

4.6 Improvement of Rural Infrastructure and Services

4.6.1 Improvement Plan of Main Farm Road

Targets and the framework of rural road development program were established based on the problems of the present road network and following aims.

- To provide adequate road protection structures and drainage facilities taking into consideration the frequent typhoons and heavy rains.
- To reinforce the motor pool of Sub Project Office (SPO) of the District Agency to encourage road operation and maintenance activities.
- To provide asphalt pavement roads in commune centers for multi-purpose use such as dry pavement for agricultural produce, market area, meeting place, recreation area, playground, etc.

Overall targets of the Road Development Programs by the end of the year 2020 are as follows:

- All communes roads are to be accessible by all-weather roads with at least gravel surface.
- District roads which function as major farm-to-market roads shall be paved with asphalt or concrete.
- Farm-to-market roads which are to be provided for agricultural areas, shall be all-weather roads.
- Farm roads shall be adequately provided to the farming areas according to the existing and proposed irrigation and agriculture development programs.
- All existing temporary drainage conduits or narrow bridges are to be replaced by permanent and wide ones.
- Multi-purpose pavements shall be provided not only to commune centers but also to remote villages.

Based on the targets described above, individual road development programs are formulated by category and by development stages. The total length of rural

roads (farm-to-market roads) for improvement/upgrading by the end of the long-term development plan period is 300 km.

The total length of farm roads to be improved is 300 km while the proposed multi-purpose pavement is scattered in 400 places including some areas in the remote communes. As to bridge development, 370m are for replacement and 500m are for new construction.

The maintenance operations are broken down into regular (routine) and periodic maintenance. If, for some reasons, road maintenance is neglected for some years, the road conditions may become so bad that heavy operations are required with more funds to restore the road to its original standards. Thus, it is important to perform steady and efficient maintenance operations on schedule.

Provincial government shall undertake such maintenance operations for national roads and provincial roads, and SPO shall be responsible for district roads and part of the commune roads. Reinforcement of Motor Pool of SPO should also be programmed in the short-term development plan period.

Traffic system in the Study Area is by land or ferry boats. The problem of land routes could be solved with the development of rural and farm roads, and bridges as well as the improvement of traffic rules and traffic safety maintenance facilities.

During the short-term development period, the development purposes are to support domestic trade and marketing organization such as the improvement of the existing bridges and to improve the traffic system in the Study Area.

In the medium-term development period, in order to promote the targets of the short-term development, the waiting sheds of 223 along the provincial roads as well as the improvement of the existing bridges.

In the long-term development, 330 waiting sheds along the commune roads and 70 waiting sheds along the provincial roads.

4.6.2 Improvement of Water Supply and Sewerage

When the health of rural inhabitant is considered, the improvement of water supply system shall be implemented first of all, and the sewerage disposal system is to follow in this relation.

As a water supply system, water resource of acceptable quality shall be developed at least for drinking and cooking, and use of deep well is to be taken into account for this purpose. Some deep well have already been dug in the Study Area, but it is recommendable to investigate the availability of groundwater comprehensively to provide a future plan of groundwater development.

The existing common washing place at the pond have many problems from the hygienic point of view. But the common washing place is a kind of communication spot of women of surrounding area, therefore it is not neglective one-sidedly. Consequently, it is necessary to provide some facility of hygienically acceptable to replace the existing common washing place, and water supply and sewerage disposal shall be separated at least.

It will be rather difficult to introduce sewerage treatment facilities in near future from the viewpoint of cost, but it is possible and necessary to reinforce the hygienic care such as re-allocation of sewerage disposal to avoid mixture with the source of water supply as a part of extension services of improvement of life style.

4.6.3 Rural Electrification Plan

From the quantitative point of view, most of villages in the Study Area have already been receiving electricity therefore expansion of electrification is not main subject, however it is very obvious that the qualitative improvement will be required due to increase of power demand in near future. Especially, the Study Area has many pumping stations for drainage purpose and it cause considerable seasonal fluctuation of power demand other than hourly fluctuation of domestic consumption, therefore the capacity of transmission as well as power generation shall be decided based on such demand fluctuation.

For stable supply of electric power, appropriate cost bearing by the consumer is not avoidable. Especially, large portions of the cost of power for drainage pumping is borne by the public authority at present, therefore new investment for improvement of facilities is hardly possible. It is necessary to reconsider the cost allocation system to the total consumption of electric power in the area.

4.6.4 Improvement of Public Sanitary Service and Administration

Despite of problems of water supply and sewerage disposal mentioned in the above para. 4.6.2, it is wonder that the Study Area is not suffering epidemic such as cholera in recent years. However, the hygienic improvement in the rural life is necessary because the rate of catch of water borne disease such as trachoma and diarrhea are still rather high.

On the other hand, the cause of recent trend of increase of tuberculosis patient is to be examined from both faces of hygiene and nutrient, and enlightenment of rural inhabitant for improvement of living circumstance shall be reinforced in parallel with diffusion of vaccination against tuberculosis.

The administrative guidance related to family planning has been implemented rather successfully, and more than 55% of farmer's household are less than 4 persons despite of the mean size of a family is exceeding 4 persons. Meanwhile, the increase rate of population is about 2.3% at present, therefore the appearance of effect of family planning will take more time.

Taking the afore-mentioned present situation into account, the role of administration in the problem of public sanitary is to be concentrated in the improvement of living circumstance.

As for medical treatment, neither number of bed in hospital nor facilities are sufficient for the demand in the area, therefore the earliest expansion and improvement are to be considered.

4.6.5 Improvement of Educational and Cultural Facilities

As explained in the above para. 3.5.3 (4), the education level in the Study Area is rather high showing the schooling ratio of primary education of more than 70% of aged population and number of pupils per a teacher of about 25. But it is rather doubtful if the quality of education is sufficiently high as shown with those statistic figures. especially, many schools are obliged to apply 2 shifts lesson due to shortage of class room, therefore the learning hour is considered as insufficient. The schooling ratio of high school is fallen down to about 20%, and one of main reasons of low schooling ratio is shortage of number of high school which cause the difficulty to send children to the high school.

The Study Area has excess man-power than the actual demand, therefore it is necessary to provide the employment opportunity other than agriculture sector in future. In such case the quality of man-power will be questioned at the first of all. To level up the quality of man-power, improvement of primary education is not sufficient, but vocational education or training is also not avoidable. Moreover, even in agriculture sector, proper education is unavoidable for achieving high productive farming.

Due to the afore-mentioned point of view, the improvement of educational facilities is a very important problem for the future development of the area, therefore a drastic review of educational facilities, including the allocation of school, is recommended.

In parallel with the improvement of educational facilities, establishment of meeting spot which is also available as a center of different cultural activities, sport facilities, etc. are to be considered to activate the rural life. In case of the Study Area, the availability of land for such facilities is rather limited, therefore it is recommended to provide those cultural facilities annexed to the educational facilities. If the sport facilities are provided nearby the school, the physical training in school will be enriched using such facilities, and interest or understanding of the parent will be deepened if the meeting spot is adhered in a corner of school building.

4.6.6 Rural Community Activating Plan

(1) Purpose of Plan

For activating rural community, the productive activities and cultural activities are closely interrelated. Namely, the increase of income is expected according to the activation of productive activities, and the interest to cultural activities, including the recreational activities, will be risen to enjoy the life, while the activation of cultural activities will increase the willingness of production. The improvement of educational and cultural facilities mentioned in the above paragraph will accelerate the activation of rural community if those facilities are used effectively.

The purpose of this plan is to grope the activation of rural community by mean of combination of such internal and outer factors as explained above.

(2) Subject of Plan

It is not necessary to say that the base of activation of rural community is the increase of productivity of man-power by mean of qualitative improvement of agriculture, however, taking the limitation of land resources in the Study Area into account, the expansion of employment opportunity in other sectors than agriculture to maintain the population and improvement of quality of man-power by mean of full of the daily giving appropriate impact from outside are also very important.

For the qualitative improvement of agriculture, it is necessary to reform the present paddy mono-culture farming by mean of promotion of the crop diversification for increasing the farmer's income and absorbing proper man-power in agriculture sector. At the same time, the promotion of agro-products processing and its marketing are to be considered introducing processible crops and livestocks. new employment opportunity will be created as the result of such efforts.

Such qualitative improvement of agriculture is, in fact, hardly possible for individual farmer of small land holding, therefore introduction of the investment of third parties or participation of farmer's organization such as cooperative is unavoidable for the implementation. Taking the socio-economic conditions of the Study Area into account, the investment of third parties will not be expected, and the solution will be found out within the farm mechanization, introduction of agro-products processing, improvement of marketing system, etc. by mean of the expansion and consolidation of activities of farmer's cooperative as mentioned in above para. 4.4.3.

The operation of farmer's cooperative is to be based on the mutual reliance of member farmers, therefore promotion and consolidation of different cultural activities will be effective to tighten such mutual reliance. Although most of cultural activities are carried out village basis at present, it is recommendable to expand such activities to the covering area of unit cooperative or commune basis to accelerate the exchanges amongst neighboring villages. It is such exchange that activate rural community making internal impact to the daily life.

It is possible to combine the cultural activities and productive activities by means of introduction of handcraft making with available material in the area such as bamboo, reed, etc. or diffusion of art of embroidery. Such products are not only consumable within the villages, but also possible to be cash income source of villagers selling the products at market as specialities of the area. Taking the diligence and willings of promotion of the inhabitant into account, there are sufficient room that such training of production will develop introduction of light industries such as processing of textile products and/or production of spare parts of different electronic equipment, etc.

The internal factors such as improvement of productivities and cultural activities are un-avoidable for activating the rural community, but, at the same time, impact from outside such as participation in sport tournament, invitation of spectators from outside to the local festivals, etc. are also important. Furthermore, the touristic development arranging the historic relics in the area is also considered as effective impact from outside.

Considering those above mentioned factors, it is desirable to examine the improvement of social infrastructure mentioned in the above para. 4.6 from the viewpoint of activation of rural community (see Appendix G.8 for summary of rural community activating plan).

4.7 Water Control and Management

4.7.1 Organization and Management

Present organizations, which have been established to operate and maintain the irrigation and drainage facilities extended over two more districts under the provincial government and those within one district under the district government, will be principally supported but recommended gradually to transfer from the government leading organization to beneficiaries participant ones. The irrigation enterprises are organized under the province and/or district and directors are appointed for them. The operation and management policies of the enterprise will be decided by the board/committee, which will be composed of representatives of agencies concerned, and implemented by the director of the enterprise. Under the director, divisions, which take charge of the planning/technical, financial, administrative, operation and maintenance, mechanical matters will be arranged. For Bac Duong Enterprise, the operation and maintenance offices will be maintained. Every divisions/offices will be sufficiently staffed depending on a volume of the works. The superintendent will be appointed for each irrigation and/or drainage pumping station together with operators depending on the number of pump units.

The director for the enterprise will rest with all technical and administrative matters with support of every division staffs. The planning/technical division will prepare operation plan of pumps based on the request of water supply from each district operation and maintenance office and inform the plan to each pumping station every week, and also prepare the guideline and operation rules necessary for operation and maintenance. The operation and maintenance division/office will provide the services to inspect whether the water management and drainage control and operated properly and report those status to the director, and take appropriate measures and/or instruct those to the gatekeeper, if any. The enterprises will manage the operation and maintenance costs basically within the water fee collected from the beneficiaries. In the future, the operation and maintenance of facilities will be responsible by the enterprises for major facilities, such as large scale irrigation/drainage pumping station, main irrigation/drainage canals and structure, major secondary canals, and by farmers' association, which will be organized for operation and maintenance of the small scale pumping station, secondary irrigation/drainage canals and farm ditches/drains and other small structures. By this arrangement, the expenses of

the enterprise will be reduced but the financial assistance to the farmers' association may be required (refer to Appendix E-3.1).

4.7.2 Water Control Plan for Drainage Systems

Paddy fields have a substantial function to control the runoff discharge by retaining the rain water in the field. In fact, it is allowed to keep the water in the depth of 20-30 cm temporary, depending on the crop growing stages. Runoff of rainfall is first controlled by paddy field, farm drains and conduits, where no deep water is keeping in the field. The excess water is also controlled by the drainage regulating sluice not to concentrate the inundation into the limited area. In other words, rain water is distributed every paddy field within an allowable water depth. Taking into account these functions of paddy field area, drainage water control will be planned. In addition, the farmers and drainage water masters concerned will be trained on the field drainage water control

The review of present water control and pump operation rules as well as the strengthening of data/information collection and evaluation system will be proposed to execute effective water control and reduce the pump operation costs. In order to achieve these strategies, the water gauges and/or staves will be installed at the confluences of creeks/main drainage canals and major drainage canals and other places necessary for drainage pump operation, which those will contribute to the adequate and effective operation of drainage pumps. The water level in the creeks and main canals will be controlled at about 50 cm below the fields, to react to the local spot rainfall. After the project, the new operation rule of drainage sluices shall be set up by review of present rules and agreements. Moreover, the monitoring system strictly to watch over the implementation of the rules shall be strengthened, because the miss operation of the irrigation cum. drainage sluices and regulating sluices on the creeks bring about inundation problems in the downstream (refer to Appendix E-3.2).

4.7.3 Water Management for Irrigation Systems

The water management at the field is one of major factors in the increase of paddy production. The water supply is variable in the crop growing stages. The water depth shall be practically kept by a few centimeters in the field except it is retained in about 5 centimeters for 2 to 3 weeks after transplantation. As seen in the Study Area, a deep water in the field bring about checking of paddy growing in the tilling stage and inundation even by a little rainfalls. A good harvest will be expected in the wetted field. Specially in the summer crops season, the paddy

field is well drained in the surface water. Although such water management in the field will be practiced by farmer, training/education on the proper field water management shall be conducted.

The irrigation water shall be supplied timely in the request and adequately in the required quantity to the field through the turnout and farm ditches. To implement the proper and effective water management, the improvement/provision of water management facilities included communication system will be provided. Mobilization of staffs are also enhanced. Furthermore, it is required to arrange the supervision system for the effective operation and maintenance of the regulating facilities. The training on the proper operation and maintenance will be precisely required. Aside from the above, in the water supply schedule, the water users will recognize well the water supplied from the pumping station and/or canals, when the water supply system is modified to the demand-oriented water control. The water supply method, which is practiced to supply the diversion water estimated based on the request of the farmers through the district operation and maintenance office one week before the water is demanded, is recommended (refer to Appendix E-3.3).

4.7.4 Operation and Maintenance of the Structures

The operation and maintenance of the facilities will be responsible by the Enterprises for the major facilities and by the water users for the facilities below the secondary canals, as stated previous section on the organization and management. The maintenance of facilities will be implemented according to the rule stipulated the scope of the works, activities, method etc. The maintenance works consist of day-to-day works and periodical maintenance works. The day-to-day works will be done by the skilled/unskilled labors concerned. The supervisor shall report on the conditions of facilities and status of operation weekly bases on the daily inspection. The periodical maintenance works, which will be executed principally by the contract basis depending on the quantity of the works, is recommendable. The repair/restoration of the irrigation facilities will be implemented in a spare time during winter/spring crop season, while the repair of drainage facilities will be done before the rainy season. The costs necessary for the maintenance will be managed within the amount of water fee collected from the farmers, while some financial assistance of the government may be necessary in case of huge construction costs required. Thereof, the repair/remedy of the facilities damaged by calamity will be carried out by the provincial/district government and/or by the farmers concerned with supply of fund and/or materials

from the government, according to the scope of the responsible management (refer to Appendix E-3.4).

4.8 Environmental Conservation Program

4.8.1 Items of Environmental Study and EIA

Based upon the result of the Initial Environmental Examination (IEE), the Environmental Impact Assessment (EIA) was carried out. However, since there is room for further investigation, the final EIA ought to be prepared according to the result of detail design. The main issues in this EIA are summarized as follows:

(1) Environmental Impact Associated with Change of Water Management

Assuming that the existing water management is changed without consideration, environmental impacts upon every aspects may come out as mentioned below. 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.

1) Occurrence of Troublesome Characters of Soil because of Water Level Down

The water level down in the ordinary drainage (for example, reformation into well-drained paddy field) without consideration may cause the low productivity of cultivated land because of the troublesome characters of soil such as the Permanently Flooded Alluvial Soils.

2) Deterioration of Water Quality because of Water Level Down

The water level down in the ordinary drainage without consideration may cause deterioration of water quality, that may give influences upon the ecosystem in the Project Area.

3) Influence upon Custom of Water Use

The drastic change of water management may give influences upon the custom of water use (including domestic water and fishing water) in the Project Area.

4) Change of Sedimentation

Assuming that the existing water management (especially the irrigation network) is drastically changed without consideration, the fertility of farm land may be influenced by the change of sedimentation.

5) Influence upon Scene of Cultural Inheritance

In the Study Area, there are many pagodas, artistic architectures and famous places that are familiar with regional residents. The water level change without consideration may give influences upon the scene of such cultural inheritances, because most of them are located against ponds or small lakes.

Judging from the above, the most effective countermeasure for the impacts is that the change of the existing water management such as setting ordinary drainage water level, drainage network, irrigation network, ought to be minimized and phased out. Moreover the improvement of existing water control and management organization after the implementation of this construction is recommended for reasons mentioned below.

- The water control and operation rule ought to be reviewed, according to the new drainage system strengthened by the increase of pumping drainage discharge.
- As agriculture in the area will develop in the increase of cropped area associated with the drainage improvement and introduction of diversified crops, the proper water supply control will be required to supply the adequate quantity of water timely.

(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 as follows.

1) Increase of Agrochemicals Use

The progress of intensive agriculture may cause the increase of agrochemicals use in the area. There is possibility that disorderly agrochemicals use will give influences upon the ecosystem.

2) Deterioration of Soil Fertility

The progress of intensive agriculture tends to cause deterioration of soil fertility by crop planting, failure in soil management, etc.

3) Deterioration of Water Quality and Ecosystem

The 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.

The countermeasures for the influences are as follows.

- 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.
- For checking on the deterioration of environmental conditions caused by the progress of local economic activities and making promptly a plan of mitigation measure if influence will come out, monitoring system ought to be set up by organization concerned.

(3) Environmental Impacts Associated with Implementation of Construction

There is possibility that the construction activities will give impacts on the environmental condition in the Study Area. The results of assessment for the each possibility of impact 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.

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.

3) Occurrence of Construction Waste of Every Kind

The disposal of construction waste such as surplus soil, the residue from the demolition of existing concrete structure, useless metals, wooden components, etc. ought to be carried out.

4) Occurrence of Erosion and/or Sediment because of Bare Land after Excavation at Borrow Pit and/or Quarry

In the hillsides scattered in the Study Area, there are some quarries, in which erosion has occurred because of awkward disposal after quarrying. The bare land ought to be adequately disposed in order to prevent the erosion and/or sediment at borrow pit and/or quarry.

5) Influences on Worker's Health and Environmental Condition such as Water Quality, Noise, Dust

The safety control for the condition of worker's health and the surrounding environmental condition ought to be carried out in the construction term.

6) 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.

For further details of this paragraph 4.8.1, Appendix H-5.

4.8.2 Environmental Conservation Program

Based upon the results of the EIA, the environmental conservation program was recommended, and was divided into 3 stages such as Term of Planning, Term of Construction and Term of Management.

(1) Term of Planning

Most important of all is that taking influences upon environment into consideration, adequate plan and design ought to be prepared.

1) Notice on Irrigation and Drainage Plan

Taking environmental influences caused by the change of water management into consideration, the new irrigation and drainage plan in the project ought to be prepared. Especially it is important to consider setting of ordinary drainage water level, drainage network and irrigation network. Moreover, as mentioned in the preceding paragraph, the change of existing ordinary drainage water level

(for example, reformation into well-drained paddy field) and network ought to be minimized and phased out in this project.

2) Overall Environmental Management Plan

The overall environmental management plan ought to be proposed in the frame of EIA in order to ensure that all protection measures which are planned in the detail design stage will be implemented effectively during construction and operation.

3) Scheme for Compensation

It is necessary for the improvement of pumping station and related facilities to compensate adequately for acquiring land and/or temporary loss of fertility in disposal area.

(2) Term of construction

For controlling sudden impacts caused by the construction, adequate schemes ought to be prepared. Thinkable schemes are as follows:

1) Mitigation Measures against Impacts Associated with Construction Activities

Mitigation measures against impacts associated with construction activities will be proposed in the overall environmental management plan. The major mitigation measures are as follows:

- Disposal of construction waste of every kind
- Disposal and stabilization of excavated soils
- Stabilization and/or reclamation of borrow sites and quarries
- Safety control for worker's health
- Safety control for surrounding environmental condition such as water quality, noise, dust, and so on

2) Monitoring for Environmental Condition during Construction

For checking upon the environmental condition as mentioned above during the construction, the responsible monitoring system ought to be prepared.

(3) Term of Management

For promoting sustainable development in the Study Area, adequate management plans ought to be prepared.

1) Strengthening of Organization for Water Control and Management

According to the new irrigation and drainage system, the strengthening of organization for water control and management is recommended, will induce not only the efficient use of water but also the conservation of environment. Because the land use of this area has been mainly paddy field and ponds from old times, the distribution and control of water is an important control factor for environment in the Study Area.

2) Strengthening of Research and Extension Activity for Agrochemicals Use

For preventing excess use of agrochemicals, the propagation and enlightenment scheme of proper agrochemicals use (including scheme of conservation of soil fertility) ought to be prepared by organization of research and extension, which ought to be strengthened with other purpose.

3) Recommendation for Setting up Monitoring System

For checking upon the deterioration of environmental conditions such as water quality, soil, etc. caused by the progress of local economic activities, according to the environmental criteria, and making promptly a plan of mitigation measure such as waste water treatment, solid waste treatment and disposal, waterworks, etc. if influence will come out, monitoring system ought to be set up by organization concerned.

CHAPTER 5 SELECTION OF PRIORITY PROJECT

5.1 Alternative Schemes of Drainage Improvement

5.1.1 Regional Drainage Schemes

The regional drainage system, which the Ngu Huyen Khe River, Kim Doi creek and Tao Khe creek are considered as a main drainage canal for each drainage area based on the topography, is an ideal system from an engineering and economic point of view. However, main drainage canal and pumping station become large scale, improvement/upgrading of secondary and tertiary canal are imperative and a big regulating pond in front of pumping station is required from a standpoint of hydraulics and water control. As a result, it has demerit, such as the costs are huge, construction period is longer, and delay in benefit generation. Furthermore, the problems/constraint, such as soils in the presently poor drainage area, water supply from the drainage canals, impact due to rapid change of drainage events and so on, shall be taken into consideration.

5.1.2 Decentralization Drainage Schemes

This scheme, like a present improvement scheme, is a method to improve a drainage by construction of pumping station for the poor drainage area surrounded by polder dikes. However, the drainage improvement is limited to the selected area, imbalance improvement is employed in the area, and total investment costs to the area as well as operation and maintenance costs become high. On the other hand, scale of the project would be appropriate for the implementation and faster benefits would be expected. The drainage operation rule between the areas has been concluded at present to moderate imbalance drainage constraint. As the gravitational drainage is prevalent in the dry season, the drainage water is discharged through the said three river/creeks to the Cau River. Therefore, the decentralization drainage scheme is considered as a part of stage improvement of the regional drainage scheme.

5.2 Logical Sequence of Drainage Improvement

5.2.1 Evaluation of Alternative Schemes

The drainage schemes for the Study Area have been worked out to evaluate the inundation events and project feasibility, grouping the Area into five (5) development blocks; that is, Dong Anh & Gia Lam drainage block, Trinh Xa & Xuan Vien drainage block, Tao Khe creek drainage block, Kim Doi creek drainage block and Chau Cau & Pha Lai drainage block, based on the design rainfall and drainage planning criteria stated previously and the topographic maps with 1.0 meter contour in a scale of 1/10,000. Thereof, the project benefits have been estimated only for a net value of crop damages prevention in the future without the project.

Gia Lam area would not persist in the additional drainage pumps for the time, except repair/replacement of pumps in some stations, because the existing pumps have been renovated/planned to be improved and the inundation damages are small, as compared to the areas in Ha Bac province. Dong Anh area is high in the frequency of inundation and necessary to add some pumps in each station, expecting higher project effects, as compared to Gia Lam area. However, for the entire block included Dong Anh and Gia Lam area, the projects would be lower in the urgency and feasibility.

Trinh Xa & Xuan Vien drainage block is moderately good in the present inundation events as compared to the other blocks. The repair/replacement of existing pumps would be required but low in the project feasibility. In either way, the priority should be given to the improvement of the Ngu Huyen Khe River and measurement to the warning water level for suspension of pump operation in the Cau River rather than the drainage improvement for the area.

Tao Khe creek drainage block would be the highest in the economic internal rate of return for the project (EIRR) and followed by Chau Cau & Pha Lai drainage block in the ratio of inundated area to the agricultural land area. Tri Phuong and Que Tan drainage areas have discharged the excess water to the Duong and Cau rivers, respectively. Que Tan area would be improved with high EIRR, while the improvement of Tri Phuong pumping station is on-going. Under such circumstance, the regional drainage scheme for Tao Khe creek drainage area as a line of Tan Chi area in the upstream and Hien Luong area in the downstream have been studied. In this scheme, it is turned out that the operation of Tram sluice would be greatly influenced in the Tao Khe area drainage improvement

scheme. Tram sluice has an enough capacity to drain the excess water in the Tan Chi pumping drainage area, upstream from the Tram sluice. When the gates are fully opened, the inundation would take place in the downstream area. In other words, the excess water in the Tan Chi pumping area had better drain to the downstream area with regulation of Tram sluice, improving drainage canals, and providing additional pumping station at Hien Luong rather than construction of additional pumping station in the Tan Tri area or Han Quang area. This scheme would be low in the project costs per hectare and comparatively high in EIRR. However, the drainage control would depend on the operation of drainage sluices, as existed two (2) drainage sluices at Tram and La Miet on the Tao Khe creek. To avoid social problems in these drainage control and sluices operation, it is recommended to make plans of separated drainage for Tan Chi area and Combined drainage for Tan Chi and Han Quang areas, in the view of the decentralization drainage. Both plan would be of urgency in large inundation damages and expected at high project benefits. Moreover it is expected to mitigate the drainage damages in Hien Luong area by diverting the runoff discharge at the upstream area.

The Kim Doi area is commonly suffered from poor drainage in the upstream area of Van sluice so that both the additional pumping station and widening of Van sluice's bay are required for the drainage improvement, and suggested to improve urgently from a standpoint of solving heavy inundation problem in the upstream area. Seeing that the high EIRR estimated from the present inundation damages might be unexpectable, the project should be formulated by expecting the agricultural effects from increase of cropping intensity and integrating with the irrigation component. Thereof, Viet Thong area is expected to implement the project with high EIRR urgently.

Chau Cau & Pha Lai drainage block is hasten to implement the drainage improvement. The EIRR would be high in Chau Cau area but low in Pha Lai area because of the river dike improvement in parallel with the inland drainage improvement.

5.2.2 Selection of Priority Area

Phasing development for improvement of drainage systems in the Study Area covering 40,000 ha has been studied for five (5) development blocks to evaluate each project feasibility. Based on the project evaluation, the development of the Study Area will be expected according to the following priority.

1. Tao Khe creek drainage block
2. Chau Cau and Pha Lai drainage block
3. Kim Doi creek drainage block
4. Dong Anh and Gia Lam drainage block
5. Trinh Xa Xuan Vien drainage block

Tao Khe creek drainage block is selected as the highest priority in the economic internal rate of return. This drainage block is divided into three (3) sub-drainage areas, for instance, Tan Chi, Han Quang and Hien Luong by Tram and La Miet sluices.

Considering the persistent social problems in the existing drainage control and sluices, it is recommendable to improve drainage systems in each sub-area within Tao Khe creek drainage block in a view point of the phasing development based on decentralization drainage method. The application of this method is expected to mitigate the drainage damages in the downstream area by diverting the runoff discharge at the upstream area in terms of urgency and the scale of the project. Therefore, the scale of the project will be decided depending upon alternative studies on a drainage plan for Tan Chi area and a combined drainage plan for Tan Chi and Han Quang areas as studied in Part II of this report.

PART II

FEASIBILITY STUDY ON PRIORITY AREA

CHAPTER 1 THE PROJECT AREA

1.1 Location and Socio-Economic Conditions

1.1.1 Location and Geography

The Project Area is an agricultural land area situated in the middle reaches of Tao Khe creek and extended most land area within Tien Son district and some land areas in Que Vo district in Ha Bac province. The area is formed as a delta within South Bac Duong area developed on the north of the Red River Delta in the land morphology and bounded by the national railway (Ha Noi-Dong Dang), irrigation canals (South main canal & N4 secondary canal), roads and the river. A total drainage area is some 8,540 ha, which is divided by the provincial road (No. 38), in terms of drainage system, to some 6,420 ha for Tan Chi area and some 2,120 ha for Han Quang area, as follows:

Drainage Area

District	Tan Chi D.A.	Han Quang D.A.	Total
Tien Son	6,420 ha	1,260 ha	7,680 ha
Que Vo		860 ha	860 ha
Total	6,420 ha	2,120 ha	8,540 ha

The topography is gentle in Tan Chi area with a slope of about 1/4,000 to 1/6,000 from the northwest to the southeast, ranging from 6.0 m to 3.0 m in an elevation, and flat in Han Quang area. Several hills and small mountains are dotted, extending from the north-east to the south-west. Cua Vua mountain with an elevation of 155.2 m is the highest. In Tan Chi area the elevated lands are in the west and north-west, the lowlands, which account for about 47% of the total land area, extend from the center area to the south and east areas. The lower-lying land with an elevation of less 3.0 m area distributed in between the small mountains in the north east portion and 2.9 m in the lowest elevation, while in Han Quang area most lands are below 3.8 m and 2.2 m in the lowest elevation, according to the 1/10,000 topographic maps.

Geologically the plain lands are alluvial, which is overlaid with deposits brought by the sediments of the Red River after long period of fold/thrust fault in the tertiary, while the hills and small mountain may be formed by the fold in that time. A weathered granites are outcropped in a few mountains.

1.1.2 Population and Socio-Economic Conditions

1) Socio-economic Particularities of the Project Area

The Project Area includes most of area between the south of route A1 which runs the northern part of the Study Area and the dike of Duong River. This area is near to capital city of Hanoi having good accessibility, therefore the inhabitant shows quick response to the policy of central government, however the improvement of social infrastructures become behind the needs of inhabitants and/or social changes. For instance, the introduction of market-oriented economy and change of land use system are providing some gap of income among the villages or individual household of farmers according to the level of response to such changes. At the same time, qualitative gap of infrastructures is also appearing amongst the villages or the covering area of unit cooperatives due to introduction of such system as improve infrastructures by the beneficiaries own hand.

The background of appearance of such gap is mainly due to difference of ability of leaders of villages and cooperatives or self-consciousness of inhabitants themselves or sense of cooperation amongst the inhabitants, however the physical conditions are also influenced largely. Especially, it is not negligible that the level of damage of water logging is greatly affecting from both sides of production (income) and measure for damage protection (expenditure).

2) Population Distribution and Particularities

The population of the Project Area was 134,650 as of 1990, and 97.4% of which were living in 17 communes and a part of 5 communes in Tien Son district, and 2.6% were living in a commune in Que Vo district. The population density was 1,577 person/km².

The average size of household in this area was 4.42 person/household which was slightly smaller than average of the whole Study Area of 4.55. It is assumed that the reason of smaller size of households is due to implementation of family planning. The male : female ratio of population is 47.1 : 52.9 which is almostly same as average of the Study Area.

According to the results of hearing survey of 100 households in 15 villages of the Project Area, 85 couples or 87.6% of 97 couples subject to the survey were borne in same village or same commune. This means that the mobility of population is

still rather low (see Appendix G.5 for details of population and family composition).

3) Present Conditions of Infrastructural Arrangement

Most of villages in the Project Area have already been electrificated, and whole houses are receiving electricity except a few houses whose electric lines are cut due to delay of payment of the charge. Electricity is mainly used for lighting and electric fan, and the rates of diffusion of radio and TV are also considerably high.

One primary/secondary school and a dispensary are allocated for each commune, and 2 high schools are in the Project Area. Most of age group population less than 30 years old are finished up to the course of secondary school.

The domestic water is mainly obtained from the hand dug well, and many houses are supplementarily using rain water because of the poor water quality of well.

The national road of route A1 runs the northern border of the Project Area, and many provincial and district roads are branched off therefrom. The service road along the canals and the crest of dike of the Duong River are also included within the road networks of the area, however most of roads are not yet paved. Especially, many of village-village roads have no sufficient difference of elevation with the surrounded paddy field, therefore traffic through many of such roads becomes difficult after rainfall.

1.2 Natural Condition

1.2.1 Topography

In general, the characteristic of the Project Area is lowlying flat area, slopes from North West to South East and from West to East, but on the other hand, the small area of hills and low mountains with elevation less than 150m are scattered.

The lowest field elevation is between +2.00m to +4.00. The area is close by the Duong River which is the main river to be drained. But in flood season, pumping drainage is necessary due to that water level of the river is higher than that of the field elevation. Area distribution on each elevation are shown as follows.

Area Distribution on Elevation

Elevation	Area	Accumulated	Elevation	Area	Accumulated
2 - 2.5 (m)	66 (ha)	66 (ha)	4.0 - 4.5 (m)	818 (ha)	5,628 (ha)
2.5 - 3.0	1,167	1,233	4.5 - 5.0	1,158	6,786
3.0 - 3.5	1,537	2,770	5.5 - 6.0	1,661	8,447
3.5 - 4.0	2,040	4,810	6.0 <	93	8,540

1.2.2 Climate

For the drainage planning information: Maximum daily rainfall mostly occurs in July, August and September, and rainfall lasts from 2 to 5 days, sometimes from 9 to 10 days. Maximum daily rainfall with 10% is 182.9 mm and 3 days consecutive rainfall with 10% is 248.1 mm.

For the irrigation Planning information: In the dry season, mean monthly rainfall are only 16-42 mm. The annual mean evaporation is 984 mm and annual mean sunshine hour is 4.4 hours and annual mean temperature is 24°C, maximum is in July as 29°C and minimum is in January as 16°C.

(The records of climate in the Project Area is shown in Appendix B.)

1.2.3 Hydrology

There are two hydrological constraints through the year. One is a drainage problem for excess water in rainy season, the other is an irrigation problem for water shortage in dry season.

The characteristic of the Project Area is lowlying and poor drainage area. During the rainy season, water level of the Duong River is higher than the water level of drainage canal in the area. Consequently, the drainage by pump is necessary in stead of gravitational drainage method. The frequency of the maximum water level at Thuong Cat and Ben Ho station are shown as follows:

Probable Year	Thuong Cat	Ben Ho
Average	10.77 m	9.02 m
1/2	10.73	7.99
1/5	11.54	8.63
1/10	11.98	8.98
1/20	12.36	9.27
1/50	12.81	9.62

On the other hand, water resource in the area is limited and the appropriate capacity of regulating facilities will be necessary in order to utilize the water resources as much as possible in the area. And also, the regulating facilities will be required in order to reduce the drainage duty.

To increase the water resource in the area, pumping water from the Duong River is required. The frequency of the minimum discharge and water level at Thuong Cat and Ben Ho station are shown as follows.

Probable Year	Draught Dis.	Annual Dis.	WL. at Ben Ho
Average	119 m ³ /s	28,575 MCM	1.43 m
1/2	110	28,139	1.42
1/5	75	24,032	1.25
1/10	60	22,106	1.17
1/20	50	20,619	1.10
1/50	40	19,051	1.04

The water quality of the Duong River is generally good and no toxic materials are contained. Salinity intrusion is not so critical. On the other hand, sediment concentration is high. The concentration of suspended load at Thuong Cat station is 948 g/m³ on an average and 5,290 g/m³ in the maximum. Amount of suspended load yield at the same station is 29.9 million tons per annum.

1.3 Soil and Land Use of Tan Chi Area

1.3.1 Soils

The 1963 soil survey for the South Bac Duong agricultural area began to show weaknesses. The new soil survey has been implemented for the Tan Chi and Han Quang area by NIAPP in 1994. The soil map of the Project Area (8,540 ha) at a scale of 1:10,000 has been formulated, according to the Guidelines for Soil Description (FAO, Rome, 1990). The major soil groupings in the Project Area are as follows:

- Fluvisols (alluvial soils)
- Gleysols (water logged alluvial soils)
- Cambisols (alluvial soils with ferric mottles)
- Plinthosols (degraded soils)
- Acrisols (strong acid soils with base poor argilic horizons)
- Regosols (high base saturation sandsoils)
- Leptosols (eroded skeletal soils)

Each of the groups is divided into soil units and subsoil units (see Appendix C-12 (map), C-13, C-14).

Characteristics of soil in the Tan Chi area are shown in Appendix C-15, C-16.

(1) Fluvisols were formed by depositing sediments of the Duong River, covering the bigger part in the Project Area (32.8% of the total agricultural area). The total area of fluvisols is 1,953 ha.

- Physical properties : Soil texture is almost loamy with 6.8-28.5% of clay, 14.4-50.2% of silt and 25.0-78.6% of sand in topsoil. Soil density is 2.2-2.5. The bulk density is 1.0-1.1. Porosity is 40-58%.
- Fertility characteristics : Almost fluvisols (except for Areni-hyper-cutric Fl.) are acidic with pH KCl ranges from 5 to 5.3 in topsoil, rich in organic matter 2.2-3.4%, medium in CEC 11.1-12.8 meq/100g soil and very poor in NPK. Since rice is quite sensitive to N levels, it is not surprising that deficiencies of this element limits production over wide areas where soil N levels are low.

(2) Gleysols occupies 3,133 ha, accounting for 52.6% of the total agricultural area. Due to the uncompleted sedimentation of fluvial deposit after the

embankment of dike systems it remains some large depressed areas, forming the gleysols nowadays.

- Physical properties : Soil texture is mostly clayey with 14.1-36.7% of clay, 36.9-38.9% of silt and 24.9-48.9% of sand in topsoil. Soil density is 2.2-2.3, Band density is 0.9-1.0. Porosity is 54-58%.
- Fertility characteristics : Gleysols are acidic in topsoil with pH KCl : 4-4.6 and strong acid in subsoil with pH KCl : 3-3.8, rich in organic matter 3-4.6%. Medium in CEC 7.6-12.5 meq/100g soil, very poor in phosphorus but high content iron in subsoil (85-94.5 mg/100g soil) that careful management for canal making is required (see profile 629, Appendix C-16).

(3) Cambisols occupy 330 ha (5.5% of the total agricultural area).

- Physical properties : Soil texture is loamy with 18.1-20.2% of clay 35.8-41.3% of silt and 40.5-43.7% of sand.
- Fertility characteristics : Cambisols are acidic with pH KCl : 4.4-4.5, rich in organic matter 3.9-4.2%, low in CEC 8.9-9.3 meq/100g soil, poor in PK in topsoil.

(4) Plinthosols. The total area of plinthosols is 250 ha (accounts for 4.2% of the total agricultural area.

- Physical properties : Soil texture is sandy loam with 6.6-16% of clay, 9-29.6% of silt and 62.8-79.7% of sand in topsoil. Soil density is 2.5-2.7, bulk density is 1.5. Plinthosols are structureless, loose when dry, very compact, especially in the plough sole horizon.

The most consistent theme across the problem soils (gleysols, plinthosols) of the Project Area are high acidity, P deficiency and associated Fe toxicity, low in CEC. The CEC is in direct proportion with the rice yield (see Appendix C-17).

In 1971, the dike of the Duong River was broken, the Tan Chi area was deposited a layer of alluvium cover of 20-30 cm. Therefore most of soils in the Tan Chi area have high base saturation.

1.3.2 Land Use

The 1994 existing land use map at the scale of 1:10,000 is used to list for 20 communes (18 of Tien Son District, 2 of Que Vo District) with the total area of 8,540 ha (7,623 ha of Tan Chi) of which 5,755 ha is dedicated to agriculture.

Agricultural production consists mostly of paddy rice cultivation in the Project Area. The common annual crops are rice, maize, sweet potato and vegetables. Perennial crop production is less well developed than annual crop production. About 200.3 ha of the land in the Project Area is classified as forest land. The remaining other category of land use (2,400 ha) covers urban, rural residential areas, water surfaces, roads, rocky hill areas (see Appendix C-20, C-4 Land use map).

According to the Guidelines Land Evaluation for rainfed agriculture (FAO, Rome 1983), the Project Area consists of 14 different land use types (LUT) (see Appendix C-20). Paddy rice is dominant crop in this area, which cultivated an acreage of 5,537 ha. Two rice crops occupy 4,317 ha (accounting for 50% of the total area). Winter spring rice produces high yield (2.7-5.5 tons/ha) while autumn rice (in rainy monsoon season) is usually subjected to the inundation. Flood season lasts from July to October, and water levels in the Duong River are higher than that in the rice fields. During 11-13 Sept. 1985 the maximum rainfall of 402 mm in Tien Son District caused the failure of rice production as follows:

- Water logging area : 6,461 ha
- Fully lost area : 5,181 ha (IWRPM, General Report, 1989)

The improved drainage system in a long-term will make fully the land available to the three crop system annually. Two rice crops plus one subsidiary crop in winter have been cultivated in high elevation land with sufficient water resources. The yields here are higher than that of only double rice crops due to adequate irrigation and high input is brought in. It is regrettable that this LUT occupies a small area of 660 ha. One rice crop plus one subsidiary crop occupies 261.8 ha due to high elevation land the irrigation has to be supplied by jumping this area is rainfed that has marginal yields. Taking the initiative in irrigation it might be possible to change cropping to growing two rice crops plus one subsidiary crop. One rice crop plus two subsidiary crops occupy 53.6 ha. Cropping pattern is groundnut - autumn rice - potato. In low depressed land, which is submerged in monsoon rains have been cultivated only one winter-spring rice crop; occupying 105 ha. This area in future may be shifted into new cropping pattern: spring rice - fish rearing. The specialized upland crop extended 216 ha is very high elevation, in future this area should be converted to growing fruit trees or perennial crops.

1.4 Agriculture

1.4.1 Agricultural Condition and Production

(1) General

The Project Area is located in the middle of the Study Area. It is true of the progress of agricultural production. For instance, taking paddy yield, Gia Lam, Dong Anh keep more than 4 t/ha in yield, the Project Area 3.4 t/ha and the others are around 3.1 t/ha. The same tendency is observed in other crops, as well. It is possible to say that the Project Area has enough characteristics to be the representative of the whole Study Area.

(2) Crop Cultivation

The present crop cultivation condition is shown in Appendix Table D-12. The latest available records on crop cultivation of each commune are of 1992.

Rice (Paddy)

From the Table D-12, it is observed that, Tien Son district has nearly the same yielding capacity of national level (3.3 t/ha) but Tan Hong commune's yield is high (4.4 t/ha). The yields in communes of Que Vo district are rather low. By the record of paddy production in the South Bac Doung Area by the Irrigation Enterprise for the last 13 years starting from 1980, the trends of yield and production of rice in the South Bac Doung Area were obtained. The yield of summer rice has the tendency of higher than winter-spring but unexpected natural calamities look to have a big effect on the yield (see Appendix D, Table D-13, Figure D-12~14).

Fertilizer (N. P. K.) application trends were shown by the data of Tien Son People's Committee (see Appendix Figure D-15~17).

Based on the questionnaire to selected 100 farmhouseholds, all farmers cultivate paddy and 6 villages out of 15, cultivate only paddy. As for variety, CR203 (37%), DT10 (15%), VN10 (8%), Moc Tuyen (7%), CR01 (4%) and N28 (1%) were used. Seeds of these varieties are purchased mostly from District Seed Center. It is observed that a certain specific variety is being cultivated in all farms in a village. This trend is observed in all crops.

Maize

The yield of maize in the Project Area is a little bit higher than the national average (1.6 t/ha) (see Appendix D, Table D-12), but the cultivation area is decreasing recently having the biggest area in 1989. The trends of production is shown in Table D-15 and Figure D-18 in Appendix D. The yield (1.7 t/ha) is better than the national average (1.6 t/ha) and increasing a bit annually but 2.5~3.3 t/ha have been recorded in nearby provinces.

15 communes out of all 27 Tien Son communes are cultivating maize, some communes along the Duong River are the main producing area at present. It is possible to say that outside dike area of these communes is the most suitable place for maize cultivation. Generally speaking, maize is not so popular crop in the Project Area for the time being.

According to the questionnaire, all farmers seem to be very much interested in variety. The names of the varieties under cultivation now, are : TSB (35%), MSB-49 (19%), Bioseed (19%), Song Boi (8%), SB49 (3%), Boi River (3%).

More than one third of the villages in the Project Area are cultivating maize. The seeds are from province or cooperative (58%), seed company (38%) and self supply (4%).

Groundnut

The yield (1.0 t/ha) is the same with national level. But, 1.8~2.3 t/ha are recorded in other provinces to be the target of the Project Area (see Appendix D Table D-12).

Although the yield is increasing slightly, production in total is rather becoming low due to decreasing cultivation area. Six (6) communes out of 27 have no groundnut cultivation. Dinh Bang Commune has the biggest area (see Appendix D Table 15, Figure D-19).

The popular varieties are Lac Sen and B500 but farmers look not so much interested in the variety judging from the questionnaire. Forty percent of the farmers are using home made seeds and neighborer's seeds, the remaining 20% are from the cooperative.

Soybean

It is one of the declining crops at present moment in the area, though soybean is an important crop. The yield (0.5 t/ha) is very much lower than the national and Ha Bac Province's average (0.8 t/ha). Hai Phong Province has the record of 1.7 t/ha. The biggest reason of the difference is supposed to be soil condition and fertility.

The variety names under cultivation are, DT (18%), DT84 (18%), HB4 (13%) and V74 (13%) but 30% of farmers did not write variety names, showing indifference to variety. The seeds are evenly from province, cooperative, self supply, seed company and neighbor.

Cropping Intensity (C. I.)

The average of C. I. of the whole Tien Son District in 1990 is 1.67 and 1992 is 2.05, which is appreciable progress in two years (see Appendix D, Figure D-20). The communes, Tan Chi (22) and Van Tuong (25) have high C. I. values. The Project Area's C. I. in 1992 is 2.0. About 90% of the C. I. is supposed to be covered by paddy. C. I. will increase by short maturation varieties and availing more land for subsidiary or short maturation industrial crops with good water control.

1.4.2 Animal Husbandry and Inland Fishery

(1) Animal Husbandry

The average of the density of ruminants in the Project Area is 1.0/agri. land (ha) and that of pig is 4.3. According to the statistics, the densities of the ruminants in Tien Son District in 1981~1985, was around 0.5~0.6, and that of pig was around 1.6~1.9. In ten years it increased two times or more. The present number of the main livestock in 1992 in the Project Area is shown in Table D-16. The densities of the main livestock, the ruminants and pig, are also shown in the Table D-16 and in Figure D-20 in Appendix D. From the data of 1990~1993, the trend of the number of pig in the district is shown by the formula.

$$Y = 2711X + 47583 \text{ where, } X : \text{Number of year} \\ (1992 = 0, 1993 = 1) \\ Y : \text{Number of pig}$$

In this trend continues and is applicable to the area, the number of pig in the Project Area will be about 35,000 in 2000 year and 47,000 in 2010 year, 1.4 and

1.9 times of that of 1992 respectively. But there must be some limiting factors to regulate the trend.

From the Figure D-20, it is possible to observe some tendencies. One is, the density of ruminants is rather higher in the districts which are located in far from the National Road No 1. The other is, on the contrary, that of pig is higher in the districts near the highway, where are densely populated town area.

The reasons to the above will be in the problems of feeding materials, conveniences of its availability, their usefulness for farm operation and easiness of transportation to market etc.

According to the questionnaire received from 100 farmhouseholds the following information became available. The figures are averaged one.

Farm Size	Livestock	up to 6 months	6~8 months	over 8 months	Total	
Small (0.13 ha)	Pig	1.2	0.4	0.0	1.6	2.2
	Ruminant	0.3	0.2	0.1	0.6	
Medium (0.27 ha)	Pig	3.7	0.5	0.1	4.3	5.4
	Ruminant	1.0	0.0	0.1	1.1	
Big (0.51 ha)	Pig	2.6	0.5	0.0	3.1	3.6
	Ruminant	0.1	0.1	0.3	0.5	
Total	Pig	7.5	1.4	0.1	9.0	
	Ruminant	1.4	0.3	0.5	2.2	
		8.9	1.7	0.6	11.2	

The number of livestock in the Project Area is different by farm size and medium farms in the area (0.27 ha) have half of total livestock followed by big farms.

(2) Inland Fishery

There are 167.0 ha of the pond and small lake of which 147.4 ha are of use for fish culture. Size of the ponds and lakes is different ranging from hundred square meters to some hectares. A number of the family pond is limited due to shortage of the land for settlement and housing. The survey shows that less 10% of the families in this area are having the pond (see Appendix D, Table D-17).

Only 6.4 ha from 263.6 ha of irrigation channels are used for fish culture. The most of the rice paddies totaling at least 201.0 ha of lowlying area which often is suffering flood during the rainy season are underutilization, neither for rice-cum-fish nor rice/fish rotation.

Presently fish productivity in this area is still very low ranging from 400 to 2,800 kg/ha/year depends on the stocking rate, pond management technique. Low fish productivity is also occurred in irrigation canals to the level near 400 kg/ha. According to the collected data, 102.5 tons of marketable fish were harvested recently, of which fish from the pond is sharing about 96% and fish from the paddies and irrigation canals sharing only 4%. Most of the lowlying area are suitable either for fish/rice rotation or for rice-cum-fish purposes.

However, only 5 ha from the paddies were used for fish culture from that 2,000 kg of marketable fish was harvested. In many family ponds fish was not stocked due to shade upon the pond or poor pond management.

The per capita fish production is about 1.0 kg/year. Presently, among 23,992 farmer families dealing with rice cultivation, only 697 families (2.9%) are combining aquaculture and agriculture activities.

Recognizing the important role of aquaculture in rural development, the People Committee of Tien Son district is intending the 5 year plan of development and strengthen aquaculture for the period 1996-2000 to achieve 650 to 750 tons of freshwater fish production. The District People Committee is encouraging the farmers with intention to change traditional agriculture activities and structure through diversifying the cultured varieties including fish and it's production.

Water supply for all region is taken from the Duong River, a branch of the Red River. Water quality is quite good for aquaculture purposes with pH range from 7.0-7.7 and saturated desolved oxygen. Although water source is not polluted, the turbidity rather high (secchi disc transparency 20-30 cm) due to abundance of alluvium in it, especially during the rainy season.

It is necessary to be careful of water quality in future by monitoring the water quality periodically for supplying good water to inland fishery purposes.

1.4.3 Agricultural Economy

(1) Population and Labor Force

Population of the Project Area is 134,650 with 30,190 households. According to the Provincial Data, a rate of farm households in Tien Son District is 85.5 percent, i.e., 25,807 farm households. Labor force in the area is estimated at 80,002 (average labor force per household : 3.1), based on the farm survey.

Consequently, from the viewpoint of labor force and actual farming, it can be expressed more than 70 percent of the labor force surplus exists in the area (see Appendix I, Table I-4.7).

(2) Farm Household Economy

Farm household economy study in the area has been carried out based on the farm survey (sample farmer : 100). Analysis of the survey have been made by farming scale classified into three types; small, medium and large-scale. The results of the analysis are as follows:

- Small-scale farmer:

(average farm size : 0.13 ha, 39 households of 0.18 ha or less)

It is very difficult to maintain production costs and living expenses based only on farm income (1.5 million VND). The living of farmer is barely relieved by income from animal husbandry (pig raising) and off-farm income, i.e., a proportion of animal husbandry and off-farm income, among gross family income, reaches 16.2 percent and 30.0 percent respectively.

- Medium-scale farmer:

(average farm size : 0.27 ha, 49 households ranging from 0.19 ha to 0.36 ha)

Farmer produces the surplus income (about 143.5 thousand VND) from agricultural production and animal husbandry (pig raising). A proportion of animal husbandry income is about 36 percent, among gross family income. This income greatly contributes to farm household economy of farmer. In addition, farmer earns from off-farm works owing to marginal income level for living.

- Large-scale farmer:

(average farm size : 0.51 ha, 12 households ranging from 0.37 ha to 0.87 ha)

Farmer produces large amount of the surplus income (about 1.1 million VND) from farm, animal husbandry and off-farm incomes. It can be seen even this farmer's group earns off-farm income from off-farm works. However, farmer can afford to maintain production costs and his living expenses by farming and animal husbandry.

Viewing the above mentioned, the income gap of farmers produces a greatly effect on the area of farmland. Among these farmers, the income from secondary crops in winter season occupies ranging from 5 percent to 12 percent, and the income from animal husbandry contributes to farm household economy (see Appendix I, Table I-3.1).

1.4.4 Marketing and Processing

(1) Marketing

Marketing of rice paddy produced in the Project Area is mainly dealing with local merchants such as village and district merchants. Paddy collected by the merchants ships to Bac Ninh Factory of Ha Bac Husking Company. Most of husked rice destinates to wholesalers in surrounding provinces such as Quan Ninh, Hai Phong, Bac Thai and Lang Son, and small amount of rice is export to Nanning and Guanzhuo markets in China (see Appendix I, Figure I-2.1).

As industrial crops such as groundnut and soybeans are collected by local merchants and large producers in the area and then they ship to Ha Bac Vegetable Oil Factory in Bac Giang town, Ha Bac province. Products of vegetable oil and oil cakes are mainly consumed in the north Viet Nam (see Appendix I, Figure I-2.2).

There are six rural free markets in the area. These markets are established in favorable location of each commune and open everyday. Among these markets, Giau market in Tu Son is biggest and deals with all kind of tradable goods including farm products. Other markets are dealing with farm products and daily necessities. Administrator of these markets is assigned by District People's Committee (see Appendix I, Table I-3.3 and 4).

In the rural free markets, there are many problems; space for dealing, ordering, storage place, security, fire prevention, communication, sanitation and environment.

(2) Processing

As the above mentioned, there are two processing factories for farm products produced in the area.

1) Ha Bac Husking Company, Bac Ninh Factory

Ha Bac Husking Company belongs to the Ministry of Agriculture and Food Industry and has two factories; Bac Giang and Bac Ninh. Husking capacity of Bac Ninh factory is 90 ton/day and storage capacity is 4,000 ton for paddy and 3,000 ton for white rice. They have two operation seasons annually; one is from January to April and another one is from September to December.

2) Ha Bac Vegetable Oil Factory

Ha Bac Vegetable Oil Factory belongs to the Ministry of Light Industry and is established in Bac Giang town and this is only one processing factory in the north Viet Nam. The factory operates mainly vegetable oil manufacture extracting from groundnut and soybeans, on the other hand, instant noodle, bottling of mushroom and fish sauce are produced. Annual operating capacity of vegetable oil is 3,000 ton and 5,000 ton of extractions (cake).

Besides, there are many private small-scale rice mills owned by richest farmers in village level and widely exist home food industries of rice noodle in rural areas.

1.4.5 Agricultural Supporting Service

Research, extension, material supply, farmer's organizations, agricultural credit, loan and crop insurance will be included in the agricultural supporting services.

Here, research and extension conditions in the Project Area are selected for discussion.

(1) Research

There are altogether thirty national level programmes in the five year plan, 1991-1995, and agriculture related ones are four as follows;

Title	Abbreviation	No. of Subject	Ministry in Charge
1) National Program for Food Development	K No. 1	19	MAFI
2) N.P. for Animal Husbandry D.	K No. 2	20	- do -
3) N.P. for Biotechnology D.	K Co. 8	18	- do -
4) N.P. for Social Rural D.	K Xo. 8	9	MST

It is possible to find out by this titles where the national level problems exist. Not national but in ministry level, there are four programmes at preset of rubber and coffee etc. in agriculture sector, all of the research results are going to be utilized for agricultural production.

Locally, there are seven national and provincial research or experimental organizations related to agriculture and fishery in not so far area of Ha Bac province. Their names and locations (district) are as follows;

Name	District
1. Provincial Paddy Experiment Station	Tien Son
2. Experiment Station for Legumenus (INSA)	Viet Yen
3. State Farm-Fruit Tree (VEGETEXCO)	Luc Ngan
4. Ba Ha Provincial Citrus Farm	Tan Yen
5. Research Institute for Aquaculture No. 1	Tien Son
6. Lang Giang Fishery Experiment Station	Lang Giang
7. Gia Lung Fishery Experiment Station	Gia Lung

It is very big advantage for the Project Area that many Research Institutes are located in it or nearby districts. For the farmer, cooperation with these institutes with the help of extension agents will be critical for the success of the projects, which will be proposed in future for the development of the Project Area. Some other National Research Institutes such as Vegetable and Fruits, and Livestock Husbandry etc. are also located not so far from the area.

The Project Area has really big advantage on receiving the information of agricultural technology.

(2) Extension

The new organization of agricultural extension was set up in 1993 and the organization chart and staffing etc. became clear as shown in Appendix D, Figure D-21. The activity of the new organization has started actually from 1994 in

district level after completing the arrangement especially of finance. In grass root level, the role of the extension workers are as follows for the time being.

- Technical transfer
- Management of farmers club
- Setting up demonstration farm
- Management of field day

It looks that the above mentioned activities are still based on a up-down system. Time will be necessary for changing the trend and it is hoped that in the near future farmers will play a main role in the activities.

In commune level, one official staff for each commune is allocated by the government. Under the position, 30 agricultural extension workers (AEW) are officially acknowledged in Tien Son district. There are some AEW's, who have the carrier of agricultural education or training, under contract to support the activities.

Integrated Pest Management (IPM)

Viet Nam has officially joined the regional Inter-country Programmer in the South and Southeast Asia on Integrated Pest Management (IPM) since 1989 and from 1990. IPM programmer has been conducted on a national scale to protect crops from insects and diseases.

The principle of the activities are summarized as follows;

- Keeping crops healthy without killing natural enemies.
- Looking after own fields with care and weekly monitoring of the condition of each field for insects and diseases control.

It is observed in the principle that the philosophy of environmental conservation not by using so much chemical to prevent crops from insects and diseases but forecasting the outbreak in an early stage.

It is said that the farmers in Viet Nam have used too much chemicals to prevent insects and diseases when they saw a slight sign of the damage caused by them. The consequence of killing natural enemies, contaminating water, loosing much money to buy chemicals and exhausting labor force, are all on the shoulder of farmers themselves.

The IPM program is under the full responsibility of the Plant Protection Department and its local organization structure is closely linked among different levels from the central government to the provinces, districts and villages. The Project Area is also very active in IPM activities.

For education of the staffs for IPM activities, annual training course have been held and so far 916 instructors were born and 23,000 farmers were trained in the course.

1.4.6 Farmer's Organization

The inhabitants of almostly whole villages in the Project Area are forming such HOI organizations as the farmer's association, oldmen's association and women's association other than the farmer's cooperative of HTX organization. The veteran's association have been established since the beginning of 1990s with the membership of retired army officials and soldiers aiming solidarity of members and participation in social activities.

1) Farmer's Cooperative

The present activities of each of farmer's cooperatives are rather variable by the communes. The intention of leaders of PC of commune are strongly reflected on the activities of farmer's cooperative, and difference of cognizance of those leaders on the free-market-economy-system is actually defining the direction of cooperative activities which have been supporting the regional economy through agriculture. Although some cooperatives are still operating such activities of cropping plan, supply of seed, fertilizer and other agri-input, joint holding of agri-tools and draft animals, etc. as productive community, most of the cooperatives are transferring those activities to the farmer's own initiative remaining the function of land management as *raison d'etre*. Some cooperatives accept the borrowing of land against the payment of rental.

All farmers in the area are member of the cooperative and member of cooperative can receive a certain land against such duties, in most of cases, as payment of membership fee of 5,000 VND/annum, land tax of 15,000 VND/sao/annum in minimum but depending on the classification of land, and water fee of 12,000-24,000 VND/annum.

The membership fee is usually expended as the remuneration of staff of cooperatives such as chairman, deputy chairman, accountant, etc., improvement of infrastructure within the covering area, emergency measures for water

logging, etc., borrowing part of such expenditure from the Agricultural Development Bank if the deposit of membership fee is not sufficient. Besides, some villages levy a certain amount of contribution from each household of inhabitants for repairing and/or paving of village road.

2) Activities of HOI

The parallel existence of farmer's cooperative and farmer's association may prove that the farmers are looking the cooperative as an administrative organization. Most of farmers are getting information on farming practice and marketing from the farmer's association, and some villages have HOI of sericulture, fish-culture, VAC (garden crop, fish-culture and livestock farming), etc. which have similar function as cooperative.

The women's association is second large organization next to the farmer's cooperative from the viewpoint of number of member because most of adult women are participating. It is a general trend of the whole Study Area that women are participating in economic activities including agriculture very positively, and there is many matrilineal families in Project Area.

Consequently, the activities of women's association is active playing an important role on family planning, improvement of living circumstance, etc.

Half of members of oldmen's association are also women, and the member are participating on conservation of temples and/or shrines, ceremony of ancestor worship, festivals, reforestation around the village and other social works. Age of most of members is over 60, but some are 40s. The villagers whose children are married and forming own family participate, in many case, to the oldmen's association.

Other than the farmer's association whose membership fee is 10,000 VND/annum, most of HOI organizations are expended within a framework of membership fee of 2,000-5,000 VND/annum, therefore, except very rare cases, no HOI has office nor specialized meeting place. In many cases, the members gather at the yard of shrine or house of leader when member's meeting is requested (see Appendix G.5 for details of farmer's organization in Project Area).

1.5 Irrigation and Drainage

1.5.1 Irrigation and Drainage Systems

(1) Irrigation System

The irrigation water source for the Project is the Ngu Huyen Khe River, supplementing the water from the Duong River through Long Tuu intake when the water is insufficient in the Ngu Huyen Khe River. The water is taken by Trinh Xa pumping station and diverted to the north and south main canals.

The irrigation water for the Project Area is distributed through the South main canal of Trinh Xa irrigation system, supplementing the water from Tan Chi pumping station to the downstream area of N4 secondary canal. While, Tri Phuong pumping station supplies the irrigation water for Canh Hung area with the excess water in the its drainage area. In addition to the said two station, there are about 19 irrigation pumping stations and 18 dual purpose pumping stations for irrigation and drainage built and operated by the communes and/or villages to pump up the water from the secondary and tertiary canal of Trinh Xa irrigation system and/or drainage canals, creeks, ponds etc. Where no pumping stations are built, use of portable pumps and practice of manually drawing up with a big scoop are noticeable.

In Trinh Xa pumping station, pumps built in 1962 are still used presently, of which eight (6) units out of totally installed eight (8) units are operational. Though present pump capacity is reported to be 2.5 cu.m/sec, it shall be verified by the survey. The water pumped up are distributed to three ways, drainage, North and South main irrigation canals by operation of gates provided in the discharge tank.

The south main canal is unlined and equipped with many check structures. Many gates of check and off-take structures are timeworn, moved out, not operational and/or difficult in operation and not in condition to regulate the water in quantity. Therefore, the most water pumped up from Trinh Xa pumping station are wasted in the upstream reaches. Due to absence of adequate maintenance works, it may be noted that the canals are not well-shaped, turnouts are collapsed and maintenance roads are not passable in the long reaches. The gates of check structures are timeworn and not operational in the most gates as well as the gate of turnouts.

The most secondary canals are deteriorated and equipped without check structures. Except major secondary canals, the water diverted from the main canal flows down to the lower-bedded canal, like a drainage canal, without an adequate water head necessary to irrigate the lands in their commanded area. In the tertiary level, the irrigation canals interconnected with each other, like the meshes of net, and may be used as a dual purposes for irrigation and drainage and are not equipped with check structure. Thereby, farmers draw up the water manually by using water-proof scoop to irrigate their land and spend much working time for this drawing up.

Bac Duong Irrigation Enterprise is responsible for the water management. As the report of actually irrigated area for the Project Area is not available, the irrigated area in Tien Son district is reported to be about 6,740 ha for the winter/spring paddy and 7,020 ha for the summer paddy on the average for the latest five (5) years, which correspond to be 74% and 82% of the total cultivated land area with the winter/spring and the summer paddy in the district, respectively. As reported that the irrigation water has been supplied by the extension of pump operation, it is seemed that the water management means to make the schedule of pump operation with inadequate consideration in the water head, assuming that paddy lands are served by second and/or third stage pumping irrigation system (refer to Appendix E).

(2) Drainage System

The Project Area is surrounded by Kim Doi and Trinh Xa drainage area on the north, Tri Phuong drainage area on the west, the Duong River on the south and Hien Luong drainage area on the east. The boundary line is drawn down, starting the crossing point of South main canal and the national railway, clockwise through the national railway, Trinh Xa drainage canal, the south main canal, the Ten creek, the Duong River, No. 4 secondary canal, and South main canal up to the starting point. Tan Chi and Han Quang drainage area are separated by the provincial road No. 38 to the west and the east, respectively. The excess water in Tan Chi drainage area are collected to the Tao Khe creek and flows down to Han Quang drainage area through Tram sluice in the dry season and discharge to the Duong River by Tan Chi pumping station in the rainy season, in principal. The excess water in Canh Hung area on the Duong River drains to the Tao Khe creek within Tan Chi area through the Sluiceway. Han Quang area is situated in the upstream of Hien Luong drainage area and its excess water flows down through Tao Khe creek and discharges to the Cau River

through the sluiceway in the dry season and by pumps in the rainy season at Hien Luong.

Tan Chi pumping station has been constructed in 1975 with 68 units of pumps (300 mm×33 kw), of which eight (8) units have also been used for irrigation purpose. The pump discharge capacity is reported to be 800 cu.m/hr per one unit or 15.11 cu.m/sec in the total. However, it is learned that the actual discharge capacity per one unit has been decreased to 600 cu.m/hr or 75% of the reported one at present, according to the discharge measurement at the delivery canal. In addition, the operation of pumps is managed in 50 units more or less, because of machine troubles and electric motors failed in the continuous operation. It is reported that major troubles are broken in bolts of coupling between pump and motor and over-heating of motor.

Main drainage canal is Tao Khe creek, branched to the pumping station through the diversion canal (L=1,300m) and equipped with Tram drainage sluice (B=2.00m, 2 bays) at the downstream end of Tan Chi area. The Tao Khe creek is disordered in the cross-section and its flow capacity is estimated to be about 7 cu.m/sec. Tram sluice has an enough capacity to drain the excess water in Tan Chi area but regulated in its gate opening height, taking into account the inundation state in the downstream area. Major secondary drainage canals are Trinh Xa drainage canal, Cau Nau drainage canal and Phat Tich drainage canal. Each drainage canal equips with control sluiceway at the confluence with Tao Khe creek but not operational.

In Han Quang area, no pumping station exists. The excess water are flown down to the Tao Khe creek directly in the southern area and through the Ten creek in the northern area and discharge to the Cau River, via. the Tao Khe creek, through Hien Luong sluice in the dry season and by the pumping station in the wet season. At the downstream end of the area. La Miet sluice is built but not operational. The Tan creek has also an irregular shape in the cross-section and with lower dikes.

The lands with an elevation of below 4.0m have frequently inundated, as caused by insufficient flow capacity of the Tao Khe creek and decrease of pump discharge capacity. Local inundation have taken place in the lower land commonly due to an inadequate drainage network, insufficient capacity of conduit, etc. Those low-lying land are surrounded with small polder dike to prevent the incoming flow from the outside area and equipped with pumps. In the Project Area, 12 drainage pumping stations and 18 dual purpose pumping stations are operated and

maintained by the communes and/or villages but claimed in lower drainage capacity. According to the report of Bac Duong Irrigation Enterprise, annual inundated and damaged in Tien Son district are about 3,460 ha and 1,730 ha on the average for the latest 13 years, and correspond to 32% and 16% of total agricultural land in the district, respectively (refer to Appendix E).

1.5.2 Farm Road

The national road 1A runs parallel to the north main rail way at the west part of the area. The provincial roads (route 288, 295 and 270) branch off the national road at the Bac Ninh town, the Tien Son and Tu Son respectively from North to South. The national road is paved by the asphalt concrete with 100% and well maintained, however a number of bicycles and hand tractor obstruct the smooth traffic for the trucks and public buses besides the road is narrow with 8~9m width.

The provincial road route No. 288 is paved with asphalt concrete and other two provincial roads are paved with gravel, the width of which are 5m to 7m classified to 6 class. The passage of motor vehicle is few so that a number of bicycle do not obstruct the traffic at present.

The width of district roads, which link the major roads and villages, are 3m to 5m with gravel pavement and low banks. The number of crossing structure for the drainage and irrigation canal is shortage. The density of commune road and village road is high but the roads are narrow with width of 2~3m, so that there are difficulties for a large size of vehicle to enter into some villages. Most of them are not all-weather type of road. The density of farm road in paddy field is low due to irrigation method. The farm crops are carried out by the manpower or carts.

There are regular services of a railway and buses between Hanoi city and the area. Small regular buses and unregular omnibus services link major communes and towns. There are only four services of railway a day.

1.6 Related Project

As for the comprehensive development plan for the Red River Delta, 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. As the Project Area is situated in the middle on the north of this Delta study area, it is expecting that this study will guide an approach to the Delta development with a land area of 16,700 sq.km out of a total delta area of 27,800 sq.km as well as approach to the subject matters to be studied in the water resources sector for the Project, such as the warning water levels, the impact to the downstream reach of the related river due to discharge of proposed pumps, etc.

The Red River Development Plan by the Asian Development Bank has initiated to implement for the water resources sector, as stated previously. This project aims to rehabilitate/upgrade the selected 20-30 small and medium scale of irrigation and drainage systems within the Delta focusing on drainage improvement and implement the project packaged several systems to be completed within five (5) years, in order. The project are composed of rehabilitation/replacement of existing pumping station (irrigation and drainage), construction of pumping station to upgrade a capacity of irrigation and drainage within the area, rehabilitation/improvement/construction of major facilities (sluices, intakes, etc.), repair/expansion/construction of transmission lines, and improvement of drainage canal capacity. As the project benefits, increase of land area cultivated with paddy and diversified crops (increase of cropping intensity) and increase of yield per hectare have been expected.

The Ministry of Water Resources have studied on the drainage improvement of Bac Duong area by itsself. According to the general report prepared in 1989, as to the drainage improvement of Tan Chi area, three (3) alternative plans have been proposed, increasing the present drainage coefficient of 2.15 lit/sec/ha to 4.0 lit/sec/ha, (1) to construct 12 units of pumps with a discharge capacity of 3.2 cu.m/sec per unit in stead of existing all pumps as the independent drainage plan for Tan Chi area, (2) to install eight (8) units of pumps with a discharge capacity of 3.2 cu.m/sec per unit at Han Quang leaving Tan Chi pumping station, as the combined scheme of Tan Chi and Han Quang area, (3) to add 60 units of the same pump as present type to the existing pumps, taking up 120 units for Tan Chi drainage area and construct the pumping station with 30 units of pumps (300 mm×33 kw) for Han Quang drainage area, respectively. In the latest study on the individual drainage scheme for Han Quang area, it has been proposed to

provide five (5) units of pumps (1,000 mm×320 kw), corresponding to a planed drainage coefficient of 4.5 lit/sec/ha, reportedly.

1.7 Problems and Needs of the Project

(1) Natural Resources

Water resources is one of major factors for the Project among natural resources in the area. The feasibility study area covering 8,540 ha is fed by 12 m³/sec of irrigation water which is conveyed from the Duong River by means of Long Tuu canal and Trinh Xa pumping station. Hydrological records observed at Thuong Cat Station show the mean lowest discharge of the Duong River for 33 years is 119 m³/sec. Rainfall stored in existing ponds and canals is being used for irrigation and inland fishery cultivation.

In terms of water resources, the Project Area is full of potential water amount and affected by deficiency of irrigation water unless proper irrigation systems are not managed and maintained.

Regarding groundwater, local people is using it as domestic water by shallow wells. However, in the eastern part of the Project Area, people are using rain water by providing water tanks where the groundwater is contaminated due to urbanization.

In terms of land resources, 70% of the Project Area is used as agricultural land and 53% 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.

Improvement of such water logged areas by providing proper drainage systems will contribute to increase crop cultivation in its yield and production, and to meet food requirements of the increasing population in the area.

(2) Agriculture

The Project Area is located in the middle of the Study Area, which shows the representative features of farming in terms of problems and needs involved in the project development.

Farm yard manures have been applied in the fields but the amount is far less than the recommended. Soil fertility is the base of production potential and this is one of the subjects to be taken seriously in the area. In this issue, leguminous crops are appropriate as one of components of the cropping pattern.

More amount of fertilizer should be applied to paddy and other crops to get a higher yield. Essentially this problem belongs to economy and policy. All farmers should have a full understanding of the importance of the fertilizer.

As balance of the fertilizer N:P:K to paddy, the ratio 1:0.5:0.2 has been recommended but actually applied P and K is much less than that. Especially P is now becoming the limiting factor in the production.

There are so many varieties of crops being cultivated in Viet Nam. In case of paddy, nearly 70% of the area is covered by IRRI varieties. In future Vietnamese origin varieties will prevail in the fields. In that case new type variety with short stem, high yield and good grain quality is expected. Short maturation variety is also urgently needed for intensification of crop cultivation.

Agricultural extension activities are one of the biggest problems for increasing agricultural production. The Extension Department, MAFI was established in 1993 and the national organization was newly set up. It is going to play the key role of agricultural production. Supporting of extension activities will be the best way to level up the living standard of farmers in the Project Area.

Land holding problems will become last and the biggest in agricultural production. So small and fragmented farm land have a disadvantage in farming management comparing with those in the southern Viet Nam.

(3) Farm Household Economy

Farmers within the Project Area have a high potential to improve their livings by a solution of existing problems on the farming such as flood and drought, technical supporting, credit, marketing and so on.

According to the farm household economic survey, income gap is generated by the area of farmland. And low yield of paddy in the area is reflected to their farm income. Nevertheless, in really, income from animal husbandry (pig breeding) is contributed to their gross family income. Through the improvement of farming condition, farm household economy of farmers in the area would be better.

(4) Marketing and Distribution

Problems on marketing of farm products exist in the area. These problems, such as lack of management and arrangement of market, lack of storage space and

facility, lack of communication, and insanitary condition, in rural free markets in the area are affected to the marketing activities in the area will be activated.

Furthermore, presently, farmers and/or their organization have no marketing facilities, therefore, they undergo a disadvantage in the existing marketing system due to produce the profit from farming. In order to solve these circumstances, formation of marketing organization by farmers is urgently needed. Consequently, formation of the rural marketing system under market economy should be considered.

(5) Environmental Aspect

The major constraints concerning an environmental aspect may be divided into the following features.

1) Environmental Impact Associated with Change of Water Management

Assuming that the existing water management is changed without consideration, environmental impact upon every aspect may come out.

Especially it is important to consider ordinary drainage water level, drainage network, etc.

The constraints because of the change of water management area as follows:

- Occurrence of Troublesome Characters of Soil because of Water Level Down
The water level down in the ordinary drainage (for example, reformation into well-drained paddy field) without consideration may cause the low productivity because of the troublesome character of soil such as the Permanently Flooded Alluvial Soil.
- Deterioration of Water Quality because of Water Level Down
The water level down in the ordinary drainage without consideration may cause deterioration of water quality, that may give influences upon the ecosystem in the Project Area.
- Influence upon Custom of Use
The drastic change of water management may give influences upon the custom of water use (including domestic water and fishing water) in the project area.

- **Change of Sedimentation**
Assuming that the existing water management (especially the irrigation network) is drastically changed without consideration, the fertility of farm land may be influenced because of the change of sedimentation.
- **Influence upon Scene of Cultural Inheritance**
In the feasibility study area, there are many pagodas, artistic architectures and famous places that are familiar with regional residents.
Judging from the above, the change of the existing ordinary drainage water level and the existing irrigation & drainage network ought to be minimized and phased out.

2) Negative Influence Associated with Local Economic Activities

The progress of agricultural development and/or urbanization may because not only positive influence but also negative influence in the project area.

The constraints because of the negative influence are as follows.

- **Increase of Agrochemical Use**
The progress of intensive agriculture may cause the increase of agrochemical use in the feasibility study area. It is possible that disorderly agrochemical use will give influence upon the ecosystem.
- **Deterioration of Soil Fertility**
The progress of intensive agriculture tends to cause deterioration of soil fertility by crop planting, failure in soil management, etc.
- **Deterioration of water quality and ecosystem**
The progress of local economic activities and urbanization may cause the increase of domestic waste and waste of every kind, that may cause the deterioration of water quality and ecosystem.

3) Erosion in the Hillsides

Erosion is coming out in the hillsides scattered in the feasibility study area, and may give influences upon not only lands and/or canals but also productivity of cultivated land.

CHAPTER 2 DEVELOPMENT PLAN

2.1 Objectives and Strategy of the Development

2.1.1 Objectives

The Tan Chi and Han Quang areas which were selected as a highest priority area have been strongly affected by persistent inundation and deficiency of irrigation water. These areas are distinctive in low yield of agricultural production and poor living standard for local people.

The objectives of the development under the feasibility study will be summarized as follows, considering the above situation:

To alleviate poverty and raise living standard for local people.

To improve environment of the rural areas.

2.1.2 Approach to the Development

In order to achieve the above objectives, the following development components should be involved in the development plan.

(1) Improvement of Drainage Systems

The most important constraint to developing of the Project Area is persistent inundation in farm land which will occur due to deterioration of the existing pumps and canal facilities. The actual drainage capacity is insufficient to meet the requirements of designed drainage. The improvement of drainage system in the area is requisite to solve an inundation-problem. From a view point of efficient operation and maintenance for drainage system, access roads to such facilities should be improved.

(2) Improvement of Irrigation Systems

Shortage of irrigation water during the crop-growing season is also one of the essential constraints to agricultural development after improvement of drainage systems. Improvement of irrigation systems in the Project Area contributes to supply the stable irrigation water to the improved drainage area throughout the year in accordance with crop water requirements based on the proposed cropping calendar.

(3) Establishment of Sustainable Agriculture

Intensive and multiple farming system should be introduced to the Project Area basing on the land use plan after improvement of drainage and irrigation systems in order to promote sustainable agricultural development under accelerating market economy and to conserve the natural and social environment with the Project.

(4) Stability of Farmers' Economy

By introduction of new farming system, farmers' income will be increasing and be stabilized. This increase of farmer's income will result in activation of the depressed Project Area.

(5) Improvement of Environmental and Social Conditions

The project components should make contribute to 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. These impacts on environment and rural society will be evaluated in terms of environment.

2.1.3 Relation between National Plan and the Project

The Fifth Five Year Plan (1991-1995) emphasizes the important role of agriculture sector to the national economy and the necessity of rural development for the economically and socially depressed areas. Based on this national plan, the Ministry of Water Resources lunched the rehabilitation programs and gave a high priority to the Project Area. The objectives of the Project and the development strategy are therefore accorded with the national policies.

2.2 Basic Concept of the Development

2.2.1 Proposed Project Area

The major objective of this feasibility study is to find out the possibility of agricultural development based on improvement of drainage systems in the proposed project area which is 8,540 ha covering Tan Chi and Han Quang area. The land resources of the Project Area is shown as follows;

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

The area possesses ample human resources as seen from the population density of 1,577 persons per square km in 1990 (total population : 134,650). Assuming increasing rate in population is 2.3 percent, the population in the area will become 181,000 in 2000 and 212,000 in 2010. This rapid popular increase is giving a great deal of pressure to the Project Area in terms of food supply, on which agricultural development plan is urgently required to be established.

To assure the food supply of 300 kg/person which is set up as the food security in Viet Nam 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, though farm land per farm household is very small at 0.13 to 0.52 ha.

In order to solve problems existing in the area, project components should be finally selected depending upon the priority requirements based on evaluation investment cost and benefits. In this area, priority for development components is given to drainage, irrigation, fish pond and farm road in turn. Concerning investment cost for the project, current investment cost per ha in irrigation and drainage project and economic situation in Viet Nam is considered as an important factor for justifying the project.

2.2.2 Improvement of Drainage Systems

Agriculture is a leading industry in the Project Area. The upgrading of land productivity by intensive agriculture is the most essential subject in the district economic development, as indicated a dense population (1,330 persons/sq.km-1993), a big share of agricultural population (about 80% of total households in

farmers' household) and a small farm size (about 0.2 ha/farm on the average). In the Project Area, a main problem to the increase of land productivity is the inundation which have taken place every year. Little production due to rainfall calamity have brought about loss of the willingness to cultivate and the status unable to ensure the minimum income necessary for the life to the farmers with a small land size. An inundation constraint to the peoples gaining the income mostly from agriculture in the Project Area become a big object of public concern in the district. Consequently, the solution of inundation problems is required urgently in the Project Area.

A direct objectives of farmland drainage is to drain the excess water on land surface (surface drainage) and the excess moisture in soils (subsurface drainage). For the Project Area, the surface drainage is presently required. In either way, it might as well initiate the removal of water logging (storm drainage) and gradually follow the ordinary drainage after completion of irrigation systems. The sub-surface drainage is ignored so that the introduction of diversified crops might be limited in the variety due to groundwater table. However, more variety of diversified crops might be cropped on the high ridges by utilizing rich manpower. Aside from such farmland drainage, in the light of present canals used for irrigation and drainage purposes, the excess water from residential and commercial land would be tackled in the future from a standpoint of water quality and environmental aspects.

The present water logging is caused not only by the decrease of drainage capacity of Tan Chi pumping station due to deterioration but also by the increase of runoff discharges from the urbanization along the highway, deforestation of mountains and hills, increase of domestic wasted-water. In addition, the under-arrangement of systematic drainage canal network, insufficient flow capacity of canals due to sedimentation, absence of water management/control of irrigation and drainage canals, deficient sectional area of drainage conduits/sluceways, deep water keeping in the field, etc. might support the present water logging.

Under the above view, 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.

2.2.3 Proposed Cropping Pattern

As mentioned in para. 4.2.3, "Proposed Cropping Pattern" in the Study Area, the specification of agricultural land in the Project Area will be strengthened and upland crops such as subsidiary crops and short industrial crops area will increase at the cost of paddy field.

But rice production is the most important for securing food for the people, it is necessary to consider carefully the problem of restricting the paddy field by converting some area for another crops-cultivation.

Two alternative plans are proposed based on the latest available crop production data of 1992, in Appendix D, Table D-18 and Figure D-22, 23. The basic idea for the two alternatives, A and B is nearly the same with that of the Study Area. They are as follows;

- A: - The paddy area is the same with that of 1992.
- In compliance of the necessity of crop diversification and for increasing farm income, some subsidiary crops, short industrial crops and vegetables are taken up to be cultivated more in the fields, which will become available by water control for winter cropping.
- The area is estimated as 25% of the summer paddy area.
- B: - The paddy area is restricted to 4,000 ha in both seasons, which is about 80% of the area in 1992.
- Some area of two successive paddy cultivation will be converted to upland crop cultivation in winter and spring.
 - The area of 105 ha, where only one winter-spring paddy is cultivating is going to be inland fishery area to utilize the depressed area and water, expecting much better income than paddy cultivation.
 - 35% of whole summer paddy area will be able to become for winter season's subsidiary crops, short maturation industrial crops and vegetable productions by water control.
 - Mountainous area 77 ha are now mainly for cassava cultivation but in future, the area will be used for another crops such as fruit like lychee and others.

The cropping intensity of these plans are as follows;

Without project	1.88
Alternative A	2.27
Alternative B	2.44

It is advisable to choose the alternative B for the implementation of the Project. the reasons are as follows;

- 1) As shown in Chapter 4, the project evaluation tells that the alternative B has higher economical internal rate of return (EIRR) than A.
- 2) The area will reach the scheduled level of condition of the production after 3 years of the completion of the Project. It is estimated at the beginning of next century. By that time, the area will have been surrounded by industrial zones and lots of part of the area will have been urbanized. The area will have a bigger advantage to supply fresh foods and vegetables to the zones than present. Taking advantage of geographical location for getting more income to farm household is to be emphasized.
- 3) Utilizing natural condition such as the low lying area for inland fishery, making use of the by product of legume crops as feeding material of livestock and applying the FYM of the livestock more to the soil, are recommendable use of natural condition and ideal circulation of elements.
Alternative B is more advantageous than A in this sense.
- 4) People in the Project Area need more nutrients such as protein, mineral, vitamin and oil to level up the living standard. For that, alternative B is more preferable.
- 5) Widening the difference of income between agricultural sector and other industrial one's is becoming a very serious problem. The alternative B is more effective to alleviate the trend.

In case of implementation of the Project, special consideration should be given to small farmers to secure enough food grain to the family.

2.2.4 Optimum Scale of Development

The optimum scale of development for the Project Area is obtained on the basis of alternative studies which were discussed between the Ministry of Water Resources and the JICA Study Team.

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

This plan aims at the improvement of Tan Chi area which the existing Tan Chi pump station commands. Tan Chi area covers 6,420 ha of gross area and 4,249 ha of agricultural land. 31.11 m³/sec of drainage water is planned to be drained by means of Tan Chi existing pump station and newly proposed pump station. In this case, Tran bridge gates will be closed in order to stop the water flowing down to Han Quang area at the time of floods.

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

This plan aims at the improvement of the whole Project Area which covers 8,540 ha of gross area and 5,652 ha of agricultural land. From a viewpoint of drainage improvement, 41.11 m³/sec of drainage water will be drained to the Duong River by means of existing Tan Chi pump station and newly installed pump station in Han Quang.

(3) Alternative Study

Alternative studies on both options will be evaluated by using project cost, incremental benefit, and economic internal rate of return. In terms of project cost, construction cost of drainage/irrigation facilities, fish pond and their associated cost are involved. In terms of benefits, incremental benefits are estimated based on the proposed cropping pattern B (refer to paragraph 2.2.2) which will be assured by improvement of drainage and irrigation facilities. By using project cost and incremental benefits, economic analysis will be made and economic internal rate of return will be obtained.

2.3 Development Plan

2.3.1 Land Use Plan

(1) Basic Concept toward 2010

The Project Area represents an area of rice monoculture, but rice yield remains somewhat low. With rice monoculture on 0.3 ha land on average household farmers have no possibility of capital formation. The Project Area is land scarce population dense. Population pressures are increasing and the carrying capacity of the land is being exceeded. Local scarcity of land due to population pressure has led either to intensification and diversification of agricultural products. Soil testing and observation have shown that farm lands-qualities have been changed a lot by those trend of soil acidity being higher. Almost all soils are very poor in nutrient elements, especially in phosphorus.

Taking into consideration the above situation, basic concept of land use plan in the Project Area toward 2010 will be summarized as follows:

- Improving the agricultural productivity of the land that is already under cultivation and developing rational systems of management for farming.
- Improving the efficiency of agricultural inputs such as water, seed, fertilizer which are necessary for increasing productivity.
- Monitoring changes in the productivity of land (increasing the efficiency of water use is the key to improving productivity of land and preventing its degradation).
- The need for land use planning in the flooded areas is to first select the areas with the mitigation of water disasters as the best chance for success.

(2) The potentiality of Agricultural Development

The following suggestions are considered.

- To stabilize and increase autumn rice crop with a stable yield due to well drain out.
- To facilitate for winter crop after solving drainage conditions in the Project Area, the early autumn rice area will increase and allow to expand the winter crop area, raising cropping intensity to 2.5 by expanded winter crop. All grain legumes with the exception of groundnut are considered. These crops are grown on any available vacant land, too. There is some risk in growing these crops due to the possibility of severe cold damage.

- It is necessary to apply intensive farming and to develop high quality vegetables to provide and supply the EPZ and Hanoi Market. Its advantage is to be adjacent to the EPZ Hanoi-Yenvien with convenient road system.
- Perennial crop production is less well developed than annual crop production, it involves mostly fruit trees or paddy rice + fishery + fruit tree.
- The research results showed that in Tan Chi area, no fertilizer treatment gave low yield due to phosphorus deficiency prompt and long term effectiveness of fused magnesium phosphate (FMP) fertilization is so high. On gleysols there may be recommended rate of $100\text{N}60\text{P}_2\text{O}_5/\text{ha}/\text{crop}$.

The potential suitability after specified major land improvement (e.g. the rehabilitation of irrigation and drainage) is as follows (Appendix C-22):

- Areui-Hypereutric Fluvisols (Alluvial soils with light texture) occupying 343.7 ha, have been and will be used only under upland crops.
- Fluvisols and Cambisols, occupying 1,940 ha will use for paddy rice + subsidiary crops.
- Gleysols, occupying 3,133 ha, after the improvement of drainage system may be devoted to double rice crops + subsidiary crops (winter) or a part of which (deep water logged area) should be shifted into new farming pattern : rice + fish + fruit trees.
- Plinthosols, occupying 250 ha, have been and will be used for upland crops or rice + upland crops in areas that where sufficient irrigation water is available.
- Aerisols and Leptosols, occupying 277.8 ha, is recommended only for reforestation or residential use.

2.3.2 Improvement of Drainage Systems

(1) Drainage System

The improvement of drainage system have been worked out for the drainage system for Tan Chi area (A=6,420 ha) and combined Tan Chi and Han Quang area (A=8,540 ha), as reported that the study for Han Quang area was completed by the Ministry of Water Resources. Tan Chi drainage area has been divided into six (6) sub-drainage areas for Trinh Xa No. 6 secondary canal, Phat Tich area in the upstream of Tao Khe creek, Cau Nau canal joined with Tao Khe creek at Cham sluice, the area directly drained to Trinh Xa drainage canal, Canh Hung

area drain to Tao Khe creek and the area directly drained to Tao Khe creek, as examined the local water logging due to insufficient capacity of drainage sluiceways and/or conduits. While, Trinh Xa drainage canal joins with Tao Khe creek at Ba Cay. These sub-drainage areas are equipped with the drainage sluiceway/conduits at the downstream end of the canals. In Han Quang area, sub-drainage areas consist of the systems for the areas directly drained to Tao Khe creek and through Tan creek and join each others at the downstream end of the area. The excess waters in Tan Chi area flow down to Han Quang area through Tram sluice.

(2) Runoff and Drainage

Within and in vicinity of the Project Area, six (6) rainfall observation stations are located, which have only daily rainfall records observed at 7:00 a.m. every day for the period of 33 years (1960-92). Since the rainfall records at Tu Son station within the Project Area were available only for 22 years and the rainfall among the stations were poorly correlated, area rainfalls have been calculated by Thiessen Method, to determine the rainfalls for the Project. The probability of rainfalls have been calculated by Iwai-Kadoya method, following the probability of exceedance in the logarithm normal distribution. For the design rainfall, a consecutive three (3) days rainfall of 248.1 mm with 1/10 year probability has been adopted. The hyetograph daily pattern, which was of frequent occurrence in the last records, has been allotted for the probable daily maximum rainfall in the second day, the rainfall in the first day subtracted the probable daily maximum rainfall from the probable consecutive two (2) days rainfall, and the rainfall in the third day subtracted the probable consecutive 2 days rainfall from the probable consecutive 3 days rainfall, as follows:

First Day	Second Day	Third Day	Total
49.0 mm	182.9 mm	16.2 mm	248.1 mm

For the runoff analysis in the study area, the rainwater flow method has been applied, which is complicated in calculation but be the most applicable method corresponding with the various physical conditions, since the runoff discharge records/data actually observed and hydraulic data/information on the flood events were scarcely available within the area. Prior to the runoff calculation, the hyetograph of design rainfalls has been modified to the hyetograph of hourly rainfall by applying Sherman type, as the rainfalls in the Project Area are generally intensified in the relatively short time. The equivalent roughness,

which is equivalent to roughness coefficient of Manning formula applied to the flow on the saturated land, have been determined to be 0.6 for mountainous land, 1.0 for paddy field, 0.4 for upland field and 0.025 for residential area. The gradient of rivers/creeks/channels and slope of land have been decided based on the 1/10,000 topographical maps. The river flow factors (K & P values) for each creek and drainage channels have been estimated by the cross-section of existing water ways.

The base flow might consist of wasted-water of irrigation and domestic water, while the rainfall losses might be involved in the initial losses, seepage losses and retention in the area. Considering that the drainage problems are taken place only in the rainy season, and that the antecedent rainfall to the 3-day consecutive rainfall might be expected to be substituted for the initial losses, it is assumed that the base flows are negligibly small and rainfall losses ignore.

For drainage analysis, the series of reservoir model, which is the method to flow down the drainage water in the blocks, regarded as a reservoir, to the other blocks, regulating by the hydraulic structures, such as sluice gate, culverts, etc. The drainage discharge depends on the flow capacity of the hydraulic structure and the difference of water level at the upstream and downstream of the structure and the difference at the upstream and downstream of the structures. Seeing that the water logging area depends on the topography of land, the land slope have been evaluated, based on the topographical maps with a scale of 1/10,000 indicating every 1.0 meter contour line supplemented to 0.5m by the survey in the course of the study. An area and volume every 0.5 meter in an elevation have been computed for drainage analysis, which would be regarded as an area and volume of inundated water. The datum elevation of land, which is covered about 10% of the benefited area for the respective blocks, have been determined to express the inundated depth and area under the design rainfall. The design criteria for drainage improvement, which the inundated period should not exceed one day (24 hr.) in a water depth of 0.246m and/or three (3) days (72 hr.) in a water depth of 0.159m, assuming that the growing of paddy may be tilling to booting stage in which inundation has frequently taken place for the month of July through September, have been applied.

The drainage analyses, which have integrated the drainage model with the runoff discharges mentioned previously, have been made by using computer. In the calculation, Tram sluice was closed and the excess water were discharged by the existing and additional/new pumps at Tan Chi in case of individual drainage

scheme, and Tram sluice was opened and the excess water were discharged by existing Tan Chi pumping station and new pumps to be installed in Han Quang in case of the combined scheme for Tan Chi and Han Quang area. For the above two (2) schemes, a drainage coefficient of 4.85 lit/sec/ha for the Tan Chi individual scheme and 4.82 lit/sec/ha for the combined scheme would be proposed and the required drainage discharges are shown as follows:

Scheme	Ex. Drainage (cu.m/s)	Add. Drainage (cu.m/s)	Total (cu.m/s)
Tan Chi individual	15.11	16.0	31.11
Combined Drainage	15.11	26.0	41.11

(3) Proposed Drainage System

Tan Chi pumping station would be replaced with new pumps and transformer facilities, and improved in the structures and buildings of the station, because the existing pumping station have arrived at the time of replacement from a mechanical and engineering point of view. Additional pumping station would be constructed in Tan Chi or Han Quang, in accordance with the alternative study. In the case of increasing a drainage capacity of Tan Chi station, new pumping station would be constructed to meet the requirement summed up the replacement and additional pump's discharge capacities.

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. Other sluiceways would be also improved to convey the excess water effectively. The bridges and conduit, if those are a bottle neck in the drainage water passage, would be enlarged into the adequate size.

The existing drainage canals included Tao Khe and Tan creeks would be improved to meet the increased drainage requirement. Construction of new drainage canals would also be required to solve local waterlogging area due to depressed land or absence of adequate drainage canal network.

2.3.3 Irrigation Plan

(1) Objectives

The project would be integrated with the irrigation component to supply the water to the land to be reclaimed by the drainage improvement where are presently not planted with crops due to the water logging and the land where are insufficient in the irrigation water, expecting the increase of production yield with lower investment costs. In addition, an effective water management at the field would be practicable and ensure a high production. Furthermore, farmers would be relieved from a heavy water-lifting work, by upgrading of the irrigation system which would enable the water supply to serve directly from the canals.

(2) Design Water Requirement

The consumptive use of water for crops have been estimated by Blaney-Criddle method, in which monthly evaporation calibrated by Penman method and crop factors of 1.05/1.1/1.25 were applied depending on the crop growing stage. Percolation in the field was assumed to be 1.5 mm/day, prevailing clay soils in the area. Land preparation was estimated to take 15 days for the summer paddy and 30 days for the winter/spring paddy with water requirement of 70 mm and 190 mm, respectively. Nursery land would be required to take 30 days for both the seasonal paddies. The effective rainfall were calculated for every a half month by using daily rainfall for the latest ten (10) years from 1983 to 1992, which were about 80% of the values calculated by allowing to retain the water in an effective depth of 80 mm but ignore a daily rainfall of less than 5 mm. The water required with 1/5 year probability for each seasonal paddy at field were estimated, taking the above requirements into account, and summarized below:

	Winter/Spring Crops	Summer Crops
Land Preparation	190 mm	70 mm
Crop Water Requirement	308 mm	478 mm
Percolation	128 mm	138 mm
Effective Rainfall	70 mm	383 mm
Field Water Requirement	556 mm	303 mm

The diversion water requirement were estimated every a half month, applying overall irrigation efficiency of 51% in the summer season and 54.4% in the winter/spring season based on farm losses 25% of in the summer season and 20% in the winter/spring season, conveyance losses of 20% and water management losses of 15% in the annual season. As a result, the peak diversion water requirement was estimated to be 1.33 lit/sec/ha (third from the biggest one) for the last half month of August in the design year of 1992. Therefore, considering proposed land use and cropping pattern, the water requirement for the design of canals and structures would be proposed to be 1.3 lit/sec/ha.

(3) Proposed Irrigation System and Works

Most land in the Project Area would be irrigated by the canal system, as reviewed the water level available in the existing Trinh Xa South main canal. Thereby, the land area currently irrigated by the second stage pumping system would be gradually suspended and transformed to the canal irrigation system. Nevertheless, the some land area, which would be necessary to improve the large scale of canal system in its upstream area and required in a vast cost, will be remained as the second stage pumping irrigation system. The existing irrigation canals network would be followed in the planning but modified in the some canals to ensure the water supply for the second stage pumping area.

The South Trinh Xa Main Canal would be improved, focusing on the implementation of effective water management. The improvement would be made from the beginning point of the canal at Trinh Xa pumping station up to Hap Linh gate at sat. 17 + 520. All regulating gates would be replaced with new gates to make it operational. The gates of turnout would also be provided or replaced with new ones to divert the water adequately. Nevertheless, the rehabilitation/improvement of the Main Canal would be studied further, taking the master plan of irrigation into account.

The secondary and tertiary canals would be improved and/or upgraded up to the point which has a commanded area of not less than 50 ha. These canals would be lined with bricks for the major canals which have a canal length of more than 2 km and/or a commanded area of not less than 150 ha. Others remained and farm ditches would be unlined. Check structures would be proposed, if necessary for effective water management.

2.4 Agricultural Development Plan

2.4.1 Agricultural Production Plan

(1) Food Supply

In para. 2.2.3 two alternative plans are suggested as the future production plan. Alternative A is planned without changing the present paddy area. B is with some restriction of the area.

The information in the questionnaire from 100 farmhouseholds in the Project Area, tells that in the small farm household, the paddy/capita is 239 kg, medium is 328 kg and big 486 kg. The small farm household is, even at present moment, under the line of 300 kg/capita.

To alleviate the situation, especially in case of small farm, special consideration will be given to apply the alternative B by not restricting paddy area.

It is said that, integrated countermeasures which are composed of controlling growth rate promoting food production and others are necessary against the severe situation of a food security problem. The agricultural production has the main positive role in it.

(2) Alternative Plans

- Vegetable :

Vegetable production is very much emphasized in the plans for better income by utilizing the limited area as much as possible. About 30 kinds of vegetables are being cultivated in the area at present.

Tomato is very labor consuming compared with other crops but very much profitable. The season is, at present, mostly winter to spring, then market price is sometimes low because of overproduction. It is urgently needed to set up processing factories or cold storages for tomato and other perishable vegetables but it needs huge investment. To avoid the situation, off season cultivation, in case of tomato, spring-summer crop has been suggested by the Institute for Vegetable and Fruits (IVFR). The variety for the season is CSI, bred in the Asian Vegetable Research, Development Extension Center (AVRDEC), in Taiwan. It is not F₁ hybrid and around 25 t/ha will be expected. The cultivation technology has been established.

Cabbage production is concentrated in winter season and the market price is low as in the case of tomato. So, cultivation of cabbage in summer season is profitable and it has been tried in IVFR. The information from the Institute will be very much valuable.

Specific vegetables to the area such as baby corn, small cucumber will be worthwhile to be tried. In that case, marketability should be checked beforehand. Cultivation of these crops under the contract with some big markets or stores in Hanoi will be one of the ways to breakthrough.

Setting up of processing factory of vegetable is the best incentive of vegetable production. It is hoped that in early time it will be built up in the export processing zones (EPZ) in the Project Area.

- Paddy + Fish + Fruit System

It is suggested to use the low paddy area for fish cultivation but as mentioned in and shown in Appendix D, Figure D-6, some area will be necessary to make dike to keep water for paddy cultivation and fish feeding. Fruit tree cultivation is recommended on the dike and duck feeding, lotus cultivation in the pond will be suggested. All of these practices depend on circumstances. Also some types of utilizing the low lying area as pond for fish culture, rice cum fish and rice/fish rotation are to be considered accordingly in various situations.

(3) Animal Husbandry

The famous agricultural products in Ha Bac province are 4-Ls, i.e., lua (rice), khoai lang (sweet potato), lac (groundnut) and lon (pig).

Pig is the most important animal in the Project Area as commodity as mentioned above, and Tien Son district is in the top in pig breeding in the Study Area. Located nearby the capital Hanoi, the area has a big advantage as the supplying base of pig meat, which is the favorite animal protein food of Vietnamese. Moreover the marketability of pig meat is still very high since Hanoi is said in about only 50% pig meat self-sufficiency condition.

Pig is also very good FYM producer. Sustainability is one of the basic concept of agriculture and FYM is the biggest element supporting the concept. One of the most important problem to pig raising is variety. It is essential to raise cross bred

pig to produce good quality meat otherwise market price will be much lower than cross bred. To produce lean meat by feeding is very difficult.

Feeding materials of pig are, at present, rice bran (about 60%) crop residue (25%), rice (4%) and lees (1%), but sweet potato has been used as well.

Bean cakes of groundnut and soybean are very valuable concentrated feeding materials of not only pig but also other livestock and fish. The processing factory is located nearby district and intending to extend oil extracting and cake making capacities. It is hoped to establish good circulation of mutual relationship between legume production and the processing facility.

Milk production in Viet Nam is not so much and at present 10% of the demand is fulfilled by domestic production. Gia Lam district is supplying some amount of milk. In the Project Area, milk production will be realized in future with increasing fodder crop production capacity.

Duck rearing is also recommendable in the paddy + fruit + fish system mentioned above and in the ponds for fish breeding. The price of the meat is not so high in the market as chicken but duck is rather profitmaking livestock.

2.4.2 Farm Management

The Project Area is located in the middle of the Study Area and it is classified to II type, middle class, in land use classification in the Study Area, which is going to be type I, urbanized land use.

The farm management in the area is forced to follow the tendency.

- 1) Some land use patterns are suggested from the view point of soil in para. 2.3.1 and 2.3.2. There are many kinds of soils in the area. The farmers are requested to know the soil properties of their own farms and cultivate most adaptable crops in them. From the view point, district clay soil area, 69 ha altogether is to be used carefully, because it contains high Fe and the area will suffer from high acidity by drying.
- 2) The application of newly suggested cropping patterns to the three farm size farm households is tried for economical evaluation. It is observed that smaller farm size and more multiple cropping are going to have high cropping intensity. The farmers who have the farm of over 2.5 of cropping

intensity will be forced to work hard but it is one of the difficulties to overcome for earning more income.

3) Necessity of group

- Water deficiency is the biggest problem for crop cultivation especially in no-rain seasons. Building and rehabilitation of pumping stations and irrigation canals are urgently needed and together with that formation and improvement of the organizations or groups are seriously requested for utilizing the water efficiency. There is a good example of forming a body for water utilization in Gia Lam and its information will be helpful to materialize the idea.

As for inland fishery,

- Presently, arable land is provided to the farmers into small pieces. It is difficult to do fish culture in the ordinary paddy fields. It is suggested that during rainy season, the group of the farmers who are interested in aquaculture should be permitted for fish raising in the low laying land. In return, fish farmers should pay rental fees to the land owners so that the land owners will not suffer the difficulties during this period.
- People's Committee will encourage the farmers and give assistance to them to sustainably develop aquaculture in the area.
- To implement project successfully, it is essential to organize project office in which the project program officer will be recruited for supervising the implemented activities.
- The RIA No. 1 should be involved in the project activities as the technical consultant. The RIA No. 1 also should be responsible for training and demonstration programs and supply good and standard fingerlings for the project site.

Formation of farmers' group or new cooperative is also necessary for ordinary farmers for improvement of own technology and for the case to response the demand to supply a kind of farm product which is above certain quality level, in a certain amount, at a certain time, to a certain designated area. The case will come out in the near future.

- 4) The average of the size is 0.3 ha in the area. As in the case of small size farm (1.3 ha and 3.7 persons), it is difficult to harvest enough paddy for family.

Farm size problem is critical and fundamental issue not only in the area but also in whole country. It is hoped to have good political solution in the near future for the people in the local area.

2.4.3 Marketing and Processing

(1) Marketing

As mentioned in 1.4.4, almost all the paddy produced in the priority area deals with local merchants as middlemen which are given considerable weight in the marketing system. Groundnut and soybeans produced in the area are also dealing with local merchants.

With the project implementation, agricultural production in the area will be remarkably increased as 11,331 ton of paddy and 2,450 ton of industrial crops. Accordingly, establishment of marketing information center and provision of storage facilities are indispensable to compete with local merchants aiming to take advantage over the existing marketing system of agricultural products. The marketing system mentioned in Part I, 4.5.3, is also proposed in the area.

(2) Processing

Processing facilities for agricultural products, such as husking and vegetable oil extracting, in the area (Bac Ninh) and its surrounding area (Bac Giang, Ha Bac province) satisfy a need for actual crop production.

At present the working capacity rate of Bac Ninh Husking Factory is 42 percent at the maximum, i.e., 10,000 ton/year. For industrial crops, Ha Bac Vegetable Oil Factory has an extension plan as a key factory of agricultural processing in the north Viet Nam under the national policy.

Concerning tomatoes to be introduced widely in the area in future, it will be possible to attract the processing factory for tomato or to incorporate tomato processing into the factory mentioned. Further the potentialities of processing industry consist in a preparation of vegetable products in the area.

2.4.4 Supporting System and Extension Services

Some of the problems regarding support system has been touched in other section already, such as;

The "seed law" has to be enacted as soon as possible to supply good quality seed to farmers. New paddy seed supply to farmers in the Project Area is not enough and it is suggested to enforce the capacity of seed multiplication farm.

Fertilizer distribution system has to be improved to supply cheaper fertilizer to farmers on time of cropping season and setting up a new organization to integrate the fertilizer related issues is suggested.

The present conditions of agricultural credit, crop insurance are explained as well. Strengthening of farm credit especially for small scale farm household is the most important problem to support farmers.

The new system under the new law started in 1993 in agricultural extension activities. The extension activities under the new law in Tien Son district actually started from 1994.

The strengthening of extension activities is the most efficient way to develop agricultural production, though it looks taking time. Then supporting the following points of the activities of Tien Son People's Committee is most urgently needed for the Project Area.

- Training extension staff through seminars, short term training course and visits successful agricultural areas in another regions for studying new and updated technical knowledge.
- To equip the Extension Station with vehicles for extension staff so that they can have more chances to visit the fields and meet farmers. Bus and driver are also necessary for visiting other advanced areas with farmers' group.
- To equip the Station with some tools such as projectors, cameras, T.V., video set etc., and apparatuses for measuring water quality testing and soil analysis etc.
- To invest on some more demonstration plots.

Especially the extension activities on aquaculture are going to be emphasized since almost of the farmers have no experience of this field. The following activities will be needed through extension system.

- Training program on rice-cum-fish, rice/fish rotation. Group should be formed for the farmers interested in this sector.
- Training program on rearing techniques specialized on producing fingerlings.
- Meeting with the farmers having their land in low-lying area to discuss about land problems such as owning and renting.
- The Project Directorate should have close contact with the RIA No. 1 about the activities and the other technical aspects.

2.4.5 Renovation Plan of Farmer's Organization

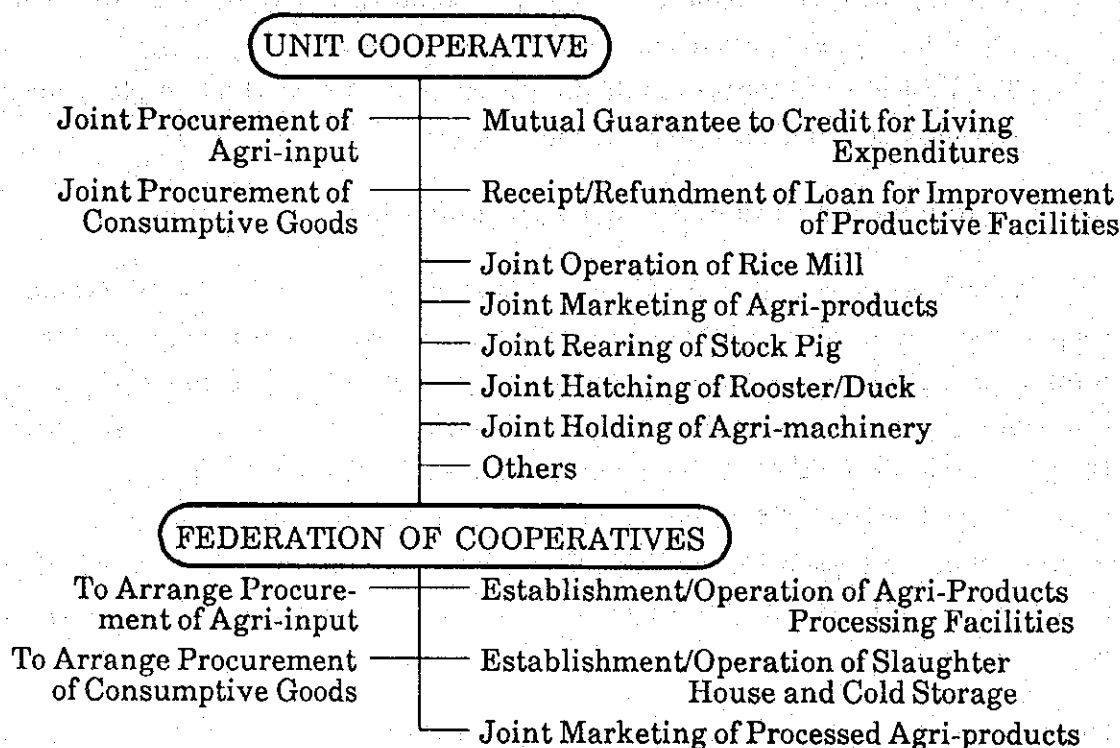
The Project Area consists of about 110 villages which form 46 farmer's cooperatives. Every 2.4 villages is, therefore, forming a cooperative, however the number of members varies from less than two hundreds to more than one thousand. This means that the structure of cooperative is not uniform even from the view-point of number of members. To make the farmer's organization be a base of productive and socio/cultural activities, the unification of unit organization is an essential condition because the activation of unit organization is not sufficient, but the tightening of cooperation amongst the unit organization is also very important.

On the other hand, the population of communes in the Project Area varies from 4,500 to 12,800, except Han Quang commune of Que Vo district, therefore the difference of size is still large if farmer's cooperatives are consolidated as commune basis. It is desirable to form 26-28 farmer's cooperatives per some 5,000 population.

In case of renovation of farmer's cooperative, it is recommended to transfer the land management function of existing cooperatives to the PC of commune or other administrative offices together with function of collection of land tax and water fee. Then the unit cooperatives are to be formed applying the procedures explained in Appendix G.7 clarifying the details of cooperative activities to the member farmers. The existing farmer's association will lose its raison d'être if farmer's cooperative become real farmer's organization, and the farmer's cooperative and association will substantially be unified.

After renovation of unit farmer's cooperatives, it is recommended to form the regional federation of cooperative with 10-15 unit cooperatives, and such federation might be developed to federations of district level and provincial level. The cooperative activities will be expanded and strengthened through such procedures.

As the function of unit cooperatives and regional federation in the Project Area, following activities are considerable:



As shown above, the purpose of establishment of federation are to support the activities of unit cooperatives ensuring the scale merit as shown left column of above chart, and to invest in the works which are difficult to be operated by unit cooperative from the viewpoint of scale/fund. For those works which are possibly operated by unit cooperatives as shown in the upper right column of above chart, it is recommended to entrust to the initiative of unit cooperatives as far as possible.

2.4.6 Farm Household Economy

As described in 2.4.1, an increase in crop yield and expansion of secondary crops will be expected with the improvements of drainage facilities and farm management, and strengthening of the agricultural extension activities.

In order to presume the future conditions of typical farmer, analysis of the farm household economy based on agricultural production plan have been done. As the results of the analysis are as follows;

(1) Small-scale Farmer:

A great contribution to improve the farm household economy of this farmer is not only an increase in agricultural production but also pig raising as animal husbandry. Farmer can be gained the surplus income (about 556 thousand VND) without off-farm income even such small-scale farm and family labor force.

Among gross family income, a proportion of animal husbandry income reaches about 36 percent. Accordingly, it can be said that animal husbandry occupies still an important position in his farming.

(2) Medium-scale Farmer:

Farmer earns the surplus income (about 2.4 million VND) which shows four times as compared with the present situation though he does not obtain off-farm income. All the expenditures can be maintained on the farm income (about 5.2 million VND).

However, animal husbandry income accounts for about 37 percent, among gross family income (about 8.4 million VND). Because of the farmers in the area have a pig raising-oriented, it is natural that the extension of animal husbandry contributes to the farm household economy.

(3) Large-scale Farmer:

Owing to considerable farm income (about 5 million VND), farmers can afford to perform the sufficient farming, and it will attract and accelerate the improvement of farming technology and introduction of new crops. Consequently, the pervasive effects over the area, generated from these situations, will be anticipated.

As mentioned above, the remarkable increase in agricultural production and farm income in the area will be expected from the high productivity, the extension of secondary crop cultivation during winter season, and the prevention against waterlogging; these will be produced with the improvement of drainage facilities in Tan Chi area of the project (see Appendix I, Table I-3.2).