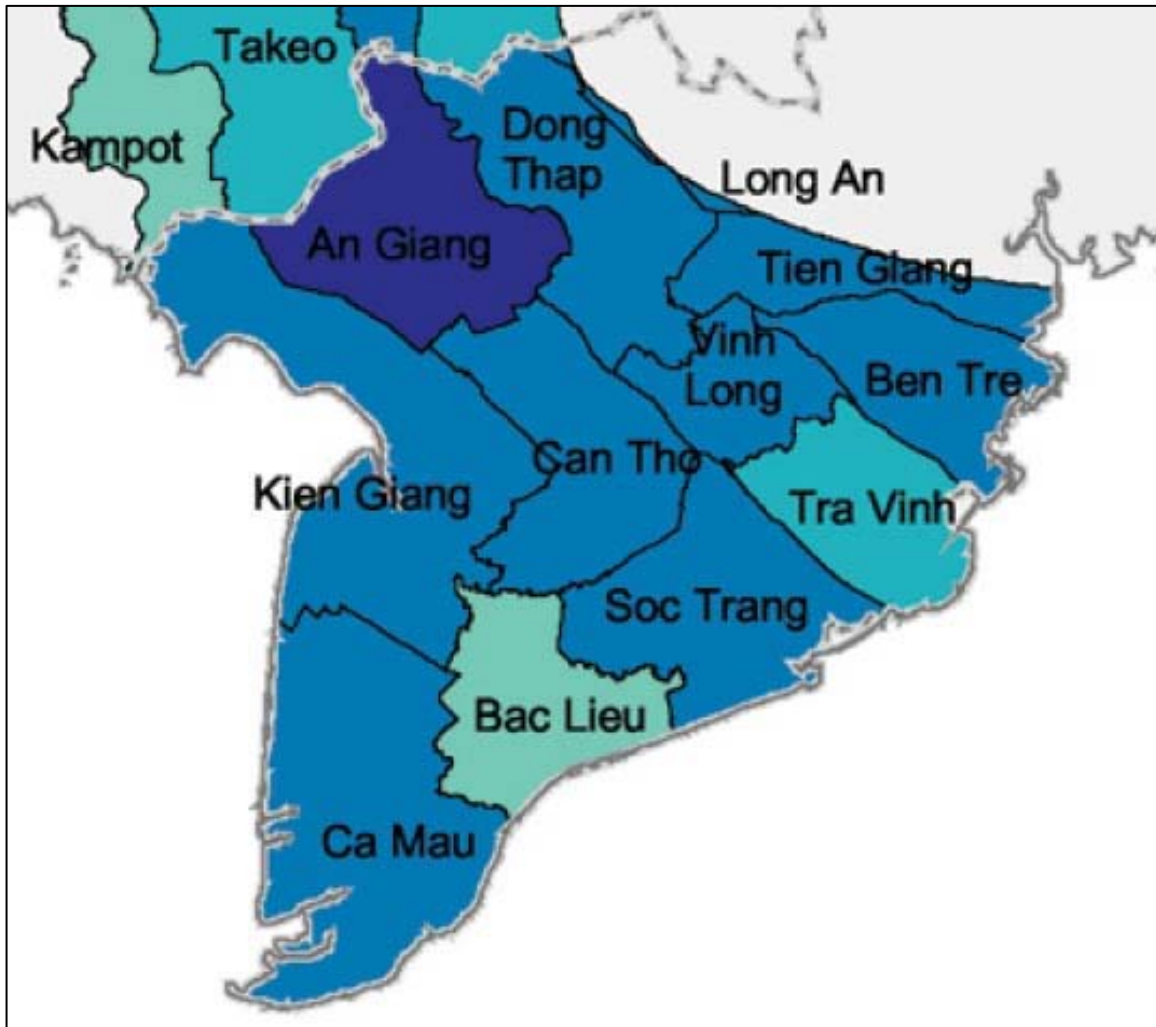
### 2.1.3. Climate

Mekong Delta, in general, and the sub-area 10V, in particular, is located in the monsoon tropical region. Due to topographical characteristics, the climate is rather hot year-round, and there are two distinct seasons depending on the activity of circulation of monsoon atmosphere: wet and dry. The dry season is same as the duration dominated by the northeast monsoon current prolonged from November to next April, and characterized as dry, hot and very little rain the wet season usually starts in May and lasts until November, when the southwest monsoon current dominates, and characterized as hot, humid and high rainfall. The specific characteristics are listed as following:

#### ***Temperature:***

Monthly average temperature varies from 27 to 28°C. The lowest temperature appears in January (25.5°C) and the highest temperature appears in June (28°C). The difference among months in a year is about 3-5°C. The highest value of average temperature is approximate 32°C and the lowest is about 23.5°C. Generally, high temperatures usually can be met from April to June, whereas low temperatures are in December and January. Differences in spatial distribution of temperature are not much.

Figure 1: Provinces covered by the Sub-area 10V



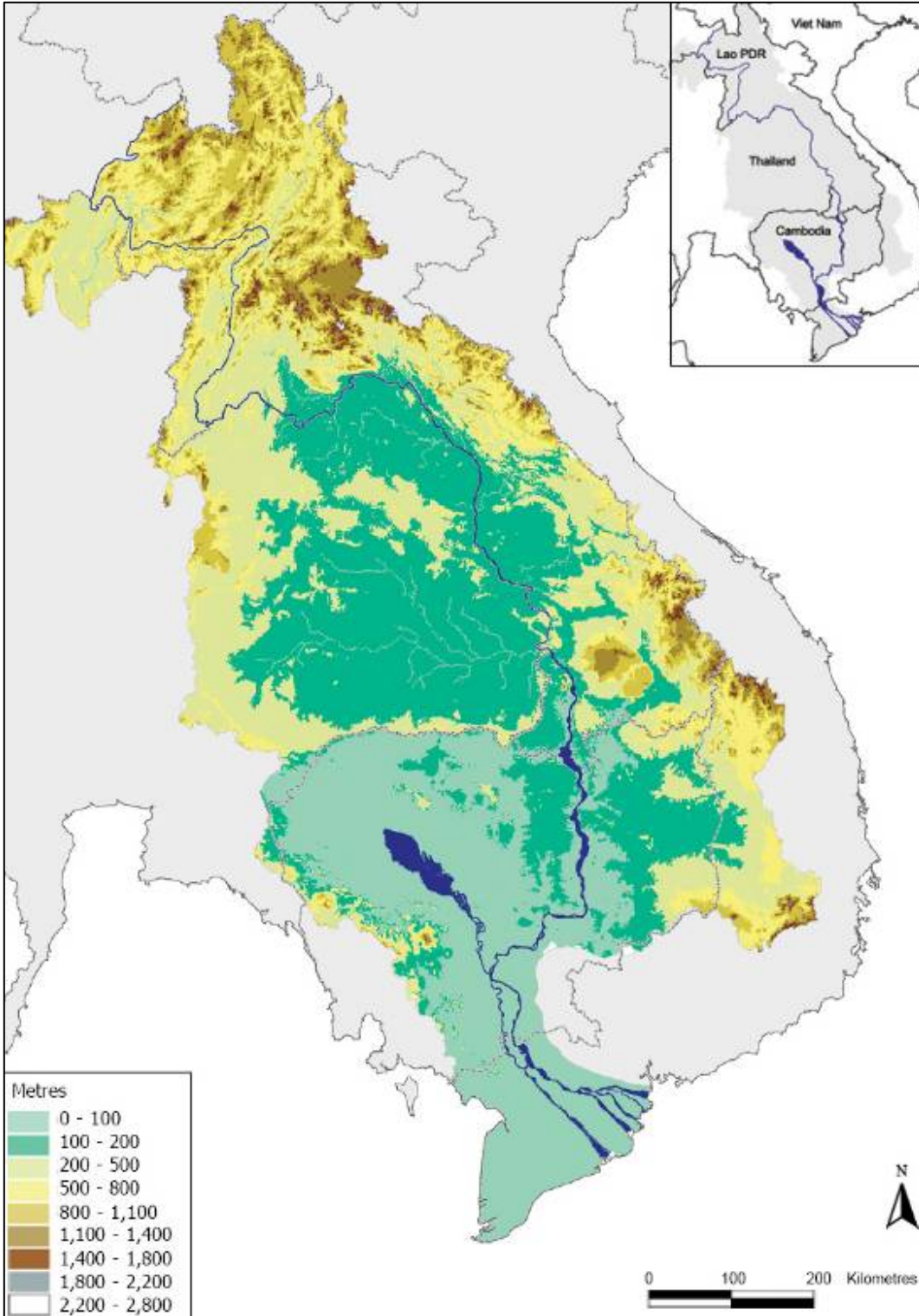
***Evaporation, Humidity and Wind Velocity:***

***Evaporation:*** Lower Mekong basin entirely lies on the monsoon tropical region of Northern hemisphere, extending in 13 latitudes (from 8°7' to 21°3'). As a result of complex topographical characteristics as well as under the condition of a region in the low latitude, the climate of the Lower Mekong Basin, in generally, is sunny and hot, and distinguishes between dry and wet depending on the activity of annual monsoon current. Average temperature varies from 27 to 30°C. Therefore, evaporation ratio is high. Especially, evaporation in surfaces of hydropower-reservoirs, irrigation canals and even in the natural rivers is very high. This is a main reason causing water loss in the basin.

The evaporation regime varies in space and time. During a year, evaporation reaches the maximum values in March, April and May. The maximum value is usually reached from 180 to 220 mm. In August and September, evaporation still reaches 100-150 mm. The yearly average evaporation is from 1,500 to 1,800 mm. There is a trend that evaporation ratios increase from upstream to downstream and

from East – West direction. The table below shows evaporation values in some stations in the Lower Mekong basin.

Figure 2: Elevation above Sea Level



Source: MRC, 2003.

**Humidity:** Humidity reaches the max values in wet season and gradually decreases till dry season. Average humidity values in August, September and October are in range of 84-89%, wherein February, March and April are 67-81%.

Wind characteristics: Average wind speed is approximate 2 m/s. In coastal zones (Sub-area 10V), max speed can be met in February and March. The wind speed frequency of 5% is estimated at about 15-18m/s. In October, November, wind speed is small except for some specific situation. In the Great Lake, there are some places where the average wind speed is lower than 1 m/s.

**Sunny Characteristics:** The whole basin is located in the rich radiation area. In one day, sunny period lasts for more than 6 hours (and about 2000-2500 hours per year). In February and March, there are 8-9 sunny hours per day, whilst in August and September; there are only 4.6-5.3 hours per day.

**Rainfall Characteristics:**

The rainfall in the Cuu Long Delta is not evenly distributed in time and space. Western zone of the sub-area 10V has the highest rainfall, about 1800-2400mm per year. Rainfall in eastern zone of the sub-area 10V is approximate 1600-1800mm. The central zone (from Chau Doc – Long Xuyen – Can Tho – Cao Lanh to Tra Vinh- Go Cong) has the smallest rainfall, about 1,200-1,600mm per year. About 90% of yearly rainfall falls in wet season while about 10% in the dry season. In January, February and March, there is almost no rain, causing severe drought periods. In the wet season, heavy rainfalls often fall causing inundation but there are some periods when there is no rainfall prolonged from 10 to 15 days and even 20 days causing damages for cultivation. There is no large difference among years in terms of rainfall, but the change of rainfall between the beginning and the end of rainfall season is high. Wet (rainy) season starts in May and ends in November, but as observed, in June there can be no rain, but in December there is still heavy rd rain. The change of rainfall patterns causes difficulties for agricultural activities.

Table 9: Average Monthly Rainfall Distribution (mm)

Stations	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Vinh Long	9.1	0.1	9.2	30.4	139	171	180	176	214	273	131	30
Long Xuyen	8.3	2.6	11.7	66.5	147	152	209	174	214	260	131	42
Can Tho	8.9	2.3	9.7	43	170	195	212	209	250	271	146	32
Ttan An	6.9	2.3	7.2	35.6	187	222	204	187	245	261	136	40
My Tho	5	2.5	4.5	38	149	188	186	171	233	267	104	35
Rach Gia	8.9	6.8	33.4	88.8	240	259	292	334	305	277	171	38
Ca Mau	16.4	7.6	34.1	101	270	323	324	365	349	331	190	64

However, long-lasting showers (3-5 days) can cause the severe inundation problems in the study area in rainy seasons. There is no rule for the distribution of 1-day, 3-day and 5-day max rainfall. Generally, 1-day max rainfall is in 3-day max rainfall, whilst 3-day max rainfall is in 5-day max rainfall. The 1-day, 3-day and 5-day max rainfall has been used as the typical and the worst conditions for rainfall in

the Cuu Long Delta. The below tables present some characteristics of rainfall in the study area.

Table 10: Average Drought Period in Wet Season in the Sub-area 10V

Station	V			VI			VII			VIII		
	7 days	10 days	15 days	7 days	10 days	15 days	7 days	10 days	15 days	7 days	10 days	15 days
Vinh Long	1.1	0.7	0.3	1.0	0.3	0.0	1.0	0.5	0.1	0.9	0.2	0.0
Long Xuyen	1.2	0.5	0.2	0.9	0.6	0.3	1.1	0.5	0.2	1.1	0.5	0.1
Can Tho	1.0	0.6	0.2	0.9	0.2	0.0	1.0	0.3	0.0	0.6	0.1	0.0
Ttan An	1.2	0.7	0.4	0.9	0.5	0.0	1.4	0.6	0.0	1.1	0.4	0.0
My Tho	1.3	0.7	0.2	1.2	0.5	0.2	1.2	0.5	0.2	1.0	0.3	0.2
Rach Gia	0.8	0.4	0.0	1.0	0.5	0.0	1.0	0.5	0.1	0.7	0.2	0.1
Ca Mau	0.7	0.2	0.1	0.8	0.3	0.0	0.6	0.3	0.0	0.5	0.2	0.0

Table 11: Maximum Rainfall with Frequency of 10% in 1-day, 3-days and 5-days (mm)

Station	VI			VIII			IX			X		
	1 day	3 days	5 days	1 day	3 days	5 days	1 day	3 days	5 days	1 day	3 days	5 days
Vinh Long	77	103	127	56	79	106	78	111	144	95	138	186
Long Xuyen	73	106	118	77	114	134	76	103	131	92	153	173
Can Tho	99	137	159	72	109	138	74	117	144	98	168	227
Tan An	73	90	123	91	158	176	87	126	169	144	188	212
My Tho	93	130	155	86	111	133	73	113	147	107	155	190
Rach Gia	109	168	214	163	226	282	132	194	227	110	162	200
Ca Mau	97	150	193	109	194	252	108	185	220	99	151	185

## 2.2. Population and Livelihoods

### 2.2.1. Population

Population of the sub-area 10V in 2002 was about 16.76 million, including 13.7 million rural people (sharing 82.9%) and 3.04 million urban people. The number of people in each household was 5.4 people rather higher than the average of the nation. The growth rate was about 1.55%/year, with an average density 423 people/km<sup>2</sup>, and unevenly distributed over the area. The highest population density was concentrated in provinces along the Mekong River and the Bassac River, and the lowest is located in provinces, which are far from freshwater-sources like Ca Mau, Bac Lieu, Kien Giang and Long An. The population in labour age was about 9.7 million people. Communities living in the sub-area include Kinh people, Khmer, Hoa (Chinese). Of that, the Kinh people were about 88%.



The education of the sub-area is considered as low level in comparison with that of the nation. The percentage of the people, who are not graduated primary school, is 32.8% (the nation 15.8%); graduated high school 7.9% (the nation 16.5%). As well, non-specialist is at 90.2% (the nation 80.8%); people graduated from primary school or over are about 6.7% (the nation 11.2%). Therefore, to develop the Cuu Long Delta, in general, and the inundation area, in particular, a policy for education and improvement of technical knowledge are needed. Moreover, rate of using agricultural labour hours is low as about 73.1/73.9% in comparison with the nation. Therefore, it is needed to change production structure to create more jobs for community.

Table 12: Population of the Sub-area 10V in 2002

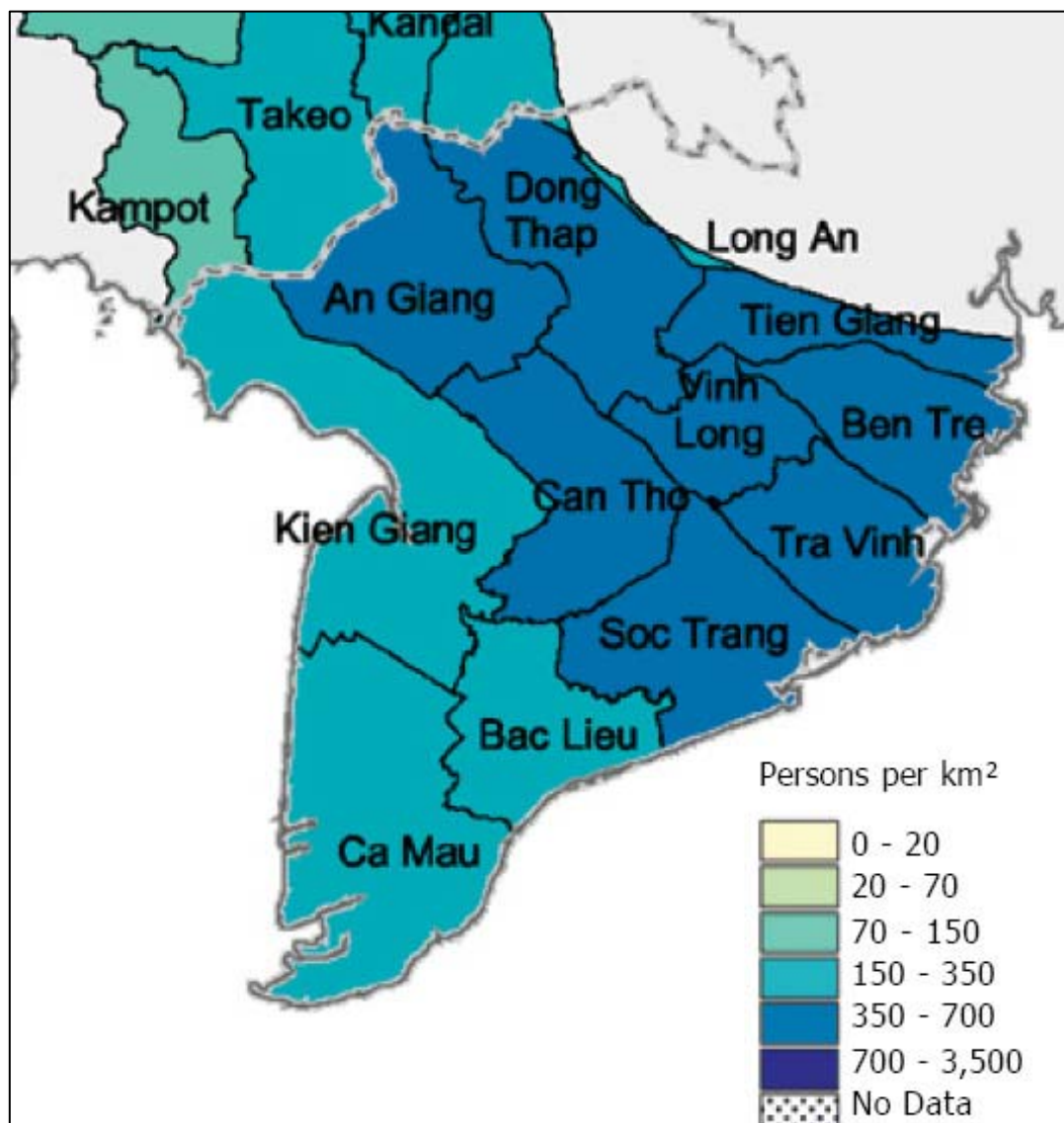
Province	Are (ha)	Population (people)	Density (per./km <sup>2</sup> )	Urban (people)	Rural (people)	Growth Rate (%)
Long An	435,509	1,364,355	313	224,928	1,139,427	1.68
Dong Thap	23,811	1,622,072	501	242,540	1,379,532	1.53
Tien Giang	236,663	1,648,922	697	212,117	1,436,805	1.57
Ben Tre	231,500	1,336,720	577	144,720	1,192,000	1.34
Vinh Long	148,448	1,029,710	694	152,175	877,535	1.33
Tra Vinh	222,580	996,206	448	129,898	866,308	1.35
An Giang	340,623	2,122,539	623	490,430	1,632,109	1.62
Can Tho	298,600	1,878,226	629	460,504	1,417,722	1.51
Soc Trang	322,300	1,226,667	381	226,110	1,000,557	1.75
Bac Lieu	254,188	774,395	305	188,773	585,622	1.16
Ca Mau	521,182	1,165,876	224	220,650	945,226	1.87
Kien Giang	626,900	1,601,550	255	350,096	1,251,454	1.84
<b>Total</b>	<b>3,962,304</b>	<b>16,767,238</b>	<b>423</b>	<b>3,042,941</b>	<b>13,724,297</b>	<b>1.55</b>

### ***Labour, Farmer Household's Economy and Income:***

- The sub-area 10V (the Cuu Long Delta) has had a large amount of labours. In year 2000, population in labour ages was about 9.7 million people, (about 4.8 million people in the inundation areas). Of which, agriculture labours shared 70 %. Most of rural population involved in agriculture production activities. Due to uneven population density, farmland for each person was different from area to area. For instance farmland each person in riparian area of the Mekong River and the Bassac River is about 0.1-0.2 ha/person, and about 0.2-0.4 ha for each agriculture labour.

- The income of the population of the area is mainly depended on the agriculture production. Recent investigations show that other incomes of the population in the sub-area shared only about 10-30 % of the total income, and depending on areas and household. At present, GDP per person in the sub-area is about 300 USD/year, and unevenly distributed over the area, rich households shared about 30%, and about 20-30% households below poor level.

Figure 3: Population Density in the Sub-area 10V



Source: MRC, 2003.

### 2.2.2. Economic Situation

Total production of the sub-area in the year 2002 was estimated 89,089 billion VND (approximately 5.9 million USD). Growing rate in 1996-2000 averaged to 7.5% higher than that of the nation (7%). However, due to low commodity value and commodity that produced only based on the potential of the area not based on requirement of the market, thus agriculture production has faced many challenges.

Sources of the economy of the sub-area 10V, in general, and of the inundation areas, in particular, are mainly agriculture, and in addition, fishery, forestry, industry of exploitation of materials, agricultural and fishery processing industries, and services. Recently, the economy of the Cuu Long Delta and of the inundation area has developed remarkably. In the year 2000, rice production reached 11,742,808 tons; GDP per person was about 300 USD/person/year. Strong investment in water resources development and infrastructure from the government, in combination with reasonable frameworks, and policies, has created dynamic for production. However, the economy of the basin is considered, in general, as a backward agriculture economy with a low mechanization level, undeveloped infrastructure, low urbanization, naturally based production, instable living condition. Floods and inundation are major constraints to the socio-economic development of the inundated area of the sub-area. Specially, low agricultural commodity price in recent years causes much difficulty for local people; hence change in production structure is one of urgent matters for development of the sub-area.

In comparison with 8 economic zones of the nation, the economy of the sub-area in terms of agriculture, industry, and construction, is ranked the seventh, only higher than that of the Central Highland. The progressive economic zone is the Southeast Area where the rate of agriculture is account for 10%.

## 2.3. Sector Summaries

### 2.3.1. Agriculture

#### *Upland Crop Production:*

The upland crop production is unstable, for instance, in year 1980 production of upland crops converted to rice volume was about 249,000 tons, sharing 5.1% the total food production; in year 1995 this reduced to 165,000 tons, in year 2000 only about 120,000 tons. Particularly, maize production has potential to develop fast in the future due to application of advance in seeds and high requirement from national markets. Upland crop area is reducing such as soybean decreased to 8.3%, groundnut decreased to 3.6%; and sugarcane reducing due to low price.

#### *Cultivation:*

Table 13: Rice production

Items	Unit	1980	1985	1990	1995	2000	2002
<b>1. Cultivation area</b>							
Total rice area	1,000ha	2263	2346	2547	3121	3924	3813
Increased rate	1,000ha	210	83	201	574	803	-111
Average increased percentage	%	2.05	0.72	1.66	4.15	4.69	
<b>2. Yearly rice yield</b>							
Yield	Tons/ha	2.26	3.01	3.71	4.02	4.25	4.58
Increased yield rate	Tons/ha	0.01	0.75	0.70	0.31	0.23	0.33
Average increased percentage	%	0.13	5.90	4.27	1.62	1.12	

Items	Unit	1980	1985	1990	1995	2000	2002
<b>3. Yearly rice production</b>							
Production	1,000 tons	5115	7062	9459	12832	16677	17477
Increased rate	1,000 tons	505	1947	2397	3819	2457	800
Increased rate per year	1,000 tons	101	1442	450	1422	-1362	400
Average increased percentage	%	2.19	6.66	6.02	6.29	5.38	

Sources: Sub-Institute for Agriculture and Projection Planning

### ***Land Use:***

Table 14: Land Use in 1985 - 2000 (ha)

Items	1985	1990	1995	2000
Natural area (12 provinces including islands)	3,965,800	3,957,606	3,956,900	3,971,232
Agriculture land	2,441,900	2,463,472	2,498,164	2,970,316
Ratio (%)	61.57	63.13	63.13	74.80
1 Annual crop area	2,130,900	1,970,788	1,993,613	2,226,252
1.1 Rice and upland crops area	1,973,700	1,826,535	1,837,144	2,082,663
Triple crops	4,200	97,091	148,335	359,349
Double crops	614,500	925,768	1,014,791	1,333,881
Single crop	1,355,000	890,529	674,018	292,307
Single crop + fish, shrimp				97,125
1.2 Upland crop areas	156,000	144,253	156,470	134,084
2 Perennial trees and mixed gardens	272,800	346,483	334,081	514,694
Of that: fruit		137,492	179,957	197,320
3 Pasture area		1,260	1,035	18

Source: SNIAPP / Sub National Institute for Agriculture Projection and Planning

### ***Efficiency of Land Use Types:***

- Land used for only rice cultivation is less efficient than land used for other cropping structure like rice-upland crops, upland crops, fruits and rice and fishery culture. Diversification of rice cropping structure is a main focus in cultivation by the next years.
- Land used for triple rice is less efficient than triple crops like rice - upland crops but high efficient than only double crops, therefore increasing cropping rotation is one of important measures to increase the efficiency of land use and income of local farmers. The efficiency of land used for the rice-upland crops is higher than that of land used for only rice cultivation but the difference is not large (except for land used for rice-vegetable), therefore, in order to enlarge the area for rice-vegetable cultivation, it is

needed to apply advance of technique, particularly varieties, and on the other hand, new organization for agricultural products consumption is needed to be established.

- The efficiency of the land used for rice-fishery is much higher than the land used for only rice or rice-upland crops, and suitable to ecological conditions in many areas. The rice-fishery land used type can overcome some limitations in terms of time, disaster, and market in comparison with the only rice or rice-upland crop land used types, and it has high potential in terms of enlargement. Therefore, it is needed to concentrate on investment to keep economic growing rate in the 2001-2010.
- The efficiency of the land used for intensive fruit cultivation is high. It can be continued to enlarge areas in the shallow inundation areas to contribute to increase the income of local farmers. However, it is also needed to concentrate on improvement of mixed gardens, which share high rate in total of upland crop areas of the sub-area, and needs to find out the measures to protect the gardens against floods during rainy season.
- The efficiency of the land used for only sugarcane and pineapple is low, unstable. It is needed to apply new variety with high yield in order to reduce price, increase the competition, and sustainable development in the area.

#### ***Fruit Tree and Perennial Industrial Trees:***

Many places in the Cuu Long Delta have favourable conditions for development of fruits and perennial industrial trees such as coconut, banana, oranges, mandarin, pomelo, mango, pineapple, longan, rambutan, durian, mango steen, etc. Fruit area, at present, is estimated at about 205,500 ha, with a production of over 1.531 million tons; of that area of mixed gardens is remaining large area with low yields, low quality. Recently, provinces in the area have invested in improvement of mixed gardens, varieties but due to budgetary limitation the progress is still in low implementation. On the other hand, high floods in 1994, 1999, and 2000 have caused remarkable damages for many fruit gardens.

#### ***Livestock:***

Pigs: Pig breeding is progressed rather stably in comparison with the others. The growth rate of this breeding during 1990-2000 was about 5.98%. Of that time, the progress in 1990-1995 was stronger than that of in the rest. Average pork production increased 6.21%/year during the period 1990-2000 and the product was about 320,000 tons in year 2002. Number of buffalo decreased, cows used for cultivation was changed to cows used for meat production.

#### ***Drought:***

Drought has occurred recently, particularly in 1993, 1998 and in 2003. Even in rainy season, the drought also occurs that prolongs about 7-10 days, local people called "Ba Chang" drought. Specially, serious drought occurs in coastal provinces

causing shortage of water not only for agriculture development but also for domestic uses.

***Existing Hydraulic Works:***

In order to develop agriculture sector in the Cuu Long Delta, many hydraulic works have been built over the last two decades. Presently, main canals, first, secondary and on farm canals have been built with a density of about 6-10m/ha ensuring supply capacity for agriculture development, but in terms of fishery development, hydraulics works need to be improved and upgraded. According to year 2002 statistics, hydraulics works used for irrigation are as follows:

- Main and first level canal system with a total length of 4430 km, bed width 8-40m, and bed elevation from – 2.0m to – 4.0m;
- About 105 pumping stations, with a total designed irrigation capacity of 81,620 ha, but the actual irrigation areas about 23,377 ha. In general, these pumping station systems are not suitable to the real situation of the Cuu Long Delta so far. Presently, the measures to take water from canals to the fields are mainly used small pumps for irrigation with irrigated area for each pump of about 0.2 – 0.5 ha;
- Sluice systems used for salinity prevention, drainage and drainage of acid water comprised of about 153 sluices systems, with a dimension of about 2-84 m. These sluice systems have proved their efficiency in reality. It needs to continue to use this kind of hydraulic structures with a large numbers by the next years. In addition, there are a number of culverts for irrigation and drainage; and
- Low embankment systems for early flood control at the beginning of August and protection of summer-autumn crops with a total length of about 7000 km.

During the last five years, hydraulics works has progressed rapidly due to the implementation of pivot plan programs such as: Quan Lo Phung Hiep program, Plain of Reeds, Tu Giac Long Xuyen, South Mang Thit, sea dikes and river embankment, and flood control program. Many hydraulics works for irrigation have been built but their efficiencies are not high due to:

- Management, maintain and operation activities are not well implemented, particularly small-scale projects managed by districts and communes levels, not to be repaired correspondingly due to budgetary limitations.
- Backward irrigation techniques.

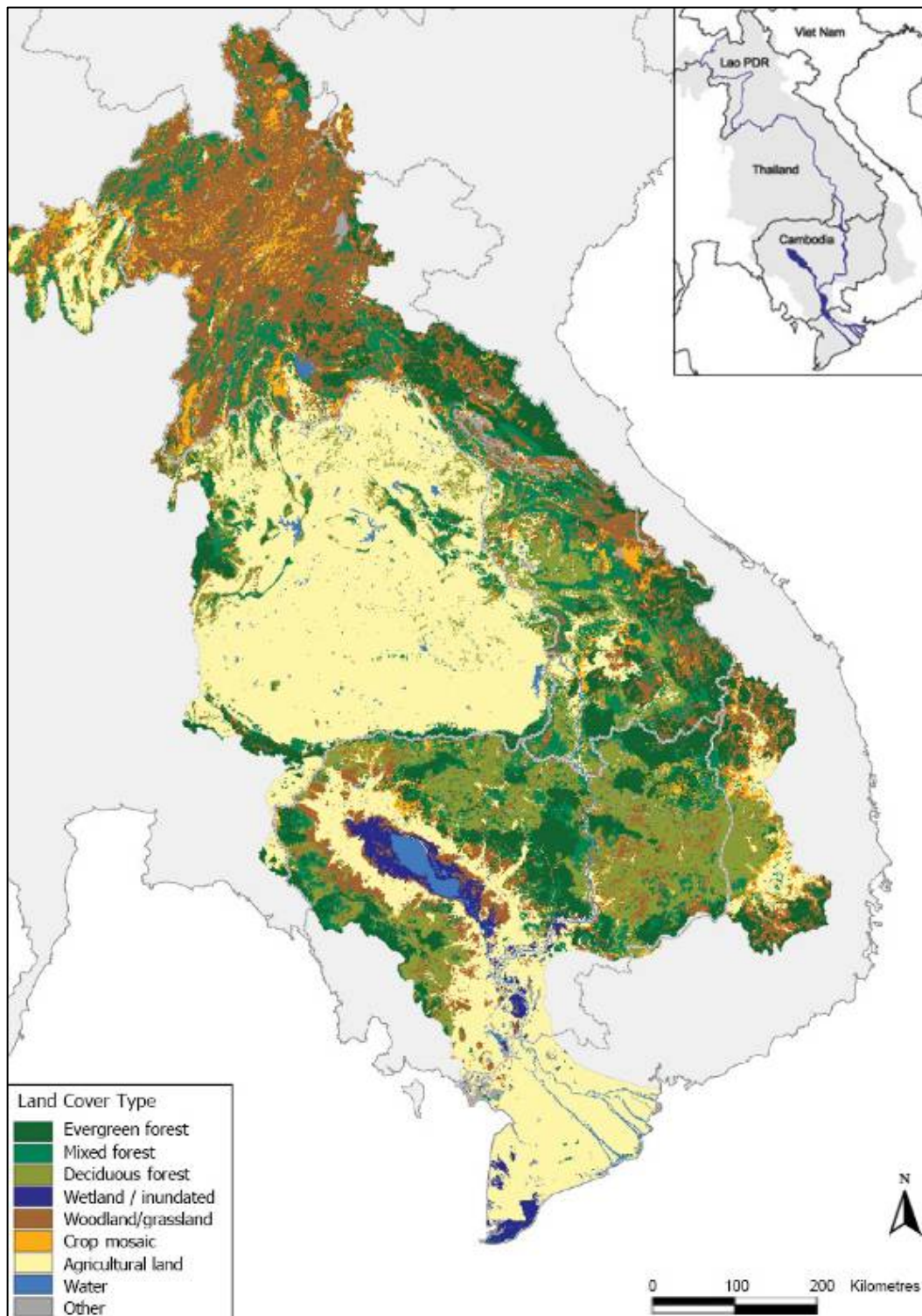
**2.3.2. Forestry**

***Forest Area:***

According to an inventory study on the forest, the present total forest area in the Cuu Long Delta is 280,484 ha, of which, natural forest is 58,136 ha and planted forest area is 222,344 ha. Coverage rate was about 7.1% (year 2001). Total forest

production was about 6.71 million m<sup>3</sup>, sharing about 0.8% total national forest production. The coverage rate of the Cuu Long Delta is the lowest in comparison with the whole nation (33.2%).

Figure 4: Land Cover in the LMB



Source: MRC, 2003.

**Forestry Existing Planning and Activities:**

Table 15: Existing Forest and other Forestry Areas

No	Forest types	Total	An Giang	Bac Lieu	Ben Tre	Can Tho	Ca Mau	Dong Thap	Kien Giang	Long An	Tien Giang	Tra Vinh	Soc Trang
	Forestry area	527832	18401	24782	14032	4443	194325	16034	145000	60095	8077	26238	16405
I	<u>Land having forest</u>	280480	9176	6480	3451	2043	101714	9059	80732	47047	4282	8019	8477
1	Natural forest	58136	573	778	994	0	9753	0	40637	1553	368	1794	1686
1.1	Mangrove forest	15281	0	778	994	0	7852	0	1809	0	368	1794	1686
1.2	Forest inundated with acid water	7758	0	0	0	0	1365	0	4840	1553	0	0	0
1.3	Wide-leaf forest	35097	573	0	0	0	536	0	33988	0	0	0	0
2	<u>Planted forest</u>	222344	8603	5702	2457	2043	91961	9059	40095	45494	3914	6225	6791
2.1	Mangrove forest	73249	0	1599	2451	0	56609	0	1782	330	1653	6145	2680
2.2	Forest inundated with acid water	114103	3200	4103	0	2043	35352	8912	10097	44032	2253	0	4111
2.3	Mangrove forest	34992	5403	0	6	0	0	147	28216	1132	8	80	0

Source: Sub-Institute for Forestry Inventory and Planning No 2.

- Planning special used forest areas is about 67,364 ha, of which about 50,704 ha have forest. Important special used forests in the Cuu Long Delta of Vietnam include Tram Chim National Park (in Dong Thap province), U Minh Thuong natural preservation area (Kien Giang province), Vo Doi natural preservation area, Dat Mui natural preservation area (Ca Mau province), and Thanh Phu natural preservation area (Ben Tre). In addition, there are some areas preserved for birds with about ten or more hectare areas in Ca Mau, Bac Lieu, Ben Tre and Dong Thap. There are some special used forests, which are now in progress of implementation like Lung Ngoc Hoang (Can Tho), Tra Su and Ha Tien (in Kien Giang province). These areas are precious ones remained in the Cuu Long Delta.
- Under Forestry Planning, economic forest area is about 268,867 ha, of which about 147,759 ha have forest. Plant varieties planted in these areas is malaleuca planted in the acid sulphate soils; mangrove, cypress, etc. planted in estuarine areas.
- Protection forest area is 191,601 ha, of which about 82,017 ha have forest. Protection forest area is the mangrove forest along the coast in Ca Mau, Kien Giang, Bac Lieu, Soc Trang, Tra Vinh, and Ben Tre. Newly formed coastal protection forests are progressing in Kien Giang, An Giang, Dong



Thap and Long An. Protection forests are planned but not yet implemented, hence much attention needs to be paid by the next years.

- Regarding to scattered forest/trees, annually locals have grown about from 15 to 20 million trees. Scattered trees are abundant and diversified about 30 varieties.
- On the management and forestry assistant aspect, ten of twelve provinces have their management system from provincial forest protection department to district levels. Frameworks and functionaries of these departments are overlapped. The conditions for operation, exchange of information, facilities, and information update are poor.

### ***Forest Ecosystems:***

#### ***Mangrove Ecosystem:***

*Cajuput ecosystem:* cajuput forest is located in almost lowland areas, acid sulphate soil areas, and peat soil areas like Plain of Reeds, Long Xuyen Quadrant and U Minh.

Table 16: Mangrove Forest Area over the Period of Time

Year	1950	1983	1988	1995	1998	2001
Area (ha)	250,000	126,000	93,000	72,000	73,000	88,530

*Natural preservation wetland areas:* Due to the importance of the mangrove forest, 11 natural preservation wetland areas have formally established with a total area of about 40,000 ha in the Cuu Long Delta. Of these preservation areas, there are national parks, which characterize for flood plain area including Tram Chim National Park, U Minh Thuong National Park in peat soil area. In addition, there are some wetland areas, which are proposed for establishment of national parks as Xeo Quyt (Dong Thap), Hon Dat (Kien Giang) and Bird garden in Binh Dai (Ben Tre).

### 2.3.3. Fisheries

#### ***Aquaculture:***

Table 17: Aquaculture Results

Items	Unit	1996	2000	Increases
Total area	Ha	315,819	431,147	+115,328
Development index	%	100	137	
Of that: Shrimp	Ha	188,486	285,854	+ 97,368
Development index	%	100	151,6	
Product	Tons	284,141	351,553	+ 67,412
Development index	%	100	123.7	
Of that: Shrimp	tons	25,677	70,651	+ 44,974
Development index	%	100	275.1	

Source: Sub-Institute for Economy and Fishery Planning

***Fishery Capture:***

Table 18: Fishery Captured Volume Results

No	Items	Unit	1991	1996	2000
1	Ships	number	7,915	15,683	17,788
	Development index	%	100	198	225
2	Total capacity	Cv	188,172	778,071	1,417,349
	Development index	%	100	413	753
3	Product	tons	182,709	496,106	796,641
	Development index	%	100	272	436

Source: Sub-Institute for Economy and Fishery Planning

***Fishery Processing and Consumption:***

Table 19: Result of Aquaculture Production

No	Items	Unit	1991	1996	2000
1	Total frozen fishery processing enterprises	enterprise	45	46	55
	Development index	%	100	102	122
2	Total exported volume of frozen fishery production	Tons	31,600	73,889	99,215
	Development index	%	100	234	314
	Of which: Shrimp	Tons	26,800	57,633	60,319
	Development index	%	100	215	225
3	Total exported fishery value	Million USD	120	307.4	717.34
	Development index	%	100	256	598
4	Average export price	1,000 USD	3.80	4.16	7.23
	Development index	%	100	109	190

Source: Sub-Institute for Economy and Fishery Planning

Table 20: Rate of Exported Fisher Production according to the Market (%)

Market	1997	1999	2000	2001
Japan	50.27	40.80	31.75	26.14
United State	5.15	13.85	20.38	27.81
Europe	9.87	9.58	4.85	5.9
Asia (excluding Japan)	31.06	29.08	27.89	17.32
Others	3.65	6.69	15.13	22.83
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Institute for Strategic Planning – Ministry of Plan and Investment

***Fishery Infrastructure and Services:***

- *Fish harbours:* Until year 2000, there are 14 fish harbours located in the coastal provinces. The fewest provinces have one fish harbour (Ben Tre, Tra Vinh), and there are some under construction harbours in (Soc Trang, Bac Lieu). Tien Giang province has two fish harbours; Ca Mau province has 3 harbours; and Kien Giang has 5 harbours (2 harbours inland and 3 harbours in islands).
- *Fish stations:* In the Cuu Long Delta, there are 75 fish stations. Of which, coastal provinces have 51 stations. Fishery mechanism: there are 141 small and medium scale enterprises, which repair, and create new ships/boats and other fishery equipment for fishery production; mainly concentrated in 7 coastal provinces (110 enterprises). There are 72 fishery markets, where fishery productions are selling.
- *Fishery species production enterprises:* In year 2000, there are about 465 enterprises which produce marine shrimp species with a total number of about 2,500 million species.

***Fishery Organization and Management:***

Apart from fishery processing and export activities, in which the state fishery enterprises are dominant in production, other activities are responsibility by non-state enterprises. Private and farm-based economies play a decidable role in production of fishery materials for fishery sector.

***Contribution of Fishery Sector:***

Table 21: Result of Fishery Production Activities in 1995, 2000, 2001

Items	Total Product (Tons)	Index (%)	Marine Capture (Tons)	Index (%)	Inland Capture and Aquaculture (Tons)	Index (%)	Average Fishery Production (kg/person)	Export Value (10 <sup>3</sup> USD)	Index (%)
<b>1995</b>									
Cuu Long Delta	685,979	52.47	415,350	43.85	270,629	58.84	35.7	261,469	40.5
The Nation	1,407,130	100.00	947,180	100	459,950	100	14.7	645,316	100
<b>2000</b>									
Cuu Long Delta	1,144,987	52.65	796,641	54.76	348,226	48.36	66.02	717,34	48.51
The Nation	2,174,815	100.00	1,454,814	100	720,001	100	25.89	1,478,609	100
<b>2001</b>									
Cuu Long Delta	1,260,315	52.25	812,425	53.32	447,890	50.92	77.94	837,404	47.56
The Nation	2,403,238	100.00	1,523,690	100	879,548	100	31.71	1,760,600	100

Source: Sub-Institute for Economy and Fishery Planning

Figure 5: Completed Hydropower Projects in the Mekong Basin



#### 2.3.4. Hydropower

Presently, there are 1,025 communes in a total of 1,318 communes of the sub-area that are supplied power. Provinces, which supplied for all communes, include: Tien Giang, Can Tho, An Giang, Dong Thap, Vinh Long, and Soc Trang. All inland districts with a total of 1.2 million farmer households, which has accessed power network, have linked with national grid.

By 2003, all communes are strived to supply power for over 80% of households and by 2005 all households are used power for their needs. That supplies basic power need for socio-economic development of the sub-area.

The Cuu Long Delta is a centre of high power load and in the future, when gas sources in the Southwest shelf is exploited; the power plant used gas sources would be implemented. In the period of 2005-2006 there will be two power plants used gas resources including O Mon 1 - 600 MW and Ca Mau - 720MW depending on capacity of gas exploitation in the future and it would be became a centre of gas power plants with a thousands of MW.

#### 2.3.5. Transportation

The sub-area 10V has high potential for navigation development with two main routes from Ho Chi Minh City (HCMC) to Ca Mau and from HCMC to Kien Luong with a navigation density of about 0.68 km/km<sup>2</sup>, higher than many areas of the nation. Main goods, which are transported by navigation routes are rice, construction materials, and agriculture materials; and shared about 90% total navigation transportation. Particularly, the two main routes share about 70-80% of the total.

In order to support for navigation activities, a network of harbour from provincial centres to district centres have been formed. The main harbours include Can Tho, My Thai (An Giang), Cao Lanh (Dong Thap), Vinh Thai (Vinh Long), My Tho (Tien Giang), Dai Ngai (Soc Trang), Bac Lieu, Ca Mau, Rach Soi, Kien Luong, Hon Chong (Kien Giang). Of that, there are six harbours, which located in main rivers including Vinh Thai, Cao Lanh, My Tho (in the Mekong River), Can Tho, My Thai, Dai Ngai (in the Bassac River); and international harbours including Can Tho, Vinh Thai, My Thai, Nam Can, Hon Chong. In particular, Can Tho has been identified as an international harbour from 1992, and can allow 5-10 thousand tons ships moored. The major limitation to the navigation network and harbours is sedimentation in main rivers, in harbours and bank erosion, which result in high cost for dredging and maintaining the system.

#### 2.3.6. Tourism

##### ***Kinds of Tourism:***

Vietnam, in general, and the Sub-area 10V, in particular, has a many kinds of the natural environment and that are precious natural resources for tourism development. Kinds of tourism include:

- *Mangrove ecosystem*: the mangrove forests are located along the coast of Vietnam but mainly located in the South, particularly in the Ca Mau Peninsula. This ecosystem is the environment of many kinds of saltwater inundated trees, fish, shrimp, crab, and birds, particularly big bird varieties. If these mangrove forests are invested for development these will promote ecological tourism in the area, particularly in combination with the Mekong River Basin.
- Coral ecosystem remains in some areas of the Vietnamese Sea. There are about 95 coral varieties in the North and about 255 coral varieties in the South. Coral ecosystem is the high potential resources for tourism development like in the Con Dao Island, and Phu Quoc Island.
- *Marine ecosystem*: with a length of about 3,200km, Vietnam has about 600,000 ha of beaches for tourism development.
- *Wetland ecosystem (swamp)*: This is mainly concentrated in the Mekong Delta of Vietnam. This kind of ecosystem attracts many varieties of birds and it can be developed a unique kind of tourism.
- The diversification object-cultural kind in Vietnam includes cultural heritages such as temples, pagodas like Ba Chua Su, Bay Nui temple. This kind of object culture is precious sources for tourism development.
- The non-object culture kind is characterised as the culture of 54 Vietnamese communities through out architecture patterns, dancing, music, tradition, usages and customs and traditional festivals. The Mekong River Basin from the northwest, central highland to the delta has many minority communities lived, therefore there are many kinds of non-object cultures which can be developed in terms of tourism in combination with cultures of minority groups.
- *Traditional trade villages*: handicraft, pottery, bamboo and rattan, etc., are the kinds of special cultures attracting tourists.
- Museums are important measures to disseminate aspects of the cultures including geography, history, art and culture of a particular area, and are precious not only in introduction to foreign tourists but also attracting domestic tourists.
- *Drinking and eating art*: The art of eating and drinking of Vietnam becomes well-known, diversification with high quality that could attract tourists. Apart from many kinds of vegetable, fruits, many kinds of sea foods, the culture of eating and drinking of Vietnamese has also herigiated cultures of eating and drinking of South of Asia countries like China, Thailand as well as the art of eating and drinking of the western countries as France, therefore the art of eating and drinking of Vietnamese is well-known and esteemed.

### ***Tourism Infrastructure and Services:***

- *Airlines:* The airline is a main measure to support for foreigners to Vietnam. At present, there are 3 domestic airports in the Cuu Long Delta including routes from Ho Chi Minh City (HCMC) to Can Tho, Ca Mau, and Kien Giang. Presently, newly established airlines include HCMC-Xiem Riep (Cambodia)-Hue; Ha Noi-Seoun; Ha Noi-Bejing...which are cultural centres of the Asian area.
- *Roads:* Cars, means of transportation can reach 12 provinces in the Mekong Delta. The quality of road system is in rather good condition.
- *Navigation:* Marine and river transportation are becoming important means for international and domestic tourism. Particularly, in the Cuu Long Delta, with 11 river harbours of the total 18 harbours of Vietnam, the navigation routes can linked with all urban centres of the Mekong Delta and of Cambodia and can develop ship tourist services.

### 2.3.7. Domestic and Industrial Water Supply

Due to investment from the Government and support form international agencies, it is primarily to solve the fresh water and sanitation problems in some resident areas. Until now, there are about 30% of households using hygienic latrines and about 15% breeding households, who have hygienic facilities. However, over 60 - 65% rural population are not accessed to clean water, even when the pollution is increasingly over 70% rural households do not have hygienic latrines that are one of fearful problem. Many water-related and sanitation diseases such as diarrhoea, worms, etc. have occurred, and of that, rural population takes high rate.

Table 22: Existing Groundwater Uses in Sub-area 10V in 1998

No	Province	Large Capacity Wells		UNICEF Wells		Total Q (m <sup>3</sup> /day)
		No. of Wells	Q (m <sup>3</sup> /day)	No. of Wells	Q (m <sup>3</sup> /day)	
1	Long An	17	14,000	6,120	33,300	47,300
2	Tien Giang	25	15,500	20,750	81,590	97,090
3	Dong Thap	19	23,700	6,100	18,300	42,000
4	Ben Tre	9	6,430	4,600	13,800	20,230
5	An Giang	3	1,850	3,823	11,640	13,490
6	Kien Giang	8	8,180	40,000	120,000	128,180
7	Can Tho	11	10,020	30,731	86,056	96,076
8	Vinh Long	6	3,600	5,858	17,574	21,174
9	Tra Vinh	4	8,080	20,000	60,000	68,080
10	Soc Trang	8	7,900	46,000	165,200	173,100
11	Ca Mau	18	15,000	35,100	105,300	120,300
12	Bac Lieu	5	4,900	24,000	72,000	76,900
<b>Total</b>		<b>133</b>	<b>119,160</b>	<b>243,085</b>	<b>784,760</b>	<b>903,920</b>

Source: Institute for strategic planning – Ministry of Plan and Investment

Presently, over 50% rural households use shallow wells, 25% use water from rivers, ponds without any treatment, 10% households use rainfall stored in tanks, the remaining use water from drilled-wells and small scale water supply systems, which supply for communes, hamlets, etc.

In urban areas, water supply for industry is normally shared with domestic water supply systems, in some few large industrial zones, there are private water supply systems for industrial uses. Sources of industrial uses are mainly from surface water.

Table 23: Existing Urban Water Supply Plants in the Sub-area 10V

Urban Towns	Urban Population	No. of Water Supply Plants	Capacity (m <sup>3</sup> /day)		Sources	Length of Pipeline (100m)
<b>Sub-area 10V</b>	<b>2,593,007</b>	<b>53</b>	<b>241,960</b>	<b>196,360</b>	<b>(well)</b>	<b>468,041</b>
Long An	108,000	10	18,200	13,100	Canal	10
Dong Thap	586,675	7	14,500	7,280	Canal	5
An Giang	349,500	5	19,900	24,000	Canal	33,330 ( $\phi$ 100-400)
Tien Giang	189,933	9	51,500	45,600	Canal	14 40,800 ( $\phi$ 100-500)
Ben Tre						
Ben Tre town	110,000	Son Dong	7,200	3,000	Canal	27,000
Vinh Long	148,500	3	16,100	4,950	Canal	36,620
Vinh Long Town	137,000					
Tra On town	11,500					
Tra Vinh	163,400	3	8,560	4,550		6 33,118
Can Tho	392,000	6	54,400	48,480	Canal	4 195,813
Soc Trang	126,932	4	12,200	10,600		8 37,300
Kien Giang	161,000	3	19,000	16,500	Canal	4 33,060
Minh Hai	257,067	2	20,400	12,300		20 31,000

Source: Institute for strategic planning – Ministry of Plan and Investment

Table 24: Water Demand for Industrial and Domestic Uses in 1998 and 2000 (m<sup>3</sup>/s)

Year	Month					
	Jan	Feb	Mar	Apr	May	Jun
1998	11.8	11.4	9.5	9.4	10.2	12.1
2000	11.8	11.4	9.48	9.42	10.1	12.15

Drainage systems are commonly used for domestic wastewater, urban wastewater, rainwater, wastewater from tourist, and services enterprises, which directly release



into canal or river systems. At present, wastewater without treatment causes serious pollution for these own urban areas and spreading to adjacent areas.

### 2.3.8. Flood Control and Management

#### *Flood Situation:*

Annually, flood season starts from July and prolongs to November, later than upstream floods about 1 month and about 2 months later than rainfall inland. Floods rise and fall down slowly, quite mildly, with an intensity of about 10-15 cm/day, the highest rate about 20cm/day, the amplitude of a whole flood levels is about 3-4m. Floods propagate slowly taking 3 days from Phnom Penh to Tan Chau (200km). From Long Xuyen, Cho Moi to the sea, in case of high tide the floods propagate more slowly. Variation, in terms of time and peak floods between years, is not high, however due to the Cuu Long Delta is a quite flat area, if the flood is larger than the normal it causes inundation in larger area and prolongs. Normally, floods in the Mekong Delta have only one peak occurred at the end of September or beginning of October but two-peak floods still occurred as in 1978, 2000 normally appear in high flood years.

Due to over flows from the Mekong River, large area in the north of the Cuu Long Delta of Vietnam is inundated. The inundated area is about 1.4 million ha in low-flood year and about 1.9 million ha in the high-flood year with inundated depths of about 0.5 – 4.0 m and inundation duration of about 3 to 6 months.

Floods flow into the Cuu Long Delta through main rivers and from inundation areas in the Cambodia territory. The average flow is about 38,000 m<sup>3</sup>/s (or about 4.40m at Tan Chau, and 3.88 at Chau Doc in terms of water level), in high flood year the flood flow reaches 40,000 – 45,000 m<sup>3</sup>/s, of which, the flow through the main rivers is about 32,000 – 34,000 m<sup>3</sup>/s, sharing about 75 - 80%, floods flow from the border about 8,000 – 12,000 m<sup>3</sup>/s, sharing 20 - 25%, of which, floods flow into Long Xuyen Quadrant about 2,000 – 4,000 m<sup>3</sup>/s, into the Plain of Reeds about 6,000 – 9,000 m<sup>3</sup>/s. In the main river, the flood flow at Tan Chau is 23,000 – 25,000 m<sup>3</sup>/s (sharing 82 - 86%), at Chau Doc about 7,000 – 9,000 m<sup>3</sup>/s (sharing 14 - 18%). Total flood volume, which flows in the Cuu Long Delta, is about 350 - 400 billion m<sup>3</sup>. Of which, flows through the main rivers, share 80 - 85%, through the border share about 15 - 20%. In terms of water level, there is a difference between the Tien (Mekong River) and Hau (Bassac) Rivers. At the same time, water level at Tan Chau is about 40 - 60 cm higher than water level at Chau Doc. Therefore, there is always a movement of floodwater from the Mekong River to the Bassac River through out canals, which linked these two rivers such as Tan Chau - Chau Doc, Vam Nao..... Among that, Vam Nao is the biggest. Due to the movement of water, the flows at My Thuan and Can Tho in the Mekong River and Bassac River respectively are almost balanced (51 and 49%).

Most of floodwater flows into the East Sea through the main rivers; the remaining flows into the West Sea and the Vam Co River.

Flooding occurrence in the Cuu Long Delta can be divided into three phases. The first phase is from July to August, in which floods in the main rivers rise quickly

and flow into farmlands and storing in the fields. In this phase, floods carry out much sedimentation. The second phase is the time, when floods are high (water level at Tan Chau over 4m, at Chau Doc over 3.8m); floods flow through two main directions including through the main rivers and through the border of Vietnam and Cambodia, and flow into the Plain of Reeds and into the Plain of Reeds and Long Xuyen Quadrant. The flows through the border contain less sediment, and dominate the high sediment flows from the Mekong River and the Bassac River reducing the sedimentation for these areas. The third phase is the time, when floods are reducing, normally from end of October when the flow from the Cambodia side reduces, flood water level in the Cuu Long Delta gradually reduces until December and almost areas are no longer inundated. Floods cause much damage in terms of people deaths and property loss but bring much benefit such as sedimentation, farm sanitation and a good environment for fishery development.

### ***Existing Flood Control Activities and Constructions:***

*Construction from 1996 up to date:*

#### *Long Xuyen Quadrant:*

- After the study on flood control planning, and particularly the Decision 99 TTg of the Prime Minister, the implementation of flood control structures in the Long Xuyen Quadrant has progressed well. At present, the group of structures No. 1 almost finished (completed 23/23 sluices and canals). The group of structures No.2 has been built including Vinh Te Canal, flood prevention embankment from Chau Doc to Tinh Bien, rubber dam Tha La, Tra Su and completion of Xuan To bridge (viaduct). In the group of structures No.3, structures named T5, T6, and T4 had completed.
- During the flood in year 2000, proposed flood control constructions have brought into operation their efficiency. However, it is necessary to improve and enlarge the width of floodgates on the Road 80, Mac Can Dung. At the same time, from Ba Hon canal to Ha Tien, along the national road 80, construction of bridges is constructed instead of sluices in order to support for fishery development activities in the coastal area.

#### ***Plain of Reeds:***

The structures have been implemented including Tan Thanh - Lo Gach canal and flood control route from Hong Ngu to So Ha-Cai Co, Sa Rai Canal, Hung Dien, Hong Ngu (Stage 2), Cai Co Long Khot and 4 canals in the south of Nguyen Van Tiep Canal such as Cai Beo, 307, Ba Ky - Ba Tra, Thanh Nien - Ong Muoi, and bridges in the National Road No1, 30 and Binh Chau. Specially, the structures to protect the resident/urban areas of Hong Ngu, Tan Hong, Tan Hung, Vinh Hung, Moc Hoa had been implemented. Experienced in the floods in year 2000, flood control structures have brought into operation their efficiency. However, there are not sufficient structures, therefore, the efficiency of flood control/protection are not high. At the same time, floods 1996, 2000 and 2001 show that the proposed flood control measures have proved their reasonable efficiency, but the selection of their dimensions and structure types is still difficult and not clear. There are many

opposite ideas on the flood control sites, structure types, etc. These issues will be clearly identified in further study phase.

In addition, in order to develop agriculture, the implementation of thousands km of levees for protection of summer-autumn rice and early seeding the winter-spring rice had been carried out.

***Limitations on Existing Situation of Economic Sectors in the Sub-area 10V:***

*Limitation:*

- Poor resolving goods consumption, which result in difficulty for local farmers to consume their production and suffer loss of their income due to low price that set out by private merchants.
- Poor forecasting the capacity of goods consumption. Therefore, it could not create sustainable production and development causing large amount of damages. Some times, there are no goods for selling, but some times goods cannot be sold.
- Poor management including management of natural resources such as land, water resources, biological resources and poor management of socio-economic aspect. Therefore, it causes seriously deforestation, exhausted fishery and biological resources; policies, social laws, rules are not fully enforced.
- Low developing industries, particularly the agro-production processing industry. It causes limitation on goods consumption of farmers' products as well as reduces their incomes due to their products only raw products with low price.

*Remaining Problems:*

- Underdeveloped road system. It causes difficulty to rural development including economy and society aspects.
- Poor living conditions of the local people in the Cuu Long Delta due to poor environmental sanitation, shortage of fresh water, and power in domestic uses, and prolonged floods. Annual inundation areas are largely damaged, local resident areas are flooded, and hundreds thousand of households have to be resided to other places therefore their lives are not stable.
- Shortage of fund for investment.
- Low consumption of products.

## 2.4. Water Resources

### 2.4.1. Water Availability

***River System Affects Hydrological Regimes:***

The reach of the Mekong River from Kratie to the East Sea is about 545 km. After passing through Phnom Penh, at the confluence of the Mekong River and Tonle Sap River, the Mekong bifurcates, forming two distinct rivers, the Mekong and Bassac, which discharge into the East Sea through nine estuaries: Tieu, Dai, Ba Lai, Ham Luong, Co Chien, Cung Hau, Dinh An, Tran De and Hau. Actually, there are only 8 estuaries, as Hau was filled by sedimentation.

At the Phnom Penh intersection, the Mekong River is connected to the Great Lake by the Tonle Sap tributary. This tributary plays an important role for regulating water flow into the Cuu Long Delta. From Kratie, The Mekong River runs along low-lying areas, which are affected by tidal movements. Bed level of the river varies in the 'broken line' trend as a result of interaction between river and sea. The bed level varies from 10-30 m, some places 40 m. The section from Phnom Penh to Tan Chau-Chau Doc is slightly affected by tidal movement, with amplitude of 1.0-1.5 m in Tan Chau- Chau Doc and 0.2-0.5 m in Phnom Penh. In flood seasons, tidal movement no longer affects.

Small rivers and springs in Cambodia do not play the main role for distribution of flow, but they are important for conveying floodwater of the Mekong River or the Bassac River when it overflow.

In the left side of Mekong River, there are 6 small rivers and springs directly or indirectly connect to the main Mekong River, including:

- *The Vaico River:* This is the upstream part of the West Vam Co River. It originates in the plain of Pre Veng province. Its elevation is from 10-15 m running Northwest-Southeast direction though Svay Rieng town and Long An province of Vietnam. The basin area is 1720 km<sup>2</sup> and the length of river is 110 km. This river is one of the main rivers to retain and convey floodwater from the Mekong River to Vietnam. There are some typical cross sections:

Location	Bed Level (m)	Surface Width (m)	Bed Width (m)
Road 105	-1.58	50	30
Road 109	-0.13	30	10
Svay Rieng	-0.89	74	35

- *Prek Tate River:* This is the upstream part of the East Vam Co River. It originates in low-hilly lands of Pre Veng Province. Its elevation is from 7-10 m, and it runs Northwest-Southeast direction though Kam Chaimea, Svay Rieng and Tay Ninh province of Vietnam. The basin area is 1380 km<sup>2</sup> and the length of river is 54 km. In the section near the border, riverbed is deep and is affected by tidal movement. There are some typical cross sections:
- *Tonle Toch River:* This river is in the West-North border zone. It connects 2 locations of the Mekong River. The inlet is in Phum Peam Prathnoud (distance 10 km from Kampong Cham town) and outlet is in Ba Nam

(distance 5 km from Niek Luong ferry). In flood season, floodwater from main Mekong River goes to the Tonle Toch River, filling in swampy regions and finally runs toward downstream direction. Riverbed is deep and wide. Bed-width is about 100m, and bed-level is about 6-8 m. The basin area is 1900 km<sup>2</sup> and the length of river is 120 km.

Location	Bed Level (m)	Surface Width (m)	Bed Width (m)
Phum Tuon Tamoc	6.46	15	0
Phum Prey Taprum	4.77	65	40
Phum Tuon Donon	4.74	60	40
Kam Chaimia	0.90	60	35

- *Tonle Prasat River:* This river is in the Western border zone. Its inlet connects with downstream reach of Tonle Toch at Toeng Lost. It runs meanderingly North-South direction and finally meets So Thuong River in Vietnam. The basin area is 650 km<sup>2</sup> and the length of river is 62 km. Playing the role as the river to convey water from Mekong river, Tonle Prasat river has the deep and widens cross sections and its bed slope is low but abundantly change. There are some typical cross sections:

Location	Bed Level (m)	Surface Width (m)	Bed Width (m)
In front of Huu Nghi bridge	-6.94	102	30
Piencho Town	-5.86	125	30
Near So Thuong	-8.82	120	30

- *Tra Bek River:* The Tra Bek links with So Ha river in Vietnam. The inlet is in Huu Nghi Bridge and it runs Northwest-Southeast direction to Trabek Bridge and change to South north direction and finally joins So Ha River at Thong Binh in Hong Ngu district. The basin area is 575 km<sup>2</sup> and the length of river is 57 km. Playing the role as the river to convey water from the Mekong River as well as receiving large effects from tidal movement, the Tra Bek River's cross sections abundantly change along the river course. There are some typical cross sections:

Location	Bed Level (m)	Surface Width (m)	Bed Width (m)
Huu Nghi bridge	-1.76	32	9
Trabek bridge	-2.03	93	30
Near So Ha	-1.09	38	10

- *Prek Kongpong Chrey:* It is a natural river originating from swampy areas in Mesong district, Prey Veng province. It runs North-South direction and meets Cai Co River in Vietnam. The basin area is 326 km<sup>2</sup> and the length of river is 35 km. In dry season, it is considered as a 'dead' river.

It can be seen that all of small rivers and springs in Cambodia closely relate to rivers and canals in the border zone. In dry season, there is no area of water originated; therefore, base flow is very low. In flood seasons, these rivers and

springs play a role of floodwater storage and conveyance floodwater to Vietnam and creating more complex in terms of flood regime and flood control for Plain of Reeds.

In the right side of the Bassac River, there are some small rivers that originate from Nui Ba Mountain in Ta Keo, Kongpong Spu and Kandal provinces. Some of them run directly to the Bassac River, some run toward low-land areas in the border zone then go into Vinh Te canal. The lowland areas along the Bassac River and border zone have elevation from 1.2 to 2.0 m and widths of 3-10 km. They become inundation areas of about thousand ha with depth of 0.5 -3 m.

Besides, in sub-area 10V, there is a densely canal system, including a number canals of primary/secondary and triple canals with density of 6-10 m/ha. This system makes the hydraulic regime of the study area more complicated.

### ***Hydrological Characteristics of Surface Water:***

- The Mekong River is one of the ten biggest rivers in the world (the 10th in basin area and 6th in water resources). It originates from Tibetan plateau and runs through territory of China, Myanmar, Laos, Cambodia, Thailand and Vietnam. The basin area is 795,000 km<sup>2</sup> and the length of river is 4,200 km. Water resources of the Mekong River is supplied by 2 main sources: melting snow in upstream mountains and rainfall.
- Annually, the Mekong River conveys 441 billion m<sup>3</sup> water across Kratie, with the average discharge of 13,708 m<sup>3</sup>/s, flow module of 21/1/s/km<sup>2</sup> and flow depth of 690mm. Wherein:
  - 18% from upstream part (24% basin area)
  - 55% from Western Truong Son (28% basin area)
  - 10% from Eastern and Northern Thailand (19% basin area)
  - 17% from remaining sub-areas (29% basin area)
- Water flow in the river basin is divided into 2 separate seasons: Flood season (from June to November with the run-off accounting for 90%) and dry season (from December to May with 10% of average flow). In June, dry flow is the lowest.
- Hydrological regime of the Cuu Long Delta is affected directly from: Water flow from upstream, tidal movement of the East Sea and Gulf of Thailand as well as rainfall in the plain. Flood season in the Cuu Long Delta starts in June or July and ends in November or December (delaying 1 month from the upstream part of the Mekong River and 2 month from rainy season). Dry season lasts for 6 months. Great Lake, its basin is 85,000 km<sup>2</sup> is a natural storage with the capacity of 85 billion m<sup>3</sup>. The Great Lake surface area varies from 3,000km<sup>2</sup> to 14,000 km<sup>2</sup>. It receives water flow from the Mekong River annually 60 billion m<sup>3</sup> in flood seasons and it plays a very important role for regulating water flow in both dry and wet season for Mekong Delta. From Phnom Penh to the sea, the Mekong River divides

into 2 main branches: Mekong River and Bassac (Hau) River, and hydrological regimes of these rivers with effect of tidal movement are differing from hydrological regime in the upstream part of the Mekong River. Some information is shown in the below table.

- Discharge distribution ratio from Phnom Penh to the Mekong River and the Bassac River through Tan Chau and Chau Doc plays an important role for hydraulic regime in entire Cuu Long Delta. Annual ratio is 83%/17% for Tan Chau/Chau Doc and it is a stable ratio. The ratio changes a little bit lower in flood season (80%/20%) and higher in dry season (84-86%/14-16%). However, distribution ratio between 2 branches: Mekong and Bassac at Phnom Penh is unequal. Vam Nao River is considered as a connecting river and it is a tributary to supply water for Bassac River. The role of Vam Nao River is to balance water flow between 2 branches (50% for Mekong River and 50% for Bassac River).

Table 25: Average Discharge and Discharge in Several Return Periods at Phnom Penh

Month	Avg. Discharge	10%	20%	50%	75%	80%	85%	90%	95%
I	7,786	9,218	8,681	7,731	6,935	6,859	6,515	6,431	6,104
II	4,609	5,517	5,180	4,572	4,125	4,019	3,900	3,752	3,544
III	3,182	3,637	3,471	3,169	2,900	2,883	2,790	2,743	2,631
IV	2,736	3,256	3,037	2,709	2,465	2,408	2,375	2,270	2,134
V	3,932	5,347	4,758	3,790	3,135	3,086	2,825	2,693	2,469
VI	10,202	14,415	12,722	9,875	7,945	7,509	6,950	6,417	5,642

- Hydraulic- Hydrological regime in Cuu Long Delta also depends on tidal movement from the East Sea and the West Sea (Gulf of Thailand). Tide in the East Sea is of a semidiurnal kind, while tide in West Sea is diurnal. Tidal movement changes in short and long-term period (daily, monthly and yearly). Therefore, the environment is plentiful to develop diversified biology system.
- Water resources in the Cuu Long Delta: Annually average water availability in the Cuu Long Delta to the sea is about 471 billion m<sup>3</sup>, of which 23 billion m<sup>3</sup> are caused by rainfall in the field of Cuu Long Delta and 448 billion m<sup>3</sup> are from outside (upstream). Annually average water volume in Mekong Delta is near 59% of total water volume in Vietnam. Specific discharge of the Mekong River and the Bassac River is 30l/s.km<sup>2</sup> and that of Ca Mau peninsula is 20l/s.km<sup>2</sup>.
- Dry flow: In dry season, discharge in the Cuu Long Delta is very low. Monthly average discharge at Phnom Penh from February to April is 2000-4000m<sup>3</sup>/s. It reaches the lowest value of 2380m<sup>3</sup>/s in April in medium year. In dry years, this value is under 2000m<sup>3</sup>/s. Dry season in the Cuu Long Delta is considered from January to June (6 months). Flow regime in the dry season in the Cuu Long Delta is significantly affected by tidal movement, but the amplitude reduces quickly from the estuaries (2.3-2.8m) to transition zone-interior field (0.3-0.5m). In dry season, water level in

canals is always lower than that of in the inter-fields, therefore, it causes difficulties for irrigation and the main measures for irrigation are pumps. In a 15-day tidal period, spring tide duration is the days to temporarily storage water in the interior canal systems and to raise average water level in the system and contrary.

- Flood flow: Annually, flood season in the Cuu Long Delta starts in July and ends in November. It happens after floods in upstream basin 1 month and rainfall period 2 months. Flood levels change slowly, with the difference of 10-15 cm/day. The max difference is just 20 cm/day, and the amplitude of entire flood is about 3-4 m. Flood flows also propagate slowly. It takes 3 days from Phnom Penh to Tan Chau (200 km) and from Long Xuyen, Cho Moi to the sea. It even takes more time in the spring tide period. The differences among flood period and flood peak are not much. However, as characteristics of lowland delta, the Cuu Long Delta can suffer with large inundation area if it meets high floods. Flood in the Cuu Long Delta usually has 1 peak occurring in the end of September or at the beginning of October. However, in high- flood years, flood peak can also occur 2 times (e.g. year 1978, 2000).

Table 26: Low Flow at Tan Chau and Chau Doc Stations ( $m^3/s$ )

Station/ year	I	II	III	IV	V
<i>Year 1996</i>					
Tan Chau	6,030	3,530	2,390	2,010	3,760
Chau Doc	1,450	846	511	440	751
Tan Chau + Chau Doc	7,480	4,376	2,910	2,450	4,511
<i>Year 1997</i>					
Tan Chau	8,140	5,330	3,230	2,620	2,720
Chau Doc	2,020	1,160	661	547	551
Tan Chau + Chau Doc	10,160	6,490	3,891	3,167	3,271
<i>Year 1998</i>					
Tan Chau	5,885	3,452	1,762	1,457	1,989
Chau Doc	1,604	683	418	358	435
Tan Chau + Chau Doc	7,489	4,135	2,180	1,815	2,424

- According to the classification of the Hydrometeorology Services, flood response timing and levels in Vietnam appear in 4 stages, each of them corresponds to the suitable serious stages of floods. If water level at Tan Chau is less than 4m, the flood can be considered as a small flood. If water level is between 4.0 - 4.5m, the flood is considered as a medium flood and if water level is higher than 4.5m, the flood is considered as a big flood. In the past, there are 13.2% of small floods, 46.2% of medium floods and 40.6% of big floods. Statistical data shows that within the last 60 years, every 2 years there was a flood, which exceeded waning level III (water level at Tan Chau was higher than 4.2 m). In the period of 1937-1952, water levels in every year were equal or higher than waning level III.



Especially, in 4-year period 1937 – 1940, water levels in Tan Chau exceeded 4.85m and in 4-year period 1946 – 1949, water levels at Tan Chau exceeded 4.6m. In 1994, 1995 and 1996, maximum water levels in Tan Chau were higher than 4.6 m. Maximum water levels in several years are presented in the below table.

Table 27: Maximum Water Levels in Several Years in Tan Chau (m)

Year	1961	1966	1978	1984	1991	1994	1996
Hmax	5.27	5.28	4.94	4.96	4.80	4.67	5.03
Date	11,Oct	27,Sep	9,Oct	13,Oct	13,Oct	3,Oct	7, Oct

Note: Water levels are followed with Hon Dau datum

### Water Quality:

- Rainfall: Rainfall sources in Mekong Delta is plentiful and in good quality. It can be used for domestic use as well as for irrigation.
- Groundwater: Flood prone (inundation) areas in the Cuu Long Delta have plentiful ground water resources, including groundwater in shallow and deep layers. Nowadays, groundwater in shallow layers has been polluted and it appears in bad quality. However, groundwater in deep layers is very fresh and good.
- Surface water: Rainfall sources in the Cuu Long Delta is plentiful and in good quality. It can be used directly for domestic uses as well as irrigation.
- Surface water quality in main rivers: Water is from the upstream parts of the river. Water quality seasonally varies. In dry seasons, water contains much dissolved materials. In flood seasons, water contains less dissolved materials.

Water in Tien and Hau rivers contains much alluvium sedimentation. It is brought from upstream parts of the river. At Tan Chau, average content of alluvium sedimentation in flood seasons is about 800g/m<sup>3</sup>, maximum content of more than 1000 g/m<sup>3</sup> is in August and in dry season, the content is about 200 g/m<sup>3</sup>. At Chau Doc, average content of alluvium sedimentation in the flood season is about 200-300g/m<sup>3</sup>, maximum content is more than 400 g/m<sup>3</sup>. After Vam Nao River, the content increases as a result of supplement from the Mekong River.

Table 28: Average Main Water Quality Index Concentration at Tan Chau – Chau Doc, 1994

Station	Season	PH	EC	Ca	Mg	Na	K	Al	CL	SO4
			meq/ l	meq/ l	meq/ l	meq/ l	meq/ l	meq/ l	meq/ l	
Tan Chau	Dry	7.69	17.48	0.86	0.41	0.47	0.04	1.22	0.20	0.39
	Wet	7.35	12.10	0.62	0.36	0.31	0.03	0.96	0.14	0.25
Chau Doc	Dry	7.43	14.32	0.70	0.47	0.34	0.04	1.05	0.21	0.27
	Wet	7.37	11.69	0.62	0.34	0.28	0.03	0.96	0.17	0.17

Table 29: Average Concentration of Nutrition at Tan Chau – Chau Doc, 1994

Station	Season	Total N (mg/l)	Total P (mg/l)	Total 02 (mg/l)	COD (mg/l)
Tan Chau	Dry	0.52	0.06	8.21	1.84
	Wet	0.61	0.18	5.69	4.35
Chau Doc	Dry	0.70	0.06	7.12	2.72
	Wet	0.58	0.14	5.68	5.17

Quality of overflow water from border zones: Data of flood in year 1996 shows that water quality from this source is generally non-aluminous and it contains of small amount of toxic material. Maximum content of alluvium sedimentation in flood seasons is about 200g/m<sup>3</sup>.

Quality of water in interior field: Change of water quality is complex, depending on climate and hydrological regime. The main dissolved materials can be listed: Na, K, Ca, Mg, Fe, Al, SO<sub>4</sub><sup>-</sup>, Cl<sup>-</sup>, and HCO<sub>3</sub>. Content of these ions seasonally varies. It is high in dry seasons and low in flood seasons and it bellows the critical condition. However, in some places (especially in high-aluminous areas), in some months, content of Fe and Al is high and it exceeds the critical condition. Content of other materials is low.

#### ***Sedimentation:***

There is a year-round conveyance of sediment to farm fields through canal system which link with the Mekong River and Bassac River. The period, with the highest sediment concentration is from July to September. Main conveyance direction is from the Mekong River and Bassac River, however, only areas along rivers with a width of about 20-30 km are supplied much sediment, the area located far from the river is supplied less. Recorded data from 1991 to 1997 shows that the highest sediment content at canal inlets on the canal block from Hong Ngu to Cao Lanh is about 300 - 900g/m<sup>3</sup>, from Chau Doc to Long Xuyen about 200 - 400 g/m<sup>3</sup>, but further in farm field is about 100 - 200 g/m<sup>3</sup>.

#### ***Acid Water:***

Acid water is an issue of the Cuu Long Delta, in general, and of the inundation areas, in particular. Acid water has affected to water quality and consequently affected to production and living condition of local people. Acid water appears mainly in acid sulphate soil areas; in some area acid water appears as a result of water movement in from other area but not many. Acid water appears normally from May to July (in some places prolonged to August and September). Specially, in addition to acid water in the beginning of the rainy season, the Long Xuyen Quadrant and Plain of Reeds appears acid water at the end of the flood season, normally from December to January. Previously, in May and June, acid water area was almost over the inundation area of the Cuu Long Delta, but at present this phenomenon is concentrates only in the Ha Tien Quadrant, Bac Dong and U Minh.

***Salinity Intrusion:***

Salinity intrusion is varies very complicated depending on previous floods, fresh water from upstream, summer-autumn rice cultivation situation, climate at the beginning of the rainy season. Generally, late-rainy years, low amount of rainfall at the beginning resulting high water abstraction for summer-autumn rice cultivation, low flow from upstream cause strong salinity intrusion as appeared in 1993, 1998. In the Plain of Reeds, during the last some years, salinity has intruded further and the duration was longer. In 1993 the highest salinity index at Moc Hoa was 4.3g/l, at Tuyen Nhon 7.5g/l. In 1998, salinity in the main river, of the Vam CO River, Cai Lon River, and in the Long Xuyen Quadrant intruded stronger than that of in 1993. Area in Hon Dat - Ha Tien, Bo - Bo has both effects of salinity intrusion and acid water therefore poor water quality exists longer affected to production. Preciously, when water resources is underdeveloped, salinity affected area is about 2.1 million ha, presently; this area is about 1.4 million ha.

***Microbiological Pollution:***

In general, surface water in the Cuu Long Delta has high microbiological pollution, average coli form concentration is about 300,000 - 1,500,000/100ml. The main reason is due to waste without treatment from humans, livestock.

***Pesticide Pollution:***

At present, there are few studies on this matter. However, investigation documents of Sub-Institute for Water Resources Planning, Can Tho University, Environment Protection Centre, Public Health and Sanitation Institute of Ho Chi Minh City show that there is no remarkable problem regarding to this issue, but in some local area this matter has affected to aquaculture of some fishery variety. In some areas, where one used pesticide for winter-spring rice, water flora and fauna are almost no longer existed.

***Ground Water Resources:***

Groundwater is mainly contained in sedimentary layers. In the aging order, they are divided into 7 divisions:

Aquifers include:

- Porous complex aquifer in the non-divided forth age sedimentary deposit
- Sedimentary deposit porous complex aquifer Holoxen (QIV)
- Sedimentary deposit porous complex aquifer Pleistocene middle – late ages (QII-III)
- Sedimentary deposit porous complex aquifer early Pleistocene (QI)
- Sedimentary deposit porous complex aquifer Pliocene (N2)
- Sedimentary deposit porous complex aquifer Miocene (N31)

- Porous complex aquifer Mezozoi – Paleozoi (MZ-PZ)

At present, groundwater is mainly used for domestic use and in some places groundwater is used for irrigation of vegetable, fruits. Groundwater is very valuable in the dry season from December to May, however in some places; groundwater is also used in the rainy season when long drought occurs. According to geologists, groundwater in the Cuu Long Delta is only enough for domestic use and irrigation of vegetables, etc. Main irrigation sources for agriculture development are surface water.

Groundwater resources: According to the report (1998) of Vu Van Nghi, Tran Hong Phu, Dang Huu On, the ground water resources of the Cuu Long Delta: natural static reserve: 84,786,000 m<sup>3</sup>/day, dynamic volume 6,971,111 m<sup>3</sup>/day, and the total daily volume of 91,575,000 m<sup>3</sup>/day

On the groundwater quality aspect, groundwater with mineralization of M<1g/l, shares 46% total groundwater volume, enough for supplying domestic uses. Groundwater with mineralization of about 1-4 g/l is about 19 million m<sup>3</sup>/day, sharing 31%. It can used to supply for other demand such as: industry and agriculture. The remaining about 23% should not be used except when treatment is made.

#### 2.4.2. Water Demand and Use

##### ***Industrial and Domestic:***

Based on the growing population forecast and water supply criterion, the water demand for domestic uses of the sub-area 10V is 987.2 million m<sup>3</sup> by year 2010 and 1564.7 million m<sup>3</sup> by year 2020.

Table 30: Water Demand for Domestic Uses of Sub-area 10V

Sub-area 10V	2000	2010	2020
Growing population rate (million people), %	16.745*	1.8	1.1
Water demand (10 <sup>6</sup> m <sup>3</sup> )	495.5	987.2	1564.7

*Industrial water demand:* In the sub-area 10V, power plants as O Mon 1 O Mon 2 (600MW), mixed gas-turbine power plants (720 MW) will be implemented parallel with forming of industrial gas-power-fertilizer/nitrogen zone (800000 tons urea/year) in Ca Mau, Kien Giang cement factory (3.05million ton/year); 2 groups fabricate-sewing-dyeing in Can Tho and Long An; large and medium scale fishery processing enterprises in Ca Mau, Soc Trang, Can Tho, Tra Vinh (over 250000 ton/year). In addition, there are about 6 industrial zones and some additional industrial zones. Moreover, there are some medium and small scale industrial zones (30-40ha) in Can Tho, Bac Lieu, An Giang, Ben Tre, as well as enlargement of industrial zones in urban towns, where there are processing industry and post-harvesting processing enterprises, supporting trade village, etc.

***Agriculture Demand:***

Water requirement is mainly concentrated in months in the dry season (December to May). According to water balance study for The Mekong Delta in Vietnam, total water demand at present is about 1200-1500 m<sup>3</sup>/s (environmental flow is still not mentioned) but the probability of irrigation water is not high due to low capacity of water structures and they are not constructed synchronously. Total water requirement by the year 2010 is higher while the average flow at Tan Chau and Chau Doc is only about 2000 m<sup>3</sup>/s. Therefore, if the upstream countries increase using of water for agriculture development then the water supply for the Cuu Long Delta will meet many difficulties such as further salinity intrusion inland, and shortage of freshwater, particularly the freshwater for the coastal areas.

Table 31: Water Demand for Agriculture in the Dry Season (m<sup>3</sup>/s)

Water Demand	January	February	March	April	May
Existing year 2000	1,021	1,235	929	644	633

Water demand for agriculture is estimated from water demand standard and plans of main crop cultivation and breeding development of the sub-area by year 2010. The primarily result of the calculation shows that the agriculture water demand of the sub-area is about 35-40 billion m<sup>3</sup>.

The most important factor, which needs to be considered in supply for agriculture of the sub-area, is temporal hydrological regime, and amplitude of other factor affected to water quality (salinity, acid water).

Table 32: Agriculture Water Demand of the Sub-area 10V

	Development Plan		Average Water Demand
	Unit	Year 2010	
<b><i>Crop</i></b>			
1. Rice	ha	3,800,000	9000 – 10000
2. Maize	ha	46,500	2000 – 2500
3. Vegetable, bean	ha	230,100	2000 – 2200
4. Sugarcane	ha	100,200	2500 – 3000
5. Cotton	ha	24,000	2000 – 2200
6. Fruit	ha	280,500	2000
<b><i>Livestock</i></b>			
1. Buffalo, cow	Head	88,300	90 – 106
2. Milk cow	Head	12,000	120
3. Pig	Head	4,022,000	50
4. Poultry	Head	63,359,000	20

Note: water demand at farm field excluding rainfall

***Fishery:***

Freshwater demand for aquaculture is roughly estimated and it is conditioning. The key factor is water quality, which is strongly affected by ways of agricultural cultivation in areas having surface water. These surface water areas are decidable to

the efficiency of the fishery aquaculture but not the quantity of these surface waters.

Table 33: Water Demand for Aquaculture Development

	2005		2010	
	Million m <sup>3</sup>	% Compared with the Potential	Million m <sup>3</sup>	% Compared with the Potential
Sub-area 10V	11,984	2.7	13,339	3.0

### ***Transportation:***

On the technical respect, least available depth (LAD) in the dry season is used as a planning criterion to estimate water transportation demand.

Table 34: Water transportation demand in the sub-area 10V

Name	Route	Length (Km)	Ship (DWT)	LAD (m)
Ho Chi Minh City - Kien Luong	Through Te Canal, Cho Dem Ben Luc, East Vam Co... Rach Gia - Ha Tien canal	297.8	300	3.0
Ho Chi Minh City - Kien Luong- Ba Hon	Through Rach Ong Lon , Cay Kho canal, Rach Soi , Rach Gia - Ha Tien canal - Ba Hon canal	320.8	300	3.0
Ho Chi Minh City -Ca Mau - Nam Can	Through Te canal, Rach Ong Lon, Can Giuoc river, Ganh Hao River, Bay Hap canal, Tac Nam Can canal	393.3	300	3.0
Moc Hoa - Ha Tien	Vam Co River, Cai Bac river, Hong Ngu .... Ha Tien	183.5	200	2.5
Hieu Liem - Soai Rap River	Hieu Liem - Dong Nai river-Sai Gon River - Nha Be River- Soai Rap river	144	300	3.0
Tan Chau Hong Ngu - Cua Tieu	Vietnam-Cambodia border - Tan Chau - Dong Thap , Vinh Long , Ben Tre ,...Cua Tieu	260.4	3000	6.0
Rach Gia - Ca Mau - Ong Doc River mouth	Rach Gia town - Ca Mau - Ong Doc river	182.6	1000	4.0
Mekong River	From Vietnam-Cambodia border to the sea	260.4	5000	7.0
Bassac River	From Vietnam - Cambodia border to the sea	228	5000	7.0
Ham Luong River	Confluence of MK river - Ham Luong to Ham Luong river mouth	86	1000	4.0
Quan Lo - Phung Hiep	Intersection of Phung Hiep - Hau Giang - Quan Lo - Phung Hiep to Ca Mau	104.5	300	3.0
Go Dau – East Vam Co River-	Ben Soi – East Vam Co - Go Dau - Duc Hue	189	3000	6

Name	Route	Length (Km)	Ship (DWT)	LAD (m)
Soai Rap river mouth	- Ben Luc - Soai Rap			
Moc Hoa- Soai Rap river mouth	Moc Hoa – West Vam Ca to Tan An - Soai Rap river mouth	163.5	1000	4.0

Source: Southern Sub-institute for Transportation Design

## 2.5. Environment

### ***Soil Environment:***

The sub-area 10V is blessed with the most fertile soils of Vietnam favourable for agriculture development and fishery particularly fruits with high value for export. However, the soils in the area are degraded due to impacts by the nature as well as human activities.

- The exploitation of preservation forest areas is seriously resulting in rapid vegetation cover reduction; reduction of the biological diversification, many precious animals is extinct due to unbalance ecology system. Therefore, an efficient measure to protect special used forest areas is needed as well as forming more preservation areas to preserve precious genes.
- Due to forming year-round flood control areas, the sedimentation in farm fields is reduced, and also to limit the advantage of flood to clean the toxic matters, farm field sanitation, therefore the soil is degraded.
- The Cuu Long Delta has a large area of acid sulphate soils where the cultivation by embankment for cultivating pineapple, sugarcane, cassava has affected to adjacent areas.
- Due to triple rice cultivation, the fertile of the soil is reduced remarkably.
- Due to brackish and saline fishery cultures, the areas, where conjunction between the freshwater and saline water are formed, have affected to socio-economic development.
- Often forest fires have changed the ecological environment, particularly in the Ca Mau, Bac Lieu and Kien Giang provinces.

### ***Water Environment:***

- At present, waste waters without treatment from towns, cities, industrial zones, hospitals are directly poured into canals resulting in water pollution with the indexes such as COD, BOD, etc. higher than the acceptable values.
- Due to un-well managed infrastructure development, that changes the flow regime, causing bank erosions like in Tan Chau, Chau Doc, Long Xuyen, Sa Dec, Vinh Long town, My Tho city...seriously affected to living condition

of the local people, increasing the sedimentation in canals, reducing the life of canals.

- Drought: Annually, there are six months in the dry season when the total rainfall shares only 10-15% of the average annual rainfall, particularly almost no rainfall in February, March, and April. Parallel with the drought, the salinity intrusion also increases further inland; in year 1998 the salinity intrusion increased further inland about 20-30km, resulting in difficulty for water supply for irrigation and domestic uses.
- Floods and inundation: Due to the characteristics of the hydrological regime, floods occur in the area annually causing inundation over a large area of 1.9 million ha, with inundated depth of about 0.5-4.0m, and the inundation duration of about 2-5 months. After flooding, the matter of resolving post-flooded problems in terms of environment is costly, annually an amount of about 1000-2000 billion VND has to spend for this matter.
- Due to construction of infrastructure in the inundation area, that limit the movement, reside, growing and development of the water flora and fauna. This results in reduction of natural sources of fishery in farm fields, and in canals. The larger flood control area much higher the reduction of natural sources of fishery.

## 2.6. Trends

- It is necessary to have resources zoning based on water resources;
- Water resources planning should be integrated in transition of socio-economic sector structures;
- The priority is given to water resources development to serve for agriculture and fishery requirement;
- Processing industry/post harvesting technologies are paid attention;
- Socio-economic development towards to industrialization and modernization and taken into account the sustainable development among sectors of agriculture-fishery-mangrove forests;
- Improve intellectual standards of the people through education and training
- Trading and service need to have higher investment; and
- International cooperation and environmental protection should be taken into account in integrated water resources development.

## 2.7. Trans-boundary Issues

The water resources development in the Sub-area 10V would cause potential impacts through international border as follows:



### 2.7.1. Construction of Flood Control, Irrigation and Drainage Systems

- The construction of flood control system along the Vietnam and Cambodia border, along the Vinh Te - Vinh An - Tan Thanh - Lo Gach canals as well as the “closed” areas with the year-round flood control embankment could cause increasing inundation depth and duration in the Cambodia side. At the same time, it could change partly flow regime in the Cambodia side. These problems would be reduced if there were a good international cooperation.
- The construction of resident protection areas along the Vietnamese and Cambodia border would affect to the flow regime and fish migration current from Cambodia to Vietnam.
- The construction of irrigation and drainage along the border would reduce water levels on the Cambodia’s side that is one of implicit contradiction in using of water resources.
- The construction of hydraulic works in main tributaries would change the ecosystem along the Mekong River as well as fresh water fishery immigration currents that would reduce sources of fishery for Cambodia.
- The increase of water abstraction of the upstream countries would affect to the low flow regime of the Cuu Long Delta in Vietnam that would cause more serious salinity intrusion and acid water problems than that of the present.

### 2.7.2. Infrastructure Development

The Mekong River is the main navigation route of the countries located in the basin therefore the construction of bridges, dredging the river and its branches, harbours will impact on the countries which use the water resources both in the dry season and the flood season and the ecosystem.

### 2.7.3. Cooperation on the Development in the Border Areas

Water resources development in the sub-area 10V based on basin development plan will result in such positive impacts as:

- Promoting cooperation on sharing water resources, reducing implicit contradictions in uses of water among countries and sectors in the basin;
- Developing the economy, encouraging the cooperation in exchange of commodity, relation among the upstream countries;
- Finding ways to reduce investment to flood control structures, land reclamation, irrigation and drainage involved in agriculture development;
- Improving living standards in the area, contributing to preserve traditional cultures of all communities, ensuring the national security; improving public awareness in sharing and using water resources; and
- Cooperating nations in protection of the ecology and environment, reducing poverty and hunger through out economy development.



### 3. The Agenda for Development

## 3.1. Development Opportunities, Demands and Limitations

### 3.1.1. Development Opportunities

The sub-area 10V covers 12 provinces of the Cuu Long Delta of Vietnam. Despite of many difficulties and limitations, the sub-area has many opportunities for socio-economic development as following:

#### ***Priority Development Policies of the Government of Vietnam:***

Based on the conditions of the sub-area, in particular, and the conditions of the nation, in general, the Government of Vietnam has launched the priority development polices for regional development, specially the Decision Nos. 01/1998/QD-TTg, 99/QD-TTg and 173/QD-TTg for development activities and programs for the sub-area by 2010, as well as policies on changes in movement of economic structures, economic development of all sectors in order to improve the living condition of the local people, particularly the minority communities of the sub-area 10V. These policies include:

- Encouraging non-state enterprises and local people to invest into agriculture, fishery development, agriculture, fishery production processing industries with a priority on development of dominant production in the sub-area such as rice, fishery production, and fruit.
- Forming, extending agro-commodity production areas and industrial trees, which have potential for export.
- Prioritizing to licensing land use right and to give the land use license for farming owners, which give them the ways to loan from the banks.
- Prioritizing the settlement, sustainable cultivation, construction of transportation, power supply, and culture activities in the remote areas (program 135 – hunger clearance and poverty reduction).
- Prioritizing reasonable state budgets in combination with ODA loans for investment on transportation and water resources development in the sub-area.
- Exempting from or reduce or income tax, VAT for projects, which invest on processing industry; and industries, which servers for agriculture development. Exempting agriculture land use tax for extremely difficult households.
- Implementing priority policies for national and international investment, reducing renting land prices, and reducing income tax in the beginning period.

On the other hand, the Government of Vietnam will implement priority policies as follows:

- Encouraging all socio-economic sectors to create jobs and training, state budgets will prioritize to invest into main infrastructures development.
- Reserving land and encouraging investors carrying out aquaculture projects in new reclamation areas, where investors develop infrastructure and they can sell, hire, or rent in order to get back their investment in the vein that apply to industrial zones.
- Establishing linked organizations such as: farmer -cooperative – enterprise with reasonable policies aiming at the farmers who should produce their product by advanced contracts. By year 2005, there must be over 50% farmer households who produce their product by contracts with economic organizations, processing enterprises, and trade organizations. Firstly, implementation of contracts on sugarcane, cotton, milk cow, and fishery production, then step by step implementing other production contractions will be carried out. The contract on the production consumptions is one of responsibilities of the processing enterprises and consumptions belong to all economic sectors. Formation of associations on assistance in production and consumption, protection of production and business rights for each sector.
- Budgets including state budget and local budget, mobilization local sources and other donors in order to increase investment on the infrastructure such as transportation, water resources, education, health, resident areas, public works in resident areas.
- Launching a policy to encourage economic sectors to invest in producing suitable materials for house construction, infrastructure in the sub-area areas.
- Launching a state investment credit to ensure budgets for socio-economic development projects, projects on production processing for export, agriculture, forestry and fishery development projects.
- Developing a public encouragement policy as supporting in training programs; exempting or reducing land use taxes for investors; a prioritized credit for all kinds of investment in industry, handicrafts in the sub-area 10V. Establishing a stimulate industry fund (by the state fund, from donors, privates and from investment capital restore) in order to develop industry and handicraft.
- Solving basic problems such as no land or shortage of land use of farmers: create more land by reclamation. Reviewing land uses of all organizations, state enterprises in order to revoke land use licenses in year 2001 and in early 2002 all land where it is used inefficiently or not yet used, will be given to local authorities to license to farmers for their production. Creating conditions for part of farmers, who have no land or are shortage of land, to reside in new economic areas; improvement of land management capacity, completions of land administration report, licensing land use right, and close management of changes in land use. Illegal land use transfer is strictly forbidden. Complain and dispute in land use must be completely resolved; It is continued to implement the policy of reducing tax of agriculture land

use in the inundation areas and local areas where there are difficulties in terms of consumption market; exempting poor households (according to the new criteria) and households under program 135 from the tax of agriculture land use must be implemented.

- Regarding minority community, it is continued to implement the aid policy on price for Khmer people, whose living conditions are really difficult. Resolving the loan for minority people from the bank of the poor and other sources are prioritized; activities on encouraging agriculture and increasing of guiding minority people for practice and production must be well implemented. From 2002 forward, exempting the poor minority people and policy households from (a) the contribution to school construction, school fees, book fees for students; and priority resolving of the problem of job of graduated students (b) the fees of medical examination at all medical stations, hospitals must be implemented.

***Development Cooperation between Sub-area 10V with Cambodia:***

The sub-area 10V borders with Cambodia over a length of 330km, where has high potential for bordering cooperation and exchange of culture. The governments of Vietnam and Cambodia have agreed to study a common development plan (flood control planning, etc.) and on that basic the trade agreement, clearance of tariff will be signed, and will progress in common agreement for trade and tourism.

It is implemented the trade centres in the border as Ha Tien, Tinh Bien, Tan Chau, Moc Hoa, Duc Hue, Moc Bai as well development of transportation routes linked with the border as National road 30, 91, N1, Asia Road...).

Regarding the ASEAN cooperation framework, beside of transportation, the cooperation must be implemented in information technology.

***International Cooperation in the Sub-area Development:***

The sub-area 10V is a focal area of the nation, therefore many studies and investments from international agencies and governments have implemented. The following are some typical international cooperation:

- The study on salinity intrusion (supported by the Australia Government);
- The master study on socio-economic development of the Cuu Long Delta (VIE 87-031) (supported be the World Bank);
- The program on clean water and rural environment sanitation (supported by UNICEF);
- Program on investment in water resources projects in the Cuu Long Delta (supported be the World Bank);
- Flood Control Planning (supported by South Korean Government);
- The project on investment in National Road No.1, Highway Ho Chi Minh - Can Tho, (supported be the World Bank);

- Natural Disaster Mitigation Program, (supported by the World Bank);
- Support to Capacity Building of Water Resources Institutes, (supported by DANIDA); and
- The Mekong River Commission (MRC) has also supported some studies/programs as BDP, WUP, Tam Phuong project, flooding control plan.

***Investment for Studying Water Resources Development Plan in the Sub-area:***

The water resources development in the Cuu Long Delta has been studied by Sub-Institute for Water Resources Planning (SIWRP) and related institutes and agencies. Some major studies include:

- The orientation of water resources development in the Cuu Long Delta, (implemented by SIWRP in 1990);
- SIWRP has implemented 40 projects on water resources development for sub areas;
- Flood control planning in the Cuu Long Delta, (implemented by SIWRP in 1999);
- Water resources planning for Ca Mau peninsula, Long Xuyen quadrant, Plain of Reeds (implemented by SIWRP in 1997-2002);
- Master Plan for the Cuu Long Delta, (implemented by SIWRP);
- Water resources plans for 12 provinces of the Mekong Delta; and
- Pre-feasibility and feasibility projects for areas and hydraulic works.

***The Potential of the Sub-area:***

- The Cuu Long Delta is a large plain and fertile area of the Southeast Asia and of the World, and is an important area for food production, fishery, and fruit of the nation. It is determined as an area for the national food security of the nation.
- The Cuu Long Delta has the coast over 700 km, about 360,000 km<sup>2</sup> of privilege economic zone, bordering with the East Sea and Gulf of Thailand, very favourable for marine economic development.
- The Cuu Long Delta is located in very important area in terms of international exchanging relation, located in the most dynamic economic one of Vietnam at present, bordered with the dynamic and developed economic zones and important partners such as Thailand, Singapore, Malaysia, Philippine, Indonesia.... Moreover, the Cuu Long Delta is an area, which has international navigation routes as well international airlines linked South Asia and East Asia as well as other continentals and islands of the Pacific Ocean...

- The Cuu Long Delta is bordered with Cambodia, adjacent to Laos, Central Highland, and Southern Area, where have minerals resources, rich forest, and high potential hydropower.
- The Cuu Long Delta is located in the flat area with a densely river network favourable for navigation.
- The Cuu Long Delta is located in the tropical monsoon area favourable for a diversified agriculture development. Moreover, mild climate, and no typhoon are also advances of the Cuu Long Delta.
- The Cuu Long Delta has abundant fresh water resources, a diversification hydrological regime, creating different ecological zones. These support the sub-area to develop many sectors such as agriculture, fresh and salty fishery, and ecological tourism.
- The Cuu Long Delta with 16.7 million people, of which about 8.1million people in labour age, about 22.3% that of the nation, are the important human resources for socioeconomic development.
- The farmers of the Cuu Long Delta easily cope with the commodity production structure, which are suitable for agro commodity export.

### 3.1.2. Development Requirements

During the last few years, due to growing population rate, low agro-commodity price is, the local people income is low in comparison with that of the nation and the rate of poverty and hunger is high pressure on the economic development requirement.

The Vietnamese government wish to promote the industrialization, modernization, rural development, trade and changes in economic structure are also increasing the water demand which in turn cause the degradation of the water resources, salinity intrusion, pollution, forest fire, frequently floods occurred...therefore it is necessary to have a water resources development in the Sub-area 10V in order to develop the sub-area in terms of sustainable, socio-economic development, and society equity and civilization.

The Government of Vietnam has identified that the Cuu Long Delta is the area, which serves as the national food security area of the nation; therefore the Government will have the priority policy for the next year. Particularly, the delta has a relationship with neighbouring countries in general, and Cambodia in particular, based on the principle of improvement of living condition in terms of basic needs, culture, mental of the local people.

Based on the fundamental of development opportunities, development requirements, the orientation of the development of the Sub-area 10V are as follows:

- Control foods, salinity intrusion, and develop water resources system in order to support for the needs of changes in economic structure;
- Develop services, processing and post harvesting technologies;



- Sustain and improve the local people knowledge; and
- Cooperate with Cambodia and other countries in the border area.

***Trade, Tourism and Services Development:***

- It is necessary to do well the forecast activities, market information, trade promotion in order to expand the international and national markets by fund of state enterprises, the donors and private supports with the support from the government; Construction and development of frontier pass economic zone in the provinces, which have favourable conditions.
- Exploitation of the potential and advantage of the sub-area to develop the tourism, ecological tourist and try to keep the growing rate of the tourist sector in the period of from 2001-2005 reaches over 20%/year, and by 2005 the value of the tourist sector must reach over 800 billion VND.
- Diversification and improvement of the efficiency of service activities, of that rapid speeding up the services which serve for goods production, export and serving for people like: transportation, export, labour export, technological services, input and output material supply services for agriculture and fishery. The growing rate of these service sectors in the period of 2001-2005, must reach 8-10%/year.

***Science, Technology and Environment:***

- Improvement of scientific, and technology capacity in the area and mobilization of sources of scientist and technologist from outside to create the incentives for new studies with high efficiency aiming at improving the contribution of the science and the value of the product and creating the incentives for socio-economic development in the Mekong Delta of Vietnam.
- Investment for upgrade of the infrastructure for agriculture, forestry and fishery development studies in order to apply these new technology to support for changes in production structure, particularly changes in seeds for cropping, varieties for breeding and fishery culture, agriculture, forestry and fishery product processing and maintaining industries aiming at satisfying the requirement of the national and international markets and export.
- Application of new science and technology in construction, and new materials for construction structures that are suitable for areas where are soft foundation, and annual flooding; study on the dredging the route from Ding An river mouth to Can Tho port for 10000-ton ship accessed.
- Study on establishment of software technology at Can Tho and development and exploitation of internet of the sub-area.

***Health, Education and Training:***

- Reinforcement and development of hospital system which support for preliminary health services, controlling diseases, diagnosis and heal for local people, immediately investment for construction of regional hospital at Can Tho in order to satisfy the need of health services of the local people in the sub-area with a high quality.
- Continuation of consolidation and upgrading local health services station particularly in commune, hamlets; it is needed to have a policy to persuade doctors to work at local health service centres in communes, by year 2005 there will be about 80% communes which have doctors.
- Rapidly creating changes in education and training, satisfying the need of education of local people and socio-economic development of the sub-area; paid attention to attract young children of the Khmer people and other minority groups to go to schools.
- Consolidation and completion of the school network plan including the kindergarten schools and primary and secondary schools (including the resident schools for the minority groups) in combination with resident planning suitable for frequent inundated areas; try to clear school rooms which serves for three shifts per day in the year 2001-2002, by year 2005 construction of solid and semi-solid schools try to reach 80%, ensuring the study and can avoid the flood problems.

***Labour and Job:***

- Parallel with changes in economic structure; strongly develop traditional works, investing in development of rural infrastructure which is suitable with plans, changes in production structure, creating jobs for local labours.
- Provinces in the Mekong Delta of Vietnam have to coordinate with central ministries, sectors and enterprises in studying, supplementing education and training program in order to satisfy the need of labour sources; striving to move about 240000 labours from rural areas to serve for industry and services; reducing the rate of unemployed in the urban areas to below 4%; trying to keep the labour structure by year 2005 as 53% in agriculture sector, 17% in industry and 30% in service.

***Infrastructure Development:***

Continuing to promote the construction of the infrastructure to create the condition for rapid socio-economic development in the sub-area; plans of transportation, construction, resident, power, water supply are needed to supplement, adjust correspondingly with water resources development and flood control plans in order to satisfy the flood drainage requirement; at the same time ensuring the safety for infrastructure when annually flood occurs.

***Water Resources:***

- Investment in construction of hydraulic works in combination with transportation and fishery developments, build of resident areas according to the Decision No 99/TTg dated 09 February 1996, in order to support for changes in production structure and people.
- Starting supplementation and completion of master plan on water resources development in term of irrigation, drainage of acid water, salinity intrusion prevention and keeping fresh water... satisfying the need of programs of changes in economic structure of the sub-area; supplementing and adjusting the flood control planning based on the calibration of the floods of 2000 in combination with the whole Mekong River basin context in order to make the suitable for flood variation and the new issues occurs in the basin as well as ensuring the requirement of rapid and sustainable socio-economic development of the sub-area.
- The objectives by year 2010 are to complete water resources development and flood control system of the sub-area in order to satisfy better the need of the production and reducing the damage which causes by floods, ensuring the safety for local people, and economic infrastructure.
- Continuation of implementation and completion of water resources development constructions in terms of irrigation and drainage, flood control, salinity intrusion prevention in Long Xuyen Quadrant; Promoting the study in which give the basic fundamental for investment for construction water resources construction and flood control for the Plain of Reeds and the area in the Vam Co River basin.
- Completion of construction units in the project funded by the World Bank as in Quan Lo Phung Hiep, South Mang Thit, and O Mon Xa No; Ba Lai water resources project in Ben Tre province.; construction and completion of in-farm hydraulic works in order to support for about 800 thousand ha of shrimp and other fishery production.
- Implementation water resources system in the West Area of the Bassac River, in the south of Ca Mau peninsula ... in the U Minh Thuong, U Minh Ha that satisfy the need of diversification of production. Review, completion of the seas dike system, river mouth embankment in the coastal provinces in order to support for changes in production structure, resident protection, and drainage of the sub-area.

***Transportation:***

- In the next five years, it is necessary to solve the problems on the transportation particularly road system and take advantage of navigation in to account of the sub-area; routes of national and provincial roads which need to be improved and solidified with an aim at 90%; new construction of Routes N1, N2 parallel with national Road No1, new construction of route QuanLo- Phung Hiep, route in the south of Bassac River (91c).

- Upgrading harbours in the main navigation routes such as Vinh Long Port, Cao Lanh port on the Mekong River; My Thoi port in the Bassac River, ports in the Ca Mau River, My Tho port (in Tien Giang province), Dai Ngai port; improve the dimension of bridge Mot Thang Gieng (Bridge 1st January), Soc Trang, Vinh Thuan bridge, improvement of Sa Dec bridge, construction of Thoi Binh bridge.
- Completion of two navigation routes in the south and Can Tho port; continuation of improvement of Can Tho port phase 2 comprising of 76 m of harbour bridge, construction of road system in the harbour station, loading facilities; investment in construction of Cai Cui (Can Tho), Can Giuoc port (Long An), Dinh An port (Tra Vinh).
- Determination of dimension, location of bridges in the road system in conjunction with the canal system in order to find out the suitable measures (over flood level, dry bridges, ways of flood drainage...) aiming at not only ensuring the safety of transportation but also not affecting the flood flows and caused rise of flood levels.

***Construction of Resident Areas, Routes and Houses of Local People in the Frequently Inundated Areas:***

- Construction of resident areas, routes over flood level (floods in 1996 and 2000 used as designed criteria). Construction of resident areas, routes and public constructions such as schools, medical stations, etc..., must ensure over the flood levels of 1961 and flood level of 2000, local people in the inundation areas having safety, sustainable lives and not having to remove to other places when floods occurs; at the same time create favourable conditions for production development suitable to the condition, traditions of the local people, shifting the local people to civilization, modernization direction and satisfying the need of industrialization, rural modernization and development.
- Resident routes, areas, and local people's houses have to be built according to the plans in terms of raising house foundations, construction of ring dikes or construction of pillar houses ensuring the safety for houses in the flood season suitable for the plans ratified by People Committees when commented by the Ministry of Construction.
- Creation of public infrastructures for education, health, and cultures, which can be operated in the flood season.
- Have to implement, complete the construction plans, resident areas in combination with infrastructures supporting for local people's living conditions. In the short term, the priority is paid to the deeply inundated areas.
  - In the towns, high density population combination raising house foundation in local area with building ring dikes to protect the resident areas, as well as finding out measures to drain water and sanitation activities, necessary public infrastructures, suitable with particular condition of each area.

- In case of commune centres, where commune offices, schools, medical stations, markets, houses located have to build with a scale of about 3-5 ha for about 100-120 households in combination with farmland suitable with living condition, production of local people and construction of public infrastructures.
- Resident routes are built based on the main canal banks and along the main roads; on these routes locating the resident areas. Resident areas can be located on only one side or both of a canal, a road and can be continuously or in some parts of the routes suitable for flood control planning and particular conditions.
- In case of building dikes for protection of production and living condition of the local people with a scale of commune, district it must have a concrete plans, and must not build scattered that could be protected local areas but caused problems for large areas.
- The five-years plans from 2001-2005, it needs to concentrate on the completion of construction of route and areas of resident and essential infrastructure in the inundation areas and in the coastal areas ensuring normal operation of school system, hospitals, medical centres, cultural areas in the flood seasons against floods and ensuring no inundation for these areas.
- In the next coming years, completion of detail construction plan of the resident areas in the inundation areas, concentration on the completion of five resident areas in the pivot areas where the implementation of resident areas are not yet completed, summarizing for experience for enlargement, and by year 2005, it must have completed the resident routes, areas protect against flooding.

## 3.2. Key Development Objectives

### 3.2.1. Key Issues

The analysis of the economy of the sub-area 10V in the national economic context shows that, the advance of the sub-area is agriculture and fishery development. However, during the development of the socio-economy of the basin, there are some issues, which need to be concentrated to solve, as follows:

- Un-reasonable land use planning, particularly the land use for agriculture and fishery. Sometimes, severe conflicts occur in production.
- Agriculture, fishery – the main economic sectors- have formed a commodity production, but spontaneous production resulting in many difficulties in terms of consumption market, price fluctuation, flooding impact, salinity intrusion, and drought.
- Unreasonable investment structure. Not much attention has been paid to applying science and new technology to production. Matters such as new seeds/breeds, new technique in cultivation and breeding, maintaining,

processing have not been invested satisfactorily resulting in reduction of efficiency of large investment such as water resources development.

- Living conditions of local people are still difficult such as high hunger and poverty rate, low education level (just higher than that of the Central Highland), lack of infrastructure for socio-economic development.

### 3.2.2. General Overview for Development by the Next 10 Years

The Cuu Long Delta (the sub-area 10V) is determined as one of pivot economic centre of the nation. For development, the sub-area has to exploit the potential, its advance in terms of location, land, water resources, forest, sea, and labours; and promote its advance in rice export, fishery and agricultural production. Due to having started at low level in comparison with other areas of the nation, the sub-area has to speed up the scale of production, quickly increase the production value and then improve the social quality.

The sub-area must continue to play its role in term of largest exporter of rice, other agriculture products and fishery products of the nation. The sub-area has to promote production and improve quality of foods, vegetable, fruit, and fishery commodity. It has to develop processing industry, mechanism for agriculture production, home crafts/industries and services. Taking its advance in agricultural, fishery commodity, it has to take the initiative of exchange of import/export sector and tourism with other countries particularly the Southeast Asia countries. Strongly changing economic structure, increasing rate of industrial and service labours are the things that have to be done. Promoting international cooperation in infrastructure development plan, resettlement plan, and production plan those corresponds to the floods situation and salinity constraints of the area, is also an important consideration.

### 3.2.3. Socio-economic Development Objectives

#### ***Economic Growth:***

- Striving to reach the GDP growing rate of about 1.3 to 1.5 times the average national GDP is one of objectives. Forming modern agriculture, fishery production areas, which have high quality and valuable commodity, high competition capacity; ensure the national food security; and keep amount of exporting 3 million tons of rice, create special agricultural production, larger amount of agriculture and fishery commodity in the nation, is an important objective of the economic development. The sub-area is striving for increasing industrial production at a rate of 14-16% per year, trying to reach the industrial GDP at a rate of 33-34% of the total GDP. Development of processing industry with high level and forming of large-scale industrial areas for gas-power-fertilizer combination are also the main target in the economic development of the sub-area.
- Infrastructures, which need to satisfy the development requirements; to ensure safety and sustainability for local people in the inundation area, are completed.
- It is promoting biological technology.

- Urgent issues in education, society such as living condition of the Khmer people, no-land people, un-employees, illiterate...need to be solved; step by step improving local people' lives in trend of civilization and modernization.
- The Socio-economic development in combination with national safety and security, protection of the nation's sovereignty needs to be implemented.

Table 35: Development Indexes by Year 2010

Period	1996-2000	2001-2005	2006-2010
<b>Nation</b>	<b>6.9</b>	<b>7.5</b>	<b>7.5</b>
- Agriculture and forestry	4.3	4.0	3.8
- Industry and construction	10.6	11.0	10.0
- Services	5.8	6.1	6.4
<b>Sub-area 10V</b>	<b>5.3</b>	<b>9.1</b>	<b>9.5</b>
- Agriculture and forestry	3.4	5.1	5.0
- Industry and construction	9.2	15.3	15.0
- Services	5.7	11.5	10.5

- Population growth rate needs to be controlled, keeping the population at 17-18 million people in year 2010. Hunger households and special difficult communes need to be cleared out by the year 2005; to ensure 100% communes having 7 kinds of essential infrastructure. Poverty is reduced to 10% (annually reducing about 18,000 households).
- Issues of society, essential infrastructure for local people, improving education standard of local people, particularly ethnic minority groups need to be solved and ensured.

#### ***Transition of Economic Structure:***

Main objective of transition of economic structure identified by year 2010 is to reduce agriculture GDP to 41%. Industry contribution increases to 25% and service to 34%.

Table 36: Economic Structure (%)

	2000	2005	2010
Sub-area 10V	100	100	100
- Agriculture	53.0	43.5	41.3
- Industry	17.9	24.0	24.5
- Service	29.1	32.6	34.2

Sources: Provincial plans

### 3.2.4. Orientation for Sector Development

#### ***Agriculture:***

*Rice production:* Rice production is an advance of the Cuu Long Delta. About 1.8 million ha, where have water resources for irrigation and drainage, needs to be stabilized for double rice cultivation, (of which, one million of high quality production rice for export) in order to maintain rice product at about 17-19 million tons/year. Adjustments of cropping structures, rice seeds, which are suitable for change of floods and markets, and at the same time improvement of technical knowledge, farming technique for farmers have to be done. Rice areas, where yields are low, unstable; areas along river banks; rice areas in suburban, along roads will be changed to other high valuable crops or changed for aquaculture.

*Industrial trees:* Sugarcane area of about 90,000 ha to ensure materials for existing sugarcane factories is needed to be stabilized. Application of new advance of science, techniques of new varieties in combination with extensive farming to increase yield of sugarcane in year 2005 reaching 80 ton/ha needs to be implemented.

Continuation of improvement of processing technology, of which much attention have to be paid in post harvesting technology and processing of coconut, cotton, cassava,...increasing of commodity value and efficiency of land use up to as 1.5 to 2 times as that of the present has been done.

Based on science conclusion on efficiency of cotton development in the area, a plan as well as a measure to enlarge of cotton area with high yield in a suitable area is needed. However, the development of cotton production is necessary to be developed in trend of development of cotton rolling industry, and weave fabric as well as development of jute tree in favourable area to supply raw material for wrapping and paper industry.

*Fruit tree:* Development of high competition and high valuable tropical fruit like mango, longan, orange, mandarin, pomelo, pineapple, mangos teen, durian and other fruit trees with an existing area of about 240,000ha to double is needed. Area, where frequently inundated, a change of crops and seasonal structure suitable for inundated condition or a measure of food mitigation is needed.

#### ***Livestock:***

It is continued breeding such as pigs, poultry, and beef in order to supply domestic demand and export as well as rapid development of milk cow to supply materials for milk processing factories in Long An, Can Tho and other local areas.

#### ***Forestry:***

- Mangrove forest in the southern area, particularly mangrove forest area in Ca Mau, Bac Lieu, Soc Trang, and Tra Vinh...is protected and developed and it should be considered as vital issue of the ecology of the southern area. Combination of protection and development of special used forest, natural protection area, and place-name forest areas as well as development



of ecological tourism; as well as increasing development of reforest areas in acid sulphate soil and other suitable areas; newly reforest area of about 100,000 ha of malaleuca in low-land areas in Plain of Reeds, Long Xuyen Quadrant, Western Bassac River areas, and Southern Ca Mau Peninsula is to be carried out.

- Intensification of protection and development of forest areas in inundated ecological areas; reforestation and in combination with aquaculture, improvement of protection capacity, ensuring efficiency of forestry sector and protection of ecological environment have to be done.
- Strong development of trees, which have large branches and could be protected against waves as well as wooden trees in resident areas, along roads, canal banks, housing gardens with a target up to 2010 of coverage areas in the area over 15%, is to be implemented.

### ***Fishery:***

- It is promoting the potential and advance of fishery as an largest fishery production area and largest exporter of the nation; development of aquaculture in all water bodies as fresh water, bracket water and saline water, specially development of high value shrimp, fish and other valuable mollusca. According to a general plan of the area and in each local area, a target of aquaculture areas increasing to 700,000 ha by year 2005, capture and aquaculture production of about 1.7 million tons with an export value of about 1,500 million USD.
- Aquaculture need to be diversified as interpolated cultivation, rotational cultivation, specialized cultivation, intensive cultivation, semi-intensive cultivation, ecological culture and diversification of people involved aim at gaining high economic results, protection of ecology and environment, reducing risks, rapidly responding to the requirement of international and national markets, particularly high potential markets.
- Development of infrastructure for aquaculture, particularly hydraulic works like dike, canal, sluices, drainage facilities, electricity pumping station,...is prioritized to be implemented for forming project area with large and medium scale areas for aquaculture in order to synchronous investment, and ensure of rapid, sustainable and high efficiency fishery development.

### ***Industry:***

Main industrial sectors are concentrated to develop as follows:

- Agriculture, fishery and forestry production processing industry, particularly fishery processing. Improvement of quality of fishery processing enterprises in Ca Mau, Soc Trang, Can Tho, Tra Vinh... is prioritized to be implemented for increasing processing capacity up to 250,000 tons/year by the year 2005;

- Developing mechanism for infrastructure development, agriculture and rural development;
- Producing construction materials for infrastructure and housing development. By year 2005, cement production is to increase to 4.17 million tons, of which, about 3.05 million tons is to be developed in Kien Giang province;
- Regarding to wine, beer and beverage sector, quality improvement, increasing of capacity, and rearrangement of factories in order to improve quality for consumption of the area is concentrated to be implemented. The issues such as consumption markets, improvement of juices beverage production quality; study to build additional factories with a capacity of over 10 million litters/year to use fruit as mango, longan, orange, mandarin, rebuttal... need to be solved;
- Developing to attract investors to 6 concentration industrial areas as well as step by step planning to form other medium and small scales industrial areas; and
- Continuing forming concentration industrial areas, district industrial areas in towns for demands of storing, processing agricultural products; development of industry, home craft, and handicraft villages to produce production to supply for consumptions and export in order to contribute to promote the rural industrialization process.

***Power:***

Development of thermal power plants: O Mon 1, O Mon 2 and Ca Mau to supply for needs of socio-economic development with a total capacity of about 2070 MW.

### 3.3. Economic Sector Development (10-year timeframe)

#### 3.3.1. Agriculture

Based on socio-economic development for the Cuu Long Delta for 2001-2005 and 2010 approved by the Prime Minister, in combination with agriculture and rural master plan of provinces in the region, agriculture development in the Cuu Long Delta by 2010 will concentrate on the orientation as follows:

- Concentrate on efficient and sustainable exploitation of potential and advance in terms of geological location, land, water resources, biological resources and labours in order to continue the development of agriculture, fishery, and forestry at a high growing rate, promoting its position/advance in rice, fishery and other agro-product export to the nation. It is necessary to improve efficiency of sector production as foods, vegetable, fruit, breeding, fishery, processing industry, promoting agro-mechanism progress to create rapid movement of economic structure in trend of increasing the rate of industry and services.

- Strongly move agriculture structure in trend of improving efficiency and sustainable development, increasing value in each area unit, increasing farmer's income; concentrating on high-competition production sectors in combination with processing industry and consumption markets.
- Continue to invest on socio-economic infrastructure development including: transportation, water resources sector, health, education and training, building resident areas and houses in the inundated areas, in estuarine areas and in the coastal area. It is essential to intensify the natural disaster prevention capacity to reduce damage caused by flooding and natural disasters, to ensure the safe and sustainable lives for local people in inundation areas, in estuarine area and in the coastal area.

***Land Use Structure:***

Selection for land use by year 2005 and year 2010 are as follows:

- Allocation of land use by sectors:
  - Agriculture land will decrease from 2,970,316 ha in year 2000 to 2,908,637ha by 2005 and to 2,864,251ha by year 2010; and
  - Almost water surface area and un-used land will be exploited for forestry, fishery and agriculture development.
- Agriculture land use structure:
  - Strong change in land use in trend of reducing area of annual crops, increasing area of perennial trees and aquaculture, improving mixed garden to fruit gardens;
  - Changing rice area to fishery and special rice cultivation, strong movement in trend of diversification of kinds of rice growing areas;
  - Area of perennial trees increase from 397,377ha in year 2000 to 479,791ha by year 2005 and to 540,662ha by year 2010; the ratio of perennial tree area in total agriculture area correspondingly increases from 13.38% to 16.65% and then to 18.84%;
  - Surface water area used for aquaculture (mainly shrimp culture) rapidly increases in period of 2001-2005 and slightly increases in period of 2006-2010 from 229,352 ha in year 2000 to 407,039ha by 2005 and to 430,149ha by year2010, the ratio of surface water area used for aquaculture correspondingly increases from 7.72% to 16.46% and then to 17.79%;
  - On the fishery aquaculture land, the surface water area used for only aquaculture slowly increases, mainly increasing by expanding shrimp-rice cultivation; and

- Land use rotation in rice growing area: this rotation ratio will increase from 2 in year 2000 to 2.32 by year 2010, due to no single crop area and about one third areas used for triple crops.

Table 37: Land Use by 2010 (ha)

Items	2000	2005	2010	2005/2000	2010/2005	2010/2000
<b>Total area</b>	<b>3,971,232</b>	<b>3,976,266</b>	<b>3,976,266</b>	<b>5,034</b>		<b>5,034</b>
<b>I. Agriculture land</b>	<b>2,970,316</b>	<b>2,908,637</b>	<b>2,864,251</b>	<b>-61,679</b>	<b>-44,386</b>	<b>-106,065</b>
1. Annual crop area	2,226,252	1,908,108	1,810,173	-318,144	-97,935	-416,079
1.1. Rice–upland crop	2,082,663	1,746,679	1,631,992	-335,984	-114,687	-450,671
a. Triple rice – upland crops (UC)	359,349	308,169	564,800	-51,180	256,631	205,451
b. Double rice –upland crops	1,333,881	1,289,937	989,966	-43,944	-299,971	-343,915
c. Single crop	292,307	81,410		-210,897	-81,410	-292,307
d. Single rice + 1 fishery	97,125	67,163	77,226	-29,962	10,063	-19,899
1.2. Mountain field	9,506			-9,506		-9,506
1.3. Other	134,084	161,429	178,181	27,345	16,752	44,097
2. Mixed garden	117,317	43,586		-73,731	-43,586	-117,317
3. Perennial trees	397,377	479,791	540,662	82,414	60,871	143,285
a. Industrial trees	118,429	122,761	120,501	4,332	-2,260	2,072
b. Fruit	197,320	270,439	320,806	73,119	50,367	123,486
c. Other	81,628	86,591	99,355	4,963	12,764	17,727
4. Pasture	18	2,315	4,957	2,297	2,642	4,939
5. Aquaculture surface water area	229,352	474,837	508,459	245,485	33,622	279,107
a. Shrimp culture	183,999	407,039	430,149	223,040	23,110	246,150
- Shrimp-growing	176,852	242,078	248,488	65,226	6,410	71,636
- Shrimp –rice	7,147	164,961	181,661	157,814	16,700	174,514
b. Fish-growing	30,800	52,212	56,654	21,412	4,442	25,854
c. Other	14,553	15,586	21,656	1,033	6,070	7,103
<b>II. Forestry</b>	<b>337,688</b>	<b>430,770</b>	<b>438,135</b>	<b>93,082</b>	<b>7,365</b>	<b>100,447</b>
1. Natural forest	76,629	76,767	78,112	138	1,345	1,483
2. Replanted forest	261,059	354,003	360,023	92,944	6,020	98,964
<b>III. Special used land</b>	<b>223,516</b>	<b>262,682</b>	<b>309,846</b>	<b>39,166</b>	<b>47,164</b>	<b>86,330</b>
<b>IV. Resident area</b>	<b>101,313</b>	<b>122,118</b>	<b>142,254</b>	<b>20,805</b>	<b>20,136</b>	<b>40,941</b>

Source: SNIAPP (Sub National Institute for Agriculture Projection and Planning)

***Agricultural Development Criteria:***

*Rice production:* According to estimation by the World Bank (WB) in April, 1999, in comparison with 10 Asian Countries, Vietnam has highest advance in rice export (mainly in the Cuu Long Delta) (RCA on rice export of Vietnam is 69.7; much higher than RCA of Thailand: 28.7).

In the rice production areas of the nation, rice production in the Cuu Long Delta is the most favourable and has highest advance in competition. Rice production for the next years will develop in trend of: promoting intensive cultivation, increasing yield and quality in order to reduce investment, to increase price, reduce risks in rice production. The areas having low efficiency will change to fishery culture and other crop cultivation that have market assurance, higher income and much higher sustainability. According to the agriculture development orientation, food production, particularly rice production, is a strategic objective, of that the Cuu Long Delta is the area no 1 of the nation. Two rice-growing seasons are winter-spring rice and summer-autumn rice, Seasonal rice is cultivated in accordance with rice-shrimp, rice-fish cultivation models. Most of triple rice areas changed to double rice - fishery production model. The proposed rice growing area is as follows: total year-round rice cultivation area 3,321,000ha, with a production of 16-17 million tons.

*Maize production:* Maize production in the Cuu Long Delta is mainly used as livestock foods. Parallel with promoting breeding and fishery development, the demand on maize product is rapidly increased in order to supply materials for livestock food processing factories and will be developed in the next years. Almost maize area will be rotated in rice areas in shallow inundated alluvial soil land in riparian areas. Total cultivation area is 136,000 ha, with a production of about 753,000 tons.

*Sweet potato production and others (winged yam, taro, etc.):* all kind of common cassava (sweet potato, winged yam, taro, cassava, etc.) produced in the Cuu Long Delta is mainly used for inner consumption. Total cultivation is about 20,000 ha, with a production of 314,000 tons.

*Soybean production:* Soybean will be developed strongly in order to change the inner demand, this kind of demand will be increased largely in the future on one side to reduce the pressure on rice consumption, on the other side to increase the efficiency of land use and farmers income. Soybean area is expanding mainly in shallow inundated alluvial soil land in riparian areas by applying double rice+1 upland crop cultivation model. Total soybean cultivation area is 93,700 ha, with a production of about 163,600 tons.

*Cotton production:* According to the orientation of the government, cotton will be strongly developed to supply inner demand, this demand will be increased higher in the future on one side to reduce the pressure on rice consumption, on the other side to increase the efficiency of land use and farmers income. Cotton area is expanding mainly in shallow inundated alluvial soil land in riparian areas by applying double rice + 1 cotton crop and single rice + 1 cotton crop cultivation

models. Total cotton cultivation area is 49,000 ha, with a production of about 110,500 tons.

Table 38: Existing and Planed Crop Cultivation Areas by 2010

Area: 1,000ha; Yield: ton/ha; Production: 1,000 tons							
No	Items		1990	2000	2010	Average Growth Rate (%/year)	
						2000/1990	2010/2000
1	Year-round rice	DT	2,580	3,936	3,321	3.16	-1.68
		SL	9,480	16,881	16,360	5.72	-0.31
A	W-S rice	DT	752	1,520	1,498	6.99	-0.15
		SL	3,631	8,003	8,622	8.45	0.75
B	S-A rice	DT	908	1,881	1,532	5.85	-2.03
		SL	3,207	6,990	6,639	7.69	-0.51
C	Seasonal rice	DT	920	535	292	-7.12	-5.89
		SL	2,642	1,888	1,099	-4.74	-5.27
2	Maize	DT	11	16	136	22.47	24.12
		SL	26	48	753	30.92	31.76
3	Sweet potato	DT	20	10	20	10.72	18.28
		SL	193	146	314	0.07	19.15
4	Cassava	DT	12	8	10	-3.21	2.02
		SL	102	69	121	0.34	5.72
5	Vegetable	DT	42	96	185	12.89	6.76
		SL	659	1,185	2,620	10.93	8.26
6	Bean	DT	23	15	41	1.95	10.46
		SL	26	17	72	4.83	15.39
7	Groundnut	DT	13	9	30	5.35	12.79
		SL	23	19	72	8.10	14.04
8	Soybean	DT	17	7	94	11.00	29.25
		SL	24	16	164	16.54	26.57
9	Sugarcane	DT	53	87	112	6.62	2.57
		SL	2,510	5,171	8,454	10.79	5.04
10	Coconut	DT		112	117		0.49
		SL		659	857		2.66
11	Pineapple	DT	26	20	37	2.10	6.35
		SL	407	205	471	-0.60	8.65
12	Fruit	DT	144	206	307	6.54	4.09
		SL		1,531	3,281		7.92

Source: Sub National Institute for Agriculture Projection and Planning

*Sugarcane production:* Sugarcane in the Cuu Long Delta has fewer advances in competition than that of in the Southern Area of Vietnam due to inundation

situation, low sugar content, and the efficiency of sugarcane production is lower than that of fruit and cultivation of triple season of rice and upland crop. However, due to the existence of sugar factories, it will be maintained the production with reasonable scale to supply materials for these existing factories. Sugarcane area is about 112,000 ha, with a production of 8,454,200 tons.

*Pineapple production:* Pineapple is considered as main fruit of the world. Pineapple production in 1992 reached 10.35 million tons, exported 568.600 tons and about 731.700 tons was canned. Total fresh pineapple export production is about 40% total production pineapple, the highest in other fruit production. Areas, where will concentrate to produce pineapple, are the riparian area of Cai Lon River, and Kien Luong - Kien Giang, Bac Dong - Tien Giang and Long An. Total area is 37,100 ha, with a production of 470,000 tons.

*Fruit production:* The Cuu Long Delta has advance in development of fruit and at present the Cuu Long Delta has highest area in comparison with that of other areas of the nation, with specialized cultivation area along National Road No. 1 from Tien Giang to Soc Trang, where has favourable navigation and road system, and abundant fresh water year-round. Famous fruit in this area includes mango, durian, oranges, mandarin, pomelo, longan, rambutan, which can export to Chinese markets, etc. The trend of development is to continue expanding fruit area in the non flooded alluvial land in the riparian areas, and to combine the intensification of intensive cultivation with improvement of quality, building flood protection dikes for concentration fruit cultivation area; intensification of applying new technique in variety, cultivation, and post-harvesting technology; combination fruit cultivation with fishery development in canal system in the fruit garden as well as breeding in fruit garden to ensure high and sustainable efficiency of fruit cultivation. Total area is about 306,700 ha, with a production of 3,281,000 tons.

### ***Hydraulic Works Development:***

According to water resources development of the sub-area 10V, in order to satisfy the socio-economic development objectives for the next years, water resources sector has to improve the capacity of existing hydraulic works systems as well as has to construct new hydraulic works as follows:

- Building flood control construction to protect summer-autumn crops and early seeding of winter-spring crops safely as well as protect people in the flood season.
- Building “closed ring” embankment systems to protect fruit gardens as well as building “semi-closed ring” levee systems to protect summer-autumn rice areas.
- Building sea dikes and river mouth dikes in combination with building sluice system to control salinity, to keep fresh water for production and for supplying water to domestic uses.
- Developing in-farm water resources for serving different production models.

- Upgrading main canals, primary canal to convey water, to drain and to reclaim land in the acid sulphate soil areas.

### ***Livestock:***

*Table 39: Planed Cattle and Poultry in the Cuu Long Delta by 2010*

Livestock	Unit	2000	2005	2010
Buffalo	Head	63,737	57,364	51,629
Meat cow	Head	197,210	265,928	370,343
Milk cow	Head	1,435	12,000	31,000
Pig	Head	2,976,636	3,423,134	4,001,388
Poultry	1,000 head	44,212	53,147	63,992

Source: Sub National Institute for Agriculture Projection and Planning

The Cuu Long Delta has advance in sources of foods and labours but limit by inundation; and the living environment is seriously affected by wastes from breeding. On the other hand, meat price is still high and export markets are not clearly identified therefore the breeding of the Cuu Long Delta is mainly to develop reasonably for supplying inner demand. Main livestock are pigs and poultry.

### **3.3.2. Forestry**

Forest in the Cuu Long Delta plays an important role in protection of the environment, preservation and development of the biological resources, and partly supplying wood demand in domestic used and construction; but for a long time the protection activity has not been paid attention remarkably the forest area reduce from 377,157 ha in 1990 to 309,233 ha in 1995, yearly reduction of about 13.585ha. In the period of 1996 - 2000, the reforestation and forest protection activities had been paid much attention therefore mangrove forest strip in the coastal area have been step by step recovered. The problem of destroying of mangrove forest for shrimp culture has been prevented basically. Heavy acid sulphate soil areas in the Long Xuyen Quadrant and in Plain of Reeds have replanted cajuput, and in 2000 the forestry area having forest is increased about 28,455 ha more than that of 1995, yearly increasing to 5,691 ha.

*Table 40: Planed Forest Development in the Cuu Long Delta by 2010 (ha)*

Item	2000	2005	2010
Total forest area	337,688	430,770	438,135
1. Natural forest	76,629	76,767	78,112
2. Replanted forest	261,059	354,003	360,023

The development trend for the next years is to continue to expand the forest area in important areas (e.g. mangrove forest, cajuput forest in heavy acid sulphate soil areas, areas adjacent to the border, etc.), increasing forest area of 337,688 ha in 2000 to 430,770ha by 2005 and to 438,135ha by 2010. It is necessary to intensify measures to protect forest, and step by step to combine the forest development



with fishery aquaculture contributing to preservation of animal resources and improvement of the value of forestry economy, and contributing to beautify the scenery.

### 3.3.3. Fisheries/Aquaculture

#### *Brackish and Saline Aquaculture:*

The planned brackish and saline aquaculture area by 2005 and 2010 is only concentrated in 8 coastal provinces in the Cuu Long Delta: year 2005: 563,636 ha increasing to 145,869 ha so in comparison with that of in 2001 (417,767 ha); by year 2010 increasing 27,436 ha in comparison with that of in 2005. The remaining area allowed to expand for development by 2010 is mainly alluvial ground in the coastal area and nearby the river mouth.

Table 41: Brackish and Saline Aquaculture Area by 2005 and 2010

No	Province	Area (ha)				
		2001	2005	2005 Compared with 2001	2010	2010 Compared with 2005
1	Long An	3,288	5,880	2,592	7,820	1,940
2	Tien Giang	4,610	7,166	2,556	8,570	1,404
3	Ben Tre	30,061	33,480	3,419	35,300	1,820
4	Tra Vinh	15,091	26,215	11,124	27,773	1,558
5	Soc Trang	35,856	53,114	17,258	60,815	7,701
6	Bac Lieu	83,365	129,313	45,948	129,313	0
7	Ca Mau	217,898	246,900	29,002	249,000	2,100
8	Kien Giang	27,598	61,568	33,970	72,481	10,913
<b>Total</b>		<b>417,767</b>	<b>563,636</b>	<b>145,869</b>	<b>591,072</b>	<b>27,436</b>

Source: Sub-Institute for Economy and Fishery Planning

Table 42: Planning Common Tiger Prawn/Shrimp Area and Production in the Mekong Delta by 2005 and 2010

Province	Area (ha)				Production (ton)			
	2001	2005	2010	10 – 01	2001	2005	2010	10 - 01
Long An	3,236	5,820	7,750	4,514	1,621	4,640	8,240	6,619
Tien Giang	2,355	4,274	5,000	2,645	1,348	4,000	7,054	5,706
Ben Tre	26,573	29,922	31,742	5,169	9,413	20,609	39,127	29,714
Tra Vinh	12,023	22,215	22,942	10,919	3,430	18,715	26,055	22,625
Soc Trang	35,870	51,414	59,725	23,855	18,968	38,638	56,336	37,371
Bac Lieu	82,452	123,313	123,313	40,861	27,699	61,204	98,207	70,508
Ca Mau	217,898	238,000	238,000	20,102	55,330	98,000	150,000	94,670
Kien Giang	26,800	59,508	68,381	41,581	4,800	23,634	45,220	40,420
<b>Total</b>	<b>407,207</b>	<b>534,466</b>	<b>556,853</b>	<b>149,646</b>	<b>624,612</b>	<b>269,440</b>	<b>430,238</b>	<b>307,633</b>

Source: Sub-Institute for economy and fishery planning

Proposed brackish and saline aquaculture is also only in 8 coastal provinces in the Cuu Long Delta and is as follows by 2005: 487,438 tons, increasing 296,108 tons in compared with that of year 2001 (191.182 tons) and by 2010: 759,158 tons, increasing 271,720 tons in compared with that of year 2005.

### ***Freshwater Aquaculture:***

Freshwater aquaculture appears almost all provinces of the Cuu Long Delta. The delta has large potential aquaculture area and a densely river-canal network to develop diversified aquaculture (e.g. specialized, intensive, cage, etc., and to diversify aquaculture object as freshwater fishes, shrimps, special fishery, etc. with high yield supplying for processing industries of provinces of the sub-area.

Aquaculture area is distributed over 12 province; but the order (the area over 20000 ha) is as follow Soc Trang, Ca Mau, Kien Giang, Can Tho, Tra Vinh, Sac Trang by year 2005. By year 2010 these province will extend except Bac Lieu province. The Ca Mau province will maintain the aquaculture same as that of in 2005. Particularly, the Kien Giang has a remarkable growing rate of aquaculture area from 39,785 ha by year 2005 to 62,368 ha by year 2010; but due to low yield, the production is lower than that of some provinces.

Table 43: Aquaculture area of fresh water by year 2005 and 2010

No	Province	Area (ha)				
		2001	2005	2005 -2010 Compared with 2001	2010	2010 -2005 Compared with 2005
1.	Dong Thap	2,330	19,200	16,870	29,200	10,000
2.	An Giang	1,252	4,200	2,948	5,200	1,000
3.	Vinh Long	5,000	7,145	2,145	11,200	4,055
4.	Can Tho	13,910	29,375	15,465	45,000	15,625
5.	Long An	1,735	5,180	3,445	10,850	5,670
6.	Tien Giang	4,272	10,030	5,758	11,430	1,400
7.	Ben Tre	2,201	9,770	7,569	14,250	4,480
8.	Tra Vinh	22,662	21,526	-1,136	38,394	16,868
9.	Soc Trang	6,061	19,710	66,903	29,185	9,475
10.	Bac Lieu	5,120	3,283	-1,837	3,283	0
11.	Ca Mau	36,293	40,000	3,707	40,000	0
12.	Kien Giang	15,181	39,785	24,604	62,368	22,583
<b>Total</b>		<b>116,017</b>	<b>209,204</b>	<b>93,187</b>	<b>300,360</b>	<b>91,156</b>
<b>No. of Cage</b>		<b>5,432</b>	<b>8,412</b>	<b>2,980</b>	<b>13,037</b>	<b>4,625</b>

Source: Sub-Institute for Economy and Fishery Planning

Table 44: Freshwater aquaculture production by year 2005 and 2010

No	Province	Production (ton)				
		2001	2005	2005 -2001 so 2001	2010	2010 -2005 so 2005
1.	Dong Thap	35,797	112,550	76,753	171,250	58,700
2.	An Giang	83,641	84,000	359	109,000	25,000
3.	Vinh Long	7,000	23,133	16,133	37,426	14,293
4.	Can Tho	30,857	59,717	28,860	171,300	111,583
5.	Long An	12,906	16,315	3,409	23,475	7,160
6.	Tien Giang	14,823	30,967	16,144	40,329	9,362
7.	Ben Tre	1,664	42,418	40,754	47,756	5,338
8.	Tra Vinh	19,520	33,537	14,017	73,906	40,369
9.	Soc Trang	4,519	16,103	11,584	29,606	13,503
10.	Bac Lieu	6,923	1,748	-5,175	2,998	1,250
11.	Ca Mau	32,358	8,000	-24,358	18,000	10,000
12.	Kien Giang	6,700	14,043	7,343	36,837	22,794
<b>Total</b>		<b>256,708</b>	<b>442,531</b>	<b>185,823</b>	<b>761,883</b>	<b>319,352</b>
<b>Of that, cage</b>		<b>52,525</b>	<b>98,862</b>	<b>46,337</b>	<b>156,783</b>	<b>57,921</b>

Source: Sub-Institute for Economy and Fishery Planning

### 3.3.4. Hydropower

Electricity of the Sub-area 10V is mainly developed by thermal and gas-turbine power plants. According to 2010 plan, there will be 3 power plants O Mon 1, O Mon II and Ca Mau.

Table 45: Main Parameters of Power Plants in Sub-area 10V by 2010

Plant	Install Capacity (MW)	Operation Year
O Mon I	600	2006
Ca Mau	720	2006
O Mon II	750	2010
<b>Total (MW)</b>	<b>2070</b>	

### 3.3.5. Transportation

- It is necessary to prevent degradation of navigation routes in the Cuu Long Delta, step by step to recover and upgrade priority routes such as route Ho Chi Minh City-Kien Luong, and route Ho Chi Minh City-Ca Mau, and to consolidate other routes.
- It is essential to construct Can Tho port in the Bassac River as a centre of the Cuu Long Delta. Firstly, it allows for 5,000 tons access and then ship 10,000 tons. The capacity of loading is about 1.5 million tons/year and then increases to 2.5 - 3 million tons/year by year 2010, to ensure the access of normal cargo and container ships of the whole Cuu Long Delta. This prospect depends on the study result of dredging the Dinh An River mouth. In addition, about 1-2 large harbours can be constructed.
- It is necessary to upgrade harbours along the Mekong River and Bassac River such as My Thoi, My Tho, Vinh Thai, Nam Can, Kien Luong, and Hon Chong to allow the access of marine ships. It should be often to dredge navigation routes, specially the Dinh An River mouth, Tieu River mouth (Mekong River) and Tran De River mouth related to Nam Can harbour.
- All roads located in the inundation areas should be designed based on flood peak of 1961 and roads located outside should be designed based on tidal level of 1994.

### 3.3.6. Tourism

Kinds of cultural and ecological tourism will be developed. Combination the tourism with protection of the environment, preservation of natural conservation area, and wetland area will be implemented. It is necessary to link the tourism network of the sub-area to that of the southeast area as well as other areas of the nation, specially the cooperation with Cambodia and Laos in the Mekong River. It is also necessary to upgrade existing tourism infrastructure to facilitate tourists. The most important matter is to train human resources involved in tourism sector.

### 3.3.7. Water supply

Water demand for agriculture is estimated from water demand standard and plans of main crop cultivation and breeding development of the sub-area by year 2010. The primarily result of the calculation shows that the agriculture water demand of the sub-area is about 35-40 billion m<sup>3</sup>.

The most important factor, which needs to be considered in supply for agriculture of the sub-area, is temporal hydrological regime, and amplitude of other factor affected to water quality (salinity and acid water).

### 3.3.8. Flood control

The requirements of the flood control activities are to:

- Control flood year-around for an area of about 910,000 ha, of which, agriculture is 693,000 ha to create condition for development of agriculture,

fishery, improvement of living conditions for local people, development of infrastructure, rural development; and to reduce the magnitude of the inundation depth as well as duration to ensure the safety for summer-autumn harvesting. Taking consideration of flood control criteria, in the full flood control areas, the flood 2000 as designed; in the areas non-full flood control, the flood 2000 and inter-field rainfall with frequency 10% considered as designed one.

- Build structures to protect resident areas, main road system, and to reduce the damage caused by floods.
- Reduce flood water with less sediment from the border side flow into the Plain of Reeds and eastern areas of the Long Xuyen Quadrant; and to convey the much sediment flood water from the Mekong River and the Bassac River into the fields and to flush the acid water as well as to clean the field.
- Convey flood water to Ha Tien Quadrant to increase the sedimentation, to flush the acid water to improve the soil as well as the environment of this area.
- Build salinity prevention system in the coastal area of the West Sea that will improve the coastal area of Rach Gia-Ha Tien to create condition for increasing cropping seasons and supplying water for domestic uses in this area.
- Created more main canals that will create more inland navigation lines and take advantage of the dredging materials for road development as well as housing foundation improvement

The plan of flood control activities in the Cuu Long Delta is to build flood control structures to create safe and sustainable living conditions for the local people, to develop socio-economy, and to improve and protect the environment. To control floods year-round for southern area of Cai San canal, southern area of Vinh An canal, southern area of Nguyen Van Tiep Canal and eastern area of Bo Bo - My Binh canal; as well as control floods timely for deep inundation areas. The measures for flood control in the Cuu Long Delta are as follows:

- To build structures system to protect resident areas including urban areas, towns, commune centres, supplement areas and to resettle rural people along roads, main canals and primary canal. Additional, in combination with housing foundation embankment to resettle about 11.8 million people by year 2010 that could be adopted the size of 2000 floods.
- To build 24 main roads, which link with urban areas, and densely population areas, with a total length of about 2,266 km. These roads have level to protect the areas from the 2000 flood. Rural roads are not over the main floods and will be built with a density of about 0.42 km/km<sup>2</sup>. In addition, in order not to obstructing the flood ways, reasonable floodgates, which are used for drain floods, must be built at reasonable locations. Taking the flood of year 1961 into consideration, an estimation of needed areas for flood withdraw is of about 37,665 m<sup>2</sup>. At presently, Plain of Reeds

and Long Xuyen Quadrant has 25,343 m<sup>2</sup> and 12,322 m<sup>2</sup> respectively. In comparison with the existing, about 5459 m<sup>2</sup> is needed to enlarge, of which Plain of Reeds needs and Long Xuyen quadrant needs 1,548 m<sup>2</sup> and 3,911 m<sup>2</sup> respectively. If the floods of year 2000 are taken into consideration, the Long Xuyen Quadrant and the Plain of Reeds need to enlarge 5000 m<sup>2</sup> of the flood withdraw area, more than that of consideration in case of flood year 1996. Thus, in comparison the existing floodgates, much more floodgates need to be enlarged.

- To build structures which control floods flowing across the border to the Plain of Reeds, Long Xuyen Quadrant, and western area of the Bassac River.
- To build structures to control floods from the Bassac River and Mekong River to farm fields.
- To build structures system to drain floods inland to the West Sea, the Mekong River, the Bassac River, the West Co River; and structures to control tides from the East Sea and the West Sea.
- To build structures to control flood year round for Western area of the Bassac River, southern area of Vinh An Canal, southern area of Nguyen Van Tiep canal and eastern area of Bo Bo canal.

Based on the fundamental flood control structures and the hydraulic parameters in the farm fields, the flood control area can be classified into three areas, which need to be controlled at different scale as follows:

- Non-controlled flood area is located in the north of the National Road N1 with an area of about 117,800 ha. This area is difficult to develop agriculture at high level. However, by adapting the measures of avoiding floods in combination with construction of ring embankment to protect against early floods, selecting crop calendar; thus double paddy crops of winter-spring and summer-autumn can be produced but summer-autumn crops must be harvested before 20 July annually.
- Timely-controlled flood area is limited from the south of the flood-protected site, which protect the flood flowing across the border, to the north of Nguyen Van Tiep canal, north of Cai San canal and the east of Bo Bo-Rach Tram My Binh Canal, with an area of about 859,000 ha. Due to controlling flood at the beginning and at the end of the flood season, the winter-spring and summer-autumn cropping seasons are safely produced and the highest water levels in the Long Xuyen Quadrant and the Plain of Reeds are reduced to about 20-40 cm and 10-40 cm respectively therefore large amount of money which invest in construction of infrastructure, are also reduced. On the other hand, due to construction of main roads and resident areas to adapt floods, damages caused by flooding are also reduced creating safety and sustainable lives for local people.
- Year-round flood-controlled area is the area of the remaining inundation area with an area of about 938,490 ha. In this area, due to controlling floods year-roundly, agriculture, infrastructure, civilized and modern rural area,

and the environmental sanitation can be developed and improved at high level.

In addition, it can be combined with non-structure measures for flood control as flood forecasting, cropping calendar guidance, new varieties that can be adapted the inundation, growing in short duration in order to ensure the safety, and sustainability for production. Following are the descriptions of the flood control for key flood controlled areas:

**Long Xuyen Quadrant:**

The Long Xuyen Quadrant is located in the northwest of the Cuu Long Delta with an area of about 490,000 ha, bordered with the Vietnam-Cambodia in the North, the West Sea in the west, and Cai San Road in the east and the Bassac River in the northwest.

The objectives of flood control for the Long Xuyen Quadrant are to:

- Protect resident area, town and urban areas safely;
- Ensure transportation smoothly year-round in national roads, main roads as Road 80, Road 91, National Road N1, N2 and provincial roads as Long Xuyen - Hue Duc, Long Xuyen - Tri Ton;
- Reduce flood level at the beginning and at the end of the flood season to ensure the double rice cropping in the winter-spring and summer-autumn safely;
- Reduce flood peaks in the main flood season for southern area and along the national road 80;
- Reclaim soils in the Ha Tien Quadrant for agriculture production; and
- Combine with other hydraulics works to form a complete water resources construction system for socio-economic development as well as to combine with construction of transportation works, resident areas to form rural area in trend of modernization and civilization.

Flood control alternatives for Long Xuyen Quadrant include 4 groups of main structures as follows:

- Controlling floods flowing across the border to the Long Xuyen Quadrant to drain out to the West Sea.
- Constructing structures to drain flood out to the West Sea.
- Constructing structures to prevent salinity intrusion and to keep fresh water for the coastal area in the West Sea.
- Constructing a structure system to control floods from the Bassac River to the Long Xuyen Quadrant.

*Group No.1: Structures system in the coastal area in the West Sea*

- Dredging, newly excavating, and constructing 23 canals to drain floods from Rach Gia - Ha Tien to the West Sea.
- Improving bridges along National Road 80.
- Constructing 74 km sea dike system in the West Sea with dimensions as follows: adapting the tidal level 1.2m at Rach Gia, top level of the dike +2,00m, top width B=3m as well as constructing 23 sluices to prevent salinity.

*Group No.2: Structures system to control floods flowing across the border*

Constructing a dike system to prevent the floods flowing across the border and constructing flood control structures to control the floods flowing across the border to the Long Xuyen Quadrant include:

- Flood prevention dike from Chau Doc to Tinh Bien and from Ba Chuc to the beginning of Ha Giang Canal. This dike is built in the south bank of the Vinh Te Canal.
- Flood control structures including Tra Su sluice with B=28 m, bed level – 3.0 m with a drain capacity of 700 m<sup>3</sup>/s; structures at the beginning of Moi Canal, T5, T4, T3, T2, Nong Truong canals and 7 bridges at the beginning of canals in the Ha Tien Quadrant.

There are two different ideas on the flood control site from Chau Doc to Tinh Bien including: (i) located along the south bank of the Vinh Te canal; and (ii) beside the National Road 91. In addition, there are a number of different ideas on the dimension of the Tra Su sluice. These ideas will be clearly resolved in the feasibility study phase.

- Dredging and enlarging Vinh Te Canal with bed width of B=30m, bed elevation -3,0m to ensure the discharge Q=37 m<sup>3</sup>/s in the dry season, enlarging flood plain along the Vinh Te canal from K23+600 to K36+500 to drain the flood discharge of 1,940m<sup>3</sup>/s (used flood in 1961).
- Construction of spillway in combination with construction of a “dry” bridge in the north of Xuan To (no name bridge), with a width B=300m, bed elevation +1.0m to drain a maximum discharge of 1,220 m<sup>3</sup>/s.

*Group No. 3: Canals to drain inland flood to the West Sea*

Construction of a canal system for irrigation, drainage of water and acid water bring sedimentation including 18 main and first canals with a total length of 721 km. These canals almost exist but improvement is needed except for some new canals.

There are some issues needed to pay attention, when construction of flood control system in the Long Xuyen Quadrant is implemented. The implementation of this



system should be started from the seaside first in order to create capacity of flood drainage and combination with transportation system and ring dike to protect towns and resident areas.

*Group No. 4: Structures system to control floods from the Bassac River to Long Xuyen Quadrant*

Construction of 8 sluices at the beginning of canal along the Bassac River including: canal No.2, Can Thao, Tri Ton, Muoi Chau Phu, Ba The, Chac Nang Gu, Mac Can Dung and Chac Ca Dao canals.

***The Western Area of the Bassac River:***

The western area of the Bassac River is limited by the Cai San Canal in the north, the Bassac River in the East, the Cai Lon River in the west and Cai Con, Quan Lo - Phung Hiep in the south, and located in the land of Can Tho and Kien Giang provinces. Total area of the western area of the Bassac River is 365,060ha, of which the agriculture land is about 288,143 ha.

The objectives of flood control in the western area of the Bassac River are to:

- Ensure the safety for resident areas, towns, urban areas and transportation routes as National Road No., National Road 80, provincial road Can Tho - Long My, National road Can Tho - Vi Thanh - Go Quao- Rach Gia.
- Control floods year-round for over 42,000 ha of fruit;
- Control floods year-round for cultivation triple crops for most of the paddy fields;
- Bring sedimentation from the Bassac River to farm fields for fertilization of the soil; and
- Combine with other water resources constructions to form a complete system for agriculture development at high level and also combine with transportation construction, resident area to build rural areas in trend of civilization and modernization.

*Flood control alternatives for the western area of the Bassac River:*

- It is prevented the flow of the floods from Long Xuyen Quadrant to the western area of the Bassac River due to its poor quality and due to the fact that this flow causes inundation of the western area of the Bassac River. It is controlled the flow of the flood from the Bassac River in order to take the initiative of bringing sedimentation for soil fertilization. To drain flows inland to the Cai Lon River by saline prevention construction and taking advantage of the neap tide duration to drain out.
- Construction of flood control structures along the national road 80, as well as construction of flood control structures for farm fields year-round as follows:

- In the Cai San-Xa No sub-area, the eastern area of the National Road 91 the flood control construction is built by setting up small areas and the western area of the National Road 91 to build embankment to protect according to the 3 subprojects as Cai San - Thot Not, Thot Not - O Mon, O Mon - Xa No.
- In the Can Tho - Long My sub-area, small, medium scale projects will be implemented in accordance with particular conditions.

**The Plain of Reeds Srea:**

The Plain of Reeds is limited by the Vietnam-Cambodia border, the East Vam Co, the Cho Gao Canal and the Mekong River with a total area of about 703,338 ha, sharing 18% of the Cuu Long Delta.

The objectives of the flood control for the Plain of Reeds are to:

- Ensure the safety for resident areas, towns, urban areas and main transportation routes as National Roads No. 1, 30, N1, 62, 50, 864 and provincial roads Bac Nguyen Van Tiep, Cai Lay - Kien Binh, Dong Phuoc Xuyen and Tram Chim - Tan Hong;
- Take the initiative of control early floods and ending floods to ensure the production of double crops in winter-spring and summer-autumn seasons for the northern area of the Nguyen Van Tiep Canal;
- Control flood year-round for the southern area of the Nguyen Van Tiep canal, fruit areas and industrial areas in the eastern area of the Bo Bo Canal, Tan Lap state-managed farm (Cu Chi) and the Bac Dong - Cho Bung area; and
- Combine with other hydraulic works to form a complete water resources system for agriculture development as well as combination the water resources development with development of road network, resident area in trend of building the civilization and modernization rural areas.

*Flood control alternatives for the Plain of Reeds area:*

**Group No. 1:**

- Construction of flood prevention and flood control routes along the south bank of the Tan Thanh Lo Gach canal, with top elevation of + 6.5 m at Hong Ngu and + 5.5 m at Vinh Hung. Dredging and enlarging Tan Thanh Lo Gach canal phase 2 with bed width of 32 - 24m, and bed elevation of – 3.0 m.
- Building of 10 sluices along the flood these routes, of which, there are five sluices for flood control such as Construction 2/9, Khang Chien, with bed width B=30 m, construction Binh Thanh B=20 m, Construction Thong Nhat B=20m, Cai Cai B=25 m and the remaining five sluices for irrigation.

- Enlarging 3 floodgates including Electricity Pillar No. 10, Tra Du - Cay Da and Cai Sach -Nam Hang along the road Nam So Thuong enough for drainage of flood to the Mekong River from Hong Ngu to Tan Chau. These floodgates can drain about 3,700 m<sup>3</sup>/s.
- Dredging 4 flood drainage canals adjacent to the Mekong River including Canal 2/9, Khang Chien, Binh Thanh, Thong Nhat which link with Doc Vang Ha, Doc Vang Thuong and Ba Rang river mouth to drain 3000 m<sup>3</sup>/s, enlarging the Song Trang canal linked with Ca Rung ditch and Ca Gua canal with a width of 20m, bed elevation of -3m; enlarging canal 28 with a width B=20m, bed elevation of -3m.

Group No. 2:

- Dredging and upgrading block 2 of the Hong Ngu canal with bed width of 40m, bed elevation of – 4 m to drain flood water to the West Vam Co River.
- Dredging and upgrading the Dong Tien - Lagrange canal to ensure the requirement of sources of freshwater, drainage as well as navigation requirement of the Plain of Reeds with bed width of B=30 m, bed elevation of -3.50 m.
- Dredging and upgrading An Phong-My Hoa-Nam Ngan - Bac Dong canal with bed width of B=14 m, bed elevation of -3,00 m, with a total length of L= 90 km.
- Enlarging and dredging Canal 79 to drain floodwater in August and ending flood to the West Vam Co River, supplement freshwater for this area. Total length of about 45 km, bed width of 15 m, and bed elevation of -3.0 m.
- Constructing the Lagrange sluice for saline prevention, drainage of tidal water, floodwater and constructing other sluices adjacent to the Vam Co River.

Group No. 3 (southern area of the Nguyen Van Tiep canal):

- Dredging and enlarging 21 canals linked the Nguyen Van Tiep canal with the Mekong River such as canals 307, Cai Beo, Duong Thet, Canals 6,7,8... Both banks of these canals will be used as flood control dikes.
- Construction of sluices for prevention of tide and drainage: These constructions uses for prevent the spring tide level and drain during the neap tide duration along the Mekong River from Cao Lanh to My Tho to take initiative of preventing inundation, quickly drain inland water to the Mekong River.

Group No. 4 (The area between the two Vam Co rivers):

Dredging and enlarging the Bo Bo Canal to drain out the flood waters, dredging and enlarging canal linked two Vam Co rivers, bank embankment to create ring

dikes to prevent inundation caused by floods for industrial tree cultivation as: sugarcane, pineapple, banana...

Group No. 5:

- Protection of 12 towns located in deeply inundated area such as Tan Hong, Tan Hung, Vinh Hung, Thanh Binh, Tam Nong, Thap Muoi, Moc Hoa, Tan Thanh, Thanh Hoa, Hong Ngu, Tan Phuoc and Dong Thanh.
- Protection of commune centres and important resident areas against inundation.
- Building 3 ecological reservoirs such as Lo Moi (Tan Phuoc), Lang Sen (Moc Hoa) and Tram Chim (Tam Nong) to preserve the natural and ecology of the Plain of Reeds, to improve the climate, to keep moisture and supply water partly in the dry season.

**Flood control for the area between the Mekong River and the Bassac River:**

The area between the Mekong River and Bassac River is limited by the Mekong River in the north, the Bassac River in the south, the border of Vietnam and Cambodia in the west and the East Sea in the East with an area of about 357,277 ha.

The flood control areas between the Mekong River and Bassac River can be classified into 7 sub-areas as the northern area of the Vinh An canal, the area of the Than Nong canal, the Cho Moi area, the northern area of Lap Vo, the southern area of Lap Vo, the Northern Mang Thit area, the Cho Lach - Chau Thanh (Ben Tre) area and islands. Particularly, the northern area of the Vinh An canal has a relation with the drainage of flood flow from the Mekong River to the Bassac River, therefore, this is a non-control flood area. The remains are the year-round flood control areas.

### 3.4. Identification of Assets

- Mangrove forests along coastal; indigo forests in Dong Thap province, Long Xuyen Quadrangle;
- Bio-ecological system (precious water birds: Red crane....) and wetland system;
- Fishery sources;
- Land and water resources;
- Kho Me and Oc Eo cultures (pagodas, festivals);
- Human resources; and
- Landscapes and national parks/natural conservation areas/wet land.

## 3.5. Constraints

### 3.5.1. Natural Condition

- About 30% area in a total of 3.97 million ha of natural area have favourable condition for agriculture development, the remaining consists of 1.6 million ha of acid sulphate soil, 750,000 ha saline land and grey soil and 134,000ha are not favourable for agriculture development.
- There are two distinct seasons in the Cuu Long Delta that is affected by the tidal regimes from the East Sea and the West Sea; the dry season is affect by salinity intrusion in the coastal areas (about 750,000 ha); in the rainy season the problem is the flooding which causes inundation of about 1.9 million ha, with a duration of about 4-5 months with a depth of about 0.5-4.0 m. About 4-5 years the high flood occurs causing many damages in terms of people deaths, loss of properties these are the main constraints on the socio-economic development in the Mekong Delta of Vietnam.
- Poor infrastructure, particularly the transportation system, power supply network and water supply system. Temporary houses like cottage, bamboo share about 73%, in comparison with that of the nation this rate is about 42.3%; Households, which accessed the power supply system, are about 24.4% in comparison with that of the nation this rate is about 54.8%. The road system with a length of about 6,600km (excluding the rural roads), of which there are 12 national roads with a length of 1,600 km, provincial roads of about 2,499 km. National Road No. 1 is main road with a good condition (just improvement), the remain is serious degraded causing difficulty in transportation, on the other hand commune roads are very few (about 400 remote communes, small cars cannot access), “monkey” bridges are many and annually destroyed by floods.

### 3.5.2. Social Situation

- By year 2020, the population of the sub-area is estimated at about 27 million people of that the migration to the urban areas is previously is understood due to the fact that the urbanization increases annually 3-5%. This will press to the environment, natural resources, infrastructure, and services, which will not satisfy the urban development.
- Although the economy of the sub-area are progressing forward in trend of increasing industry and service and decreasing the agriculture but the agriculture is still a dominant sector. The agriculture labours are still high sharing about 73%, and the income in the rural areas is rather difficult, the rate of poverty and hunger is lower than that of the nation. The living condition of the local people are still very difficult, the rate of the poverty and hunger is about 17.2%, in comparison with the nation the sub-area is ranked third after the northern mountainous zone and zone 4 in terms of the poor.
- Low industrial development, poor facilities, technique and technology particularly the non-state industry. Industrial labours are in general not well

trained, mainly craftsman, low mechanism, only about 4-5% of labours are graduated university, and focus on the management activities. Rural industry does not have their direction in the planning, mainly unprompted, in addition rudimentary and simple production does not have the investment of the Government.

- The rate of government fund mobilization is about 10% GDP of the sub-area, sharing about 9.2-12.2% of the nation. About 20% of the local expenditure is focus on the basic construction, on under-developed urban areas, the rate of urbanization is low (about 15-16%), and is unbalanced (some provinces this rate reached only 7-8%)
- Socio-economic disparity between the Mekong Delta of Vietnam and the southern focal economic zone is very large, GDP per person of the sub-area is about one third that of the focal economic zone. If the Mekong Delta is still continue in low development the emigration current will be move to HCMC and other provinces in the southern focal economic zones.
- At present, the price of agro-commodity is extremely falling down reducing the income of the local people in the rural area particularly in the remote area, and minority groups.

### 3.5.3. Management of Planning Activities

- Planning management activities are not synchronous, flexible, and are not linked with the consumption markets. These have experienced in 2000, 2001, 2002 such as local people have changed rice cultivation to shrimp culture causing problems to the ecology of the sub-area. At the same time, the local people are not guided technically; have not the consumption markets resulting in out of business of the local people and when they want to grow rice back, the land is affected by the salinity intrusion.
- On the other hand, sector-planning studies are not in integrated manner. Sectors develop their planning but not combine with other sector plans resulting in contradiction and low efficiency in implementation. When plans had studied, the contents of these studies are not understood by the local people therefore investment activities are unprompted and some time contradiction. The attitudes and execution of the local households are not high which mainly follow the markets causing loss in investment.
- Parallel with planning management the investment structure is not reasonable, or investment is not synchronous and is not concentration therefore the efficiency if not high. This is the fact of the un-developed countries therefore in order to avoid the above-mentioned problems it is necessary to have supported from the government in the planning and water resources development activities.

### 3.5.4. Agriculture and Water Use

- Unused lands and unstable production share with a high rate, most of these are acid sulphate soils, saline soil, and far from fresh water sources. These

areas can be continued to reclaim but a large amount of investment and synchronous are needed.

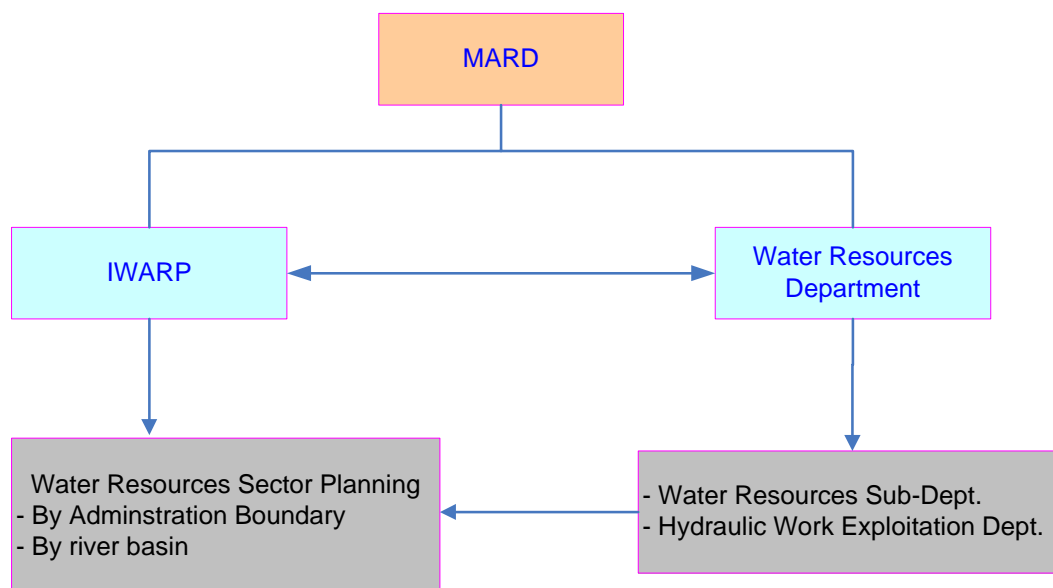
- Efficiency of land uses is not high, and is in unstable manner due to not combining with other purposes. Spatial integrated exploitation is not well implemented, therefore, that do not take advantage of high potential in each area
- In many areas, farming intensity and investment for cultivation are low, particular to fishery culture and upland crop cultivation.
- There is no close coordination between sector and sector and among local authorities in the orientation planning process of strategic land use.
- Yield and quality of the products are low, poor competition. Processing and post harvesting technologies are limited. Product outputs are only in raw materials, difficult for consumptions.
- Infrastructure for agriculture development of different type of cultivation is limited, particularly hydraulic works does not meet production requirement yet.
- Abundant water resources but concentrated only in the six-month rainy season, on the other hand, floods, salinity, acid water and acid sulphate soils have caused a lot of difficulties.
- Changes in land uses due to fishery development that are not followed by the set-up planning resulted in changes in water demand difficulty for water resources planning and management processes.

### 3.5.5. Institutional Capacity

A flowchart for water resources management in Vietnam has shown as in figure below. Ministry of Natural Resources and Environment has a responsibility in licensing water use and wastewater release into rivers. Observing this organization chart, there are some limitations as follows:

- There is no river basin organization;
- There is no integrated master plan according to basin boundary (there is only sector and field planning);
- Sector plan is not consistent with river basin plan; no unified consideration is taken into account for; and
- Policies under Law on Water Resources are not yet concretization; poor consciousness attitudes of the local people in terms of implementation.

Figure 6: Water Resources Organization and Development Chart



## 3.6. Cross-cutting Issues

### 3.6.1. Possible Impacts on Socio-economic Environment

Water resources development activities, which support for socio-economic development, aim at:

- Supporting industrialization of the sub-area, improving the growing rate of economy, and creating internal economic accumulation;
- Serving the progress of economic changes, labour structure according to orientation of industrialization; and
- Serving the changes of cropping and breeding structure, taking advantage of the sub-area in combination with the markets. This sub-area is a large area of agriculture development, fruits and fishery therefore hydraulic measures supported for agriculture development is very important in order to sustain the improvement of the efficiency of production as well as creation of condition for agro-product processing industry.

Specially, water resources development scenarios in the sub-area will, in principal, solve the problems of annual inundation, the shortage of fresh water in the dry season. In addition, these will contribute to sustainable living condition of the local people, incomes and their living condition. However, parallel with the economic benefit, there are some disadvantages when implementation of water resource development projects is carried out.



***Emigration:***

- On the population side, the Cuu Long Delta had about 16.740.000 people in year 2002. This is main human resources for economic development. The population density was estimated at about 412 people/km<sup>2</sup> higher than the national average (235 people/km<sup>2</sup>), and ranked third in terms of population among 8 national economic zones of Vietnam after the Red River Delta and Southeast Area. The population of the Cuu Long Delta is rather densely and almost there has not been immigration since the last few years. At present, natural growth rate is about 2.4% and urban population shares a rate of about 17.5%, rural population of about 82,5%. Rate of using agricultural labour time is only about 73.1%. Subsequently, there appears a trend that the immigration from the rural areas to urban areas and in industrial areas, however no study on this matter so far.
- The Cuu Long Delta has a densely river network and one has resided in this areas few hundreds year ago. In order to reside and maintain their lives, people have lived in high elevation land strips along rivers and canals. Therefore, people housed along the canal popularly. This main characteristic creates many favourable conditions in their lives but its impacts on the socio-economic development such as houses, means of transportation, and means for fishery capture which cause many limitations to navigation, roads, and construction of hydraulic works due to compensation in implementation and enlargement of existing construction. For instance, there are some constructions in which the compensation rate cost about 40 - 50% the total investment cost. In addition, the pollution caused by untreated wastewater from resident areas has been increased.

***Public Analysis:***

- There are about 10 million labours in all economic sectors in the Mekong Delta of Vietnam but the rate of skilled labours is as low as about 3.4% while this rate of the nation is about 15%. This is a basic constraint to development of all sectors. At present, it appears that newly-opened industrial areas are shortage of skilled labours. In fishery sector, skilled labours in terms of capture and pilots are shortage or serious shortage of technical aspect when fishery aquaculture has progressed strongly since recent three years.
- The situation of un-evenly distribution of land use is popular in the Mekong Delta due to un-evenly population density. The average land use in the riparian areas along the Mekong River and the Bassac River is about 0.1-0.2 ha/person, about 0.2-0.3 ha/person in other areas. The uneven distribution of land use results in difference in income and living standard between the highest and the lowest about 7.9 times. This is also a reason causing the encroachment of forest for cultivation, hunting, etc. which cause land loss and forest fires.

Due to low income existence, unequal economy most of local people could not get loans for investment in agriculture production, fishery aquaculture and means for

fishery captures, means of navigation in order to response to the high requirement of production demand. In addition, the application of science technology such as crop varieties, processing industry, post-harvesting industry, young tree culture and slowly use of phytopathology have caused many impacts on product quality and economic efficiency in agriculture.

### 3.6.2. Possible Impacts on Ecological Environment

Water resources development causes positive impacts and activities as follows:

- Protection and reforestation of protection forests, special used forest;
- Construction of flood control, salinity control, resident protection, water supply and drainage works;
- Agriculture development;
- Navigation development;
- Fishery development; and
- Reforestation, increasing of forest coverage, harmonization of ecosystem in the area.

However, the development of water resources system also cause negative impacts with respects to:

- Loss of fish emigration current and spawning;
- Lost of land and coverage;
- Increase of eutrophication at year-around flood control areas;
- Changes in ecosystem in the Mekong Delta of Vietnam;
- Impacts on natural preservation forest; and
- Pollution on large area due to agriculture, fishery development which use chemical fertilizers resulting in changes of and extinction of flora and fauna in the water as well as existing sources of fishery.
- Navigation safety: navigation accidents like shipwrecks, ship crash causing damages and water pollution (e.g. oil spreading).

### 3.6.3. Possible Impacts on Physical Environment

#### ***Geomorphology:***

Implementation of water resources system, if there are no careful plans, would cause changing flow regime resulting in riverbank, bank erosion and sedimentation of the river-canal systems.

***Surface Water:***

- Salinity intrusion is one of natural phenomena in the coastal area of the Mekong Delta. On the main river, salinity with an index of 4 g/l from the East Sea intrudes strongly into inland from 40 to 50 km and from 20 to 30 km on the West Sea. Total salinity-affected area was estimated at about 1.4 – 1.6 million ha. Of that, there were about half of that the duration prolongs from 1- 3months. During the last 25 years, strong salinity intrusion occurred in 1977, 1992, 1993 and 1998 that seriously affected to production and people's lives in the coastal area. Increasing water uses in dry season upstream causes further salinity intrusion inland in the Cuu Long Delta of Vietnam.
- Acid sulphate soils and acid water movement are the major constraints in the Mekong Delta. Total acid sulphate soils area is about 800 - 900 thousands ha. Most of that are located in the Plain of Reeds, Long Xuyen Quadrant, and Ca Mau Peninsula. Annually, acid water (pH<5) occurs two times, from May to August and from December to January, with total period of time of about 3- 6 months. The existing strong acid water affected include Bac Dong, Bo Bo (Long An), Ha Tien Quadrant (Kien Giang) and the centre of Ca Mau Peninsula. During the implementation of water resources systems in these areas acid sulphate index increases during the first three to five years causing difficulty for agriculture development and fishery of the surrounding areas.
- In the year-around flood control areas, acid water effects also occur due to agriculture development and drainage system.

***Groundwater:***

Water abstraction for cultivation and domestic uses that if there are not good management, the pollution will be more serious due to infiltration from waste water after uses into existing not so good groundwater.



## 4. Sub-area Scenarios and Development Strategies

## 4.1. Key Issues

The key issues in the sub-area can be classified into: (i) sector issues; and (ii) management issues. The main issues are as followings:

- Lack of water in dry season for irrigation / salinity prevention / waterline for navigation, especially in the areas far from main branches;
- At present, un-sustainable development is applied for all sectors. The sectors developments don't conform to the planning. The unbalanced development between supply-demand is addressed; especially land use between sectors of agriculture and aquaculture;
- Investment is unbalanced with demands demonstrating with the infrastructures investment for flood mitigation, water structures for aquaculture;
- Unbalanced in management between sector agencies and between central and provinces;
- The intellectual standard of people is very low; the non-trained labours are dominated in the Mekong Delta;
- Trans-boundary issues are not considered in the planning. The water resources development planning is not taking into account enough eight sectors mentioned in the BDP; and
- It is awareness that the development in the sub-area need to cooperate with the neighbouring countries at the border areas.

## 4.2. Driving Forces

### 4.2.1. Social

- Density population (16.3 millions, of which 8.0 mill live on agricultural production); non-trained labours are dominated;
- Population arrangement is mainly along canals and reaches with very temporary houses (9 mill of people with poor houses);
- Low living standards 200-300 USD/capita/year. Poverty rate is 15% in average, in some areas, it is 52%;
- Water supply for urban and rural areas is main issues, especially people living far from water resources; and
- The living is affected by natural disasters such as flooding, lack of freshwater.

### 4.2.2. Economic

- Agriculture occupied high rate 50-65%;

- Products with low values, impossible competition; Lack of information and market forecasting;
- Science and technologies are applied in agriculture and fishery with low level (fertilizer, post-harvesting, culture...);
- Low investment for aquaculture and fishing facilities and inland waterway;
- The sector planning does not meet the production in time and requirement;
- The policies of product consumption, land management are unreasonable and non-reality;
- Poor infrastructures for socio-economic development and tourism;
- Agricultural production depends upon nature;
- Sector development are unbalanced with the Delta Master Plan; and
- All socio-economic activities are affected and distributed by development activities upstream.

#### 4.2.3. Environment

- Salinity intrusion so far inland ( 1.4- 1.6 million ha from 1-4 months);
- There is about 1.9 to 2 million ha are in flooded areas;
- It is about 900,000 ha effected by Acid-sulphate from May to August;
- Some mangrove forests along coastal and even some embankment for flood protection are destroyed to culture shrimp and fishes resulting in eco-environmental impacts;
- Flooding results in some positive and negative impacts on environment;
- Bank erosion and river sedimentation are considerable; Tan Chau, Hong Ngu, Long Xuyen town, Mang Thit town; and
- Water quality is in degradation.

#### 4.2.4. Water Resources

- Long dry season from 6 to 7 months with total rainfall in dry season accounts for less than 10% in comparison with total;
- Average discharge from 1800-4000 m<sup>3</sup>/s at Tan Chau and Chau Doc in dry season with low water levels result in difficulties for agriculture development;
- Agriculture and other sectors development are affected by semi-tide thus gravity irrigation depending upon tidal amplitudes; and
- Presently, about 1.5 million ha is irrigated. It is estimated that 30-40% population in rural areas supplied by water.

### 4.3. Scenarios and Elements by Sectors

Components	Unit	Lowest	Highest
<b>I. TRENDS</b>			
<b>1. Society</b>			
Increasing population	%	1.55	2.0
Income per capita	USD	400	500
Poverty	%	0	10
Population use clean water	%	30	100
Water supply per capita:	l/per./day		
- Urban		100	200
- Rural		60	120
<b>2. Economy</b>			
Economic structure			
Agriculture, forestry, fishery	%	41	35
Industry, construction	%	24.5	29.5
Services	%	34.5	35
The main economic sectors			
Agriculture: Changing plant structure, effective per each hectare	Million/ha	20	50
Industrial crop plants, fruits			
Increasing two – rice crop + Fish; 1 rice + 1 shrimp; three – rice crop; one – rice + 2 others			
Develop maize, cotton			
Develop breeding (oxes, buffalo...)			
Develop processing industry			
(ii) Forestry: Protecting the present forest, reforestation, increasing forest cover	%	11.0	15
(iii) Fishery.	ha	500,000	700,000
<b>II. RISKS</b>			
<b>1. Climate change</b>			
Drought	ha	800,000	1,000,000
Floods	ha	1,400,000	1,900,000
Forest fire	ha	30,000	50,000



Components	Unit	Lowest	Highest
<b>2. Marketing change: the price of agricultural productions is changing</b>			
Coffee	USD/ton	200	300
Cotton		900	1,600
Fruits			
<b>3. Transboundary</b>			
Changing flow regime in upstream during the dry season	m <sup>3</sup> /s	2,200	1,000
Increasing over flooded through boundary	m <sup>3</sup> /s	13,200	15,000

### III. THE DEVELOPMENT ACTIVITIES

#### 1. Agriculture

##### a. Land use

Rice	ha	1,500,000	1,650,000
Industrial crop plants	ha	262,670	312,000
Long – term crop plants	ha	540,000	640,000

##### b. Crop plants, animals

Winter – Spring Rice	ha		1,498,000
Summer – Autumn Rice	ha		1,532,000
Winter crop	ha		292,000
Maize	ha		136,000
Sweet Potatoes	ha		20,000
Vegetable	ha		185,000
Sugarcane	ha		112,000
Coconuts	ha		117,000
Fruits	ha		307,000
Buffalo	head	51,629	
Ox	head	370,343	
Pig	head	4,001,388	
Milk cows	head	31,000	
Poultry	head	63,992,000	

##### c. Irrigation

Surface water	ha	2,410,000	2,410,000
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Components	Unit	Lowest	Highest
Paddy rice		1,500,000	1,650,000
Industrial crops		910,000	760,000
Groundwater	ha		
<i>d. Develop processing industry</i>			
Processing Rice	tons		
Processing Fruits			
Processing Cotton			
Processing Sugarcane			
<b>2. Forestry</b>			
Forest area			
Area	ha		
Present area		44,737	
Reforestation		6,600	
New forest		59,600	
Forest - Fishery		15,900	
<b>3. Tourism</b>			
Number of tourists	Pers/year	500,000	1,500,000
<b>4. Water supply</b>			
For Domestic	1000 pers.	18,000	19,000
Water demand	10 <sup>6</sup> m <sup>3</sup>		
For Industry	10 <sup>6</sup> m <sup>3</sup>		
<b>5. Flood Control</b>			
All year	ha		900,000
Seasonal	ha		866,000
No Flood control	ha		134,000
<b>6. Policy</b>			
For agriculture			
Reduce poverty			
Priority for investment			
Cooperation with other countries			

## 5. Proposed Project Ideas

**Project 1:**

Date:	July 2004
Raised by:	Vietnam In-land Waterway Administration Ministry of Transport, Vietnam
Project Title:	Improvement and Promotion of Navigation between Vietnam and Cambodia
Development objective:	To improve cross border navigations between Vietnam and Cambodia
Background and justification:	There are constrains in inland waterway transport between the two countries such as custom procedures, fee collection, check in and check out processes, quarantine... or technical difficulties relating to shallow water, dredging, channel maintenance and management... This will be Technical Assistance project for a study to promote transportation between the two countries in 2005 – 2010
Strategic relationship:	It is obviously that further improvement and promotion of the navigation in the lower Mekong basin will be relevant to the Strategy of the Navigation sector. Moreover, inland waterway transportation is also seen as one of national priorities in most downstream countries, Vietnam and Cambodia.
Priority:	High
Expected outputs:	Agreed procedures concerning the border crossing (in terms of custom check) Improvements of navigation aid systems along rivers Plan for channel maintenance and management joined by two countries
Time frame:	2 years
Cost estimate:	Approximately 2 Million USD (external sources)
Project locations:	Along the Mekong and Bassac rivers

**Project 2:**

Date:	July 2004
Raised by:	Vietnam In-land Waterway Administration Ministry of Transport, Vietnam
Project Title:	Improvement of environment control in navigation development between Vietnam and Cambodia
Development objective:	To have better monitoring and controlling environmental impacts caused by inland waterway transports and cross border navigations between Vietnam and Cambodia
Background and justification:	Inland waterway transport is recently increasing rapidly at the rate of 9-10% per year (including passenger and cargo transport). An increase of navigation properly and certainly influences to environment.  There are no any studies relating to the assessment of environment impacts caused by navigation and inland waterway transport.  It is necessary to carry out some activities for controlling and mitigating pollution in inland waterway transport
Strategic relationship:	Environment protection for sustainable development is one of the most important for Mekong cooperation area under the Mekong Agreement. Moreover, this idea should be relevant to strategy for environmental protection within the MRC Environment Programme.
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed assessment of pollution status caused by inland waterway transportation and cross border navigation on main channels between Vietnam and Cambodia; and</li> <li>– Draft environmental protection procedures within inland waterway transport and navigation by two down stream countries, Vietnam and Cambodia.</li> </ul>
Time frame:	2 years
Cost estimate:	Approximately 2 Million USD (external sources)
Project locations:	Along the Mekong and Bassac rivers

**Project 3:**

Date:	October 2004
Raised by:	Vietnam In-land Waterway Administration Ministry of Transport, Vietnam
Project Title:	Strengthening capacity in environment protection for Vietnam Inlands Water way Administration
Development objective:	To improve capacity of the Inland Waterway Administrations of Vietnam and Cambodia in environmental protection
Background and justification:	<p>Recently, inland water transport activities in this area have increased more than 10% per year, including operating of vessels, ports and piers, manufacturing and maintaining vessels, building inland water works, dredging rivers, etc.</p> <p>Most of those activities do not have technical facilities to prevent pollution. Those discharge to environment a very big volume of oil, rubbish, sewage, dangerous wastewater, goods (coal, building material, dangerous cargo/explosive material, pesticides), and especially in accidents.</p> <p>The bad water quality has a serious impact on riparian's livelihood, fishery and other relevant sectors, living environmental, ecology systems and other sensitive areas in rivers. There is an important lack of capacity within IWAs to tackle this problem (lack of regulations, knowledge, skill, equipment, finance...).</p> <p>However, it will demand strong efforts to reduce the above-mentioned impacts. VIWA, within its scope, should define the environmental responsibilities and management relating to the inland water transportation.</p>
Strategic relationship:	Environment protection for sustainable development is one of the most important for Mekong cooperation area under the Mekong Agreement. Moreover, this idea should be relevant to strategy for environmental protection within the MRC Environment Programme.
Priority:	High
Expected outputs:	Improved environmental protection, to be achieved through a credible and operating Environmental Inspection Services within Inland Waterway Administrations of Vietnam and Cambodia
Time frame:	1 year
Cost estimate:	Approximately 1.5 Million USD (external sources)
Project locations:	Along the Mekong and Bassac rivers

**Project 4:**

Date:	October 2004
Raised by:	Sub-institute for Water Resources Planning
Project Title:	Planning for embankment development in the Mekong delta
Development objective:	To complete the embankment to protect agriculture production and settlements from the severe floods, contributing to stabilize resettlement and infrastructure systems in the Mekong Delta in Vietnam
Background and justification:	<p>Agricultural production with infrastructure system in the Mekong Delta is always threatened by severe flooding yearly.</p> <p>Embankment systems in An Giang and Dong Thap have proved efficiencies in protecting production from early flood, reduce remarkably loss and damages in the delta.</p> <p>Planning of Embankment system development will be in line with the planning for water resources Development in the Mekong Delta, which has recently been approved by the Government</p>
Strategic relationship:	BDP, HRD
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed planning for embankment systems development in whole delta;</li> <li>– Guidelines to provincial levels in developing embankment systems in relevant to the Planning for Water Resources Development in the Mekong Delta; and</li> <li>– Direction in investment into infrastructure system for production and living condition in the Delta</li> </ul>
Time frame:	5 years (2005-2010)
Cost estimate:	150 mil US\$
Project locations:	Mekong Delta in Vietnam

**Project 5:**

Date:	October 2004
Raised by:	Irrigation section, Department of Agriculture and rural Development of Dong Thap Province
Project Title:	Development of Bank protection construction in Sa Dec town, Dong Thap province
Development objective:	To protect bank erosion along the Tien river in Sadec Town, contributing to stabilization of agricultural production and living of local people in Dong Thap
Background and justification:	<ul style="list-style-type: none"> <li>– Bank erosion in Sadec occurred seriously every year, especially during flooding season;</li> <li>– Loss and damages of agricultural lands and properties are being threatened by bank erosion in Sadec; and</li> <li>– Lacking of construction and appropriate methods in protecting river banks in Sadec</li> </ul>
Strategic relationship:	BDP, EP and FMMP
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Integrated solution for bank protection in Mekong delta in general and in Dong Thap Province, in particular;</li> <li>– Built 920 m of the bank protection constructions along the Tien river bank in Sadec town to protect bank erosion every year; and</li> <li>– Completed guidelines on procedures for building the bank protection construction in Mekong delta.</li> </ul>
Time frame:	6 years (2005-2010)
Cost estimate:	18 mil US\$
Project locations:	Sadec town, Dong Thap province



**Project 6:**

Date:	October 2004
Raised by:	Management Board of Tram Chim Park Dep. of Agriculture and Rural Development of Dong Thap
Project Title:	Protection and development of Tram Chim national park, Tam Nong District, Dong Thap province
Development objective:	To protect the wetlands eco-system in Tram Chim national park, contributing to conserve floras and fauna in the wetland area in Dong Thap province
Background and justification:	<ul style="list-style-type: none"> <li>– Degradation of wetland eco-system in Tram Chim due largely to lacking of appropriate protection approaches;</li> <li>– Loss of fauna and flora due to un-control exploitation by people living from outside; and</li> <li>– Management and monitoring system are poor and not yet completed.</li> </ul>
Strategic relationship:	BDP and EP
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Integrated solution for the wetlands eco-system in Tram Chim park to prevent uncontrolled activities in exploitation;</li> <li>– Completed planning in use of water resources and other related resources towards sustainable manners; and</li> <li>– Stabilized resettlement for ambient living of local people.</li> </ul>
Time frame:	3 years (2005-2007)
Cost estimate:	4 mil US\$
Project locations:	Tram Chim National Park, Dong Thap province

**Project 7:**

Date:	October 2004
Raised by:	Dep. of Transportation, Dong Thap province
Project Title:	Development of the road systems in Dong Thap province
Development objective:	To form the complete axial transportation network connecting to the national network, facilitating economic development in Dong Thap province
Background and justification:	Poor transportation system in Dong Thap province, resulting in economic development isolated with other parts within country High cost in transportation
Strategic relationship:	BDP
Priority:	High
Expected outputs:	Completed axial transportation network in province connected to the national transportation systems
Time frame:	4 years (2005-2008)
Cost estimate:	13 mil US\$
Project locations:	Dong Thap province

**Project 8:**

Date:	October 2004
Raised by:	Tram Chim National Park, Dong Thap province
Project Title:	Appropriate exploitation of aquatic resources in the Tram Chim national park
Development objective:	To conserve and develop the aquatic eco-system in Tram Chim national park towards sustainabilities
Background and justification:	<ul style="list-style-type: none"> <li>– Weak management system to uncontrolled uses of aquatic sources leading the loss of some precious species of flora and fauna; and</li> <li>– Poor facilities and tools to protect illegal activities in exploitation of aquatic resources.</li> </ul>
Strategic relationship:	BDP
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed procedure in appropriate exploitation of aquatic resources for sustainable development; and</li> <li>– Stabilization of eminent living of local people, contributing to increase incomes from related activities.</li> </ul>
Time frame:	5 years (2005-2008)
Cost estimate:	2 mil US\$
Project locations:	Tram Chim National Park, Dong Thap province

**Project 9:**

Date:	October 2004
Raised by:	Irrigation section, Department of Agriculture and rural Development of Dong Thap Province
Project Title:	Study on sedimentation distribution and establishment of procedures for dredge and management of the canal systems in Dong Thap Province
Development objective:	To increase efficiency in use of irrigation systems in Dong Thap province, by improving conditions of the irrigation system
Background and justification:	<ul style="list-style-type: none"> <li>– Flooding and low flow during dry season are main reasons for sedimentation in irrigation system;</li> <li>– Sedimentation in the irrigation system led to low efficiency in use; and</li> <li>– Poor study on sedimentation distribution and rules for appropriate solutions for sedimentation.</li> </ul>
Strategic relationship:	BDP, EP and AIFP
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed study on sedimentation and its rules and distribution;</li> <li>– Completed procedure to dredge and prevent irrigation scheme from fast sedimentation; and</li> <li>– Formulated regulation in protection of irrigation schemes from sedimentation.</li> </ul>
Time frame:	3 years (2005-2007)
Cost estimate:	0.8 mil US\$
Project locations:	Dong Thap province

**Project 10:**

Date:	October 2004
Raised by:	Tram Chim National Park, Department of Agriculture and rural Development of Dong Thap Province
Project Title:	Study on cleaning-out the Mai Duong tree in the Tram Chim National Park
Development objective:	To conserve and develop the natural resources in the Wetlands eco-system in Tram Chim national park
Background and justification:	<ul style="list-style-type: none"> <li>- Fast growth and over spread of Mai Duong tree caused degradation of fauna and flora in Tram Chim park; and</li> <li>- Exhaustion of nutrition in land and water resulting in poor environment and aquatic eco-system in the Tram Chim park.</li> </ul>
Strategic relationship:	BDP, EP and AIFP
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>- Conserved good environment for wetland eco-system in Tram Chim national park; and</li> <li>- Completed procedures in protecting the growth of Mai Duong tree.</li> </ul>
Time frame:	5 years (2006-2010)
Cost estimate:	3 mil US\$
Project locations:	Dong Thap province

**Project 11:**

Date:	November 2004
Raised by:	Irrigation section Department of Agriculture and Rural Development of Dong Thap Province
Project Title:	Bank erosion protection for river system in the area along the border lines between Vietnam and Cambodia (Vietnam and Cambodia)
Development objective:	Formulate integrated action plan for bank erosion protection of the river systems in bordering areas between Vietnam and Cambodia
Background and justification:	<ul style="list-style-type: none"> <li>– Bank erosion in the river system in the bordering areas between Vietnam and Cambodia are seriously, especially during flood season with high velocity of flood flow;</li> <li>– Causing loss in human life and properties and damages to infrastructures for production; and</li> <li>– Increase sedimentation to downstream.</li> </ul>
Strategic relationship:	The project idea are relevant to sustainable development of natural resources and environment protection within BDP mandate and strategy
Priority:	High
Expected outputs:	Integrated action plan for bank erosion protection of the river systems in bordering areas between Vietnam and Cambodia
Time frame:	03 years
Cost estimate:	Approximately 1,200,000 USD
Project locations:	Dong Thap, An Giang and Long An in Vietnam and Prey Veng, Svay Rieng and Takeo in Cambodia

**Project 12:**

Date:	November 2004
Raised by:	Department of Agriculture and Rural Development of Dong Thap Province
Project Title:	Development of the rural industries and traditional handicrafts in Dong Thap province
Development objective:	To improve living condition of the local people by developing other income sources, contributing to poverty alleviation in remote and border areas in Dong Thap province
Background and justification:	<ul style="list-style-type: none"> <li>– Low income from agriculture activities;</li> <li>– Leisured labour forces during transition of cropping seasons could not be used for income generation; and</li> <li>– There area a great potentials in tradition and rural handicrafts in Dong Thap province.</li> </ul>
Strategic relationship:	BDP
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Mobilized idle labour for development of rural industries and handicrafts;</li> <li>– Increased off-farm income to farm households; and</li> <li>– Encouraged conservation of traditional industries and rural services.</li> </ul>
Time frame:	5 years (2005-2007)
Cost estimate:	N.A.
Project locations:	Dong Thap province

**Project 13:**

Date:	November 2004
Raised by:	Irrigation section; Department of Agriculture and Rural Development of Dong Thap Province
Project Title:	Establishment of procedures for operation of large-scale irrigation schemes in the Mekong delta
Development objective:	To increase efficiency in use of irrigation schemes in whole Mekong delta by applying appropriate procedures for operation
Background and justification:	<ul style="list-style-type: none"> <li>– Water resources are playing important roles in agriculture production. Water sharing between provinces in Mekong delta require appropriate procedures for operation of large-scale irrigation schemes; and</li> <li>– Irrigation schemes have been built effectively for agriculture and other purposes in use, but management by integrated ways for enhancing efficiencies of water use is still poor.</li> </ul>
Strategic relationship:	BDP and AIFP Relevance to national strategy in development of the Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed procedures for operation of large-scale irrigation schemes; and</li> <li>– Improved skills in management of irrigation schemes in Mekong delta.</li> </ul>
Time frame:	2 years (2006-2007)
Cost estimate:	N.A.
Project locations:	Mekong delta in Vietnam



**Project 14:**

Date:	November 2004
Raised by:	Department of Agriculture and Rural Development of An Giang Province
Project Title:	Improvement of infrastructures for communes regularly affected by floods in An Giang province
Development objective:	To stabilize production and people's living in remote communes in An Giang province, contributing to minimization of damages caused by severe floods
Background and justification:	<ul style="list-style-type: none"> <li>– An Giang located in upper part of Tien and Hau rivers flowing into Vietnam, suffered from severe flood every years. Serious loss of properties and life and damage of infrastructures during flood season; and</li> <li>– Poor infrastructures in communes affected seriously by floods are main reasons for loss and damages.</li> </ul>
Strategic relationship:	BDP strategy and FMMP programme Relevance to national strategy in flood protection in the Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Improved infrastructure and technical bases for communes and villages effected by floods, such as concrete irrigation systems, roads, schools, clinic, etc.; and</li> <li>– Stabilized lines and concentration of settlements of the people living in these communes.</li> </ul>
Time frame:	5 years (2006-2010)
Cost estimate:	NA
Project locations:	An Giang province

**Project 15:**

Date:	September 2004
Raised by:	Department of Agriculture and Rural Development of An Giang Province
Project Title:	Development and improvement of in-field irrigation systems for better water use efficiency
Development objective:	To stabilize the agriculture production and increase water use efficiency by improvement of in-field completed irrigation schemes.
Background and justification:	<ul style="list-style-type: none"> <li>– In-field irrigation schemes have been completed and served for agriculture production;</li> <li>– Poor maintenance and management of irrigation schemes causing low water use efficiencies; and</li> <li>– Some main items in irrigation schemes as pumping stations, canal system are in poor condition.</li> </ul>
Strategic relationship:	BDP strategy and AIFP programme Relevance to national plan in development of agriculture in the Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Improved in-field irrigation schemes in An Giang province; and</li> <li>– Stabilized agriculture and increased water use efficiency.</li> </ul>
Time frame:	3 years (2006-2008)
Cost estimate:	NA
Project locations:	An Giang province

**Project 16:**

Date:	October 2004
Raised by:	Irrigation section, Department of Agriculture and Rural Development of An Giang Province
Project Title:	Establishment of bio-diversified conservation areas of Tra Su and Long Xuyen quadrangle
Development objective:	To conserve and develop bio-diversification areas of Tra Su and Long Xuyen quadrangle
Background and justification:	<ul style="list-style-type: none"> <li>– Great potentials in development of bio-diversification areas in Tra Su and Long Xuyen quadrangle; and</li> <li>– Huge sources of benefits from fishery to economic development of An Giang province.</li> </ul>
Strategic relationship:	BDP strategy and AIFP programme Relevance to national plan in development of agriculture in the Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Established bio-diversification conservation areas of Tra Su and Long Xuyen Quadrangle;</li> <li>– Increased income of the local people from fishery resources; and</li> <li>– Improved eco system and environment in An Giang.</li> </ul>
Time frame:	13 years (2006-2018)
Cost estimate:	2.5 mill. US\$
Project locations:	An Giang province

**Project 17:**

Date:	October 2004
Raised by:	Fishery section, Department of Agriculture and Rural Development of An Giang Province
Project Title:	Planning for fishery development in the Mekong and Bassac rivers in Mekong delta
Development objective:	To develop fishery sector in relevant to general development strategy of the Mekong delta towards sustainable development and environment protection.
Background and justification:	<ul style="list-style-type: none"> <li>– There is a great potentials in development of fishery sector in Tien and Hau Rivers in Mekong delta;</li> <li>– Un-controlled and un-planned development impacting on water environment and low productivities; and</li> <li>– Planning for fishery development can meet with direction of industrialization and modernization in Mekong delta.</li> </ul>
Strategic relationship:	BDP strategy and MRC Fishery programme Relevance to national plan in fishery development in the Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed planning for fishery development in Mekong delta in Vietnam; and</li> <li>– Increased income from fishery sector, contribution to economic growth in Mekong delta.</li> </ul>
Time frame:	13 years (2006-2018)
Cost estimate:	4.5 mill. US\$
Project locations:	An Giang province

**Project 18:**

Date:	September 2004
Raised by:	Department of Agriculture and Rural Development An Giang Province
Project Title:	Comprehensive development in areas between Bassac and Mekong rivers (Vietnam and Cambodia)
Development objective:	To formulate integrated planning for socio economic development in the area between Mekong and Bassac river
Background and justification:	<p>The area between Tien and Hau rivers are low land of 25,000 ha in Vietnam and 35,000 ha in Cambodia. Natural conditions are the same for both sides Vietnam and Cambodia.</p> <p>Economic development in this area is very much effected by flood every year. As a result, economic growth is lower than other areas in Mekong Delta.</p> <p>It is urgently needed to formulate an integrated planning for socio – economic development for this area in Vietnam and Cambodia, which could set out framework and action plan for further cooperation between two countries in developing this area for benefits of people living in Mekong delta.</p>
Strategic relationship:	<p>The project idea is relevant to development water resources that can support to the Development strategy for the Lower Mekong Basin.</p> <p>Consistent with the National development strategies and priorities in exploitation and management of the natural resources</p>
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Integrated planning for socio economic development of the area between Mekong and Bassac rivers; and</li> <li>– Identified priority activities for improvement of flood protection and proper development of potential economic sectors such as agriculture, fishery, navigation and cross border trade.</li> </ul>
Time frame:	5 years
Cost estimate:	Approximately 5 Million USD
Project locations:	An Giang province in Vietnam and Kandal in Cambodia (Sub-area 10V – 10C)

**Project 19:**

Date:	October 2004
Raised by:	Forestry Inspection Section; Department of Agriculture and Rural Development of An Giang Province
Project Title:	Rehabilitation of the eco-system of the mangrove forest and the acid sulphate wetlands in the Mekong river basin in An Giang Province
Development objective:	To maintain and conserve eco-system of mangrove forest and acid sulphate wetlands in the Mekong basin in An Giang province
Background and justification:	<ul style="list-style-type: none"> <li>– Uncontrolled exploitation of mangrove forest and wetlands become more seriously, resulting in degradation of environment and eco-systems;</li> <li>– Low investment to improve infrastructure for protection of mangrove forest; and</li> <li>– Lacking of guidance and management tools for development of agriculture and fishery activities, resulting in unbalances between protection and exploitation.</li> </ul>
Strategic relationship:	BDP Strategy, AIFP and EP National strategies in protection of eco-system and environment in Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed planning for areas developing protection forests and eco-system reservation;</li> <li>– Improved infrastructures for management and protection; and</li> <li>– Issued guidance for forestry inspection and management.</li> </ul>
Time frame:	5 years
Cost estimate:	Approximately 8.4 Million USD External source: 5.9 Mill Local contribution : 2.5 Mill
Project locations:	An Giang province

**Project 20:**

Date:	November 2004
Raised by:	Department of Agriculture and Rural Development of An Giang Province
Project Title:	Development of the warning system for flood, drought and bank erosion in An Giang Province
Development objective:	To strengthen capabilities in warning of natural disaster such as flood, drought, bank erosion and environment degradation, contributing to protection of agriculture production, infrastructure system and living of the local people in An Giang province
Background and justification:	Lacking of warning system, resulting in inactive preparations to cope with natural disasters.  It is expected that with low cost of project, but can bring back high efficiency in economic development and protection of environment and living condition for local people.
Strategic relationship:	BDP Strategy, FMMP and EP  National strategies in protection of eco-system and environment in Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Completed warning systems for flood, drought, bank erosion and degradation of natural resources; and</li> <li>– Guidance for application of results as provided by warning systems.</li> </ul>
Time frame:	3 years
Cost estimate:	Approximately 0.4 Million USD
Project locations:	An Giang province

**Project 21:**

Date:	November 2004
Raised by:	Forest Inspection Section; Department of Agriculture and Rural Development of An Giang Province
Project Title:	Conservation of bio-diversification in the Tra Su mangrove forest
Development objective:	To conserve bio-diversification system in Tra Su mangrove forest in An Giang province
Background and justification:	Degradation of bio diversification and environment due largely to uncontrolled activities in exploitation of mangrove forest in An Giang province.  Low investment to infrastructure for protection and enrichment of bio-diversification in mangrove forest
Strategic relationship:	BDP Strategy, AIFP and EP  National strategies in protection of eco-system and environment in Mekong delta
Priority:	High
Expected outputs:	<ul style="list-style-type: none"> <li>– Increased coverage by enlarging plantation and mangrove forest;</li> <li>– Reserved landscape and natural views for tourism; and</li> <li>– Increased farmer's income by services and forest production harvesting.</li> </ul>
Time frame:	3 years
Cost estimate:	Approximately 1.0 Million USD
Project locations:	Tinh Bien District, An Giang province



**Project 22:**

Date:	July 2004
Raised by:	Department of Agriculture and Rural Development of Ben Tre Province
Project Title:	Protection of bank erosion along the Giao Hoa river (from Cua Dai river to Balai river)
Development objective:	To protect agriculture production and people's living condition in Ben Tre province from threats of bank erosion along Giao Hoa river
Background and justification:	<ul style="list-style-type: none"> <li>– Bank erosion happens very often with Giao Hoa river (from Cua Dai river to Ba Lai river), threaten to agriculture production and people's living condition; and</li> <li>– Environment degradation become more seriously as consequence of bank erosion.</li> </ul>
Strategic relationship:	BDP Strategy, AIFP and EP programme Integrated planning for agriculture development in Mekong Delta in Vietnam
Priority:	High
Expected outputs:	Concreted contraction for river bank protection along the Giao Hoa river, from Cua Dai river to Ba Lai river.
Time frame:	2 years
Cost estimate:	Approximately 1.8 Million USD
Project locations:	Ben Tre province



## 6. Glossary

**Acid soils (or sulphur acid soils):** Soils that have been rendered acid due to formation of sulphuric acid by oxygenation of pyrite (natural iron sulphide, FeS<sub>2</sub>), often due to human interference (lowering of the groundwater table by drainage, or excavation of ponds for aquaculture). Such soils are unsuited for cultivation, effluents leaking from such areas can be poisonous to fish (because acid can dissolve aluminium), and the process can be practically irreversible.

**Alluvial:** Formed by river sediments. An alluvial river flows in a landscape formed by its own sediments.

**Analysis (of hydrological data):** Processing, involving a sometimes comprehensive transformation and interpretation, in order to arrive at some desired knowledge. Data analysis is often carried out stage-wise and in different contexts: On-line processing in the field, off-line processing, further synthesis for model input, etc. In general, data analysis involves both hidden and explicit assumptions about the relation between primary data and final results. (As one example, a flow rate in a river can be calculated assuming that the current measurements were made simultaneously, even if they took a whole day). Such assumptions can affect both the accuracy and the validity of the results. A suitable quality is supported by an adequate transparency of the analysis.

**Aquaculture:** Cultivation, aiming at commercial production, of aquatic plants or animals, such as fish, prawns, shellfish, etc.

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**Basic minimum needs:** These can comprise food and water, shelter, primary education, vital health care, and personal integrity.

**Biodiversity:** The number of species (of plant and animals) that actually live in an area (or biotope) where they belong. Agenda 21 (Chapter 17.7) states about coastal biodiversity: 'Coastal States, with the support of international organizations, upon request, should undertake measures to maintain biological diversity and productivity of marine species and habitats under national jurisdiction. Inter alia, these measures might include: surveys of marine biodiversity, inventories of endangered species and critical coastal and marine habitats; establishment and management of protected areas; and support of scientific research and dissemination of its results'.

**Brackish water:** A mixture of sea water and freshwater, found at places where inland waters discharge into the sea: River mouths, fjords, estuaries, lagoons, inland seas, etc. The salinity will be higher than nil, but lower than the ocean salinity of 35 PPT. Stratification is common in brackish areas, and the salinity will often vary highly, both in time and place.

**Catchment (or drainage area):** An area (delineated by a watershed) that drains through a specific river cross-section.

**Development objective (or overall objective, or development goal, or mission):** A desired future situation, which is supported by a plan (or programme or project) that is targeted towards it. The plan (or programme or project) cannot in itself assure achievement of the development objective - this is subject to a number of assumptions on related developments that are outside the control of the plan (or programme or project). Some authors recommend that only one development objective be applied from case to case, and that it be specified in time, space and quantity. See also immediate objective.

**Discharge:** Net flow or net sediment transport through a fixed cross-section of a river.

**Dispersion:** Mass transport determined by the transverse current velocity gradient and the concentration gradient (and always in the direction of the concentration gradient).

**Driving force:** A circumstance that has a major (positive or negative) influence on pursuance of a set of planning goals. It can be physical, climatic, economic, social or political, and can appear as a trend, a cycle, or an event. A driving force cannot be fully controlled by the participants in the planning process. It can be unpredictable, or not well understood, or even unknown.

**Dublin Principles (from International Conference of Water and the Environment, Dublin 1992):** (1) Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment; (2) water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels; (3) women play a central role in the provision, management and safeguarding of water; (4) water has an economic value in all its competing uses and should be recognized as an economic good.

**Ecological demand of stream flow:** The minimum stream flow required for prevention of irreversible ecological degradation. This value varies over the year and from one place to another. To maintain a healthy environment, the flow must be higher in the wet season than in the dry season, because many aquatic species have annual cycles that reflect their natural habitat. Sometimes, the water-level is critical, rather than the flow rate.

**Endemic:** Occurring only in one specific geographical area (for example one country, one river basin, or one island).

**Eutrophication:** Excessive supply of nutrients, resulting in a high primary production. Eutrophication can have negative ecological effects, such as large fluctuations of dissolved oxygen between night and day, or damage to benthic vegetation due to shading by algae.

**Flow:** Volume transport per time unit (for example through a cross-section of a river).

**Frequency:** Number of cycles (or units or events) per unit time.

**Gauging:** Measuring at a fixed point; a gauge is a measuring device (e.g. for water-level or pressure).

**Gross domestic product (GDP):** the total output of goods and services for final use produced by an economy, by both residents and non-residents, regardless of the allocation to domestic and foreign claims. It does not include deductions for depreciation of physical capital or depletion and degradation of natural resources.

**Immediate objective:** The intended situation that is achieved as the direct result of orderly implementation of a plan (or programme or project). The immediate objective is the result of a number of outputs, which, between them, are necessary and adequate for achieving the immediate objective. Some authors recommend a maximum of 3 immediate objectives, and that these are specified in time, space, quantity, and quality and target group. See also development objective.

**Integrated farming:** An area-intensive and labour-intensive combination of different parallel productions, like a fish pond, paddy, fruit trees, livestock, cash crops and vegetables. Integrated farming can give yields that highly exceed monoculture yields.

***Integrated Water Resources Management*** (as defined by Global Water Partnership): A process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

***Opportunity costs:*** The cost difference between one course of action and another (better) course of action. In a wider sense, the implications of one course of action are relative to alternative strategies. In development projects, the opportunity costs can reflect the time lag from when a new technology emerges and until it becomes available to the target group. There is often an opportunity cost related to doing nothing.

***Photosynthesis:*** The primary production (by plants, algae and some bacteria) of simple carbohydrates (such as sugar), normally from (inorganic) carbon dioxide, and using energy supplied by the sun.

***Phytoplankton:*** Photosynthetic aquatic micro organisms (algae).

***Pollutant:*** A compound that is harmful or otherwise undesired in the environment, either absolutely, or at an elevated concentration level. See also contaminant and xenobiotic compound.

***Pollution:*** Release to the environment of a substance that can harm it.

***Salinity (of sea water):*** Relative mass of the salt contents, given in PPT (parts per thousand) (kg per 1,000 kg), or in PSU (practical salinity units) (which is very nearly the same as PPT).

***Scenario:*** A hypothetical combination of events and physical conditions, describing a possible future situation.

***Sector planning:*** Planning for a specific source of income, like agriculture, fisheries, hydropower, industry, service, tourism, etc.

***Seepage:*** Slow movement of water in the ground, or from the ground to the surface.

***Stakeholder:*** A person, group or institution that has a particular interest in an activity, project, programme or policy. This includes both intended beneficiaries and intermediaries, winners and losers, and those involved in, or excluded from the decision-making process. A key stakeholder is one who can significantly influence or who is otherwise important to the success of the activity, project, programme or policy.

***Strategy:*** (1) A conceptual plan for how to reach a goal; (2) a plan, method or series of actions designed to achieve a specific goal or objective.

***Subsistence economy:*** An economy in which agricultural, hunting and other activities are undertaken primarily to meet household consumption requirements.

***Transparency (of a procedure):*** The insight conveyed to the data user about how the data were produced, for example for assessing the validity of the data for a given, possibly unforeseen, purpose. An acceptable transparency is obtained by documentation and can be supported by using standard procedures.

***Vector-borne disease:*** A disease transmitted by an organism (for example malaria).

***Water availability:*** The flow into an area from upstream, plus the (surface and groundwater) resources generated by net rainfall in the Sub-area, minus the ecological demand within the area and at its downstream boundary. The availability changes slowly, from one decade to the next, due to medium-term climate variations, or due construction of

reservoirs or diversions. The availability can be measured, and/or determined by numerical modelling, often with a high accuracy (subject to the coverage and quality of the basic hydrological data).

**Water demand:** The amount of water required for a given purpose, for example litre per person per day, or mm per crop. The demand can be present or future, and it can be actual (i.e. related to an available infrastructure) or potential (assuming full infrastructural development and no water shortage). The serviceable (part of the) demand is limited both by infrastructure and water availability.

**Water pricing:** A tool for management of water allocation between areas, sectors and individual users, assuming that an 'optimal' allocation (or just a sustainable allocation) can be determined on the basis of a water price that reflects the full costs (and hereby the full value) of water (for example, in economic theory, by charging the full costs and relying on free market mechanisms for allocation). Such a strategy can improve water efficiencies and reduce waste of water. It will often give preference to industrial allocations rather than irrigation. See valuation and cost of water.

**Watershed:** A line in the landscape (e.g. a ridge) that delineates a catchment. The surface runoff on each side of the watershed will proceed towards different locations.

**Wetland:** An area that is covered by water in at least a part of the year. A wetland can represent a special ecological habitat, sometimes with a high biodiversity, and can serve as a fish breeding ground. The Ramsar convention defines wetlands quite broadly as 'areas of marsh, fen, peat-land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including marine areas with a depth less than 6 m at low tide'.

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