

Related Project

The World Bank has implemented to prepare the Master Plan composing of the water resources and many other sectors and expected to be completed in 1995. The Red River Development Plan by the Asian Development Bank has initiated to implement for the water resources sector. This project aims to rehabilitate/upgrade the selected 20-30 small and medium scale of irrigation and drainage systems within the Delta. The Ministry of Water Resources studied on the drainage improvement of Bac Duong area by itself in 1989. Three alternative plans has been proposed, increasing the present drainage coefficient.

(5) Problems and Needs of the Project

The Project Area is full of potential water amount and affected deficiency of irrigation water unless proper irrigation systems are not managed and maintained.

70 percent of the area is used as agricultural land and 53 percent of the agricultural land is composed of permanently water logged alluvial soils which are acid in the topsoil and strongly acid in the subtop soil.

Soil fertility is the base of production potential and this is one of the subjects to be taken seriously in the area. Leguminous crops are appropriate as one of components of the cropping patterns.

All farmers should have a full understanding of the importance of the fertilizer. Now phosphate is becoming the limiting factor in the production. For intensification of crops cultivation, short maturation variety is urgently needed. To increase production, supporting of extension activities will be the best way to level up the living standard of farmers.

Land holding problems will become the biggest constraint on agricultural development. So small and fragmented farm lands have a disadvantage in farming management.

Major constraints on an environmental aspect are :

- 1) Environmental Impact associated with Change of Water Management
 - Occurrence of Troublesome Characters of Soil because of Water Level Down
 - Deterioration of Water Quality because of Water Level Down

- Influence upon Custom of Use
- Change of Sedimentation
- Influence upon Scene of Cultural Inheritance

2) Negative Influence associated with Local Economic Activities

- Increase of Agrochemical Use
- Degradation of Soil Fertility
- Deterioration of Water quality and Ecosystem

3) Erosion in the Hillsides

B-2 Development Plan

(1) Objectives of the Development

Objectives

Objectives of the Development under the feasibility study will be summarized as follows:

To alleviate poverty and raise living standard for local people.

To improve environment of the rural areas.

Development Components

1) Improvement of Drainage Systems

Improvement of drainage systems is requisite to solve inundation problems which occur due to deterioration of existing pumps and canal facilities.

2) Improvement of Irrigation Systems

Improvement of irrigation systems contributes to supply the stable irrigation water to the improved drainage area throughout the year.

3) Establishment of Sustainable Agriculture

Intensive and multiple farming system should be introduced to the area.

4) Improvement of Environmental and Social Conditions

The drainage improvement as the highest priority component of the Project will greatly lead to mitigate inundated damages and occurrences of diseases. Also, promotion of sustainable agriculture and increasing of farmer's income will alleviate poverty and raise the living standard of people in the Project Area.

(2) Basic Concept of the Development

Proposed Project Area

The land resources of the Project Area is:

	Tan Chi	Han Quang	Total
Gross Area (ha)	6,420	2,120	8,540
Agricultural Area (ha)	4,249	1,403	5,652

The population in the area will become 181,000 in 2000 and 212,000 in 2010. To assure the food supply of 300 kg/person and improve quality of food for mitigation of undernourishment, multiple and intensive farming is requisite to be implemented coping with the progress of the development.

The priority for development components is given to drainage, irrigation, fish pond and farm road in turn.

Improvement of Drainage System

The project aims to solve the persistent water logging problem in the farmland, enhance land productivity in the area, stabilize agricultural production and upgrade the rural life in the project area through construction and/or improvement of drainage pumping stations, rehabilitation and/or improvement of drainage sluiceway and canals, upgrading/extension of power transmission lines.

Proposed Cropping Pattern

Two cropping patterns have been proposed under the same concept as that of the Master Plan.

- Pattern A:
- 1) The paddy area is provided same as the level of 1993.
 - 2) Subsidiary crops, short industrial crops and vegetables will be cultivated in the area occupying 25 percent of the summer paddy.

- Pattern B:
- 1) The paddy area in each season is restricted to 4,000 ha which is 80 percent of Pattern A. The remaining 20 percent will be converted to upland.
 - 2) 105 ha will be used for inland fishery. 35 percent of the whole summer paddy area is subjected to subsidiary crop cultivation in winter season.

Cropping intensity	Present	1.88
	Pattern A	2.27
	Pattern B	2.44

In this feasibility study, pattern B is recommendable according to the following reason.

- 1) Pattern B has higher incremental benefits and economic internal rate of return than A.
- 2) Pattern B is more advantageous than A for meeting the demand of fresh foods and vegetables for adjacent industrial zones to the area in future.
- 3) Pattern B has an advantage in diversification of crops for improving imbalance of nutrient intake of local people.

Optimum Scale of the Development

The optimum scale of development has been studied on the basis of the following alternatives.

1) Option-1 (Improvement of Tan Chi Area)

This plan aims at the improvement of Tan Chi Area, 6,420 ha which the existing pump station commands. The required drainage discharge, 31.11 m³/sec will be drained by combination of existing Tan Chi Pump station and newly proposed pump station in Tan Chi Area.

2) Option-2 (Improvement of Whole Project Area)

This plan aims at the improvement of the whole Project Area, 8,540 ha. The required drainage discharge, 41.11 m³/sec will be drained by combination of existing Tan Chi and newly pump station in Han Quang.

3) Alternative Study

Alternative studies were evaluated by using project cost, incremental benefit, and economic internal rate of return and social and environmental aspects (see Economic Evaluation). Option-1 is recommendable for the scale of the development.

(3) Development Plan

1) Improvement of Drainage System

Design Rainfall: Consecutive three days rainfall 248 mm with 1/10 probability

Drainage Discharge :

(unit : m³/sec)

	Plan	Existing Drainage	Additional Discharge	Total
Option-1	Tan Chi individual	15.11	16.0	31.11
Option-2	Combined Drainage (Tan Chi + Han Quang)	15.11	26.0	41.11

Tan Chi pumping station would be replaced with new pumps and transformer facilities, and improved in the structures and buildings of the station. Additional pumping station would be constructed in Tan Chi or Han Quang.

The major control gates, such as Tram sluice, La Miet sluice, Ba Cay sluice and others necessary for water control would be improved to make it operational. The bridges and conduit would be enlarged into the adequate size.

The existing drainage canals including Tao Khe and Tan creeks would be improved to meet the increased drainage requirement.

2) Irrigation Plan

Water Requirement :	Winter/Spring Crops	556 mm
	Summer Crops	303 mm
Design Discharge :		1.3 lit/sec/ha

The south Trinh Xa Canal would be improved, focusing on the implementation of effective water management. The secondary and tertiary canals would be

improved and/or upgraded upto the point which has a commanded area of not less than 50 ha.

(4) Agricultural Development

1) Agricultural Production Plan

300 kg/capita/year of paddy is the base line of food security in Viet Nam. Considering the growth rate of population in this area, 2.3 percent, the population will be 181,000 in 2000 year and 212,000 in 2010 year. Under the proposed cropping pattern, the area will be able to supply 337 kg/capita in 2000 year and 269 kg/capita in 2010. Even the cropping intensity is proposed at 2.44, food problems will become severe. Promotion of animal husbandry and inland fishery will contribute to mitigate deficiency of food and to improve food structure.

2) Marketing and Processing

Agricultural production in the area will be remarkably increased as 11,331 tons of paddy and 2,450 tons of industrial crops. Establishment of marketing information center and provision of storage facilities are indispensable.

Processing facilities for agricultural products, such as husking and vegetable oil extracting, in the area (Bac Ninth) and its surrounding area (Bac Giang, Ha Bac province) satisfy a need for actual crop production. Concerning tomatoes, it will be possible to attract the processing factory for tomato or to incorporate tomato processing into the factory.

3) Supporting System and Extension Services

The seed law has to be enacted as soon as possible to supply good quality seed to farmers and it is proposed to enforce the capacity of seed multiplication farm.

Fertilizer distribution system has to be improved to supply cheaper fertilizer to farmers timely in cropping season and setting up a new organization to integrate the fertilizer.

Strengthening of farm credit especially for small scale farmhousehold is the most important subject to support farmers.

Strengthening of extension activities is focused upon the followings:

- Training extension staff through seminars

- To equip the extension station with vehicles and some tools for extension staff.
- To invest on some more demonstration plots.
- Training program on rice-cum-fish, rice/fish rotation.
- Training program on rearing techniques on producing fingerlings.

4) Renovation Plan of Farmer's Organization

To make the farmer's organization as a base of productive and socio/cultural activities, unification of unit organization is essential condition. In case of renovation of farmer's cooperative, it is recommended to transfer the land management function of existing cooperatives to the people's committee of commune or other administrative offices together with function of collection of land tax and water fee.

5) Farm Household Economy

Small-scale farmer can gain the surplus income (about 99 US\$) without off-farm income even such small-scale farm and family labor force. A proportion of animal husbandry income reaches about 36 percent.

Medium-scale farmer earns the surplus income (about 350 US\$) which shows three times as compared with the present situation. Animal husbandry income accounts for about 37 percent.

Large-scale farmer can afford to perform the sufficient farming owing to considerable farm income (about 1,000 US\$).

(5) facility Plan

1) Scope of Facility Plan

The facilities of the Project will cover a pumping station, drainage canals, irrigation canals, fish ponds and their appurtenant facilities. The areas subjective to the facility plan are Tan Chi and Han Quang.

2) Plan of Drainage Pumping Station

The type and number of pumps installed to the proposed drainage pumping station has been selected based on the comparative studies. Major dimensions on the designed pumping station are as follows:

Item	Tan Chi	Han Quang
Design Discharge (m ³ /s)	16.00	26.0
Design High W.L (m)	9.63	9.13
Low W.L (m)	2.00	1.50
Pump Bore (mm)	1,350	1,350
Number of Pump (unit)	4	6
Total Power (kw)	1,642	2,463

3) Plan of Irrigation and Drainage Canal

All drainage canals are proposed to be widened and deepened in order to meet the design discharge. The land acquisition required for widening canal-sections will be 35m in width and the waste land along canals will be available. Gate structures are planned at the place of crossing structures to regulate the water level. The brick lining is proposed to increase existing canal capacities.

4) Construction Plan

The temporary road to access the proposed pumping station will be provided for construction and will be remained as a maintenance road after completion of construction of the pumping station. All high voltage transmission lines shall be shifted to the safety places with 8m height.

The Tao Khe creek and Trinh Xa canals are too wide and the dike is too high to excavate the canal-bed by using a back hoe machinery and/or drag line, so that a small dredger is proposed to deepen and widen canals.

Irrigation canal works are composed of excavation, brick lining, turnout structures and will be executed under dry conditions.

(6) Project Cost

The project cost was studied for the following alternatives in both Tan Chi area and the whole project area including Han Quang area, depending upon the project components.

Alternative 1: drainage improvement

Alternative 2 : drainage improvement
 +
 irrigation improvement

Alternative 3 : drainage improvement
 +
 irrigation improvement
 +
 fish pond construction

The construction cost of the pumping station was estimated for the case of Viet Nam made pump and foreign made pump.

The followings are summary of the estimated project cost.

Project Cost

(Unit : 1,000 US\$)

	Viet Nam made Pump		Foreign made Pump	
	Tan Chi	Whole Area	Tan Chi	Whole Area
Alternative 1	13,136	20,081	29,525	42,501
Alternative 2	15,987	22,945	32,376	45,365
Alternative 3	16,399	23,738	32,788	46,158

Among the above alternatives, Alternative 3 has been selected for the project evaluation, based on needs of local farmers, economic benefits and discussions between Vietnamese side and the Study Team. As studies in Project Evaluation, the project cost is finally proposed for the case of Viet Nam made Pump and the Whole Area.

B-3 Implementation and Operation/Maintenance Program of the Project

(1) Implementation Program

The Executing Agency for the Project would be the Ministry of Water Resources (MWR). The MWR would be responsible for the planning, design, bidding and supervision of the project works, and keep close coordination with the agencies concerned on the project approval, finance and project implementation.

Concerning the construction method, the procurement of mechanical and electrical equipment, construction of pumping station and major irrigation and/or

drainage canals and structures as well as construction of fish ponds would be executed by the contract works. The construction of small irrigation and drainage canals have depended on the farmers concerned, but it is suggested for the small irrigation and drainage canals to be implemented by the force account works under the Project.

The Project requires about one year and a little more for pre-construction activities, therefore, the Project would be completed by six to seven years, while the construction works are expected to be accomplished within five years. In case construction and rehabilitation of irrigation and drainage canal systems would be implemented simultaneously with pumping stations, the implementation period could be within four years if Vietnamese budget allocation is timely made.

(2) Operation and Maintenance

For executing adequate drainage control, the operation manuals for drainage sluices and pump should be prepared and in order to implement the adequate and effective water management, preparation of water management manuals included operation of regulating sluices and turnout gates and education/training to the staffs concerned would be required.

The cost necessary for the operation and maintenance would be managed within the amount collected as a water fee from the farmers while some financial assistance of the government might be necessary in case of huge construction costs required.

The organization would follow the present organization of Bac Duong Irrigation Enterprise in principal, since the Project Area is situated within its management. In future, the Province/Enterprise would take the initiative in every operation and maintenance of the project facilities. The small scale pumping stations and small canals below the secondary canals for irrigation and drainage should be operated and maintained by the farmers concerned.

B-4 Project Evaluation

(1) Economic Evaluation

Economic evaluation of the Project will be made on the basis of the proposed cropping pattern B, two cases; option 1 (Tan Chi Area) and Option 2 (Whole Area) with Viet Nam made pump and of foreign made pump.

Economic benefits of the project generated from the project implementation are made up of three categories of benefits; agricultural production, inland fishery, and other benefits (prevention effects against flood and waterlogging damages).

1) Agricultural Production Benefits (Crop Benefits)

Crop benefits comprise incremental net agricultural production values brought about by the improvement of drainage facilities, provision of irrigation water and supporting services to the farmers. Agricultural production benefits are shown as follows:

Option 1 (Tan Chi Area)

(Unit : 1,000 VND)

Item	With Project	Without Project	Increased Value
Gross Production Value	94,223,235	52,385,018	41,838,217
Production Cost	32,077,174	24,642,704	7,434,470
Net Production Value	62,146,061	27,742,314	34,403,747

Option 2 (Whole Area)

(Unit : 1,000 VND)

Item	With Project	Without Project	Increased Value
Gross Production Value	116,815,000	65,829,767	50,985,233
Production Cost	39,687,111	31,027,500	8,659,611
Net Production Value	77,127,889	34,802,267	42,325,622

2) Inland Fishery

Inland fishery benefits can be expected through aquaculture in the ponds. Incremental annual benefit can be expected as follows:

- Option 1 (Tan Chi Area) 596,323,000 VND
- Option 2 (Whole Area) 920,792,000 VND

3) Other Benefits

Other benefits can be defined as the anticipated effects of the prevention against flood and water-logging damages, with the project implementation.

- Option 1 (Tan Chi Area) 4,802,118,000 VND
- Option 2 (Whole Area) 6,499,573,000 VND

4) Project Cost

Economic project costs in alternative 3 are estimated as follows:

(Unit : million VND)

Item	Viet Nam made Pump	Foreign made Pump
Option 1 (Tan Chi Area)	149,406	305,278
Option 2 (Whole Area)	219,154	433,918

5) Economic Internal Rate of Return

The project justification is mainly appraised based on the calculation of economic internal rate of return (EIRR).

EIRR

(Unit : %)

Item	Viet Nam made Pump	Foreign made Pump
Option 1 (Tan Chi Area)	26.9	11.1
Option 2 (Whole Area)	21.2	9.4

Judging from the EIRR, the drainage plan in either case is economically feasible. In this plan, the case of Viet Nam made pump can be obtained over 20 percent of the EIRR. In case of foreign made pump, it shows that the Project is also feasible, comparing obtained EIRR (9.4%) with 4% of EIRR in case of introduction of drainage improvement project only for Tan Chi area.

(2) Financial Analysis of Typical Farmer

Financial analysis of typical farmers in the Project Area was made on the basis of the results of the farm survey.

Financial Analysis of Typical Farmers

(Unit : 1,000 VND)

Typical Farmer		Gross Income	Surplus Income
Small-scale	without Project	1,965	- 627
	with Project	3,757	556
Medium-scale	without Project	4,665	144
	with Project	8,371	2,400
Large-scale	without Project	6,106	809
	with Project	12,526	5,032

Substantial improvement of farm household economy in the Project Area can be expected as a result of the project implementation.

(3) Socio-Economic Evaluation

With the implementation of the Project, mitigation of inundation in downstream areas, increase in agricultural production, generation of job and employment opportunities for construction works of the project and agricultural production, and the impact for agricultural sector concerned will be anticipated by bringing about the secondary and indirect effects.

(4) Environment

1) Negative Impact associated with the Implementation of the Project

There is a possibility that implementation of the project may induce negative impacts by the followings.

- Environmental Impacts associated with Change of Water Management
- Negative Influence associated with Local Economic Activities
- Environmental Impacts associated with Construction

2) Positive Impacts associated with Implementation of the Project

Direct and indirect effects will be generated as:

- Increase of agricultural production and inland fishery production
- Benefit effects reduced by improvement of irrigation and drainage systems
- Improvement of residential environmental condition in rainy season
- Improvement of public health condition

- Improvement of convenience of transportation
- Improvement of employment chance

(5) Overall Evaluation

Based on the result of economic evaluation, the project for Option-1 (Tan Chi area) by using Viet Nam made pump and materials is the most advantageous in terms of economic internal rate of return (26.9%) among alternatives. Also, Option-2 (Tan Chi and Han Quang areas) / use of Viet Nam pump and materials presents a high economic internal rate of return (21.2%). However, introduction of foreign made pump and materials is worthy of evaluation, taking into consideration the following reason and effects, though the EIRR is low.

- Pump manufacturing and quality control for a large scale of pump diameter are not actually given in Viet Nam.
- Opportunity of technology transfer on the future development of pump-technology will be given in order to produce large scale of pumps with high quality at a Vietnamese national pump factory in an early stage.
- Efficient operation and maintenance of irrigation and drainage systems will be realized by using modernized equipment.
- Effects on other similar projects in the Red River Delta

Concerning financial analysis of typical farmers, substantial improvement of farm household economy in the area is expected and farmers can get surplus income as a result of the project implementation.

The project implementation will lead the area to poverty eradication, prevention of disease, food security by stabilization of farming, expansion of employment opportunities and expansion of regional economy and correction of economic differentials. The Project will meet such basic human needs and extend socio-economic impacts on activation of the rural area.

C CONCLUSION AND RECOMMENDATION

C-1 Conclusion

JICA Study Team has carried out the feasibility study for the priority area covering 8,540 ha which was selected in the master plan study on improvement project of drainage systems and related agricultural development in South Bac Duong Agricultural Area. Based on the Study, the Project for Tan Chi area is most feasible from an aspect of economic evaluation. However, considering the social and environmental benefits and effects, the project for Tan Chi and Han Quang areas is proposed as the first priority.

The Project is composed of drainage improvement including irrigation and construction of fish ponds. Those components are the minimum requirements for the local farmers who have been desiring earnestly for the past many years. The implementation of this project will meet basic human needs and extend socio-economic impacts on activation of the rural area, assuring poverty eradication, prevention of disease and food security by stabilization of farming.

Introduction of foreign made pump and materials for the Project is worthy of consideration though economic internal rate of return is lower than that in case of Viet Nam made pump and materials. The following issues should be considered for the project justification.

- Pump manufacturing and quality control for a large scale of pump diameter are not actually given in Viet Nam.
- Opportunity of technology transfer on the future development of pump-technology will be given in order to produce large scale of pumps with high quality at a Vietnamese national pump factory in an early stage.
- Efficient operation and maintenance of irrigation and drainage systems will be realized by those modernized equipment.
- Effects on other similar projects in the Red River Delta.

In this report, the Project for Tan Chi and Han Quang areas is proposed as the first priority project, but it is urgently necessary to promote drainage projects according to phasing development identified in the Master Plan and to contribute to correct economic differentials.

From a view point of medium and long term plans, agricultural infrastructures should be improved as the first step and rural life and environment should be enriched by improvement of social infrastructures.

To extend multiple and intensive agriculture in the area, coping with market economy, strengthening of agricultural supporting system and extension services are expected to related staffs to acquire new technology and knowledge through seminar and training.

To execute the adequate operation and maintenance of irrigation and drainage facilities after implementation of the Project, the operation manuals for drainage sluices and pumps should be prepared. In addition, education/training to the staffs and farmers would be required.

Concerning renovation of farmer's cooperative, it is recommended to form the unit cooperatives in scale and activities. The farmer's cooperative and association is expected to be substantially unified.

C-2 Recommendation

It is recommendable to promptly implement the Project for Tan Chi and Han Quang areas with duly attention to the followings.

- (1) To realize prompt commencement of the project implementation, the proposed organization have to be provided soonest possible.
- (2) Project implementating agencies have to give farmers' employment opportunity in the implementation of the Project.
- (3) Appropriate countermeasures should be taken for negative influences on environment occurred by implementation of the Project.

CONTENTS

GENERAL PLAN - MASTER PLAN AREA

GENERAL PLAN - PRIORITY AREA

SUMMARY

CONTENTS

LIST OF APPENDICES

ABBREVIATION

UNIT AND CONVERSION FACTOR

PART I MASTER PLAN STUDY ON DRAINAGE IMPROVEMENT AND AGRICULTURAL DEVELOPMENT IN SOUTH BAC DOUNG AREA

	Page
CHAPTER 1 INTRODUCTION	1- 1
1.1 Background of the Study	1- 1
1.2 Objectives and Scope of the Study	1- 1
1.3 Agencies Concerned in the Study	1- 2
CHAPTER 2 BACKGROUND	2- 1
2.1 The Country's Profile	2- 1
2.2 National Economy and Agricultural/Rural Features	2- 3
2.2.1 National Economy	2- 3
2.2.2 Agricultural/Rural Features	2- 4
2.2.3 National Development Plan and Agricultural/Rural Development Policies	2- 4
2.3 Water Resources Development	2- 6
2.3.1 Planning and Policy of the Development	2- 6
2.3.2 Red River Delta Development Plan	2- 7
2.3.3 Projects/Studies Related to the Study	2- 7
2.4 Problems and Needs in the Study Area	2- 9

CHAPTER 3	THE STUDY AREA	3 - 1
3.1	General Features	3 - 1
3.1.1	Location and Area	3 - 1
3.1.2	Climate and Hydrology	3 - 1
3.1.3	Topography and Geology	3 - 5
3.1.4	Roads and Transportation	3 - 5
3.2	Present Agriculture	3 - 7
3.2.1	Soils	3 - 7
3.2.2	Present Land Use and Land Holding	3 - 8
3.2.3	Crop Cultivation and Production	3 - 10
3.2.4	Livestock	3 - 15
3.2.5	Inland Fishery	3 - 16
3.2.6	Agricultural Processing	3 - 18
3.2.7	Agriculture Supporting Services	3 - 18
3.3	Present Agricultural Infrastructures	3 - 21
3.3.1	Present Irrigation and Water Supply	3 - 21
3.3.2	Drainage Facilities and Inundation	3 - 24
3.3.3	Farm Roads	3 - 28
3.4	Agricultural Economy	3 - 29
3.4.1	Population and Labor Force	3 - 29
3.4.2	Economic Profile	3 - 29
3.4.3	Farm Household Economy	3 - 30
3.4.4	Agricultural Input Material and Equipment	3 - 31
3.4.5	Marketing and Distribution System	3 - 33
3.5	Rural Community and Organization	3 - 36
3.5.1	Regional Administration and Community	3 - 36
3.5.2	Villager's Organization	3 - 37
3.5.3	Social Infrastructures and Administration	3 - 38
3.5.4	Local Industries	3 - 41
3.6	Environment	3 - 42
3.6.1	Present Environment in the Study Area	3 - 42

3.6.2	Environmental Administration and Procedure of Approval for IEE & EIA	3 - 45
3.6.3	Initial Environmental Examination (IEE)	3 - 46
CHAPTER 4	DEVELOPMENT PLAN	4 - 1
4.1	Development Concept	4 - 1
4.1.1	Objectives of the Development	4 - 1
4.1.2	Development Potentials and Constraints	4 - 1
4.1.3	Development Strategy	4 - 5
4.1.4	Related Development Plan	4 - 6
4.2	Agriculture Development Plan	4 - 7
4.2.1	Basic Concept of Future Farming	4 - 7
4.2.2	Proposed Land Use	4 - 8
4.2.3	Proposed Cropping Pattern	4 - 10
4.2.4	Farm Management Plan	4 - 11
4.2.5	Production Plan	4 - 12
4.2.6	Animal Husbandry Development Program	4 - 14
4.2.7	Inland Fishery Development Program	4 - 15
4.2.8	Agro Processing Program	4 - 16
4.3	Improvement of Agricultural Infrastructures	4 - 18
4.3.1	Water Resources Planning	4 - 18
4.3.2	Irrigation System Improvement	4 - 19
4.3.3	Drainage System Improvement	4 - 22
4.3.4	Farm Road Improvement	4 - 26
4.4	Strengthening of Agricultural Supporting Service	4 - 27
4.4.1	Strengthening of Research and Extension Service	4 - 27
4.4.2	Agricultural Material Supply Program	4 - 28
4.4.3	Consolidation of Farmer's Organization	4 - 31
4.5	Marketing and Distribution Plan	4 - 33
4.5.1	Marketing	4 - 33
4.5.2	Post-Harvest Facilities Improvement	4 - 33
4.5.3	Distribution System Setup	4 - 33

4.6	Improvement of Rural Infrastructure and Services	4 - 35
4.6.1	Improvement Plan of Main Farm Road	4 - 35
4.6.2	Improvement of Water Supply and Sewerage	4 - 37
4.6.3	Rural Electrification Plan	4 - 37
4.6.4	Improvement of Public Sanitary Service and Administration	4 - 38
4.6.5	Improvement of Educational and Cultural Facilities	4 - 38
4.6.6	Rural Community Activating Plan	4 - 39
4.7	Water Control and Management	4 - 42
4.7.1	Organization and Management	4 - 42
4.7.2	Water Control Plan for Drainage Systems	4 - 43
4.7.3	Water Management for Irrigation Systems	4 - 43
4.7.4	Operation and Maintenance of the Structures	4 - 44
4.8	Environmental Conservation Program	4 - 46
4.8.1	Items of Environmental Study and EIA	4 - 46
4.8.2	Environmental Conservation Program	4 - 49
CHAPTER 5	SELECTION OF PRIORITY PROJECT	5 - 1
5.1	Alternative Schemes of Drainage Improvement	5 - 1
5.1.1	Regional Drainage Schemes	5 - 1
5.1.2	Decentralization Drainage Schemes	5 - 1
5.2	Logical Sequence of Drainage Improvement	5 - 2
5.2.1	Evaluation of Alternative Schemes	5 - 2
5.2.2	Selection of Priority Area	5 - 3

PART II FEASIBILITY STUDY ON PRIORITY AREA

	Page
CHAPTER 1 THE PROJECT AREA	1 - 1
1.1 Location and Socio-Economic Conditions	1 - 1
1.1.1 Location and Geography	1 - 1
1.1.2 Population and Socio-Economic Conditions	1 - 2
1.2 Natural Condition	1 - 4
1.2.1 Topography	1 - 4
1.2.2 Climate	1 - 4
1.2.3 Hydrology	1 - 4
1.3 Soil and Land Use of Tan Chi Area	1 - 6
1.3.1 Soils	1 - 6
1.3.2 Land Use	1 - 7
1.4 Agriculture	1 - 9
1.4.1 Agricultural Condition and Production	1 - 9
1.4.2 Animal Husbandry and Inland Fishery	1 - 11
1.4.3 Agricultural Economy	1 - 14
1.4.4 Marketing and Processing	1 - 15
1.4.5 Agricultural Supporting Service	1 - 16
1.4.6 Farmer's Organization	1 - 19
1.5 Irrigation and Drainage	1 - 21
1.5.1 Irrigation and Drainage Systems	1 - 21
1.5.2 Farm Road	1 - 24
1.6 Related Project	1 - 25
1.7 Problems and Needs of the Project	1 - 27
CHAPTER 2 DEVELOPMENT PLAN	2 - 1
2.1 Objectives and Strategy of the Development	2 - 1
2.1.1 Objectives	2 - 1
2.1.2 Approach to the Development	2 - 1
2.1.3 Relation between National Plan and the Project	2 - 2

2.2	Basic Concept of the Development	2- 3
2.2.1	Proposed Project Area	2- 3
2.2.2	Improvement of Drainage Systems	2- 3
2.2.3	Proposed Cropping Pattern	2- 5
2.2.4	Optimum Scale of Development	2- 7
2.3	Development Plan	2- 8
2.3.1	Land Use Plan	2- 8
2.3.2	Improvement of Drainage Systems	2- 9
2.3.3	Irrigation Plan	2- 13
2.4	Agricultural Development Plan	2- 15
2.4.1	Agricultural Production Plan	2- 15
2.4.2	Farm Management	2- 17
2.4.3	Marketing and Processing	2- 19
2.4.4	Supporting System and Extension Services	2- 20
2.4.5	Renovation Plan of Farmer's Organization	2- 21
2.4.6	Farm Household Economy	2- 22
2.5	Facility Plan	2- 24
2.5.1	Scope of Facility Plan	2- 24
2.5.2	Plan of Drainage Pumping Station	2- 25
2.5.3	Plan of Irrigation and Drainage Canal	2- 26
2.5.4	Farm Road Plan	2- 27
2.5.5	Construction Plan	2- 27
2.6	Project Cost	2- 30
2.6.1	Method of Cost Estimation	2- 30
2.6.2	Project Cost	2- 31

CHAPTER 3 IMPLEMENTATION AND OPERATION AND MAINTENANCE OF THE PROJECT 3- 1

3.1	Implementation Program	3- 1
3.1.1	Implementation Agency	3- 1
3.1.2	Construction Method	3- 1
3.1.3	Construction Schedule	3- 2

3.2	Operation and Maintenance	3 - 4
3.2.1	Method of Operation and Maintenance	3 - 4
3.2.2	Organization of Operation and Maintenance	3 - 5
3.2.3	O&M Equipment and Facilities	3 - 6
3.2.4	Operation and Maintenance Cost	3 - 7
3.3	Consulting Services	3 - 9
 CHAPTER 4 PROJECT EVALUATION		 4 - 1
4.1	Method of Project Evaluation	4 - 1
4.2	Economic Evaluation	4 - 1
4.2.1	Orientation of Economic Evaluation	4 - 1
4.2.2	Evaluation Criteria	4 - 1
4.2.3	Economic Prices	4 - 2
4.2.4	Project Benefits	4 - 4
4.2.5	Project Costs	4 - 5
4.2.6	Economic Internal Rate of Return	4 - 7
4.2.7	Sensitivity Analysis	4 - 8
4.3	Financial Analysis of Typical Farmer	4 - 10
4.4	Socio-Economic Evaluation	4 - 12
4.5	Environment	4 - 13
4.5.1	Negative Impacts Associated with the Implementation of This Project	4 - 13
4.5.2	Positive Impacts Associated with the Implementation of This Project	4 - 16
4.5.3	Conclusion	4 - 17
4.6	Overall Evaluation	4 - 18
 CHAPTER 5 CONCLUSION AND RECOMMENDATION		 5 - 1
5.1	Conclusion	5 - 1
5.2	Recommendation	5 - 2

LIST OF APPENDICES

- A. Participant to the Study
- B. Meteorology and Hydrology
- C. Soil and Land Use
- D. Agriculture and Inland Fishery
- E. Irrigation and Drainage
- F. Agricultural Infrastructure
- G. Rural Sociology and Organization
- H. Environmental Study
- I. Agro-Socio Economy and Project Evaluation

ABBREVIATION, UNIT AND CONVERSION FACTOR

ABBREVIATION

ADB	: Asian Development Bank
AVRDEC	: Asian Vegetable Research Development and Information Extension Center
CITES	: Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMD	: Construction Management Department
EIA	: Environmental Impact Assessment
EPZ	: Export Processing Zones
FAO	: Food and Agriculture Organization of the United Nations
FADINAP	: Fertilizer Advisory, Development and Information Network of Asia and the Pacific
FCRI	: Food Crops Research Institute
FYM	: Farm Yard Manure
GDP	: Gross Domestic Product
GNP	: Gross National Product
HIV	: High Yield Variety
IEE	: Initial Environmental Examination
INSA	: Institute for National Scientific Agriculture
IPM	: Integrated Pest Management
IRRI	: International Rice Research Institute
ISF	: Research Institute for Soil and Fertilizer
IWRPM	: Institute of Water Resources Planning and Management
IUCN	: International Union of Conservation of Nature
IVFR	: Institute for Vegetable and Fruits
JICA	: Japan International Cooperation Agency
MAFI	: Ministry of Agriculture and Food Industry

MSTE	: Ministry of Science, Technology and Environment
MWR	: Ministry of Water Resources
NIAPP	: National Institute of Agricultural Planning and Projects
P.C	: People's Committee
RIA	: Research Institute for Aquaculture
SCS	: State Committee for Science
SPC	: State Planning Committee
UNICEF	: United Nations International Children's Emergency Fund
VAC	: Vuon (garden), Ao (fish pond), Chuong (poultry shed)
VIHID	: Viet Nam Hydraulic Investigation and Design Corporation
WB	: World Bank

UNIT

BM	: Bench Mark
EL	: Elevation Above Mean Sea Level
M.	: Million
WL	: Water Level
cu.m	: Cubic Meter
MCM	: Million Cubic Meter
KWH	: Kilowatt Hour
l	: liter
ha	: Hectare
m	: Meter
kg	: Kilogram
km	: Kilometer
sq.m	: Square meter
ton	: Metric ton
hr	: Hour
min	: Minute

sec : Second

°C : Degree Celsius

CONVERSION FACTOR

1 sao : 360 m²

US\$ 1.00 : 10,996 VND (Viet Nam Dong) 1994, Aug.

PART I

MASTER PLAN STUDY ON DRAINAGE IMPROVEMENT AND AGRICULTURAL DEVELOPMENT IN SOUTH BAC DOUNG AREA

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The Government of Viet Nam aims at increase of food production and growth of Gross National Product, as a major target in the Fifth Five Years Plan (1991-95), taking a main strategy of agricultural development to increase food crops by leading rice and develop the agricultural resources untouched (unused and possibly cultivable land).

South Bac Duong area is located within the Red River Delta, which is the most important agricultural land in the country along with the Mekong Delta, and is of great advantage to farming, being adjacent to the capital city, Hanoi. However, farming in the rainy season is inactive because a large area of farm land is inundated every year by persistent floods which are brought about by unsubstantial agricultural infrastructures, such as deteriorated irrigation and drainage facilities, and high water level of the Red River and other rivers surrounding the area.

The Government of Viet Nam, giving the first priority to improve the productivity of agricultural land which lies in the favorable farming conditions and has an important role to supply the capital area, Hanoi city, with food products, requested the Government of Japan to extend the technical assistance for formulation of the Improvement Project of Drainage System in South Bac Duong agricultural area.

1.2 Objectives and Scope of the Study

The objectives of the Study are (1) to prepare a master plan in order to formulate an improvement of drainage system and concerned agricultural development plan (2) to conduct a feasibility study for the selected project area identified through the master plan, and (3) to carry out technology transfer to the counterpart personnel of the Government of Viet Nam in the course of the Study.

In order to achieve the above objectives, the Study consists of two (2) phases.

Phase I involves (1) collection and review of existing data and information and field survey (2) formulation of a master plan for the improvement plan of drainage system and concerned agricultural development for the Study Area

(40,000 ha) (3) identification of the priority project through the master plan study.

Phase II involves (1) collection of data and information in the selected project area through additional field survey (2) formulation of the improvement plan of drainage system and concerned agricultural development plan in the selected project area (3) preparation of environmental conservation plan, preliminary design, operation and maintenance plan (4) project implementation plan, the project costs and benefits, and (5) evaluation of the project.

1.3 Agencies Concerned in the Study

The Ministry of Water Resources is the major implementation agency in the Study. Other agencies concerned in the field of agriculture development and environment are the Ministry of Agriculture/Food Industry and the Ministry of Science, Technology and Environment, respectively. The State Planning Committee is concerned with coordination among agencies, national planning, budget allocation and external assistance.

In the Study Area, the people's committee of Ha Bac Province and those of district and communes organized under the Province fully support and cooperate the Study Team. In order to perform the Study, the Steering Committee is organized at central agencies concerned. The Committee consists of the above personnel.

CHAPTER 2 BACKGROUND

2.1 The Country's Profile

The Socialist Republic of Viet Nam forms a S-shaped on the eastern seaboard of the Indochinese Peninsula, and stretches vertically between latitude 23°22'N and 8°30'N, and horizontally between longitude 102°10'E and 100°30'E. The total area of the country is about 330,036 km², which consists of 53 provinces and cities including the Hanoi Capital and Ho Chi Minh City.

According to topography and climate, the country is divided into seven regions: the North mountain and Midland, the Red River Delta, the Central coast of Northland, the Central coast of Southland, the Central Highland, the Northeast of Southland, and the Mekong River Delta. These regions comprise of the Annamitique Chaine which run through from north to south in the west of the country, the Red River Delta in the north, the Mekong River Delta in the south, and narrow coastal plains in the central.

Viet Nam, belongs to tropical zone according to latitude, has a tropical humid climate strongly influenced by Asian monsoon; however, winter is the dry season. In the Red River Delta of the north, the average temperature in winter (December to April) is 16°C, but summer (May to October) is abundant of rainfall and heat, and a typhoon is also struck frequently. The Mekong River Delta in the south has a monsoonal climate with 25°C~30°C in mean annual temperature. Annual rainfall range is from 1,600 mm to 2,500 mm throughout the country.

According to the National Census 1989, the total population of the country is 64,411,713, and an annual population growth rate is 2.10% since 1979. Average population density is 195 persons per km². The population distributes 20.11% in urban area and 79.89% in rural area. Economically active population (in Viet Nam people older than 13 years are taken into account) is estimated at 74.2% (about 47,793 thousand) of the total. Unemployment rate is 5.8% in national level (urban area: 13.2%, rural area: 4.0%).

The population is concentrated in the Red and Mekong River Deltas. The two largest cities, Ho Chi Minh City (4.1 million) and Hanoi (2.1 million), account for about 44 percent of the urban population. Most of the border areas are mountainous and relatively sparsely populated. Ethnic Vietnamese (Kinh) account for about 87 percent of the population, and live mainly in the major delta

areas and coastal plains. The remainder consist of 53 minority groups, generally located in the mountainous areas.

Viet Nam's endowment of natural resources includes: limited, but productive, agricultural land; oil, coal and mineral resources; hydro-electric potential; and forest and marine resources. More important, however, is Viet Nam's considerable potential in terms of human resources. The population is better educated, and has a higher life expectancy, than most countries with a similar per capita income.

Viet Nam's economy is traditionally founded on agriculture. The agricultural sector, including forestry and fishing, accounted for about 34.50 percent of GDP, nearly three quarters of national employment, and about 49 percent of export earnings in 1992. Paddy production dominates agricultural output and rice is the major agricultural export.

The industry sector, including construction, accounts for about 22.6 percent of GDP, 14 percent of total employment, and about 51 percent of exports in 1992. The industrial sector remains relatively small and is concentrated in crude oil production and light manufacturing. The major industrial exports are crude oil (which has increased dramatically since 1987), coal and light industry and handicrafts.

The overall industrial sectors have been notably developed since 1990, by accelerating the innovations of economic management mechanism (doi moi) which was put into practice by a series of specific policies, directives, and solutions.

2.2 National Economy and Agricultural/Rural Features

2.2.1 National Economy

By institute new economic policy (renovation of economic management mechanism, i.e., introduction of market economy) under the National Economic Construction and Development 5-Year Plan (1986-1990) which made a historical changing point on the national economy. Viet Nam's gross domestic products (GDP) had been increased 26.4% (annual average of 4.8%) during this period. In medium term plan up to the year 2000 established by the government, annual growth rate from 1991 to 1995 is set up 7.2%.

Referring to the national statistics 1992, the structure of GDP by industrial sector is in order as agriculture and forestry (34.5%), manufacture (22.6%), commerce and trade (12.3%), and public services (10.1%). Viewing average annual growth rate from 1990 to 1992, the sectors which attained high growth rate are; finance and insurance (26.0%), manufacture (11.8%), individual services (9.8%), and public services (9.3%). The growth rate of agriculture and forestry, as an important sector of the GDP, remains 4.3% of which figure is lower than the GDP's average rate of 7.4%. Besides, GDP per capita in 1992 shows US\$159.

Viet Nam's external trade is represented by agriculture and mining goods (coal, crude oil, rice, rubber, etc.) as export and petrochemical products, materials for agriculture (fertilizer, agrochemicals), vehicles, iron and steel, etc. The trade balance gained profit of US\$ 63 million in 1992, as against a deficit of US\$ 1,366.1 million in 1986. The most contributed export products in that year were crude oil (US\$ 790 million) and rice (US\$ 420 million).

In recent years, inflation was proceeding at an annual rate of about 70% (67.5% in 1990, 67.6% in 1991). But, under control by the Vietnamese authorities, its rate declined to 17% in 1992. Further the inflation was running at an annual rate of less than 10% in 1993.

Viet Nam's economy is in the renovation period with advantages and disadvantages, achievements and constraints, opportunities and challenges.

2.2.2 Agricultural/Rural Features

The agricultural sector in Viet Nam plays an important role in the national economy. The sector accounts for 35 percent of the GDP and 50 percent of national income. Food grain, particularly paddy rice production is a major component of the sector. The paddy rice production amounted to 22 million tons in 1992, of which 2 million tons were exported.

The livestock and aquaculture subsectors have grown rapidly at the rate of 8 percent per annum, but the production system remains traditional and feed availability and quality is based on local products.

Of the present population of 69.3 million (1992), 78 percent (54 million) is living in the rural area. Taking into account the total cultivated land of 6.93 million ha, an average area per capita, 0.1 ha is much smaller than that of other countries. Generally, a farm household has 0.2 ha to 0.3 ha in the north, 1 ha to 2 ha in the south.

This sector absorbs a greater proportion of the labor force: almost 72 percent is engaged in agriculture. But, farm sizes are too small to employ the full labor force even at the peak demand. Underemployment is predominant in rural areas. There is an almost surplus labor force of 30 to 40 percent.

There are almost 8,500 communes in 450 districts. An average population of each commune amounts 3,000 to 5,000, in the delta area, 7,000 to 10,000. Social infrastructures of rural areas are poor and not yet improved. The Government is strongly supporting investment for improvement of fresh water supply, electrification, housing, school, medical services and markets.

2.2.3 National Development Plan and Agricultural/Rural Development Policies

In the Five Year-Development Plan (1991-1995), Viet Nam's GDP will be twice as high as in 1990 with annual average rate of 7.2 percent. During 1991-1995, it will increase by 5.8 percent p.a; during 1996-2000, it will increase 9 percent p.a.

In the 1990's, Viet Nam food's production will increase with growth rate of 4.1 percent. The proportion of GNP will be 42 percent to agriculture and 28 percent to industry.

Agricultural/rural development policies up to the year of 2000 by the Government of Viet Nam aim at increment of food crop production, promotion of animal husbandry, effective use of land and improvement of labor force and agro-products in quality, getting rid of the backward and traditional agriculture characterized at low production yield/self-consumption.

In order to realize such policies, the change of the economic structure will lead to absorb surplus labor force in agriculture to other industrial sectors. This means efficiency of farming and increment of productivity and crop diversification are essential for improvement of family's daily meal nutrition. In addition to the above, stability of farm household economy depends upon establishment of agricultural cooperative and restructuring of marketing system under marketing economy.

2.3 Water Resources Development

2.3.1 Planning and Policy of the Development

The water resources development in the Viet Nam, involving the water source development, hydro-power generation, flood control, drainage improvement, irrigation development/improvement components, etc., has been realized in the construction of small scale reservoir dams for the irrigation component since 1954, and large scale dams mainly for the hydro-power generation with financial assistance of Council of Mutual Economic Assistance Countries particularly in 1980s. The small and medium scale project for flood control, irrigation and drainage components have also been implemented up to date.

The recent economic renovation initiated in 1988 brought about considerable activities in agricultural production. The Government has pursued the maximum use of land resources to enhance more agricultural productivity. In the fifth five year plan and its social and economic strategy, the increase of cropping intensity and expansion of irrigated farm land are proposed. In order to achieve these purposes, the Ministry of Water Resources has prepared the Investment Plan and Development Orientation in Vietnamese Water Resources Sector towards the year 2005 in its strategy for four regional areas, northern, central, southern and mountainous areas. The plan gives a priority to the development of the northern area, particularly leading in the Red River Delta, aiming to control inundation problems, protect major city from flooding, and improve irrigation capacity and efficiency. In the long-term, emphasis will place on the development of new flood control and irrigation development.

The development plan is worked out by the Ministry of Water Resources in national level and the Water Resources Division of Local Government in provincial level in reply to the request of Districts. The priority of local/regional irrigation and drainage project implementation will be given, taking into account engineering and economic viability, urgency, balance among the area and so on. High priority will be given to the rehabilitation and improvement of hydraulic structures. Under the above selection criteria, a high priority is given to the Bac Duong area for the project implementation.

2.3.2 Red River Delta Development Plan

The Red River Delta has had a long history in its development. A number of dikes and channels were constructed in the time of Ly and Tran dynasty. The Duong River connected between the Red River and Thai Binh River was excavated in 14 century. Many dams for purposes of hydropower generation, flood control, irrigation, etc. have been constructed in the river basin so far. In addition, the construction of several storage dams for flood control and hydropower generation are planned. In the Delta, about 3,400 pumping stations for irrigation and drainage have been constructed and an irrigated land area of some 750,000 ha have been developed. However, the review of the water resources development in the basin as well as the delta has been inquired.

Preparation of the Master Plan to guide the development of the Red River Delta was commenced on May, 1993 by the World Bank with financial assistance of UNDP and is expected to be completed by the end of 1994. It is understood that the Master Plan will involve preparation of short term, medium term and long term development plan selection of some projects for the feasibility study suitable for international institutes financing. Finally the Government will formulate the Red River Delta Development Plan based on the Master Plan prepared by the World Bank.

2.3.3 Projects/Studies Related to the Study

The Institute of Water Resources Planning and Management under the Ministry of Water Resources, has provided the study on the Project of Water Resources Planning for Bac Duong Area covering a gross land area of some 72,700ha. The South Bac Duong area is a part of this Bac Duong area bounded by the Ngu Huyen Khe River to the south.

The study report involves the physical characteristics of the area, such as geography, topography, and meteo-hydrology, social and economic status, present status of water resources works, drainage planning for Bac Duong area, and recommendation. Several schemes and alternative plan for the drainage improvement have been worked out and concluded to take prompt action on the implementation.

The Asia Development Bank has a plan to rehabilitate and/or upgrade approximately 20-30 small-scale to medium-scale irrigation and drainage sub-projects as a link of the Red River Delta Development. Phan Doi area located in

the north Bac Duong area is proposed for the first package projects, and the drainage improvement for Kim Doi drainage area and rehabilitation/improvement of Trinh Xa pumping station within the JICA Study Area are listed for the future sub-projects. According to the MWR, these projects are still under the stage of study, and the project implementation scheme will be reviewed and finalized after the completion of the World Bank Master Plan Study and JICA Study.

The other projects within the JICA Study Area are not noticeable, such as construction of locally funded small pumping station and domestic water supply project in Bac Ninh town and so on. These may not affect to formulation of the master plan study.

2.4 Problems and Needs in the Study Area

The Study Area has been strongly affected by heavy rainfall with longer duration which concentrates in the months of July to September and at the same time by occurrence of flood in the rivers. Every year, a large area remains fallow or inundated, thus, annual crop yield and production is low and unstable. Living standard of local people is very low comparing with other provinces in the neighborhood of Hanoi.

From a viewpoint of water resources, the irrigation and drainage systems in the Study Area has been provided since 1950's, but agricultural production of main crops is not remarkably increasing due to degradation and low capacity of their facilities. Outstanding issues in the Study Area are a large area of single crop cultivation and low yield. 6,200 ha of total single crop area 7,300 ha becomes fallow land, that concentrates in Yen Phong and Que Vo districts. Average paddy yield in Que Vo district, is 1.8 ton/ha and the lowest one in the heavily inundated year decreases at 0.81 ton/ha.

Considering the above problems existing in the area, major objectives of this Study are to establish an optimum drainage plan to solve persistent inundation in order to allow growing summer crops in the abandoned area and increasing the winter crop area to improve soil conditions. In addition to improvement of drainage, crop cultivation, distribution and marketing of agricultural products and strengthening of agricultural supporting services are required to be studied. The area is behind in development due to following the traditional agriculture in northern Viet Nam which are composed mainly of rice production.

To cope with market economy by free-market policy, gradually transforming from the transitional pattern of agriculture/forestry/fishery/to the new pattern of agricultural rural industry/commercial business, rural economy in the area is required to be established taking into consideration the following items.

Optimum land use, increase of production by intensive farming, improvement of crop variety through services of agricultural extension and guidance, adequate provision of post-harvest facilities, cropping pattern with high value, arrangement of surplus labor force in agricultural area, promotion of rural industries improvement of agricultural cooperatives in fund, technology and management, distribution and marketing, activation of rural community, improvement of social services and infrastructures and environment.

CHAPTER 3 THE STUDY AREA

3.1 General Features

3.1.1 Location and Area

The Study Area is located at a distance of about 30 km in the northeast of the Capital Hanoi, and in longitude about 106° East and latitude about 21° north. The area is situated in the northern part of the Red River Delta, surrounding with the rivers which are the Ngu Huyen Khe River and Long Tuu diversion canal on the north, the Cau River on the northeast and east and the Duong River on the south and west.

The area extends over three districts and one town in Ha Bac province and two districts in Hanoi City, and have a gross area of some 40,000 ha, as shown below:

(unit : ha)

District/Town	Juridical Area	Study Area	
Yen Phong	1,620	1,420	
Tien Son	15,400	14,850	
Que Vo	17,160	16,850	
Bac Ninh	2,640	2,540	
Sub-total	36,820	35,490	For Ha Bac
Dong Anh	1,090	960	
Gia Lam	4,240	3,570	
Sub-total	5,330	4,530	For Hanoi
Total	42,150	40,020	

3.1.2 Climate and Hydrology

(1) Climate

The climate in the Study Area belongs to the tropical monsoon zone, consisting of the dry season, November to March, and the rainy season, April to October. As the records at Hanoi meteorological station, mean annual rainfall is 1,661 mm, of which 89% fall in the rainy season, specially in July to September, in the dry season, mean monthly rainfall are recorded at 16-42 mm, and the average sunshine hour is short as 4.4 hour per day, and specially short in dry season as 2.9 hour per day.

The annual mean temperature is 24°C; the hottest month is July in terms of monthly mean temperature (29°C), and the lowest is 16°C in January. The annual mean relative humidity is high, as 82 percent. The annual mean evaporation is low, as 984 mm.

The prevalent wind direction in winter season is North-East with average speed of about 2.0 m/sec. The prevalent wind direction in summer season is South-East with average wind speed of about 1.8 m/sec. Typhoons and storms occur in the season from July to October. There are about 6.5 typhoons landed in a year, maximum times in 1973 is twelve ones.

In general, high temperature and sultry days prevail in the rainy season and cloudy days with widely varied temperature are lasting in the dry season. Summary of the climate are shown as follows (For climate in Hanoi, see Appendix B).

Climate of Hanoi

	Rainfall	RL. Humidity	Max RL. Humid	Evapo-ration	Wind speed	Sunshine	Tempe-ration	Max. Temp.	Mini. Temp
(Unit)	(mm)	(%)	(%)	(mm)	(km/hour)	(hour/day)	(°C)	(°C)	(°C)
Jan.	22.7	81.3	95	70.3	6.99	2.4	16.3	26.4	8.9
Feb.	27.1	84.2	95	58.6	7.99	1.7	17.1	27.7	9.9
Mar.	42.1	85.8	97	57.9	7.39	1.6	20.0	29.2	12.7
Apr.	105.0	86.3	96	65.8	7.99	3.0	23.7	32.3	16.5
May	173.5	82.5	95	96.7	7.88	6.1	27.4	36.7	20.4
Jun.	255.7	82.2	95	97.7	6.59	5.8	28.8	36.7	22.9
Jul.	256.2	81.8	95	99.4	6.54	6.5	29.1	36.9	23.4
Aug.	286.9	83.9	96	84.7	5.49	5.8	28.5	35.6	23.5
Sep.	247.0	82.7	96	85.9	5.61	6.1	27.4	34.2	21.7
Oct.	156.1	81.1	96	95.8	6.10	5.3	24.8	32.0	18.0
Nov.	72.7	79.0	95	88.0	5.91	4.6	21.3	29.9	13.6
Dec.	15.8	78.4	95	83.3	6.17	4.1	18.0	27.2	9.8
AVERAGE	138.4	82.4	95.5	82.0	6.7	4.4	23.5	32.1	16.8

(2) Hydrology

1) River System

The red river basin (A = 169,000 km²) is a wider river system, which is second in Viet Nam in terms of catchment area, originated in Van Nam province of China, and forms a huge delta interconnecting with rivers of Thai Binh river system.

The Study Area is situated in the nearly starting point of delta formation, and surrounded by the three rivers which are the Ngu Huyen Khe and Cau rivers in the Thai Binh river system and the Duong River in the Red river system. The Duong River is branch of the Red River connected with the Thai Binh River, which is excavated in 1390.

The Thai Binh basin ($A = 12,700 \text{ km}^2$) has the upstream area to the north east of the study area, extends to the south, and form a delta in the downstream reaches together with the Red River. The Ngu Huyen Khe River is a tributary of the Cau River which run to the south east on the north east of the study area. The Cau River is called as Pha Lai River after joining with the Thuong River. The Thai Binh River is named below the confluence of the Pha Lai River and the Duong River.

The Red River has an annual mean water discharge of about $3,710 \text{ m}^3/\text{sec}$ (average in 1902-92) and the lowest water discharge of $500 \text{ m}^3/\text{sec}$ (April, 1960) at Son Tay observation station. The water discharge of the Duong River is $939 \text{ m}^3/\text{sec}$ in an annual mean at Thuong Cat station located at about 7 km upstream from Long Tuu intake and the Cau River has an annual mean water discharge of about $50 \text{ m}^3/\text{sec}$ at Thac Buoï station located at about 30 km in the north of the study area. The water discharge records of the Ngu Huyen Khe River are scarcely available.

2) Hydrological Station

The water level records are available since the early 1900's from Thuong Cat station located at upper reaches of the Duong River, middle reaches of Duong River, Dap Cau station of The Cau River at north east of the Study Area and Pha Lai station of the Thai Binh River at the south east of the Study Area.

3) Maximum and Minimum Water Level

The annual maximum and minimum water level at each stations mentioned above are shown as follows.

(unit : m)

Year	Thuong Cat	Ben Ho	Dap Cau	Pha Lai
Average	10.77	8.02	5.42	5.83
Maximum	13.49 (1971)	9.44 (1985)	8.01 (1921)	7.15 (1986)
Minimum	9.24 (1965)	6.71 (1965)	2.83 (1954)	4.50 (1974)

4) Warning Water Level and Pump Operation

The warning water level for the protection of the embankment are set up at the hydrological data observation point of major rivers. Pumping stations in the Study Area can drain out when water level of the nearest station is below WL. 9.40 m at Ben Ho Station and 6.8 m at Dap Cau respectively. The warning water level at Ben Ho, Dap Cau, Pha Lai and Hanoi station are as follows.

(unit : m)

	Level-1	Level-2	Level-3
Ben Ho	6.60	7.50	8.40
Dap Cau	3.80	4.80	5.80
Pha Lai	3.50	4.50	5.50
Hanoi	9.50	10.50	11.50

5) River Network

The four rivers which run through the Bac Duong area are the Red River, Duong River, Cau River and Ngu Huyen Khe River. Duong River, a branch of the Red River, has a distance of 63 km passing the South Bac Duong area from its river mouth to Pha Lai and width of this portion vary 200 to 300 m. Within the area, Tao Khe creek is main drained canal of pumping stations. Irrigation water in this area comes mainly from Trinh Xa pumping station located at Ngu Huyen Khe River through South irrigation canal. Ngu Huyen Khe River originated from Thiep pond runs to Vuc De lake, Dang Xa sluice on the Cau River. The length from Vuc De lake to Dang Xa sluice is about 40 km with average width varying from 30 to 70 m.

6) Tao Khe Creek

Originating from Ninh Hiep, the water flows toward the East and joins Cau River at Hien Luong, the creek has a length of 37 km and contribute to Tien Son and South Que Vo districts as the main drainage canal. Tao Khe creek is a main drainage canal for Hien Luong, Tan Chi and Chi Phuong pumping stations. The width of creek vary from 15 to 30 m. There are some regulators such as Tram, La Miet along the creek.

7) Hydrological Characteristics

In dry season: Rainfall is not much, water level and discharge are low, weather is cold, rivers, ponds, lakes and swamps are dried up. Irrigation water supply by gravity using natural waters is not sufficient. The main water resources are Ngu Huyen Khe and Duong rivers. The water supply is by Cong Thon pumping station and Trinh Xa pumping station respectively.

In rainy season: Humidity is high, heavy rainfall, high water level, ponds, lakes and swamps are full of water. Ground water level reaches high, at this time much water in the field can not be drained by gravity but mainly electrical or diesel engine pumps.

3.1.3 Topography and Geology

The Study Area forms the big polder surrounded by three rivers and consists of numerous drainage blocks bounded by roads, irrigation canals and so on within the area. Moreover, particularly in the lower lying area, a great number of small dike are constructed, forming a small polder, to protect the land from the incoming excess water of the outside area.

The land is nearly flat, gently sloping with 1/8,000 to 1/10,000 from the west to the east. Hill and small mountain with a height of 30 to 170 m are scattered in the middle of the area and isolated in Bac Ninh town and the east of Que Vo district area. The land elevation varies from 2 to 7 m. The lower land lies in the east of the Study Area, Que Vo district, with the lowest elevation of 1.0 m.

The land belongs to Tonkin waving formation in geology and is overlaid with the alluvial deposit by the sediments of the Red River and Cau River after the complicated complex formation is formed by reiterating the fold/thrust fault for a long time. The sediments are about 10 m or more in a depth, reportedly. A weathered granite outcrops on the hill in Tien Son district.

3.1.4 Roads and Transportation

The national road (Route 1A), which traverses the north east part of the area to the north east from Hanoi to the People's Republic of China through Bac Ninh town, and Route 28, which branch off the Route 1A at Bac Ninh town and runs to Hai Phong city through Pha Lai, are main roads and five provincial roads branched off the national roads are major roads in the area (see Appendix B, Table B-2.5). A number of district road links the main and major roads and

villages. In addition, the top of river levee, irrigation canal dikes and polder dikes are used as a village road. However, these roads are poor in maintenance and muddy in a rainy day. The roads are paved with asphalt for the national roads but with gravel for the provincial roads.

The total length of the two national roads in the Study Area is 55 km with a density of 1.4 m/ha, and the total length of the five provincial roads is 56 km with a same density of the national roads. Besides of national and provincial roads, the density of roads in the Study Area is estimated as 9.0 m/ha including district roads, commune roads and village roads.

The railway to the China runs parallel with the said national road Route 1A. The bus services are available through the national and provincial roads. Thus it is great convenience to have access to Hanoi and/or the China. However, number of transport by train and bus is very limited. The transportation by bicycle and/or hand tractor is common in the area.

Strictly speaking, the present work of transportation in the Study Area is too weak. Number of transport means is getting higher, but these means are not strictly controlled.

3.2 Present Agriculture

3.2.1 Soils

The South Bac Duong agricultural area covers 40,000 ha, bounding by the Cau River on the North and the Duong River on the South.

Locating within the Red River Delta, the Study Area has a considerable geographic diversity with inselberg in some places.

The soil map of South Bac Duong agricultural area was made for the first time in 1963 in framework of program for making soil map of Ha Bac Province at the scale of 1:50,000 (see Appendix C-1, C-2).

The major soil units in the Study Area consist of:

- Undeposited alluvial soils of the Red River (Eutric Fluvisols)
- Undeposited alluvial soil of the Thai Binh River (Dystric Fluvisols)
- Water logged alluvial soils (Gleysols)
- Alluvial soils with yellowish-red mottles (Cambisols)
- Degraded soils on old alluvium (Plinthosols)
- Yellow-Red soils on sandstone (Acrisols)
- Eroded skeletal soils (Leptosols)

According to the Guidelines for Soil Description (FAO, Rome 1990) almost all soils in the Study Area are fluvisols, gleysols, cambisols, plinthosols, and they occur in the flat plain. It is well documented that these soils were formed at the late Holocene epoch (QIV³) after filling up of fluvial sediment. They have been developed by the deposition of silts through the ages from the Red River (named Hong River) the Thai Binh River and their tributaries Duong River, Cau River. Plinthosols were formed mainly on old alluvium (riverine sediment) that was deposited at the epoch of late Pleistocene of Quaternary (QIII²). This sediment has distributed at the altitude of 6-7 m above sea level. In humid regions most of these soils have a B horizon that is richer in clay than the overlying A horizon.

Characteristics of soil in the South Bac Duong agricultural area are shown in Appendix C-3 and C-4. Fluvisols (alluvial soils) are mostly brownish soils that formed in recent water deposited sediments on flood plains, considering somewhat fertile soils. This area is flooded frequently even it is protected by dikes or levees. Most alluvial sediments came from eroding soils and contain an appreciable account of organic matter. Gleysols and Plinthosols are problem

soils. Gleysols have mucky soil mass, connotative of an excess of water and permanently flooded alluvial soils. They are acidic and very poor in phosphorus. Both factors are the constraint to rice yields. The rice plants suffer from a lack not only of phosphorus but also of potassium especially in the plinthosols. The majority of soils, while having a relatively high content of total phosphorus (0.1%) have negligible trace content of available phosphorus. Consequently, improvement of the phosphorus status of gelysols must be regarded as one of the urgent problems in the farming of the Study Area for the increase of all crop yields and soil fertility. Plinthosols have their own specific soil fertility, crop and water management constraints. The decline in the contents of organic matter has a negative effect on the physical properties of soils, which lose their structure, become heavily compacted during the monsoon rains. Because of the unfavorable reaction (pH below 5), lack of nutrients especially NPK CaMg the soils can not produce stable high crop yields without being improved in the course of cultivation. The thickness of topsoil is dominantly less than 15 cm with the silty texture.

3.2.2 Present Land Use and Land Holding

(1) Present Land Use

Land use as we see it today is a result of combination of natural genesis and man's past and present attempts to manipulate land resources. An existing land use map at scale of 1:50,000, accounting the area of land use in the Study Area, has been formulated by NIAPP in 1994 (see the map, Appendix C-5 and C-6). The field survey results showed that many individual progressive farmers do achieve yields of 5-6 tones of paddy per hector in spring rice crop and 4-5 tones per hector from the monsoon crop. This indicates that there remains potential for future yield increases in the Study Area.

Among the Study Area with 6 districts which have 28,000 ha of agricultural lands of which 25,154 ha has devoted to rice cultivation, 1,549 ha was dedicated for upland crops (sweet potato, groundnut, soybean, maize, vegetables). Total annual crops occupy 26,703 ha. Perennial crop production occupying only 188 ha is less well developed than annual crop production. Present suitability of land for all crops is 26,891 ha. Winter crop occupies small area 2,670 ha, accounting for 10% of the total annual crops.

Rice is by for the staple food crop in the Study Area, providing the people with about 80% of carbohydrate and 40% of the protein intake. But rice yields remain

relatively low compared with those of neighbor provinces in the Red River Delta, taking Ha Bac province as for comparison. While Thai Binh province has raised rice yields to more than 5 tones of paddy per hector/crop, Ha Bac province's average is less than 3 tones/ha/crop (see Appendix C-7).

The main constrains in the Study Area are as follows:

- 1) Some 5,000 ha produces only one crop of spring rice because it is subjected to deep flooding during the monsoon seasons.
- 2) Percentage of cash crops is very low, less than 10%, groundnut, soybean, mungbean are as well known legumes that can be fixed Nitrogen for improving soil fertility.
- 3) Fertilizer application is imbalance, for many years local farmers used an increasingly larger amount of nitrogen fertilizer. Phosphorus is becoming the first factor affecting rice yield.

The Research Institute for Soil and Fertilizers (ISF) in the last decade paid more attention to the effect of phosphorus on rice cultivation. The positive results have been shown on Appendix C-8. The effect of phosphorus application is obvious. Application of phosphorus is to economize on nitrogen fertilizers.

In gleysols high levels of phosphorus are needed beneficial. High yielding varieties of rice should be tried in comparison with the usually grown varieties at a range of fertilizer combinations where the problems have diminished. For rice production these soils should remain continuous watering of the fields to leach out the acidity over time. One of the most effective strategies available to farmers to modify plinthosols is through the application of FYM and the rotation of cash crop cultivation with groundnut, soybean, mungbean cultivation. The expansion of a winter cash crop will bring more income to the farmer than just growing rice. Leguminous plants consist high content of protein which improving human's nutrition status.

(2) Land Holding

The land holding system in Viet Nam had mainly been joint holding by village unit, and this system was almostly completed in the time of the Ly-Tran dynasty who introduced feudal system in Viet Nam, then succeeded by the Le dynasty. However, the land lord class appeared in seventeen century in parallel with progress of privatization of land because the rich farmers in the village were increasing their farming land buying the communal land or reclaiming the un-