

2.5 Facility Plan

2.5.1 Scope of Facility Plan

The excess water in the Project Area shall be drained to the Cau River through the Hien Luong sluice by gravity in usual and is drained to the Duong River by pumps at the Tan Chi pumping station in flood time, being collected to the Tao Khe creek through the secondary drainage canals as existing drainage system.

The frequent inundation at the low land in the area are caused not only by the shortage of capacity at the Tan Chi pumping station but by the insufficient capacity of the drainage canals and crossing structures. Taking this matter into account, the drainage facilities at secondary canal level are proposed to be improved, based on the drain discharges to fulfill the drainage standard which is obtained from the drainage analysis.

The lowest land is proposed to transfer to the fish ponds in order to expect no effect on inundation and to consider the influence on the environment because of too much lowering the ground water.

The required water to irrigate shall be taken at the Trinh Xa pumping station and delivered to farm lands through the south irrigation canal and its secondary canals to improve and renovate these existing facilities. The irrigation facilities are so planned as to avoid pumping and land acquisition of crop fields.

The facilities shall be planned for two drainage systems based on the irrigation and drainage plan, taking geographical conditions, existing drainage system and effect into account. The project facilities are composed of a pumping station, drainage canals, irrigation canals, fish ponds and these appurtenant facilities.

The two areas for the alternatives shall be (1) Tan Chi area and (2) the whole area which includes Tan Chi area and Han Quang area.

The proposed plan will be decided depending upon comparisons of the project cost estimation and economic evaluation.

2.5.2 Plan of Drainage Pumping Station

The proposed pump station types were carefully compared among ① Vertical Mixed Flow Pump Type Structure, ② Inclined Pump Type Structure and ③ Screw Pump Type Structure; in due construction with their adaptability to the sites, construction costs and their O&M costs. As a result, the Vertical Mixed Flow Type Structure is recommended as the most suitable for the Project.

The number of the vertical mixed flow pumps is to be planned comprehensively considering following points. Pump and motor costs tend to set of the number of pumps because of their costs in general. The larger the pump's bore the higher the efficiency becomes, and the better the efficiency the lower the running costs. Considering possible break-down, the risk of diversification must be considered as the working ability ratio in the case of a break-down, and also to respond to the fluctuations of the required drainage water during a year. Moreover, easy maintenance and easy repair shall be considered.

From above points, the proposed quantity of pumps carefully compared among ① Case with 3 Pumps ② Case with 4 Pumps ③ Case with 5 Pumps, in due consideration with their pump facility costs, their civil work costs and their O&M costs as well as the ability to procure the spare parts and to renew the same type of pumps in Viet Nam.

As a result, 4 Pumps (Vertical Mixed Pump ϕ 1,350 mm \times 4 Nos) is recommended as the most suitable (see Appendix F, F-2.2).

A suction basin is planned to protect vortex productions and air suction and to suck the water freely from all directions. a settling basin is planned to discharge the pumped-up water safely with enough wall height. Auto-screens are recommended to be provided at the entrance of the suction basin to protect for the trash to flow into the pumps.

The design dimensions for the drainage pumping stations are shown below.

	Tan Chi	Han Quang
Design Maximum Discharge Q (m ³ /s)	31.11	26.0
Existing Pump Station Discharge Q _{ep} (m ³ /s)	15.11	–
Proposed Pump Station Discharge Q _{dp} (m ³ /s)	16.00	26.0
Design High Water Level at River Side (m)	9.23	8.73
at Settling Basin (m)	9.63	9.13
Design Low Water Level (m)	2.00	1.50
Pump Bore ϕ (mm)	1,350	1,350
Pump Efficiency (%)	83.5	78.5
Pump Numbers	4	6
Pump Capacity (m ³ /s/unit)	4.00	4.33
Pump Total Head (m)	8.5	8.5
Pump Power (kw/unit)	410.5	410.5
Pump Total Power (kw)	1,642	2,463

2.5.3 Plan of Irrigation and Drainage Canal

(1) Drainage Canals and Related Facilities

Existing excess water is pumped up by small pumps due to insufficient capacity of the drainage canals at lower place of the central north part of the area heightening the dike of canals. The existing slope and width of the Trinh Xa Canal is contrary to the proposed direction.

The all drainage canals are recommended to be widened and deepened to conform to the design discharges in accordance with the detail hydraulic calculation of each drainage canals. The width of land acquisition for the widening of the canals shall be within 35m of the waste land along to the canals, including the spoiled dike space. The acquisition land is estimated at 60 ha in total.

The gate structures are proposed at the place of crossing structures to regulate the water level at ordinal times not so as to make ground water lower than the existing level. The maintenance roads are recommended on the one side of the dike with 4.5m in width and gravel pavement.

As for the standard canal cross sections, which are satisfied with the above-mentioned criteria and least cost, the proposed types for main canals and secondary canals are shown in Appendix F, F-2.4.

(2) Irrigation Canals and Related Facilities

The canal alignments are recommended to be same as those of existing canals. The brick lining is proposed to increase the canal capacity in order to adapt the design discharge to the existing canal size not so as to obtain the farm land. The widths of bank top for canals are 4.5m for the maintenance road side with gravel pavement and 3.0m for the other side.

As for the standard canal cross section, which are satisfied with the above-mentioned criteria and least cost, the proposed canal types for the main and secondary canals are shown in Appendix F, F-2.3.

2.5.4 Farm Road Plan

Farm roads are planned taking the rural transport and transportation development of Tien Son and Que Vo district in phase of 1994-2000 into account. On the basis of the maintenance roads for the irrigation and drainage canals, the farm road scheme shall aim at improving the farm road net work so as to cope with the introduction of modern farming as well as the increase of crop production, and also at improving the area traffic and transport conditions to promote the active crop production and sales linking the villages to markets.

Farm roads should have sufficient widths for the agricultural machineries and 4 ton tracks with all weathered pavement. The farm road plan is composed of lengthening and widening the maintenance road for canals, and construction of crossing structures. The lengths of roads to be improved and constructed are shown in Appendix F, F-1.4. The four places of bridges and 120 places of culverts are to be constructed according to the Tien Son district scheme.

The maintenance roads for irrigation and drainage canals are constructed by this project.

2.5.5 Construction Plan

Prior to commencement of construction works, it is essential to confirm the existing conditions of the boundary of construction land, irrigation and drainage, road conditions, thickness of surface soil of cultivated area, etc. with the related persons. The construction is made according to following procedures.

(1) The Pumping Station

The pumping station will be constructed adjacent to the left flood protection dike of the Duong River. The temporary road to access the site shall be branched off the provincial road route 288 at Tan Chi town along the right side of Tao Khe creek with 4.5m in width and 50 cm in thickness of sand and gravel. This temporary road shall be remained as the maintenance road for the Tao Khe creek. A temporary diversion canal shall be provided in order to keep a function of the existing drainage system.

The sheathing with steel sheet pile shall be installed protect to the flood flowing into the farm land, before opening the dike. Piling work will be executed by the crawler crane (40t) with vibro hammer.

All hivoltagage transmission lines shall be shifted to the safety places with 8.0m in height by the State's authority before commencement of the works.

(2) Drainage Canals

The improvement works of the drainage canals are composed of widening canals, crossing structures and regulating structures. The excess water flows in the canals throughout the year and the diversion canals are not reasonable to be provided during the construction because of the topographical conditions and their scale, so that excavation works are carried out in the water. The Tao Khe creek and Trinh Xa canals are too wide and the dike is too high for the back hoe and/or the drag-line to excavate the bed of canals so that small pump dredger (P200 class) is proposed to deepen and widen these canals. Back hoes and/or drag-lines will be used for the other drainage canals.

The excavated and dredged soil shall be dried by the sun and placed at the acquired land along the canals. For the embankment of the maintenance road on the drainage and irrigation canals, soil will be transported from these spoiled bank. The dredged water or excavated with soil shall be treated through sediment pond to be released to the canals. Cofferdam with steel sheet pile will be used for construction work of the related structures. To carry the pump dredger into the canals, a temporary stage should be considered.

(3) Irrigation Canals

The works consist of canal improvement by excavation and/or brick lining, turnout structures, and reconstruction of related structures such as check gates structures and crossing structures. During the construction works, supply of irrigation water should be stopped and dewatering of remaining water should be executed by pumps. In this case, all works shall be executed under dry conditions. Temporary roads for construction are provided along the canals and filled with dredged or excavated material at drainage canals. The base course of the road shall be sand and gravel with 50 cm in thickness and 4.5m in width. After construction work, these roads are remained as the maintenance roads.

2.6 Project Cost

2.6.1 Method of Cost Estimation

The project costs are estimated at the prices of September, 1994 based on the Notice No. 2981XD-GDKT issued by the People's Committee of Ha Bac province, the Construction Services dated June 15th, 1994. The costs, which are not shown in the notice, are estimated by using of marketing price.

The construction costs for the pumping station, the fish pond facilities and the irrigation and drainage canal are estimated by using the international competitive-bid contract method, the local competitive-bid contract method and force account respectively.

Import duties and various taxes are based on the State's Notice (No. 110-HDBT and additions) and Fundamental laws and regulations of Viet Nam respectively. The cost for land acquisition and compensation is estimated at 0.1 USD/m² which is classified as an aquaculture of agricultural land and forestry land in a plain area (State's Notice August, 1994).

The physical contingency is estimated at 10% of the base cost which is the sum of construction and associated cost. The price escalation is estimated at 5% per annum for the local currency portion and at 2.9% per annum from G-7 CPI-World Bank (1990 = 100).

The construction cost on a contract base include the direct construction costs such as preparation, civil, mechanical and electrical works and in-direct cost. The in-direct cost is composed of 10% for overhead and 3% for profit of the direct construction cost.

Import duties are estimated at 0% for pump equipment and 15% for electrical equipment. All taxes and duties are not estimated for the works on the force account but 10% of the direct costs are estimated as overhead for in-direct cost.

The project cost is composed of the construction cost, the association cost, the physical contingency and the price escalation. The construction cost is composed of the pumping station work, the drainage canals work, the irrigation canal work, and fish ponds work.

The association cost is composed of procurement cost for construction machine, the land acquisition cost, the consulting services and the project administration

cost. The exchange rate between Viet Nam dong and US dollar is determined at 10,996 dongs for one dollar.

2.6.2 Project Cost

The costs are estimated for the following three alternatives for Tan Chi area and the whole priority area to decide the scale of the project. Final selection will be carried out by economical evaluations in Chapter 4.

First Alternative; is composed of the drainage improvement such as the construction of new pumping station, repair of existing pumping station and widening of drainage canal.

Second Alternative; is composed of improvement of irrigation facilities adding to the component of the first alternative.

Third Alternative; is composed of construction of fish ponds facilities adding to the component of the second alternative.

The construction costs for the pumping stations are estimated by using of prices of imported equipment because of the large scale of pump facilities which are not able to be produced in Viet Nam, though that is planned to be produced in near future.

The construction costs for the Pump equipment produced in Viet Nam are also estimated by using conjectured price from the price of 1,000 mm pump equipment.

The project costs are summarized as below. Details are shown in Appendix F-3.2.

(Unit : 1,000 USD)

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

Note: The above project costs include physical contingency and price escalation.

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 studied in Chapter 4 Project Evaluation, the project cost is finally proposed for the case of Viet Nam made Pump and the Whole Area.

CHAPTER 3 IMPLEMENTATION AND OPERATION AND MAINTENANCE OF THE PROJECT

3.1 Implementation Program

3.1.1 Implementation Agency

The Executive 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. The Project would be implemented under the present organization of the MWR and required to be of great importance in the coordination of activities among the departments and institutes concerned. Prior to the start of project works, the Project Manager would be appointed under the Construction Department, MWR, who would rest with the day-to-day works. Under him, aiming at the smooth implementation, Administration section, Planning & Engineering section, Construction section, Mechanics & Material section and Right-of-way Coordination section would be provided. Administration section would serve the works in charge of office operation, personnel, finance and others not concerned to the other sections. Planning & Engineering section would have the works for planning and monitoring of construction works, design of force account works and engineering support to the construction, etc. Construction section would supervise the contract works and execute the force account works. Mechanics & Material section would be responsible for procurement and management of equipment and materials for the force account works, every material tests with regard to the construction quality control and management of office equipment. Right-of-way & Coordination section would deal with land acquisition, education/training to farmers, management of claim during the construction. For this project office set-up, the number of project engineers and staffs would be increased.

3.1.2 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 work. The open international competitive bidding would be conducted in case of the project with financial assistance from international institution.

The procedures of pre-qualification and bidding for the contract works have not been authorized. According to the draft procedure, the Awarding Committee chaired by a leader of the ministry would be created under the MWR. Every matters would be dealt with by the department concerned under the present organization and approved by the committee, through administrative arrangement of Construction Department or Planning Department.

The construction of small irrigation and drainage canals have depended on the farmers concerned. In case of leaving those construction works to the farmers, it is so often seen that the canals have been untouched and/or have not coincided with the plan. Consequently, effects of such project might not be expected. Therefore, it is suggested for the small irrigation and drainage canals to be implemented by the force account works under the Project.

3.1.3 Construction Schedule

Upon the project approved, the detailed design as well as preparation of bidding documents, specifications and others documents/drawings necessary for the approval and implementation of the project works should be commenced and at the same time the selection of consultants would be carried out. The consultants would be selected first by the technical proposal. After approval of the selection, the contract conditions would be concluded. The pre-qualification documents would be reviewed by the consultants upon the commencement of consulting services and advertised after the Approval. The procurement of construction equipment for the force account works would be bidden in the early stage of the project schedule so as not to delay the schedule of the force account works. The contract works would be bidden upon the approval of detailed design and construction drawings and started in the construction. The bidding for the procurement of mechanical and electrical parts of the pumping station would be completed at least 18 months before the completion of the building of the station. The arrangement of all right-of-way should be accomplished before the construction with every efforts. These pre-construction activities are estimated to take about one year and little more.

The construction would be implemented by the approved construction schedule, according to the specifications and construction drawings. In principal, the construction of irrigation canals would be carried out from the upstream and the drainage canals would be constructed starting from the downstream. In the rainy season, specially in July to September, the construction would be controlled in a certain parts of the works, to prevent damages due to heavy rain. The deep

foundation of the pumping station and fish ponds would be constructed in the dry season. These construction would be supervised by the staff of Construction section according to the construction supervision manuals. 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 would be within four years if Vietnamese budget allocation is timely made. (See Appendix F, F-3.3)

3.2 Operation and Maintenance

3.2.1 Method of Operation and Maintenance

The centralized network to collect the water levels, by installation of water gauges/staffs on the creeks, major drainage canals and drainage sluices, to instruct the operation of drainage pumps and sluices adequately. In as much as it has less possibility to provide the regulating pond to meet a capacity of the drainage pumps in the immediate upstream, the operation of pumps might depend on the water levels of the gauges/staffs mentioned previously in the initial operation stage. The drainage sluices would also be properly operated depending on the water levels in the downstream and pump operation. Specially for the operation of Tram sluice it is necessary to send correct instruction so as not to meet an inundation damages in the downstream. For executing adequate drainage control, the operation manuals for drainage sluices and pumps should be prepared.

For the irrigation water management to supply the water with adequate quantity in time for the requirement, Trinh Xa pumping station would be operated under the demand-oriented supply system by perceiving a necessary quantity of the water one week before the supply. The regulating sluices and turnout gates would also be operated properly. Therefore, the system to properly notify the water supply schedule to the staffs concerned is imperative. The system to reply with the rainfall in the water supply should be established, when it is rain able to effectively use for the irrigation. On the other hand, the illegal water use by the farmers should be strictly prohibited. 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. In addition, by undertaking the education to farmers, more effective water management would be expected.

The maintenance of the facilities consists of daily maintenance and periodical maintenance works. The inspectors should observe the state operation of the facilities, as a day-to-day activity. If it is necessary for the repair, he should take prompt action to report to the chief and restore those structures with assistance of staffs concerned. Specially, it is required to pay close attention to the pumping equipment. While, the periodical maintenance works for the facilities, pumps and electrical devices would be done by the contract works in principal, depending on the extent of damage. Those repair should be carried out with advice of supervisor/experts, because an incomplete repair and/or un-skilled service might

bring about a heavy damages in the near future. The repair/restoration of the irrigation facilities would be implemented in a spare time during the winter/spring crop season, while the repair of drainage facilities would be done in the months of March to May before the rainy season. In order to implement proper maintenance works, it is integral to provide maintenance manual for the facilities and pumping equipment as well as training/education to the staffs concerned.

The costs 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 repair/remedy of the facilities damaged by calamity would be carried out directly by the provincial/district government and/or by the farmers concerned with supply of fund and/or materials from the government, depending to the scope of the responsible management.

3.2.2 Organization of Operation and Maintenance

The organization would follow the present organization of Bac Duong Irrigation Enterprise in principal, since the Project Area is situated within its management area. The Enterprise is under the administration of Water Resources Services in Ha Bac provincial government, and has a main office in Tu Son, Tien Son district. Under the Director, one Board and five (5) Divisions are organized, of which four (4) divisions in charge of the operation and maintenance works for each district area are provided with offices in the respective district and the staffs together with the provincial government staff under the Director appointed by the provincial government. The staffs of Head Works Irrigation Division are in the quarter of Trinh Xa pumping Station. Thereby, the staffs for Board of General Management serve in Tu Son office. Board of General Management has three (3) section of Planning & Technology, Personnel & Administration and Finance, and four (4) Team of Investigation, Repair & Rehabilitation, K4 and Work Management. The communication is kept up by radio among the Board/Divisions and by telephone to every pumping stations.

Planning & Technical Division deal with the Planning and management of operation and maintenance works in the entire Bac Duong area at present and is expected to continue those works and conduct the planning of irrigation water management, drainage water control and facilities' maintenance as well as monitoring and management of pumps and sluices as a day-to-day activity after the Project. The superintendents for each pumping station and gate-keepers for

each sluice would be appointed. The communication would be kept up by telephone between the main office and pumping stations and to the gate-keepers through Operation and Maintenance Division in Tien Son district. In order to implement adequate and effective irrigation and drainage water management, the inspection/communication team would be organized in the Tien Son office, which should be mobilized. The team would serve to monitor the present state of facilities and operation of irrigation/drainage sluices, and check the offtake water discharge from the main/secondary canals, and provide the instruction/guidance of proper gate operation to the gate-keepers, as a daily works.

The Province/Enterprise would take the initiative in every operation and maintenance of the project facilities for the time being. In future, it is advised that the operation and maintenance of major facilities, such as Trinh Xa pumping station, Tan Chi pumping station and main irrigation and drainage canals and structures including the Tao Khe creek, should be under Bac Duong Enterprise but 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. For this institutional set-up, the farmers' association would be developed to shoulder a part of the system operation and maintenance, aiming to make the farmers understand necessity of operation and maintenance and common use of the facilities among them. By this arrangement, the expenses of the Enterprise might be reduced but the financial assistance to the farmers' association might be required.

3.2.3 O&M Equipment and Facilities

Each O&M office shall be equipped with following equipment and facilities in order to carry out the works proposed in the foresaid section.

(1) Bac Duong Irrigation Enterprise (Sub Project Office)

Small pump dredger 200PS	1 unit
Appurtenant equipment	
Spare parts (200 hour)	
Boat (Anchor, Tug)	2 unit
Jeep	1 unit
Motorcycle	5 unit

(2) Pumping Station

Pick-up truck	(1t)	2 unit
Back hoe	(0.6 m ³)	3 unit
Dump truck	(10t)	5 unit
Bull dozer	(11t)	1 unit
Motorcycle		5 unit
Portable pump	(200 mm)	5 unit
O&M office	(200 m ²)	1 unit
Tenement hous	(100 m ²)	2 unit
Car shed	(150 m ²)	1 unit
Hand talking		5 unit

Among of them, a pump dredger shall be used for the dredging works on the drainage improvement so that the procurement cost is estimated in construction machine of the project cost. After completion of the construction work the dredger will be used for the maintenance work.

Existing heavy machines shall be used for other above mentioned construction machines.

3.2.4 Operation and Maintenance Cost

Operation and maintenance cost is composed of salary and insurance, electricity charge for pumping station, operation and maintenance cost for civil and mechanical equipment, and administration cost. These costs are estimated from the actual expenditure of Tan Chi pumping station and Trinh Xa pumping station in recent 5 years of records, taking the scale of the proposed pump station into consideration.

Renewal costs for the equipment are estimated according to the life of each equipment, of which dredger and pump equipment are 30 years and pump dredger is 15 years for the economic evaluation. The renewal cost for other equipment for O&M is estimated in the miscellaneous cost as depreciation reserve. The summary of annual operation and maintenance cost is shown below.

Summary of Annual Operation and Maintenance Cost

(unit : USD)

Item	First Alternative		Second & Third Alternative	
	Tan Chi	Whole Area	Tan Chi	Whole Area
a Salary and Insurance	10,500	18,600	10,500	18,600
b Electricity Charge	76,500	113,100	95,200	131,800
c Repairing Cost				
Civil Work	4,756	6,256	9,511	12,511
Mech. & Elect.	32,474	35,054	32,474	35,054
d Miscellaneous	27,041	35,572	54,076	71,138
Total	151,271	208,582	201,761	269,103

- Note :
- 1) First Alternative: Drainage Improvement Project only
 - 2) Second Alternative: (Drainage + Irrigation) Improvement Project
 - 3) Third Alternative: (Drainage + Irrigation + Inland Fishery) Improvement Project
 - 4) O&M cost for Inland Fishery is neglected due to small project cost.

3.3 Consulting Services

In order to ensure the rapid and sound execution of the Project, the services of a consultant team which would be composed of the foreign and Viet Nam local firms in a joint-venture manner would be provided under the Project during the seven-year service period. To assist MWR in detailed design and construction for procurement of equipment and for construction of irrigation/drainage systems and fish pond. It is estimated that about 270 man-months of consultant services would be required (see Appendix F, Figure F-3.4).

MWR and Central Project Office would provide appropriate full-time professional and technical personnel who work with the consultants and are trained and guided in their performance by the consultants. General terms of reference for the consultants are given below:

- Review all previous engineering studies, data and reports, propose modification if necessary and supplement information as required by additional survey and investigation;
- Prepare detailed design, construction drawings, detailed specifications, cost estimate and tender documents;
- Assist in invitation of tenders and evaluation of tender documents
- Assist the Project office in construction management, quality control, testing of pumps and other equipment and any other works relevant to the construction;
- Evaluate O&M of Tan Chi pumping station, related canal structures and assist in development and water management of the Tan Chi irrigation and drainage system; and
- Prepare the O&M manual of relevant structures.

CHAPTER 4 PROJECT EVALUATION

4.1 Method of Project Evaluation

The method of project evaluation is as follows;

- (1) Economic evaluation
- (2) Financial analysis of typical farmer
- (3) Environmental impact of the project
- (4) Socio-economic impact of the project
- (5) Comprehensive evaluation

4.2 Economic Evaluation

4.2.1 Orientation of Economic Evaluation

With regard to the evaluation of the priority area the EIRR as the main indicator for the project evaluation is calculated the both Cropping Pattern Type I (the pattern which puts emphasis on crop diversification) and Type II (the pattern which puts emphasis on paddy cultivation). As the results of economic calculation, it is concluded that the Type I which is in line with national policy is better than the Type II, for economic justification.

Accordingly, the calculation of economic evaluation will be made on the basis of the Type I, two cases; Option 1 (Tan Chi Area) and Option 2 (Whole Area) with of Viet Nam made pump and of foreign made pump (see Appendix I, Table I-4.17 (1)-(8)).

4.2.2 Evaluation Criteria

The economic evaluation will be adopted on the basis of the following criteria.

- 1) Economic, benefits and costs of the project are expressed in monetary terms.
- 2) On the assumption that the project life is 50 years after completion of the project and that both benefits and costs in annual form over the project life are converted to the respective present worth value.
- 3) The benefits and costs are evaluated with incremental value based on the difference between without and with the project implementation.
- 4) Economic internal rate of return (EIRR) is used as the main indicator for economic evaluation.

4.2.3 Economic Prices

(1) Economic Prices of Commodities

The economic prices used in the evaluation will be adopted based on the following criteria.

- 1) The value of traded/tradable goods is measured by border prices in Viet Nam Dong.
- 2) As for a forecast of commodity prices, "Price Prospects for Major Primary Commodities, 1990-2005" evaluated by the World Bank is used.
- 3) No conversion factor was evaluated by the international monetary agencies in terms of the value of no-tradable goods. Therefore, factor 1.0 is selected.
- 4) The official exchange rate to be used for the evaluation is adopted US\$ 1.00 = 10,996 VND, the average rate of August, 1994

(2) Economic Farmgate Prices of Farm Products

- Rice

According to World Bank Commodity Price Forecasts in the year 2000, the Thai white rice, broken five percent, CIF Bangkok is projected at US\$ 336/ton. The economic price of paddy rice at the farm level is estimated at 1,785,900 VND/ton, CIF Hai Phong, rearranging from Bangkok to Hai Phong, on the basis of the processing costs and intermediate margins which are obtained in the field survey (see Appendix I, Table I-4.2).

- Soybeans

Since, CIF Rotterdam soybeans are projected at US\$ 300/ton in the year 2000, the farmgate price for this crop is estimated at 4,348,000 VND/ton (see Appendix I, Table I-4.4).

- Groundnuts

Owing to shelled groundnuts, the economic price is calculated multiplying the World Bank's Weighted Index of Commodity Prices for actual export price. The farmgate price for this crop is estimated at 5,295,000 VND/ton (see Appendix I, Table I-4.3).

- Maize

Since, FOB Gulf maize, No. 2, Yellow is projected at US\$ 139 in the year 2000, the farmgate price for this crop is estimated at 2,354,000 VND/ton (see Appendix I, Table I-4.5).

- Other crops

The economic prices of potatoes, sweet potato, and vegetables (represented by onion) are estimated based on the results of the field survey. Economic prices of these crops are shown as below.

Potatoes	1,000,000 VND/ton
Sweet potato	300,000 VND/ton
Vegetables	1,000,000 VND/ton
Others	1,200,000 VND/ton

(3) Economic Prices of Fertilizers

Fertilizers are currently imported and economic prices are estimated as follows, using the projected price in the year 2000 by the document of World Bank.

Urea	3,200,000 VND/ton
DAP	3,200,000 VND/ton
TSP	2,800,000 VND/ton
Phosphate Chloride	2,500,000 VND/ton

(4) Economic Prices of Agro-chemicals

The market prices of pesticide, insecticide and herbicide are obtained from the field survey. The economic prices for these chemicals are converted by a factor of 1.0.

(5) Economic Prices of Farm Labor

Pricing of farm labor is the assessment of opportunity costs. The opportunity costs of farm labor are estimated at 2,344 VND using the general criteria of the opportunity for off-farm employment in the off-season of farming and farm wage in the farming season and outside labor market. An average farm labor wage in the area is 10,000 VND per day.

(6) Economic Prices of Electricity

The prices of electricity used for pumping is 450 VND/kwh in day time and 180 VND/kwh in night time, but this current tariff reflects a subsidy of 30 percent of long run marginal cost. Therefore, a base subsidy adjustment of 30 percent is used. The economic prices of electricity are estimated at 315 VND/kwh in day time and 126 VND/kwh in night time.

4.2.4 Project Benefits

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).

In crop benefits, the goal of full development will be set up at three year after completion of the project implementation. Fishery benefits will be set up at first year after completion of the project implementation. Prevention effects against flood and waterlogging will be corresponded to the reduction of damaged area.

(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, for economic evaluation, based on the agricultural development plan have been calculated as shown below (see Appendix I, Table I-4.9 (1)-(2)).

1) 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

2) 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 Benefits

Inland fishery benefits can be expected through aquaculture in the ponds. Incremental annual benefit can be expected as follows (see Appendix I, Table I-4.11).

- 1) Option 1 (Tan Chi Area) : 596,323,000 VND
- 2) 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 waterlogging damages, with the project implementation (see Appendix I, Table I-4.12).

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

4.2.5 Project Costs

Economic costs of the project are comprised of construction works, project administration, consulting services, and physical and price contingencies, but taxes and price contingency are excluded from the economic costs.

(1) Project Costs

Project construction costs were estimated on the basis of 1994 price levels. Since the main construction works are scheduled to be completed within some five years, changes in future price relationships were not considered. Economic project costs are estimated as below (Appendix I, Table I-4.14).

1) Option 1 (Tan Chi Area)

Of Viet Nam made pump	149,406 million VND
Foreign currency	86,885 million VND
Local currency	62,521 million VND
Of foreign made pump	305,278 million VND
Foreign currency	228,793 million VND
Local currency	76,485 million VND

2) Option 2 (Whole Area)

Of Viet Nam made pump	219,154 million VND
Foreign currency	111,914 million VND
Local currency	107,240 million VND
Of foreign made pump	433,918 million VND
Foreign currency	314,642 million VND
Local currency	119,876 million VND

(2) Operation and Maintenance Costs

Operation and maintenance costs comprise administrative and general expenditure including salary and wage, costs of equipment repair and maintenance, and electricity tariff and office maintenance. Economic costs for operation and maintenance (annually) are estimated as below (see Appendix I, Table I-4.15).

1) Option 1 (Tan Chi Area) : 1,111 million VND

2) Option 2 (Whole Area) : 1,424 million VND

(3) Replacement Costs

On the basis of the following lifespans of pumps installed by the project, the replacement costs are estimated.

- Drainage pump : 30 years
- Machinery for O/M: 15 years

4.2.6 Economic Internal Rate of Return

The project justification is mainly appraised based on the calculation of economic internal rate of return (EIRR). Additionally, the net present value (NPV) and benefit/cost ratio (B/C ratio) are also taken as economic indicators. The net present value and benefit/cost ratio are calculated using the discount rate (see Appendix I, Table I-4.17 (1)-(4)).

The results of these calculations are as follows;

1) Option 1 (Tan Chi Area)

- Of Viet Nam made pump

EIRR = 26.9%

Item	Discount Rate		
	25%	27%	29%
N.P.V. (million VND)	4,344	231	-3,791
B/C ratio	1.06	1.00	0.93

- Of foreign made pump

EIRR = 11.1%

Item	Discount Rate		
	9%	11%	13%
N.P.V. (million VND)	47,826	2,089	-27,358
B/C ratio	1.19	1.01	0.87

2) Option 2 (Whole Area)

- Of Viet Nam made pump

EIRR = 21.2%

Item	Discount Rate		
	20%	22%	24%
N.P.V. (million VND)	6,443	-3,578	-11,068
B/C ratio	1.05	0.97	0.90

- Of foreign made pump

EIRR = 9.4%

Item	Discount Rate		
	7%	9%	11%
N.P.V. (million VND)	102,550	13,875	40,461
B/C ratio	1.28	1.04	0.88

Judging from the EIRR calculated as above mentioned, the drainage project plan in either case is economically feasible. In this project plan, the case which uses of Viet Nam made pump can be obtained over 20% of the EIRR. In case of foreign made pump, it shows that the project is also feasible, though the EIRR of low percent. Therefore, in order to improve depressed agricultural and rural circumstances, and to increase agricultural productivity and income of rural people, and to vitalize regional economy, by the improvement of drainage facilities in the area, the project plan is recommended to be implemented in the early stage.

4.2.7 Sensitivity Analysis

Sensitivity analysis is made for Option-2 in the event of variations in prices of farm products and crop yields and escalation of construction costs. The results are shown as follows;

Results of Sensitivity Analysis

Option 2 (Whole Area)

Case	EIRR	
	Viet Nam made	Foreign made
1. Original (EIRR)	21.2%	9.4%
2. Price/Yield of Farm Products 10% of decline/decrease	18.8	8.3
3. Production Costs 10% of increase	20.7	9.2
4. Construction Costs 10% of increase	19.1	8.5
5. Delay of Production Target 1 year	17.6	8.5
2 year	15.3	7.8
3 year	13.7	7.2
6. Combination with 2 and 4 Each 10%	17.0	7.3

4.3 Financial Analysis of Typical Farmer

In order to justify financial viability of the project at farm level, financial analysis (profit and loss, and cash flow) of typical farmers (average scale of farming) in the priority area was made. These typical farmers are determined on the basis of the results of the farm survey. The cropping pattern with the project situation of the farmers was set up considering the improvement of a drainage scheme based on the current farming pattern (see Table I-4.19 and Table I-4.20 (1)-(3)).

Features of typical farmers are summarized as follows:

Typical Farming Pattern

(Unit : ha)

Area	Cultivated Crop	Actual Situation		With Project	
		Wet S.	Dry S.	Wet S.	Dry S.
Small-scale farmer 0.13 ha	Paddy Rice	0.13	0.13	0.13	0.13
	Groundnut		0.02		
	Soybeans		0.01		0.01
	Maize		0.02		0.02
	Sweet Potato		0.002		0.0045
	Potatoes		0.002		0.002
	Vegetables		0.0004		0.0204
Medium-scale farmer 0.27 ha	Paddy Rice	0.26	0.27	0.26	0.21
	Groundnut		0.01		0.04
	Soybeans		0.01		0.031
	Maize		0.01		0.03
	Sweet Potato		0.001		0.021
	Potatoes		0.001		0.021
	Vegetables		0.003		0.063
Large-scale farmer 0.51 ha	Paddy Rice	0.42	0.51	0.42	0.40
	Groundnut		0.01		0.09
	Soybeans				0.057
	Maize		0.01		0.06
	Sweet Potato				0.04
	Potatoes		0.01		0.06
	Vegetables		0.01		0.10

Calculation of the farm household economy of typical farmers was made on the basis of the following conditions.

- 1) Farm income is estimated based on farmgate prices of farm products and crop yield obtained by the farm survey. Off-farm income is excluded from gross farm income.
- 2) Production costs are expressed by financial prices.
- 3) Family labor is excluded from production costs.
- 4) For production costs, the loan conditions of Agricultural Bank are applied. Borrowing period sets up six months for annual crops. Monthly interest is 1.8% for small-scale farmer, and 2.5% for medium- and large-scale farmer.
- 5) Production value with the project is estimated by the target yield.
- 6) Payment of interest concerns only the loan interest for production costs.
- 7) Water charge is applied the current price.

Results of Financial Analysis of Typical Farmers

(Unit : 1,000 VND)

Typical Farmer	Gross Income	Product. Cost	Living Expenses	Payment Interest	Water Charge	Surplus
Small-scale						
w/o	1,965.4	413.7	2,164.6	0	14.2	-627.1
w	3,756.6	923.7	2,262.7	67.0	14.2	556.1
Medium-scale						
w/o	4,664.9	796.6	3,695.3	0	29.5	143.5
w	8,371.0	1,970.2	3,970.4	251.0	29.5	2,400.9
Large scale						
w/o	6,105.7	1,294.2	3,972.6	0	29.5	809.4
w	12,526.0	2,933.1	4,531.8	318.0	29.5	5,031.7

Note : w/o = without Project
 w = with Project

Taking all this into consideration, substantial improvement of farm household economy in the area can be expected as a result of the project implementation (see Appendix I, Table I-4.20 (1)-(3)).

4.4 Socio-Economic Evaluation

With the project implementation, increase in agricultural production, generation of job and employment opportunities for construction works of the project and agricultural production, and the impact for agriculture sector concerned will be anticipated by bring about the secondary and indirect effects as mentioned below.

(1) Expansion of Employment opportunities

Employment opportunities will generate as the construction implemented. Also, the job opportunities will expand by increase in planted area. After completion of the project, owing to greatly increase of agricultural production, employment opportunities in fields of transportation and marketing will expand and also bring about favorable results to the regional economy.

(2) Stabilization of Farming

With the improvement of drainage facilities, stable farming will be materialized by prevent against flood and waterlogging damages for paddy (summer-autumn crop). Hence, even small-scale farmer is expected to obtain the surplus of about 556,000 VND annually, in the farm household economy side. Furthermore, due to improve farm income, expansion of animal husbandry (pig raising) will be anticipated, and an increased revenue of 2,921 million VND will be calculated (see Appendix I, Table I-4.18).

(3) Expansion of Regional Economy and Correction of Economic Differentials

Increased agricultural production will stimulate investment in seed, fertilizer, and agro-chemicals as farm input. This in turn will expand the agricultural markets in the region. Increased agricultural production translates into an increase in wages and profits for the rural population, which can be expected to be directed towards consumption and savings. These circumstances will promote investment, functioning to expand the scale of the local economy in the area and neighboring agricultural areas in the north Viet Nam. Consequently, correction of economic differentials with the area and surrounding areas will be anticipated.

(4) Effects Extending to Downstream Areas

By implementation of the drainage improvement project in Option-1 (Tan Chi area) and Option-2 (Tan Chi and Han Quang area), EIRR obtained from drainage improvement is 3.8% and 4.0% and EIRR including effects extending to down stream areas becomes 5.1% and 4.6% respectively. This means that indirect benefits are fully anticipated.

In case Option-2, existing water troubles occurring between Tan Chi and Han Quang areas will be solved by rehabilitation and efficient operation of Tram Sluice.

To solve this persistent problems as soon as possible give a great impact on improvement of social environment for farmers living in both areas.

4.5 Environment

It is recognized through the IEE and the EIA carried out in this study that this improvement project will have some components which will impact on the environmental condition, however the most severe impact was already caused by the initial construction of this system, while the impact of the proposed works will be relatively minor.

Therefore this project is ranked as Category "B" project by the World Bank's Operational Directive which defines 3 environmental categories for projects, in which Category "A" project has the highest potential impact and Category "C" lowest, the implication of Category "B" ranking of this project is that although a full environmental analysis is not required, sufficient environmental analysis is needed to define the important issues and to develop the appropriate mitigation plan.

4.5.1 Negative Impacts Associated with the Implementation of This Project

There is the possibility that the implementation of this project may induce negative impacts as follows.

(1) Environmental Impacts Associated with Change of Water Management

Assuming that the existing water management is changed without consideration, environmental impacts upon every aspect as mentioned in the IEE and this time EIA may come out. Particularly it is important to consider the influences which may be caused by the change of water management such as setting ordinary drainage water level, drainage network, irrigation network. For instance, from the viewpoint of large size machinery workability and rotational cropping in future, lowering water level of drainage canal that is changed by down of drainage canal bed and pumping drainage in the term of ordinary drainage is desirable for the non-irrigation period or upland cropping. While from not only economical viewpoint such as increase of construction and management cost, increase of water requirements, but also environmental viewpoint as mentioned

in the IEE and this time EIA, lowering water level of drainage canal is not favorable in the Project Area.

Judging from the result of the IEE and the EIA in this study, the most effective countermeasure for the environmental impacts is that the change of the existing water management ought to be minimized and phased out, and that taking such a concept and influences on environment into consideration, adequate plan and design ought to be prepared. In addition to this, the improvement and strengthening of existing water control and management organization is recommended.

As it turns out, since the concept of plan mentioned above was already adopted in this study, it is reasonable to suppose that the impacts on environment associated with the change of water management, namely associated with the improvement of existing irrigation and drainage system, will be minimized.

(2) Negative Influence Associated with Local Economic Activities

The progress of agricultural development and/or urbanization may cause not only positive influences but also negative influences in the Study Area.

It is recognized that since the progress of intensive agriculture will cause the increase of agrochemicals use in the area, there is possibility that disorderly agrochemicals use will give influences upon the ecosystem. Moreover there is possibility that the progress of intensive agriculture will tend to cause deterioration of soil fertility by crop planting, failure in soil management, and so on.

The most effective mitigation measure for the impacts mentioned above is that for preventing excess use of agrochemicals, the propagation and enlightenment scheme of proper agrochemicals use (including conservation of soil fertility) ought to be prepared by organization of research and extension. Moreover, an overall environmental management plan ought to be proposed as a link in the chain of the EIA in the detail design stage, in order to ensure that such a scheme will be planned and will be implemented effectively.

At the same time, the implementation of this project will induce the activation of local economic through the development of agriculture in the Project Area, moreover the growth of capital Hanoi City will induce urbanization in and around the Project Area. Such a progress of local economic activities and urbanization

may cause the increase of domestic waste water and waste of every kind, that may cause the deterioration of water quality and ecosystem.

It may be beyond the scope of this project to provide any means of solutions. Never the less, it is important to recognize the dependence of this project upon the surrounding area and to suggest mechanisms which can be used to track the situation, if not to rectify it.

From the viewpoint above, monitoring system ought to be set up by organization concerned in order to check on the deterioration of environmental conditions caused by the progress of local economic activities and to make promptly a plan of mitigation measure even if influence will come out. Such a scheme of monitoring ought to be proposed as a link in the chain of the overall environmental management plan in the detail design stage.

(3) Environmental Impacts Associated with Implementation of Construction

There is possibility that the construction activities will give impacts on the environmental condition in the Project Area. The results of assessment for the each possibility of impact, and mitigation measures are as follows.

1) Influences on Downstream Area and/or Downstream Channel

The new pumping station will not give influences on the downstream and/or downstream channel because pumping drainage will be controlled by warning water level of the rivers, moreover there is no comparison in the scale between the discharge of the rivers and the increasing discharge of pumping drainage from the Project Area in flood season.

2) Influences on Residential Environment Associated with the Establishment of New Pumping Station

The new pumping station will not give influences on the residential environment because the site is located more than about 300m from the nearest settlement, and land acquisition for new pumping station and related facilities will be small scale. Moreover, the site of new pumping station is used as mediocre paddy field, in where endangered species of flora and fauna do no inhabit.

3) Land Acquisition for New Pumping Station and Related Facilities

The notice concerning compensation for acquiring land in the project is as follows:

- Keeping their means of living more than the present condition at least.
- Acquiring substitutive land in the same elementary settlement if possible.

4) Construction Impacts of Every Kind

There is possibility that the construction activities will give impact of every kind on surrounding environment as follows:

- Occurrence of construction waste of every kind
- Occurrence of erosion and/or sediment because of bare land after excavation at borrow pit and/or quarry
- Influences on worker's health and environmental condition such as water quality, noise, dust, and so on

Such construction impacts mentioned above will be avoidable by means of taking countermeasures as previously mentioned in this time EIA. Further details of these countermeasures ought to be proposed as a link in the chain of the EIA in the detail design stage.

Judging from the above, it is reasonable to suppose that although this improvement project will have some components which will impact on the environmental condition, the implementation and operation of this project will not be restricted, and will be promoted, by means of taking proper environmental countermeasures against such impacts.

4.5.2 Positive Impacts Associated with the Implementation of This Project

It is recognized that this project may give not only the negative impacts mentioned above, but also the positive impacts, which are divided into 2 categories, direct effects and indirect effects.

(1) Direct Effects

Direct effects generated from the project implementation are as follows:

- Increase of agricultural production and/or inland fishery production
- Benefit effects reduced by improvement of irrigation and drainage system

In consequence, farmer's income will be increasing and be stabilized. Usually, such effects are countable as benefits, and are used as parameters of the economic evaluation of the project.

(2) Indirect Effects

While indirect effects, namely social effects generated from the project implementation, are usually uncountable as benefits.

Resulting from the project implementation, the indirect effects may be come out in the Project Area as follows:

- Improvement of residential environmental condition in rainy season
- In relation to this, improvement of public health condition
- Improvement of convenience of transportation
- Increase of employment chance through construction of this project and the progress of intensive agriculture

Moreover, resulting from the progress of local economic activities promoted by the project implementation, the indirect effects will be come out in the Project Area as follows:

- Improvement of standard living conditions
- Creation of new jobs
- In relation to this, increase of employment chance

4.5.3 Conclusion

Although this project will have some components which will give negative impacts upon the environment in the Project Area, the impacts will not be absolute restrictive factors for the implementation of this project by means of taking proper countermeasures. While the implementation of this project will induce much positive impacts, not only countable benefits but also uncountable effects of every aspect, and will contribute to the sustainable development of the Project Area.

From what has been mentioned above, in conclusion, the implementation of this project should be proposed, on the premise that the proper countermeasures against negative environmental impacts will be taken.

4.6 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 high economic internal rate of return (21.2%). However, introduction of foreign made pump and materials is worthy of project justification, 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.

The main project component is drainage improvement, which will greatly contribute to improvement of rural life and environment. Necessary countermeasures should be taken for the negative impact occurred before implementation of the project.

Considering the above issues, direct and indirect benefits will be obtained through implementation of the project. Rapid promotion to implement the project is strongly expected.

CHAPTER 5 CONCLUSION AND RECOMMENDATION

5.1 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 for 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.

5.2 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 implementation 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.

JICA