planning and implementation.

3) Facilities should be designed as simple as possible so that the beneficiaries can operate and maintain the facilities by themselves.

4) Capital costs should be minimized so that the beneficiaries can afford paying amortization.

4.2.4 Consistency with horticulture sector policies

While keeping consistency with the DA's policies given in the Vegetable Development Plan 1992-1995, the strategies for the Project are directed to the following:

1) Agricultural extension and training requirement for enhancing the vegetable production in the area should be clarified and possible component of this aspect be included in the Project.

2) Post-harvest facilities at the farm level should be considered in the Project.

3) Establishment of trading posts and marketing information system should be examined and be included in the Project to the possible extent that the beneficiaries can operate and maintain.

4) Institutional framework for the implementation of the Project should be clarified together with those for O&M.

4.2.5 Environmental considerations

In the traditional project planning, specific objectives were at first set-forth and then an project proposal were prepared based on the evaluation of alternatives. However, the evaluation was tended to focus on maximizing short term economic gains but neglect long-term environmental liabilities. This exercise often resulted in formulating environmentally unaccepted projects, as having been widely criticized.

In the formulation of development plans, particular emphasis should be placed on early identification of environmental impacts and mitigation measures. Modification of development plan should be exercised to minimize negative environmental impacts while maintaining the expected positive impacts. Resulting development plan should enhance economic development of the area without long-term environmental destruction.

Meanwhile, considering soil erosion and forest destruction presently observed in the Study area, following measures should be taken for the attainment of environmental

preservation and ecologically sustainable agriculture in the area:

1) prohibiting further destruction of natural forest
2) restoring sites damaged by the project
3) thorough application of soil conservation measures to vegetable farming
4) encouraging minimum use of chemical fertilizers and the use of organic fertilizers
5) establishing farming practices or varieties that enable minimum use of agro-chemicals
6) providing access rights over the use of the Public Forest lands to the present occupants

4.2.6 Participation of Women in Development

Republic Act 7192 enacted in 1992, known as Women in Development (WID) and Nation Building Act, promotes women's position and participation in development. Agricultural Development Plan for 1991-1995 also seeks to develop the capabilities of rural women to contribute to agriculture and rural development as a priority concern. In this way, the Government has recently been taking steps to strengthen women's role in development.

In the public consultation survey in the Study area during Phase 2, 105 women were interviewed to collect women's opinions to the development plan. The women are generally involved with household chores and assisting works in farm production. Assessment of work load shows that almost 50 % of the total women respondents believe that their work load is heavy and other 50 % believe it is not. To conclude, 89 % of the respondents said they appreciated the proposed project for the following reasons:

- The project will increase crop yields and farm income.
- The project will create better living condition.
- The project will increase the prices of vegetables.
- The project will reduce women's work load.

Further, 93 % of the women respondents would want to participate more in economic activities, especially marketing, processing and storage of their farm products, as listed below.

- Marketing
- Processing/storage

- Crop classification/grading
- Participation in organization/cooperatives as members or officers

Taking such women's intention in consideration, the Project was formulated in order to promote the women's participation in economic activities, together with providing some training packages particularly for women covering marketing, food processing and storage, and institutional development.

4.3 Public Consultation on Proposed Development Concept

Public consultation survey was carried out during Phase 2 field works period in collaboration with NIA for the purpose of introduction of the preliminary development plan proposed in the Interim Report to beneficiaries and hearing of their opinions on the proposed plan. The procedure of the public consultation survey was as follows:

1) preliminary public consultation meeting with Barangay officials at each Municipality,
2) public consultation meeting with beneficiaries at each Barangay, and
3) individual interview to selected beneficiaries by prepared questionnaire.

In the public consultation meetings in the respective Barangays in the Study area, the development concept and plan of the project components were explained to the attendants. Almost all attendants broadly appreciated and accepted the plan during the public consultation meetings. Total of about 1,100 attendants expressed great interest to the development plan and had animated discussions over the proposed components. After the meetings, interviews were individually carried out with the selected 116 farm households using the questionnaire.

Out of 116 respondents, percentage of acceptance including conservative response were 89 % for irrigation, 96 % for marketing activities, 94 % for agricultural extension and training, 96 % for soil conservation, and 92 % for rural water supply components, as indicated as follows:

Acceptance of the Development Plan

(Unit: %)

Components	Accept	More or less accept	Others
Irrigation development	77	12	11
Improvement of marketing activities	92	4	4
Agricultural extension and training	83	11	6
Soil conservation	90	6	4
Rehabilitation of rural water supply	84	8	8

Source: Public Consultation Survey undertaken by the JICA Study Team

There were a few respondents who claimed additional improvements of the proposed development concept and plans. These opinions were elaborately examined to make the development concept more realistic, attractive and acceptable to the prospective beneficiaries. The project concept, development plan and proposed facilities were reviewed and refined as follows:

1) Irrigation systems should be facilitated in the farmlands located within the Public Forest lands.

   - Provision of irrigation systems was also proposed in the existing upland farmlands within the Public Forest lands.

2) Municipal governments should support the transactions of vegetables at the trading posts.

   - Marketing cooperatives would responsible for operational works of the trading posts. Municipal Agricultural Offices (MAOs) should undertake technical/ managerial collaboration of marketing activities to the cooperatives.

3) There was a right-of-way problems for additional roads construction connecting farm to market.

   - Construction of secondary roads connecting farm to market were excluded from the project components because of a necessity of environmental preservation in the Study area.

4) Training on irrigation practices was needed.

   - "Upland Horticulture and Irrigation Technology Center" was planned to perform training programs on irrigation and horticulture technologies to the farmers.

5) Financial support to the demonstration fields and the materials supply for extension of soil conservation practices were necessary from governmental agencies.

   - Transplanting of tree nurseries was implemented at the demonstration fields by the Project.

- "Soil Conservation Extension Center" were planned to provide tree nurseries to the farmers so as to accelerate soil conservation scheme.

4.4 Proposed Framework of Project Components

The basic development concept of this Project is discussed in the foregoing sections. It indicates that the present forest will be faced to a danger of total destruction in the uplands. Although manifold measures such as ISFP and reforestation programs are executed, the fundamental issue is the general poorness of the farmers, which causes the problems stated above.

In establishing framework of the Project components, the first priority is given to the preservation of the forest, which can be accomplished if the farmers would settle down their own lands with security of land tenure and improvement of welfare and livelihood. For this, provision of various infrastructures is needed comprehensively as all in one so as to uplift the farmers' income which is sufficient for the farmers to live on the limited farmlands, without further devastation of the forests. Ancillary works and services for supporting the farmers to realize the improved farming and marketing are also needed at the same time.

In this regard, it is proposed that the upland fields in the Public Forest lands are to be included in the beneficiary areas. It is noted that the lands to be developed are limited to the existing upland fields alone, and that special attention will be paid to the protection of soil erosion.

The public consultation survey was conducted based on the project components which are proposed in the Interim Report during Phase 2. Meanwhile, meetings were held with the NIA, the concerned agencies and the local government offices in due course. On the basis of the foregoing, proposed framework of the project components are finalized as stated in the following table.

Proposed Framework of Project Components

Components	Project Framework
Irrigation development	Sufficient farm incomes that farmers can live on within the limited farmlands ensure them preventing further destruction of the forests. Aiming at stabilization of vegetable production and uplift of farmers' income, irrigation facilities should be provided. Avoidance of serious drought damages of crops and high cropping intensity of vegetable farming can be accomplished by the systems. Irrigation development should be proceeded taking into account of the necessity of soil conservation in the A&D lands and the existing upland fields, especially in the Public Forest lands.
Improvement of marketing activities	One of the countermeasures for uplifting the farmers' income is to improve the marketing activities. Proposed development plan is composed of the provision of farm-to-market roads and improvement of marketing system with trading posts construction.
– Road improvement	Farm-to-market road network in the area is poor at present. Most of the existing main roads in the area are poorly maintained, and are not passable by vehicles during the wet season. Poor road network imposes farmers to laborious transportation works, and results in low vegetable price due to the damages during transportation. To cope with such a situation, a high priority should be given to the road improvement.
– Trading post	Farmers are very weak in position for determining the prices, because they don't have satisfactory facilities and organization to sell their products and are isolated from the latest information on wholesale prices in Manila. Construction of trading posts contributes to develop the collective marketing system by marketing cooperatives on basis of marketing information.
Agricultural training and extension	Agricultural training and extension on standard cultural techniques and irrigation practices are needed so as to rise the vegetable productivity in the area. "Upland Horticulture and Irrigation Technology Center" will be placed as a central facility in demonstrating and training for the said technologies to be transferred to the farmers.
Soil conservation	Located in mountain slope and with seasonally concentrated rainfall, the Study area are susceptible to severe soil erosion. Adoption of soil conservation techniques in vegetable farming is a must in the Study area in order to achieve sustainable agricultural development. Creation of demonstration fields and establishment of "Soil Conservation Extension Center" should be included in the Project to extend the soil conservation practices to the farmers.
Rehabilitation of rural water supply system	Existing rural water supply systems have been fairly well facilitated in the Study area. However, only intake devises shall be urgently rehabilitated to ensure water conveyance capacity of the systems.

CHAPTER V FORMULATION OF DEVELOPMENT PLAN

5.1 Project Components

The basic development concept of the Project is discussed in section 4.4 focused on the present status of forest destruction in the Study area. It is predicted that if no measures are taken, the present forest of Mts. Banahaw and San Cristobal would be completely devastated in the near future.

Irrigation development is one of the most important project components in order to forbid further devastation. It is indispensable to include part of the Public Forest lands, because large part of promising upland fields by means of irrigation is located in this area. It should be noted that the lands to be irrigated are limited to the existing upland fields alone, and that special attention will be paid to the protection of soil erosion in view of steep slope of the land.

A high priority is also given to the improvement of marketing facilities consisting of rural roads and trading posts. Provision of them will surely contribute to raising of the farmers' income and hence their livelihood, which results in checking of everlasting devastation of forest. It should be noted that the concrete pavement of the roads is limited to the existing ones and the trading posts will be constructed outside the Public Forest lands.

It is essential to establish an agricultural training and extension center as one of the project components, considering the various requirements of demonstration and training for the propagation of irrigated vegetable technologies to the farmers in the Study area.

The promotion of soil conservation measures is another important project component. The proposed project is to establish demonstration fields of soil erosion control technologies at several sites in the Study area. For this, Soil Conservation Extension Center will be also constructed so as to supply tree nurseries and to transfer soil conservation technologies to the farmers.

Rural water supply systems are well facilitated in the Study area. However, some urgent rehabilitation works will be included in the Project to attain efficient use of water.

5.2 Irrigation Development

5.2.1 Assessment of endowed resources

(1) Assessment of water resources

As discussed in section 3.6, there are several water sources in the Study area in the form of surface flow, spring yield and groundwater (sub-surface flow). In order to establish a water resources plan, available discharges of respective sources and their locations are detailed in this section (see Table 5.2.1.).

Water sources available for irrigation are confirmed at three sites in the Municipality of Nagcarlan. Bukal Spring in the Nagcarlan river yields 0.04 cum/sec of water at El. 890 m approximately in the dry season. Discharge of the Nagcarlan river is estimated at 0.04 cum/sec at El. 400 m. San Vicenta Spring in the San Diego river yields 0.01 cum/sec at El. 300 m.

There are six water sources in the Municipality of Liliw. Springs located at the uppermost stream in the Liliw river discharge 0.003 - 0.005 cum/sec in the dry season at El. 890 m, which is being developed to irrigate farmlands located between El. 600 m and El. 800 m. There are two Luquin springs at El. 620 m and El. 540 m approximately, which yield 0.07 cum/sec and 0.23 cum/sec, respectively. Flow of the Liliw river is estimated at 0.23 cum/sec at the elevation below 540 m. There are another two springs, viz., Gawanan and Sirian, which yield 0.01 cum/sec and 0.03 cum/sec, respectively. All the waters from the two springs are supplied to Liliw as rural water.

There exist three water sources in the Municipality of Majayjay. Maimpis spring, which is located at El. 600 m in the Maimpis river yields 0.20 cum/sec in the dry season. Discharge of the Maimpis river is estimated more than 0.20 cum/sec, but the elevation of the river water is lower than 600 m. The Olla river has a fairly large discharge of 0.10 cum/sec in the dry season. Gravity irrigation is practiced for the area of approximately 40 ha.

(2) Assessment of land resources

Land resources in the Study area are considered to be abundant under the present land use condition. According to the land suitability analysis for diversified crops (refer to section 3.7.2), moderately suitable lands extend over approximately 900 ha or 30 % of the Study area. Also about 350 ha of the Study area is classified into marginally suitable lands, which requires appropriate soil erosion control for sustainable cultivation. The present

vegetable cultivation area is estimated at 760 ha, which lies mostly on the moderately or marginally suitable lands. Therefore, the Study area still has a large potential for extension of vegetable cultivation. Especially Nagcarlan has large potential area for the extension, where most lands are covered with small-scale coconut plantations. While, lands in Liliw have been already developed for agricultural use.

(3) Assessment of human resources

The number of farm households in the Study area is estimated at 1,340 for the total agricultural area of about 2,000 ha. During the farmers' household survey, most of respondents replied that they used to hire adequate labors at the harvest season although few respondents replied shortage of labor force to fully cultivate. The representative farmers of most farm households are 40 to 50 years old and have experiences of present conventional vegetable cultivation. Therefore, the human resources in the Study area are considered to be sufficient for the irrigated agricultural development.

5.2.2 Irrigation methods and water requirement

As described in section 3.9, the farmers in the Study area have been practicing irrigation using such tools as hand-carried water pot, sprayer and small bucket for the maintenance of the soil moisture around the main root zone of crops at a high level with minimum water application during the period of seeding and transplanting for the promotion of germination, rooting and growing.

Such irrigation practice seems to be suitable for the areas where the water resources potential is low. In agricultural development project, it is common to integrate the development of farmlands and upland irrigation facilities as a comprehensive unit. However, it is a difficult task to obtain water for the Study area because amount of water for the irrigation use is insufficient.

It should be also noted that the availability of groundwater is unreliable in the Study area. Thus, an effective farming system in terms of the use of limited water resources is in important demand. In this regard, the drip irrigation system is expected to be the most reliable water-saving system, and hence recommended as the future on-farm development in the proposed irrigation areas.

The study on the irrigation water requirements is carried out with reference to the "Irrigation Engineering Manual for Diversified Cropping" prepared in 1991 by the Diversified Crops Irrigation Engineering Project (DCIEP), which has been undertaken by NIA with the support of the JICA through technical cooperation. Investigation on basic data for upland irrigation was conducted by courtesy of DCIEP of the pilot demonstration farm in Barangay Bukal, Nagcarlan and the results were used for estimating water requirements. In addition, necessary data for the assessment of water requirements were collected in and around the Study area together with relevant experts and counterpart personnel sent from NIA.

The total readily available moisture (TRAM), which was defined as the total moisture consumed in the effective soil layer after 24 hours (FC24) to depletion of moisture content for optimum growth (DMCOG), was measured by DCIEP in the pilot demonstration farm in January 1994. The value of TRAM in the Study area is estimated at 48 mm.

Consumptive use of water (CU) is defined as the amount of moisture in the effective soil layer consumable under the conditions where normal growing crops are expected. It will be decided synthetically through the comparative study among modified Penman method, evapotranspiration ratio method, and soil moisture depletion method.

As shown in section 3.4.1 of Appendix-IV, there is no notable difference between the pan evaporation actually measured and potential evapotranspiration estimated by modified Penman method. However, since the measurement value of pan evaporation cannot be obtained in cumulative years in the Study area, it is preferable to adopt modified Penman method in estimating potential evapotranspiration.

Crop coefficient (Kc) at each growing stage is estimated on the basis of the "Crop water requirements" published by FAO in 1977. Proposed cropping pattern is classified into six types as shown in Appendix-IV. Kc values are calculated by averaging the Kc value estimated at 5 day intervals according to each proposed cropping pattern type as shown in Table VII-3.1 of Appendix-VII. Daily consumptive use of water (CU) is obtained as follows by multiplying potential evapotranspiration (ETo) by Kc.

Daily Consumptive Use of Water of Each Proposed Cropping Pattern

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ETo	2.06	2.59	3.26	3.88	3.69	3.04	2.85	2.76	2.96	2.58	2.33	2.02
Type1	1.9	2.7	2.0	2.3	2.6	3.1	2.5	1.7	2.1	2.5	2.1	1.2
Type2	1.9	2.5	2.0	2.6	3.2	2.7	-	1.7	2.2	2.4	2.2	1.3
Type3	1.4	2.3	3.1	2.3	2.6	3.1	2.5	1.7	2.1	2.6	2.1	1.2
Type4	1.9	2.7	2.0	2.3	2.6	2.8	2.5	1.7	2.0	2.3	2.1	1.2
Type5	2.1	2.4	1.4	2.4	3.3	3.1	1.7	1.8	2.6	2.3	-	1.4
Type6	1.5	2.4	3.0	2.4	3.1	2.8	-	1.7	2.1	2.6	2.1	1.2

In order to confirm the daily consumptive use of water thus calculated, an investigation of moisture consumption in the upland field (tomato field) was conducted by courtesy of DCIEP using tensiometers at the pilot demonstration farm in Bukal from April 13 to June 14, 1994 (harvesting). Due to the rains which fell almost everyday, it was not possible to obtain accurate data throughout the entire growing period. No data were obtained, especially, during the crop growing stage and mid-season stage covering April 28 to June 9, 1994 when the maximum consumptive use of water was expected to had been occurred. Out of 62 days of growing period only two days in April and five days in June, when the moisture content became lower than the water-holding capacity. It is concluded, therefore, that the daily consumptive use calculated using modified Penman method is the most reliable one in this Study.

Simulation of soil moisture is conducted for three years from 1979 to 1981, of which daily rainfall record is available at Liliw in the Study area, based on the assumption that maximum net amount of water to be replaced is 2.0 mm/day. Fig. VII.3.1 of Appendix-VII shows the results of the simulation for each proposed cropping pattern. They prove that soil moisture can be kept mostly above the depletion of moisture content against optimum growth except for a few days at the end of the dry season of 1979.

It is desirable that soil moisture content is cross-checked by using daily rainfall record for at least ten years. Rainfall pattern of Caliraya, of which record covers more than ten years, indicates the highest correlation with that of Liliw. Simulation of soil moisture is also conducted using the modified daily rainfall, based on the assumption that maximum net amount of water to be replaced is 2.0 mm/day. It is understood that the soil moisture can be kept mostly above the depletion of moisture content against the optimum growth expect for two years of 1969 and 1970 as shown in Fig. VII.3.2 of Appendix-VII.

Furthermore, it should be noted that since drip irrigation method (water saving irrigation) is proposed in the Study area, it is expected that consumptive use of water calculated

based on the above conditions shows rather higher value than actual one as proved by the comparative study on consumptive use between sprinkler irrigation and drip for sugar cane conducted in Amami Island (see "Drip Irrigation" in Land Development Standard, Page 15, published by MAFF of Japan in 1987). In this regard, net amount of water to be replaced of 2.0 mm/day will be sufficient to maintain optimum moisture throughout all the seasons.

5.2.3 Irrigation system plan

There are a number of water resources in the form of either surface flow, spring yield or groundwater (subsurface flow) in the Study area. Arable lands for vegetable cropping are scattered in the entire Study area. Comparative study results on irrigation system plan and prospected benefited area will be discussed in this section in terms of location, elevation, magnitude (or size) of water sources and areas to be irrigated and facility plan.

(1) Gravity irrigation system

Considering the condition of the endowed water resources and distribution of the arable land for vegetable cropping as well as administrative boundary, two irrigation systems are proposed, namely Nagcarlan irrigation system and Liliw irrigation system, in each Municipality.

1) Nagcarlan irrigation system

According to the land use survey conducted in Nagcarlan, the existing upland crop lands including those in the coconut plantations are scattered here and there as small farm lots. However, more than 80 % of those crops fields are concentrated on the elevation between 500 m and 900 m.

On the other hand, as discussed above, Bukal spring in the Nagcarlan river is located at El. 890 m, which yields 0.04 cum/sec of water in the dry season. By taking water at this elevation it is possible to irrigate these present upland crop land by gravity. Because the amount of spring yield is the limiting factor, benefited area is estimated at 155 ha. Since this water source is used for present rural water supply through existing pipelines, intake work is designed so as to serve both for irrigation and rural water supply.

Irrigation facilities of this system consist of; 1) intake work, 2) farm ponds, 3) water conduit pipelines, 4) water distribution pipelines, and 5) hydrants. The intake work is

proposed to be constructed at elevation of 880 m in order to irrigate elevated upland fields. Farm pond with its capacity of approximately 360 cum will be installed to cover one irrigation block with an area of 20 to 40 ha. Total of five farm ponds are required for the Nagcarlan irrigation system. Two conduct pipelines with diameters of ø 4" to ø 10" will be laid to connect the intake structure with the farm ponds. Several distribution pipelines with a diameter ranging from ø 3" to ø 6" will be laid from the farm ponds to beneficial areas. Ninety five (95) common hydrants will be installed at the distribution pipelines to supply water to each irrigation area covering 1 to 3 ha.

There are another two water sources in Nagcarlan, discharge of the Nagcarlan river (middle stream) and spring yields of San Vicenta Spring, etc. in the San Diego river. Development of the former source is extremely difficult because most of the discharge is subsurface flow, and hence, collection of water by means of cut-off wall does not seem to be effective. While, the elevation of the latter is too low to irrigate the existing crop lands in the Study area.

2) Liliw irrigation system

According to the land use survey conducted in Liliw, the existing upland crop lands including multi stories cropping under coconut plantations are scattered almost the entire Study area. It is understood that approximately 160 ha are situated at higher elevation than 600 m, and that another 170 ha are located lower elevation than 600 m.

Regarding the water sources, as discussed in the preceding paragraphs, there are six water sources, consisting of five springs and one river flow. A spring exists at El. 900 m with yield of 0.003 - 0.005 cum/sec in the dry season. Since all the yields of these springs have been taken by the existing intake facilities which were constructed by local people, that there is no possibility for further development as a water source. Luquin Springs in the Liliw river are located at El. 620 m with a yield of 0.07 cum/sec and at El. 540 m with a yield of 0.23 cum/sec. By taking water from the upper spring, it is possible to irrigate present upland crop lands located lower elevation of 550 m by gravity. Since the area of crop lands is the limiting factor, benefited area is estimated at 165 ha.

In order to maximize the beneficial area, it is proposed to locate the intake work at the elevation of 620 m. Farm pond with its capacity of 360 cum will be constructed to cover one irrigation block with an average area of averagely 32 ha. Thus, total of five farm ponds will be facilitated. Two water conduit pipelines with a diameter of ø 4" to ø 10" will be laid under the ground to connect the intake structure and the farm ponds. Several distribution pipelines of its diameter ranging from ø 3" to ø 6" will be installed connecting the farm ponds and beneficial

areas. Seventy eight (78) common hydrants will be installed on the distribution pipelines to supply water to each irrigation area covering 1 to 3 ha.

These are another two water sources in Liliw, yields from Gawanan spring and Sirian spring in the Liliw river. Since these water resources have been already developed for rural water supply in Liliw, no development potential is left for irrigation purpose.

(2) Storage reservoirs and/or ponds

As stated in the preceding, total amount of water for irrigation purpose is not necessarily sufficient to cover the potential lands in the Study area. Therefore, it is considered to impound water diverting adequate water during the wet season by constructing reservoirs or ponds. Study results on this matter indicate that it is necessary to impound 870 cum of water to increase 1 ha of irrigable area on an average.

During Phase 2 study, geotechnical investigation using borings was conducted to explore foundation condition and permeability of foundation for water storage purpose in the Study area. It is understood that the permeability of foundation was extraordinarily high, and hence seepage of water was very large in quantity. With regard to the excessively high permeability, covering of storage area with impermeable materials, such as vinyl, rubber sheets, and concrete lining is recommended. However, the construction cost of approximately ₱ 1,000 will be required to store 1 cum of water, which accounts for more than ₱ 870,000 to serve 1 ha of lands to be irrigated as stated section 6 of Appendix-VII.

Furthermore, for the provision of the large scale reservoirs/ponds, it is necessary to accommodate large right-of-way in the Public Forest lands. A large scale logging and earth movement will be inevitable for the construction of such facilities, which will result in destruction of forests. In view of the preservation of forest and landscape, it is not recommendable to include these structures in the Project.

(3) Pump irrigation

Pump irrigation is contemplated to increase irrigable area. It is not technically impossible to irrigate another 79 to 145 ha of farm lands located in Barangays Sungi, Luquin and Novaliches by pumping up water from the Liliw river. In section 7 of Appendix-VII, two alternatives are selected to examine the costs of construction and O&M in terms of lifting head and irrigable area.

In Case 1, all the farm lands covering an area of 145 ha are irrigable with a pump head of 250 to 300 m, whereas in Case 2, farm lands covering an area of 79 ha located between El. 600 m and El. 700 m are irrigable with a pump head of 100 to 150 m. The costs for the construction and annual O&M of the former case are as high as ₱ 314,000 and ₱ 28,000 per ha, whereas those of the latter are, ₱ 277,000 and ₱ 10,000 per ha, respectively.

The study results indicate that pump irrigation is not only very expensive in terms of costs for construction and O&M, but also it requires large amount of foreign currency, construction of access roads to the pump station, high technique in operation and maintenance, etc. It should be also noted that consumption of large quantity of fuel will adversely affect the environment and natural resources. Development of the water resources by means of pumps is not recommended in view of the foregoing.

5.2.4 Operation and maintenance plan

The irrigation system is categorized as a Communal Irrigation System (CIS). After the completion of the construction works under the supervision of NIA, the systems are turned over to the Irrigators' Associations (IAs).

Implementation schedule of the Project has not been determined yet. In case that necessary steps for financial assistance would be made by the government in order to start the construction works of CIS from the middle of 1996, it is necessary to formulate and register the IAs in 1995 for the promotion of the farmers participation of CIS.

Catalyzing the participation of farmers in irrigation development is undertaken by the Irrigation Development Offices (IDOs), who station in the Municipal offices of the proposed CIS service areas and assist the farmers to organize themselves. IDOs help farmers in identifying and discussing problems related to irrigation and guide farmers in securing necessary assistance from NIA.

IAs are required to pay back the government the construction cost of their CIS. During the construction stage, the IAs should pay part of chargeable cost to be determined by the government. Reminding chargeable cost should be adjusted in accordance with the prescription of the local government of the Province of Laguna.

Upon the turn over of the completed irrigation system, the beneficiary farmers shall operate, maintain and administrate CIS in accordance with the by-Laws of the IAs, and the rules and regulations which IAs shall promulgate with the concurrence of NIA.

The beneficiary farmers shall spend for the cost of repairs, rehabilitation and improvement of the irrigation systems while the same is under the administration of IAs.

Major repairs or rehabilitation of intake works, etc. may, upon request of the beneficiary farmers and under such terms and conditions which shall be embodied on a supplemental agreement between the parties herein be undertaken by NIA.

The existing rules and regulations shall govern the operation and maintenance of CIS in principle. However, IAs shall introduce whatever innovative changes or improvements are needed in their organization, operation procedures and conduct of business to effectuate a more efficient and profitable operation and management of the irrigation systems.

The beneficiary farmers shall learn on-farm irrigation technologies which are best-suited on the selected crops at the Upland Horticulture and Irrigation Technology Center, where on-farm irrigation facilities will be installed for demonstration and training purposes.

Major facilities including the water-source facilities, water diversion facilities and the operation and control facilities shall be managed by responsible personnel or designated operators in order to clarify the range of responsibilities.

Rotational irrigation is employed in principle. The date and time of water supply shall be based on the planned rotation schedule. No arbitrary use of water shall be allowed.

5.3 Improvement of Marketing Activities

Everlasting devastation of the forest has to be checked by improving marketing facilities consisting of roads and trading posts which are proposed to be included in the Project as another important component. Provision of paved roads and trading posts will surely contribute to rising the farmers' income and hence their livelihood as detailed in the subsequent sections. It is noted that the concrete pavement of the roads is limited to the existing ones and the trading posts will be located at outside the Public Forest lands in order to preserve the present forests.

5.3.1 Framework of improvement plan

The Study area is located adjacent to Metro Manila, the largest vegetable consuming city, in two-hours drive distance. The Study area is geographically advantageous in terms of transportation and marketing of farm products, especially fresh vegetables. However, the vegetable farms are scattered over the area and the road condition connecting farms with main roads is poor. The vegetables are therefore transported by manpower or horses using mountain trails. As for the marketing, the farmers sell farm products to wholesalers at an unreasonably low price because the farmers lack sufficient market information and transportation means.

Taking the above conditions into account, the Project should propose 1) the improvement of roads and 2) the construction of trading posts. Road improvement directly contributes to the decrease of transportation cost of farm products/inputs, increase in market values of farm products, amelioration of working conditions, and acceleration of development of the area. The trading posts will help appropriate price setting and planned and stable vegetable supply to be attained by proposed marketing cooperatives. These plans are expected to substantially encourage agricultural development of the area as well as improve living condition and farmers' income in the area.

5.3.2 General plan of farm-to-market roads

(1) General plan

The road network in the Study area has been developed mainly for the shipping of vegetables and coconuts harvested in the elevated mountain slopes of Mts. Banahaw and San Cristobal. Vegetables are handled at the existing trading posts, which are temporarily provided along the main roads in every harvest seasons. However, the poor roads lead to damages of vegetables during transportation, and result in higher transportation cost of agricultural commodities. This implies that the poor road condition is one of the biggest factors that hinder efficient marketing activities and the increase of farm income. Further, poor drainage condition of the existing roads causes consequent traffic inconvenience in the wet season, especially in highly elevated area where almost all of the vegetable farms are located. This also impede smooth vegetable transportation and expansion of cropping area as well as the extension of cropping season to the wet season. The improvement of farm-to-market roads is essential for the promotion of agricultural development in the area.

The following are economical and social effects accrued from the road improvement.

1) savings of vehicle operating cost between farms and market

2) amelioration of severe working conditions

3) increase of vegetable farm gate price by decreasing spoilage of vegetables during transportation

4) extension of farm land

5) activation of agricultural extension service, such as transferring of modern farm management techniques

6) extension of cropping area by means of constant transportation service (especially during the wet season)

7) improvement of living condition through facilitation of rural infrastructure

8) improvement of marketing channel for agricultural commodities

9) activation of communication between rural societies

Road improvement plan is composed of rehabilitation of existing Provincial and Barangay roads. The road improvement, together with the improvement of trading posts, is a core component of agricultural infrastructure improvement in the Study area.

(2) Road improvement plan

The existing roads to be improved are listed below.

Proposed Road Length of Main Roads

(Unit: km)

Municipality	Road Name	Total Road Length	Improvement Length	
			Pavement with gutter	Gutter
Nagcarlan				
	1) San Francisco - Bukal	6.6	6.0	0.6
	2) Sinipian - Silangan Lazaan	6.0	0.8	5.2
	3) Malinao - Kanlurang Lazaan	1.7	1.5	0.2
	4) Kanlurang Lazaan - Bukal	2.1	2.1	0.0
	(Sub-total)	(16.4)	(10.4)	(6.0)
Liliw				
	5) Ibabang Sungi - Ilayang Sungi	4.4	1.0	3.4
	6) Novaliches - Luquin	5.7	3.2	2.5
	(Sub-total)	(10.1)	(4.2)	(5.9)
Majayjay				
	7) Pangil - Bukal	4.3	3.9	0.4
	(Sub-total)	(4.3)	(3.9)	(0.4)
	Total Length	30.8	18.5	12.3

Note: Concrete pavement of 12.3 km was completed.

Concrete pavement is proposed in due consideration of minimization of maintenance cost. Appurtenant structures, such as bridges, cross drainages, and slope protection shall be planned. Drainage facilities will be facilitated in total road length of 30.8 km.

5.3.3 General plan of trading posts

At present, vegetables produced in the Study area are individually handled between farmers and buyers from Manila or local brokers at existing trading posts as mentioned in section 3.9.7. This present marketing system is the simplest and the most practical taking the quantity of vegetables handled and scattered production areas into account. However, the farmers' income remains at quite low level because of very low bargaining power of the farmers. The main objective of the construction of trading posts is to develop the collective marketing system of vegetables in the area by establishing marketing cooperatives. Other objectives are mentioned below:

1) to attain of planned shipping and production,

2) to strengthen the bargaining power of the farmers by cooperative handling and shipping of products,

3) to improve the quality and values of products and stabilize the prices by providing weighing, washing, bagging and storage facilities,

4) to exchange marketing information and cultivation techniques, and

5) to develop and strengthen the planned cooperatives.

There are two alternatives in terms of the size of the trading facilities: one is a large scale "trading center" which will handle the products from in and around the Study area, and the other is several small scale "trading posts". The construction of large scale trading center is not a practical alternative considering the present unorganized marketing activities. Small scale trading posts are far more desirable in the area because they could back up organizing marketing cooperatives that are expected to make collective marketing possible.

The trading posts should be constructed at the rate of about one per 50 ha of farm land. Fig. 6.3.1 shows proposed location of the trading posts. The trading post includes weighing, washing, bagging and storage facilities as well as an office for the exchange of marketing information. The layout of the trading post is explained in section 6.3.

Proposed Trading Posts

Municipality	Road Name	No. of Trading Posts
Nagcarlan	San Francisco - Bukal	4
	Sinipian - Silangan Lazaan	2
	Kanlurang Lazaan - Bukal	2
(Sub-total)		(8)
Liliw	Ibabang Sungi - Ilayang Sungi	2
	Novaliches - Luquin	3
(Sub-total)		(5)
Majayjay	Pangil - Bukal	2
(Sub-total)		(2)
Total		15

5.3.4 Organization of marketing cooperatives

Considering the present marketing situations (low selling prices of vegetables and very low bargaining power of the farmers), the first step that should be undertaken is to organize the vegetable farmers in the area. It should be the entry point for realizing the plan for the improvement of marketing activities in the Study area. The organization of marketing cooperatives will strengthen the bargaining position of the farmers both in the sales of their products and in the procurement of farm inputs, promoting stable and fair prices between the producers and the traders.

The proposed trading post should be operated by marketing cooperatives. Where cooperatives exist, they should establish collective marketing system of products. While where no cooperative exists, new marketing cooperative should be organized. The marketing cooperative will be taken as a production and marketing unit in itself to facilitate collective production programming, marketing and the transfer of production and marketing technologies. A marketing tie-up may be arranged between the cooperatives and traders through a marketing agreement of purchase at a reasonable price. Individual marketing cooperatives will be re-grouped later to organize an association of the cooperatives named a "vegetable growers association" as being practiced in Baguio and/or the existing vegetable growing areas in the country.

The proposed trading post will be constructed to provide each or combined marketing cooperatives with the suitable venue required for various activities of the cooperative. In this sense, the construction of trading post should be delayed until respective cooperative could be organized. In order to promote the organization of marketing cooperatives, new members of the cooperatives should be given the privilege that they would be trained at the proposed

"Upland Horticulture and Irrigation Technology Center" on new technologies of growing vegetables, cropping patterns and production scheduling in relation to the market.

In order to ensure that the cooperatives can deal with legitimate traders on a long-term regular basis, there is a need to accredit traders in the area. It involves registration of traders with the Bureau of Trade and sanctioned by the Municipal governments to ensure its implementation. In the registration procedures, priority should be given to the traders who have adequate capital and can make purchase commitment on a regular basis.

5.3.5 Operation and maintenance plan

(1) Roads

Proposed road facilities are composed of the Provincial and Barangay roads. The existing Provincial and Barangay roads should be maintained by the Provincial and Municipal governments, respectively. The proposed roads will be concrete-paved, common in the Philippines, with drainage structures. Therefore, the maintenance is easy and less costly. Principal O&M works are; 1) tree/grass cutting on road shoulders, 2) removal the silt accumulated in the drainage, 3) repair of pavement and bridges, etc.

(2) Trading posts

Respective cooperatives are responsible for operational works of the proposed trading posts. Otherwise, Municipal governments have ownership and are responsible for the minimum maintenance works of the trading posts.

Principal operational works enumerated below are performed in technical collaboration with the Municipal Agricultural Offices.

1) Collection of marketing information and dissemination to other cooperatives
2) Control of shipping schedule
3) Strengthening of marketing cooperative's organization
4) Promotion of workshop aiming at extension of farming technologies
5) Procurement of office tools and marketing equipment
6) Periodical evaluation of cooperative's activities
7) Preparation of annual marketing report

5.4 Agricultural Training and Extension

5.4.1 Necessity of training and extension

Lack of knowledge regarding vegetable production technologies coupled with poor extension system is limiting the vegetable production in the Study area. The following are specific requirements of training and extension on horticulture and irrigation technologies in the Study area:

1) Technologies presently applied for vegetable cultivation are not those developed in the area but simply transferred from other vegetable growing areas in the country. Vegetables are largely influenced by location specific conditions, and therefore specific technologies best suited to the area which are already developed by UPLB/BPI should be propagated to the farmers through the improved extension service network together with demonstration activities.

2) Crops grown in the area are limited to a few kinds such as tomato, cabbage and radish. Many farmers intends to diversify their cropping patterns in order to improve their farm income; however, no technical support has been made to the farmers due to lack of the required information. Training of appropriate technologies on the profitable new crops are long waited.

3) Vegetables are grown mainly in the dry season and the planted area in the wet season is limited to only 30 %. Low cropping intensity is caused by lack of irrigation in the dry season and excess rain water in the wet season. After the proposed Project is implemented, vegetables can be grown under irrigated condition throughout the year. In order to maximize the potential yield under the irrigated condition, new varieties that are already made available in the seed market should be introduced to the area. Training and extension will be needed for the propagation of new varieties.

4) During the heavy wet season from August to November, only sweet potatoes are grown in the limited area. However, UPLB already developed new horticultural crops which are suitable for wet season planting. Field trials and demonstration is needed for the introduction of these new crops to the area. This will greatly help the farmers to improve the farm income during the wet season.

5) Irrigation will be new technology in the area; in order to realize the maximum benefits from the Project, the farmers should learn on-farm irrigation technologies which are best-suited to the selected crops. Training and extension will be needed on this aspect.

6) Many farmers requires post-harvest technologies on vegetables. The areas most in need on this aspect include 1) on-farm preservation technologies, 2) small scale technologies of vegetable processing and 3) post-harvest handling technologies for marketing. Training and extension on these aspects are needed.

7) Great needs also exit on the pest control technologies which minimize the use of agro-chemicals.

5.4.2 General plan of "Upland Horticulture and Irrigation Technology Center"

Considering the above requirements of demonstration and training for the propagation of irrigated vegetable technologies to the farmers, the "Upland Horticulture and Irrigation Technology Center" should be established as one of the project components. The proposed Center will have the following functions:

1) Demonstration of the appropriate technologies on:
   - standard cultural techniques and cropping pattern of vegetables,
   - on-farm irrigation methods,
   - new horticultural crops which are more profitable,
   - new varieties of tomato and cabbage,
   - new crops suitable for wet season planting,
   - post harvest operations and processing,
   - effective soil erosion control measures, and
   - effective pest control measures.

2) Multiplication of recommendable vegetable seeds,

3) Training of agricultural extension workers on the new technologies, and

4) Demonstration of new technologies and field training of leading farmers.

The "Upland Horticulture and Irrigation Technology Center" will be established near to the existing pilot demonstration farm at Barangay Bukal of Nagcarlan, considering the current activities of the pilot demonstration farm which has been operated by the Municipal office of Nagcarlan with technical assistance from the UPLB. The proposed site will be located in the center of the prospective irrigation area and also be connected with the Municipality hall of Nagcarlan by the roads to be improved under the Project.

The proposed facilities of the "Upland Horticulture and Irrigation Technology Center" with a total area of 1.5 ha, are composed by:

1) Experiment, demonstration and seed multiplication farm,
2) Irrigation facilities,
3) Green houses,
4) Laboratory,
5) Class rooms,
6) Accommodation,
7) Offices,
8) Garage/Storage,
9) Meteorological station, and
10) Others.

5.4.3 Operation and maintenance plan

The proposed "Upland horticulture and Irrigation Technology Center" will be operated and maintained by the Department of Agriculture (DA Region IV office) in close coordination with the Municipality office of Nagcarlan, UPLB and NIA. The Center will be incorporated into the existing research and extension network of DA and be operated under managerial responsibility of DA. In particular, the National Crop Research and Development Center (Economic garden) of BPI, Los Baños will be a chief technical arm of DA Region IV for the operation of the Center.

The Center requires at least such experts and technologists as 1) irrigation engineer and technologists, 2) agronomist and agriculturists specialized in horticultural crops, 3) agricultural extension specialist, and 4) extension workers and field assistants for proper operations. Activities of the Center may be supported by 1) contract employment of high quality local staff, 2) overseas training of key employees and 3) visiting consultation by overseas specialists, particularly for seed multiplication.

5.5 Soil Conservation

5.5.1 Necessity of demonstration and extension

Located in mountain slope and with seasonally concentrated rainfall and frequent typhoons, the Study area are susceptible to severe soil erosion. Vegetable farms have the highest erosion potential in the area due to the scarce vegetation cover and the prevailing farming practices which are not oriented to soil conservation. Adoption of soil conservation techniques particularly in vegetable farming is a must in the Study area in order to achieve sustainable agricultural development.

The promotion of soil conservation measures is an important project component. The conservation measures can be seen as a part of farming practices in characteristics and thus farmers must apply them by their own efforts. Thus, the project will support the farmers to adopt the measures by means of demonstration and transfer of the techniques.

5.5.2 Proposed soil conservation measures

There are three types of soil erosion control measures, namely 1) vegetative measures, 2) structural measures, and 3) cultural measures. They all have merits and demerits. To

identify measure(s) suitable for the proposed project area, following matters was particularly taken into account:

1) the measure(s) shall be simple and less costly so as to enable farmers to adopt
2) the measure(s) shall target not only soil erosion control but also nutrient replenishment and moisture conservation

The descriptions of soil erosion control measures and their merits and demerits are summarized in Table 5.5.1. In general, vegetative measures are easy and less expensive to establish and repair compared with structural measures. In addition, vegetative measures can improve the soils if nitrogen fixing trees are used for hedgerow and the leaves and cuttings are used as green manure and mulching materials. On the other hand, they are less effective in very steep slopes and difficult to attain erosion control effect immediately after the establishment. The structural measures have the characteristics almost opposite to the vegetative measures, i.e., difficult and expensive to construct and maintain but become effective right after the establishment. The cultural measures are the ones already or potentially mingled in the vegetative and structural measures.

Taking into account of the experiences of DA and DENR in promoting soil conservation measures and topographical condition of the Study area, vegetative measures such as contour hedgerow, wattling and Sloping Agricultural Land Technology (SALT) are proposed as soil conservation measures to be promoted by the Project.

5.5.3 General plan of demonstration and extension for soil conservation measures

(1) Demonstration farms

The Project will create demonstration fields of soil erosion control technologies at several sites in the area. The main objectives are field trials/demonstration and easy understanding of the soil erosion control technologies by farmers through learning by showing. The adoption should be further encouraged through extension support.

The proposed sites were chosen from the existing farms considering followings:

1) existing farms located in steep slope,
2) easy accessibility for high demonstration effects, and
3) willingness of the owners of the sites to cooperate.

A total of 12.1 ha of demonstration fields was chosen at nine sites comprising of 3.6 ha in Nagcarlan, 7.3 ha in Liliw and 1.2 ha in Majayjay. The technologies to be demonstrated were selected from ones mentioned in the previous section, depending on the physical condition of the sites. More than two measures should be demonstrated at a site to enable the target farmers to select one(s) fit to them. The demonstration fields should be run by the owners under the technical assistance of extension agencies. The owners will be trained beforehand to manage the fields.

(2) Soil Conservation Extension Center

In order to effectively transfer the technologies to the farmers, it is proposed to establish "Soil Conservation Extension Center". The Center will function not only to train farmers but also as to produce tree nurseries to be provided to farmers and as a base of extension agencies. The Center is proposed at Liliw because:

1) Many existing fields in Liliw are located in very steep land, and

2) ISF program was already started and CENRO established a temporary office to supervise the program in Liliw.

5.5.4 Operation and maintenance plan

The proposed demonstration fields will be operated and maintained by the land owners under the technical and material support from PENRO in Laguna Province of DENR. PENRO will train the owners to properly manage the fields. In addition, PENRO will periodically provide extension services to farmers.

PENRO will have prime responsibility for the operation and maintenance of the proposed Soil Conservation Extension Center. Municipal offices of Nagcarlan, Liliw and Majayjay must cooperate for the O&M.

In order to ensure the objectives, it is proposed that DENR assigns experts and technicians for training and supervising farmers, managing the Center, growing tree nurseries, and distributing the nurseries and other necessary materials to farmers. The O&M costs shall be burdened by DENR and Municipal governments but by beneficiaries in order not to discourage the adoption of soil conservation measures. To support these activities, the Project will provide truck, 4-wheel drive pickup and jeep, etc. as O&M equipment.

5.6 Rural Infrastructures

Conditions of the existing rural infrastructures are studied in section 3.8, and the most are perceived to be sufficient to support the proposed project except improvement of the rural road network and some rehabilitation of two rural water supply systems. The improvement of the rural roads is designated to be the most important measures incorporating into the improvement of marketing activities.

Existing rural water supply systems in the Study area are considerably well maintained at level I (point source) or level II (common faucet system or stand post) in services classification. Spring water located at the elevated slope of the Mt. Banahaw ranging from El. 550 m to El. 900 m is being tapped as a water source due to its potability. Existing water conduit system has been contributed to minimize the operation and maintenance cost. In Nagcarlan, only Bukal spring is available to supply water to related Barangays, namely, Barangay Bukal, Abo, Kanlurang Lazaan, Silangan Lazaan, Malinao and San Francisco in the Study area. In Liliw, small yield quantity of several springs located in the National Park is being utilized by conduit for farm size irrigation and rural water use in the high elevated area in Barangays Luquin, Novaliches and Ilayang Sungi.

Adequate yield obtained at Luquin spring is also utilized for rural water use in the remaining area in Liliw. However wasteful use of water caused by leakage from conduit and improper water flow control are observed in both areas, the problems will be solved by the Barangay Water Works and Sanitation Associations (BWSAs) and routine public administration.

5.6.1 Rehabilitation plan of rural water supply system

Urgent rehabilitation works of rural water supply system are integrated into the components of the proposed Project as follows:

1) New intake facilities for Abo rural water supply system in Nagcarlan will be constructed at the same site with the intake facilities for the proposed Nagcarlan upland irrigation system. The new intake facilities will secure stable water intake even in the dry season and free from the troublesome of rebuilding of temporary bamboo intake-pipe by every flood.

2) Two intake concrete boxes of Gawanan rural water supply system in Liliw will be replaced. The connecting conduit from intake concrete boxes to the existing conveyance conduit will be also replaced for the improvement of present hydraulic defect.

5.6.2 Operation and maintenance plan

In general, rural water supply systems under BWSAs have been constructed with the subsidy of construction materials and engineering services from DPWH. An autonomous body of the BWSAs has a full responsibility for the operation and maintenance of the system under the guideline of the Municipal governments.

5.7 Future Land Use and Agricultural Production

5.7.1 Future land use

The implementation of the proposed project will motivate considerable changes on the land use in the Study area. As described in section 3.5, present land use in the Study area consists upland vegetable field of 760 ha and coconut farm of 1,220 ha out of the total area of 3,000 ha. Meanwhile, around 790 ha of the Study area is located in the National Park area and 390 ha is in the Public Forest lands.

With regard to the environmental preservation in the National Park, further expansion of agricultural land use should be prohibited. Accordingly, the agricultural land located in the National Park area, which is estimated at 100 ha comprising of 80 ha of vegetable field and 20 ha of coconut farm at present, should be excluded from beneficial area of the proposed Project so as not to induce further destruction of forest. While, provision of the Project facilities aiming at agricultural development in the Public Forest lands has been accepted by governmental agencies concerned on condition that further expansion of agricultural lands be restricted.

The implementation of the Project will motivate considerable changes on the land use in the Study area. Total area of 1,390 ha, comprising of 340 ha by provision of irrigation systems and 1,050 ha by improvement of marketing activities by means of roads and trading posts construction, will be improved as a vegetable farm lands. The coconut farms of 630 ha will be gradually converted to vegetable farms along the improved farm roads. This transformation of land use must be accompanied by the soil conservation methods promoted by the Soil Conservation Extension Center to prevent the soil erosion hazards.

These changes in land use in the Study area by the Project are shown as the following table and detailed in Table 5.7.1.

Summary of Land Use Changes by the Project

(Unit: ha)

Land Use	without Project	with Project	Difference
Vegetable farm	760	1,390	+630
- Rainfed	760	1,050	+290
- Irrigated	0	340	+320
Coconuts	1,220	590	-630
Forest/scrub	750	750	0
Others *	270	270	0
Total	3,000	3,000	0

Remark: "Others" includes river beds, residential areas, rice land, etc.
The acreage of vegetable farms is shown in gross
Vegetable farm in rainfed includes the vegetable farms in the National Park area

5.7.2 Crops and cropping pattern

The Study area is a newly developed vegetable production area, and the varieties of vegetables are limited. According to the farmers' household survey, farmers desire to expand the cropping area especially for tomato and cabbage in the dry season and for cabbage, beans and sweet potato in the wet season if sufficient water is available by the Project. It is faithfully reflected of present cropping pattern, however, majority of the farmers simultaneously expect introduction of highly profitable vegetables.

Most of sub-tropical vegetables have a large possibility to be planted under the natural conditions in this area. High cropping intensity and cultivation of various high profitable vegetables will be accomplished, provided that the land productivity and marketing condition are improved by the Project, and the agricultural training and extension services make remarkable achievements at the proposed Upland Horticulture and Irrigation Technology Center.

Accordingly, proposed cropping pattern is prepared to achieve high cropping intensity by means of cultivation of highly profitable and suitable vegetables based on prevailing present cropping pattern. In this connection, 25 vegetables commonly dealing with in markets have selected to examine their profitability, marketability, and suitability of cultivation in the Study area. Analysis results are summarized in Tables 5.7.2, 5.7.3 and 5.7.4. On the basis of the overall rank of these vegetables, following 12 vegetables were finally selected and combined into some types of the cropping pattern as shown in Fig. 5.7.1.

tomato, cabbage (dry and wet season), radish, sweet potato, beans (Baguio beans and sitao), carrots, Chinese cabbage, celery, lettuce and cauliflower

Preparing proposed cropping pattern, the following were taken into account:

1) Generally in advanced vegetable production area such as Baguio and Second Laguna in Cavite Province, annual cropping intensity was about 300 % or more due to the intensive use of farm land. In this regard, it will be possible to raise the cropping intensity up to 300 % under the irrigated condition in the Study area. Cropping pattern is composed of two crops in the dry season and one crop in the wet season. To attain high productivity, vegetable protection from excessive saturation of soil by means of vinyl covering, etc. will be necessary during the wet season.

2) With regard to the area not being irrigated under the Project, 200 % of cropping intensity will be attained together with encouragement of farmers' intention of vegetable production induced by improvement of agricultural infrastructures by the Project. Two crops under the present cropping pattern are conducted in every seasons.

3) The proportion of tomato planting is presently so high that the continuous cropping of tomato induces increase of crop diseases, as well as soil deterioration, soil sickness. To reduce such anxiety on the crop farming, the proportion of a crop should be limited within 50 % in each cropping pattern, and the continuous cropping of the same kind or family of crops in a particular farm should be avoided as far as possible.

4) Both of laborious farming practice and technical skills are in general required to successfully cultivate high profitable crops, so that such crops should not be introduced too much regardless farmers' ability.

5) Legume crops should be incorporated in crop rotation as much as possible since they can improve the soil fertility. In proposed cropping pattern, the legume newly increased is represented by sitao that is more profitable than Baguio beans represented existing legume on the cost and return analysis.

5.7.3 Proposed farming practices

All of the vegetables in the proposed cropping pattern are common in upland fields and markets of this country, and ordinary farming practices are already established by agricultural research institutes of DA, agricultural universities and colleges, extension offices, etc. However, it is impossible to produce high quality vegetables without appropriate acknowledge about local characteristics of the area. The following are taken into consideration for farming practices of vegetables in the Study area:

1) The mechanization of farming practice will be very difficult because the upland fields of the Study area are highly undulated. Land preparation using animal power will be common even in the future. Though acceptable period for land preparation will be tightened due to high cropping intensity, thorough land preparation should be essential for all kinds of vegetables. The contour hedgerow should be practiced as much as possible in order to protect upland soil from erosion.

2) High quality seeds must just promise the good products and high profit to the farmers. So that high quality seeds should be introduced instead of traditional ones. New recommendable varieties for proposed crops should be determined and diffused by MAOs as soon as possible. Generally the seed beds prepared in the Study area seem to be so narrow and poor to get good seedlings, that more investment should be taken for the seed bed preparation.

3) According to the soil survey, the soil in the Study area is relatively fertile and suitable for vegetable production. Generally it will be unnecessary to take any particular measures for soil improvement. However further fertilizer application should be necessary to rise up of the unit yield and cropping intensity of vegetables. At present, application of chicken manure is very popular in the Study area, and the application of not only chicken manure but also various kinds of organic fertilizers should be still more promoted.

4) As the Study area is located at the upstream in the watershed of the Laguna Lake, excessive use of agro-chemicals might cause the pollution of the water resource downstream of the Study area. Agro-chemical use is generally increased together with an expansion of cropping intensity, the greatest care should be paid for the amount and intervals of agro-chemical use. Furthermore, effective use of organic fertilizer, mulching, weeding of the plants that serve as host, avoidance of susceptible vegetables in succession, plant protection against the heavy rain, etc., should be practiced to reduce plant pests and diseases at the same time. In addition, plant pest clinic, forecasting of pests and diseases, and training of farmers on crop protection should be promoted for proper pest and disease control.

5) Agricultural marketing are activated through improvement of marketing conditions by means of the roads and trading posts construction under the Project. Accordingly harvesting should be carried out in due consideration of marketability based on the market information. Scheduled planting and harvesting should be accomplished at the stage of an individual and a local. Furthermore, careful handling of the products from the picking up on the field to the selling at the trading posts should be performed. Transporting, sorting, grading and packing of the products should be improved to maintain the economic value of the products at the markets. Based on periodical marketing research, marketing cooperatives shall prepare post-harvesting manuals for farmers.

Notwithstanding several efforts by related agencies, many problems and constraints are still lying comprehensively on the country's vegetable industry. Some of them are unavailability of superior varieties, high cost of inputs, ineffective and inadequate research, training and extension services, limited post-harvest technology, lack of financing and low credit availability, etc., which must be affect to the improvement of farming practices in the Study area. However those nationwide problems and constraints will not be worked out only by a few local governments but the orchestrated activities of national and regional government agencies will be expected.

The proposed "Upland Horticulture and Irrigation Technology Center" must greatly contribute to improve the present farming practices for proposed vegetable production.

In Table 5.7.1, the production costs of vegetables were roughly estimated to compare the marketability of several vegetables. However the production costs of the proposed vegetables in the Study area were re-estimated more precisely, and those are summarized in Table 5.7.5 and 5.7.6.

5.7.4 Anticipated unit yield of crops

In the Study area, it is worried that unit yields of the vegetables will decrease in future because of the unfavorable degradation of soil fertility, unless any soil conservation measures will be conducted in the farmlands. The unit yield rates of the vegetables have remained on the same level as a whole in Laguna Province these years. Taking in to consideration of such situation, the future unit yields will not exceed the current unit yields at least under the condition without the proposed Project. Therefore, the unit yields of the vegetables under without Project condition is estimated at the same levels as present.

The unit yield of vegetables in the Study area is in very low level as mentioned before. Despite of high potential of land for vegetable production, insufficient agricultural infrastructure contributes to low farm productivity in the Study area. For instance, the unit yield at where irrigation systems will be provided by the Project will be remarkably raised as the same level as in advanced areas, such as Baguio and Second Laguna. Assuming these improvement, anticipated unit yields of each vegetable in the Study area are estimated as tabulated in Table 5.7.4 in the irrigated area, based on the average unit yield in advanced areas.

The unit yield of vegetable in the non-irrigated area will be also certainly increased due to increase of farm inputs and rationalization of farm practices associated with improvement of existing agricultural restrictions by the Project. Consequently, the increase of unit yield of the crops in the area was estimated about 20 % up of the existing crop unit yield, or about 80 % of the anticipated unit yield of the crops in the irrigated area.

The anticipated unit yield of each proposed vegetable is shown in following table:

Anticipated Unit Yield of Crops

(Unit: ton/ha)

Crop	Irrigated area	Rainfed area
Tomato	14.7	12.0
Cabbage (Dry)	17.6	8.4
(Wet)	10.6	8.4
Radish	15.3	10.8
Sweet potato	15.4	12.0
Baguio beans	6.7	6.3
Carrots	12.6	10.1
Cauliflower	9.4	n.p.
Celery	12.6	n.p.
Chinese cabbage	13.9	n.p.
Lettuce	11.9	9.5
Sitao	10.3	8.2

n.p.: not produced

5.7.5 Agricultural production under future condition with Project

Based on the future land use described in section 5.7.1, proposed cropping pattern in section 5.7.2, proposed farming practices in section 5.7.3, and the anticipated unit yield of crops in section 5.7.4, the amount of the vegetable production in future with project was estimated as shown in the following table. These targets will be achieved by five years in the area, with irrigation, and by ten years in the area without irrigation under the improvement of marketing facilities and supporting services provided by the Project.

Agricultural Production under Future Condition with Project

	Irrigated area			Rainfed area			Total
	Area (ha)	Unit yields (kg)	Production (tons)	Area (ha)	Unit yields (kg)	Production (tons)	Production (tons)
Tomato	160	14.7	2,352	465	12.0	5,580	7,932
Cabbage							
(dry season)	96	17.6	1,689	186	8.4	1,562	3,251
(wet season)	64	10.6	678	186	8.4	1,562	2,240
Radish	64	15.3	979	186	10.8	2,009	2,988
Sweet potato	96	15.4	1,267	279	12.0	3,348	4,615
Baguio beans	32	6.7	214	93	6.3	586	800
Carrot	96	12.6	1,210	93	10.1	939	2,149
Chines cabbage	96	13.9	1,335				1,335
Celery	32	12.6	403				403
Lettuce	32	11.9	381	93	9.5	884	1,265
Cauliflower	32	9.4	301				301
Sitao	160	10.3	1,648	279	8.2	2,288	3,936

Remark: "Area" shown in net area

This anticipated production of the vegetables will not affect surplus supply to Metro Manila. The market share of the products from the Study area is roughly estimated at only 5 %

of the demand of Metro Manila in the fifth year after completion of the Project, and also 7 % in the tenth year (see Appendix-IV.2.4).

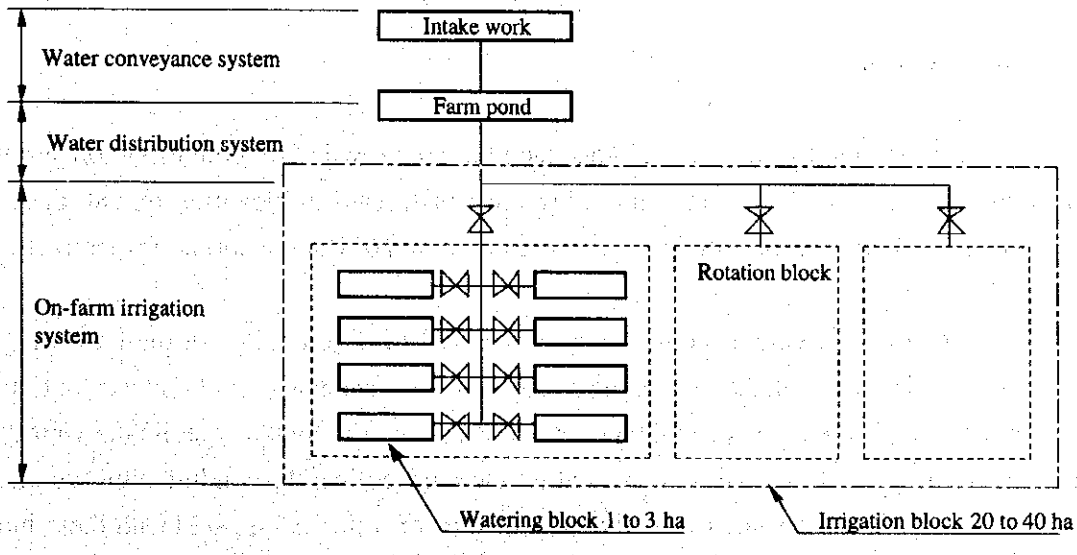
6.1 Irrigation Facilities

(1) Upland irrigation system

Upland Irrigation system consists of water conveyance system, water distribution system, and on-farm irrigation system as illustrated below.

Water conveyance system is a general term for a series of facilities from intake work to farm ponds. Water distribution system is those of facilities from farm pond aiming at regulation of water demand within a day, to on-farm irrigation facilities. On-farm irrigation system is a general term for a series of facilities from the valves covering the watering blocks to other secondary facilities.

As stated in irrigation development plan, gravity irrigation is adopted for both of Nagcarlan irrigation system and Liliw irrigation system.



Schematic Diagram of Whole Irrigation System

Fig. 6.1.1 is the schematic diagram which represents the arrangement of main irrigation facilities such as intake works, farm ponds, pipelines, and common hydrants.

Whole beneficial area is divided into ten irrigation blocks, comprising of five block in Nagcarlan and five blocks in Liliw. Irrigation block area ranges from 21 ha to 42 ha to attain appropriate irrigation practices, e.g., water distribution and flow control.

The location of each irrigation block tabulated below is shown in Fig. 6.1.2.

Beneficial Area by Irrigation Block

Municipality	Irrigation block No.	Area(ha)	Remarks
Nagcarlan	N-1	27	Water resource: Bukal spring
	N-2	27	
	N-3	41	
	N-4	21	
	N-5	39	
	Sub-total	155	
Liliw	L-1	34	Water resource: Luquin spring
	L-2	42	
	L-3	28	
	L-4	30	
	L-5	31	
	Sub-total	165	
Total		320	

(2) Intake work

In order to divert spring water, intake facilities are provided for both irrigation systems. The intake facilities of Nagcarlan and Liliw are constructed at elevation of 880 m at the downstream of Bukal spring, and 620 m at the downstream of Luquin spring, respectively.

An elaborate structural contrivance is required to divert water in the case that the diversion work is constructed at where the riverbed slope is steep and voluminous stone flows down by floods. There are several intake types such as natural intake type, intake weir type, water cushion intake type, bar screen intake type, and collecting conduit type which are structurally classified according to the diversion method of water. Compared with these intake types, water cushion intake type is recommended because of its structural advantages against deposit of bed load, collision of cobble stone, as well as ease of maintenance works.

(3) Farm pond

Farm pond is facilitated to each irrigation block. To control hourly fluctuation of water demand at on-farm level. Considering topographical limitation and appropriate operation works of water distribution and flow control devices, total of ten farm ponds are distributed to each irrigation block. Proposed farm ponds shall be planned in higher portion of each irrigation block so as to distribute irrigation water by gravity.

Assuming that net amount of water to be replaced is 2 mm a day and water storing time is 12 hours a day, the capacity of farm pond is estimated at 360 cum to cover one irrigation block with an average area of 32 ha. Concrete water tank is proposed for farm pond structure, taking account of high permeability of volcanic deposits of the foundation.

(4) Pipeline

Pipeline systems are classified into two categories, namely conduit pipelines and distribution pipelines according to the function. Conduit pipelines are generally defined as pipelines connecting between the intake works and farm ponds, and distribution pipelines are placed from farm ponds to on-farm facilities.

System capacity of each pipeline is shown as follows:

System Capacity of Pipeline

Category	Capacity (lit/sec/ha)	Operation Time (hrs)	Remarks
Conduit pipelines	0.26	24	Water conveyance time
Distribution pipelines	0.39	12	Net irrigation time

Note: Net amount of water to be replaced = 2 mm/day

Galvanized Iron pipes (schedule 40) are proposed in terms of rot-proof and durability, and diameter of which varies from ø 80 mm (ø 3") to ø 250 mm (ø 10") corresponding to the discharge variations. Diameter of pipe is estimated to regulate flow velocity ranging between minimum allowable velocity 0.3 m/sec and standard velocity 1.0 m/sec. Sluice valves, air valves, and blow off valves should be properly equipped for smooth operation and periodical maintenance of pipelines. Pressure dissipating water tanks with a capacity of 10 cum will be also installed properly to maintain water pressure inside of pipelines not to exceed 15 kg/sq.cm.

(5) Common hydrant

A common hydrant is installed to supply water to each irrigation area covering approximately 1 ha to 3 ha which can be irrigated within a day. Irrigation water is supplied by using farmer's own hoses joined with outlet of common hydrants or hand-carried watering pot.

Details of the proposed irrigation facilities are summarized as follows:

Proposed Irrigation Facilities

Item	Quantity					
	Nagcarlan		Liliw		Total	
Beneficial area	155	ha	165	ha	320	ha
Intake works	1	site	1	site	2	sites
Farm ponds	5	sites	5	sites	10	sites
Pipeline						
ø 250 mm (ø 10")	450	m	350	m	800	m
ø 200 mm (ø 8")	2,050	m	750	m	2,800	m
ø 150 mm (ø 6")	1,130	m	820	m	1,950	m
ø 125 mm (ø 5")	3,800	m	660	m	4,460	m
ø 100 mm (ø 4")	4,720	m	6,390	m	11,110	m
ø 80 mm (ø 3")	16,530	m	12,100	m	28,630	m
Total	28,680	m	21,070	m	49,750	m
Common hydrants	95	units	78	units	173	units
Pressure dissipating tanks	2	sites	2	sites	4	sites

Note: Pressure dissipating tanks are installed to control excessive hydraulic pressure in pipeline, etc.

6.2 Farm-to-Market Roads

Total of seven routes, connecting between farm lands and market and contributing to shipping of farm products are proposed for road improvement plan among the existing roads in the Project area (see Fig. 6.2.1).

The proposed roads shall be paved with concrete to attain transportation convenience of farm products and ordinal public traffic, and drainage L-shape gutters shall be facilitated at both sides of concrete pavement. Comparing with an asphalt pavement, a concrete pavement is much cheaper on O&M especially in the steep land, and is executed there more commonly. Concrete pavement with 4 m width is basically employed for the proposed Barangay roads, and 5 m width is, employed for Provincial roads.

Fig. 6.2.2 shows the standard section of the proposed roads. Furthermore, drainage L-shape gutters shall be supplementarily constructed at the both side of existing concreted main roads where no drainage has been equipped.

In addition, cross drainage culverts are facilitated with proper intervals. Box-culvert type bridges are proposed at the four sites where the proposed roads cross the main river, in consideration with topographic condition, structural stability and construction schedule.

Proposed improvement plan of farm-to-market roads is summarized as follows:

Length of the Proposed Roads

Municipality/Road name	Pavement (1)		L-shape Gutter (2)	Bridge	Total
	W = 5 m	W = 4 m			
Nagcarlan					
San Francisco-Bukal	1,524 m	4,515 m	581 m	1 no	6,620 m
Sinipian-Silangan Lazaan		764 m	5,267 m		6,031 m
Malinao-Kanlurang Lazaan		1,523 m	127 m		1,650 m
Kanlurang Lazaan-Bukal		2,144 m		3 nos	2,144 m
Liliw					
Ibabang Sungi-Ilayang Sungi		976 m	3,424 m		4,400 m
Novaliches-Luquin	1,607 m	1,603 m	2,490 m		5,700 m
Majayjay					
Pangil-Bukal		3,883 m	397 m		4,280 m
Total	3,131 m	15,408 m			
	18,539 m		12,286 m	4 nos	30,825 m

Notes: (1) L-shape drainage construction is included in pavement works
(2) Total length of 12,286 m of L-shape gutter is constructed along the existing concrete pavement roads

6.3 Trading Posts

The location of 15 trading posts shall be planned along the existing main roads taking consideration of its accessibility and the present location of existing temporary trading posts. The location of the proposed trading posts, eight in Nagcarlan, five in Liliw, and two in Majayjay is indicated in Fig. 6.3.1. Plan of trading posts equipped with the following facilities corresponding to various uses is illustrated in Fig. 6.3.2.

Working space: Working space has a floor area of 100 sq.m for the purpose of weighing, packing and storage of farm products. The structure is a steel frame with shade. Floor is set up at 80 cm higher than parking lot to mitigate working burden, such as the loading and unloading of the farm products.

Parking lot:	Parking lot has 5 m in width and 10 m length, sufficiently enough for loading and unloading of farm products by two to three vehicles.
Washing basin:	Washing basin is provided so as to wash the farm products, such as radish and carrot. Water is distributed from the existing rural water supply conduits laying along the road, and two faucets are installed at the both sides of the washing basin.
Office space:	Office serves to exchange the information on whole sale prices and managerial work of the trading posts.
Office equipment:	Weighing machines and office tools.

6.4 Upland Horticulture and Irrigation Technology Center

The Upland Horticulture and Irrigation Technology Center is composed of demonstration farm and center building, of which whole layout is shown in Fig. 6.4.1.

(1) Demonstration farm

Consolidated farms are planned in order to demonstrate standard horticultural technologies and on-farm irrigation practices. It has a total area of about 1 ha, being divided into ten farm lots. The greenhouse is provided for the purposes of demonstration and research of farming practice during the wet season. On-farm irrigation practices are also demonstrated by using several kinds of irrigation instruments such as sprinkler, micro-jet, micro-sprinkler, and drip tube, which were used in the existing demonstration farm in Bukal. The arrangement of irrigation instruments on the demonstration farm is shown in Fig. 6.4.2. Besides, irrigation system including water tank with a capacity of 20 cum, pump station, and pipelines are established so as to operate irrigation instruments placed on the demonstration farm.

(2) Center buildings

Center building contributes to training of farmers on horticulture and irrigation technologies and operation and management of the demonstration farm. The proposed layout of the center building is shown in Fig. 6.4.3. The following are the proposed facilities and equipment of the Center building.

Main building (total floor area: 264 sq.m)

Seminar room:	One room (35 sq.m) with educational equipment.
Laboratory:	One room (30 sq.m) with laboratory equipment.
Office:	One room (24 sq.m) with office tools.
Accommodation:	Three rooms (36 sq.m) with furniture.
Dining hall:	One room (54 sq.m) with kitchen.
Garage/storage:	One garage and two storage rooms (56 sq.m).
Experiment instrument:	Soil test equipment, seed production instrument, etc.
Meteorological observation station:	Rainfall recorder, wind velocity/direction meter, sunshine duration meter, evaporation pan, temperature, humidity meter, etc.
O & M equipment:	Office tools, computers, copy machine, tractors, 2 ton trucks, 4 wheel jeeps, pickup cars, motor bikes, etc.
Others:	Security fence, electric and water supply facilities, etc.

6.5 Soil Conservation Facilities

Demonstration and extension of soil conservation measures are proposed as one of the project components, in which demonstration fields for its extension and the Soil Conservation Extension Center aiming at the extension of soil conservation technology and supply of tree nursery are proposed.

(1) Demonstration fields

The objectives of the demonstration fields are field trial and easy understanding of soil conservation technologies by farmers themselves through learning by demonstration. The technologies to be demonstrated will be selected among several methods, such as contour hedgerow, Sloping Agricultural Land Technology (SALT), and wattling according to the site condition. Initial works such as transplanting of tree nursery will be implemented at the demonstration fields scattered in the project area.

Fig. 6.5.1 shows the location of the proposed demonstration fields, and details are listed below:

Proposed Demonstration Fields

Municipality	Number	Total area
Nagcarlan	3 sites	3.6 ha
Liliw	5 sites	7.3 ha
Majayjay	1 sites	1.2 ha
Total	9 sites	12.2 ha

(2) Soil Conservation Extension Center

The Soil Conservation Extension Center serves to supply of the saplings for counter hedgerow and/or SALT, and to train the farmers on soil conservation technologies. The layout of Center building in Fig. 6.5.2 is proposed.

The following facilities and equipment are required:

Total area:	3,000 sq.m
Tree nursery:	2,000 sq.m
Irrigation facilities:	Pumps, pipelines, valves, water tank, and sprinkler system
Center building:	156 sq.m
Seminar rooms:	Two rooms (72 sq.m) with educational equipment
Office:	One room (35 sq.m) with office tools
Garage/Storage:	One garage and two storage rooms (56 sq.m) with farming tools
O&M equipment:	Office tools, farming tools 2 ton trucks, pickup cars, 4 wheel jeeps, etc.

Location of the Center is proposed inside of the proposed irrigation system coverage along the Novaliches road Liliw Municipality.

6.6 Rural Water Supply System

Based on the inventory survey of existing rural water supply facilities, urgent rehabilitation works will be conducted for two Rural Water Supply Systems (RWSSs), viz., Abo, RWSS in Nagcarlan and Gawanan RWSS in Liliw.

(1) Bukal spring of Nagcarlan

Spring yield at Bukal spring is presently utilized for the rural water at Barangays Abo, Bukal, San Francisco and Malinao.

Intake devices are comprised three intake pits providing water to each Barangays. However, the intake device which has provided water to Barangay Abo has primitively constructed with bamboo being laid on the riverbed, and it has to be rehabilitated each time after flood.

Thus, intake at Abo shall be unified into the proposed irrigation intake to sustain stable water supply to Barangay Abo.

(2) Gawanan springs of Liliw

Domestic water of Liliw is derived from Serian spring and Gawanan #1 and Gawanan #2 springs. Gawanan intake boxes and their distribution pipelines were built in 1926, since then no rehabilitation was done to maintain the rural water supply system. Water being taken by intake box at Gawanan #1 is conveyed by pipelines with sizes ranging from ø 150 mm (ø 6") to ø 100 mm (ø 4"). Besides, ø 100 mm (ø 4") conduit pipe installed at Gawanan #2 intake box is interconnected to ø 150 mm (ø 6") conduit pipe of Gawanan #1 spring at the lower portion at about 120 m downstream. The field reconnaissance conducted in the study reveals the necessity of urgent rehabilitation stated below.

1) Renewal of the existing decrepit intake boxes

2) Replacement of the conduit installed between intake boxes and the junction of two conduits so as to improve the hydraulic defect

The rehabilitation works are planned as follows:

System name	Spring name	Rehabilitation works	Quantity	Remarks
Abo RWSS in Nagcarlan	Bukal	Intake conduit	1 LS	ø 100 mm (ø 4") steel pipe
Gawanan RWSS in Liliw	Gawanan #1	Intake box conduit	1 no 270 m	4.0m*3.5m*2.5m steel pipe ø 150 mm (ø 6")
	Gawanan #2	Intake box conduit	1 no 270 m	4.0m*3.5m*2.5m steel pipe ø 200 mm (ø 8")

Details of the designing for the proposed facilities are described in Appendix VIII.

CHAPTER VII IMPLEMENTATION SCHEDULE AND COST ESTIMATES

7.1 Project Construction Plan

7.1.1 Project components and work volume of the construction works

The components to be constructed under the project are discussed in the previous chapter, and the major construction works are summarized as follows:

Major Construction Works

Items	Description	Q'ty	Unit	Remarks
1 Irrigation Facilities	Irrigation blocks	10	blocks	Total irrigable area: 320 ha
	Intakes	2	sites	Water source: Spring yield
	Farm ponds	10	sites	Concrete structure (Capacity: 360 cum/pond)
	Pipeline	49,750	m	(ø 80 mm - ø 250 mm)
	On-farm facilities	173	units	(Hydrant valves)
2 Road Construction	Concrete pavement	18,539	m	W = 5.0 m: 3,131 m W = 4.0 m: 15,408 m w/ L-shape drainage ditch
	Drainage culvert	132	sites	RC pipe/box culverts type
	Bridge	4	brdgs	Box type
3 Trading Posts		15	bldgs	Storage space/office (Floor area: 152 sq.m)
4 Upland Horticulture and Irrigation Technology Center	Center building	1	bldg	(Floor area: 264 sq.m)
	Demo-farm	1	site	(Area: 1.0 ha)
	Green house, etc.	3	houses	(Floor area: 630 sq.m)
	Storage/garage	1	bldg	(Floor area: 56 sq.m)
5 Soil Conservation Works	Center building	1	bldg	(Floor area: 156 sq.m)
	Storage/garage	1	bldg	(Floor area: 56 sq.m)
	Tree nursery farm	1	site	(Area: 0.2 ha)
	Demonstration fields	12.2	ha	Contour hedgerow, SALT
6 Rehabilitation works on Rural Water Supply System	Intake facilities	2	sites	Concrete tanks
	Rehabilitation of conduit	1	LS	(ø 150 mm - ø 200 mm)

Major work volumes for the proposed components were estimated based on the preliminary design of the facilities. The following are the major work volumes of the proposed construction works. Small earth movement is not indicated in the table.

Major Work Volumes

Items	Materials	Q'ty	Unit	Remarks
1 Irrigation Facilities	Excavation	17,000	cum	(excluding surface smoothing)
	Reinforced concrete	1,400	cum	
	Reinforcing bar	90	ton	
	Gravel foundation	300	cum	
	Pipeline	49,750	m	ø 250 mm: 800 m
	(ø 80 - ø 250 mm)			ø 200 mm: 2,800 m
				ø 150 mm: 1,950 m
				ø 125 mm: 4,460 m
				ø 100 mm: 11,110 m
				ø 80 mm: 28,630 m
	On-farm facilities	173	units	(Hydrant valves)
2 Road Construction	Concrete for pavement	23,500	cum	
	Reinforced concrete	1,200	cum	
	Gravel sub-grade	25,000	cum	
	RC pipes	550	m	ø 300 mm: 20m
				ø 450 mm: 145m
				ø 600 mm: 275m
				ø 750 mm: 60m
				ø 900 mm: 50m
3 Trading Posts	Reinforced concrete	670	cum	Other works:
	Reinforcing bar	25	ton	Electric works
	Roofing (G.I. sheet)	3,000	sq.m	Plumbing works
	Structural steel	60	ton	Gravel pavement
4 Upland Horticulture and	Reinforced concrete	170	cum	Other works:
Irrigation Technology Center	Reinforcing bar	9	ton	Electric works
	Roofing (G.I. sheet)	420	sq.m	Plumbing works
	Structural steel	0.5	ton	Gravel pavement
	Structural lumber	7	cum	Fencing works
	Concrete for pavement	400	cum	
5 Soil Conservation Works	Reinforced concrete	100	cum	Other works:
	Reinforcing bar	5	ton	Electric works
	Roofing (G.I.sheet)	250	sq.m	Plumbing works
	Structural steel	0.3	ton	Gravel pavement
	Structural lumber	4	cum	Fencing works
6 Rehabilitation works on	Reinforced concrete	20	cum	
Rural Water Supply System	Reinforcing bar	2	ton	
	Conduit	540	m	ø 200 mm: 270 m
				ø 150 mm: 270 m

Notes: The above table shows only major items, and excludes minor items.
The quantities of the above table exclude amount of loss.
RC pipe: Centrifugal reinforced concrete pipe
G.I. sheet: Galvanized iron sheet

7.1.2 Construction planning

(1) Workable days

Workable days are estimated as follows, taking into account of daily rainfall in the Project area. Construction works are broadly composed of; 1) concrete works (road pavement, concrete farm ponds, etc.), 2) earth works, 3) piping works, 4) building works. Amongst these works, concrete works volume occupies the majority of whole construction volume. In relation to the fact, workable days are estimated primarily aiming at the concrete works. The following are estimated assuming that concrete works are discontinued in the case a daily rainfall is 15 mm or above.

Workable Days

(Unit: days)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Workable days	25	24	25	23	23	18	20	20	20	16	18	22	254

Source: Rainfall data at Liliw (1979 - 1983)
Note: Construction works are discontinued in the case daily rainfall is 15 mm or above.

(2) Temporary works

Temporary works shall be planned to achieve the appropriate quality control, to minimize construction cost, to secure the safety of labors and machinery/equipment, to maintain appropriate construction schedule, etc. The following are the temporary works required for the construction works:

1) Construction of concrete batching plant (quality control of concrete and minimization of construction period)

2) Establishment of stock yards for construction materials and motor pool for construction equipment (quality, safety control)

3) Installation of electric and water supply system (quality, flow control)

4) Maintenance work of material transportation roads and foot-pass (safety control of labors and construction machinery/equipment)

5) Set up of temporary strut retaining wall (safety of labors)

6) Establishment of soil disposal yards with proper erosion protection (environmental preservation)

7) Installation of drainage canals/culverts (environmental preservation and maintenance of construction schedule)

8) Installation of scaffold and staging (safety of labors)

(3) Construction plan

Construction plan of the major proposed facilities are as follows:

1) Irrigation facilities

Irrigation facilities are composed of the intakes, farm ponds and pipeline installation works. Construction works broadly consist of earth work, concrete work and pipeline work. Transportation of the construction materials (cement, aggregates, steel bar, steel pipes, wooden forms, etc.), concrete mixing and earth works are carried out by man-power because of its restriction of temporary road construction in due consideration of the environmental preservation in the Project area. Construction planning shall be established taking transportation capacity (labor force) and construction schedule. All of the excess materials, e.g., excavated earth materials, form lumber, steel materials and temporary structures shall be properly disposed outside of the critical environmental area. Conduit pipe shall be lain under the ground surface. Regarding intakes, concrete structures are recommended so as to mitigate surface wearing by flow, and to ensure impermeability through foundation. Also confronting to the difficulty of access due to prohibition of O&M road construction in the critical environmental areas, in addition, another exploration relating to stability of intake structures and impermeability shall be conducted prior to the construction works.

2) Rural road

Road works are composed of pavement, drainage, and bridge construction works. Regarding quality control and construction control maintenance, all concrete shall be produced at the batching plant and transported by agitator-body trucks or dump trucks. Proper mixing capacity and transportation cycle time shall be examined to efficiently achieve concrete casting works. Drainage culverts and bridges construction shall be completed during the dry season to minimize flood damages in the wet season. Furthermore, detailed planning for the route selection of concrete pavement shall be decided in consideration of transportation of farm products and common traffic in the Study area. Gravel sub-base with its thickness of 15 cm shall be constructed to protect concrete pavement from traffic load including construction machinery/equipment. Replacement method shall be adopted provided bearing capacity is too small against load.

3) Trading posts

Construction works of trading posts are composed of foundation, floor, steel structure and roofing works. Appropriate distribution of man power to proposed 15 trading posts and effective manufacture of steel structures result in minimization of the construction period.

4) Upland Horticulture and Irrigation Technology Center

Construction works are comprised of the center building, storage/garage, green house, demonstration farm, and irrigation system for the demonstration farm, etc. Procurement schedule of heavy equipment for earth work, concrete delivery schedule from batching plant and delivery of electric and plumbing materials shall be planned before the construction works. Condition of the foundation shall be also exploded by means of test pits excavation for the preparation of prospective specific foundation treatment.

5) Soil Conservation Extension Center and demonstration fields

The Center facilities are comprised of the center building, storage/garage and nursery farm. Procurement schedule of heavy equipment and construction materials, furthermore, detailed foundation exploration of the center building will be carried out before the commencement of the construction works to secure the construction schedule.

Transplanting of tree nursery at the demonstration fields will be carried out with participation of the beneficial farmers. Technical assistance by PENRO is simultaneously expected during the construction period.

6) Rehabilitation works of domestic water supply system

The rehabilitation works are replacements of timeworn intake boxes and conduits in proposed two sites in Nagcarlan and Liliw. Temporary diversion works which contribute for present water supply shall be facilitated before the commencement of the construction works. Transportation of the construction materials, concrete mixing are carried out by man-power because of its restriction of temporary road construction in due consideration of the environmental preservation in the Project area.

(4) Construction schedule

Construction schedule is planned as shown in Fig. 7.1.1 on each project component. Construction schedule is calculated in terms of the workable days, concrete mixing capacity, number of laborers, working hours a day, as well as temporary works. As a result of the calculation, the construction works could be completed within 18 months including mobilization/demobilization.

Monthly rainfall amount is fluctuated in a year, and most of rainfall is concentrated during the wet season from May to December. Earth works shall be conducted during the dry season because earth works are severely affected by consistency of soil. Meanwhile, the existing road in the Project area will hardly be utilized for passing of the transportation of construction materials, equipment and labor force to the scattered sites due to the rough and irregular surface condition. In this connection, concrete pavement works of these existing roads shall be commenced prior to the other construction works. Concrete pavement works shall be continued even during the wet season with proper drainage works and surface protection works of pavement from heavy rainfall.

The indispensable equipment for project implementation, agricultural and soil conservation extension services shall be provided immediately after the completion of each proposed facility to expect an earliest appearance of the input procurement effect of the equipment.

7.2 Implementation Schedule

The project implementation schedule consists of three stages, viz., 1) preparatory works for project implementation stage, 2) detailed design stage, 3) construction supervisory stage. The project implementation schedule including one year for pre-construction activities, such as submission of the Project Description (PD), project proposal, establishment/ strengthening of beneficiaries' organizations, as well as financial allocations/supplements for the project implementation and O&M by related agencies, is presented in Fig. 7.1.1. As described in section 8.2.2 in detail, PD shall be submitted to DENR Regional office to get Environmental Compliance Certificate (ECC) prior to the commencement of the construction works because the project implementation in the critical environmental area can not be proceeded without ECC issuance.

Furthermore, establishment and strengthening of beneficiaries' organizations, such as IAs and marketing cooperatives are inevitable to attain smooth project implementation. These beneficiaries' organizations are given a relative importance of not only O&M activities of each proposed facilities immediately after the completion of the construction works, but beneficiaries' participation on project planning/designing during the project implementation stage. The following are constructive activities during the pre-construction stage.

1) establishment and strengthening of IAs on O&M works for irrigation practice
2) establishment and strengthening of marketing cooperatives on O&M works for marketing activities
3) Explanation of the project implementation schedule and proposed components, and dissemination of the project effects

7.3 Project Cost Estimates

7.3.1 Assumptions

The project cost is estimated based on the following assumptions:

1) Unit prices are analyzed on the basis of average prices as of mid-1994.
2) The exchange rate used in estimate is:

   US$ 1.00 = ₱ 27.00 = J¥ 100.00

3) All construction works will be undertaken under the contract basis. Contractor(s) will be selected by international competitive bidding. All

construction machinery, equipment and construction materials are to be provided by the contractor(s).

4) Taxes on the construction materials, machinery and equipment imported from abroad are to be exempted and are not included in the cost estimate.

5) The construction cost based on unit cost is divided into foreign and local currency portions. Local currency portion is estimated on the basis of the current price in Laguna Province and foreign currency is estimated based on the CIF prices at Manila.

6) The construction costs are estimated with paying attention to the protection of the nature resources, e.g., estimate of protection of soil disposal areas from soil erosion, transportation of construction materials by man-power without temporary roads construction, disposal of excess construction material to outside of critical environmental area, proper temporary drainage system to prevent water contamination, expenses for monitoring and inspection works on negative impacts of natural resources, etc.

7) As the project sites are located in the critical environmental area, construction works which affect negative impact, as well as maintenance road, shall be restricted. Assuming a difficulty of maintenance works for proposed facilities, durability corresponding to each facility is considered in the proper selection of materials and in the structural designing.

8) Construction period is estimated at 18 months taking account of proper quality control, construction schedule maintenance and minimization of construction cost, etc., as described in 7.1.2 (2) "Temporary works".

9) The physical contingency of 10 % of the total costs of detailed design, construction, O&M equipment, administration/engineering and land acquisition is included in the Project cost.

10) Price contingency is also taken into account at an annual escalation rate of 4 % for the foreign currency portion and 8 % for local currency portion.

7.3.2 Project cost

Financial Project cost is comprised of the following items:

1) Construction cost

Construction cost is composed of direct construction cost, cost for temporary and preparatory works, contractor's expenses. The cost for the temporary and preparatory works are assumed at about 5 to 10 % of the direct construction cost. The contractor's expenses are assumed at about 20 % of the direct construction cost. Total construction cost is estimated at around ₱ 214.6 million.

2) Procurement Cost of O&M

The costs of O&M machinery and equipment are estimated based on the current price in Manila. Total O&M cost is estimated at around ₱ 12.2 million.

3) Administration cost

Construction works are undertaken by the governmental staff with assistance and advice of the consultants. Administration cost is estimated based on the required number of government staff for detailed deign and construction supervisory works. Total administration cost of ₱ 4.7 million comprising of ₱ 0.4 million for the pre-construction works, ₱ 1.4 million for the detailed design works and ₱ 2.9 million for the construction supervisory works is estimated.

4) Engineering service cost

The cost for engineering cost is approximately calculated at about ₱ 38.9 million, comprising of ₱ 13.4 million for the detailed design works and ₱ 25.5 million for the construction supervisory works. The Consultants will assist and advice the governmental staff in the detailed design and construction supervision periods.

5) Land acquisition cost

Around 2.3 ha of land will be acquired or affected for the construction works. Total land acquisition cost is estimated at about ₱ 2.1 million.

6) Physical contingency

As described in section 7.1, the physical contingency is fixed at 10 % of the total of the above five items.

7) Price contingency

As also mentioned in section 7.1, the price contingency is fixed at 4 % for the foreign currency portion and 8 % for the local currency portion.

The Project cost is estimated as follows:

Project Cost

	(Unit: ₱ million)
Total Project cost	347.3
(Foreign portion)	179.0
(Local portion)	168.3

Detailed project cost is summarized in Table 7.2.1.

7.3.3 Annual O&M costs

The annual operation and maintenance costs are composed of salaries of the project staff, project office expenses, the materials and labor cost for repair and maintenance of the project facilities and O&M equipment (see Table 7.3.1). Total operation and maintenance costs are roughly estimated at ₱ 6.0 million per annum.

Operation and Maintenance Cost of the Project Facilities

(Unit: ₱ '000)

Facilities	Annual O&M cost
1) Irrigation Facilities	970
2) Roads	120
3) Trading Posts	1,870
4) Upland Horticulture & Irrigation Technology Center	2,170
5) Soil Conservation Center	870
Total	6,000

Note: O&M of domestic water supply system is negligibly small amount.

Out of above O&M costs, those of irrigation facilities and trading posts should be burdened by beneficiaries who will get considerable incremental income with the Project. O&M costs of Upland Horticulture and Irrigation Technology Center, Soil Conservation Center and Roads, should be provided by DA, DENR and the related Municipal government respectively, and their budgetary scales are deduced to be sufficient for the requirement (see Appendix-IX.2).

7.3.4 Annual fund requirements

Annual fund requirements are estimated as listed in Table 7.1.2 in conformity with the project implementation schedule. The annual amount of the required costs is ₱ 0.4 million for pre-construction works in 1995, ₱ 148.3 million for the detailed design and construction works in 1996, and ₱ 198.6 million for construction works in 1997.

CHAPTER VIII ORGANIZATION AND MANAGEMENT

8.1 Existing Organizations related to Project Implementation and O&M

Major governmental organizations related to Project implementation and O&M are National Irrigation Administration (NIA), Department of Agriculture (DA), Department of Environmental and Natural Resources (DENR), Department of Agrarian Reform (DAR), Provincial Government of Laguna (PGL), and Municipal governments (MGs) of Nagcarlan, Liliw and Majayjay. The organization structure and activities of these organizations are mentioned below.

8.1.1 National Irrigation Administration (NIA)

NIA has established in 1964 under Republic Act 3601 as a semi-autonomous agency responsible for planning, constructing, operating and maintaining all National Irrigation Systems (NISs). NIA was empowered to investigate and study all national water resources for irrigation purposes. In 1974, Presidential Decree No. 552 provided NIA with broader power and authority to undertake related projects, such as flood control, drainage, land reclamation, hydropower development, domestic water supplies, road construction, reforestation and other activities to maintain the ecological balance, in coordination with other agencies.

Organizational structure of NIA is referred to Fig. 8.1.1. At its central office at Quezon City, Metro Manila, NIA's organizational structure includes four units; 1) Project Development and Implementation, 2) System Operation and Equipment Management, 3) Finance and Management, and 4) Personnel and Administrative Services. NIA has 11 Regional Irrigation Offices (RIOs). Each RIO is headed by a Regional Irrigation Director (RID). Some 100 irrigation system offices (ISOs) are each responsible for one NIS, or a cluster of NISs, and headed by an Irrigation Superintendent (IS). Other 67 Provincial Irrigation Offices (PIOs), each headed by a Provincial Irrigation Engineer (PIE), are responsible for communal irrigation development. ISs and PIEs are directly supervised by the RID of the region.

Region IV office of NIA, which is located at Pila, Laguna, is responsible for the project implementation of the Project.

8.1.2 Department of Agriculture (DA)

DA is the principal agency of the Philippine government responsible for the promotion of the country's agricultural growth and development as the sound foundation for real industrialization. Its efforts focus on the upliftment of the quality of human lives, especially those of the small farmers and fishermen, and on the long-term sustainability of resource productivity.

In 1901, the Insular Bureau of Agriculture was created under the Department of the Interior. After several reorganizations, DA was reorganized in 1987. In 1992, the Local Government Code was implemented bringing significant changes in the organization and functions of DA. The extension function of DA were devolved to the concerned Local Government Units (LGUs), from the provincial down to the municipal level. Thus, the Regional offices of DA now only concentrate on providing technical assistance to LGUs and to farmers and fisherfolk on a need basis. Organization of DA is referred to Fig. 8.1.2.

The following are the general functions of DA:

1) creation of a policy environment conducive to increased incomes in agriculture
2) production, verification and dissemination of information relevant to productivity and development
3) production, testing and dissemination of superior plant and animal germplasm
4) facilitation of market access and the promotion of agro-based enterprises
5) implementation of empowerment programs to provide access to the benefits of development

DA has 13 Regional offices which are charged with implementing agricultural extension at regional and provincial levels. Region IV office in Quezon City is in charge of agricultural extension of the Project.

Staff Bureaus and their major functions are as follows:

1) Bureau of Agriculture Statistics (BAS)
Provision of agricultural statistics to support planning at the national, regional and provincial levels
2) Bureau of Agricultural Research (BAR)
Coordination of research works for vegetable cultivation and demonstration trials of newly developed varieties

3) Bureau of Soils and Water Management (BSWM)
Soil research, resource conservation and implementation of water utilization development program

4) Agricultural Training Institute (ATI)
Technical assistance and training for farm families, subsistence fishermen, and cultural communities

5) Bureau of Fisheries and Aquatic Resources (BFAR)
Coordination of activities on development of fisheries and aquatic resources

6) Bureau of Animal Industry (BAI)
Production, testing and dissemination of animal industry and animal germplasm, production and distribution of breeds of livestock

7) Bureau of Plant Industry (BPI)
Coordination of activities on development of new varieties and seed production

8.1.3 Department of Environmental and Natural Resources (DENR)

DENR was established in 1987 by reorganizing the Department of Environment, Energy and Natural Resources (DEENR). Its task is to ensure the sustainable use, development, management, renewal and conservation of country's forest, mineral lands, offshore areas and other natural resources, including the protection and enhancement of the quality of the environment. DENR is composed of eight Staff Offices, six Staff Bureaus, and the Field Offices which are composed of the Regional, Provincial Environmental and Natural Resources Offices (PENROs) and Community Environmental and Natural Resources Offices (CENROs). Numbers of these offices are 14, 73 and 163, respectively. The six Staff Bureaus and their major functions are as follows. The organization structure of DENR is given in Fig. 8.1.3.

1) Forest Management Bureau (FMB)
Reforestation, range management, watershed rehabilitation, forest protection, timber management, and implementation of ISF program

2) Land Management Bureau (LMB)
Land disposition, land surveys, and land record management

3) Mines and Geo-Sciences Bureau (MGSB)
Geological surveys and mining rights application and processing

4) Environmental Management Bureau (EMB)
EIS processing and environmental quality monitoring

5) Ecosystem Research and Development Bureau (ERDB)
Technology generation and verification on the restoration, development and rehabilitation of deteriorating ecosystems and natural resources

6) Protected Areas and Wildlife Bureau (PAWB)
Management of protected areas, preservation of biological diversity, and maintenance of recreational sites

The Study area is under the jurisdiction of Region IV office, PENRO Laguna, and CENRO Los Baños. With relation to the Project, the Regional office is responsible for evaluating environmental impact documents and an application for the development of the Public Forest lands. The Regional Executive Director has the authority to issue an Environmental Compliance Certificate (ECC) and a development clearance. PENRO Laguna will be responsible for the operation and maintenance of the Soil Conservation Extension Center and demonstration fields of soil conservation measures to be established by the Project. There are two Social Forestry Officers in PENRO who are working for seven ISF programs in the Province. Their functions are to organize farmers participated in the ISF programs, transfer of technologies on upland cultivation and agro-forestry, distribution of tree seedlings required for hedgerow and agro-forestry, and overall supervision of the ISF programs. It is expected that they perform the same functions for the demonstration fields of the Project.

8.1.4 Department of Agrarian Reform (DAR)

DAR has a main function of implementation of Comprehensive Agrarian Reform Program (CARP) commenced in 1987. DAR performs a nationwide agrarian reform in the Philippines under its basic operating law of Comprehensive Agrarian Reform Low (CARL, Republic Act No. 6657). DAR has 12 Regional offices, 76 Provincial offices and about 1,500 Municipal offices. The organization structure of DAR Central office located in Quezon City is comprised of the following three major units under the Secretary, as shown in Fig. 8.1.4.

1) Policy and planning
- Prepare plans and programs of agrarian reform
- Policy analysis on an appropriate agrarian reform implementation
- Maintain an information system in coordination with the established monitoring system

2) Field operation and support
- Provide technical assistance to regional offices
- Review and evaluate reports and other documents submitted by regional offices
- Coordinate with other government and private agencies
- Conduct operation, research and evaluation of agrarian reform implementation

3) Legal, finance and administration
- Provide legal assistance on CARP implementation
- Manage financial issues
- Provide administrative services

There exist five bureaus under the these Undersecretaries; Bureau of Agrarian Reform Information and Education, Bureau of Agrarian Reform Beneficiaries Development, Bureau of Land Development, Bureau of Land Acquisition and Distribution, and Bureau of Agrarian Legal Assistance.

In the Study area, most of the land is categorized in Public land, and the land is declassified as an A&D lands. Most of A&D lands are still in a status of unreleased public land due to its complicated application procedures although the farmers living or cultivating in A&D lands have claimed their land patents for many years. Meanwhile, the certain parts of the Study area have actually been subjected to CARP scheme. In this connection, thus, DAR is expected to legally and technically support the farmers on land transference in the Study area.

8.1.5 Provincial Government of Laguna (PGL)

The Province of Laguna has 29 Municipalities and one City (San Pabro), and a total 671 Barangays. There are four political districts. Regarding three Municipalities relevant to the Study area, Nagcarlan and Liliw are categorized in District 3, and Majayjay is in District 4. The Provincial government is headed by the Governor. Several offices under the office of the Governor are performing managerial, technical and general administrative support services. This section deals specifically with aspects of local administration; the formulation, approval, funding, implementation and monitoring of plans, geared towards local development. Organization structure of the Provincial Government of Laguna is shown in Fig. 8.1.5.

As for the project planning/implementation, the following responsible bodies have authority for its coordination and planning.

(1) Provincial Development Council (PDC)

Provincial Development Council (PDC) headed by the Governor is composed of Municipal/City Mayors, chairman of the Appropriations Committee of the Board members, regional heads of various government departments/agencies and representative from NGOs. PDC has functions as follows:

1) Formulates socio-economic development policies, and public investment programs,