

**Vietnam-Netherlands Water Partnership
On Water for Food and Ecosystems (WFE)**



FINAL REPORT
MAIN CASE-STUDY



**INTEGRATED AND SUSTAINABLE USE OF WATER
RESOURCES FOR MAINTAINING ECOSYSTEMS OF
XUAN THUY NATIONAL PARK**

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ABBREVIATION & ACRONYMS

APC	Agriculture Production Cooperative
CPC	Commune People's Committee
DARD	Department of Agriculture Rural Development (at Province)
DWRM	Department of Water Resources Management
ICD	International Cooperation Department
IMC	Irrigation Management Company
IUCN	The World Conservation Union
IWRM	Integrated Water Resources Management
HH	Household
MB	Management Board
MARD	Ministry of Agriculture and Rural Development
MCD	Centre for Marinelife Conservation and Community Development
MERC	Mangrove Ecosystem and Rural Development
MONRE	Ministry of Natural Resources and Environment
LVN	Netherlands Ministry of Agriculture, Nature and Food Quality
O&M	Operation and Maintenance
DPC	District People's Committee
PDS	Participatory Diagnostic Study
PPC	Province People's Committee
P/S	Pumping Station
TOR	Terms of Reference
VEPA	Vietnam Environment Protection Agency
VIWRR	Vietnam Institute of Water Resources Research
VND	Vietnamese Dong
XTNP	Xuan Thuy National Park
WFE	Water for food and ecosystems
WG	Working Group

Note:

Exchange rate \$1=16,500 VND

General information of the case study

Program	Viet Nam – Netherlands Water Partnership on Water for Food and Ecosystems (WFE)
Project name/ case study	Case-study #1: “Integrated and sustainable use of water resources for maintaining ecosystems of Xuan Thuy National Park ”
Donor	Ministry of Agriculture, Nature and Food Quality of the Netherlands (LNV), through IUCN (The World Conservation Union) in Vietnam
Line management agency	Ministry of Agriculture and Rural Development (MARD)/ICD
Project management agency:	IUCN (The World Conservation Union)
Project implementation agency	Vietnam Institute for Water Resource Research (VIWRR)
Project implementation site	Xuan Thuy National Park – Giao Thuy district in Nam Dinh province
Key partner institutions	<ul style="list-style-type: none"> • Institute of Hydrology and Meteorology • Management Boards of Xuan Thuy National Park • Vietnam Environmental Protection Agency (VEPA) • Department of Agriculture Rural Development (DARD), Nam Dinh
Project duration	5 months
Project tentative budget	USD 32,000 (From LNV) and USD 4,600 (From VIWRR)

Integrated and sustainable use of water resources for maintaining Ecosystems of Xuan Thuy National Park

I. INTRODUCTION

1.1. Background

This case study is designed to support the development of the Viet Nam – Netherlands Water Partnership on Water for Food and Ecosystems. The partnership is between Viet Nam's Ministry of Agriculture and Rural Development (MARD) and the Netherlands Ministry of Agriculture, Nature and Food Quality (LNV). IUCN has been asked to coordinate the Partnership development process, including through undertaking studies that will identify strategies for the management of water resources that balance agricultural production with the maintenance of the integrity of critical ecosystems that depend on adequate water flows.

It will build on the overall strategy of the global Water for Food and Ecosystems Programme, which seeks to promote an ecosystems approach to agricultural production and a productive services approach to ecosystems management. This will in turn provide a basis for ensuring more effective synergies between agriculture and ecosystems, the two largest water users, within an Integrated Water Resources Management (IWRM) framework.

The approach to the WFE Partnership will be to build a consensus on innovative approaches to balancing production and sustainability through developing the knowledge base and the involvement of key stakeholders in dialogue and discussion.

Case studies will be drawn from appropriate projects/programmes that have been or are being implemented throughout the country. The purpose of the case studies is to identify mechanisms through which main areas of water management, which are traditionally approached as single purpose management regimes, can be enhanced to become more integrated, multi-stakeholder based management systems_in which the original activity is maintained and improved and at the same time linked water-dependent activities are also taken into account in management decisions.

Water for food and ecosystems (WFE) form a specific sub-set of the broader IWRM approach. IWRM is concerned with a holistic integrated approach to water resources management, with a specific focus on coordinating and integrating the water demands and impacts (in and outflows) of the different sectors and stakeholders in a congruent IWRM management plan at the river basin scale. Special focus herein is given to match water demand of the multiple sectors and stakeholders with available supply at the river basin through integrated and multi-stakeholder coordination and management plans.

The specific aim of the WFE case-studies is to identify and develop innovative practices in water use and management for the agriculture and environment sectors that can: a) alleviate

the water demands and pressures in the river basin – especially for agriculture, while; b) securing an adequate level of (water) productivity. The focus is on how agricultural water use and productivity can become more environmental (and IWRM) friendly, while retaining required (economic) productivity; and co-exist and actively support ecological sustainability and/or rehabilitation. The explicit aim of the WFE approach is to develop alternatives to the traditional zero-sum trade-offs between agriculture, water supply, industry and environment that are typical for many IWRM scenarios, by fostering innovative approaches and practices in which agriculture and environment can co-exist while maintaining agriculture and ecological productivity and value.

The final report is carried out based on the contract signed between the IUCN and VIWRR on June 6th 2008. This report is also prepared with the results of case study in some survey and investigation data on status of water sources in Xuan Thuy National Park (XTNP) in phase 1 which VIWRR carried out in April 2008; the results gained from discussions in monthly meetings and workshops in IUCN and comments of domestic and international consultants.

1.2. The case study area (Xuan Thuy National Park)

Xuan Thuy National Park (XTNP) is located on the right side of Red River in Ba Lat estuary in Giao Thuy district, which are about 40 km from Nam Dinh city and 130 km from Hanoi (See Map). The area totals 7,100 ha, including Con Lu, Con Ngan and Con Xanh. The buffer zone in XTNP covers 8,000 ha, comprising of the remaining area of Con Ngan (from the field side of sea-dike to Vop river), area of Bai Trong and area of 5 communes (Giao Thien, Giao An, Giao Lac, Giao Xuan and Giao Hai)¹.

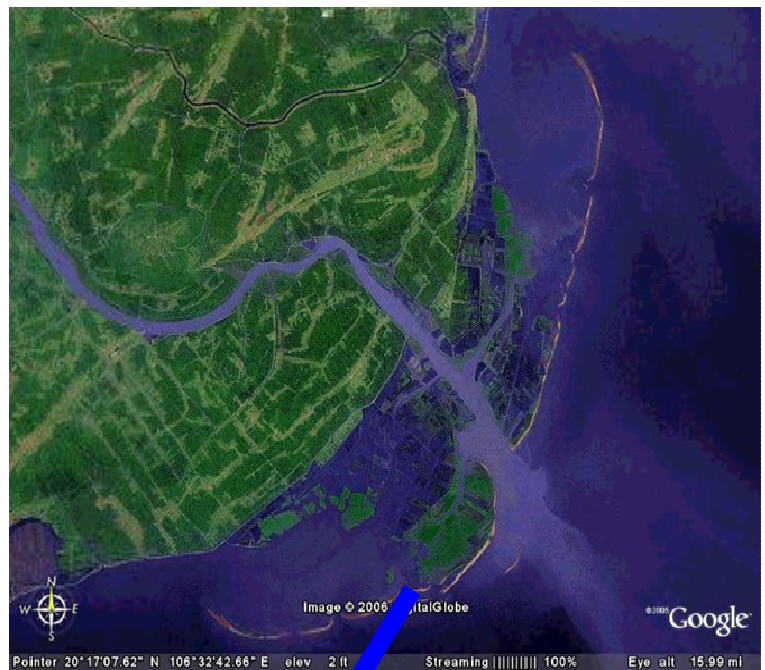
This is the river estuary in coastal plain with a large area of wetland, the most typical coastal ecosystem not only in Nam Dinh province but also in the North of Vietnam. This area is situated in the river estuary where the annual accumulation and sedimentation in the tidal mud flat is about some tens of meters on average. The coastal river alluvial plain provides habitats for precious marine products such as shrimps, grabs, fishes, areca, edible seaweed, and other species. Internationally, Xuan Thuy Park is an important bird ‘station’ to the international migratory birds, including Black-faced Spoonbill – a rare bird in the IUCN Red Book on threatened species.

In October 2004, UNESCO recognized Xuan Thuy Park as the most important zone of the biosphere reserve in the Red River Delta, and this confirms the international special position of the Xuan Thuy Park. Coming next is the buffer zone where the aquaculture and agricultural production mainly take place (*mainly concentrating in 5 communes in the buffer zone*), bring in high come for the local people, but this is also the potential reason for negative impacts to the environment and threatens the sustainable development of the national park. The unreasonable interference of human in agricultural production, aquaculture and fishing, and the principle on sedimentation in river flow in tidal region cause a great impact to the water regime and quality in the Xuan Thuy Park, affecting negatively to the balanced natural ecosystem in the region. Therefore, it is essential to have

¹ See annex 2

a rational adjustment via technical measures and managerial institution to ensure the sustainability of the ecological environment meanwhile to ensure the development of aquaculture, fishing and agricultural production to improve living conditions of the local people.

Location of Ba Lat estuary (Red River Mouth)



Map of Xuan Thuy National Park



1.3. Objective

Devise a water & natural resources management strategy for the Red Rive Estuary that is explicitly focused on:

- (i) Maintaining and fostering the ecosystem of the national park and reserve;
- (ii) Providing explicit services to food production systems (e.g. agriculture, fisheries, aquaculture a.o.) in and around the national reserves that are non-intrusive to the ecological integrity (i.e. ecological sustainable food systems);
- (iii) Reviewing environment issues in terms of water resources, of Xuan Thuy National Park

II. METHODOLOGY

2.1. *Collection and analyst of secondary data*

- Conduct on the basis of review of existing materials/ documents from ministries, programs and departments (MARD; MONRE; DWRM; Institute of Hydrology and Meteorology, Institute of Water Resources Planning; Management Boards of Xuan Thuy National Park and other data from statistic department at Nam Dinh) dealing with estuary and Red river basin study;
- Study and use effectively documents from IUCN, VEPA, MCD, MERC and others organization.
- Study and use effectively the outputs/ results of additional case study in estuary;

2.2. *Primary data: interview famers and local people in 5 communes*

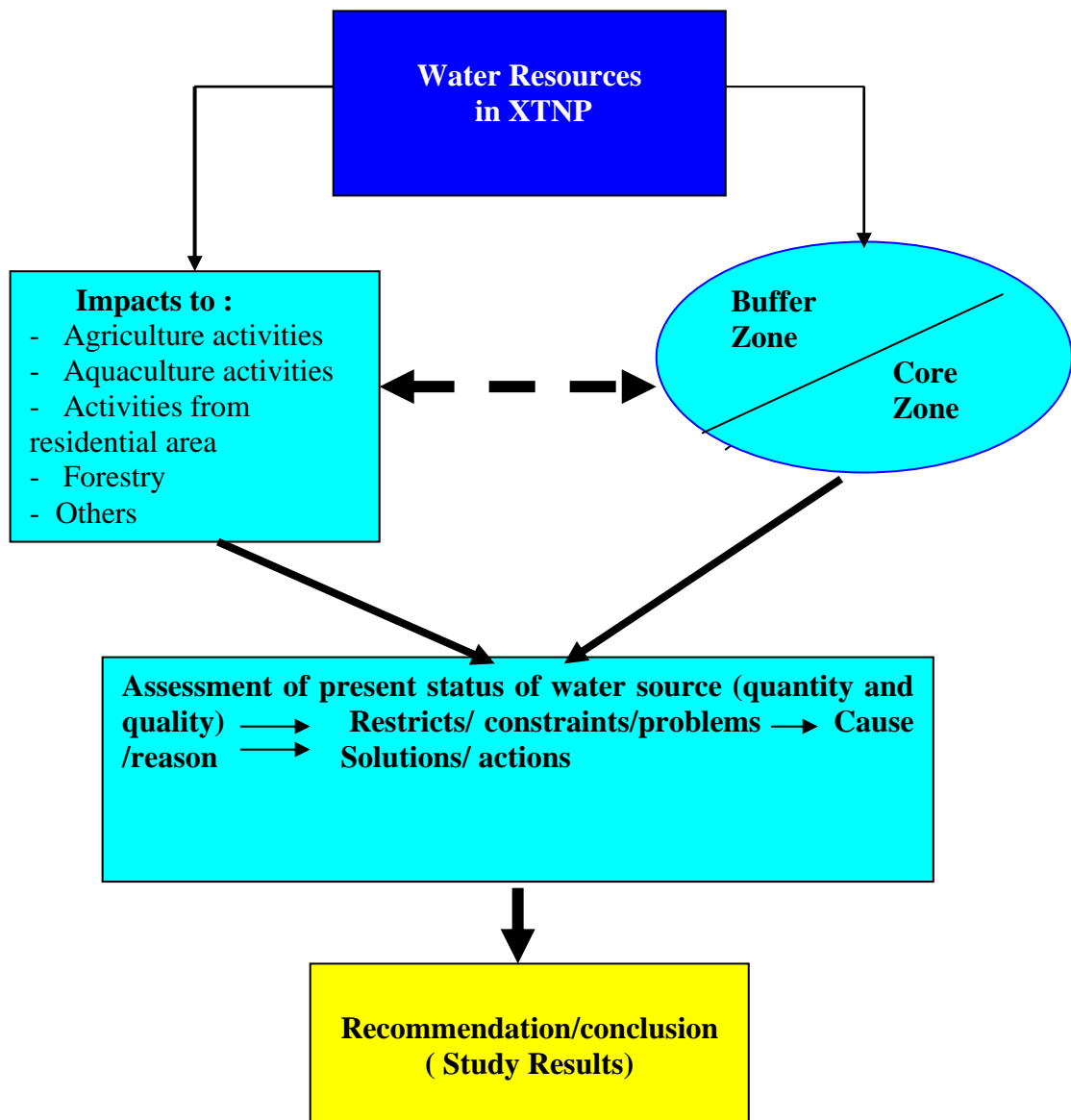
2.3. *Monitoring and analyzing water quality*

2.4. *Participatory Diagnostic Survey (PDS)*

The VIWRR experts and officials in Xuan Thuy National Park, officials in district in charge of irrigation and drainage, agriculture, aquaculture, environment and relevant parties in 5 communes in the buffer zone (Giao Thien, Giao An, Giao Lac, Giao Xuan and Giao Hai commune) are formed into two groups to carry out a field survey to evaluate states of water resources, hydraulic works, and environment in the core and buffer zone against the evaluation criteria and forms, questionnaires; and to propose solutions to improve water recourses, structures, environmental issues. Both the technical and institutional aspects were taken into consideration .

2.5. *Mini workshop/ round table discussion on outputs/ results study with Stakeholders/experts*

Flow Chart of the Study Process



III. RESEARCH RESULTS

3.1 *Natural characteristics of XTNP*

General characteristics

The tidal plain in coastal estuary in Giao Thuy district covers an area approximately 10,000 ha, comprising of: Bai Trong, Con Ngan, Con Lu & Con Xanh (or Con Mo).

The alluvium ground in Giao Thuy district has an averaged elevation of 0.5 – 0.9m, particularly in Con Lu, it may be up to 1.2 – 2.5 m. In general, the coastal plain in Giao Thuy slopes gradually from North towards the South, from East to West.

Terrain in tidal plain is divided by Vop River and Tra river into 4 sub-zones: Bai Trong, Con Ngan, Con Lu and Con Xanh.

- *Bai Trong*: Running from Ba Lat estuary to the end of Giao Xuan commune in a total length of 12 km, and averaged width of 1,500m. North part of Bai Trong is the national dike system (Ngu Han dike), and to the South is bounded by Vop river. Most of area in Bai Trong subzone is divided into plots, formed up with shrimp or crab and aquatic product farming plots. Bai Trong has an area of about 2,500 ha, of which 80 ha is alluvial plain and are planted the mangroves (RNM).

- *Con Ngan*: Con Ngan locates between Vop and Tra rivers with a total length up to average width about 2000 m. The remaining area of Con Ngan (in buffer zone) is also divided in checks or plots for aquaculture. The remaining area is bounded by Vanh Luoc dike and Tra river in the core of XTNP where mangrove forests exist with a part of shrimp farming swamp (close to the Red river) and a part of sandy dune in tail of Con Ngan which is being used by local people for extensive clam farming. Total natural area of Con Ngan approximately covers 2,000 ha.

- *Con Lu*: is almost in parallel with Con Ngan which is 12,000 m long and averaged 2,000 m wide. In eastern part and southeastern part of Con Lu, there is a high sand dune (1.2- 2.5 m) where is not affected by tide and the terrain slopes towards the Tra river. Except for the sand dune, the remaining area of Con Lu is in prone of free tidal affect, with developed mangrove forests. Con Lu has a total area of approximately 2,500 ha.

- *Con Mo* (or Con Xanh): is an alluvial deposition adjoining Con Lu in elevation range of 0.5 – 0.9 m. The area of plain at low tide is over 200 ha.

The core zone of XTNP comprises of Bai Trong, Con Ngan, all Con Lu and Con Xanh, with emerged land area in low-tide period totaling 3,100 ha and wetland area: 4,000 ha. The total natural area covers 7,100 ha.

Soil characteristics:

Soils in all Red river estuary in general are formed with silt and alluvia accumulated in entire Red river system.

Types of soils in XTNP are classified as below:

- Buffer zone: covers 8,000 ha; in which 1,407 ha: wetland, 6,593 ha: emerged land, 220 ha: sandy soils, 6,373 ha: silt and clay soils, mangrove forests: 1,724 ha, casuarinas forest: 6 ha (Details are in Table 1).

- Core zone: covers 7,100 ha, comprising of 3,100 ha of emerged land, 4,000 ha of wetlands. The core zone has 948 ha of sand and sandy soils, 2,152 ha of clay and silt soils, mangrove forests: 1,855 ha, 93 ha (Details are in Table 2).

Table 1: List of area of different types of soil in Buffer zone

Unit: ha

Type of soil Location	Frequently submerged land	Silt + clay soils			Sand and sandy soil			Total		
		Mangrove forest	Bare land	Total	Casuarina forest	Bare land	Total	With forests	Bare land	Total
5 communes in buffer zone	699.4		3,576.6	3,576.6					4,276.	4,276.0
Bai Trong	708.0	844.0	992.0	1836.0	6.0	214.0	220.0	850.0	1914.0	2764.0
Con Ngan		880.0	80.0	960.0				880.0	80.0	960.0
Total	1,407.4	1,724.0	4,648.6	6,372.6	6.0	214.0	220.0	1,730	6,270	8,000.0

Table 2: List of area of different types of soil in Core zone

Unit: ha

Type of land Location	Frequently submerged land and rivers, streams	Silt + clay soils			Sand and sandy soil			Total		
		Mangrove forest	Bare land	Total	Casuarina forest	Bare land	Total	With forests	Bare land	Total
Con Ngan	300	644	140	784		200	200	644	640	1,284
Con Lu	1,200	1,118	250	1,368	93	521	614	1,211	1,971	3,182
Con Mo	2,500					134	134		2634	2,634
Total	4,000	1,762	390	2,152	93	855	948	1,855	5,245	7,100

Source: Nam Dinh DARD, 2007

There area about 25 species adopting in submerged conditions and in swampy soils that create over 3,000 ha of mangrove forests.

Spreading over Con Lu is nearly 100 ha of casuarinas forest.

Characteristics of mangrove forests

In XTNP, there are representative types of mangrove forests in the region:

- *Monotype and mixed mangrove forests*: This is a quite popular mangrove forest, distributed from the middle till the end of Con Ngan and Con Lu, on an area of almost 2,000 ha. Initially, projects only planted one type of plant – *Kandelia candel* (L.) Druce, then they additionally planted other plants (Dang and Ban Chua). These plants grow quite fast, greenly and have a large coverage, however, the adaptability to severe weather conditions is less than other types of mangrove forests.

- *Naturally mixed mangrove forests*: This type of mangrove forests has a special important role in the region. These forests have a large coverage, large living mass and enable to adapt to severe natural conditions. This type of mangrove forests has most diversified composition and distributed focally in the start end of Con Lu and Con Ngan (in the strict-protection sub-zone of the National park) on a natural area of nearly 1,000 ha.

- *Mangrove forests in shrimp-farming lagoons*: This is a special type of mangrove forests. They exist because they have individuals and plants in mangrove forests of natural mangrove forests, adapt with frequently submerged living conditions in shrimp farming lagoons. Number of species, the coverage, and area are all lesser than other two types mentioned above (only about 500 ha, on the start end of Con Ngan). Main species of mangrove forests are Su, Ban Chua, O Ro (natural origin species of mangrove forests).

- *Casuarinas forests on sand dunes*:

On sand dunes along the coastal line in Con Lu, there are strips of casuarinas forests and other natural forest species. Casuarinas forests help stabilize the sand dunes and also are important habitats of indigenous bird species.

3.2. Characterization of the ecosystem and value of Xuan Thuy National Park

Bio-diversity

Vegetation and biotope

Species which reside alluvial areas and mangrove forests have highest bio-diversity. HTV of mangrove forest of Xuan Thuy National Park consists of statistical 192 species, belong to 145 genera of 60 families of vascular plants (Table 3). Xuan Thuy National Park includes various halophytic species which are allocated mainly in coastal areas of Tonkin plain.

Table 3 : Quantities of various species of plants in coastal salt-marsh forest of Giao Thuy district

Taxon	Family		Genus		Species	
	Quantity	%	Quantity	%	Quantity	%)
<i>Pteridophyta</i>	5	8.3	6	4.1	8	4.1
<i>Angiospermae</i>	55	91.6	139	95.9	184	95.8
<i>Dicotyledoneae</i>	47	78.3	110	75.9	135	70.3
<i>Monocotyledoneae</i>	8	13.3	29	20.0	49	25.5
Total	60	100	145	100	192	100

Source : Nguyen Hong et al. , 2004, supplementary figures of MERC

Plant species

Mangrove forest's plants comprise of woody plants, shrubs, lianas, herbaceous plants, aquatic plants, parasitic plants, semi-parasitic plants, stipe plants and underground stem plants. (Table 4)

Table 4. Forms of life of plants in Giao Thuy district

	Form of life	Species quantity	%
1	Woody plant	22	11.5
2	Shrub	23	12.0
3	Liana	15	7.8
4	herbaceous or underground stem plant	109	56.8
5	Succulents	4	2.0
6	Aquatic plant	7	3.6
7	Parasitic and semi-parasitic plants	2	1.0
8	Other forms : stipe and fern	10	5.2
	Total	192	100

Source : Nguyen Hong et al. , 2004, supplementary figures of MERC

Flora-diversity and mangrove forest area

Xuan Thuy mangrove forest has 8 communities which appear in buffer zone area and central area, each has some specific plant communities.

1. Littoral grass (*Sporobolus virginicus*) - *Scirpus kimsonensis* community
2. Glory Bower (*Clerodendron inerme*) – Coastal Cottonwood (*Hibicus tiliaceus*) - Milky mangrove (*Excoecaria agallocha*) community
3. Angel's Trumpet (*Datura metel*) – castor oil plant (*Ricinus communis*) community
4. Ironwood (*Casuarina equisetifolia*) - Variegated Vitex Shrub (*Vitex trifoliata*) community
5. Littoral Spinegrass (*Spinifex littoreus*) - tropical creeping vine (*Ipomoea pes-caprae*) community
6. paddle weed (*Halophila ovalis*) - *Halophila minor* – *Myriophyllum dicoccum* community
7. Sedge (*Cyperus malaccensis*) - tall reed (*Phragmites karka*) community in aquatic products pond
8. Mangrove forest community

Basically, Xuan Thuy National Park has two main types of community :

- *Aegiceras corniculatum* + *Sonneratia caseolaris* + *Avicennia mariana* + *Acanthus ilicifolius* community, which allocated in the north.
- *Kandelia obovata* - *Aegiceras corniculatum* community, allocated in the south.

Zooplankton and phytoplankton

Phytoplankton

Table 5. Composition of coastal phytoplankton in Giao Thuy district

		Class		Family		Genus		Species	
		n	%	n	%	n	%	n	%
1	<i>Eguenophyta</i>	1	16.67	1	5	1	2.32	1	0.89
2	<i>Chlorophyta</i>	1	16.67	2	10	3	6.97	4	3.57
3	<i>Pyrrophyta</i>	1	16.67	1	5	3	6.97	8	7.14
4	<i>Cyanophyta</i>	1	16.67	1	5	2	4.65	4	3.57
5	<i>Bacillariophyta</i>	2	33.32	15	75	34	79.10	95	84.82
	Total	6	100	20	100	43	100	112	100

Source : Vu Trung Tang, 2003; Le Xuan Tuan and Mai Sy Tuan, 2005

Zooplankton

As of surveys in 2004, 55 species of 40 genera found (Table 6).

Table 6. Composition of coastal zooplankton in Giao Thuy district.

		Class		Family		Genus		Species	
		n	%	n	%	n	%	n	%
1	<i>Copepoda</i>	2	28.57	18	62.07	23	57.50	38	69.09
2	<i>Cladocera</i>	1	14.29	6	20.69	7	17.50	6	10.90
3	<i>Cystoflagellata</i>	1	14.29	1	3.45	1	2.50	1	1.82
4	<i>Polychaeta</i>	1	14.29	1	3.45	1	2.50	1	1.82
5	<i>Amphipoda</i>	1	14.29	1	3.45	1	2.50	1	1.82
6	<i>Mollusca</i>	-				5	12.50	5	9.10
7	Other group	1	14.29	2	6.90	2	5.00	2	3.64
8	Total	7	100	29	100	40	100	55	100

Zoobenthos

Zoobenthos are quite diversified, includeing 154 species found (Do Van Nhuong and Hoang Ngoc Khac, 2004-2005). Mangrove forest's zoobenthos comprise of following groups : *anelida*, *ten-legs Crustacean*, *Gastropoda of Mollusca* and *Bivalvi*. In these families, the most diversified families are *Ocypodidae* with 26 species, accounts for 16.88 %, *Grapsidae* with 21 species, makes up 13.63 % of total species. The other families have fewer species, represent a little proportion.

Birds

Nature reserve is an important places of aquatic migratory birds (Le Dinh Thuy, 2004). According to preliminary research results of Birdlife International (2006), 219 species of 41 families of 13 classes are found in Xuan Thuy National Park (Table 7). Typical species of regional avian fauna are *Ciconiformes*, *Anseriformes*, *Charadriiforme*, *Passeriformes* and *Podicipediformes*.

Table 7. The species are listed in IUCN and Vietnamese Red list of Threatened Species (Anon, 2002)

TT	Scientific name	Common name	IUCN Red list	Vietnamese Red list
1	<i>Tringa guttifer</i>	Nordmann's greenshank	EN	
2	<i>Limnodromus semipalmatus</i>	Asian Dowitcher	NT	R
3	<i>Eurynorhynchus pygneus</i>	Spoon-billed sandpiper	EN	
4	<i>Vanellus cinereus</i>	Gray-headed Lapwing	LC	
5	<i>Larus saundersi</i>	Saunders's Gull	VU	R
6	<i>Egretta eulophotes</i>	Chinese Egret	VU	
7	<i>Threskiornis melanocephalus</i>	Black-headed Ibis	NT	
8	<i>Platalea minor</i>	Black-faced Spoonbill	EN	R
9	<i>Pelecanus philippensis</i>	Spot-billed Pelican	VU	R
10	<i>Mycteria leucocephala</i>	Painted Stork	NT	R
11	<i>Terpsiphone atrocaudata</i>	apanese Paradise-flycatcher	NT	

Note : IUCN 1996: EN (Endangered), VU (Vulnerable), NT (Near Threatened), Vietnamese 2000: R (Rare)

Source: Birdlife International, 2006.

Besides, mangrove forest has variety of other phyla as following :

- Insecta : 113 species of 50 families of 10 classes.
- Red river's estuarine fishes comprise of 161 species, 101 genus, 62 families, 16 classes.
- 37 species of amphibian and reptile with amphibian accounts for 13 species. There are 17 species which live in dry environment of outside area of dyke.

3.3. Changes in ecosystem and reasons

Changes in ecosystem can be divided in two main periods:

1. Before 1986: In this period, population was low and economic activities had not caused pressure to XTNP, so mangrove forests were not cut or destroyed (deposit areas outside the river, Trong sediment around the communes: Xuan Giao, Giao An, Giao Lac, all covered with mangrove forests), aquatic produce catching in buffer zone was not popular, birds were not hunted or trapped for food. In this period, code on mangrove forest management and exploitation was not yet issued.
2. After 1986 (when Vietnam turned its economy to the market economy), many changes have experienced in area of mangrove forests and biodiversity here, this mainly is resulted from the exploitation of resources, livelihoods, population pressure, and changes of policies. These affect greatly the mangrove forests and the national parks (Table 9).

3.4 *Some changes in utilization of XTNP resources*

1960 – 1964:	Mangrove forests were cut for growing sedges and reeds.
1960 – 1964: 1968:	Growing aquatic produces in the cooperative movement Mangrove forests were recovered and protected. Cutting plants for firewood and aquatic produce catching were not permitted but still happened.
1978 – 1979:	Mangrove forests were cut and destroyed for shrimp farming.
1970 – 1982:	Mangrove forests were cut extensively for growing sedges to make sedge mats for exporting
Since 1986:	A part of mangrove forests, deposits have been used for aquatic farming. Confronting the market demand and high price of shrimp, series of shrimp farming ponds have been built. Existing collective shrimp farming ponds were contracted publicly (usually with groups of family households).
Since 1990 1992-1997:	Farmers in movement of oyster farming developed fast. Mangrove afforesting which was financed by the Program 327 and the grant offered by Denmark Red Cross. In this period, exterminatory catching emerged.

3.5 *Main causes of declination of biodiversity*

- **Land reclamation and sea encroachment to extend cultivated land and to resettle**

Reclaiming land and encroaching towards the sea are main activities in the development history of coastal villages. As reported by the Chairman of Giao Thuy District, in the planning of Giao Thuy district, it is planned to build dikes and grow mangrove forests towards the sea in order to maintain the protection forests in some location (Phan Nguyen Hong and Quan Thi Quynh Dao, 2004);

- **Flow change**

In the XTNP there are two main rivers: Tra river and Vop river. These two rivers are important to remain the ecosystem of the National park, any change may affect the ecosystem. In 1986, one weir across Vop river was built in order to extend the shrimp farming area without taking into account a natural flow and eventually, water in downstream of Vop river becomes fresher because water from the Red river flowed in but was not circulated, so mangroves along the river died massively. Oyster farming area was also affected seriously. In 2001, the weir was destroyed and the natural flow of Vop river was recovered. However, its impacts to the mangrove ecosystem still exist.

In addition, unreasonable excavation of canals to convey fresh water into lagoons or ponds affects the living environment of birds in the core zone. When mangrove forests were cut to make shrimp farming ponds, many species of birds and reptiles disappeared.

- **Destroying mangrove forests to make shrimp farming ponds reduces the biodiversity**

Spontaneous movement on shrimp farming gradually encroaches the preservation area. According to the Research Center of Natural Resources and Environment in 2002, in 1986-1998 indicated that after 12 years the area of Xuan Thuy Ramsar reduced from 1,412.91 ha to only 402.95 ha (or 71.4% decrease), meanwhile, the area of shrimp farming ponds jumped from 415.27 ha to 2,743.6 ha (660.9% increase) in 1998. Newly planted mangrove forests in 1998 only covered 357.85 ha, making 5.83% total area of the national park. In addition, the area of rush and reed inside and outside ponds also increased dramatically, from 152 ha (1986) to 390 ha (1998), or 258.3%. These data show that it is essential to have measures to protect and develop the mangrove forests.

Losing mangrove forests means losing the habitat, reproductive area and nursery of many aquatic and terrain creatures. In places where mangrove forests are destroyed, the plant protection compositions accumulated in aquatic produces increases so many species grow slowly and abundance of aquatic produces die accordingly.

Chemicals from the semi-intensive and intensive shrimp farming farms used uncontrollably are washed by tide water from the inlands to river estuaries and canals into mangrove forests and destroy the nutrition process of the microorganisms. Consequently, many detritus feeding animals can not live and affect in chain other animals, and high-value aquatic produces in the mangrove forests are reduced.

- **Over-, exterminatory catching**

Catching aquatic produces with exterminatory methods, though reduces, still happens with some catching tools such as net, trap, electric attack, or toxic substance. The abundance of other aquatic produces such as *Panulirus*, *Haliotes*, *Chlamys*, *Logigo* also reduces.

In tidal areas in Giao Thuy district, on average, each day, hundreds of women and children catch aquatic produces. Catching high-value aquatic produces such as grabs, mature (even pre-mature) sergeant fish for sale still exists, this reduces such precious aquatic produces. The over-catching of aquatic produce reduces the quality and quantity of aquatic creatures, and changes significantly the structure of aquatic community.

- **Socioeconomic activities resulting in soil and water pollution in mangrove forests**

The increase of population and the development of industry and agriculture in processing increases the utility of natural resources and dispose many types of wastes to the environment, including toxic wastes. Mangrove forests in river estuaries and along coastal line have to bear wastes: domestic wastes, medical wastes, residues in agricultural production (pesticides, chemical fertilizers, etc.). Most of untreated industrial wastes are disposed into river estuaries. River estuaries are also places where ships and boats access to. Every year, wastes disposed into the Red river are up to 2,817 tons of Cu, 730 tons of Pb, 2,015 tons of Zinc, 448 tons of arsenic, 11,000 tons of Hg, 118 tons of cadimi, 24,602 tons of nitrate, etc. (Marine study program, National level, KT 03.07 – Ministry of Natural Resources and Environment, 2003).

Fishing boats and ships also dispose a great number of waste water, oils and grease, leaking oils during their operation. It is estimated that each fisherman disposes 0.5 kg of solid wastes into the sea and this amount of wastes shall increase per fishing ship, each fishing

ship usually has 4-5 fishermen. The anchored boats and ships also dispose about 200-300 kg of wastes per day (MoNRE, 2003).

Most of such untreated wastes are disposed directly to river estuaries and such toxic substances or chemicals containing high-content of organics are all harmful to aquatic creatures.

- **Bird and animal trapping, cattle grazing**

Wild bird and animal trapping is prohibited and reduces. However, due to economic profits, this illegal activity still exists.

Animals gather in a large amount (300 -500 buffaloes and goats) inside the core area (Con Lu) and this causes the disturbance to scenery and affects living habitats of water-birds.

- **Other reasons**

Introduction of Casuarin and Ngao Ben Tre (*Meretrix lyrata*) other than indigenous species into the local wetland may affect species, communities and ecosystem. Ramsar convention encourages the stakeholders formulating effective legal frameworks and program for preventing and minimizing the reproduction and raising intrusive species inside the wetland.

- **Protection of environment and biodiversity for the mangrove forests/ deposits, and institutional strengthening**

Controlling the environmental pollution and preserving the regional biodiversity is an important task of the national park. It is necessary to have supporting policies and strengthen appropriate institutions in order to prevent hunting and trapping water-birds, migrate birds, or using exterminatory methods to catch fish, that may affect the biodiversity in the region. It is essential to improve the effectiveness of law on environment protection and biodiversity protection in the region.

3.6 Hydrological condition assessment

Hydrological characteristics of the study area

Tide: Tide in this area is diurnal tide with 25 hour cycle and has great amplitude; the average amplitude is 150 – 180 cm. The maximum tide is 4.5m and the minimum is 0 m.

Hydrology: Water in the tidal mud flat of Giao Thuy district is supplied by the Red river. There are two main rivers in the tidal flat: Vop river and Tra river. Besides, there are many small canals which supply water naturally.

Vop river: 12 km long from Ba Lat estuary to Giao Hai sea. It is the baseline which separates Con Ngan and Bai Trong. In 1986, Vop dam divided Vop river in two parts: West and East Vop parts. Thus, there has been no water flow for many years, the Vop river bed near the Red river is silted fully. In 2002, Vop bridge was constructed but the water flow through Vop river is still small.

Tra river: flowing from Ba Lat estuary to the south and finally to the sea, joining the Vop river at Giao Hai sea, 12 km long. It is the boundary which separates Con Ngan and Con Lu. The middle part of the Tra river has been filled up (from Con Tan – Bai Nut to the end of Con Ngan) and the reason is the sea wave pushing the dune across Ba Mo area (Con Lu) and spreading over the mud flat (nearly 3 km in the middle of Tra river has been filled up).

Therefore, Tra river could only be passed by when the tide flooded over the mangrove. This is a restriction for the hydrological condition in this area and has the negative impact on the existence and development of many plants and animals in the end of Con Ngan and Con Lu.

Hydrological condition of Red river system

The Red river has total annual flow volume of water of 114,109 m³ and the silt flow is 115 millions ton/year. This flow has distributed to silt up the Red river Delta with the average speed forward to the sea is 17 - 83 m/year. In the flood season, the water flow accounts for 75 – 90 % of the total water and brings 90 % of the total silt in a year. Subsequently, the river delta is inundated, estuarine canals is silted and freshened. Conversely, in the dry season, the estuarine area is restricted. When the tide operates, it brings seawater through the rivers and canals penetrating deeply to the mainland, increasing the saline area (nearly 20 km backward to the mainland).

The salinity in this area varies much, depending mainly on the Red river flood regime and phase of hydrology. In winter, the average salinity is fairly homogeneous, about 28 – 30 ‰. In summer, the average salinity is lower than in the winter, about 20 – 27 ‰.

3.7 *Climate characteristics:*

- The tidal mud flat of Giao Thuy district locates in the tropical and monsoon climate area. Winter is from November to March in the next year. In early winter, the atmosphere is cold and dry and cool at the end. Summer is from May to September, the atmosphere is hot and wet, storms and tropical low pressures appear frequently.

- Total radiation is huge, about 95 - 105 Kcal/cm²/year. Total annual temperature is 8000 – 8500⁰c. The annual average temperature is 24⁰c, the amplitude is very big (the minimum: 6.8⁰c, the maximum: 40.1⁰c).

- The annual rainfall is 1,175 mm. The number of the rainy days in a year is 133. The highest rainfall in a year is 2,754 mm and the lowest is 978 mm.

- Wind condition: from October to March, the popular wind way is northeastern. In summer, it is southeastern. The average speed of wind is 4 – 6 m/s. In the stormy day, it can be even 40 – 50 m/s (The hugest storm was C with the wind level was 12th on 13/8/1968). Every year, there are approximately 3 – 5 storms, mainly in July, August, and September. The most special storm happened on 26/8/1973. Big rain and strong wind made a confined flood which divided Con Lu in two parts and led the Red river flow straight to the sea (the former Red river way, now the filled up Red river, flow to the tidal mud flat of the Tien Hai district – Thai Binh province). The geographic name, Con Vanh of Thai Binh province, has existed since then.

- Moisture: rather high, approximately 70 – 90 %. In October, November, and December, the moisture is low (always below 75 %). In February, March and April it is rather high (80 -90 %) with drizzle. The average evaporation is 86 -126 mm/month and maximum in July. The annual average evaporation is 817. 4 mm.

3.8 *Socioeconomic – livelihood characteristics*

Agricultural production

Agriculture is a key sector in the economic development structure in communes in buffer zone of XTNP with two main branches: cultivation and husbandry

Cultivation

Previously, due to monoculture of rice and less application of technical advances, the yield of crops was low. In the movement of change of agricultural pattern, production in the buffer zone has no longer had monoculture of rice or crops but introduced with other short-term cash crops and other fruit trees with higher economic values. This helps create more commodity goods, increase income sources and improve the spiritual and material life of local people.

So far, the area of rice cropping covers 2,598 ha, making up 85.7% of cultivated area, land for cash crops and other crops make up only 14.3% of cultivated area. The production converted in rice gains 27,966 tons/year, the averaged food gains 623 kg/person/year. Thus, the food security of communes in buffer zone is secured. This is an advantage for the cause of 'taking short to nurse long' in transiting the economic structure in the region.

Husbandry

Poultry and livestock rising has been paid attention to the increase of quantity and quality. On average, each HH has 3-4 pigs, 10-15 poultry in different types. Compared with previous years, piglet and poultry tend to increase faster, while cattle tend to reduce. In commune, various models on farming, industrial husbandry are extended and developed such as: models of super lean pig, super-egg laid duck, French goose, etc. which initially bring about significant economic benefits to household economic income gain. Other HHs mainly husband in salvage method so the production and effect are not high.

Husbandry in the buffer zone communes only contributes to improve daily living conditions, increase HH economy and produce manure for agricultural inputs. Currently, the veterinary network is very thin, and epidemics frequently happens such as: Foot and Mouth Disease-FMD (cattle), head beriberi and white faces disease in small pigs, barbone in poultry, etc. that restrict the growth rate of cattle and poultry in the region.

Aquaculture

All communes in buffer zone have activities in aquaculture, natural catching and services, among these, aquaculture makes up 51.5%, and natural catching makes up 48.5%. Some communes have established the aquatic product exploitation and processing cooperatives such as in Giao Hai and Giao Thien communes.

Mollusca farming in Giao Lac, Giao Xuan and Giao Hai communes develop fasts with nearly 500 ha in sandy plains in ends on Con Lu, Con Ngan, and gains dozens of billion Vietnam dong. However, this is only the spontaneous, extensive, and uncertain aquaculture, so the sustainability is not reliable.

Shrimp farming in shrimp farming swamps in the region, recently, has gained not good results because the farming environment is polluted, natural aquatic products are decreased due to over-catching and gradually exhausted in community. On average, farming on one

hectare only yields just above 100 kg shrimp/year, and averaged income is less than 10 million VND/ha/year.

Services and aquatic processing are quite new and in small size, they are not yet responsive to the huge potential of marine economic sector in the region.

The rate of labour in agricultural sector in the project area is 75% on average (March 2007). In accordance with the statistic data provided by the Agriculture Division of Giao Thuy district about the rate in different sectors as hat: cultivation: 40%, husbandry (cattle and poultry): 10%, marine economy: 36%, and other jobs: 14%. Therefore, the marine economy makes up a large proportion and is also one of reasons explaining why marine economic activities cause great pressure on the National Park. In addition, hundreds of farmers only use 1/3 of time for agricultural activities, and the remaining time is free so the unemployment proportion in the rural area in the National park is quite high.

Economic and income generation activities

The income of local people in Giao Thuy district depends on main activities: cultivation, husbandry, aquatic farming (catching/ harvesting and farming); industry (salt making); services and tourism. As reported by Giao Thuy DPC, agricultural production in farm-style, fishery and forestry are main activities, making up 50% of total production values. In the 3 main activities, fishery makes up 23-35% and shall constantly increase in 2002-2007.

Cultivated area is mainly for two-rice cropping with averaged yield of 5.7 tons/ha in winter rice and 5.1 tons / ha in summer rice. The cultivated area on average is very low. Therefore, though the yield is high, and the income from husbandry is also not low but the income from pure agriculture is not sufficient for farmers and this is one of reasons that thousands of people pour in the buffer zone to catch aquatic produces, cause disturbances and affect the ecosystem in XTNP.

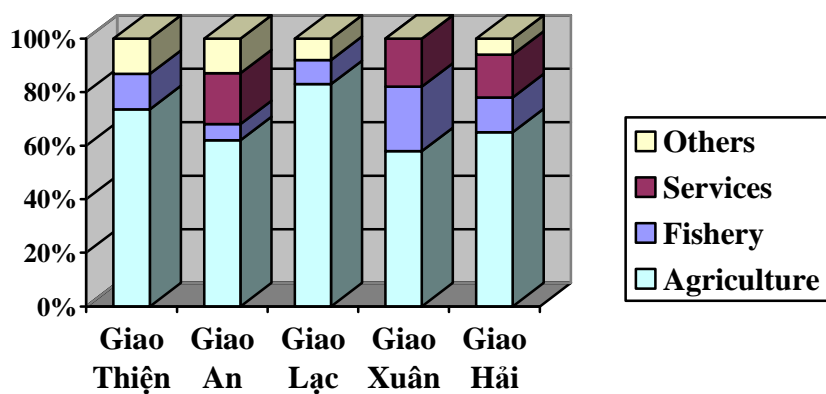
In addition, land for aquaculture was allocated more in 2007, the area of extensive shrimp farming is about 2,000 ha, and the area for oyster farming is about 300 ha. These models create more jobs and significant incomes to the local communities.

As reckoned by the Fishery Division, in 1997, the district had 295 ha for oyster farming. This area increased about 650 ha in 2005, i.e. 2.2 times higher.

Among 400 ha out of 650 ha of oyster farming is in the preservation area in the buffer zone of Xuan Thuy National Park. About 20.2% of Xuan Thuy population invests in aquaculture, particularly in oyster farming. On average, the area of one oyster farming plot is about 1.7 ha, and yield is about 10-15 ton/ha.

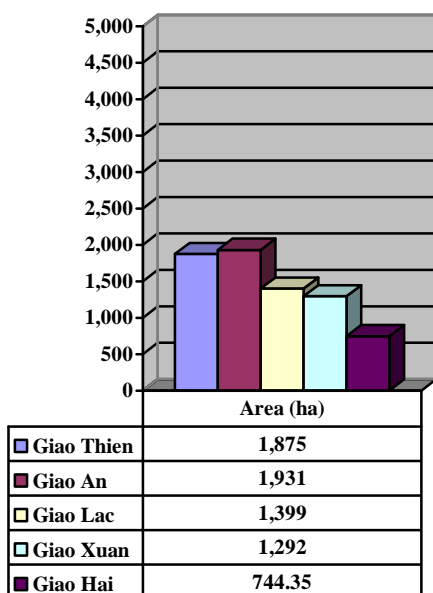
Various sources contribute to income of family households. Mangrove forests contribute up to 51% of income of a better-off household and 35% of a well-off household. Only 20% of income from poor household comes from one source. Poor households depend on the traditional economic activities such as cultivation and husbandry. Due to the lack of resources such as fund or land, individuals in poor households have to live on their own labor and labor force contributes a great part in their income (making up 21.8% of total income).

Chart presenting the job structure of communes in the buffer zone in XTNP

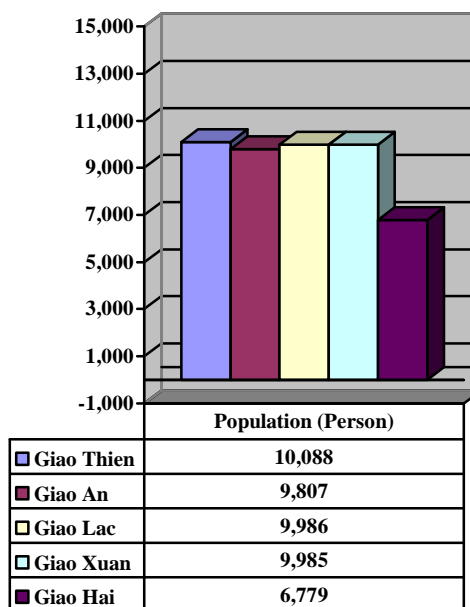


Source: Socioeconomic report MCD

Area of 5 communes in the buffer zone



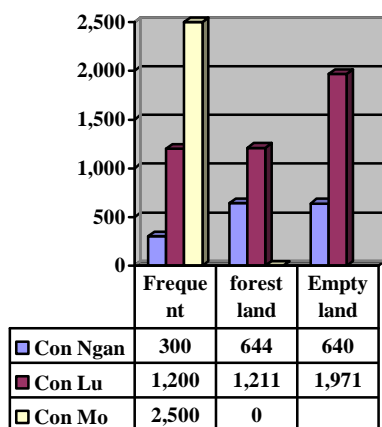
Population of 5 communes in the buffer zone



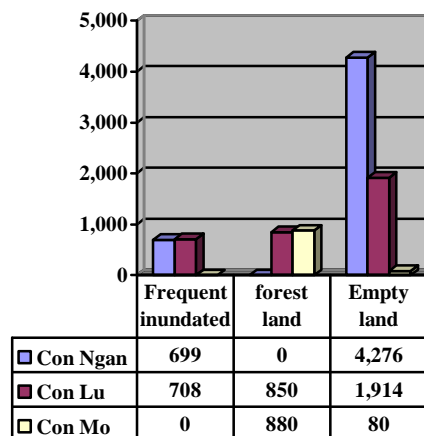
Sources: Giao Thuy Agriculture Department

Land utilization

Comparative area of some kinds of land in the core zone (Unit:ha)

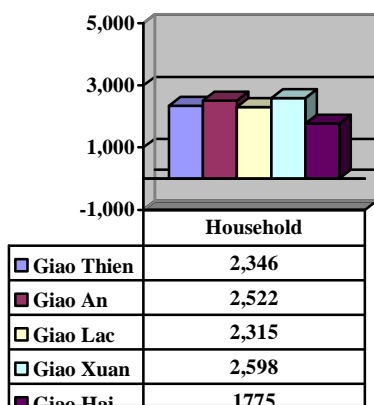


Comparative area of some kinds of land in the buffer zone (Unit:ha)

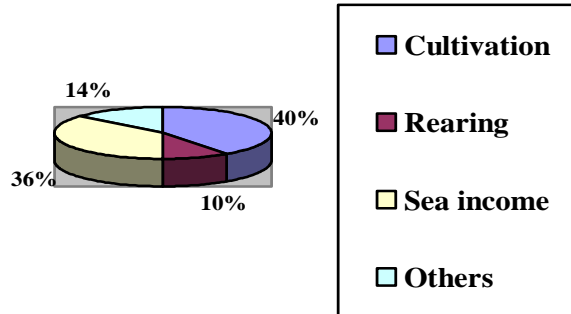


Sources: DARD of Nam Dinh Province

Total households of 5 communes in the buffer zone



Structure of income of 5 communes in the buffer zone



Sources: Giao Thuy Agriculture Department

Sources: Giao Thuy Agriculture Department

Table 8 **Average Income per HH**

Income	Giao Hai Commune		Giao Xuan Commune		Giao Lac Commune		Giao An Commune		Giao Thien Commune	
1.Cultivation	2,379,167	26%	1,266,667	16%	1,955,735	19%	1,186,301	18%	1,972,000	20%
2. Husbandry	1,790,021	20%	1,313,333	17%	4,264,154	41%	753,425	12%	2,361,900	24%
3. marine economy	3,210,123	35%	1,753,333	23%	2,507,692	24%	2,164,384	34%	2,482,200	26%
4. Others	1,800,311	9%	3,413,333	44%	1,784,615	17%	2,339,726	36%	2,887,120	30%
Total	9,179,622		7,746,667		10,512,197		6,443,836		9,703,220	

Nguồn : Household Survey July, 2008

3.9 *Assessment and analysis of the current WFE and IWRM pressures at play*

General assessment on the impacts of upstream water use to the downstream area of Red River delta and to the environment river estuary and coastal zone as well as the impacts to the erosion, saline intrusion, flood and eco-environment at river estuary:

Vietnam is on the trend of fast development, and this development strongly affects to the utilization of resources, particularly land and water resources. In late 1980s, the Government introduced economic reform policies, moved the country from a centralized economy to a market-based economy. Since then, the agricultural productivity, industrial growth rate, and other sectors all increased, provided a strong base for a sustainable economic development. Deriving from this development, in the coming decades, Vietnam probably shifts the agriculture-based society to a more urbanized and industrialized society. Therefore, water resources will probably be managed more effectively otherwise they may restrict the expected development, misbalance ecosystems, and result in severe floods and pollution. It is likely to improve such negative impacts because the population keeps increasing and pressures of climate change possibly become worse.

Taking into account the study on impacts to water resources, it will be a mistake if only the upstream or downstream is focused on. In current trend, the integrated use approach is applied in any study and more concern is prioritized to the environmental and ecosystem protection aspects. The study on Red river basin is also in this case.

Water resource in the Red river is a complicated issue because (i) water is abundant in rainy season but it goes with floods, i.e. a pressing problem in the last centuries. In contrast, water becomes rare in dry season due to increasing consumption of the cities and other economic industries in the basin; (ii) the quality of water source is reduced because the physical conditions of river basin becomes worse, sediment in river increases while the urbanization and industrialization increases quickly, so water sources, both surface and groundwater, are polluted. The reclamation of wetlands for agricultural use in downstream results in increasing acid sulfuric concentration in water sources and over-use of fresh water causes

further encroachment of saline water into the inland; the water management in the market-based economy is a real challenge to managers.

The Red river basin, one of the 9 main river basins in Vietnam. In the catchment in tropical and subtropical regions, the weather is affected with the southeast monsoon, rainfall varies from 1,200mm to 4,800 mm. This difference is lower than the averaged rainfall, i.e. 1,700mm. However, the weather difference in season remains widely. Only 10% of rainfall happens from November to March, i.e. the dry season of the catchment. May to September falls in the rainy season. Dissimilarly to other catchments, the annual mean temperature in the Red river basin differs more.

The inflow of the Red river estimates about 115 to 137 billion m³. About 40 % of the inflow originates from China. This is the largest basin in Vietnam in terms of area, making up 16% of the total water volume in Vietnam, and the second largest basin but Mekong river basin. ?? The population in the basin make up 1/3 of total national population, and about 15% of population live in urban areas. The averaged population density is 280 persons per 1km², one of most populated rural areas in the world.

In upstream, Hoa Binh reservoir plays a key role in regulating the low flow, particularly in January to March every year. Water from the Red river supplies various demands in downstream, but the agricultural supply makes up 95%. In downstream, Ba Lat estuary with coastal wetlands play a very important role in controlling saline intrusion, retaining freshwater, preventing sunlight radiating directly to land so land is not alkalized, such as in Thai Binh and Nam Dinh provinces. Particularly, in downstream, Xuan Thuy coastal national park is recognized as a RAMSAR reservation in Vietnam.

To construct a dam for water storage may create not only a huge benefits but also a lot of negative impacts for both its catchments and river mouth area.

Every year, a very large amount of suspended, bottom rolling and diluted materials have been pursued to the coastal line.

The sudden losses of large amount of fresh water, sedimentation and nutrition to the coastal zone may result a lot of problems such as: shoreline erosion, saline intrusion, changes of hydrological regime, loss of resident and breeding areas of marine animal and vegetation, nutrient deterioration and reduction of productive potential of coastal zone. Consequently, that leads to the losses of bio-diversity and benefit from aquaculture production.

In Vietnam, the impact assessment of dams to the environment of reservoirs and their upstream and downstream has been paid with a lot of attentions but their impacts on river estuaries and coastal zones is in advert direction.

Since 1975, many big reservoirs have been built. Most of them are multi purpose projects beside the purpose of flood control and hydro-power generation. The biggest project is Hoa Binh Dam which was started in 1979 and fully put in operation in 1989. Its maximum storage capacity is 9.5×10^9 m³ in which 5.6×10^9 m³ is regular operating storage. It in one hand generates 7.8×10^9 kWh annually equivalent to 40% of total national electricity production and in the other hand reduces flood water level in downstream river. Beside that,

the reservoir can also provide some additional functions such as: water supply for drinking and irrigation in dry season, navigation, pollution prevention, salinity control.

To the reservoirs which are mainly used for irrigation and those uncontrollable outside of Vietnam boundary, the changes of seasonal flow distribution due to reservoir operation create the big changes in eco-environment at river estuary and coastal zone especially the saline intrusion in dry season.

The storage of the hydropower reservoirs is considered not big enough while the volume of sediment deposit is really high. In case of Hoa Binh reservoir, it has the sediment deposit of 50×10^6 tones/year but the sediment transport of Da River in many year has been 53×10^6 tones/year. This factor is concerning the increase of river bank erosion in Red River delta although in last 10 year the number of storm has been less than before. The evident for this problem can be seen when comparing indicators in 2 periods from 1965 to 1990 and from 1991 to 2000. The erosion speed on over 20km long in average increases from 8.6m/year to 14.5m/year and the eroded area from 17ha/year to 25ha/year.

Although no quantitative full survey and evaluation has been carried out but it is clear that the insufficient sediment bearing transported from inland to the sea due to the deposit in reservoirs is one of the main reason of serious bank erosion in both spatial and intensity extents.

Hoa Binh reservoir can delay and reduce the peak flood water levels but that keeps high water level in the river in long period. This may lead to the saturation, instability of dike system and high consequence of dike break. As flood water is kept at the reservoirs, maximum flow at river estuaries is reduced and leading to the fast formation of dunes that rises up the river bed (as it happens at Day river mouth). Thus, potential risk of flood and dike break will be high.

The impacts on aquaculture

According to the records from former Ministry of Fishery (1996), Hoa Binh dam caused the lost of river alluvial ground and block the migration way for breeding of many high value fish categories living in the sea such as sardine, hilsa herring. It also causes the lost of 500 millions of small young fish, 50% of reserve of mix water shrimp, crab and fish in shallow sea. The exploitation yield of hilsa herring fish from Red river, Balat and Bach Dang estuaries in 1962 to 1964 was 8-15 tones/year but non harvestable these day. The same situation to the sardine fish was 40-356 tones/year in period of 1964-1979 but now is zero. The shrimp yield at the time being is only 50% of that before the completion of Hoa Binh reservoir.

The impacts on drought in Red River delta and solutions

Red River rises from China with its catchment area of 169,000 km², of which 86,680 km² is inside Vietnam boundary including 26 provinces in Red river delta. Thousands of irrigation systems have been constructed in its catchment that provide irrigation water for 620,00 ha of spring paddy field, 730,000ha of summer paddy field and some 10,000ha of upland crop, vegetable, industrial plant, fruit trees. Beside that, these systems also provide the drainage service and flood control for protecting a large area of cultivated land, industrial zones and urban areas.

With these irrigation systems, hundreds thousand hectares of single crop can be shifted to double or triple crops a year with increasing crop yield from year to year.

Although the Red river has a very huge flow volume (around 135 billions m³/year) but temporally unevenly distributed during the year. The discharge distributed in dry season (7-9 months) is only 20%-30% of total annual discharge. Particularly, in recent years, the drought occurrence becomes more and more seriously in the catchment. In 2003, rainy season was finished earlier than usual that led to the shortage of 10-30% when compared to the average annual rainfall. Consequently, from September 2003 to March 2004 in many areas, the shortage of irrigation was from 100 to 300mm. The dry weather in a long period caused the high rate of evaporation and the river flow was 10 to 20% less than average annual flow. In year 2004, rainy season was finished earlier 1-2 month than usual with the rainfall deficit in 10 months was 30% less than average annual rainfall.

In dry season of 2005-2006, Hoa Binh reservoir stored water to the normal working level at 117m above mean sea level and that was 58.05m of Thac Ba reservoir. Even though, in February 2006 no water was released from Hoa Binh and Thac ba reservoirs. As the result, water level of the further downstream of Red river was very low.

The causes of continuous drought in Red river catchment in recent years:

- The complicate changes of weather with the delay start and early finish of rainy season that lead to the reduction of rainfall in its catchment in comparing to the average annual rainfall resulting high rate of evaporation in dry weather condition.
- The increase of population rate in accordant with fast economic development making the complicate activities of water use while the development of water resources is still far behind with insufficient irrigation system for balancing water use between dry and wet seasons. Most of irrigation systems which were constructed and put in operation for a long time are now deteriorated and can not satisfy the water demand for the time being.
- Water regulation of big reservoirs (Hoa Binh and Thac Ba) in some periods of dry season have not been suitable to the water demand of downstream areas.
- Water resources forecast, especially for long term, has been limited that causes difficulties for evaluation and planning water use in dry season.
- Another problem taken in to account is the water access ability of some irrigation systems at upstream of Thao river and of the others in China that lead to the reduction of river flow into Vietnam boundary in dry season.
- Too much over exploitation of protective forest in upstream catchment (the forest coverage in Son La and Lai Chau provinces was reported with 30% remain);
- Climate changes and as well the effects from international upstream water resources.

Management solutions to the downstream area in common.

- Strengthening the executive board to ensure the effective drought prevention, minimizing the saline intrusion at downstream area.
- Evaluating and balancing the water resources in river system, streams, lakes and ponds;
- Verifying the irrigation schedules of each existing irrigation system and producing flexible, reasonable and saving water use plan.
- Improving the coordination between agriculture and electric agencies. The operation of the reservoirs will be based on the predictive meteo-hydrological data in combination with high tide in order to maximize the storage capacity in reservoirs, lakes, ponds and on the field.
- Verifying and evaluation the irrigation systems, dredging and clearing the canal bed, checking the power supply for permanent and temporary pumping stations;

- Changing the cropping pattern to up-land crops that consume less water but maintaining the effective agriculture production.
- Organizing the activities for communication, dissemination and guide to mobilize local people in participatory drought reduction.

To the XTNP:

Establishing the monitoring system of water regime and environment:

The permanent monitoring:

The water monitoring system in NR will be including some water level monitoring stations and periodict water sampling locations. Based on the existing conditions of topographic, physical facilitiesstructures and management ability, in Xuan Thuy NR flowing permanent monitoring system can be proposed:

- + Station T1: Located near Con Ngan Monitoring Station
- + Station T2: Located near Cai De Sluice
- + Station T3: Located near Vop Bridge;

Recording schedule: once a day at 7.00 am. The record book must be in pre-printed form for all station. The formal national elevation (at Dau island) will be transferred to the level “0” at water staff gauge which is fixed to the benchmark on top of the sluice for verification when needed.

10 fixed locations for water sampling are selected (see Tabe 7 – Water sampling locations). Water samples will be taken once a month at mid time of the month and after the pesticide is sprayed in agriculture areas (inside dike protection);

Person in charge

It is recommended for 3 staff of water level monitoring station in charge of water level monitoring, recording and water sampling. Daily report will be submitted to technical staff for any problem to be solved. Water sample taken every month will also be given to responsible technical staff.

The technical staff, who is specified on hydrology, takes the duty of seting up the permanent monitoring system and provides the professional guideline for other staff of stations. He or she will take the water samples for analysis as well as report the Director of NR on evaluation and propose the measures for water quality management.

3.10 Status of water resources in Xuan Thuy National Park

Irrigation system for agriculture in 5 communes in buffer zone

Irrigation system of 5 communes in buffer zone is fed from Red River via 8 intakes. Then water is transferred through canals to irrigate all fields in 5 communes (See table 9).

Table 9: Irrigation system in 5 communes in buffer zone

No	Name of irrigation sluice	Commune	Distance from the sea	Dimension (B x H)m	Command area (ha)
1	Ha Mieu 1	Xuan Thanh	26 km	4x6.3	1700
2	Ha Mieu 2	Xuan Thanh	25 km	10x6.6	4000
3	Cat Xuyen	Xuan Thanh	23 km	3.3x6.7	900
4	Lieu Dong	Xuan Tan	22 km	2.6x3.6	150
5	Cong Tai	Xuan Tan	20 km	4x4.8	700
6	Ngo Dong	Xuan Phu	17 km	10x5.7	3000
7	Con Nhat	ND town	15 km	8x6	1700
8	Con Nam	Hong Thuan	8 km	4 x5.7	1300

Among 7 irrigation sluices mentioned above, only Ngo Dong and Con Nhat sluices irrigate directly for 5 communes in buffer zone with quite high irrigation capacity (approximately 4,700 ha) and other 5 sluices mainly irrigate for other communes: Xuan Thanh, Xuan Phong, Xuan Phuong, etc. Only a small irrigation flow is irrigated for 5 communes in buffer zone.

In winter-spring crop, this region is affected with quite severely saline intrusion. On average, the saline affected area is about 20 km long with concentration of 2 ppt. In peak period: 2nd and 3rd months of lunar calendar, the saline water may encroach up to 30km inland². According to MARD Standard, when rice is newly transplanted, irrigation water for rice has maximum concentration of salinity up to 1 ppt and when rice grows up, the maximum concentration of salinity can be 1.5-2 ppt. However, as regulated by Xuan Thuy IDMC (which manages primary, secondary irrigation and drainage sluices in Xuan Truong, Giao Thuy districts) the irrigation sluice can only be opened when the saline concentration is about 0.8 ppt. Thus, in seasonal crop (winter-spring crop), both Ngo Dong and Con Nhat sluices are closed. Water for agricultural irrigation is mainly transferred from Ha Mieu 1 and 2 sluices.

² Reported by IDMC

Drainage system for agriculture in 5 communes in buffer zone.

Drainage sluices in 5 communes in buffer zone all locate under the sea dike and drain to the buffer zone outside the dike system of XTNP. This system has 7 main drainage sluices, namely: Moc Giang sluice (under Red river dike), Hoanh Dong drain, drain No.10, Hoanh Lo sluice (built in French time) – this sluice is mainly to supply water for inhabitants living outside the sea dike system, Dai Dong sluice, Cai De sluice and sluice No.9. The main technical parameters of these drainage sluices are presented in Table 6 below.

Table 10: Drainage sluices for agriculture in 5 communes in buffer zone

No.	Name of drainage sluice	Drainage area	Drained area (Ha)	Dimension (B x h)m
1	Moc Giang	Giao Huong Giao Thien	800	4x6.5
2	Hoanh Dong	Giao Thien	900	4x6.7
3	No. 10	Giao An	800	4x5.9
4	Hoanh Lo	Giao An	150	1.2x1.37
5	Dai Dong	Giao Lac	864	4x6.3
6	Cai De	Giao Xuan Giao Hai	1,400	5x3.5
7	No. 9	Giao Long Giao Hai	2,000	8x6.2

5 out of 7 drainage sluices drain for 5 communes in buffer zone: Giao Thien, Giao An, Giao Lac, Giao Xuan and Giao Hai, namely: Hoanh Dong, No. 10, Hoanh Lo, Dai Dong and Cai De drainage sluices. All these 5 drainage sluices, in addition to drain water for communes in the buffer zone, they also drain for other communes in upstream such as Giao Thanh, Giao Nhan, Giao Ha, Giao Huong, etc. (communes in the eastern part of Giao Thuy district) through the dual irrigation and drainage canals: Con Nhat, Con Nam, Dong Binh, etc.

Among 7 drainage sluices in Table 10, only Moc Giang sluice drains to the Red river about 6 km from Ba Lat estuary. Other sluices drain directly to the buffer zone outside the dike of XTNP. Drainage sluices: Hoang Dong, No.10, Dai Dong drain directly to Vop river, Cai De, No. 9 drainage sluices drain directly to the sea at the end of the National Park. Therefore, the buffer zone and core zone of XTNP will be affected significantly by these waste water sources.

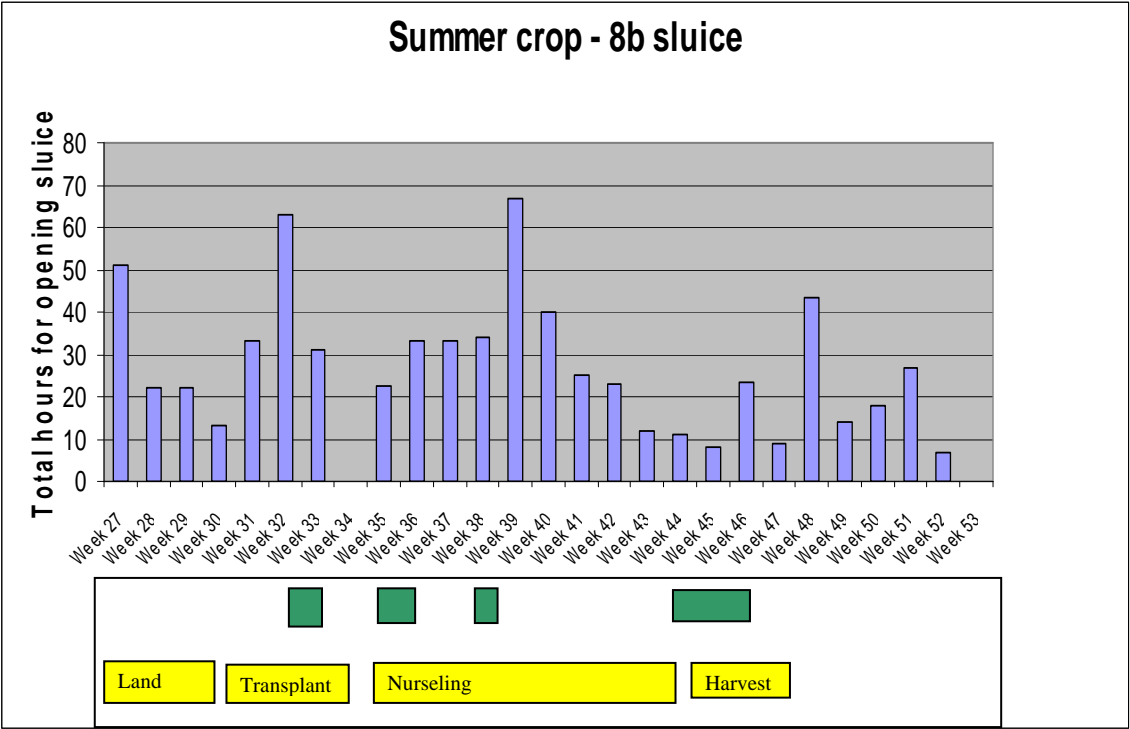
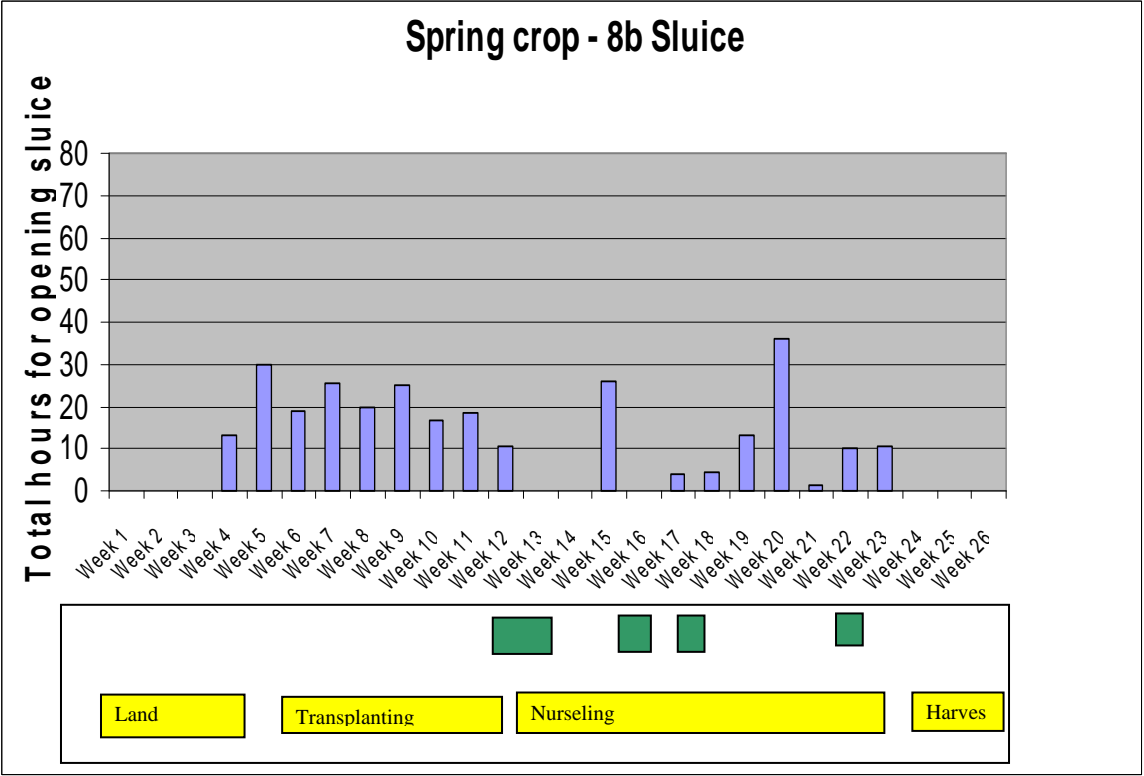
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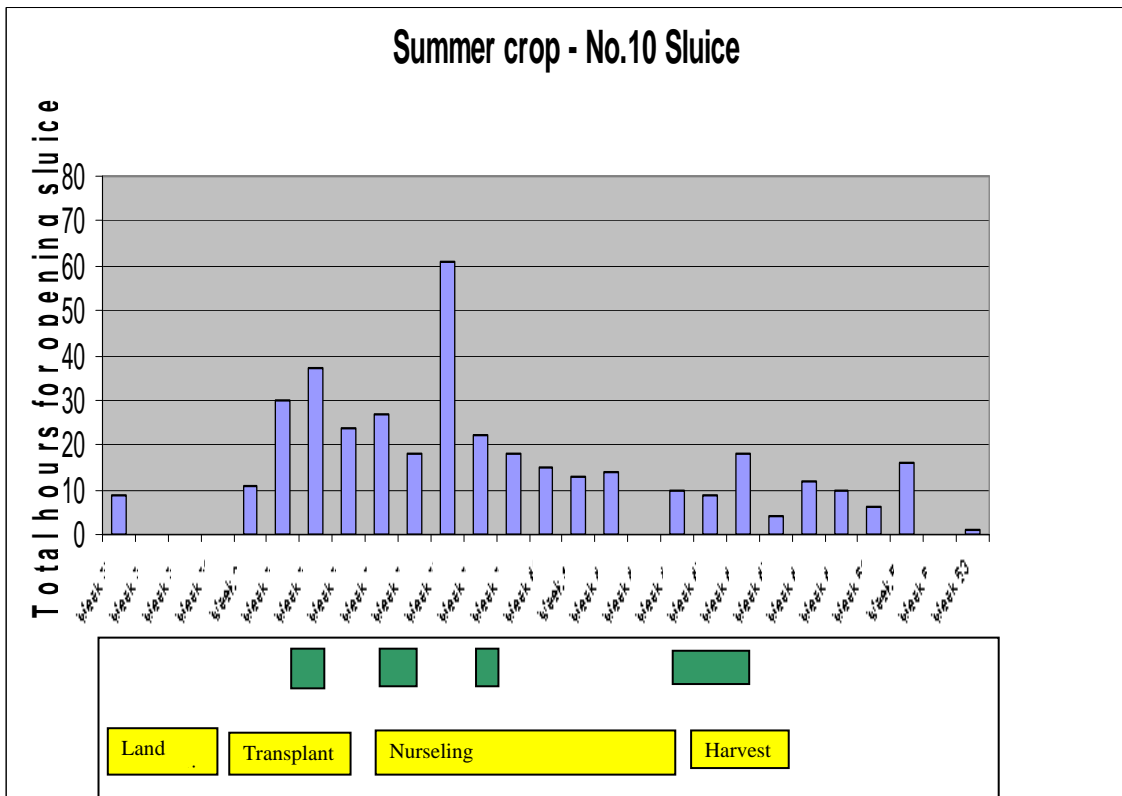
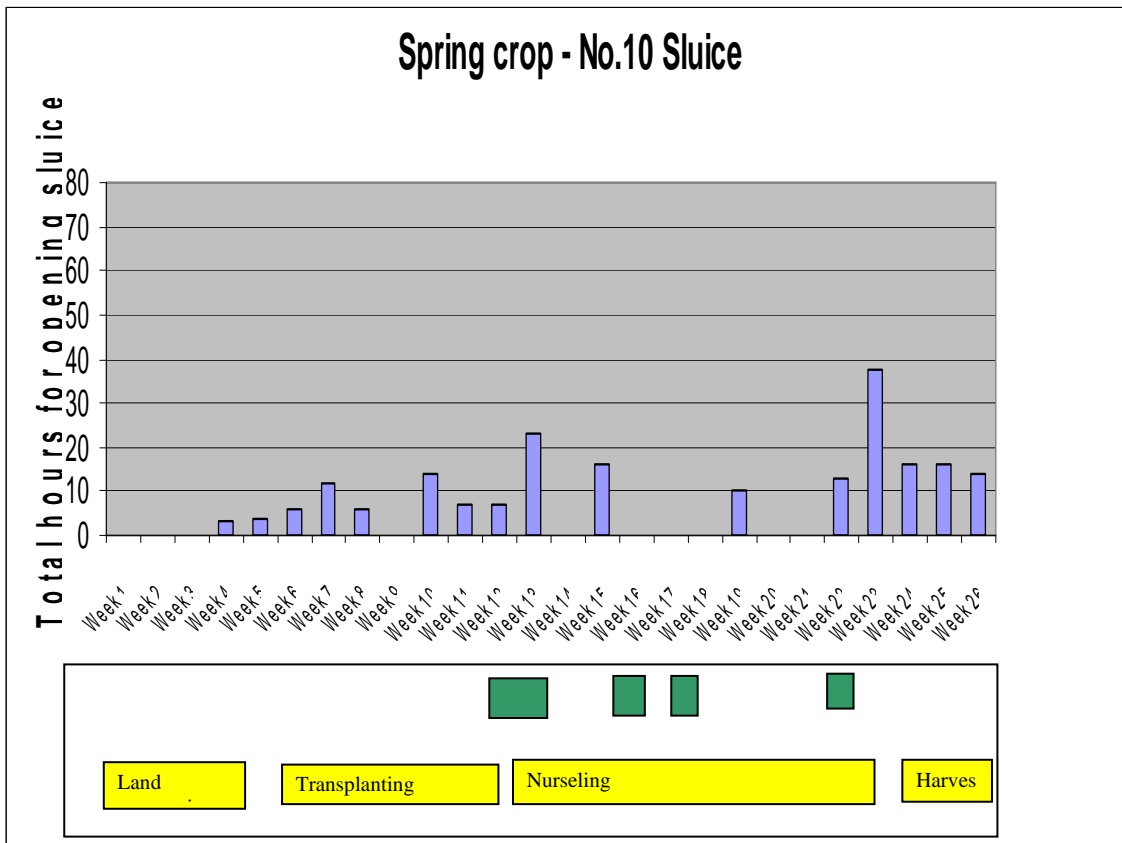
Under-dike sluices system in XTNP

Study on relation between the time of operation of under-dike sluices with time of pesticide application and cropping calendar in order to identify the impact of inflow sources from the agricultural production areas (5 communes in buffer zones, including residential area) through sluices into Xuan Thuy National Park.

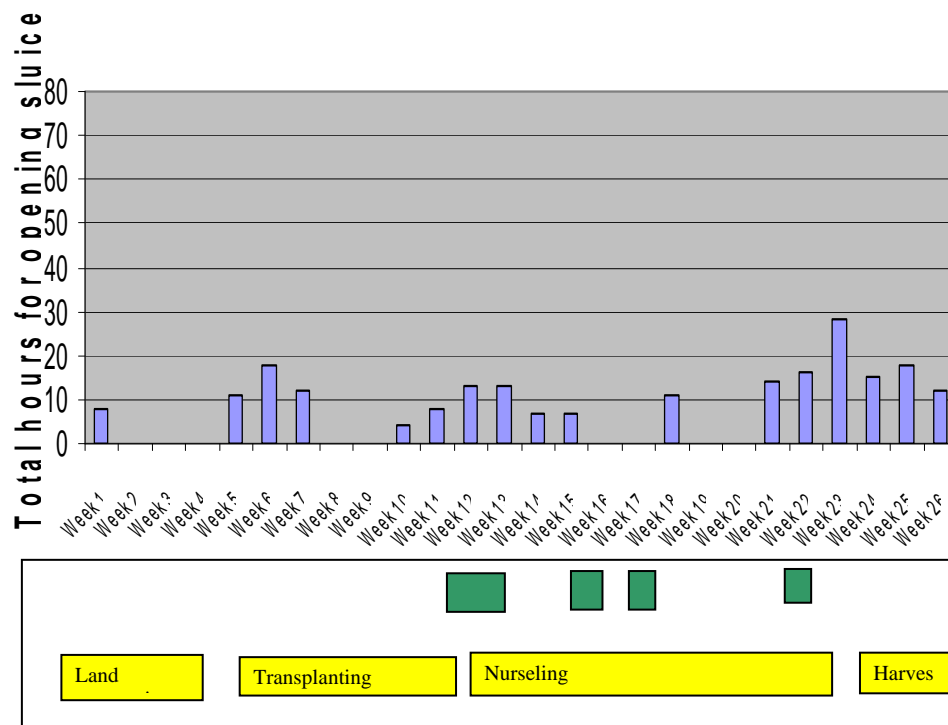
Water source flowing from the agricultural production area into XTNP is very important that should be studied carefully. Because it is the agricultural production area so the application of pesticides and agricultural chemicals in production is significant, so it can be roughly estimated that the cultivated area of 5 communes in the buffer zone total 2.900 ha, each year, about 4.5 tons of pesticides shall be applied with other chemicals on fields. Then, the residues run into canals and together with wastes discharged in residential areas into the water source and flow to under-dike sluices close to the national park. The operation (drainage) of under-dike sluice is very important, because, if they are opened in the time when pesticides are applied, the residues of pesticides and chemicals shall flow into XTNP in water. In order to study the impacts of economic activities in the buffer zone through the sluices, IWRR specialists collected and analyzed data on time and hours of sluice opening (operation) of 5 sluices along the dike in order to compare with data on time of pesticide application and cropping calendar and analyze their impacts. The data used is the seasonal crop in 2007 and winter-spring crop in 2008. The results are presented in diagram below.

**Relationship of operation time of sluices to spraying pesticide time & cropping calendar
(from buffer zone -5 commune to XTNP)**

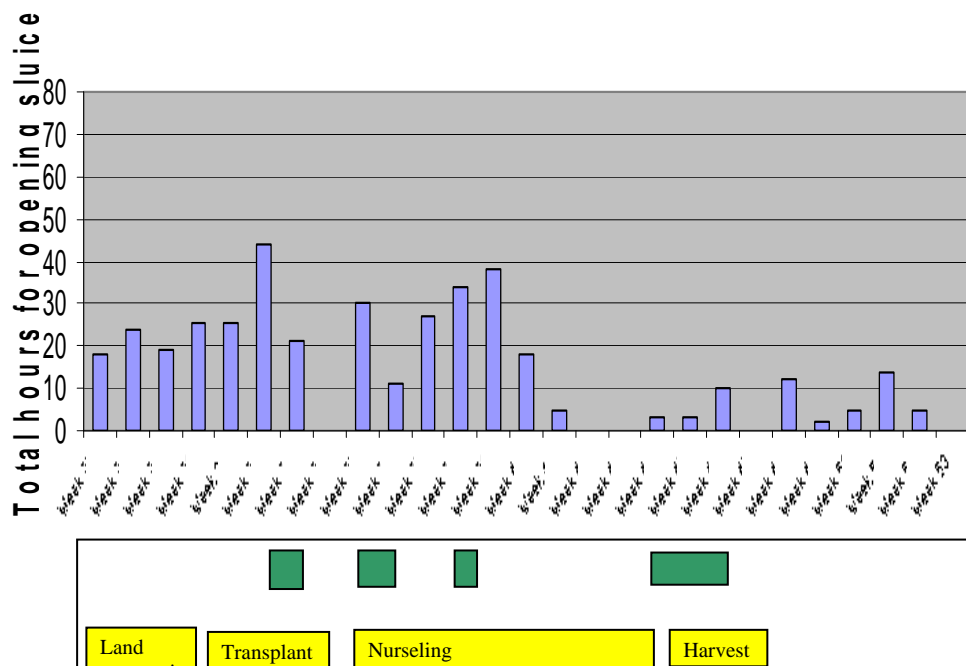


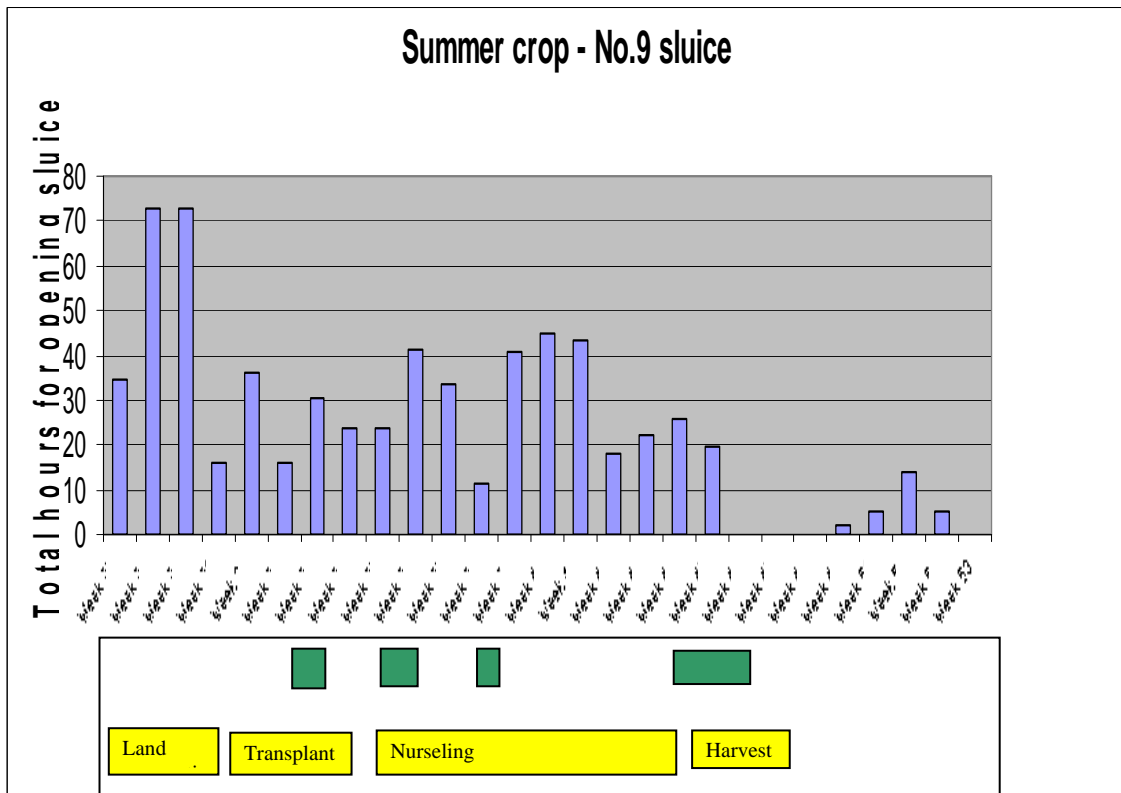
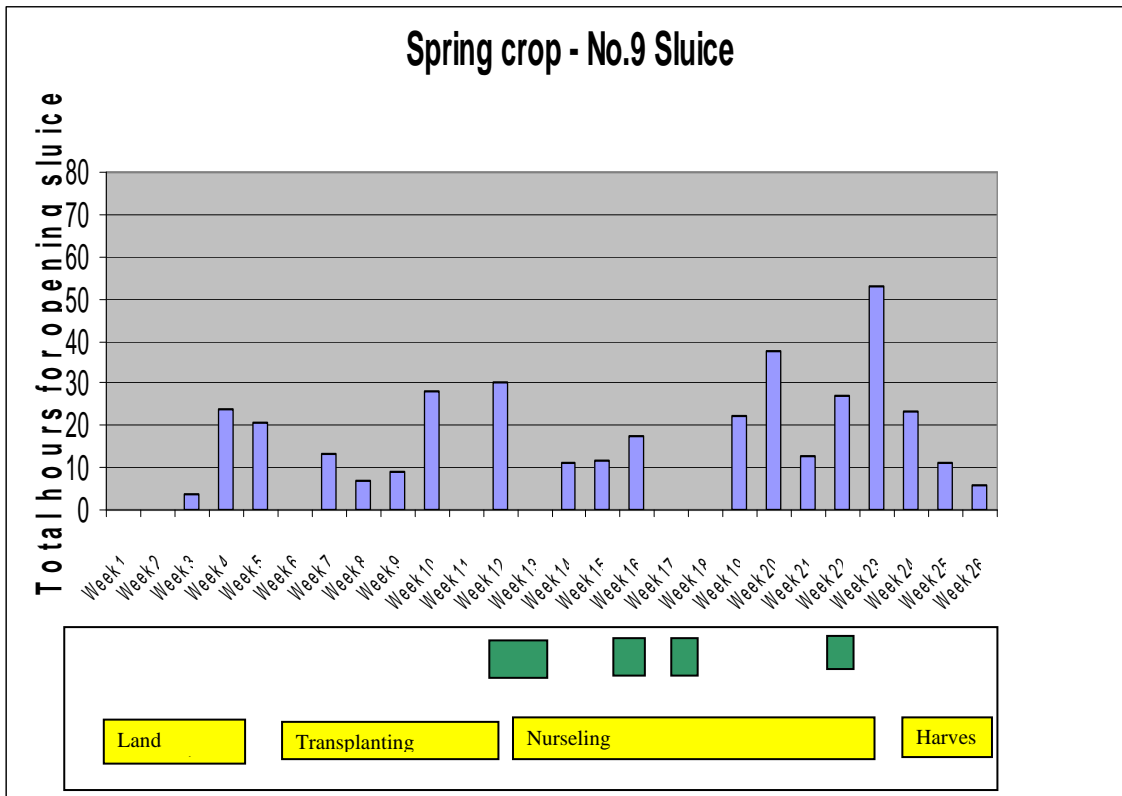


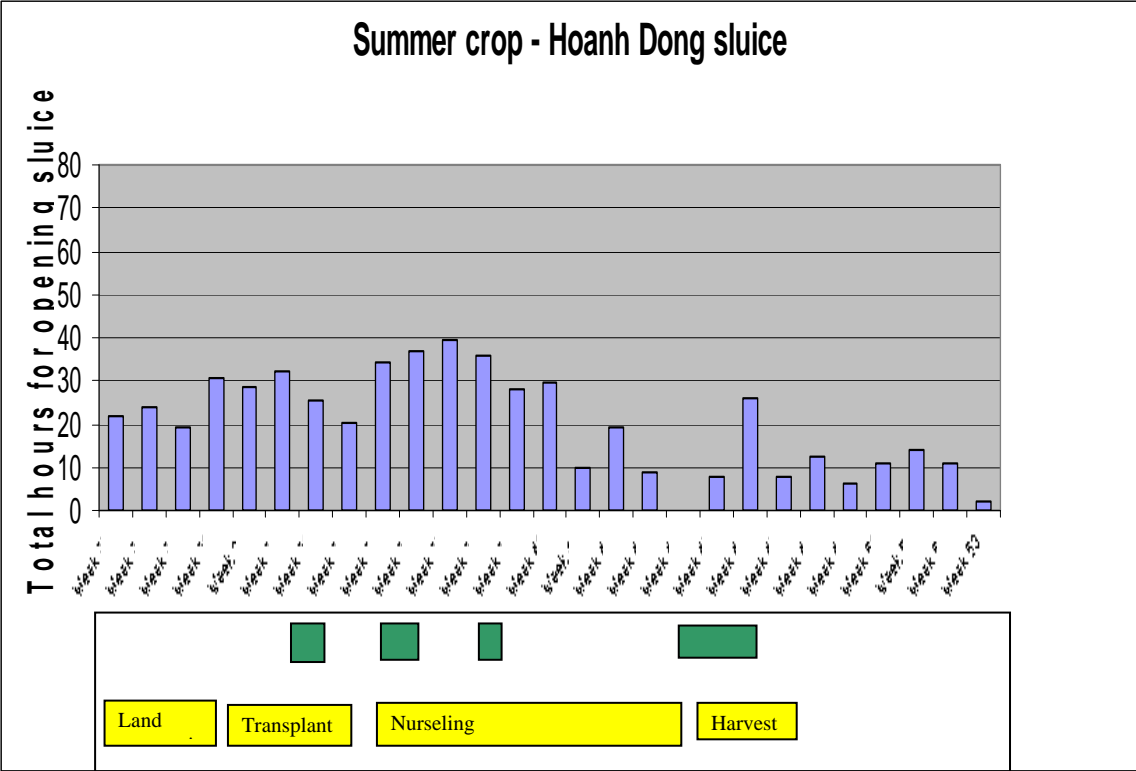
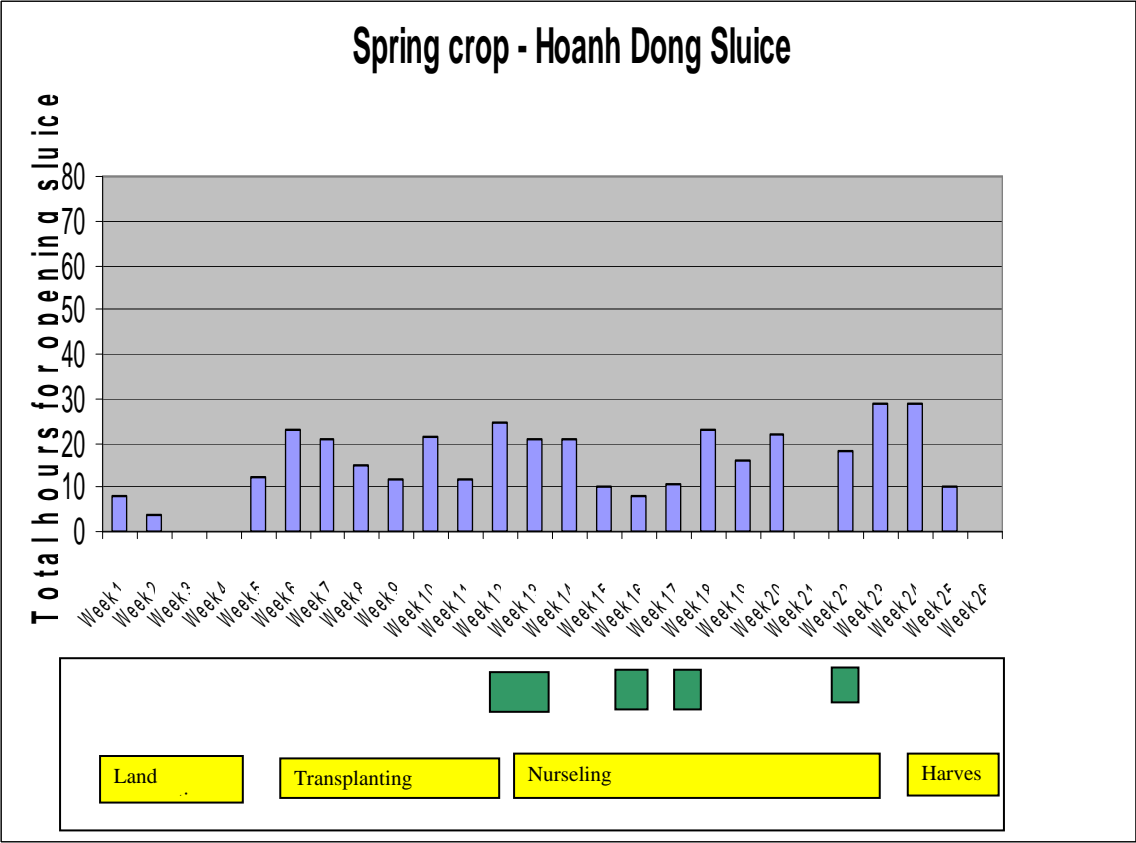
Spring crop - Dai Dong Sluice



Summer crop - Dai Dong sluice







Note

Week 1 began from January, 1st, 2007



Spraying pesticide schedule



Crop calendar

Initial conclusion

- It is obvious that the time of drainage through these sluices in the winter-spring crop is only equal to 1/5 of the total time to drain for the seasonable crop;
- Each cropping season has 4 times of pesticide application, which are not fixed times but depend on situation of pests. There are cropping seasons that the pesticide to kill *Nilaparvata lugens* (brown backed rice plant hopper) is applied when rice is about to harvest (normally, in this period, pesticide is not applied but farmer waits till the harvest);
- Pesticides usually are applied in 3-6 weeks after rice plants are transplanted (in the caring period), so in this period, it is necessary to take care of water drainage and quality of water;
- According to the results presented in diagram it can be concluded that during the land preparation and about ½ of the time when it starts transplanting (1st week to 10th week in case of Winter crop and 37th to 33rd week in case of the seasonal crop), sluices should be opened to let water to the national park in order to get the best quality of water.
- Therefore, it can be concluded that the regulation of operation schedule of sluices to match with the cropping calendar and time of pesticide application is the most important factor to minimize impacts to XTNP.

Compared with the results obtained from the two surveys to take samples for testing quality of water, the results are similar to the above statements.

Recommendation

- In order to have a more accurate conclusions, it is necessary to collect more data on time of sluice operation, time of pesticide application, and cropping calendar in years, in combination with the monitoring results of water quality taken after teg sluices are opened and after each application of pesticides. The results are limited to 2 years (2007, 2008) so, it is limited to time, and in the last 2 years, rainfall tends to be higher so the samples of water quality might be varied.
- It is necessary to consider and build up a plan on sluice operation which is consistent with the cropping calendar and related to the pesticide application. In order to do so, it is essential to have a coordination between Giao Thuy IMC and 5 cooperatives in the buffer zone and the management staffs of Xuan Thuy national park.

Assessment of irrigation and drainage system in 5 communes in buffer zone.

The irrigation and drainage system in Giao Thuy district in general and in 5 communes in buffer zone in specific, most were built long time ago, about 30, 40 years ago. With specific characteristics of river estuary, every year, there is a great alluvial amount, about over 100 million tons. In time, alluvia have accumulated significantly in transfer canals and in irrigation and drainage sluices. In addition, the degrading of irrigation and drainage structures so though the annual maintenance and repair are carried out, however, as evaluated by local managers, the capacity of present irrigation and drainage system remains only 70% of the design capacity and does not meet the actual irrigation and drainage demand. In addition, human factor also affects and contributes to the

degrading of canals. Presently, canals in 5 communes in buffer zone are blocked to raise poultry such as ducks, geese. This hinders the flow and changes cross-section of canals. In addition, waste water from husbandry by local people along canals is discharged directly into canals without being treated, and cause to eutrophication in aquatic environment. This is a suitable condition for water plants and mosses, weeds to grow strongly in canal bed and block canal bed. Currently, this irrigation and drainage system needs to be upgraded, repaired and modernized in order to meet with present and future demands.

Presently, irrigation and drainage system of Giao Thuy district is managed in the decentralization manner. Xuan Thuy IDMC is assigned to manage and operate the system of primary and inter-commune secondary irrigation and drainage structures in the district. The remaining secondary and tertiary irrigation and drainage works are handed over to cooperatives for management with cooperative members. The funds for operation, management and maintenance are allocated from the state budget and water fee collected via the cooperatives. However, this budget is very small and only sufficient to cover operation costs. Present maintenance and repair is mainly carried out by farmers in small size and temporary manner.

Assessment of water supply and drainage system in aquaculture area

The buffer zone of XTNP has a large area for aquaculture, about 3,500 ha, farming saline, brackish, and fresh water aquatic products. Except for the fresh water aquaculture that is inside the dike, the remaining aquaculture areas all are outside the dike and close to the core zone of the XTNP. With an area of nearly 50% of total area of national park, the aquatic farming is a great impact to the sustainability of the national park. Currently, the aquaculture in this area is carried out by the procurement manner which is owned by Giao Thuy DPC, and CPCs in buffer zone manage administratively. However, currently, people can do what they want to do without following any plan. Consequently, the mangrove area in present shrimp farming area reduces significantly to only 10-20%, even in some area, mangrove does no longer exist, meanwhile, the standard for eco-shrimp farming technique, the density of mangrove in the farming area is 30-50%, and it is 75% for the biodiversity standard. One more reason that leads to the reduced concentration of mangrove is that aquatic farming needs to retain water so it changes the living environment of 'Su' plant (*Su plant must live in area where tide is up and down, in the estuaries*).

The fresh water aquaculture covers an area of 200 ha and locates inside the sea dike. Water supply for this region is the water supplied for agriculture and taken from drainage canals, and then this water is discharged to the drainage canals or Nguyen Van Be saline control river and discharged to the submerged land outside the dike or to Vop River via the agricultural drainage system. Fresh water aquatic farming ponds are affected significantly by quality of agriculture drainage water. As reflected by local people, when agricultural fields are applied with pesticides, if intakes to the aquaculture ponds are not closed on time, aquatic products will be polluted. Intakes, most of outlets of these aquatic farming ponds are built, operated, maintained by farmers.

Area of brackish aquaculture covers approximately 1,700 ha, most concentrates on Con Ngan (1,000 ha). This aquaculture area is large, well organized and gained high economic benefits. Water for aquaculture in the buffer zone outside the dike is supplied

by two rivers: Tra and Vop, of which Vop River directly affects to the aquatic farming area. The inflow of Vop River is from the Red river and from drainage system in the communes in buffer zone so it dilutes the salinity in water and facilitates the development of brackish aquatic farming. Therefore, the irrigation and drainage capacity as well as aquatic environment of Vop River are very important to the ecosystem in the national park as well as to the aquatic farming area in the national park.

The intakes and outlets in brackish aquatic farming ponds are usually small, with averaged dimension of 1.5 x 2m, and are constructed, operated by farmers. The water intake and release is subject to the high and low tides. Only in necessary cases, small pumps are used to pump water in or out.

In clam farming area, it is in saline water and has an area of approximately 1,000 ha concentrating in tails of XTNP. The farming technique is to zone the farming area in water submerged land, without any dike or irrigation and drainage structure. Water supply for this area is natural sea water, subject to the tide regime in North of Vietnam.

In recent years, due to the saline water intrusion, climate change so the yield of clam reduces. Presently, the district has a plan to connect the tail of Tra river with Vop River, and a plan to dig two canals K2 and K4 to take water for river estuary into clam farming area.

As presented above, the water supply for agriculture and aquaculture in 5 communes in buffer zone is all from the Red River. Water supply for agriculture is taken directly from the Red river via intakes; water for aquaculture is partially taken from drainage water from agricultural production so the water is more or less affected.

The agricultural area locates inside the dike so it is not affected seriously by sea water. The intake sluices are opened and closed in procedures to prevent saline water (> 0.8 ppt) intruding into fields. While intake sluices to 5 communes in buffer zone are closed, Ngo Dong and Con Nhat sluice, the water for agricultural production in the 5 communes is diverted from upstream, Ha Mieu 1 and 2 sluices, etc. This is the water source supplied for agricultural production for the communes in upstream. Therefore, water quality for agricultural production is additionally affected by drainage water from these communes.

Water source for aquaculture is mainly sea water, water from the Red river still runs into Vop and Tra rivers. However, the drainage water from agriculture discharges directly into the aquaculture area outside the dike, so it is certainly affected. In the buffer zone in area outside the dike, there is a phenomenon that should be given due attention to, i.e. water in small gulf (*in tails of Vop river and Tra river*) – clam farming area is saltitized.

The reason of salitization may originate from the fact that in 1986, a dam was built on Vop River. This dam prevents water from Red river running into the small gulf, so water in small gulf is no longer diluted. Meanwhile, the dam makes sediment accumulated in front of the dam, but since 2003, this dam has been opened, rebuilt as a transportation bridge. However, due to over-accumulation in the upstream, the size of bridge is very small (only equal to 1/3 of river cross-section), and local people also spontaneously built or block the current to catch aquatic products. This helps reduce significantly the flow of fresh water through Vop River. Thus, the quality of small gulf has not yet improves remarkably. According to the observation results gained by the XTNP, the salinity in this area is about 29-30 ppt much higher than the averaged salinity in river estuary (24-25 ppt.), i.e. almost equal to the salinity in sea water (32-33 ppt), much higher than the

averaged salinity in river estuaries: 24-25 ppt. Thus, water is salted, in tails of Vop and Tra river mangrove die massively, because, in saline water teredoe grows faster and clings to body of Vet - *Bruguiera cylindrica* (L.) Blume, while Su (*Aegiceras corniculatum* (L.) Blanco) die of salinity. As expressed by farmer in aquaculture in the gulf, after each heavy rain, aquatic creatures in this locality grow and develop faster because salinity in water is diluted. Normally, the living rate of aquatic products here is low.

3.11. Assessment of water quality in residential zone, agricultural production zone, aquatic farming zone

Xuan Thuy National Park is located in the area of Red River Estuary, in Giao Thuy district, Nam Dinh province. With such geographical location, the environment of the National Park is suffering from negative impacts from not only the River but also residential activities near by. Specifically, located at the end point of the River, the water resource of the Park is considered to be influenced by pollutants and wastewater from human activities in the upstream of the River. They could be wastes from industrial sites and urban areas along the River coming into the Park through 2 provincial rivers namely Vop and Tra Rivers. Besides, the National park might be affected by residential activities from 5 communes in the buffer zone of the Park. Surveys show that wastewater from those communes is regularly drained into the National park (aquatic areas and core zone) through 5 sluices that are under the dike system of the area.

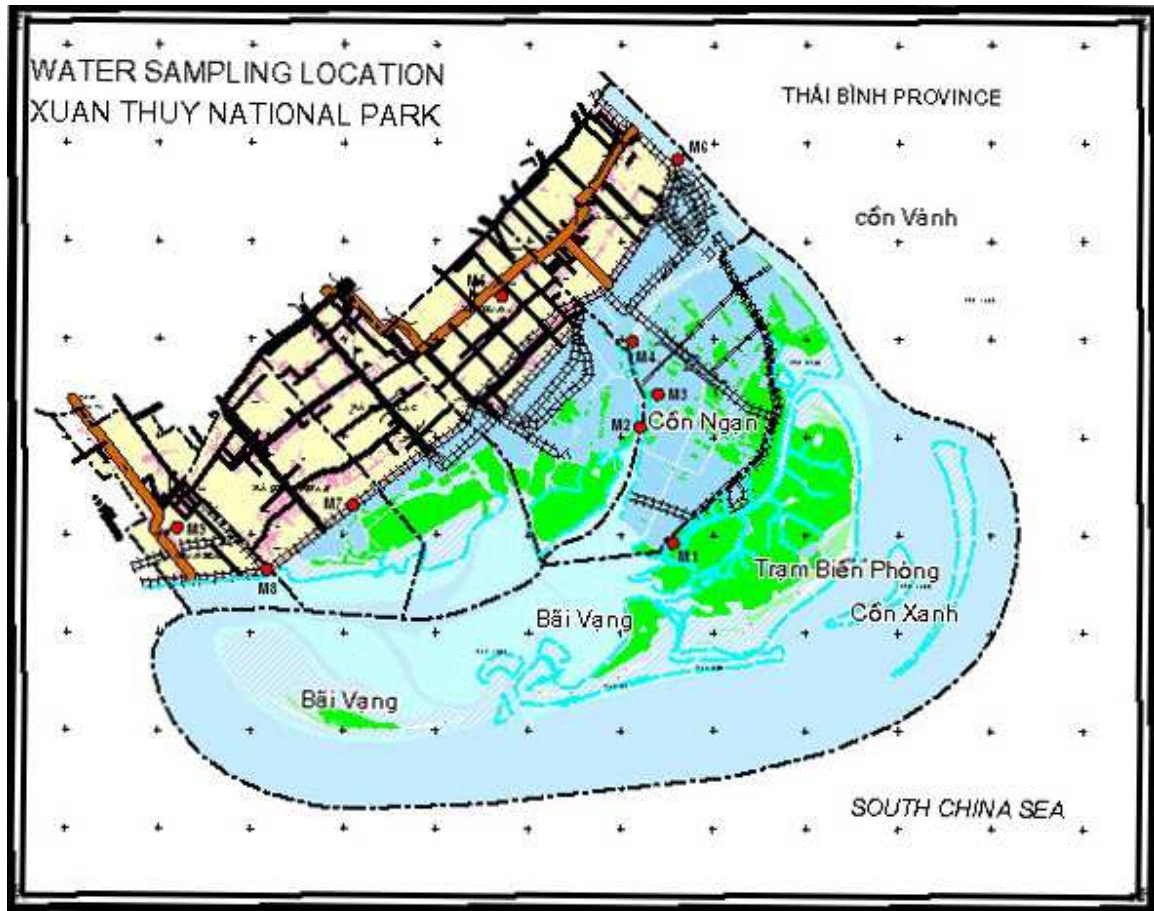
Therefore, to evaluate the water resource quality of the Park, staff from VIWR tested the water quality in both the Red river area where water from the River come in to the National Park, and the water quality at the upstream of 5 sluices where receive wastewater of 5 communes in the buffer zone. For this, water samples were collected at the Red River mouth, Vop and Tra Rivers, aquaculture areas, under-dike sluices and on-farm areas. The water sampling not only assists to test current condition of the water resource of the Park, but also additionally could help investigate links among water resources of areas of residential, agricultural, aquaculture and core areas as well as causes for potential water pollution of each area.

Totally 10 water samples were collected at different sites along with interviewing a large number of local people. Water samples were taken 2 times in late April 2008 (phase 1) and late August 2008. All water samples were taken at similar site in both the 2 times. The location of sampling, and objectives of selection of water samples are presented in table 11 and location map of water sampling below

Table 11: Location of water samples

Nr	Name of sample	Location	Objective
1	Sample 1	End of Tra river	Checking quality of water in Tra river for shrimp farming in buffer zone in the national park
2	Sample 2	Right site of Vop river – intake and outlet of shrimp farming ponds	Checking quality of water in Vop river for shrimp farming in buffer zone in the national park. Checking impacts of domestic waste water in 5 communes in buffer zone to rivers before pouring into the sea
3	Sample 3	Middle of Vop river	Checking impacts of domestic waste water in 5 communes in buffer zone to rivers before pouring into the sea
4	Sample 4	Left site of Vop river – intake and outlet of shrimp farming ponds	Checking quality of water in Vop river for shrimp farming in buffer zone in the national park. Checking impacts of domestic waste water in 5 communes in buffer zone to rivers before pouring into the sea
5	Sample 5	Drainage canal close to Giao An CPC office	Checking quality of surface water, impacts by fertilizers and pesticides to the surface water.
6	Sample 6	Red river, at point pouring water into National park	Checking quality of inflow in National park
7	Sample 7	Upstream of Khai Sinh sluice, Giao Lac commune	Checking impacts of 5 communes in buffer zone to National park.
8	Sample 8	Upstream Cai De sluice, Giao Xuan + Giao Hai communes	Checking impacts of 5 communes in buffer zone to National park.
9	Sample 9	Drainage canal in front of Mr. Le's House, Village 2, Giao Hai commune	Checking quality of surface water, impacts by fertilizers and pesticides to the surface water
10	Sample 10	In front of inlet of Ngo Dong sluice	Checking quality of inflow for agriculture in the buffer zone.

Location map of water sampling



Water quality of agricultural area in the five bufferzone communes

Water source for agriculture in the buffer zone is delivered via Ngo Dong sluice. The result of water quality analysis at the upstream of the sluice indicates that basically the indicators of water quality of the sample taken at the upstream of the sluice are satisfactory to the quality standards of irrigation water for (TCVN 6773: 2000) and the quality standards of surface water (TCVN 5942-1995). However, the salinity level of water exceeds the permissible limits for surface water. This indicates that the upstream water sources of the buffer zone is salty and may affect to human activities in this area.

Analyzing the quality of agricultural water in 5 communes in buffer zone, the project study team took 2 water samples in Giao An commune (M5) and Giao Hai commune (M9). The collection times were in late April and August. Analyzing results show that in terms of salinity, both samples present high values, compared to national standard. Other indicators such as Nitrate (NO_3^-), Nitrite (NO_2^-) and PO_4^{3-} are all satisfied the quality of surface water (TCVN 5942-1995), implying that the surface water source is not yet affected by the fertilizers in agricultural activities.

At the first collection time, water test did not find the residue of pesticide (Regent) in water samples though there is a warning from local government and people about the

harm of this pesticide. At the second time, Regent value was defined (0.01mg/l). However, the value is still meet the standard and does not affect to human and aquatic life.

Table 12: Water samples in Giao An commune (M5) and Giao Hai commune (M9)

Nr	Indicator	Unit	Standard of irrigation water – TCVN 6773:2000	M5		M9	
				Time 1	Time 2	Time 1	Time 2
1	pH	-	5,5 – 8,5	7.15	7.15	7.29	7.29
2	EC	µs/cm		2230	2000	1308	1520
3	TDS	mg/l	<1000	1331.34	1250.35	780.89	1198.36
4	DO	MgO/l	>=2	7.80	7.1	7.20	7.0
5	COD	mgO/l		4.80	4.85	3.20	3.45
6	BOD ₅	mgO/l		3.31	3.2	2.05	2.15
7	PO ₄ ³⁻	mg/l		0.06	0.045	0.09	0.055
8	NH ₄ ⁺	mgN/l		0.35	0.35	<0.01	<0.01
9	NO ₂ ⁻	mgN/l		<0.01	<0.01	0.04	0.04
10	NO ₃ ⁻	mgN/l		0.04	0.042	0.18	0.19
11	Cl ⁻	mg/l	<= 350	548.27	450.23	206.11	400.02
12	SO ₄ ⁻²	mg/l		72.74	70.74	61.68	64.68
13	Ca ²⁺	mg/l		50.31	51.31	35.22	36.22
14	Mg ²⁺	mg/l		26.46	26.46	16.26	16.26
15	As	mg/l	0,05-0,1	0.004	0.004	0.004	0.004
16	Coliform	MPN/100 ml	<=200	0	50	40	30

M5: Water sample on drainage canal close to the Office of Giao An CPC

M9: Water sample on drainage canal in front of Mr. Le's house, village No.2, Giao Hai commune

The water source in outlet of under-dike drainage sluices is the outflow of the agricultural water and domestic water sources from 5 communes in buffer zone, before flowing into the core zone of national park through the under-dike sluices. Testing results of water samples at Khai Sinh sluice - Giao Lac commune (M7) and Cai De sluice – adjoining point of Giao Xuan and Giao Hai communes (M8) in both 2 collection time

indicate that all tested indicators except Clorua satisfy the standard of quality of surface water

Water quality in the core area

The water source at the Red River estuary is not significantly affected with economic and social activities in the upstream. The sources of water supply are still qualified.

The water sources of Tra River and Vop River do not affected by Regent pesticide – the chemical that is normally used in the buffer zone. In all 3 samples at Tra River (M1), Vop River (M3) and Red River estuary (M6), there is no identification of this pesticide. Water in these two Rivers has a high concentration of salinity (23.9‰ and 33‰ respectively). Water in Tra River has a higher density of salinity compared with Vop River. Indicators on organic substances such as BOD5, DO, and coliform, are within the permissible limits.

Table 13: Indicators of water sample in Red river estuary, Tra River and Vop River

No	Indicator	Unit	Coastal sea water standard – TCVN 5943:1995	M1		M3		M6	
				Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
1	pH	-	6,5-8,5		7.1		7.02		7.20
2	EC	µs/cm		40100	38100	55400	50300	10670	9670
3	TDS	mg/l		23940.29	25945	33074.63	35074	6370.15	5370
4	COD	mgO/l		1.76	1.71	1.80	1.60	1.48	1.48
5	BOD ₅	mgO/l	<10	1.25	1.20	1.21	1.20	0.99	1.05
6	PO ₄ ³⁻	mg/l		0.04	0.05	0.04	0.04	0.08	0.08
7	NH ₄ ⁺	mgN/l	<0.5	0.52	0.52	<0.01	<0.01	0.46	0.46
8	NO ₂ ⁻	mgN/l		0.01	0.01	0.01	0.01	0.02	0.01
9	NO ₃ ⁻	mgN/l		<0.01	<0.01	<0.01	<0.01	0.08	0.06
10	Cl ⁻	mg/l		229.1	10109	10507.38	14021	8655.12	4000
11	SO ₄ ⁻²	mg/l		668.9	520	898.4	658	196.36	200
12	Ca ²⁺	mg/l		45.28	213	213.81	214	155.12	100
13	Mg ²⁺	mg/l		30.53	552.65	559.65	418.25	513.86	140.56
14	As	mg/l	<0.01	0.005	0.009	0.007	0.004	0.009	0.009
15	Coliform	MPN/100 ml	<1000	40	40	20	40	0	20

M1: Water sample in end of Tra River

M3: Water sample in middle of Vop River

M6: Water sample in Red river estuary, where water runs into Xuan Thuy National Park

Water quality in the aquacultural area

Water for aquaculture is primary sourced from Tra River and Vop River. The water tests at both times in both Rivers show no identification of Regent pesticide. These water resources are qualified in terms of indicators like DO, BOD, NO_2^- and NO_3^- .

Interviews of local people and staff show that in the aquacultural area, pollutant is also come from aquacultural activities besides outside sources. Many people believe that residual of fish and shrimp feeding food pollutes the water source of shrimp ponds. Besides, the over use of lime to clean shrimp ponds is also another cause for the water pollution in the aquacultural area.

Table 14: Indicators of water sample inlet & outlet of shrimp farming pond of Vop

No	Indicator	Unit	Coastal water standard for aquaculture – TCVN 5943:1995	M2		M4	
				Time 1	Time 2	Time 1	Time 2
1	pH	-	6,5-8,5	7.03	7.0	7.12	7.35
2	EC	μs/cm		45300	46300	33500	35500
3	TDS	mg/l		27044.78	27044	19999.99	19990
4	COD	mgO/l		4.64	4.64	2.40	2.40
5	BOD ₅	mgO/l	<10	3.16	3.05	1.58	1.50
6	PO ₄ ³⁻	mg/l		0.04	0.04	0.03	0.03
7	NH ₄ ⁺	mgN/l	<0.5	0.31	0.31	0.32	0.32
8	NO ₂ ⁻	mgN/l		0.01	0.015	0.01	0.02
9	NO ₃ ⁻	mgN/l		<0.01	0.020	<0.01	<0.01
10	Cl ⁻	mg/l		11618.74	10620	8655.12	83256
11	SO ₄ ²⁻	mg/l		773.8	632	585.3	583.2
12	Ca ²⁺	mg/l		218.00	215	155.12	150.3
13	Mg ²⁺	mg/l		707.20	678.20	513.86	515.21
14	As	mg/l	<0.01	0.003	0.001	0.005	0.003
15	Coliform	MPN/100ml	<1000	220	400	3500	900

M2: Water sample in right side of Vop River – Inlet and outlet of shrimp farming pond

M4: Water sample in left side of Vop River – Inlet and outlet of shrimp farming pond

Overall conclusion about water quality of Xuan Thuy National Park

Some conclusion can be drawn from the research as follows:

- Inflow water to the National Park (at Ngo Dong Sluice) is in good quality except being salty.
- Water resource at Red River mouth – the second inflow to the National Park is not affected by pollutants from the River's upstream activities.
- Water resources in the buffer zone and core zone of the National Park are salty at different levels. This was found in all areas of the national park.
- There is no pesticide effect to the national park water sources.
- Water sources at sampling points in Xuan Thuy National Park (except for the salinity) are not yet polluted and affected by domestic and agricultural activities.

Recommendations

Although some conclusions are made from the study, those are just initial outputs. It is a need that further research with longer time for water quality monitoring is necessary in order to draw a comprehensive picture about the water resources in the National Park, as well as the inter-linkage among water users in the area. Besides, some other research focusing on fields that have not yet considered in this study should also be included in future research. For these reasons, below activities are recommended for next studies:

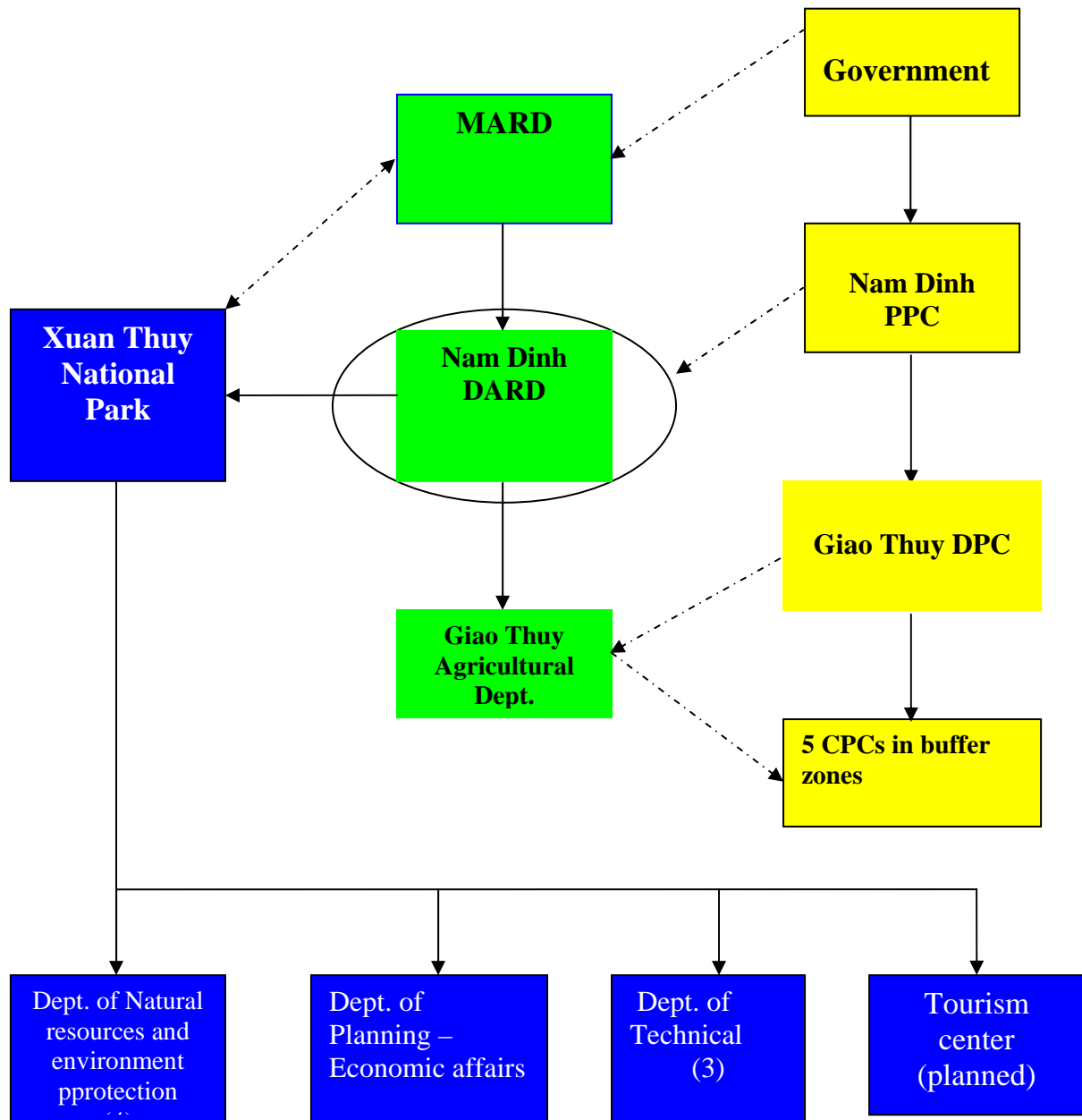
- Regularly continue to monitor water quality at 10 sampling points to make a long time data.
- Set up a monitoring network of monitoring stations. The network will have a responsibility to regularly monitor the quality of the National Park's water resources.
- Study the negative impacts of solid waste from residential area in the buffer zone to water sources of the core zone, aquacultural and agricultural areas. Opinions at the November workshop indicate the possible effect from this kind of pollutant to the water resources of the Park.
- Study the self-pollution at shrimp ponds where the water source at these areas has been polluted by the over use of lime in cleaning process and residuals of shrimp food in ponds.
- Deeper study the effects of Vop Dam to the water resources of the National Park.

3.12. Assessment management institution at two levels

Establishment and Management of XTNP process

Period	Starting point	Management
Before 1993	District People Committee (DPC) of Xuan Thuy established the Center for Water resources – Environment (The center managed all activities related to water resources and environment in the whole district. The nature reserve was one of center' management).	Xuan Thuy DPC
1993	Institute of Forestry planning proposed to incorporate the Xuan Thuy nature reserve under National Parks and Nature reserves system of Vietnam. Area 5.640 ha. Until 1994, its area was extended to 7.100 ha	MARD
19/1/1995	The Prime Minister authorized the Ministry of Forestry (now MARD) to sign the Decision ref. 26-LN/KH: <i>Approving technical – economic factual foundations of Xuan Thuy wetland nature reserve</i> . From that time, the Xuan Thuy park was officially established and under management Forest subdivision – Nam Dinh.	PMU under MARD
10/1995	Nam Dinh PPC established Nature Reserve PMU.	
2003	The Government recognized Xuan Thuy nature reserve as National Park.	PMU under MARD
10/2004	UNESCO recognized Xuan Thuy as main region of biosphere reserve of the Red River Delta.	PMU under MARD

Organizational chart of Xuan Thuy National Park



Management decentralization

Management of Xuan Thuy National Park is divided into 2 levels:

1. Central level: MARD (Dept. of Forestry management), Ministry of Natural Resources and Environment (Environmental Protection Dept.);
 2. Local level: Nam Dinh PPC, DARD, Giao Thuy DPC, 5 CPCs of buffer zones, namely Giao An, Giao Lac, Giao Thien, Giao Hai and Giao Xuan.
- *Administrative management:*
 - Nam Dinh PPC
 - Giao Thuy DPC
 - 5 CPCs of buffer zones
 - *Technical management:*

- MARD (Forestry Management Dept.); DARD; Fishery Subdivision (however, there is no agency responsible for fishery of Xuan Thuy National Park)
- Assisting Dept. of Environment Protection (MONRE),

Functions of the XTNP MB

- Assisting DARD to chair, coordinate with other sectors and Giao Thuy DPC in master planning, setting long-term, mid-term and annual plan.;
- Acting as investor in managing and effectively using State budget and other aid sources;
- Protecting bio-scene of the biology-geography development regions (development of geography and creature community at Ba Lat estuary and along the East Sea);
- Protecting coastal zone of the Red River;
- Science research in and out country;
- Coordinating with sectors, local governments in socio-economic development of buffer zones. Promoting efficiency of culture, education and ecological tourism;

Analysis

It is obviously that the responsibility of the XTNP MB is significantly onerous. At present, the MB has 11 staffs of which 9 are engineers, 2 are intermediates. Assisting the security, there are 4 staff of Forestry Management Station under Nam Dinh Forestry Management Subdivision. With limited number of staff, it is difficult to fulfil their duties. According to the plan 2010, to ensure the effectiveness of the National Park, to realize Ramsar convention and to fulfill duties of a national park, the MB needs about 32 persons including a group covering eco-tourism. Hence, it is necessary to strengthen capacity building and training from now on.

The decentralization as present has revealed shortcomings as some fields managed by 2 units, for example, with Forest protection, regional Forestry Management Station, some from the Nature reserve and from DPC are involved. However, there is field without direct management such as fishery or water resource and canal system outside the dike. It should empower and unify management to the XTNP MB under **MARD-DARD-XTNP** and propose a mechanism of coordinating the National Park with other agencies. In the short-term, it should merge regional forestry management to the XTNP MB.

IV. CONCLUSIONS AND RECOMENDATIONS

Conclusion

It can be said that the water sources in XTNP play a very important role in maintaining the ecosystem as well as the recent economic development in this area. Studying the effective and sustainable integrated water use in this area is essential because of the following main reasons:

- Water sources in this area do not supply the agricultural production, aquaculture but also the domestic use of people in 5 communes in buffer zone.
- XTNP is recognized as Ramsar area so the study on utilization of water sources is extremely important to maintenance of ecosystems of the mangrove forest here.
- XTNP locates near the Red river so beside the impact of socioeconomic activities, the environment in the surrounding area, it has to be affected by socioeconomic activities, environment in upstream of Red river (where many industrial zones, factories, agricultural activities and other activities that are polluting the river every day), and many other natural effects.
- Previously, no study is yet carried out about the water source in the region.

The study may contain some important contents as below:

- The area of XTNP is affected by 2 water courses: water from upstream of the Red river flows into two branches: Tra river and Vop river; (ii) water source from the Red river runs through 5 communes in the buffer zone to supply water for agricultural production, livelihood, economic activities then it runs through under-dike sluices into inner part of XTNP;
- There is not any stable plan for the irrigation and drainage system (particularly when the aquaculture developed fast, the planning has been changed significantly). The dam filling across Vop river in 1986 changed the flow regime and it proves in many negative impacts to the ecosystem such as mangrove trees died massively, productivity of clams in downstream of Vop river reduced significantly (interviewing some households farm clams in downstream of Vop river); affecting to the deposition in river estuary and the erosion problem. This impact may remain in many years regardless that the dam on Vop river was removed and replaced with a bridge;
- Present status of irrigation and drainage works and canal systems in the study area were built dozen of years ago so now they are degraded severely (as assessed by Giao Thuy IMC, the irrigation and drainage capacity now only reaches to 75% maximally);
- The irrigation and drainage system almost has no monitoring tools of water level, flow rate and quality;
- The under-dike drainage sluices have no water quality monitoring tools though these sluices drain water into the inner part of the National park.

Recommendation

Technical aspect

- Vop river is an important branch of the Red river in XTNP. Though, Vop dam was demolished in 2003 and it was replaced with a 25m wide bridge. So far, there is not any study to identify that with such a bridge width the flow regime can be ensured to maintain the normal development of ecosystem as it used to with the previous natural river when it was not yet disturbed by human. Therefore, it is recommended that there should have a study on flow/hydraulic regime and other issues related to accumulation, erosion, scouring, salinity of Vop river in order to find out appropriate solutions to maintain the sustainable ecosystem, contribute to facilitate the development of the national part systematically.
- It is necessary to set up monitoring stations which monitor some indicators such as water level, flow rate, quality, and some indicators related to the climate change. These stations are proposed to be in the following locations
 - + Station T1: Located near Con Ngan Monitoring Station
 - + Station T2: Located near Cai De Sluice
 - + Station T3: Located near Vop Bridge;
- Under-dike sluices: It is necessary to monitor in season and prepare graphs on relations between time to operate sluices, time to apply pesticides, chemicals and cropping calendar in order to have a suitable adjustment/operation of under-dike sluices, prevent pollution by waste water from the agricultural production areas and residential area in the inner part and the core zone of the National park.

Management and institution:

- Strengthening human resources with professional skills on natural resources protection for the XTNP management unit;
- Implementing strictly the regulation on coordination of management, protection, and development of Xuan Thuy National Park No. 1892/2006/QĐ-UBND issued on August 11th 2006, Regulation on Ramsar management, regulation on sustainable and wise utilization of resources in wetland area – Ramsar area in XTNP;
- Undertaking green rules of communes and villages in the buffer zone;
- Developing rural handicrafts, creating replacement incomes in order to release economic pressure on exploitation of aquatic/marine products in XTNP;
- Developing sustainable eco-models in potential tourism areas in the surround areas;
- Strengthening the dissemination and campaign on environmental protection in schools and local communities.

In conclusion, in order to make use of integrated water resources effectively to maintain the ecosystem of Xuan Thuy National Park, not only technical measures are used but also good management measures must be applied with a clear institution, and it is more important to have local people and relevant agencies in the locality to involve in.

V. ANNEX

ANNEX 1 LIST OF PARTICIPANTS ON THE MINIWORKSHOP

(Held 3th November, 2008)

	Name	Position	Office
1	Nguyen Viet Cach	Director	Xuan Thuy National Park (XTNP)
4	Bui Van Bach	Staff	Resources and Environment Department , Giao Thuy District
5	Phan Van Truong	Staff	Resources and Environment Department (XTNP)
6	Cuong	Head	Planning and Investment for Rural Infrastructure Department-DARD
8	Nguyen Trong Khai		Agriculture Rural Development, DARD, Nam Dinh
9	Pham Ngoc Kham	Head	Giao Xuan Agriculture Cooperative
10	Tran Quang Vong	Vice Chairman	Giao An Commune
11	Tran Van Dien	Vice Chairman	Giao Hai Commune
12	Nguyen Thanh Binh	Vice Chairman	Giao Lac Commune
13	Tran Huu Phat	Staff	Planing Department, DARD, Nam Dinh
14	Tran Dai Nghia	Deputy Head	Agriculture Rural Development, Giao Thuy District
15	Tran Van Thuan	Deputy Director	IMC, Giao Thuy
16	Cuong	Head	Planing Department, DARD, Nam Dinh
17	Phan Van Truong	Staff	Xuan Thuy National Park
18	Pham Vu Anh	Staff	Xuan Thuy National Park
19	Viet	Staff	Planning and Investment for Rural Infrastructural Structures Department- DARD
20	Nguyen Tung Phong	Team leader	VIWRR
21	Le Quang Anh	Social- Economic experts	VIWRR
22	To Viet Thang	Environment expert	VIWRR
23	Tran Minh Chinh	Agriculture expert	VIWRR
24	Trinh Ngoc Lan	Environment expert Ecology	VIWRR
25	Nguyen Lam Son	Irrigation & drainage expert	VIWRR
26	Le Thi Hong Nhung	Irrigation & drainage expert	VIWRR
27	Nguyen Viet Anh	Irrigation & drainage	VIWRR

		expert	
28	Duong Quocs Huy	Irrigation & drainage expert	VIWRR
29	Vu Hai Nam	Hydrological Expert	VIWRR
30	Nguyen Quynh Son	Community development expert	VIWRR
31	Thai Gia Khanh		Paning Institute for water resources
31	Tran Van Dat		Center for water resources and environment
32	Mr. Nam		Paning Institute for water resources
33	Mr. Son		Hydrological Institute
34	Mr. Hai		Hydrological Institute

Annex 2 Area and population in 5 communes in Buffer zone

No.	Communes	Area (ha)	No. Household	No. Villages	Population	No. population /km2)
1	Giao Thien	1,875.37	2,346	14	10,088	1,023
2	Giao An	1,930.75	2,522	22	9,807	1,180
3	Giao Lac	1,389.71	2,315	22	9,986	1,331
4	Giao Xuan	1,292.45	2,598	10	9,985	1,291
5	Giao Hai	744.35	1,775	18	6,779	1,207
	Buffer zone	7,232.63	11,556	86	46,585	1,206

Source: Agricultural Department, Giao Thuy District 2006

Annex 3 Area and distribution of types of land for aquaculture

Type of land	Area (ha)	Percentage (%)	Distribution
1. Land for fresh water aquaculture	188.22	7.51	Dispersed inside the national sea dike
2. Land for brackish and saline water aquaculture	2,317.56	92.49	Mainly focused in Con Ngan and apart of Bai Trong
Total	2,505.78	100	

Source: Statistic data of Giao Thuy district and communes in 2008

Annex 4 Area of forests and alluvia plains in XTNP

Unit: ha

<i>Location</i>	<i>Type</i>	<i>Alluvia plain, bare sand dune</i>	<i>Shrimp farming land</i>			<i>Mangrove forest</i>	<i>Casuarina forest</i>	<i>Total area (excluding other land)</i>
			<i>With mangrove forest</i>	<i>No-forest</i>	<i>Total</i>			
Bai Trong		187	36	812	848	808	6,0	1,849
Con Ngan		340	960	80	1040	556		1,936
Con Lu		639	67		67	1,051	93,0	1,850
Con Xanh		124						124
Total		1,290	1,063	892	1,955	2,415	99,0	5,759
<i>Area belonging to XTNP</i>		<i>1,103</i>	<i>217</i>		<i>217</i>	<i>1,545</i>	<i>93</i>	<i>2,958</i>

Source: Nam Dinh DARD, 2007

Annex 5 Result of Household’s interview – 5 communes in the buffer zone.

Source of water for domestic use – Wet season

No	Commune Source	Giao Hai			Giao Xuan			Giao Lac			Giao An			Giao Thien		
		No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)
1	Well	1	5%	1%	1	5%	1%	2	11%	2%	1	5%	1%	8	42%	8%
2	Deep well	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	2	11%	2%
3	Piped water supply	1	5%	1%	1	5%	1%	1	5%	1%	20	100%	20%	1	5%	1%
4	River/stream	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	5	26%	5%
5	Irrigation channel	1	5%	1%	1	5%	1%	2	11%	2%	1	5%	1%	5	26%	5%
6	Drainage channel	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%
7	Rainwater	20	100%	20%	21	100%	21%	18	95%	18%	1	5%	1%	19	100%	19%
8	Other	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	3	16%	3%

Note: - R1(%): Percentage calculated in each commune
- R2(%): Percentage calculated in comparison with total 5 communes

Source of water for domestic use – Dry season

No	Commune Source	Giao Hai			Giao Xuan			Giao Lac			Giao An			Giao Thien		
		No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)	No	R1 (%)	R2 (%)
1	Well	1	5%	1%	8	38%	8%	13	68%	13%	1	5%	1%	11	58%	11%
2	Deep well	20	100%	20%	15	71%	15%	2	11%	2%	1	5%	1%	2	11%	2%
3	Piped water supply	1	5%	1%	1	5%	1%	2	11%	2%	20	100%	20%	1	5%	1%
4	River/stream	1	5%	1%	1	5%	1%	5	26%	5%	1	5%	1%	4	21%	4%
5	Irrigation channel	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	6	32%	6%
6	Drainage channel	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%
7	Rainwater	1	5%	1%	1	5%	1%	2	11%	2%	1	5%	1%	15	79%	15%
8	Other	1	5%	1%	1	5%	1%	1	5%	1%	1	5%	1%	3	16%	3%

Note: - R1(%): Percentage calculated in each commune
 - R2(%): Percentage calculated in comparison with total 5 communes

Discharge domestic water.

No	Commune Source	Giao Hai			Giao Xuan			Giao Lac			Giao An			Giao Thien		
		No	R1(%)	R2(%)	No	R1(%)	R2(%)	No	R1(%)	R2(%)	No	R1(%)	R2 (%)	No	R1	Rate2
1	River/stream	20	100%	20%	2	10%	2%	9	47%	9%	9	45%	9%	8	42%	8%
2	Irrigation channel	1	5%	1%	3	14%	3%	3	16%	3%	1	5%	1%	6	32%	6%
3	Drainage channel	1	5%	1%	19	90%	19%	1	5%	1%	13	65%	13%	7	37%	7%
4	Other	1	5%	1%	1	5%	1%	9	47%	9%	1	5%	1%	3	16%	3%

Note: - Rate 1(%): Rate of answerers in comparison in one commune
 - Rate 2(%): Rate of answerers inside one commune in comparison with total 5 communes

Annex 6 Top 3 of 8 priorities for improving life in buffer zone

Priorities No	Giao Hai						Giao Xuan						Giao Lac						Giao An						Giao Thien					
	1 st		2 nd		3 rd		1 st		2 nd		3 rd		1 st		2 nd		3 rd		1 st		2 nd		3 rd		1 st		2 nd		3 rd	
	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R	No	R
1	13	65	0	0	2	10	21	100	0	0	0	0	18	95	0	0	0	0	11	55	7	35	1	5	18	95	0	0	1	5
2	3	15	5	25	0	0	0	0	3	14	0	0	0	0	16	84	0	0	2	10	8	40	7	35	1	5	11	58	1	5
3	0	0	1	5	1	5	0	0	0	0	0	0	0	0	2	11	5	26	1	5	2	10	0	0	0	0	0	0	1	5
4	2	10	4	20	1	5	0	0	7	33	1	5	0	0	0	0	4	21	1	5	0	0	0	0	1	5	3	16	6	32
5	0	0	5	25	2	10	0	0	7	33	6	29	0	0	0	0	4	21	0	0	2	10	0	0	0	0	5	26	1	53
6	0	0	3	15	11	55	0	0	4	19	6	29	0	0	0	0	4	21	2	10	1	5	8	40	0	0	0	0	1	5
7	0	0	0	0	1	5	0	0	0	0	8	38	0	0	0	0	1	5	2	10	0	0	4	20	0	0	1	5	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Priorities No :

1- Domestic water

2- Sanitation

3- Better housing

4- Education

5- Health

6- Greater agricultural production

7- Aquaculture

8- Other

R: Percentage