

cultivated land. The survey result of 3,653 villages in the northern Viet Nam by the Central Committee of Land Reform in 1953 reported that the communal land in the surveyed villages was not exceeding 25%, and 24.5% was held by land-lord, 47.2% was owned by landowner farmers (see Appendix G.1-3 for details).

At the land reform undertaken in 1953-56, the farm land owned by the land lord and landowner farmer were nationalized, and its management was entrusted to the newly established farmer's cooperatives. Therefore the farmer's cooperative had a character of collective farm. After governmental decision of introduction of free market system in the mid of 1980s, many of farmer's cooperatives applied to lend the land to the member farmers with 15-20 years period, however some cooperatives are still keeping the collective farming system.

The present cultivation area per a farmer is 1-1.5 sao or 360-540 m<sup>2</sup> which consist of 2-3 plots.

### 3.2.3 Crop Cultivation and Production

From the agricultural production and ecological view points. Viet Nam can be divided into two, North and South. Both are subdivided into four and altogether 8 ecological regions are recognized as follows;

- North – North mountain
- North midland
- Red River delta
- North central coast
- South – South central coast
- Central highland
- North east of south land
- Mekong Rivers delta

The most fertile plans are the Mekong River Delta in the South and the Red River Delta in the North. These areas are favorable to the cultivation of paddy followed by subsidiary crops and animal husbandry.

Agriculture is a traditional practice in the national industry of Viet Nam, playing an important part in the national economy, accounting for around 35% in the gross national product and 30% in the total national export earnings. Rice is the biggest agricultural product and Viet Nam is the third exporting country in the world at present.

About 90% of the Study Area is in Ha Bac Province, which is classified into North midland. But it has big alluvial paddy field which is the characteristic of the Red River Delta.

Basic cropping calendar in the Study Area is shown as follows:

Month	11	12	1	2	3	4	5	6	7	8	9	10	%	
2 rice + 1 sub. crops.	△			△				○	○				7.2	
	△			○				△	△		○	○		
1 rice + 2 sub. crops.	△			△				○	○				2.9	
	△			○				△	△		○	○		
2 rice	△			△				○	○				49.0	
	△			○				△	△		○	○		
1 rice + 1 sub. crops.	△			△				○	○				8.0	
				○							△	△		
1 winter-spring rice	△			△				○	○				18.1	
1 summer rice								△	△			○	○	2.6

Legend : △ seeding ○ harvesting

Rice is by far the staple food crop in the Study Area providing the people with about 80% of carbohydrate and 40% of the protein intake. But rice yields remain same or relatively low compared with the national average except Hanoi district's area (see Appendix D, Table D-6). Paddy (Rice) occupy 80% of the farm land in the Study Area in two seasons and no winter paddy is observed. Tien Son is the leading district in paddy production.

Total rice production of Bac Duong Irrigation Enterprise area in 1993 was almost doubled in comparison with that of 1980's (Report of the Bac Duong Irrigation Enterprise). It was due to an expansion of cultivated rice land in Que Vo district and an increase in the rice yield in Tien Son district. But due to the aberrant weather and the soil related constraints, the rice yield is still low and unstable. From 1980 to 1992 the rice yield increased from 2 ton/ha to 3 ton/ha which is somewhat lower than the average yield of the Red River Delta (RRD). In 1985 rice yield decrease to 0.8 t/ha due to floods. In 1987 and 1991 there were also a decrease in the rice yield in spring crops, 1.85 ton/ha and 1.14 ton/ha respectively, due to the abnormally warm weather.

In 1980's in some other districts, the HYV (VN10, DT10) yielded 10-12 ton/ha/year in large area showing the potential of rice production through

technical advance and replacement of one rice crop with intensified cropping pattern: Spring rice - summer rice - winter crops. This change is associated with the introduction of short duration rice varieties, suitable for intensive farming under water control condition.

The rapid expansion in the use of hybrid rice has contributed to an increase in rice production in Yen Phong district and others. F<sub>1</sub> paddy seed have been imported and partly planted at present, but its future looks to be not so promising due to market price and cost of production.

Generally speaking, the advancement of rice production in the Study area has been supported by the following factors.

#### 1) Environment Control

Such as water level control in rainy season and irrigation facilities in no rain season.

Integrated pest management (IPM) activities have been contributing so much to prevent losses by pests and diseases.

#### 2) Varietal Improvement

So called high yielding varieties (HYV) with short culm height have been introduced from mainly International Rice Research Institute (IRRI). Though these introduced varieties are most popular in the area but many home bred new varieties have been used as well. The growing period of some new varieties are short compared with the traditional ones and multiple cropping became possible by using these HYVs.

#### 3) Fertilizer

Following the introduction and breeding of new HYVs, the application of fertilizer has to be increased. The import of fertilizer increased from 129,000t (1960) to 634,000t (1990) and the yield increased accordingly.

#### 4) Climate

It is said that the visit of typhoon to Viet Nam has comparatively decreased recently resulting in stabilization of crop yield.

## 5) Policy

Transition to free market system from controlled one and land allocation to farmers with the policy "Doi Moi" gave tremendous impact and incentive to the farmers to produce much more farm products.

With the big advancement in the agricultural production, these are still some problems to overcome for advancement.

- Biological problem : deficiency of rice varieties of lodging tolerance, resistant against adverse conditions and lack of pure seeds.
- Physical problem : drought at the beginning of the winter spring season, flooding in the rainy season and high acidity of the soil in general.
- Socio-economic problem : Low income of farmhousehold, relatively high cost of production.

Maize has both local and high yielding hybrid varieties. In the Study Area, farmers have three crops seasons a year: spring maize, summer-autumn maize, and winter maize.

The area increased from 5,900 ha (1985) to 9,800 ha (1992) in Ha Bac province. This crop is certainly to be recommended for areas where irrigation supplies are not always sufficient for rice. Maize is generally well fertilized. For 3 ton/ha crops, an average of 140 kg N/ha appears to be adequate. This could then create the basis animal husbandry. Labor input is somewhat less than that for rice production.

Sweet potato can be easily grown, requires low inputs and often is harvested after 3-4 months. It can grow in warm, sunny spring season, at the same time it withstands drought well in winter season after two rice crops. For that reason it suites to dry upland in Tien Son, Que Vo district, on degraded soils with light texture. But it is not a commercial crop as there is no technology for its processing. Yield is 7-8 ton/ha which reflects low input costs. If sweet potato could be processed into starch, the crop value could double or triple thereby contributing to raising employment and farmers' income. It is used mainly for domestic consumption in particularly as animal feed. Labor input is low compared with that for rice production.

Groundnut is grown in all district of Ha Bac province. The area somewhat decreased from 8,800 ha in 1985 to 8,300 ha in 1992. The reasons for decreased production are: a) poor quality seed being planted, b) low price in the export

market, c) an increased consumption of meat by the local population. At present, only one oil mill in Tan Yen district operates and uses about 3,000 tons per annum. This crop is mostly grown on light degraded soils in rotation with maize, rice. Manure 5-6 ton/ha is supplied with 200 kg/ha SSP and often some 50 kg/ha urea is applied. There remains a need to select the leaf spot resistance variety from ICRISAT collection.

Soybean areas have been slightly diminished in Ha Bac province from 9,400 ha in 1985 to 6,900 ha in 1992. This crop is favored by farmers as a soil improving intercrop. Soybean is grown in spring, summer and winter. Winter soybean has high profit margins which is almost double that of rice. Soybean is the profitable crop if yields of 1.5 ton/ha can be obtained. Some 100 kg/ha urea for soybean seem excessive but inadequate modulation may be a problem.

Vegetable : in the north, tropical and temperature vegetables are grown. Farmers grow their daily use vegetables mostly in their home gardens VAC, where water is available, almost every day watering is done during dry periods (sprinkler irrigation). It is natural that the target of marketable vegetable production is Hanoi and other big cities. In future foreign market will come up.

Perennial crops are mostly grown on non-irrigated lands: citrus, lychee, longan, chiku are the predominant crops in VAC ecosystem.

For subsidiary crops, many kinds of annual crops have been cultivated and their sowing and harvesting times are shown in Appendix D, Figure 1 and 3.

### Cropping Intensity

Crop rotation with a good irrigation, rational fertilizer use and integrated pests management (IPM) would reduce the risk of natural calamity and at the same time maintain soil fertility. The risk of pest and disease damage is hoped to become less significant due to the improved varietal resistance, too. Flood risk for autumn rice has somewhat diminished following the construction of Hoa Binh Dam, and going to be reduced further by installing new drainage facilities.

The cropping intensity of the districts are shown in Appendix Table 1, as Bac Ninh 1.74, Tien Son 1.94, Yen Phong 1.84, Que Vo 1.75, and Gia Lam 2.15. But in the near future all these figures will exceed 2.0 by the improvement of canal system and drainage facilities.

The present condition of fertilizer application for each crop in Ha Bac province is shown in Appendix D, Table D-3. In case of paddy, all elements are applied less than recommended amount, especially in P, K and FYM.

As for varieties of paddy and maize, the most popular ones are shown in Appendix D, Table D-4.

The application of insecticides and fungicides is necessary especially for paddy densely planted. These chemicals are all imported from advanced countries such as USA, Germany, France and Japan. The present condition of the application in Ha Bac province is shown in Appendix D, Table D-5. No weedicide is used at present moment.

### 3.2.4 Livestock

#### (1) General

Buffalo, cattle and pig are main livestock in the area. They play a very important role in agricultural activities. They have been admitted as a movable assets, drafting power at the time of plowing, and the producer of FYM which plays the important role in sustainable agriculture. Their meat is also very important for the domestic and foreign market. In that sense, pig is most important animal in the area of which Tien Son district is leading.

The present number of the main livestock in the Study Area is shown in Appendix D, Table D-7.

#### (2) VAC ecosystem

The VAC ecosystem is a highly intensive method of small-scale farming in which some small livestock plays an key role.

VAC is an acronym formed from the three Vietnamese words. VUON garden or orchard, AO - fish pond and CHUONG - pigsty or poultry shed. It refers to a form of domestic agriculture in which food gardening, fish rearing and animal husbandry are wholly integrated. This system is originated in the Red River Delta.

Within the ground of a farmhousehold, plants are grown in the garden and fishes are reared in the pond. The pigsty and the poultry shed are situated closed to the

pond. Pig manure is used for plants and for fish food, various garden products are used to feed the livestock and fish.

The whole VAC system is operated by the farmer's family. They consumed meat, eggs, fish, fruit and vegetables and in turn they contribute waste products to the system. But this small scale intensive farming had been neglected so long time but it was recognized as one of the most adaptable integrated farming system in Viet Nam. Many foreign countries and organizations such as UNICEF, newly established organization VACVINA have the projects to help Viet Nam people mostly from the view point of home economy, nutrient supply.

NIAPP reported that VAC contributed to 21~12.6% of income of farmhousehold. According to the publication of "VAC and VACVINA", the dietary intake for two groups of families having the same conditions of land and labour, one adult in the group with VAC system takes about 14% more energy by food in a day compared with that of without the system (see Appendix D, Table D-8).

Thus pig and small livestock have very big importance in the daily life of the people in the Study Area where population density is as high as thousand persons/km<sup>2</sup>.

### 3.2.5 Inland Fishery

#### (1) General

Inland fisheries is widely practiced in Viet Nam utilizing fresh water resources of some 1.37 million ha. The future of the aquaculture appears to be favorable with an evident demand for fresh fish and existence of well-developed market throughout the country. Aquaculture is also emphasized from the view point of protein nutrient supply to the people to level up the living condition.

The water superficies used in aquiculture in the Study Area is 1,269 ha in total as shown in Appendix C, Table C-6.

The Study Area which belongs to Hanoi, consists of the communes belonging to upstream of Duong River and Trin Xa irrigation canal. This subregion is occupied an area of higher level land with less opportunity for aquaculture development. Although, a number of the family having small pond and VAC system is not so much, but potential for cage culture is considered more less reality as this is close to Duong River and Long Tuu canal.

According to the Don Anh district information (1993), "The fish production was 350 tons, increasing by 50 tons against 1992. Many new breeding and planting professions were developed, especially the movement of fish breeding in cages was strongly developed in the communes nearby rivers and lakes with 188 fish cages.

The number of families breeding frogs, tortoises, cross bred catfish has been increased."

But the main activities will be in the other districts belong to Ha Bac Province.

## (2) Present Condition

The inland fishery harvest in 1993 in the four districts in Ha Bac province is as follows:

(Unit : ton)

Fish	T. Son	Que Vo	B. Ninh	Y. Phon
Silver carp	300	120	15	50
India carp	150	50	25	70
Carp	50	20	5	20
L. Mrigalla	50	10	10	5
Grass carp	35	50		3
Catfish	0.7	5		2
Frog	0.2			
Tortoise	0.1			
Total	595	255	60	150

Note : (1) Homestead, Ponds having average size of 120 m<sup>2</sup> 150 m<sup>2</sup>

(2) Lakes and swamps having average size of 450 m<sup>2</sup> 500 m<sup>2</sup>

(3) Production : except paddy field.

Besides, the fish-rearing in cages and rafts has been recently carried out in the Duong River with a distance of more than 15 km.

### Fish Species

Fish species observed in the area are mainly fed by microbiologies organic materials under emulsion form of aquatic vegetal low and high classes, and plankton or small aqua-living beings. The most popular species are silver carp - hypophthalmichthys harmandy (Ca Me Trang), bighead carp - aristichys nobilis (Ca Me Hoa), India carp - labeo robita (Ca Ro Hu), mud carp - cirrhina morigal (Ca Morigal), mud carp - cirrhina molitorella (Ca Troi Ta), tilapia - tilapia



mossembica (Ca Ro Phi), grass carp - ctenpharyngodon idellus (Ca Tram Co), snake head - muller (Ca Qua), common carp (Ca Chep).

### 3.2.6 Agricultural Processing

Processing of agricultural products is one of the key problems for the development of the area and its importance has been discussed for a long time. So far, the information regarding the present condition on this sector is as follows:

Tien Son has 97 units of food processing. In Que Vo 80 in Bac Ninh town, 15 and Yen Phong 75. There are 267 sets of agro-processing altogether in the four districts of the Study Area. These figures don't include rice mills judging from the data collected.

It is said that as a whole, rice milling is one of the most important agricultural processing activities in Viet Nam. It includes around 3,000 plants and employs 100,000 workers in both state and joint venture enterprises in the country. But one report tells, together with the large scale milling facilities, of 15,000 small scale mills owned by cooperatives and private individuals.

An estimated 60 percents of locally consumed paddy is milled manually, while the balance is milled by small-scale, village-level mills. The former operation is better in recovering ratio and nutrient content compared with the latter one. Moreover, since the loss of paddy in and after harvest is estimated as high as 16.0%, operation after harvesting, especially drying, storage and milling process must be improved.

### 3.2.7 Agriculture Supporting Services

#### (1) Research

The present research institutes under the Ministry of Agriculture and Food Industry (MAFI) are shown in Appendix D, Figure 4.1 (1)~(4). There are 31 organizations at present for research and training. Due to lack of fund for research works, the activities of these institutions are mostly conducted under contract with others. This contract research system (CRS) is rationalized as creating incentives for conducting research of direct relevance to the needs of farmers and ensuring its transfer. However excessive reliance on this system has serious drawback.

The contribution of these institutions should be highly evaluated under the lack of research funds and shortage of research staff. One of the most important contributions to agriculture in Viet Nam will be paddy variety breeding in the institutes. In case of Food Crops Research Institute (FCRI), since its establishment (1968), 30 new food crops varieties (17 rice, 2 potatoes, 2 turnip, 1 watermelon, 2 tomato, 1 cabbage, 2 sweet potato and 3 jujube) have been bred. FCRI has had collaboration program with other national research institutes and provincial department in research activity and in application of advanced technology to the locality.

## (2) Extension

The importance of extension activities has been recognized for a long time. But due to the lack of budget for the extension services in local area, the organization for extension has not been well functioned except some provinces such as Bac Thai and Au Gian. In Viet Nam, at the beginning of 1994, 49 provinces out of 53 had province level extension organizations but only 200 districts out of 550 had district level extension stations.

Ha Bac province has been fairly evaluated in extension activities in Viet Nam. The actual situation in Tien Son district was to cover whole area by few persons. The main activities of these staffs under Agricultural Division of People's Committee, Tien Son, is to manage several demonstration farms scattered in the district.

To improve the stagnant situation in agricultural extension activities, the Prime Minister adopted Decision 13/CP and Regulation on 2 March, 1993 in which, organizations related to agricultural extension services were newly suggested from national level to local ones. The principle, definition of extension operation and related instructions were also clearly mentioned in it.

## (3) Agricultural Credit

Agricultural credit for the farmers in the area is given through the Viet Nam Bank of Agriculture. The farmers borrow the credit from the district branches. The object of credit is within the scope of agriculture, forestry and inland fisheries. The condition of agricultural credit are as follows;

Category	Period	Interest
Long term	5 to 10 years	1.2% per month
Medium term	(a) 3 to 5 years	1.2% per month
	(b) 1 to 3 years	1.2% per month
Short term	less than 12 months	2.5% per month

Note : In case of short term, it is now set up 1.8% of monthly interest for farmer as a measure of the poor farmer households.

Presently, the loan conditions are strict because of the shortage of fund, therefore, collateral assets as house, furniture, cattle, and other properties, and insurance are needed. Its repayment condition is as : monthly payment of interest, and repayment of maturity.

#### (4) Crop Insurance

The Viet Nam Government has established crop insurance in order to relieve the reduction of farm income caused by natural disaster, pests and insects for plant crop which impede the agricultural production, and is assisted the farmers to secure income.

Presently, crop covered by the insurance is only paddy, but soybean, tea, tobacco, etc. are added from June, 1994.

The insurance premium is determined in accordance with a class added by agricultural tax i.e. land use tax.

Class	Premium			
	Insurance (kg/sao)		Insurance (kg/sao)	
	Spring crop	Other season's crop	Spring crop	Other season's crop
1st	4.8	4.2	80.0	70.0
2nd	4.2	3.6	70.0	60.0
3rd	3.6	3.0	60.0	50.0
4, 5, 6th	3.0	2.4	50.0	40.0

Insurance premium is set up at 80% of rural free market price in the district, equivalent to paddy, and farmers pay for an insurance in cash. According to farmers interviewed, the insurance premium in the area is fixed third class and below.

### **3.3 Present Agricultural Infrastructures**

#### **3.3.1 Present Irrigation and Water Supply**

##### **(1) Present Irrigation**

The irrigation in the Study area is mainly served by pumping system and supplied from the three rivers surrounding the Study Area, because the river water level is lower in the dry season. However, the water pumped up to the main canal flow down to the creeks and drainage canals so that it is necessary again to pump up to the field, due to underdeveloped on-farm ditches, insufficient and inoperative check structures and poor water management. Therefore, there are a great number of small scale pumping stations constructed along the drainage canals and creeks. In the area equipped without pump, the farmers obtain the water from the secondary/tertiary canals and/or the standing water in the drainage canals and farm drains by portable pump. As the number of portable pump unit is very limited, most farmers supply the water manually by using the water-proof scoop.

The irrigation systems in the area are operated mainly by Bac Duong, Dong Anh and Gia Lam Irrigation Enterprises. However, the quantity of water supply is not enough to irrigate the east part of the area, specially in the north east and east part of Que Vo district for the winter/spring crops. As a matter of fact, the water is scarcely available in not only the irrigation canals but also the drainage canals and depressed areas. According to Bac Duong Enterprise, the drought has occurred in about 15% of the cultivated area on an annual average for the late 13 years and the Enterprise has served to about 70% of service area. These insufficient water have been caused by the deteriorated canals and structures due to shortage of fund and much use of the water in the upstream area due to poor discipline of farmers,. While, an irrigation service rates are comparatively high, which are 89% and 95% in Dong Anh and Gia Lam Irrigation Enterprises, respectively (Refer Appendix E-1.2).

##### **(2) Irrigation Systems and Facilities**

The irrigation system in the Study Area is grouped by the operation and maintenance system organization into Bac Duong, Dong Anh area and Gia Lam area irrigation systems. All systems are served by pumping irrigation. The total service area is some 21,120 ha, accounting for about 85% of paddy area or about 80% of cultivated land area.

Bac Duong irrigation system, which serve the cultivated land in Ha Bac province, is sub-grouped into Trinh Xa, Kim Doi, Xuan Vien and Dong Sai pumping irrigation areas by the main water sources and location of pumping stations. Total service area irrigated by 16 pumping station is estimated to be some 18,690 ha.

Trinh Xa pumping irrigation area (A=10,270 ha) is involved into Trinh Xa irrigation system which main facility is Trinh Xa pumping station constructed in 1960-62. The water source is the Ngu Huyen Khe River supplemented by the Duong River through Long Tuu intake in the drought period. The water pumped up from the Ngu Huyen Khe River is diverted to North and South main canals to irrigate a planned land area of some 27,400 ha. South main canal (L=33.5 km), which serves the Study Area, traverse the middle part of the area from west to the east and convey the water to each irrigation block through the secondary canals constructed on the both side of the main canal. Nevertheless, the land area irrigated directly from the canal system are very limited, due to poor maintenance, deterioration of the facilities, the canals used dual purposes of irrigation and drainage. In the downstream area with insufficient water, the drainage pumps are used for an irrigation and/or the water is supplied by pumping up the water from the drainage canals and/or creeks. There are a great number of small 2-stage pumps managed by the communes in addition to the pumps managed by the Enterprise.

Kim Doi pumping irrigation area is classified to the pumping irrigation area involved 4-station, Kim Doi, Thai Hoa, Cach Bi and Kieu Luong pumping stations which those provide the supplemental water to the main and/or secondary canals in the downstream area of Trinh Xa irrigation system and the small irrigation areas which are served to the on-farm by 4 pumping stations, separately. A total service area is some 6,880 ha. Xuan Vien and Dong Sai pumping irrigation areas obtain the water from the Cau River and a drainage canal and serve a land area of some 970 ha and 570 ha, respectively.

Dong Anh area irrigation system consists of Dong Dau, Loc Ha and Lai Da pumping irrigation areas get the water from the Ngu Huyen Khe River and Long Tuu diversion canal to serve a land area of some 540 ha in Dong Anh district. While, Gia Lam irrigation system includes Lien Dam pumping irrigation area which pump up the water from the Ngu Huyen Khe River to serve a land area of some 490 ha and Cong Thon irrigation area which irrigate a land area of some 1,400 ha by obtaining the water from Duong River. Think Lien dual purposes of

irrigation and drainage pumping station is second stage pumping station to supplement the water to a land area of some 400 ha in the downstream area of Cong Thon irrigation system (Refer Appendix E-1.1.).

### (3) Present Operation and Maintenance

The Bac Duong Irrigation Enterprise is managed under the administration of Ha Bac province and operate for irrigation and drainage services since 1964 and maintains 33 pumping stations, about 150 km length of main irrigation and drainage canals, and sluices for irrigation and drainage. The service area is some 32,700 ha, extending over three districts and one town. However, those facilities are timeworn in the major pumps, deteriorated, insufficient in the flow area due to siltation and inoperative in a large number of check structures but not adequately restored and well maintained due to shortage of fund.

The water management by the operation of Trinh Xa pumping station is practiced by the supply-oriented water control system in accordance with the cropping pattern prepared by the agricultural section of the respective districts. No operation manual is provided taking into account effective rainfall, conveyance losses, and so on. The information of water supply given to the farmers seems to be very limited. The pumping stations other than Trinh Xa station are currently operated within the limited time (6,000-10,000 KWH) decided based on the averaged operation hours in the latest year. Bac Duong Irrigation Enterprise is expected to maintain a total power consumption within 14 million KWH. An operation cost per one (1) cu.m is estimated to be 21 Dong on an average, which lower in the large scale capacity pumps (17 Dong) and high in the small capacity pumps (25 Dong).

The water fee are estimated based on the 5 year's average paddy production yield and actual achievement of water supply and collected by cash or in kind through farmers' cooperatives since 1987. Each enterprise is managed by the independent profit system but can not be paid for all O&M expenses by the collected water fee. The balance due is financed by the payable account to the electric company and/or the bank loan. Particularly in Bac Duong Irrigation Enterprise, the collected water fee corresponds to about 42% of O&M costs. The remaining 58% is remained as the payable account to the electric company. These unpaid amount is accumulated to about several times the annual revenue to be collected as water fee, reportedly (Refer Appendix E-3).

### 3.3.2 Drainage Facilities and Inundation

#### (1) Present Drainage

In the Study Area, about 21 drainage pumping stations built in 1962-81 exist and operate to drain the excess water in the rainy season, June to October, where the river water levels are high. Specially in the month of July to September, due to much rainfall, increase of runoff water, shortage of drainage pump capacities, under-development of drainage canal networks and so on, the inundation damage to crops is in routine and suspension of summer cropping land is increasing every year. While, the gravitational drainage is employed during the month of November to May, where the water levels in the river are lower.

The inundated area, according to the Bac Duong Irrigation Enterprise, occurs every year and spreads to a land area of some 5,200 ha with the land area of some 2,560 ha failed in crops on an average for the latest 14 years. In the year of 1985 suffered heavy damages. The damages are reported to be a cropped land of some 11,900 ha is the inundated area, of which 9,200 ha was failed in the harvest. In Tien Son district the area below 4.0 m in an elevation are usually inundated and the flood water depth in Que Vo district is deeper due to the incoming water from the outside not area, reportedly. The damages extend to not only crop damages and lower yielding but also the collapse of road and polder dikes, worsening of ecological conditions, living environment, transportation and so on.

The increase of runoff water is caused by urbanization of the land along the highway, nude mountains and hills, increase of domestic wasted-water, and so on. The flood is brought from not only such incremental runoff discharge but also under-developed drainage networks, lack of farm drains, dual purposes canals for irrigation and drainage, insufficient capacity of culverts, sluices and pumps, decrease in the number of operational pump units (about 80% operational currently) and so on. The inundated area are expanded by inadequate farm management to keep the deep water in the paddy field, insufficient control and management of drainage system, improper system of data and information collection and notification, etc. The suspension in pump operation due to electric failure and warning water level set up to prevent the river levee from collapse are an external factor for inundation problem (Refer Appendix E-2.2).

## (2) Drainage System and Facilities

The drainage area for each pumping station are bounded by the roads, irrigation canals, polder dikes, etc. and can be grouped into the following five (5) drainage system areas, taking into account the main drainage canal system and/or the rivers to discharge. Each drainage area is equipped with the drainage facilities, such as pumps, sluices, regulating gates, canals, etc.:

- \* Ngu Huyen Khe river drainage system area (A = 5,850 ha);
- \* Duong river upstream drainage system area (2,620 ha);
- \* Kim Doi creek drainage system area (6,510 ha);
- \* Tao Khe creek drainage system area (17,000 ha); and
- \* Drainage system area along the Cau river (7,630 ha).

Ngu Huyen Khe River Drainage System Area consists of Trinh Xa and Phu Lam drainage pumping area discharged the water to the Ngu Huyen Khe River and Lien Dam, Dong Dau, Loc Ha and Lai Da pumping drainage area drained the excess water to the Ngu Huyen Khe and Long Tuu diversion canal. The capacity of Trinh Xa pumping station ( $2.5 \text{ cu.m/sec} \times 8 \text{ units}$ ) was planned mainly for the irrigation purpose to serve a land area of 27,400 ha so that the pump capacity may be bigger against its drainage area. However, the present capacity may be reduced because the pumps have operated for the period of over 30 years. The total capacity of pumps is estimated to be 29.7 cu.m.sec or 5.08 lit/sec/ha in drainage coefficient. This discharge capacity is big depending on a capacity of Trinh Xa pumps, while other pumping stations are small, 2.35-4.88 lit/sec/ha. Thereof, Dong Dau pumping station is under renovation and expected to be operated in 1995.

The Ngu Huyen Khe River originate from Thiep pond in Dong Anh district, Hanoi, and runs toward the south-east and joins the Cau River at Dang Xa in Yen Phong district, after turning its direction to the north-east at Dai Tu commune in Dong Anh district. A total drainage area is some 16,200 ha including the gravitational drainage area in the upstream and pumping drainage area along the river. The Ngu Huyen Khe River is connected with the Duong River to the west through Long Tuu diversion canal with intake gates. However, this canal is mainly used as the diversion canal to convey the supplemental irrigation water to Trinh Xa pumping station but not for the drainage purpose.

Dang Xa pumping station has been constructed at the confluence of the Ngu Huyen Khe and Cau rivers to discharge the river water to the Cau River, when a



gravitational drainage of Ngu Huyen Khe River is unavailable. When the water level of the Ngu Huyen Khe River is over 5.5 m at Dang Xa, the Drainage sluice is closed and then Dang Xa pumps are operated. On the other hand, according to the operation, Management and Development Rule for Bac Duong Irrigation System, when the water level of the Ngu Huyen Khe River is higher than 6.5 m in an elevation at Trinh Xa pumping station, all drainage sluices are closed and all pumps are also stopped in their operation to prevent the levee of the Ngu Huyen Khe River with a top levee elevation of 7.0 m from over-flowing and collapse. It is reported that the number of days to stop in the pump operation under this rule is about several days every year. Furthermore, in the case of water level raising over 7.0 m, the excess water in the river are delivered to the farm land by opening of the drainage sluices and operation of irrigation pumps. As a matter of fact, such emergency case have been recorded in 1978, 1980 and 1985, which brought about serious social problems in the area.

Duong River Upstream Drainage System Area, which is located on the west of the Study Area and has a drainage area of some 2,620 ha, is situated in the most upstream area of Tao Khe creek drainage system from a standpoint of gravitational drainage. According to the Operation and Management Rule for Bac Duong Irrigation System, Think Lien sluice is closed to block the water way to the Tao Khe creek and drainage is managed only by the pumps built within the area from 15 June to 15 November. In turn, for the remaining period, the excess water in this drainage area is drained by opening of Think lien sluice to the Cau river through the Tao Khe creek.

The area is equipped with three pumping stations, Duong Ha, Phu Dong and Think Lien stations, built in 1969-89 and managed by Gia Lam Irrigation Enterprise, of which Think Lien station is under construction to increase its drainage capacity ( $0.64 \text{ cu.m/sec} \times 9$ ). A total drainage capacity is 15.7 cu.m/sec at present, corresponding to 5.62 lit/sec/ha. The drainage area is divided to sub-drainage areas for each pumping station. The incoming and out-going water discharges among the sub-drainage areas are controlled by the sluices. Since the operation rule of these sluices rule has not been set up yet, the drainage water control rule is expected to be prepared for effective operation of pumps for the regional drainage. The excess waters are pumped up to the Duong River, nevertheless, the pumps operation are suspended for 3-5 days for a year due to the warning water level of the Duong River. On the other hand, the increase of runoff water, which is equivalent to about 30% of a total drainage quality at present, caused by the urbanization of the area along the national highway IA results in

the increase of pump operation hours. The Enterprise claims that the increase of operation and maintenance costs bring about the balance due in the finance. These are the urgent problems to be solved, reportedly.

Kim Doi Creek Drainage System Area is situated in the north-east of the Study Area and has a drainage area of some 6,510 ha. Kim Doi pumps (2.5 cu.m/sec × 5), which have been used for dual purposes of irrigation and drainage, may have lower in an actual capacity than the reported ones since it operated over 25 years.

The upstream area from the Van sluice has originally been planned as a part of Tao Khe creek drainage system but be transferred into the Kim Doi creek drainage system area by constructing Van sluice because of difficulty to drain the excess water to Tao Khe creek drainage system area. According to the operation rule, Van sluice can discharge the water to the downstream by about 30% of Kim Doi pumps and/or out-flowing capacity of Kim Doi sluice when the pumps and/or sluice is operated. However, this upstream area (about 2,000 ha) is poor in the drainage and suffered from a persistent inundation every year.

Tao Khe Creek Drainage System Area, which has the Tao Khe creek, as a main drainage canal, running from the west to the east in the middle of its drainage area, is equipped with Tri Phuong, Tan Chi and Thai Hoa pumping stations along the Duong River and Hien Luong pumping station on the Cau River. These were constructed a long time ago except Thai Hoa station (1986), such as Tri Phuong and Hien Luong stations in 1966 and Tan Chi station in 1975. A total discharge capacity is estimated to be 45.4 cu.m/sec or 2.67 lit/sec/ha in a drainage coefficient but may be lower in an actual discharge capacity. While, Tri Phuong pumping station is under construction to improve its drainage capacity (3.11 to 5.33 cu.m/sec).

The drainage in the area is mainly provided by the pumping system, a gravitational drainage is available through Hien Luong sluice in the dry season. The area can be sub-divided based on the topography, roads, irrigation canals polder dikes and other control structures/facilities. The pumping stations and/or drainage sluices/conduits are provided and operated by the commune/village for each small drainage area. It learned that the drainage system of Tao Khe creek drainage area is very complicated in the drainage water flow because of unsystematical operation of such pumps and sluices. Thereby, the drainage water flow are hardly defined as well as boundary of sub-drainage area.

Most drainage control sluices are hardly operated and/or not operational to control the excess water to the downstream area. It seems that the excess water in the upstream area can be flown down to the downstream area without the control except Tram Sluice (bridge). Tram sluice is located at the most downstream of Tan Chi area on the Tao Khe creek. Its operation is determined based on the rainfall, drainage capacity of pumps and inundation status in the Tan Chi area and the downstream area. Under these circumstance, it is learned that the water logging is caused by not only the lower capacity of existing pumps but also increase of water quantity to the downstream due to inoperative drainage sluices, and difficulty in application of sluice operation rule, lower capacity of drainage canal resulted in flooding and local inundation, and so on.

Drainage System Area Along The Cau River involves the pumping drainage area along the Cau and Pha Lai rivers and is equipped with Xuan Vien, Huu Chap, Viet Thong, Que Tan, Chau Cau and Pha Lai pumping stations. These stations have been built in 1976-86, except Pha Lai and Xuan Vien stations (1966-67). A total drainage capacity is 21.2 cu.m/sec and corresponds to 2.78 lit/sec/ha in a drainage coefficient. Within the area of Bac Ninh town in the north-east of the Study Area, Co Me new pumping station is under construction with finance support of the province (Refer Appendix E-2.1).

### 3.3.3 Farm Roads

The present roads connected between villages and with the national and provincial roads as well as the operation and maintenance roads along the main irrigation/drainage canals and the top or river levee and polder dikes are used for marketing and distribution. These main farm roads have a width of less than 3m except the O&M roads along the main irrigation/drainage canals and be unpaved, which are muddy in the rainy days. A density of farming roads used for farming practices is varied, depending on farm blocks as high in Tien Son district (about 56 m/ha) and low in Que Vo (about 19 m/ha). The longest distance between the main farm road to the field is about 2 km. The road width is narrow, like a levee of the field (see Appendix E, Table E-3.1).

### **3.4 Agricultural Economy**

#### **3.4.1 Population and Labor Force**

As mentioned in 3.5 Rural Community and Organization, the population in the Study Area is about 473,000 with 103,230 households and its density is 1,202 persons per square kilometer. An average household size is 4.58. Economically active population is about 237 thousand (50.25% of total population) and 83.5% (198,400 persons) of working population engage in agriculture (see Appendix I, Table I-2.1 to 2).

Accordingly, the population density in the area is extremely high as rural area and 90 percent and over of the whole households engages in agriculture.

From these circumstances, it can be estimated the agricultural land per capita is less than 500 m<sup>2</sup> (around 400 m<sup>2</sup>). According to farming survey, an average area of farmland per household is 0.24 ha and this is lower than that of national level (0.33 ha). Consequently, the labor force is remarkably surplus due to lower cropping intensity (1.93) and limited farmland.

#### **3.4.2 Economic Profile**

The Study Area extends a great part of Ha Bac Province in the north region, adjoining to the Hanoi Capital, also a part of two districts of Hanoi City. The whole area of Ha Bac Province is 4,616 km<sup>2</sup>, and divided into three distinct regions; mountainous region, midland region and plain region.

Plain region of the province, formed by alluvium deposit of the rivers such as Doung, Cau, Thuong and Luc Nam, run through the province, is a fertile land which is appropriate to cultivate paddy and vegetables. Agriculture dominates in the region, besides, animal husbandry and inland fishery are active. In the midland region which occupies 23 percent of the province, industrial crops and fruits are cultivated. In mountainous region which occupies 59 percent of the province, fruit growing and forestry are performed.

The Report of World Bank shows that GDP of 1992 in the province is 1,758.8 billion VND (current price) and account for 1.7% of the country. The agriculture and forestry sector occupies 57.8% and it performs key industry. Food production (equivalent to paddy) of the province is 665,700 tons (2.7% of the country), i.e.,

299.6 kg per capita. This figure shows low productivity compared with the national average of 349.4 kg per capita.

As the industry (8.5% of provincial GDP) of Ha Bac province, there are the Ha Bac Urea Fertilizer Plant (with the capacity of 100,000 tons per year), the Dap Cau Glass Factory (with the capacity of 1 million m<sup>2</sup> per year), the Melting Phosphorus Fertilizer Factory, Tobacco Factory, and other small- and medium-scale factories.

Two districts of Hanoi City relating to the Study Area are suburban districts-the areas supplying food for the city but rice paddy is a main crop while the remain: cereals and vegetables. The food production per year is 390 kg per capita in these districts. This figure shows higher than that of national level. Nowadays there are developing urbanization along the two highways (National road A1 and No. 3). In addition, there are developed some industrial zones and the conversion from agricultural zone to industrial zone can be seen.

### 3.4.3 Farm Household Economy

#### (1) Farm Household Economy

In the Study Area, farm household economy survey with interview in typical farmers by farm scale which are selected by agricultural section of the District People's Committee related to the area have been carried out. The results of the analysis are as follows;

Case-1: poorest farmer is unable to maintain production costs and living expenses based only on farm income (472 thousand VND), therefore, this farmer depends on off-farm income (1 million VND) from working wages earned in the other provincial labor markets during the off-season for farming.

Case-2: moderate farmer cannot produce the surplus income, though production costs and living expenses at the lowest can be maintained by farm income (4,965 thousand VND) including income from animal husbandry. Accordingly, a member of this family engages in business as a village merchant.

Case-3: progressive farmers, i.e., wealthy farmers, have high educational background. They can afford to manage the farming sufficiently and to maintain their living only in agriculture. Its surplus income obtains ranging between 4,551 thousand VND and 7,666 thousand VND (see Appendix I, Table I-2.4).

Viewing the above mentioned, it seems that the income gap of farmers produces a greatly effect on the area of farmland. Among sample farmers, the income from secondary crop in winter season accounts for ranging from 7 percent to 75 percent. This income depends on a kind of plant crop. Generally, secondary crop cultivates for the purpose of self-consumption and/or feed for animals.

## (2) Income Distribution

With regard of the poverty, the provincial authorities set forth the poverty line as annual income of 1 million VND and below. According to the annual report of Ha Bac Province People's Committee, poverty group of the rural area occupies 17.2% of the province. In the Study Area, the poverty incidence shows 18.3%. From this figures, it is clarified that the poverty incidence in the Study Area is high as compared with the rural area of the province (see Appendix I, Table I-2.5).

In order to poverty eradication in the area, the improvement of agricultural conditions such as a stabilized supply of water for agriculture in drought season, inundation prevention in rainy season, creation of job opportunities through integrated farming and so on, are needed.

### 3.4.4 Agricultural Input Material and Equipment

#### (1) Seed

Although seed has been admitted so important factor in agricultural production in Viet Nam, "Seed Law" has not been promulgated until now. Among many organizations related to the agricultural seed production business, Seed Company I, II under MAFI is the main one. It has six branch stations to cover the whole Viet Nam where, in case of paddy for instance, multiplication of seed is carried out to distribute a variety seeds to farmer through offices concerned or directly. In the Study Area, paddy seeds are available from Ha Bac Plant Enterprise or sometimes from the Central Plant Enterprise.

One of the problems on seed is its purity. Some mixture of varieties was observed in farmers' paddy fields. It is one of the reasons of yield decrease and more careful attention should be given to this problem. The enactment of seed law and farmers' careful handling of next season's seed are expected.

Most of vegetable seeds and other crops seeds are being distributed through the channel mentioned above. All the F<sub>1</sub> seeds are imported and vegetable F<sub>1</sub> seeds

are mostly from Japan. But some organizations have started the F<sub>1</sub> production in Viet Nam.

## (2) Agro-chemicals

### Pesticide

About 20 kinds of pesticides are being used in Viet Nam at present. The annual average application quantity in the country is 11,000~13,000 tons (max. 16,000 tons~min. 10,000 tons) of which

- about 55%~ 60% are for insects
- 20% are for diseases
- 20% are for weed
- 1% are for rats and others

The application of these chemicals is increasing rapidly. As shown in Appendix D, Table D-5, nine chemicals are mainly used in the Study Area. Wofa Tox, Valida Cin and other three are most popular.

These chemicals are imported from foreign countries such as Japan, USA, France, Germany and so on, through central companies and Import-Export companies provincial level. If specific chemicals are going to be imported by local company, it is necessary to get permission of Plant Protection Department. Local governments provide financial support for the imports and collect the information on the effects of the chemicals.

### Fertilizer

In 1992, total chemical fertilizer imported in Viet Nam was as much as 2,829,000 tons in total since Viet Nam is producing very limited amount. This figure is measured in ammonium sulphate equivalent, in which urea converted at 2:1.

About 30% of the import are through national (Central) Company and remaining are through Import Export Company at provincial level.

Although overall intensity of fertilizer use in the South of Viet Nam (Mekong Delta) approached to the rate common in "Rice Basket" area elsewhere in Southeast Asia (120~160 kg/ha in total nutrient) but the intensity remains somewhat low in the north and central region (around 120 kg/ha).

The present fertilizer application to each crop in the Study Area is less than the recommended level in amount, especially in phosphorus and pottasium. In

cultivation, phosphorus is becoming the limiting factor in yield in the Study Area and more application of the element will be strongly recommended in future.

### (3) Equipment

According to the authorities in Ha Bac on agricultural materials related to the Study Area.

- The Agricultural Material Company, Ha Bac, which had played the main role in supplying the tools necessary for farming, was dissolved.
- Almost all of farmers have hand sprayers and most of them supposed to be imported irregularly from China.
- No tractor has been used in the area. The paddy threshers have been used among farmers by rotation system but its number is not known.

### 3.4.5 Marketing and Distribution System

#### (1) Demand and Supply

On the assumption that the average rice consumption in the Study Area is 180 kg per capita annually, as a result of the farm survey, the demand of rice in the area is estimated at 90,000 tons. Rice production in the area is assumed approximately 220,000 tons annually by calculating based on the figures of "General Report of the Project of Water Resources Planning for Bac Duong Area" prepared by Institute of Water Resources Planning and Management. Therefore, the surplus of rice is shipped to surrounding provinces through the provincial market.

According to the Census 1989, the annual growth rate of population in Ha Bac province is 2.9 percent, i.e., its figure is higher than that of national average. Assuming that this figure will continue the same as it is, the demand of rice in the province will arise more 30% increase at the year of 2000.

#### (2) Marketing and Distribution

The introduction of market economy gives a strong impact to marketing and distribution of agricultural products as well as commodities produced in another industrial sectors. It brings about actualization of agricultural products market.



### 1) Prices of agricultural products

As a general rule, the price of paddy is controlled by the Government Pricing Committee on the basis of the international market price. A farmgate price base of paddy is equivalent to rural free market price. Present farmgate price of paddy in the area is ranging between 1,200 and 1,500 VND/kg.

Prices of vegetables are completely free market price, and they fluctuate by the balance of demand and supply.

### 2) Marketing system

Each agricultural product in the area has its own marketing system. In case of rice as major crop, its marketing channel is very simple as from rural free market to export organization including husking factory through provincial marketing system.

Industrial crops such as soybean, groundnut, tobacco, etc., are made a deal with middleman. Middleman's activity is given considerable weight in this commercial transaction.

Vegetables, meats and fishes produced in the area have dealings in rural free markets which are situated in center of commune. The facility of these markets is insufficient and the administration system is not arranged. Consequently, the merit of market economy does not make full use in rural area.

### (3) International and Domestic Marketings

Agricultural products produced in the area are shipped to local and south China markets due to Ha Bac province passes through the national road 1A linked with the Hanoi Capital and the border between China and Viet Nam, where is a short distance away from the border, distribution of the commercial commodities of China is active in its movement.

Under these circumstances, the market-oriented zone of the area will be divided into two zones; one for Hanoi, the area belonging to Hanoi City and Tu Son, Tien Son District of Ha Bac province where is situated at the south part along the national road 1A and, another one for China, the rest belonging to Ha Bac province.

Major tradable commodities of agricultural products in the area, intended to be the markets of China, is represented tomato, and also freshwater fishes, tortoises,

yellow snails, etc. In the area adjoining to Hanoi City, main tradable commodities of agriculture are vegetables for consumers in the urban area.

### **3.5 Rural Community and Organization**

#### **3.5.1 Regional Administration and Community**

The Study Area consists of 3 districts and 1 city of south western region of Ha Bac province and a part of 2 districts of eastern corner of Hanoi capital, which includes 68 communes, 1 city and 1 town (see Appendix G.1-1).

The administrative units of province/capital, district/city and commune/town have the people's committee, and the chairman of the committee is administrative head of each level. The offices of different responsibilities which are similar to that of central government are allocated under the committee to form the local administration.

It is assumed that the Study Area had already been reclaimed in three century B.C. taking the historical relics in the area into account. However, it is considered that the present form of villages have been appeared at the time of Ly-Tran dynasty after the start of flood control works of the Red River.

The commune which is a terminal administrative unit nowadays is originally a ruling unit under feudal system, and there are many residential units or villages so called xom, thon, lang, trai, etc. in accordance with their forming process under each commune. Most of such villages are collective type surrounded with moat and/or bamboo bush. There are also a few number of fort type collective villages which are surrounded with high brick wall. The collective type village has been, in general, formed for self defense of villager from enemy and/or natural disaster, and its particularity is clear division of residential area and farmland. There are 354 villages in the Study Area (see Appendix G.1-2 for breakdown of villages by district).

The population of the Study Area in 1990 was reported as 472,952, and 405,229 of which were inhabitant of Ha Bac province.

The total area of the Study Area is 400.2 sq.km, therefore the mean population density is 1,182 persons/sq.km, but it is fluctuated as 2,084 at the western area near to Hanoi and 807 at the eastern area.

The census report in 1989 said that about 86.8% of population in Viet Nam are the Viet or Knh and remained 13.2% are shared by some 40 minority ethnics,

however, 99.8% of population in the Study Area are the Kinh people despite of 23 minority ethnics are living in the 6 districts which are forming the Study Area.

The urbanization ratio in Viet Nam is not very high at present. Even in the capital Hanoi, the ratio of urban population is not more than 35.7%. In case of the Study Area, about 7.7% are living in the urban area.

The low ratio of urbanization is considered as the high dependence of base of national economy to agriculture, and the urban areas have not enough economic activities to absorb mass labor force (see Appendix G.2-1 to G.2-4 for details of population and man-power).

### 3.5.2 Villager's Organization

The villager's organizations in Viet Nam are divided into two categories of Hop Tax Xa (HTX) or cooperative and Hoi or club. The former has characters of productive and administrative, and the farmer's cooperative is a representative organization.

The origin of Hoi is a traditional organization in the rural community, but it was reformed to a new villager's organization after the 1945 Revolution. Despite of such reform, the Hoi is still maintaining its traditional character, and the base of organization is the bonds of family, the feeling of solidarity of same age group, etc.

In Viet Nam, the farmer's cooperatives have been established for land distribution and management to execute the land reform since 1953. According to the land reform, whole farmland except the state farm have been distributed to farmer under a contract between the cooperative and the farmer, and the cropping schedule was instructed by the cooperative. For such purpose, almostly each village had unit cooperative at the beginning, but they were consolidated in 1976-82 period to enlarge the scale of cooperative as commune base. Although some communes are successfully consolidated the village base cooperatives, but many communes in the Study Area have 2-3 unit cooperatives.

The main duties of the farmer's cooperative are to distribute the land fairly amongst the member farmers and to provide required agri-input in accordance with the cropping plan. The plowing and other cultivating works are undertaken by the individual farmer, however some of cooperatives are holding draft animal and agricultural tools to lend them to the member farmers.

To divide the farmland impartially, whole farmland under the management of a cooperative are usually classified into some groups according to the conditions of the land, and each group of land are distributed amongst the member farmers. Consequently, each plot of farmland is small and each farmer cultivating many plots in different places.

The cooperative's operating expenditures are depending on the membership fee paid by the farmer. In the past, many cooperatives levied some ratio of exceeded production than the target yield as membership fee, but most of cooperatives are applying fixed amount, 5,000 VND/annum, as membership fee of cooperative.

Due to the recent introduction of free market system, the reform of cooperative activities is also in progress, and many cooperatives are entrusting the cropping plan and procurement of agri-input to the farmer's own initiative other than long-term lending of farmland. Accordingly, the stagnation of cooperative activities is also pointed out. The government has issued an order to evaluate and to classify the existing cooperatives to seek the future direction of cooperative activities.

### 3.5.3 Social Infrastructures and Administration

#### (1) Road and Transportation

The road networks in the Study Area are classified as national road, provincial road, district road, etc. in accordance with the executing and O&M bodies, while the lateral roads from district road to the village are maintained with the contribution of the beneficial villagers. From the quantitative point of view, the existing road network is considered as sufficient for present traffic which is mainly bicycle and motor-bike, but the width of most of village roads are narrow and unpaved and, consequently, many village roads are un-accessible after rainfall.

Although some regular passages of mini-bus are seen along the national road and a part of provincial road, the diffusion of four wheel vehicles is started very recently. The transport of people and commodity are mainly depending on the bicycle, motor-bike, ox-cart, pony-cart, etc.

The roads inside the farmland is not more than footpath, and passage of motor vehicle is hardly possible, therefore transport of harvested crops and/or agri-input are depending on the man-power or draft-animal.

## (2) Domestic Water and Sewerage

Except some villages located along the irrigation canal who are using flowing water for domestic use, most of villagers are obtaining their domestic use water from shallow wells, and rain water and/or impounded water in the ponds nearby the village are used supplementarily. The wells are mainly hand dug and shallow, but some deep wells are also dug at the dense populated area such as Bac Ninh. Most of villagers have hand dug well in their own yard and lifting water by hand. Limited number of villages have public use well with hand pump.

Some villages are providing concrete made step in the pond for washing food, kitchen wears, cloth, etc.

No sanitary consideration is applied neither at well nor pond despite of such conditions as outbreak of water borne diseases is very easy.

Most of the villages have been developed at comparatively high land, and surrounding pond and/or paddy field have function of a retaining basin, therefore it is rare that the residential area is suffered by water logging or inundation except the case of huge flood.

No treatment system of exereta, sewerage, etc. is existing in the villages, and it is often observed that the sewerage water is impounding nearby the well for domestic use.

## (3) Health and Sanitary Facilities

The district administration has the office in charge of health and sanitary as well as a general hospital. At the same time, most of communes are equipped with a health office/clinic to promote the family planning in parallel with the medical treatment of rural inhabitant.

It is considered that many occurrences of trachoma, diarrhea and other diseases of digestive organs, despite of such well arranged facilities, is due to the problem of water quality as mentioned in the above para (2). However, the water borne epidemic such as cholera has, fortunately, not been occurred since 1940s. As recent trend, tubercle occurrence is increasing especially among the young generation, therefore the sanitary office is endeavoring to diffuse vaccination.

#### (4) Educational and Cultural Facilities

The education system is unified in whole country, viz., 5 classes of primary school, 4 classes of secondary school and 3 classes of high school. There is not any superior school in the Study Area, but some teacher training school and other vocational schools are available in Bac Giang, the capital of province.

The census in 1989 reported that 17% of population over 5 years old have not experience of schooling in whole country, but about 6% of which was shared by age group of 5-9 years old, and some of them will go to school later. Incidentally, the schooling experienced ratio of population over 10 years old was 87.1%.

In case of the Study area, the ratio of schooling experienced population is higher than that of national average, viz., the average ratio of 6 related districts of the Study Area were as high as 88.8% and 92.1% at the population over 5 years old and 10 years old, respectively. However, the schooling experienced ratio is not meaning same as literacy ratio, because many pupils quit the school after short stay thereat. Consequently, the pupil/schooling age group population ratio at primary and secondary schools is about 75% and that of high school is about 20% (see Appendix G.4 for details of schooling population).

In general, one primary/secondary school is allocated at each commune, but high school is 1-2 for a district. Beside of such schools, each district has a gifted school of some 250 selected pupils from whole district.

The government of Viet Nam is recently endeavoring the maintenance and activation of traditional culture, and, in the Study Area, encouraging the cultural activities at village level. Especially, the area around Bac Ninh is famous for fork song, and many spectators are visiting for the fork song festival from out of the area. Further, similar festival of fork song is held at Lim in Tien Son district using permanent outdoor theater.

Many shrines of ancestor worship and Buddhist temples are remained in the Study Area, but most of them have been ruined throughout the French colonial period and North-South conflict period. Meanwhile, the movement of rehabilitation and/or repair of those historical relic is very active in recent years. Although provincial or district administration subsidize a part of cost for such rehabilitation, most of the costs are supplied by the inhabitant as contribution by cash or works.

#### (5) Rural Electrification

Most of villages in the Study Area have been received electricity in 1970-1980s, therefore radio, TV, electric fan, etc. are diffused other than lighting equipment. The electricity is also used as power source of small rice mill, and contributing to production as well as convenience of life of rural inhabitant.

#### 3.5.4 Local Industries

The Study Area is an agricultural zone of paddy culture, and there is not any large scale industry. While some small scale paper manufacturer are making paper from used paper, traditional craftsmanship such as hand-made paper, wooden furniture with nacre carving, wood carving, etc. are still remaining in some villages. Manufacturing of wooden furniture is good business now due to the boom of new house building in the Study Area. It is assumed that the above mentioned traditional craftsmanship are originated from Ancient China and transferred to the area in 14-15 century with Confucian culture.

Other than the aboves, there are some food processing such as rice milling, dried noodle of rice or edible canna flour, etc., manufacturing of hoe, sickle, thresher and other farm tools, brick making with mud of riverbed of the Cau River, etc., but most of them are consumed within the area.



## **3.6 Environment**

### **3.6.1 Present Environment in the Study Area**

#### **(1) International Convention on Environmental Conservation and Relevancy to the Study Area**

As of the end of 1993, Viet Nam approved the international conventions on environmental conservation as follows:

- 1) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- 2) Convention on Wetlands of International Importance Especially Waterfowl Habitat (Ramsar Convention)
- 3) International Convention for the World Heritage
- 4) International Union of Conservation of Nature (IUCN)

The Relevancy to the Study Area is as follows:

54 kinds of Mammalia and 60 kinds of birds are registered as endangered species of CITES in Viet Nam, but they do not inhabit in the Study Area and the whole neighborhood.

The wetland of about 1,200 ha is located in the mouth of the Red River, and is registered as the specific area of Ramsar Convention. But there is no possibility that the wetland will be influenced by the development of the Study Area, based upon the result of the IEE.

There is no remains registered as the World Heritage in the Study Area, however there are 74 historical pagodas, 106 artistic architectures, and 13 famous places that are familiar with regional residents.

Endangered species of flora and fauna to Red Data Book of IUCN do not inhabit in the Study Area and the whole neighborhood.

#### **(2) National Park and Forest Reserve**

Nine (9) National Parks and 87 forest or nature reserves (including National Park) are established and administered by the Ministry of Forestry, and have a gross area of about 1.1 million ha in Viet Nam.

There is no reserve in the Study Area and the whole neighborhood, although there are 2 reserves (Mt. Yen Tu : 3,000 ha and Lake Com Son : 15,000 ha) in the Ha Bac province. However, there is no possibility that the development of the Study Area will give affection to the two (2) reserves, because they are located in the eastern and mountain area of the province.

### (3) Water Quality

According to the data of station measured recently, the water quality of the Cau River (Dap Cau station) that is one of the main water resources for the Study Area, is within the limits of Provisional Environmental Criteria issued by Ministry of Science, Technology and Environment.

However, it will be essential to continue to monitor water quality of each river around the Study Area, because water quality tends to be affected by the progress of urbanization.

Moreover, it will be advisable to continue to measure and analyze water quality of canals in the Study Area.

### (4) Soils and Land Use

Total land area is about 40,000 ha, and almost 80% (about 31,000 ha) of the area is used as agricultural land. The remaining 20% (about 9,000 ha) of the area is used as residential area.

Almost all soils in the agricultural land are alluvial soils originated from the Red River, the Thai Binh River and their tributaries. The remaining soils are mainly erosive soils located on the hills scattered in the Study Area.

Permanently Flooded Alluvial Soils is a kind of alluvial soils, and has some troublesome characters which are caused by solarization (e.g. reformation into well-drained paddy field). Therefore, the area where the soil is distributed in, is used as paddy field all the year round, and is apt to be affected by waterlogging.

Erosion has occurred in the hillsides scattered in the Study Area. The height of these hills range from 40m to 70m above the sea level. The erosion may give influences upon not only land and/or canals but also the productivity of cultivated land. There are several reasons for the occurrence of erosion. One is heavy rain, another is deforestation.

#### (5) Present Agrochemicals Use

Intensive agriculture in high cropping intensity has been already done in some areas of western part of the Study Area, that are comparatively well-drained. The application of agrochemicals is apt to increase rapidly in such an intensive agricultural area.

In this study, the soil and the water quality in the cultivated land of the Study Area were tested to analyze the remaining pesticide. The measured value of them were within the limits of the criteria established by the Plant Protection Department Center of Pesticide Control of Viet Nam.

#### (6) Inland Fishery

The water superficies used in aquiculture in the Study Area is 1,269 ha in total, on condition that the production activities of aquiculture are not systematized. Water surfaces for fishery breeding in the area consist of ponds, swamps, small lakes, and paddy fields.

#### (7) Progress of urbanization

Rapid phenomena of urbanization have come out in the Study Area and the whole neighborhood because capital Hanoi City is very near, are especially remarkable along the National Road Route 1A and around Bac Ninh Town, that have many shops and small scale industrial area. Moreover progress of urbanization is coming out along the National Road Route 18 and the Provincial Road Route 20, 38, and 280 which are branch lines of the National Road Route 1A.

Progress of urbanization and local economic activities may induce negative influences on environment such as an increase of domestic waste water and waste of every kind.

#### (8) Public Health

Each district has a health-sanitary department and a general hospital, and most of communes have sanitary office of clinic type. Dispute of such facilities, catching rate of trachoma, diarrhea, diseases of digestive organs are rather high, and it is assumed that domestic water including drinking water is main reason. Most of villages in the Study Area are depending their domestic water, including drinking water, to groundwater mainly. Recently, contamination of groundwater because of urbanization induces that the method of water supply in villages is

changing from well into rain-fed. Such change is especially remarkable in some areas of western part of the Study Area.

For further details of each item mentioned above, see Appendix H-2.

### **3.6.2 Environmental Administration and Procedure of Approval for IEE & EIA**

#### **(1) Environmental Administration**

The State Committee for Science (SCS) was raised to the status of the Ministry of Science, and Technology and Environment (MSTE) in 1992. Nowadays, the MSTE has the administrative function concerning environment in addition to the functions such as regulation of industrial property rights, standardization of metrology, quality control, and promotion of science & technology, and has a function to make some pertinent suggestions regarding technical and/or environmental matters in agricultural project (including ODA project). For the organization chart of the MSTE, see Appendix H, Figure H-3.1-1.

Practical matters concerning EIA are administered by the EIA & Environmental Technologies Division of the National Environment Agency (NEA) which belongs to the MSTE. For the organization chart of the NEA, see Appendix H, Figure H-3.1-2.

Moreover, National Parks and forest or nature reserves are administered by the Ministry of Forestry to control development in forest area.

#### **(2) Procedure of Approval for IEE & EIA**

Viet Nam has recently developed a wide range of legislation and ordinances focused on environment and related matters. The significance of this legislation is that irrespective of the grade of environmental impact, environmental assessment has to be carried out on all new projects.

The project which is implemented by the Ministry of Water Resources, ought to be administered by the MSTE (and the Dept. of Science, Technologies & Environment of the provincial government) regarding the preparation of the environmental study such as the IEE, the EIA. Therefore, construction begins after the approval by the MSTE in regard to the IEE and the EIA. For the procedure of approval for the IEE & EIA in this project, see Appendix H, Figure H-3.2-1.

Moreover, as of the end of May, 1994, the major laws and ordinances regarding the preparation of the environmental study are the following:

- 1) Law on Environmental Protection, passed by the National Assembly of the Socialist Republic of Viet Nam, December 27, 1993
- 2) Provisional Environmental Criteria, published by the MSTE, February, 1993
- 3) Guideline for IEE in Viet Nam, issued by the MoST, September 10, 1993

Basically the details of examination for the prepared IEE are provided by the Guideline for IEE.

### **3.6.3 Initial Environmental Examination (IEE)**

#### **(1) Objective of IEE**

The objective of this Initial Environmental Examination (IEE) is to upgrade the knowledge on all pertinent environmental aspects related to the planed development of South Bac Duong area for the appraisal of the MWR and the MSTE.

#### **(2) Contents of IEE**

In cooperation with the parties concerned, the IEE was carried out, along with the contents recommended by the IEE guideline of MSTE and JICA, based upon the results of evaluation on the data and information collected.

The contents of the IEE are as follows:

- 1) Introduction
- 2) Principal Issues
- 3) Legal and Regulatory Framework
- 4) Approach and Methodology
- 5) Project Description
- 6) Existing Environmental Condition
- 7) Environmental Issues
- 8) Mitigation Measures
- 9) Environmental Management and Monitoring Plan
- 10) References and Appendix

### (3) Conclusion of IEE

The conclusions of the IEE are as follows:

- 1) The improvement project will have some components that will impact on the environmental condition. However it is recognized that the most severe impact was already caused by the initial construction of this project, in comparison to it, the impact of the proposed works will be relatively minor. The information on this impact system is needed, not so much as to quantify the previous impact, but to understand whether there is any need or justification for mitigative measures that can be easily implemented and may rectify the previous impact.
- 2) It is recognized that taking environmental influences caused by the change of water management into consideration, the optimal plan and design of new system ought to be prepared, moreover particularly it is important that the change of existing ordinary drainage water level, drainage network and irrigation network ought to be minimized and phased out in this project.
- 3) It is recognized that negative influences of the progress of agricultural development and/or urbanization, such as the surplus use of agrochemicals, the increase of domestic waste water and waste of every kind, may come out in and around the Study Area.
- 4) In addition to these, it is recognized that there will be impacts caused by construction, particularly such as the occurrence of construction waste, the occurrence of erosion in the bare land after excavation, the impact on worker's health, and so on.
- 5) It is also recognized that this project may give not only the negative impacts mentioned above, but also the positive impacts, particularly such as the improvement of standard living condition, the improvement of convenience of transportation, the creation of new jobs, and so on, resulting from the progress of local economic activities which will be promoted by the implementation of the project.

For further details of the IEE, see Appendix H-4.



## CHAPTER 4 DEVELOPMENT PLAN

### 4.1 Development Concept

#### 4.1.1 Objectives of the Development

The Study Area is predominantly a backward area based on low agricultural productivity due to persistent inundation and insufficient irrigation water. Most of local people are economically deprived and are suffering from poverty and disease. In order to relieve the hardship of the people in the area, the Viet Nam Government has devoted efforts to implementation of the project which was accorded with the high priority area in terms of improvement of drainage systems.

Considering the above situations, the objectives of the development under this Master Plan will be summarized as follows:

- (1) To improve living standards of local people.
- (2) To conserve and improve natural/social environment of the agricultural Area affected by inundation.
- (3) To contribute to the national economy and the public welfare.

#### 4.1.2 Development Potentials and Constraints

##### (1) Water Resources

The Red River Delta is endowed with abundant water. The annual mean water discharge is expected to be not less than 4,340 m<sup>3</sup>/sec, of which about 2,740 m<sup>3</sup>/sec depend on the Red River. Enormous water is available for the use without long and wide conveyance canal, because of the intensive water way interconnected. The water resource of the Red River have been developed through construction of a number of dams for the purposes of irrigation, hydropower, flood control, etc. Among others, Hoa Binh dam is significant and recently constructed with a capacity of about 9,500 million m<sup>3</sup>. In the Delta, about 3,400 irrigation pumping stations were constructed.

The water quality is generally good and involves no toxic materials. Salinity intrusion is not so critical. On the other hand, sediment concentration is high. The concentration of suspended materials was 847 mg/lit on an average and 6,530 mg/lit in the maximum, as reported. Amount of suspended sediment in the Red



River at Son Tay station is about 125 million tons per annum (average in 1958-87).

The irrigation water is currently supplied from the Duong, Cau and Ngu Huyen Khe rivers and the excess water in the area. The potential water quantity for irrigation in the Area is sufficient since the water requirement for the present area was estimated to be approximately 30 m<sup>3</sup>/sec, and the lowest water discharge at Thong Cat station on the Duong River and Thac Bui station on the Cau River are recorded at 165 m<sup>3</sup>/sec and 11.3 m<sup>3</sup>/sec, respectively. However, the irrigation water will be required more in the future by increase of cropped area and cropping intensity, specially in introduction of winter crops, as this trend is expected through out the Delta. The available water quantity is required to be reviewed further from a standpoint of the water resources development plan for the entire Red River Delta.

For the water source for the area, according to the operation, management and development rule for Bac Duong Irrigation System, the water through Trinh Xa pumping station takes mainly from the Ngu Huyen Khe River and can be supplemented in the time of water insufficient in the Ngu Huyen Khe River from the Duong River through long Tuu intake within a range of water level, 2.0m to 3.0m at the downstream under the conditions of the water level lower the warning water level at Thuong Cat station. In the case of Kim Doi pumping station, the excess water in the area is main water source for irrigation. In which the water is insufficient in the creek, the water can take from the Cau River within the water level of 1.5m to 2.0m in the suction pump. Other pumping stations, except the Thai Hoa irrigation cum drainage pumping station which is allowed to take water from the Duong River only for the summer cropping, can only use the excess water in the area.

The present water use to maximize use of the excess water in the Area will be effective for the water management and purification of contaminant water due to domestic wasted-water, if the regulating ponds are properly distributed, but the water quality may become to worse in the dry season and the operation & maintenance may be complicated and difficult.

The aquifer is available in the pleistocene layer with a thickness of 10m to 20m. The specific capacity is expected to be 1 lit/sec/m. The water quality is good. The domestic water of about 2,000 m<sup>3</sup>/day is currently produced by five (5) wells in Bac Ninh town. This groundwater is available for the village water supply.

For the maintenance of river dikes, the warning water levels for the major rivers are set up (see Appendix B, Table B-2.4). It is reported that operation of all pumps will be stopped to discharge to the river, while the water level is higher than the warning water level (3). In the case of the Ngu Huyen Khe River, the agricultural land suffers considerable damages due to this warning water level, as stated previously. As the influence by increasing the drainage discharge to the rivers can not be verified, the rushed implementation of perfect drainage improvement might as well take moderately up to the completion of impact assessment.

## (2) Land Resources

In considering the future agricultural status of the Study Area, urbanization and land reclamation potential are issues in land resources sector.

It may be possible to define that the term of urbanization has two faces from an agricultural view point. One is positive urbanization for the rural area and the other is negative one. In the near future, there will be the possibility of setting up small and medium firms for processing subsidiary crop in countryside. There are assumed to be the foundation, the first step for appearing of small cities or towns of the local area or economical, cultural service centers. This kind of urbanization is to be welcome to the area if the firms are founded following the regulations. It will absorb the surplus labor force in the area and stimulate the crop production activities. This is possible urbanization. Currently, both development permission and infrastructure investment are supported to be guided by master plans drawn up very five years. The master plans indicate vacant or agricultural use areas that are subject to conversion to the urban use and also the type of use. But, historically, urban planning restriction have been poorly enforced. Buildings are routinely built and plots redeveloped without permit of any sort. Most of them have negative face of urbanization to agriculture.

The population growth rate of whole Viet Nam in 1990s is expected as 2.0% and that of upland and mountainous region, to which the Study Area are belongings, is 2.3%. Then in 2000 the population in the region is 13 million, nearly 3 million inhabitants increase in 10 years. Thus, the population pressure to national economy in very high especially to agricultural sector for food security.

To cope with this situation, qualitative countermeasure by increasing yield and quantitative one by land reclamation must be carried out by any means. In latter case, the main policy is to utilize the present agricultural land to its maximum

extent by intensified cultivation. The cropping intensity of whole country in 1989 was 1.41 and 1.73 is expected in 2000 according to the national strategy.

In the Study Area, cropping intensity is around 1.8 in 1993 but it should be 2.0 or more in 2000 to meet the serious anticipated demand. About 50% of annual crops cultivation area are under double rice cropping in 1993 and it is possible to extend the area in future. Double and triple cropping have also much room to be encouraged. In addition, some area will become available by improving drainage and irrigation systems. Its extent and potential are the matters of discussion and planning.

### (3) Development Constraints

The constraints to agricultural/rural development of the Study Area include the following components:

Agriculture in the Study Area is characterized by paddy rice production and it's low yield due to distribution of acid soil, long-term persistent water logging and inadequate fertilizer. From a view point of farming and agroecology, constraints exist in small farm plots, lack of processing, marketing of agricultural products, stagnation of extension activities and insufficient introduction of farming technology.

Concerning constraints on irrigation and drainage systems, hydraulic facilities have insufficient capacities and some of them are inoperative because of deterioration. Those are leading to water-logging in the agricultural land throughout a long term period and deficiency of irrigation water. Operation and maintenance of such facilities is not well executed due to lack of funds.

The major constraints from an environmental aspect are summarized as follows:

Environmental impact upon every aspect associated with water level change, may come out in the Study Area. The water level changes (water levels of inundation, water logging, ponds and small lakes, etc.) are caused by the water management based upon the new planned drainage and irrigation systems. Constraints because of the water level changes are as follows:

- The low productivity due to the trouble some characters of permanently flooded alluvial soils caused by water level down.
- The change of sedimentation due to new irrigation and drainage systems.

- Adjustment and regulation of water and/or fishing rights due to water level change and/or new irrigation and drainage systems.
- The change of water quality due to water level down.
- The influences upon the pagodas, architectures, and famous places in the project area due to the development, especially water level change.

Negative influence of the progress of agricultural development and/or urbanization, may come out in the Study Area. The constraints because of the negative influences are as follows:

- The increase of agrochemicals use associated with the progress of intensive agriculture in the area.
- Deterioration of soil fertility by crop planting, failure in soil management, etc. associated with the progress of intensive agriculture in the area.
- Deterioration of water quality and ecosystem due to the increase of domestic waste water and waste of every kind caused by local economic activities.

The other constraint except the above components is erosion. Erosion is coming out in the hillsides scattered in the area, and may give influences upon not only arable lands and/or canals but also productivity of paddy-field rice.

#### 4.1.3 Development Strategy

##### (1) Short Term 2000

South Bac Duong Area is distinctive in agriculture production with persistent inundation and dense population which live in mostly in rural areas, so unless inundation problems are solved and agricultural production develop, increasing demand of food for consumption could not be assured. Following rural economy development, income of local people will be increased as well as purchasing capability and there will be an enhancement of domestic market for industrial commodity.

In order to build up agriculture based on high yield, quality and efficiency ensuring stability of living standard for local people, the following issues are required in the short term 2000.

To prepare the master plan on irrigation and drainage systems in the Study Area and select the highest priority area.

To commence rehabilitation projects for irrigation and drainage works following development priorities.

To upgrade farm roads and bridges connecting to main roads and irrigation and drainage facilities for easy transport of agricultural products to markets, and for efficient execution of operation and maintenance of such hydraulic facilities.

To strengthen agricultural supporting systems and research works including crops, livestock and inland fishery.

## (2) Medium Term 2010

In the medium term plan, the importance of the Study Area as a one of the major food producing region will become remarkable in accordance with rapid increase of the Capital Hanoi. This will depend on the success of structural readjustment to the agricultural sector following the allocation of land. Allocation of land to stability of rural economy will be implemented so that farmers can concentrate on investment in production development based on the intensive cultivation, animal husbandry, inland fishery and rural industry. This investment will generate substantial cash surplus for consumption or reinvestment, although agricultural credit systems need to develop for assisting capital to farmer households.

In order to encourage investment to the agricultural sector, rural infrastructure as water supply, transport facility, electricity and agro-processing facility will help and meet the demand of agro-production. In terms of social public issues such as education, public health and communication should be developed in order to improve living conditions for local people.

### 4.1.4 Related Development Plan

For the potential water resource and water level, as mentioned previously, it is expected to be guided by the Master Plan Study for the Red River Delta Development by the World Bank. As the ADB Project are expected to be selected after the completion of the World Bank Study and JICA Study, as stated previously, it is understood that the particular subject to this master plan study will not be affected to other project/studies.

## 4.2 Agriculture Development Plan

### 4.2.1 Basic Concept of Future Farming

Some environmental conditions to be anticipated for the Study Area in future may be as follows;

- 1) Urbanization
- 2) Widening incomes between agricultural sector and others
- 3) Improvement of infrastructure, such as communication by transportation, telecommunication and motorization etc.
- 4) Increase of part time farmer
  - Labors force surplus in the near future
  - Labors force shortage in the far future
- 5) Demand for high quality farm products
  - Protein, mineral and vitamin rich products
  - Clean, handy and durable products
- 6) Degradation of environment
- 7) Formation of new production system such as land consolidation and setting up cooperative under new concept will be needed.

To cope with the conditions anticipated in future as mentioned above, agriculture sector should have countermeasures. Some of them will be,

- 1) It is necessary to have clear demarcation of urban and rural area by law. The enactment of such regulation is urgently needed especially in the area.
- 2) More high profitable, marketable farm products with low cost and less labor force are needed. Especially land consolidation will be necessary by any mean for getting land scale merit in agriculture.
- 3) The access to urban area becomes easy and a marketability problem of farm products will become more serious. Installment of storage facility, better distribution system etc. is required.
- 4) Surplus of labor force in the near future is to be solved by some countermeasures such as encouragement of agro-processing factory, local handicraft industry, construction material making and starting new agricultural projects. Establishment of entertainment facilities with agriculture business in the core and corporating with tourism is also to be considered. For labor force shortage, adaptable crops introduction such as fruit tree

- cultivation, mechanization of farm operation, direct seeding of paddy, collective farming method and contract farming system will be necessary.
- 5) To meet the demand for high quality farm products, advancement of animal husbandry including cow rearing, legume crop production, and inland fishery etc. are mentioned. Moreover, crop production, with less agrochemical, better quality varieties and seed with advanced technology and better storage facility for marketing should be emphasized.
  - 6) Degradation of environment is also a very serious problem in the rural area and to cope with the situation less application of agrochemicals and full utilization of FYM are essential. Prevention of soil erosion in mountainous area is to be kept in mind as well.
  - 7) It is very difficult for farmers to adapt new circumstances of free market system for which new production and distribution organization is necessary. For the new organizations to fit the new system, special managerial know-how, which is different from the old one, is essential and education of young generation to meet the request has the top priority.

#### 4.2.2 Proposed Land Use

- (1) The classification of present land use of the Study Area  
(See Appendix C-5, C-6.)

The goal of food self-sufficiency is the central pillar of agriculture policy for years, maintaining the minimal consumption level (300 kg paddy/capita) on the limited endowment of arable land and in the face of a population growth rate of 2.5% has proved to be a major challenge.

Statistical Data of 1993 is reflected below:

District	Arable land (m <sup>2</sup> /capita)	Food grain (kg/capita)	Poor household (%)
Gia lam	642	390	3.2
Dong anh	500	392	4.5
Tien son	400	340	8.9
Que vo	720	426	20.0
Yen phong	600	375	16.0

A theoretical food availability of 300 kg of paddy per year can be roughly estimated 1,600 calories per capita/day. This diet is very poor in protein and fat.

(2) Basic concept toward 2010 and beyond:

The rural economy should form to cope with market economy, transferring from the traditional pattern of subsistence based agriculture (self-sufficiency) to the new pattern of agriculture-industry - commercial business, which makes up of GDP by 2010's structure 10% - 30-32% - 58-60% respectively. In 1993, agriculture accounts for 35.5% of GDP (Source : Red River Delta Master Plan by WB).

Since the implementation of market economy the rich-poor polarization has exposed, in some places, the gap between the rich and the poor is getting bigger. The Government has carried out the policy on hunger eradication and poverty alleviation, making encouragement to everyone. It considers this policy is one of the most important ones at the national level.

(3) Urbanization

As cities and towns expand, they often engulf existing villages that continue to farm in increasingly constricted surroundings. Urban agriculture refers not only to food crops and fruit trees grown in cities, towns but encompasses pig, poultry, fish, bees, snakes, tortoise and other indigenous animals. It is also closely linked with urbanization of rural area.

The greatest resource of the Study Area is abundant literate labor force in rural area. Process of industrialization and urbanization will be developed by bringing 3-5% of the labor force from rural area by the end of this century.

In the course of industrializing the agriculture, the processing and food industries must be developed so as to raise the value of agro-products to meet the demand of domestic consumption and export.

Along the road No 1 from Hanoi to Bac Ninh and the road No 18 from Bac Ninh to Pha Lai has estimated export processing zones (EPZ).

The acreage for agriculture will be decreased (for EPZ and for specialized uses such as roads, markets v.v...). This acreage can be reduced either in case of low or unstable yield areas for protecting environment and a part of agricultural land will be used for non-farm purpose during process of Industrialization and urbanization (see Appendix C-9, C-10, C-11, Land Suitability map).



#### (4) The Potentiality of Agricultural Development

- Among annual cropping lands 15,000 ha can practice for 2 rice crops + 1 upland crop (Winter crop). After drainage out this acreage will be increased. It is necessary to develop high quality vegetables to provide & supply the EPZ and Hanoi market.
- The need for land use planning in the flooded areas is to first select the areas with the best chance for success. Shallow drainage canals (35 cm depth) with alternative distance of 30-35m in rice fields can be established.
- Perennial crop production is less well developed than annual crop production, it involves mostly fruit trees or paddy rice + fishery + fruit trees.
- Reforestation of the barren lands, preventing soil degradation caused by man's negligence, should be recommended.

#### 4.2.3 Proposed Cropping Pattern

The following is the present and suggested land use by INSA to the area based on land water condition. With the progress of water control in the area, the paddy fields will become mainly to be two paddy cultivation and the rest will be used for one paddy and some other industry such as fishery and fruit production. But in far future, specification of agricultural land will be strengthened and upland crops such as subsidiary crops and short industrial crops will increase at the cost of paddy field (see Appendix C-6, Appendix D, Figure D-2, Table D-9).

Land Condition	Present Land Use	Suggested Land Use
Flooded	1 winter-spring paddy 1 summer paddy 2 paddy 1 summer paddy + 1 subsidiary crop	1) Paddy + fishery + duck rearing 2) Paddy + fishery + fruit tree 3) fishery + fruit tree
Lowland	1 summer paddy 2 paddy 2 paddy + 1 subsidiary crop	1) 2 paddy + subsidiary crop 2) Paddy + fishery + fruit tree
Midland	2 paddy 2 paddy + 1 subsidiary crop 2 paddy + 2 subsidiary crop 1 summer paddy + 2 subsidiary crop	1) 2 paddy + 1 subsidiary crop 2) 2 paddy + 2 subsidiary crop
High midland	Specialized in subsi. c. Garden	Fruit tree mixed with other crops such as vegetables underneath

Source : INSA

### Cropping Pattern

Based on the present condition, anticipated environment mentioned above and the expected effects of the improvement of water control and irrigation, two alternative cropping patterns are proposed and their breakdown is shown in Appendix D, Table D-10, 11 and Figure D-5.

Regarding crops, paddy, maize, sweet potato, potatoes, groundnut, soybean and vegetable are taken up as mentioned in 4.2.5, Production Plan.

The basic idea of the alternatives A, B is as follows;

- A: - Paddy area is in the level of 1993, not changing drastically, since the Study Area is located in the rice bowl in Viet Nam.
- In compliance with the necessity of crop diversification and for increasing farm income, vegetable, subsidiary crops and short industrial crops will be cultivated utilizing 25% of the two paddy area in next season.
- B: - The paddy area in each season is restricted to 15,000 ha, which is about 80% of alternative A. Then, from the area of two successive paddy cultivation, some will be converted to upland.
- Half of the one winter-spring paddy area (5,126 ha), which is depressed and water logging area in rainy season, will become stable paddy area by the new drainage system. The other half deep area will be used for inland fishery purposes.
  - 35% the whole autumn paddy area is subjected to subsidiary crop cultivation in coming seasons as the effect of water control.

It is calculated that the cropping intensity in the plan are 2.02 (Alternative A) and 2.21 (Alternative B) compared with the without project condition 1.93.

#### **4.2.4 Farm Management Plan**

The tendency of farm management based on the land use in 1993 will be briefly explained.

As shown in Appendix C Table C-6, and D, Figure D-2, the Study Area can be dividend into three types. The criteria is i) The percentage of two paddy area in the whole annual cropping area and ii) that of upland crop area.

Gia Lam Area has highest percentage of upland crop area and the one of two paddy cropping area is rather high but not as high as Tien Son and Dong Anh (Type I).

Tien Son and Dong Anh Area have highest percentage of two paddy cropping area but rather low percentage of upland crop area (Type II).

Que Vo, Bac Ninh and Yen Phong Area have rather small two paddy cropping area since they still have big one paddy cropping area. They have rather small upland crop area comparatively (Type III).

By the advancement of environment control such as drainage, irrigation of water and infrastructure, the above land use type looks to converge from Type III to I.

It means from actual rural condition to typical urban condition. It looks unavoidable trend since the Study Area is located nearby the Capital Hanoi and will be surrounded by Export Processing Zones (EPZ). Moreover new high way will be constructed from Hanoi to Bac Ninh and Bac Ninh to Pha Lai, then the area for agricultural production will decrease.

For getting the profit from the limited area for agriculture, intensification of cropping, such as more subsidiary crops cultivations in paddy field and cash crops cultivation throughout the year in much more area of upland condition is necessary.

In short, as a whole, all the farm management in the Study Area is on the way to the combination of two farm management type, one of which is 2 paddy + 1 subsidiary winter crop and the other is upland crop cultivation in the whole year round at the cost of some paddy field for getting better income.

#### 4.2.5 Production Plan

For making future production plan in the area, the followings were considered and utilized to propose cropping patterns.

##### 1) Paddy:

Rice is the staple food of Viet Nam and also one of the main goods in foreign trade at present. Then a certain amount of rice production should be guaranteed in any case, so paddy area must be kept in a certain level for any situation. All of the

national level plans such as Five Year Plan, Red River Delta Development Plan and 2000 Year Plan have stressed the importance of paddy on this basis.

2) Maize :

Maize will be emphasized in the plan from the view point of livestock feeding material. Livestock industry is also emphasized all of the national plans.

3) Sweet potato :

Sweet potato is very familiar to the local people in the area but it is becoming less popular recently mostly because of a low profit in the market. But it needs rather low investment. It is good feeding material of livestock. So it is also encouraged to extend the cultivation area.

4) Potatoes :

With changing eating habits of people, the importance of potatoes production will also be increased.

5) Groundnut :

Some of the groundnut products will be still for home consumption and for foreign trade but it will be emphasized as it is the main source of plant oil, which has been taken up many national plans especially in 2000 Year Plan. The residual cake after oil extraction is a supreme feeding material of livestock with much nutrient.

From a view point of soil fertility, it has been contributing for a long time since it belongs to legume. It is advisable to cultivate legume crops as much as possible for sustainable agriculture.

6) Soybean :

Soybean is emphasized in the proposed plan by the same reason of groundnut. But it should be recommended especially as the good protein supplier for Viet Nam people. It is indispensable to the daily diet and good supplier of plant oil. The bean cake is as good as groundnut cake for livestock feeding. It also supply nitrogen to soil, contributing to sustainable agriculture.

#### 7) Vegetable:

The area will be the main vegetable supplying area to Hanoi and the surrounding Industry Area. The Study Area also has a big advantage to supply raw materials to food processing factory zone, which will be set up in the Study Area.

More kind of vegetable with better quality, off season production by new technology, unification of products for market, preservation facility for market etc. will be necessary in future.

#### 4.2.6 Animal Husbandry Development Program

Buffalo, cattle, pig, duck, goose and hen are mentioned in the livestock survey (see Appendix D, Table D-7).

They are all closely related to agricultural production but most tightly related one will be big livestock, such as buffalo, cattle and pig. The Project Area, mostly Tien Son District, has more than 40% of the total number of pigs and pig will be selected to study the development plan in the Feasibility Study. In this chapter, buffalo and cattle will be taken up for study for the Study Area.

As has been mentioned, buffalo and cattle are very important in the area not only as the meat and FYM producer but also as a draft animal and a tool of transportation.

Their feeding materials are paddy straw, grasses, maize grain and stalk and rice bran etc. Especially paddy straw is very important and its production is one of the controlling factors of the number of the animal.

Based on the data of paddy cultivation area, paddy yield in the districts in the Study Area in Ha Bac province are mentioned below with some figures to calculate feeding capacity of the number of the ruminant in each district.

	Tien Son	Que Vo	Bac Ninh	Yen Phong
Paddy area (ha) (Total in two seasons)	17,667	12,651	1,957	1,381
Yield (t/ha)	3.75	3.1	3.25	3.1
Total ruminant (head)	11,288	15,781	1,808	1,316
Grain/straw ratio	1.0			
TDN of straw (fresh)	0.18			
Nutrient necessary for adult ruminant of 500 kg	3.3 kg/day			

Note: TDN .. total digestible nutrients

Taking the case of Tien Son district as an example:

Straw production	$3.75 \text{ t} \times 17,667 \text{ ha} = 66,251 \text{ t}$
All TDN	$66,251 \text{ t} \times 0.18 = 11,925 \text{ t}$
Necessary TDN for head/year	$3.3 \text{ kg} \times 365 = 1,205 \text{ kg/head/year}$
Feeding capacity	$8,613 \text{ t} \div 1.205 = 7,148 \text{ head}$
Number of ruminant	11,288 head
Present condition	$11,288 \div 7,148 = 1.6$

The same calculation was carried out for other districts and the results show that all of the district are now feeding ruminant livestock more than the capacity calculated from paddy straw.

For the development of animal husbandry, how to secure feeding materials and how to cultivate fodder crops is the focal problems in future.

#### 4.2.7 Inland Fishery Development Program

The present condition of inland fishery is shown in previous chapter and its activities is increasing gradually in the Study Area.

For instance, Yen Phong District information in 1993 tells that "... 60 branches of the household economic association were founded on the whole district. Many households are raising special races with high economic value such as frogs, fresh water tortoise, river fish, field and pool fishers...".

Within the Study Area, 5,126 ha has been used for only one winter - spring rice cropping since the area is low lying fields. It is estimated that after completing the drainage project, half of the area will become paddy fields but the other half (about 2,600 ha) will still be under the flooded water during 5 to 6 month in a year. The major communes related is Duc Long (Que Vo district) etc.

For utilizing the remaining deep paddy area, it is suggested to convert the area for inland fishery purposes utilizing the abundant water. But there are so many barriers to materialize the idea, especially fund. For the time being, the following practices will be suggested, it has been tried already with so many modification in some places in the area.

### Rice + Fish + Fruit Tree System

As mentioned above, depressed area where flood is frequently occur, will be divided by dike clearly into two, one for fish breeding pond the other for paddy field. If the paddy fields are supposed to be remain inside the dike, some modification will be carried out as shown Appendix D, Fig. D-6. The size of the land holding surrounded by dike is flexible and depends on circumstances. On the dike it is suggested to plant fruit trees such as lychee, longan and mandarin. This system has been suggested by INSA as one of the farming patterns in low land. It is expected to get much more income than rice by this fishery business but the fund for construction is the biggest problem.

It is possible to utilize paddy fields for fish breeding place by not making so clear dike with some deep ditch or area inside. This type of fish breeding is not so popular but has been tried by farmers for long time.

### VAC System

The fish culture is now practiced mainly in small homestead ponds in closely linked combination with garden and livestock sheds (VAC system) in the form of semi-intensive culture technics and in fact these have been gained noticeable results. If advanced technics would be transferred to farmers (a harmonious combination of species) by applying intensive farming, then, the average yield could be attained 3 tons/ha/year.

In field survey, it is also identified that 60 farm households in Ha Bac province are carrying out the culture of specific aquatic products, such as frog, trionychid turtle, tilapia. These products are being exported to China with fairly high price.

### **4.2.8 Agro Processing Program**

As mentioned before, there are 267 sets of agro-processing factories in the four main districts in the Study Area excluding rice mill. But rice processing is the most important in this sector since it has direct connection with production. It is said that, about 16% of the total production is going to be lost in the process from harvest to the end. The detailed survey on this losses has been carried out and the countermeasures to prevent the loss will be put in practice in the near future through extension activities.

Drying paddy is a very serious problem especially when harvesting time coincides with rainy season. Basic solution will be installment of country elevators and store the dried paddy in the facilities. But lots of fund, which is a dream at present, is necessary to materialize it.

Following is the tentative classification provided for the Study Area.

Operation Material	Facility, Product
1) Paddy processing	
Paddy drying	country elevator
storage	- do -
milling	alcohol, feeding material, etc.
Rice	
2) Agro-products processing	
- Animal products, etc.	
Pork & cattle meat	ham, sausage, etc.
Fish meat	smoked, sauce, etc.
Silk	textile
Milk	butter, cheese, etc.
- Field crops and vegetables products	
Sweet potato	starch (noodle), alcohol, cakes
Soybean	food materials, oil, tonic drink, cakes
Groundnut	oil, cakes
Maize	oil, starch, cake
Cassava	starch, alcohol, cake
Tomato	juice, puree, etc.
Beans, baby corn, etc.	Food materials, cakes, canning
- Fruits etc.	
Lychee, longan, mango, etc.	Bottling, canning
Ornamental plant	Bonsai, etc.

The most possible agro-products processing materials will be field crop and vegetables at present. For instance, sweet potato is very popular in the area since it is adaptable to the environment and easy to cultivate but if it could be utilized for another purposes such as starch, it can help the processing industry and absorb local surplus labor force.



### 4.3 Improvement of Agricultural Infrastructures

#### 4.3.1 Water Resources Planning

The Ngu Huyen Khe River is utilized for the water sources of Trinh Xa pumping station and others built on the river to irrigate the land in and out-side the Study Area. Even though the observed water discharge records are not available, the river water may not enough to serve the subject area because a drainage area at Trinh Xa station is small as 100 sq.km. Specially in the dry season the discharge is not so stable, because the water is used for the irrigation in its upstream basin. Furthermore, the water at Trinh Xa station may become small in the available quantity when the water utilization development is progressed in the upstream basin. Although the irrigation water can be supplemented for the Duong River through Long Tuu intake, it is preferable in the future to obtain the water mainly from the Duong River which is comparatively rich and stable in the water quantity. In this occasion, the irrigation planning will be worked out, assuming the water sources are available in the quantity. Nevertheless, the water resources planning shall be reexamined, taking into account the water resources development in the entire Red River Delta, the water utilization planning in the upstream basin, and the irrigation water utilization planning in the downstream area of the Ngu Huyen Khe River.

The Duong River is rich in the discharge (75 cu.m/sec in 1/5 year drought) and available for a main water source of Cong Thon pumping station, for pumping discharge (2.52 cu.m/sec) is small. Moreover, Thai Hoa and Kieu Luong pumping stations obtain the water from the downstream reaches of the Duong River and have no question for pumping up the water because it is allowed to obtain the water only in the high water discharge of the river in the summer season. The water quality is good involving no toxic materials to crops, while a sediment concentration is high and bring about siltation problem in the irrigation canals.

The Cau River is available for the water source of Kim Doi pumping station when the excess water in its drainage area is scarcely available. The river water discharge at the station is indefinite but may be available for a temporary water supply source in its quantity, reportedly. In the downstream area of Trinh Xa pumping irrigation system within Que Vo district, the pumping irrigation scheme to be supplied from the Cau River has been proposed but shall carefully be studied on the water utilization plan in the entire river basin rather than the establishment of urgent implementation program.

The present water management has taken the strategy to use the excess water in the Study Area as much as possible. In other words, the excess water in the Study Area is one of the water sources for the irrigation. The water supply from Trinh Xa pumping station may be saved for the summer crops, expecting effective rainfall (about 68% of rainfall for the rainy season) and excess water to a certain extent. On the other hand, the water supply for the winter/spring crops depends on the operation of Trinh Xa pumps because rainfall and effective rainfall (about 24% of rainfall for the dry season) are small, the runoff from the mountain and hilly land is not so expected and the standing water in the creeks and canal retained in the rainy season is limited in the quantity. In the above view, the utilization of excess water within the area is involved in much uncertain factors, as to the irrigation water source.

#### 4.3.2 Irrigation System Improvement

Agriculture will be developed in the increase of cropped area and introduction of diversified crops expected marketability to Hanoi through improvement of irrigation and drainage systems. The present irrigation shall be improved in order to timely supply the adequate quantity of water to the field, envisaging the future farming plan which aims at stable farming and incremental production. In line with these objectives, the restructuring of irrigation networks based on the said water resources plan, and rehabilitation/improvement of the timeworn pumps, deteriorated canals and structures, etc. are proposed.

The plan will be provided for a land area of 23,490 ha for paddy, 1,280 ha for nurseries and 1,600 ha for upland crops. However, the water supply plan has been worked out only for paddy in the short term plan, while the upland irrigation may be required in the long term plan. It is expected that the estimated water requirement may be enough to irrigate both paddy field and upland in the future. The water requirement for design of irrigation facilities is uncertain at present. Thereby, the design water requirement has been estimated to be 1.2 lit/sec/ha in the design year of 1992 (equivalent to 20% drought), taking into account water requirement for crop, percolation at the field, effective rainfall and irrigation efficiency.

The proposed irrigation systems will be discussed for Bac Duong, Dong Anh area and Gia Lam area irrigation systems, respectively. Bac Duong irrigation involves the commanded area of South Trinh Xa main canal, Xuan Vien pumping irrigation and Kim Doi pumping irrigation. In principal, the pumping irrigation system will be employed but 2-stage pumping station system will be diminished

as much as possible. It is expected to reduce the operation and maintenance costs and relieve the farmers from heavy works for dipping up water to the field by serving the water directly from the farm ditches to the field.

The improvement schemes of Trinh Xa pumping irrigation system shall be studied for the entire area of Bac Duong Irrigation system through South and North main canals. Among others, South Trinh Xa South main canal system with the proposed land area of some 17,940 ha is herein discussed in relation to the Study Area. In principal the irrigation water will be conveyed from Trinh Xa pumping station through South main canal, secondary and tertiary canals. The design water levels in existing South main canal are enough to serve most irrigable area directly through the canals so that 2-stage pumping station will gradually be suspended for irrigation and operated only for drainage purpose. Where the water head is not enough and the improvement costs are expensive to irrigate the land through the canal, these lands, particularly in the downstream area, will be irrigated only by 2-stage pumps. Thereof, Tri Phuong, Thai Hoa and other 2-stage pumping irrigation area have been included into the proposed Trinh Xa South main canal system in the total service area, considering that the water may be supplemented through South main canal in drought.

The design diversion discharge at Trinh Xa pumping station is estimated at 21.5 cu.m/sec, which is equivalent to the discharge of 6 units of vertical axis axial flow pump with a bore of 1,350 mm. The existing pumps had better replace with new ones, because it has been used for over 30 years, might be declined in its discharge capacity, and be high in the repair costs. Long Tuu diversion canal will be improved, since present flow capacity is insufficient as about 11 cu.m/sec, as well as the intake structure. It is suggested that the improvement plan of these main diversion facilities are reexamined by preparing the improvement plan of entire irrigation system included North main canal system.

South main canal will have enough capacity necessary to convey the design diversion water requirement through reshaping of cross-section and brick canal pavement. All check and turnout gates will be replaced with new ones since most of them are missing, not operational, difficult in operation and large in leakage water. Those structures will also be restored/improved, according to the renewal of gates. In addition, the bridges and road crossing structures will be improved to have adequate flow capacity. The roads for operation and maintenance of canals and structures will be provided/improved by using the top of canal dikes. The roads will be paved by gravel and have an effective width of 5m and 3m in the

right and left dikes, respectively. Those roads are expected to be effectively used as farm-to-market roads by farmers. The cross-section of major secondary canals will principally be trapezoid but allowed to be rectangular in the section with difficulty in land acquisition. The secondary canals will be paved by bricks up to the section commanded a service area of some 150 ha, and provide the operation and maintenance roads on the top of dikes in the one side. The roads with an effective width of 2-3m will be paved by gravel and expected to be used for not only operation and maintenance but also main farm roads by farmers. The remaining and small canals will be unlined.

Xuan Vien pumping irrigation system area is low in an irrigated area rate of about 13% to the planned service area. This low rate may result from that there area no adequate irrigation canals in the elevated land of the eastern area and the existing pumping stations built for dual purposes of irrigation and drainage in the lower land of the north-eastern area may be able to serve the very limited land area. Thereby, it is proposed that the irrigation system will be completely modified by constructing new pumping station to be supplied from the Ngu Huyen Khe River in the elevated land area.

Kim Doi area irrigation system is a general term, included Kim Doi, Que Tan and Dong Sai pumping irrigation system. These area shall be irrigated separately through each pumping station rather than direct irrigation from South main canal, from an economic point of view. The water sources are an excess water in the respective drainage area and/or the upstream area and may be enough to serve these area because these are located in the end of downstream area and small in a service area. However, further study will be required prior to the project implementation. On the other hand, Kim Doi pumping station is allowed to receive the water from the Cau River. The service are of each system will be the same as one at present, except Kim Doi area applied with the averaged area currently irrigated for a land area of some 1,340 ha which is left, as not irrigable directly from South main canal system. The pumps existing and/or improved under the drainage project will be utilized but the canals and structures shall be rehabilitated/improved.

Dong Anh area irrigation system, with a total service area of some 540 ha, consists of 3 irrigation systems of Dong Dau, Loc Ha and Lai Da areas, as it is, and be supplied with the water by pumps. The improvement of pumping station will be required for Loc Ha and Lai Da station. In general, the water level at each

pumping station so enough in a water head that the canals and its structures shall be improved/upgraded in order to supply the water directly from the canals.

Gia Lam area irrigation system will be the same at present. There is no special proposal on the main facilities, since the improvement of Lien Dam irrigation cum. drainage pumping station is on-going, Cong Thon pumping station is still new, as constructed in 1982, and renovation of Think Lien irrigation cum. drainage pumping station is also on-going. Only for Cong Thon pumping station in which the pumps are shifted from low floor to high floor depending on the water level of the Duong River, the building structure and type of pump shall be devised in the renovation so as to reduce the labor forces and costs and prevent mechanical trouble. Speaking of common problems as well as to the other systems, the canals and its facilities are required to effectively convey the water to the field directly from the canals because the waters are expensive by pump operation costs. Thereof, a land area of some 410 ha located inside Duong River is included in the Study Area. This land, which is fertile and actively cultivated with the diversified crops, replying to the request of irrigation, is suggested to be irrigated by using the floating pump. In either way, the first to do is to promote a diversified crops irrigation to farmers, though the request on the said irrigation is reported (refer to Appendix E-3.3).

#### **4.3.3 Drainage System Improvement**

The improvement plan aims to enhance the land productivity by reducing the persistent water-logging area and improving the rural living environment through renovation of existing pumps, construction of pumping station, improvement/upgrading of canal flow capacity. The present subject is focused on the inundation prevention. The drainage water control and village drainage will be tackled in the future, according to the land use.

For the drainage study, 3 days consecutive rainfall over the Study Area with a return period of 10 years has been adopted. The designed inundation water depth and duration are set up to employ crop damages within 10% of the yield; that is, the inundated period with a water depth of over 24.6 cm on the datum land which corresponds to about 10% of beneficial land area within a day and the period with a water depth of 15.9 cm on the datum land will be within 3 days. As a result of the drainage analysis, the drainage pump discharge capacity per unit area (herein after said as drainage coefficient) shall be upgraded from 2.5-4.9 lit/sec/ha at present to 4.7-5.6 lit/sec/ha in the future. For improvement of drainage pumps, a priority, in principal, will be given to restoration of existing ones and followed to

additional ones to meet the required drainage discharge. Nevertheless, alternatives to replace with new ones will be suggested from an engineering point of view.

For Dong Anh area, present drainage coefficient of 3.57 lit/sec/ha on an average will be increased to 5.03 lit/sec/ha. The required drainage discharge to Dong Dau pumping station will meet a discharge capacity of pumps under construction. As the drainage discharge for Loc Ha and Lai Da pumping station will be require a little more than the discharge capacity of existing ones, additional pumps will be selected to be the same type of existing ones from a standpoint of easy operation and maintenance. For Lai Da area, an increased quantity of drainage discharge due to seepage water through the levee of the Duong River will be accommodated within the proposed pump discharge capacity. In addition, it is suggested to verify the cause of seepage water through the levee as soon as possible and take the adequate measures, if necessary.

In Gia Lam area, present drainage coefficient for each pumping station, including the renewed stations, is comparatively high as 4.04-6.38 lit/sec/ha so that a large scale improvement works for the stations will not be provided, as required a drainage coefficient of 5.62 lit/sec/ha in the drainage plan. Lien Dam pumping station is under construction but a little insufficient to the required drainage discharge. Therefore, it will be required to add one more unit in the same type, considering inter-exchangeability of parts. The discharge capacity of Dong Ha and Phu Duong pumping station will meet the required drainage discharge under the existing number of pump units. Nevertheless, it will be suggested for all pump units to repair completely. Think Lien, which is under construction, will have enough capacity for the required drainage discharge.

The pumping stations on the Ngu Huyen Khe River in Trinh Xa drainage area and on the Cau River in Xuan Vien drainage area are generally old in the year of installation and uncertain in the actual discharge capacity. Huu Chap pumping station is comparatively good in the maintenance but may be required to inspect and repair all pumps for ensuring the discharge capacity. An insufficient quantity of discharge against the requirement will be shouldered by Co Me pumping station which is new and under construction. Xuan Vien pumping station has been operated for over 26 years and be costly in the maintenance as compared to others. Thereby, all pumps are planned to replace with new ones (300 mm×55 kw) to meet the required drainage discharge. Trinh Xa pumping station may need to repair 5 units out off the total 8 units to meet the

requirement, as reported to be 20 cu.m/sec in the total discharge pump capacity. However, this type of pump (870 mm×320 kw) is questionable in the discharge capacity in consideration of bore, total head, type (Axial Flow), etc., even though a discharge capacity of pump per unit is reported to be 2.5 cu.m/sec. The repair costs are also high. Therefore, further study will be required for use of existing ones by repairing. Furthermore, Trinh Xa pumping station shall be reviewed from both irrigation and drainage point of view, as used it also for the irrigation purpose. Phu Lam pumping station, which takes charge of drainage for a portion of Trinh Xa drainage system area, will be deficient in the pump discharge capacity to the requirement in its allotted area. The plan is devised to provide repair of all pumps rather than construction of additional ones and transfer a land area of some 140 ha to the drainage area of Trinh Xa pumping station which is expected to be more than enough discharge capacity as stated in the previous section. In any case, it is advisable to conduct further study before the project implementation.

In Tao Khe creek drainage system area, there are four (4) pumping stations along the creek. Among them, New Tri Phuong station is under construction, assuming that old ones may be abolished. This new pumping station will mitigate the present drainage problems but be still required to add four (4) units of the same type of pumps (300 mm×33 kw) and/or to use the existing ones by making repair/improvement of pumps and building in order to meet the drainage requirement. Tan Chi pumping drainage area will be required to be 4.85 lit/sec/ha in the drainage coefficient, in case of independent drainage scheme by closing Cham sluice. To meet the requirement, 68 units of existing pumps will be completely restored/improved and additional four units of pumps (1,350 mm×500 kw) will be procured. On the other hand, as an alternative scheme, the procurement of eight (8) units of pumps (1,350×500 kw) will be proposed from a standpoint of operation and maintenance after the construction. Han Quang area drains the excess water to Hien Luong area through La Miet sluice. In case of independent drainage scheme by closing the said sluice, the area will be required to provide five (5) units of pumps (1,000×320 kw) with a total discharge capacity of 10 cu.m/sec. In Hien Luong area which will have no incoming inflow from Han Quang area, the excess water will be discharged by Thai Hoa and Hien Luong pumping stations. Thai Hoa pumping station, which receive the excess water in the upstream area, will be required to discharge 6.83 cu.m/sec in its pumping capacity but will be improved in its original discharge capacity by repairing/restoring the existing ones and the remaining discharge (2.16 cu.m/sec) will be left to Hien Luong station. Therefore, at Hien Luong pumping station, the

required drainage discharge becomes to be 26.5 cu.m/sec. The improvement scheme of Hien luong pumping station is to repair the existing ones and add four (4) units of pumps (800 mm×132 kw). However, seeing that the reported discharge capacity of existing ones is questionable, as mentioned previously, it is suggested to conduct further investigation on the actual capacity of pumps prior to the project implementation.

The Kim Doi creek is provided with the pumping station with five (5) units of pumps (870 mm×320 kw) at the end of the creek. At present, four (4) pump units among them are operational, which a total discharge capacity is reported to be 10 cu.m/sec or 1.54 lit/sec/ha in a drainage coefficient. In the improvement plan, the existing pumps will be repaired, expecting a total discharge of 12.5 cu.m/sec and added by six (6) units of pumps (1,350 mm×350 kw) to meet the required drainage coefficient of 5.45 lit/sec/ha. Thereof the improvement of Van sluice is included in this plan. For the best scheme, the exact discharge capacity of existing Kim Doi pumps shall be verified.

For the pumping station built on the Cau River, present drainage coefficient which is low as 1.98-3.27 lit/sec/ha will be improved to 4.06-5.18 lit/sec/ha, as required. In line with this schemes, every existing pumps will be repaired/improved and six (6) units of pumps (300×33 kw) for Que Tan stations, three (3) units of pumps (600 mm×75 kw) for Viet Thong station, seven (7) units of pumps (600 mm×75 kw) for Chau Cau station and two (2) units of pumps (1,000 mm×320 kw) for Pha Lai station will be additionally procured. Thereof, the improvement of levees along the Cau River will be initiated for Pha Lai area.

Along with such improvement of drainage pumping stations, dredging of leading Tao Khe and Kim Doi creeks, and improvement/construction of drainage/control sluices, excavation/reshaping or construction of drainage canals, re-arrangement of drainage canal networks for every drainage area shall be implemented to solve the drainage problems. Furthermore, the excellent drainage improvement will be expected by solving the suspension of pump operation confined by the warning water levels, the river flow capacities and impact to the downstream reaches, power supply interruption, etc. Specially, the improvement of Ngu Huyen Khe River and drainage in its basin will bring about delightful living environment without unrest due to flood (refer to Appendix E-2.3).



#### 4.3.4 Farm Road Improvement

The present roads connecting among villages and with the national and provincial roads as well as the operation and maintenance roads along the main irrigation/drainage canals and the top of river levee and polder dikes are used for marketing and distribution. These main farm roads have a width of less than 3 m except the O&M roads along the main irrigation/drainage canals and are unpaved, which are muddy in a rainy day. A density of farm roads used for farming practices is varied, depending on farm blocks. That is high in Tien Son district (about 56 m/ha) and low in Que Vo district (about 19 m/ha). The longest distance from a main farm road to a field is about 2 km. The width of road is narrow like a levee of the field (see Appendix E, Table E-3.1).

Rural roads are one of vital elements not only in raising the living standards but also in the development of agricultural and relevant industries in the rural areas. Rural roads are classified as follows:

Road Classification	Administrative Classification	Function
Primary Road	National Road	Inter-region, Major Farm-to-Market Road
Secondary Road	Provincial and District Roads	Inter-region, Farm-to-Market Road
Feeder Road	Commune Roads	Inter-village, Farm-to-Market Road
Farm Road	Village Roads	Main Farm Road and Farm Road

The farm road improvement aims to get accessibility among rural communities so as to transport agricultural products, and to stimulate and support agricultural development as well as other infrastructure programs.

The most essential function of rural roads to be considered in this Master Plan is the farm-to-market road which is particularly utilized for transportation and distribution of agricultural products and input such as fertilizers and farming materials.

Direct effects/merits of rural road development are the savings in transportation costs and time, increase of agricultural production, and promotion of agro-industries. Farm road development is also necessary to support the irrigation and agriculture development programs.

#### 4.4 Strengthening of Agricultural Supporting Service

##### 4.4.1 Strengthening of Research and Extension Service

###### (1) Research

- Importance of local and traditional varieties are to be emphasized in the characteristics such as grain quality and photo-period sensitivities. It may be enough to be breeding subject to combine these characteristics with high yielding capacity of HYVs.
- Research on the relationship between paddy and water is necessary. For instance, water condition, such as depth, temperature and duration of logging, and yield damage of paddy in some growth stages. The growth stage of paddy, for which water is most necessary, will become clear to show farmers by the research. Based on these research results, the irrigation schedule by canal system will be able to be decided beforehand. Then, variety, transplanting time, irrigation time and its period will be scheduled accordingly to avoid the condition of water surplus in one area and water shortage in the other.
- Research on weeds, their ecology, their effect to paddy production will be necessary, especially on how to eradicate barn yard millet, which is very hazardous to rice production.
- Although the activities of the Integrated Pest Management (IPM) are very well known as a method to control the pests and diseases in paddy fields, establishment of forecasting network of their outbreak is important to secure the production.
- Adaptability trials are to be emphasized much more in each locality especially on variety, cultivation method. For this purpose, extension activities will play key role.

###### (2) Extension

- With the Decision and Regulation 13/CP, 2 March, 1993, the Extension Department was born for the former two Departments, Crop Production and Animal Husbandry, in August, 1993 in MAFI as mentioned before. In provincial level, Agricultural Extension Center, Agricultural Extension

Station, District Unit, Coordination Board for Agricultural Extension were set up.

- The administrative units of extension activities such as village cooperative, production group, progressive farmers and so on, are expected to be the front of the activities. Recruiting system of extension staffs and contract system for some special extension projects have been mentioned in the regulation too.

All of these activities should be encouraged and have to be supported by related authorities.

- The home life agent system by lady experts to improve the private living condition in local area should be considered seriously. Because, improvement of local life, ladies in farmhousehold have been neglected for so long years. The majority of Viet Nam people is living in local area.

### (3) Relation between Research and Extension

To disseminate the available information in research, two ways are suggested. One is through publication and the other is discussion on farm. In latter case, farmers will have chance to explain the problems on farm to extension agent asking the ways of solution on the spot. The former poor extension had been one of the biggest bottlenecks in agriculture development. The communication between supplier and receiver of information should be in smooth condition as mentioned above under the new extension set up.

#### 4.4.2 Agricultural Material Supply Program

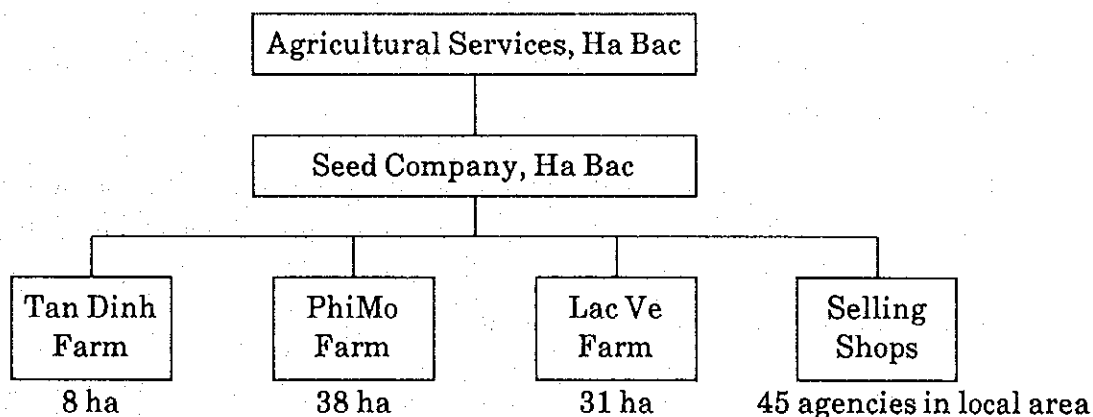
There are many materials for agricultural production, machines and tools for cultivation, seed fertilizer, harvester, thresher and so on. With the start of the Project, especially high quality crop seed and much more fertilizer for higher yield will become important.

##### (1) Seed

The problem to tach on first in this topic, is "Seed Law". No seed law has been enacted. Eventually, so many kind of seeds, which may be poor quality, are being handled in seed business, sometimes resulting in poor harvest and less income to farmers. it is one of the responsibilities of government to supply crops seeds with

certain level of quality to farmers. It is hoped that the law is enacted as soon as possible.

As for paddy seed, the main supplying organization is Central Seed Company. In Ha Bac Province, there is an organization as below under the company.



The three farms are now producing guaranteed seeds for farmers. Lac Ve Farm is in the Study Area and for the farmers in it. The paddy seed production in 1993 in the farm is 60 tons but it met only 7% of the Bac Doung Area's demand. It is necessary to enforce the function of the farm to produce good quality seed as much as possible to meet the demand of farmers.

The another main functions of the farm are yield trial of paddy varieties to check their adaptability to the area and the experiment of cultivation technologies.

The company is also handling imported vegetable seeds of cabbage, tomato, carrot, onion and water melon, but mainly for mountainous area of the province.

## (2) Fertilizer

From the Report of Fertilizer Advisory, Development and Information Network of Asia and the Pacific (FADINAP), the following informations were selected. Although all of these are of the whole Viet Nam, these are also the problems to the Study Area.

As in the case of seed, there is still no definite regulation for fertilizer. This situation should be urgently improved.

- To the year 2000 the production of phosphorus fertilizer in Viet Nam could be between 1.2 to 1.5 million tons and it nearly meets the domestic requirement but nitrogenous fertilizer would only be between 0.3 to 0.5

mil. tons. It is hoped much more N fertilizer could be produced by utilizing natural gas from the Islands area of Viet Nam.

- Upgrading of the facilities for fertilizers such as sea ports, stores, transportation and nationwide network system, is necessary to distribute fertilizers on time of crops cultivation in each locality.
- The united management system of importation and distribution of fertilizer is urgently needed.
- To keep the stable crop's productivity at least as nowadays, it is calculated that the total SA equivalent of nitrogenous is between 2.5 and 3.0 million tons. The domestic production of N fertilizer will be only 10% of the country's requirement in the year 2000.
- No potassium fertilizer has been produced in Viet Nam but the requirement is not less than 0.5 million ton which will be met by import.
- Ordinance of fertilizer is urgently needed which covers all of the issues concerning fertilizer. The main stratum which will suffer from the absence of the regulation on fertilizer is farmers especially the poor.
- By the Government Resolution No. 370 on the so called "People's Credit Fund", money can be lent to farmers who badly need it to buy fertilizer but its merits has not been confirmed.
- The leaning from may surveys, so far carried out, is that the credit and subsidy on agricultural materials such as fertilizer should go along with extension.

### (3) Others

For the efficiency of agricultural production, cooperation of farm operation, grouping or consolidation of land will be necessary. For the situation, tractors, titlers for land preparation or big sprayers for insecticide application for large area will be necessary under the control of new type of cooperative or farmers' union.

The countermeasures to the situation should be discussed beforehand in the field of material supply.

#### 4.4.3 Consolidation of Farmer's Organization

The land holding size in the Study Area is very small. In such case, the procurement of agri-input or introduction of farm machinery or marketing of products by each individual farmer is not easy. The application of cooperative activities is considered as a resolution of such problem. For instance, it is possible to buy cheaper or to save the cost of transportation if farmers buy agri-input such as fertilizer, agro-chemical or seed in bulk, or it is also possible to introduce farm machinery or facilities for reducing labor load or for availing intensive land use if some farmers accept the use of such machinery jointly. Moreover, it is easier to receive the required credit for procurement of agro-input or farm machinery from Agriculture Development Bank or other financial institutions if member of a farmer's organization guarantee the refundment jointly and mutually.

Taking the aboves into account, the consolidation of farmer's organization is considered as unavoidable for future agricultural development in the Study Area, however the main problem for successful implementation is selection of suitable organization and method of consolidation and upbringing of selected organization.

The activities of farmer's organization shall satisfy the needs of all participants of the organization in principle, while the willing of each individual member shall also be observed. These two points are seemed to be contrarily to each other, and the cooperative activities are actually facing to this problem in many countries. To solve this problem, it is necessary to confirm the common needs of members periodically and, at the same time, to keep pliability to do not restrain the member's own intention beyond the necessity.

In case of the Study Area, there is farmer's cooperatives which include most of farmers as member, therefore improvement of such existing organization shall be examined before planning new organization, and the administrative support shall be supplied to such improved organization.

Even the case of consolidation of farmer's organization based on the farmer's cooperative, the existence of different HOI is not only negligible, but the effective involvement of function of those HOI within the cooperative activities is to be examined, because many farmers are accepting the HOI as their own organization while the cooperative is seen as a terminal unit of administration. If

functions of HOI and cooperative are combined, the farmer will participate more positively to such organization.

The scale of farmer's cooperative whether to be village basis or commune basis is to be justified taking into account of the mutual relationship among the villages, however present scale of cooperative, 580 households in average, in the Study Area is seemed too small. It is recommended to be 1-2 cooperatives per commune in accordance with the population of each commune.

In relation with the cooperative activities, the existing cooperatives have not horizontal relation among the cooperatives. If many cooperatives procure agro-input or consumptive goods jointly, they will be able to get more advantages than procurement of unit cooperatives basis. Moreover, establishment of cooperative operating agro-products processing industry is possible to be introduced in future, it is hardly possible to operate such enterprise by each unit cooperative. The cooperative activities are, therefore, to be consolidated by mean of establishment of the federation of district and provincial units.

## **4.5 Marketing and Distribution Plan**

### **4.5.1 Marketing**

After the project implementation, increased production of rice will be expected to destinate for regional consumption. Vegetables are able to expand the markets in the cities with the improvement of living standards and development of agroindustry in the future. Moreover, it is expected to reestablish former relations with Russia and Eastern European countries on the export of agricultural products in the future.

Demands of industrial crops such as maize, groundnut and soybeans are high and the marketability of these crops will be expected to expand as the living standards improved and as the animal husbandry developed.

Concerning groundnut, 40 percent of the national production quantity is for exports. Especially, domestic consumption of soybeans and groundnut is a considerable increase by the people's preference for vegetable oil.

### **4.5.2 Post-Harvest Facilities Improvement**

There are no existing post-harvest facilities in the Study Area, therefore, farmers have a difficult condition to secure their profit from the products in markets. Consequently, the post-harvest facilities in each commune, i.e. a collecting and shipping center of agricultural products furnished with drying and storage facilities, should be installed. Operation of these facilities by existing cooperative is also considered.

For establishing the post-harvest facilities, it is necessary to give a guidance of its management for an administrator of farmer's cooperatives in order to conduct its operation smoothly, therefore, an active support from the government and/or public institutions is indispensable.

### **4.5.3 Distribution System Setup**

In order to achieve the target of the project, improvement of marketing and distribution system in rural area of the Study Area is necessary. Under the market economy, present commercial transaction of agricultural products as individual dealings would be brought the limits to develop rural economy, therefore, it seems that the rural economy has high potentialities to be left behind the development of another economic sectors.



Judging from present situation of rural free markets, hasty introduction of a modern distribution system in a short period will result in confusion among rural free markets. However, with the development of agricultural products' exporting circumstances and the improvement of living standards of the people in the future, modernized distribution system will be required as a long-run plan.

From these circumstances, the program in terms of distribution system of agricultural products would be proposed as the following items:

- Reorganization of existing farmers' cooperatives.
- Establishment of central marketing association.
- Set up of marketing information network.
- Establishment of well-managed markets for agricultural products in the cities.
- Set up new transportation system for agricultural products.

(see Appendix I, Fig. I-2.4)

In the future, the quality control, fixation of standards, standardization of package, formation of market administration and operation system are required by change of socio-economic environments. Hence these marketing bases should be prepared immediately by public institutions.