REPUBLIC OF THE PHILIPPINES

FEASIBILITY STUDY ON THE HIGHLAND INTEGRATED RURAL DEVELOPMENT PROJECT IN LA TRINIDAD PROVINCE OF BENGUET

APPENDIXES

OCTOBER 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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1. General

The primary soil investigation and studies, covering approximately 265,540 ha of the Benguet province, were conducted in 1968 by the Bureau of Soils, Department of Agriculture and National Resources, Manila in conformity with the USDA Soil Survey Manual. Besides, the soil investigation and studies in the La Trinidad valley, covering about 500 ha in gross, were carried out by Ramat and Baustista in 1976, making reference to the U.S. Soil Taxonomy system. These previous soil studies are accepted as the basic data and information for the feasibility study on the Highland Integrated Rural Development Project in La Trinidad, Province of Benguet, though verification on the soil classification and mapping is necessary.

The soil investigation and studies aim to identify the major soil groups and their distribution in the Project area through the review of the aforementioned studies and substantial field investigation, and also to examine the suitability of the land for irrigation development.

This soil survey covers a total area of 1,420 ha in the agreed "Scope of Works" and is divided into three zones which are Zone I (290 ha), Zone II (680 ha) and Zone III (450 ha). The present report deals with the procedure of the field investigation and studies, and final results of the soil studies including some major characteristics of soils in the Project area.

2. Soil Classification

2.1 Procedure of Soil Survey

The physiographical and landform condition of the Project area were first examined, prior to the actual field survey, by using newly prepared topographical maps scaled 1/5,000, aerial photos scaled 1/10,000 and geological map. A total of 5, 11 and 14 pits were selected for Zones I, II and III, respectively.

Through the field investigations, a total of 30 pits or pedons were dug to a depth of about one meter or bedrock or gravel layer. Each soil profile was observed in accordance with the standards described in the "Guidelines for Soil Profile Description" by FAO. Furthermore, observation of about 50 test boring pits and some road-cuts were additionally practiced for further adjustment of provisional boundaries of each soil type or soil phase.

For physico-chemical analysis in laboratory, a total of 112 soil samples were taken from the individual horizons of each profile (Table A.2.1). In addition, 30 core samples were also taken from the first and second layers of the selected pits using the standard core samplers. After removing duplication of the samples, 58 soil samples and 30 core samples were sent to the Bureau of Soils UPLB Laboratory at Los Baños, Laguna for detailed physico-chemical analysis.

The items of physico-chemical analyses are shown in Table A.2.2, and summarized as follows:

1) pH (H_2O) and pH (KCl)
2) Cation exchange capacity (CEC)
3) Total nitrogen
4) Available phosphate
5) Exchangeable cation of Ca, Mg, K and Na
6) Lime requirement
7) Organic matter content
8) Electric conductivities (ECe)
9) Particle size analysis
10) Moisture contents at pF, 1.5, 2.5, 3.0, 3.4, 3.7 and 4.2
11) Bulk Density (g/cc)

The results of soil physico-chemical analyses are presented in Table A.2.3 and A.2.4.

2.2 Soil Classification

The soil classification and mapping are herein made at the series level in accordance with the USDA Soil Taxonomy system.

The soils in the Project area are classified into 4 soil series as follows:

a)	La Trinidad Series	:	Zone I
b)	Tacdian Series	:	Zone II
c)	Puguis Series	:	Zone III (Wangal)
d)	Bineng Series	:	Zone III (Bineng)

Soils of each series were further subdivided into soil types based on the slopes, drainage condition, pH, surface soil texture and other distinguishable characteristics. The four series identified are furthermore classified into 12 soil types in the Project area (Table

A.2.5). The results of the present soil classification are presented in Table A.2.6 and Soil Map (Fig. A.2.1). The typical soil profile features of each soil type are described in Tables A.2.7 (1) -(12).

2.3 Main Features of Soil Series

2.3.1 La Trinidad Series

The soils in this group are derived from alluvial deposit and extend over the flat to gently flat lands lying on the lower portion of La Trinidad Valley. The lands covered with these soils are about 290 ha or 100% of the Zone I area. The effective soil depth is generally deep. The soil texture varies from fine to coarse throughout the profile. Generally, drainage condition is good, but water is stagnant at the depressed area during the rainy season (from May to September)

The land of these soils are mainly planted with vegetables such as lettuce, sweet potato, beans, garden pea, tomatos and strawberry as the major crop, fruit trees and ornamentals with irrigation.

There are 2 soil types described in this series namely ; La Trinidad silt loam (222 ha) and La Trinidad loamy sand (68 ha).

(1) <u>La Trinidad Silt Loam</u>

The soils of this type extend over the Eastern and Northern part of the La Trinidad valley floors. The relief is flat or almost flat. Drainage condition is moderately well to poor externally, but poor internally. This soil type covers about 222 ha of the Project area.

The surface soils are brown to dark reddish brown when wet and dull yellowish brown to dull yellow orange when dry. The soils are slightly sticky and slightly plastic when wet, firm to friable when moist and slightly hard to extremely hard when dry. The soils have moderate coarse angular blocky to blocky structure. As for chemical properties, these soils have extremely acid and very strong acid (pH 4.5-4.8) soil reaction, low organic matter content (0.48-0.8%). The CEC of these soils are high (45-46 m.e/100 g) with moderate high base saturation.

Their subsoils are strongly glayey usually colored grayish red to dark grayish yellow and brownish black when wet with common medium prominent mottling. The soils

are sticky and plastic when wet, firm to very firm when moist and very hard to extremely hard when dry. The soils have strong medium to coarse blocky structure.

Soils of this type are further divided into two types ; La Trinidad Silt Loam moderately drained type (131 ha) and La Trinidad Silt Loam poorly drained type (91 ha). The land with the latter soil phase is affected from flood during the rainy season. about 4 ha of this land is "swampy" which is submerged the whole year round.

Vegetables and ornamental plants are grown throughout the year on the elevated portion. The valley floor is planted vegetables and strawberry only during the dry season.

(2) La Trinidad Loamy Sand

Soils of this series extend along the West and Southwest part of the valley and cover about 68 ha of the Project area. The area is stony and well drained with some parts gravelly and moderately well drained externally and internally poorly drained.

The soils have deep effective soil with medium to coarse texture throughout the profile. The topsoils are dark reddish brown to dark brown in color. The soils have weak medium subangular blocky structure. The soils are slightly sticky and non-plastic in consistence when wet and slightly hard when dry. The subsoils are brown to grayish brown with common and medium distinct mottling, slightly sticky and nonplastic when wet.

As for their physico-chemical properties, the acidity of soils is very strong to strong throughout the profile. The organic matter content is low (1.74%) in the topsoil and decreases with depth. CEC and base saturation are high throughout the profile. The contents of N, P and K are moderately high to high. The total available water holding capacity is moderately high to high.

The lands of these soils are mainly planted with ornamental plants, fruits and some vegetables.

2.3.2 Tacdian Series

Soils of Tacdian series is developed from the weathering of limestone, shale sandstones and andesitic sediments. It is characterized by stoniness and the presence of rough boulder outcrops. The soils extend over Alno and Bahong covering about 680 ha of the Project area.

The major crops grown in this land is rose. Other crops planted are pechay, green onions, beans, peas, gabi, and chayote. Areas unplanted are grasslands at the time of survey due to lack of irrigation.

There are 2 soil types described in this series namely; Tacdian Loamy Sand and Tacdian Silt Loam.

(1) Tacdian Silt Loam

Soils of this type are found in Zone II and cover about 168 ha of the Project area. The topography is gently sloping, and steep, dissected with well to excessive external drainage and moderate to moderately slow internal drainage. The lands with this soils are all terraced for production purposes.

Surface soils are dark brown, dull yellowish brown and dark reddish brown. The soils have fine to medium angular blocky structure with few pebbles. The soils are slightly sticky and slightly plastic when wet , friable when moist and hard to very hard when dry. The pH of the soil ranges from 4.5 to 6.1. Organic matter content is medium ranging from 1.93 to 4.5 %. The CEC of these soils are high from 32 to 60 m.e/100 g, with moderately high to high nutrient content.

Subsoils are usually yellowish brown, dark reddish brown, grayish yellow brown and very dark reddish brown when wet. The soils have medium angular blocky structure, and are slightly sticky to very sticky and slightly plastic to very plastic when wet.

This soil type is further divided into a) Tacdian Silt Loam (about 159 ha) and b) Tacdian Silt Loam alluvial deposit phase (about 9 ha). The latter soil phase is found in the almost flat areas and is formed as alluvial deposits coming from the surrounding sloping areas.

(2) Tacdian Loamy Sand

The soils of this type extend over Bahong and Alno with an area of 512 ha. Boulders of rocks are present and stoniness is observed throughout the profile. The topography is undulating to rolling and hilly.

Surface soils are brownish black, dark brown to very reddish brown when wet. The soil structure is moderate medium blocky to subangular blocky structure. The soils are slightly sticky to sticky and slightly plastic to plastic when wet, friable to very firm when moist and hard to very hard soils when dry.

Subsoils are reddish brown, dull brown and grayish brown in color. The soils are slightly sticky and slightly plastic to plastic when wet, and very hard to extremely hard when dry. The soils have moderate medium subangular blocky structure. As for chemical properties, these soils have slightly acid to neutral soil reaction with relatively high organic matter content of 3.01%. The CEC of these soils are high (43.9 me/100 g soil). The available P of these soils are also high (77.2 ppm).

The soils of this type are further classified into two ; Tacdian Loamy Sand (163 ha) and Tacdian Loamy Sand eroded type (349 ha).

The crops grown here are the highland vegetables and cut flowers (roses and gladiolus) being grown in bigger commercial scale.

2.3.3 Puguis Series

Soils of this series are developed from conglomerates. The soils are found in Puguis and in lower Wangal of Zone III area. Total areas covered with this soil series are about 100 ha. Only one type, Puguis Loamy Sand, was mapped in this series. The surrounding topography is hilly to mountainous. Drainage condition is good to excessive. The soils are very strongly acid to extremely acid throughout the profile with high organic matter (4.57%) but the organic matter content is very low in the subsoil and substratum.

The surface soil is brown to bright yellow brown and dull yellow orange when wet. The soils have weak medium fine to coarse angular blocky, granular and crumb structures. The soils are non-sticky to slightly sticky and non-plastic to plastic when wet, very friable to loose when moist. The effective soil depth is shallow with much gravels.

The subsoil is brown to dark brown in color when wet, and dull yellow orange to bright yellowish brown when dry. The soil structure is weak to moderate coarse angular blocky and subangular blocky. Mottling was also observed.

The lands with this soils are used for cultivation of ornamental plants and highland vegetables.

2.3.4 Bineng Series

Soil of this series were developed from weathered conglomerates and extend over Bineng in Zone III with an area of 350 ha. The physiography is gently sloping to sloping and the drainage condition is good. At present, gently sloped and steep sloped areas are terraced and planted with rice, while some areas are planted with beans and coffee.

There are 3 soil types mapped under this series namely; Bineng Silt Loam, Bineng Loam and Bineng Loamy Sand.

(1) Bineng Silt Loam

This soil type is found on undulating and sloping area and cover about 305 ha of the Project area.

The surface soils are dark brown, dark reddish brown, grayish brown, dark grayish brown when wet, and dull yellow orange, light yellow, light gray, grayish yellow when dry. The soils have moderate, medium to coarse angular or subangular blocky structure. They are slightly sticky and slightly plastic when wet, very friable to firm when moist and slightly hard to hard when dry. Some areas have cracking up to 50 cm from the surface.

The subsoils are dark brown, yellowish brown, reddish black, grayish black, yellowish gray when moist and yellowish brown, yellowish gray, light yellow, dark brown when dry. The soils are slightly sticky and nonplastic when moist, friable to firm when moist and slightly hard to hard when dry. The soil structures are subangular blocky to granular. Since these areas have been planted with rice 20-40 years ago, abundant medium to coarse distinct and prominent mottles were observed. The soils formed here are deep and well drained. These soils are very strong acid to strong acid soil reaction (pH 4.6-5.4). They have high organic matter content of 3.25 to 4.42%. The CEC is high ranging from 33.13-43-68 m.e/100 g.

This soil type is further classified into two ; Bineng Silt Loam eroded type (213 ha) and Bineng Silt Loam (92 ha).

(2) Bineng Loam

This soil type covers about 27 ha of Zone III area. External and internal drainage condition is moderately good.

The surface soils are very dark reddish brown when wet and brown when dry. The soils are slightly sticky and slightly plastic when wet, friable when moist and slightly hard when dry. The soils have moderate medium blocky structure. The effective soil depth is shallow (0 to 20 cm). As for chemical properties, the soil is very strongly acid (pH 4.7) and have high organic matter content and high CEC of 4.14% and 40.44 m.e/100 g, respectively.

The subsoil is brown when wet and dull brown when dry. The soil consistence is slightly sticky, nonplastic when wet, friable when moist, and dull brown and slightly hard when dry. The soil structure is weak medium subangular blocky.

(3) Bineng Loamy Sand

These soils are located on steep slopes and along creeks covering about 18 ha of the Project area. The soils is slightly acid to neutral with high organic matter content (5.20%). The CEC of this soils are moderately high (12.90 m.e/100 g) with moderately high Ca and Mg (18.88 and 4.30 m.e/100 g). Content of available P is also high (94.77 ppm).

The surface soils are olive black in color when wet and yellowish gray when dry. The soils have moderate medium angular blocky structure. The soils are slightly sticky and slightly plastic when wet, firm when moist and slightly hard when dry. Fine roots are abundant on the upper surface (0-15 cm) and gradually increases with depth.

Subsoils are yellowish gray, not sticky and nonplastic when wet and loose when moist.

Rice are planted in the flat portion, beans on the slopes and trees and shrubs on the steep slopes.

3 Land Classification

3.1 General

The major objective of land classification Project are as follow :

1) To classify and identify land with potential for irrigation development,

2) To classify land into approximate land classes based on their limitations and potential productivity

3) To collect and provide data necessary in determination of land use and farming practice

Land was evaluated by matching crop requirement qualities that are found to have significant effects on the desired land utilization type in each zone. The land qualities were considered for two crop groups excluding rice such as vegetables and cut flowers, and plantation crops, based on crop requirement quality by PCARRD (Table A.3.1).

3.2 Land Classification

For assessment of the land resources, land factors such as soil depth, soil texture, drainability, soil pH, fertility, and topographic conditions are rated according to the crop requirement qualities as shown in Table A.3.2 and A.3.3. The land class is determined synthetically taking into account the above rate.

Land suitability class has two orders: Suitable (S) and Not Suitable (NS). The definition of these land classes are as follows:

S : S_1 ; Highly suitable class
The land in this class has no limitation for future development in general, and high return on crop production can be anticipated with the Project.

S_2 ; Moderately suitable class
This class includes suitable land in which sufficiently high productivity and profitability can be expected from soil and land. However, there are moderate limitations caused by relatively strong acid, poor fertility and seasonal flooding, etc.

S_3 ; Marginally suitable class

The land of this class is almost expected to be fairly productivity for crops, although there are some limitations which may reduce crop yield and call for higher recurrent costs for production and soil amelioration. Rather deep flooding and steep slope will be the biggest constraint in this land class.

NS : NS_1 ; Currently not suitable class

This class is currently not suitable land which has serious constraints such as poor drainage, seasonal flooding, steep slope, etc., and it is necessary to bring some improvement of soil and land condition.

NS_2 ; Permanently not suitable class

This class is unsuitable land for development programme. Because of the land having very serious limitations such as coarse textured soil with gravel, shallow soil depth, strong steep with rolling or undulating topography, resident and commercial yard, roads, rivers and others in present land use.

The land classification for the Project area was made in accordance with the above mentioned specifications, and the following land classes were identified.

(Unit : ha)

Zone	Land Class	For Vegetables & Flowers	For Plantation Crops
Zone I	S_1	82	82
	S_2	128	47
	S_3	0	81
	NS_1	4	4
	NS_2	76	76
	Sub-total	290	290
Zone II	S_1	0	6
	S_2	193	310
	S_3	123	0
	NS_1	65	65
	NS_2	299	299
	Sub-total	680	680
Zone III	S_1	0	44
	S_2	47	40
	S_3	54	17
	NS_1	63	63
	NS_2	286	286
	Sub-total	450	450
The Project Area Total		1,420	1,420

The results of land classification shows that most lands defined suitable for vegetables and cut flowers are presently used for agricultural purpose. No lands are available for further development. The land classifications are presented in Tables A.3.4, A.3.5, A.3.6, and Fig. A.3.1.

4 Conclusions

(1) Soils of the Project area are very strong acid to extremely acid due to excessive leaching so that the nutrient elements might be unavailable or inaccessible to plants. Application of lime and organic manures shall be encouraged to improve their condition. According to the results of soil chemical analysis, for example, lime requirement to raise the soil pH by 7.0 varies between 0.5 and 9.0 tons per ha depending on the soil acidity.

(2) Areas that are presently being used for vegetable production but are rated as permanently not suitable in the slope classification should be tilled with extra conservation measures to prevent soil erosion.

(3) In Zone I, drainage development would increase the land suitability.

Table A.2.1 List of Soil Samples

Name of Zone	Pit No.	Horizon Number (Cm) I	II	III	IV	V	VI	VII	Total Samples	Core Samples
Zone I	I - 1	0 - 20	20 - 40	40 - 100	-	-	-	-	3	
	I - 2	0 - 10	10 - 35	35 - 50	50 - 85	85 - 100	-	-	5	
	I - 3	0 - 20	20 - 60	60 - 100	-	-	-	-	3	
	I - 4	0 - 20	20 - 44	44 - 100	-	-	-	-	3	
	I - 5	0 - 15	15 - 60	60 - 100	-	-	-	-	3	23, 24 / 13, 14
									17	
Zone II	II - 1	0 - 15	15 - 50	50 - 100	-		-	-	3	
	II - 2	0 - 15	15 - 47	47 - 95	95 - 100	-	-	-	4	28, 29 / 27, 30
	II - 3	0 - 20	20 - 35	35 - 88	88 - 100	-	-	-	4	
	II - 4	0 - 6	6 - 38	38 - 100	-	-	-	-	3	
	II - 5	0 - 15	15 - 38	38 - 100	-	-	-	-	3	
	II - 6	0 - 20	20 - 50	50 - 100	-	-	-	-	3	5, 6, / 25, 26
	II - 7	0 - 15	15 - 100	100 - 150	-	-	-	-	3	
	II - 8	0 - 16	16 - 71	71 - 105	105 +	-	-	-	4	
	II - 9	0 - 14	14 - 81	81 - 100	-	-	-	-	3	19, 20 / 21, 22
	II - 10	0 - 25	25 - 75	75 - 100	-	-	-	-	3	
	II - 11	0 - 18	18 - 41	41 - 95	95 - 100	-	-	-	4	
									37	
Zone III	III - 1 (W)	0 - 31	31 - 50	50 - 90	90 - 100	-	-	-	4	
	III - 2 (W)	0 - 10	10 - 30	30 - 90	90 - 130	130 +	-	-	5	
	III - 3 (W)	0 - 10	10 - 30	30 - 50	50 - 65	65 - 100	-	-	5	
									14	
	III - 1 (B)	0 - 20	20 - 50	50 - 70	70 - 100	-	-	-	4	
	III - 2 (B)	0 - 20	20 - 100	100 -	-	-	-	-	2	8, 10 / 9, 11
	III - 3 (B)	0 - 16	16 - 25	25 - 100	-	-	-	-	3	
	III - 4 (B)	0 - 20	20 - 30	30 - 50	50 - 70	70 - 95	95 +	-	6	
	III - 5 (B)	0 - 20	20 - 41	41 - 63	63 - 100	-	-	-	4	7,12 / 1, 2 / 3, 4
	III - 6 (B)	0 - 15	15 - 48	48 - 100	-	-	-	-	3	
	III - 7 (B)	0 - 23	23 - 50	50 - 95	95 - 100	-	-	-	4	15, 16 / 17, 18
	III - 8 (B)	0 - 13	13 - 50	50 - 86	86 - 100	-	-	-	4	
	III - 9 (B)	0 - 15	15 - 25	25 - 35	35 - 45	45 - 68	68 - 82	82 - 100	7	
	III - 10 (B)	0 - 20	20 - 50	50 - 100	-	-	-	-	3	
	III - 11 (B)	0 - 20	20 - 50	50 - 80	80 - 100	-	-	-	4	
									44	
	Total	30	30	29	15	5	2	1	112	30

Note : (W) ; Wangal, (B) ; Bineng

Table A.2.2 Procedure and Methods of Soil Analysis

Analysis	Procedures and Methods
1. pH (H_2O) and pH (KCL)	Glass electrode method for 1:1 soil water suspension
2. Electric Conductivity (EC_e)	Electric conductivity meter method for extracts from saturated soil pastes and 1:5 soil-water mixtures
3. Cation Exchange Capacity (CEC)	N-ammonium acetate centrifuge method at pH 7.0
4. Exchangeable Ca and Mg	Sodium nitrate extraction method
5. Exchangeable K and Na	Flame-photometer method with leaching extraction by N-ammonium
6. Total Nitrogen	Micro-kjeldhl method (converting nitrogen to NH_4 by Kjeldhl digestion, and measuring the amount of NH_4 by back titration after addition of acid solution)
7. Organic Matter	Walkley-Black method
8. Available Phosphate	Bray's method.
9. Particle Size Analysis (Gravel, Sand, Silt, Clay)	Hydrometer method
10. Moisture Contents at pF 1.5, 2.5 3.0, 3.4 3.7 and 4.2	Pressure plate and sand bath
11. Lime Requirement	Veitch Method

Table A.2.3 Results of Soil Physical Analysis

Sample No.	Name of Soil Series	Name of Soil Types	Depth (cm)	Mechanical Analysis Clay (%)	Silt (%)	Sand (%)	Tex-ture	Electric Conductivity (mc/cm)	pF 1.5	2.5	3.0	3.4	3.7	4.2 (vol %)	Available Water Cap. (vol %)	Bulk Density (gm/cm3)
I-2 (1)	La Trinidad	Loamy Sand	0 - 10	3.9	15.9	80.2	LS	0.17		31.5	28.2	24.0	22.5	21.4	10.1	
I-2 (2)			10 - 35	6.8	31.7	61.5	SiL	0.12		36.1	33.4	28.6	27.1	25.4	10.7	
I-2 (3)			35 - 50	11.4	18.0	70.6	L	0.12		37.5	33.2	29.0	27.3	25.6	11.9	
I-2 (4)			50 - 85	7.7	11.8	80.5	LS	0.10		32.8	29.5	26.9	24.7	23.4	9.4	
I-2 (5)			85 - 100	4.9	9.7	85.4	LS	0.13		24.9	22.7	19.6	18.3	16.5	8.4	
I-5 (1)	La Trinidad	Silt Loam	0 - 15	25.8	46.8	27.4	SiL	0.13	58.5	48.4	45.2	36.9	32.2	29.4	19.0	0.88
I-5 (2)			15 - 38	42.0	44.7	13.3	SiC	0.12	61.7	47.9	44.2	37.6	33.1	31.1	16.8	0.94
I-5 (3)			38 - 100	31.2	53.3	15.6	SiCL	0.11		48.6	46.1	39.5	34.5	22.9	25.7	
II-2 (1)	Tacdian	Loamy Sand	0 - 10	5.4	17.8	76.7	LS	0.37	38.4	29.4	26.8	22.8	19.8	19.0	10.4	1.01
II-2 (2)			10 - 47	12.1	22.7	65.1	L	0.30	36.4	33.2	31.6	26.4	23.9	21.7	11.5	1.06
II-2 (3)			47 - 95	5.0	24.4	70.6	LS	0.20		25.1	23.4	19.3	18.4	17.5	7.6	
II-2 (4)			95 - 100	7.2	31.1	61.7	SiL	0.18		33.7	32.2	26.5	24.3	16.0	17.7	
II-6 (1)	Tacdian	Silt Loam	0 - 20	13.4	32.6	53.9	SiL	0.22	41.4	36.4	31.5	26.9	22.4	20.1	16.3	1.16
II-6 (2)			20 - 50	17.9	28.7	53.4	SiL	0.19	48.6	39.1	26.5	30.3	25.7	23.6	15.5	1.08
II-6 (3)			50 - 100	16.3	33.1	50.7	SiL	0.98		44.1	42.0	34.2	26.2	21.5	22.6	
II-7 (1)	Tacdian	Silt Loam	0 - 15	25.1	33.1	41.9	SiL	0.51		36.7	32.5	27.0	24.4	21.6	15.1	
II-7 (2)			15 - 100	26.8	37.7	35.5	SiL	0.12		37.0	33.9	28.5	24.4	22.6	14.4	
II-7 (3)			100 - 150	12.0	23.0	65.0	L	0.12		42.1	38.3	33.4	28.1	22.1	20.0	
II-8 (1)	Tacdian	Silt Loam	0 - 16	24.5	28.8	46.6	SiL	0.70		41.1	37.0	33.0	28.7	24.9	16.2	
II-8 (2)			16 - 71	12.2	22.4	65.4	L	0.08		41.6	36.8	33.2	25.0	25.2	16.4	
II-8 (3)			71 - 105	16.6	26.3	57.1	SiL	0.10		41.1	37.3	36.5	27.2	22.8	18.3	
II-8 (4)			105+	12.9	34.1	53.0	SiL	0.09		37.9	31.7	30.0	23.9	23.0	14.9	
II-9 (1)	Tacdian	Silt Loam	0 - 14	20.0	30.6	49.4	SiL	0.20	44.7	33.8	28.2	24.9	19.5	17.3	16.5	1.06
II-9 (2)		Alluvial	14 - 81	33.2	35.5	31.3	SiCL	0.10	56.6	47.5	43.9	36.5	30.6	27.2	20.3	1.02
II-9 (3)			81 - 100	22.3	28.3	49.4	SiL	0.09		39.2	35.2	30.2	25.0	21.3	17.9	
II-11 (1)	Tacdian	Silt Loam	0 - 18	22.1	29.7	48.3	SiL	0.06		36.7	33.5	28.4	25.7	20.7	16.0	
II-11 (2)			18 - 41	3.7	16.6	79.7	LS	0.04		30.9	28.7	26.4	23.2	19.9	11.0	
II-11 (3)			41 - 95	15.7	34.6	49.6	SiL	0.03		43.9	40.8	37.2	33.3	28.2	15.7	
II-11 (4)			95 - 100	9.0	19.1	71.9	LS	0.03		33.0	23.8	25.1	21.0	16.6	16.4	
III-2W (1)	Puguis	Loamy Sand	0 - 10	9.2	24.0	66.8	LS	0.13		33.7	31.4	25.8	23.7	20.5	13.2	
III-2W (2)			10 - 30	17.9	28.2	53.9	SL	0.16		36.2	33.0	30.7	27.6	24.3	11.9	
III-2W (3)			30 - 90	13.7	21.6	64.7	L	0.15		33.4	28.9	25.9	24.2	21.1	12.3	
III-2W (4)			90 - 130	15.6	21.8	62.5	L	0.29		34.4	31.6	27.9	25.3	21.8	12.6	
III-2W (5)			130+	4.8	7.6	87.6	LS	0.46		19.6	17.7	15.5	13.9	9.9	9.7	
III-2B (1)	Bineng	Silt Loam	0 - 20	15.2	31.6	53.2	SiL	0.62	44.0	39.1	36.4	32.6	30.1	27.8	11.3	1.04
III-2B (2)			20 - 100	20.7	24.4	54.9	L	0.14	40.8	35.5	33.5	31.7	29.8	25.4	10.1	1.19
III-5B (1)	Bineng	Silt Loam	0 - 20	10.9	27.4	61.7	SiL	0.10	49.1	38.1	35.4	28.7	25.2	21.6	16.5	1.06
III-5B (2)			20 - 41	9.0	28.8	62.2	SiL	0.12	43.8	39.3	33.7	29.5	26.4	23.0	16.3	1.06
III-5B (3)			41 - 63	28.7	34.2	37.1	SiCL	0.08	45.7	35.2	31.2	25.7	22.5	20.4	14.8	0.97
III-5B (4)			63 - 100	23.2	27.7	49.1	SiL	0.33		34.0	31.3	27.4	24.3	21.8	12.2	
III-7B (1)	Bineng	Silt Loam	0 - 23	15.6	26.8	57.6	SiL	0.13	53.1	35.7	30.2	25.2	21.7	17.9	17.8	1.04
III-7B (2)			23 - 50	12.1	27.5	60.5	SiL	0.19	48.0	36.4	32.5	26.1	22.2	18.5	17.9	1.09
III-7B (3)			50 - 95	25.7	23.1	51.2	L	0.14		36.7	33.8	28.8	26.6	22.3	14.4	
III-7B (4)			95 - 100	15.2	20.9	63.9	L	0.08		35.5	33.7	31.7	27.2	25.9	9.6	
III-9B (1)	Bineng	Loamy Sand	0 - 15	9.3	22.9	67.8	LS	0.51		23.2	20.9	17.0	14.6	11.8	11.4	
III-9B (2)			15 - 25	7.1	5.3	87.6	S	0.35		10.7	9.9	8.8	7.9	7.7	3.0	
III-9B (3)			25 - 35	10.0	12.7	77.3	SL	0.33		17.6	14.4	12.4	11.0	10.2	7.4	
III-9B (4)			35 - 45	6.3	10.5	83.1	LS	0.16		10.8	10.0	9.0	8.3	5.6	5.2	
III-9B (5)			45 - 68	9.8	5.9	84.3	LS	0.15		16.7	14.1	12.4	10.1	8.1	8.6	
III-9B (6)			68 - 82	-	-	-	-	-							0.0	
III-9B (7)			82 - 100	16.9	21.0	62.1	L	0.15		29.2	24.3	20.2	17.3	15.4	13.8	
III-10B (1)	Bineng	Loam	0 - 20	19.2	22.3	58.5	L	0.07		37.2	36.4	33.4	29.4	26.0	11.2	
III-10B (2)			20 - 50	28.1	18.0	53.8	CL	0.06		37.8	35.7	33.5	30.6	28.4	9.4	
III-10B (3)			50 - 100	18.8	14.2	67.0	L	0.04		37.3	33.0	30.0	25.5	23.4	13.9	
III-11B (1)	Bineng	Silt Loam	0 - 20	24.5	38.4	37.2	SiL	0.06		42.9	37.8	34.5	30.7	27.8	15.1	
III-11B (2)			20 - 50	47.4	30.9	21.7	SiL	0.04		38.6	36.5	34.8	31.6	30.9	7.7	
III-11B (3)			50 - 80	44.9	27.1	28.0	SiC	0.03		39.8	37.1	36.5	33.5	32.6	7.2	
III-11B (4)			80 - 100	40.4	28.4	31.2	SiC	0.03		41.1	37.8	35.6	32.4	31.4	9.7	

Table A.2.4 Results of Soil Chemical Analysis

Sample No.	Name of Soil Series	Name of Soil Types	Depth (cm)	P H (H2O)	P H (KCl)	Organic Matter (%)	Total Nitrogen (%)	C/N	Available Phosphate (ppm)	Cation Exch-ang Capacity (me/100g)	Exchangeable Base Ca (me/100g soil)	Mg	Na	K	Sum	Base Saturation (%)	Lime Requirement (tons/CaCO3/ha)
I-2 (1)	La Trinidad	Loamy Sand	0 - 10	5.4	4.4	1.74	0.11	9	112.32	36.74	17.70	6.62	0.48	3.55	28.35	77	2.75
I-2 (2)			10 - 35	5.2	4.4	1.01	0.08	7	11.58	46.77	19.10	7.71	0.58	1.11	28.50	61	
I-2 (3)			35 - 50	5.3	4.5	0.81	0.05	9	4.91	46.16	19.47	8.95	0.58	0.59	29.59	64	
I-2 (4)			50 - 85	5.4	4.5	0.56	0.04	8	4.21	41.62	18.00	7.78	0.67	0.30	26.75	64	
I-2 (5)			85 - 100	5.4	4.6	0.48	0.05	6	5.27	32.11	13.27	4.49	0.60	0.33	18.69	58	
I-5 (1)	La Trinidad	Silt Loam	0 - 15	4.3	3.8	4.54	0.22	12	31.24	45.98	15.35	5.31	0.65	0.20	21.51	47	7.75
I-5 (2)			15 - 38	4.8	3.9	1.98	0.09	13	4.21	46.51	16.31	7.93	1.00	0.14	25.38	55	
I-5 (3)			38 - 100	4.6	3.6	1.71	0.10	10	2.11	46.86	14.40	6.76	0.88	0.09	22.13	47	
II-2 (1)	Tacdian	Loamy Sand	0 - 10	7.4	6.3	3.01	0.12	15	77.22	43.86	33.79	3.20	0.63	0.79	38.41	88	
II-2 (2)			10 - 47	7.6	6.3	2.75	0.14	11	2.81	45.85	34.67	3.35	0.68	0.39	39.09	85	
II-2 (3)			47 - 95	7.5	6.5	1.52	0.06	15	1.40	38.74	34.23	3.76	0.91	0.43	39.33	102	
II-2 (4)			95 - 100	7.7	6.6	1.03	0.07	9	1.05	38.92	33.20	3.78	0.79	0.10	37.87	97	
II-6 (1)	Tacdian	Silt Loam	0 - 20	5.4	3.9	2.91	0.10	17	26.33	57.50	29.53	7.86	0.90	0.24	38.53	67	4.35
II-6 (2)			20 - 50	6.4	4.7	1.86	0.06	18	4.21	53.32	32.39	8.58	1.05	0.08	42.10	79	
II-6 (3)			50 - 100	5.7	4.7	1.26	0.09	8	1.76	52.71	35.77	8.37	1.24	0.08	45.46	86	
II-7 (1)	Tacdian	Silt Loam	0 - 15	5.6	4.7	2.95	0.14	12	185.97	53.84	32.98	7.42	0.68	1.52	42.60	79	1.75
II-7 (2)			15 - 100	6.3	4.8	2.21	0.10	13	101.76	47.73	35.18	5.38	0.71	0.88	42.15	88	
II-7 (3)			100 - 150	6.6	4.7	0.70	0.04	10	8.07	68.47	48.48	7.27	1.03	0.09	56.87	83	
II-8 (1)	Tacdian	Silt Loam	0 - 16	4.7	3.7	1.94	0.06	19	7.02	60.33	24.09	12.80	0.88	0.74	38.51	64	7.00
II-8 (2)			16 - 71	6.1	4.3	1.54	0.01	90	49.14	57.37	33.35	10.18	0.84	0.14	44.51	78	
II-8 (3)			71 - 105	6.5	4.4	0.08	0.007	7	87.72	55.33	41.93	8.22	0.79	0.11	51.05	92	
II-8 (4)			105 +	6.6	4.4	0.04	0.003	8	20.71	53.76	39.02	8.09	0.93	0.14	48.18	90	
II-9 (1)	Tacdian	Silt Loam	0 - 14	5.6	4.3	1.93	0.07	16	6.67	32.94	15.18	6.83	0.73	0.14	22.88	69	1.60
II-9 (2)		Alluvial	14 - 81	5.7	4.8	0.58	0.03	11	0.76	43.95	20.06	8.15	0.08	0.08	28.37	65	
II-9 (3)			81 - 100	5.9	4.5	0.32	0.02	9	2.11	39.42	18.48	8.29	0.86	0.08	27.71	70	
II-11 (1)	Tacdian	Silt Loam	0 - 18	4.5	3.6	4.50	0.02	131	1.05	35.44	2.28	1.26	0.39	0.29	4.22	12	
II-11 (2)			18 - 41	4.5	3.5	0.64	0.04	9	3.16	56.63	2.75	2.15	0.53	0.29	5.72	10	
II-11 (3)			41 - 95	4.2	3.6	0.27	0.01	16	1.76	39.60	2.52	2.59	0.40	0.22	5.73	14	
II-11 (4)			95 - 100	4.7	3.5	0.08	0.003	16	2.46	33.03	2.44	2.34	0.43	0.71	5.92	18	
III-2W (1)	Puguis	Loamy Sand	0 - 10	4.7	3.5	4.57	0.18	15	397.66	47.28	12.19	3.73	0.44	1.71	18.07	38	9.00
III-2W (2)			10 - 30	4.5	4.0	4.40	0.19	13	2.81	46.27	17.23	4.68	0.48	1.14	23.53	51	
III-2W (3)			30 - 90	5.0	4.1	2.75	0.12	13	4.21	40.16	13.61	3.67	0.50	1.11	18.89	47	
III-2W (4)			90 - 130	4.5	3.9	0.64	0.03	12	1.05	40.53	14.79	6.32	0.68	0.48	22.27	55	
III-2W (5)			130 +	4.9	4.3	0.31	0.01	18	40.37	22.30	5.51	2.53	0.50	0.34	8.88	40	
III-2B (1)	Bineng	Silt Loam	0 - 20	4.6	4.1	4.42	0.09	29	2.81	39.33	13.69	5.08	1.01	0.27	20.05	51	5.60
III-2B (2)			20 - 100	6.5	5.1	0.66	0.04	10	4.91	32.29	18.72	5.94	1.41	0.26	26.33	82	
III-5B (1)	Bineng	Silt Loam	0 - 20	4.9	4.1	3.45	0.14	14	56.16	42.19	15.50	6.01	0.54	1.09	23.14	55	4.65
III-5B (2)			20 - 41	5.4	4.4	2.52	0.10	15	12.99	40.53	14.63	8.09	0.52	0.56	23.80	59	
III-5B (3)			41 - 63	5.9	4.6	2.21	0.08	16	2.11	41.08	15.57	9.04	0.58	0.11	25.30	62	
III-5B (4)			63 - 100	5.4	4.5	1.39	0.05	16	3.51	41.27	16.68	6.70	0.65	0.51	24.54	59	
III-7B (1)	Bineng	Silt Loam	0 - 23	5.4	4.2	3.23	0.15	13	12.27	33.13	16.68	4.05	0.95	0.16	21.84	66	1.70
III-7B (2)			23 - 50	4.9	4.2	2.62	0.17	9	9.13	36.27	17.38	4.49	0.85	0.25	22.97	63	
III-7B (3)			50 - 95	6.0	4.7	1.94	0.06	19	5.27	35.57	17.54	5.31	1.28	0.47	24.60	69	
III-7B (4)			95 - 100	6.5	4.5	0.44	0.01	26	14.39	57.37	49.54	12.38	1.32	0.20	63.44	111	
III-9B (1)	Bineng	Loamy Sand	0 - 15	6.2	5.7	5.20	0.20	15	94.77	12.90	18.88	4.30	0.76	0.19	24.13	187	0.50
III-9B (2)			15 - 25	6.4	5.5	4.18	0.03	81	89.51	19.80	13.84	2.40	0.75	0.16	17.15	87	
III-9B (3)			25 - 35	6.3	5.4	1.59	0.05	18	64.94	24.24	16.68	3.22	0.70	0.18	20.78	86	
III-9B (4)			35 - 45	6.7	5.5	1.00	0.03	19	71.96	17.95	12.11	4.05	0.67	0.16	16.99	95	
III-9B (5)			45 - 68	6.8	5.6	0.93	0.04	14	87.75	22.57	17.38	3.92	0.78	0.20	22.28	99	
III-9B (6)			68 - 82	6.9	5.7	0.90	0.09	6	61.43	17.77	13.61	2.91	0.64	0.89	18.05	102	
III-9B (7)			82 - 100	6.9	5.7	0.81	0.14	3	84.24	32.39	23.44	4.74	0.75	0.17	29.10	90	
III-10B (1)	Bineng	Loam	0 - 20	4.7	3.9	4.14	0.20	12	2.11	40.44	4.25	4.43	0.40	0.76	9.84	24	7.80
III-10B (2)			20 - 50	4.9	3.9	3.55	0.10	21	1.76	40.06	3.93	4.17	0.42	0.27	8.79	22	
III-10B (3)			50 - 100	4.9	3.7	1.56	0.03	30	2.46	32.39	9.98	5.37	0.54	0.28	16.17	50	
III-11B (1)	Bineng	Silt Loam	0 - 20	4.6	3.6	3.78	0.23	10	1.40	43.68	3.38	3.60	0.28	1.19	8.45	19	8.75
III-11B (2)			20 - 50	4.6	3.7	2.61	0.06	25	1.76	37.85	1.26	0.95	0.38	1.19	3.78	10	
III-11B (3)			50 - 80	4.8	3.7	1.97	0.07	16	1.76	53.95	1.73	1.39	0.34	1.16	4.62	9	
III-11B (4)			80 - 100	4.8	3.7	1.32	0.05	15	1.05	41.64	1.97	2.91	0.35	0.99	6.22	15	

Table A.2.5 List of Soil Types Extending in the Project Area

Name of Zone	Name of Soil Series	Name of Soil Types	Profile Characteristic	Slope	Parent Materials	Pit No.
Zone I	La Trinidad	1) La Trinidad Silt Loam	Moderate well drained	Flat	Limestone	I-1
		2) La Trinidad Silt Loam	Poorly drained	Flat	Limestone	I-3,5
		3) La Trinidad Loamy Sand	Mod. to excessive drained	Gently sloping to flat	Shale, sandstone and tuff	I-2,4
Zone II	Tacdian	4) Tacdian Lomy Sand	Stony, deep profile	Gently sloping	Limestone	II-2,3,5,10
		5) Tacdian Loamy Sand eroded	Shallow to moderately deep profile	Steep	Limestone	II-1, 4
		6) Tacdian Silt Loam	Deep profile	Gentry sloping to steep	Limestone and shale sandstone	II-6,7,8,11
		7) Tacdian Silt Loam alluvial deposit	Deep profile	Gentry sloping	Shale sandstone	II-9
Zone III (W)	Puguis	8) Puguis Loamy Sand	Deep profile, gravelly	Sloping and hilly	Conglomerates	III-1, 2, 3(W)
Zone III (B)	Bineng	9) Bineng Silt Loam eroded	Deep profile	Sloping	Conglomerates	III-3, 4, 5,6 (B)
		10) Bineng Silt Loam eroded	Deep profile	Steep	Conglomerates	III-1,2,7,8,11 (B)
		11) Bineng Loam	Mod. well drained shallow profile	Sloping	Conglomerates	III-10
		12) Bineng Loamy Sand	Deep profile	Sloping	Conglomerates	III-9 (B)

Note: (W); Wangal, (B); Bineng

Table A.2.6 Soil Classification in the Project Area

Name of Zone	Name of Soil Series	Name of Soil Types	Mapping Unit	Extent Area (ha)
Zone I	La Trinidad	Silt Loam, moderately drained	1	131
		Silty Loam, poorly drained	2	91
		Loamy Sand	3	68
			Sub-total	290
Zone II	Tacdian	Loamy Sand	4	163
		Lomy Sand, eroded	5	349
		Silt Loam	6	159
		Silt Loam alluvial deposit	7	9
			Sub-total	680
Zone III (W)	Puguis	Loamy Sand	8	100
Zone III (B)	Bineng	Silt Loam	9	92
		Silt Loam, eroded	10	213
		Loam	11	27
		Loamy Sand	12	18
			Sub-total	450
	The Study Area		Total	1,420

Table A.2.7 (1) Soil Profile Description

1. Information on the Site

a. Pit number	:	Zone I - 1
b. Soil name	:	La Trinidad Series (Silt Loam,moderately drained)
Great group/ Order	:	Haplaquept/ Inceptisols
c. Location	:	near Municipal Hall, Hospital Km 5 La Trinidad, Benguet
d. Elevation	:	1,315.0m
e. Land form		
Physiographic position	:	Level plain of alluvial fan
Surrounding land form	:	Flat to almost flat (<2 %)
Microtopography	:	None
f. Slope on which profile is sited	:	Flat
g. Vegetation or land use	:	Farmland (highland vegetable)

2. General Information on the Soil

a. Parent material	:	Alluvial
b. Drainage	:	Moderately well
c. Moisture condition in profile	:	Topsoil dry, below 20cm moist
d. Depth of groundwater table	:	None
e. Presence of surface stones	:	Very few gravels
f. Evidence of erosion	:	Slight (rill)
g. Human influence	:	Slight, plowing with application of organic and inorganic fertilizer

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 - 20	Dark reddish brown (5YR 3/2) when wet, and dull yellowish brown (10YR 5/4) when dry; fine silty loam; strong fine subangular blocky; slightly sticky, nonplastic when wet; friable when moist, very hard when dry; many fine and medium pores; abundant fine roots and few gravels; abrupt, broken boundary, [Sample No. I-1(1)].
Bh	20 - 40	Brown (7.5 YR 3/4) when wet and dull brown (7.5 YR 5/4) when dry; common medium distinct mottling; fine silty clay, moderate, medium angular blocky; sticky, slightly plastic when wet; firm when moist and very hard when dry; Few fine roots; gradual broken boundary [Sample No. I - 1(2)].
Bir	40 - 100	Brownish black (7.5 YR 3/2) when wet and dull brown (7.5 YR 5/4) when dry; few fine distinct mottling; fine clay; strong coarse angular blocky; sticky, slightly plastic when dry; very firm when moist and extremely hard when dry.[Sample No. I -1(3)].

Table A.2.7 (2) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone I - 5
b.	Soil name	:	La Trinidad Series (Silt Loam, poorly drained)
	Great group/ Order	:	Hydrandept/ Inceptisols
c.	Location	:	BSU Experimental Area, behind NPRCTC
d.	Elevation	:	1,310.8 m
e.	Land form		
	Physiographic position	:	Flat
	Surrounding land form	:	Flat
	Microtopography	:	None
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland(cabbage, strawberry, legumes)

2. General Information on the Soil

a.	Parent material	:	Mixed silty alluvium
b.	Drainage	:	Poor
c.	Moisture condition in profile	:	Wet below 15 cm; topsoil moist
d.	Depth of groundwater table	:	30 cm from surface
e.	Presence of surface stones	:	None
f.	Evidence of erosion	:	None
g.	Human influence	:	Slight (Plowing and fertilization)

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 - 15	Brown (7.5 4/3) when wet and dull yellow orange (10 YR 6/4) when dry; silty loam; strong coarse blocky; slightly sticky, slightly plastic when wet; firm when moist and extremely hard when dry; many fine and very fine roots; gradual irregular boundary;.pH 4.3 [Sample No. I-5(1)].
Btg	15 - 60	Dark grayish yellow (2.5 Y 5/2) when wet and light reddish gray (5 R 7/1) when dry; common medium prominent mottling; silty clay; strong coarse blocky; sticky, plastic when wet; firm when moist and extremely hard when dry; few very fine roots and presence of old roots; few gravels; diffuse broken boundary; pH 4.8. [Sample No. I -5(2)].
Btir	60 - 100	Gray (7.5 Y 5/1) when wet and grayish yellow (2.5 Y 7/2) when dry; fine few faint mottling; clay; strong medium angular blocky; very sticky, very plastic when wet; very firm when moist and extremely hard when dry; presence of root remains, and buried partially decomposed rice straw; pH 4.6 .[Sample No. I-5(3)].

Table A.2.7 (3) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone I - 2
b.	Soil name	:	La Trinidad Series (Loamy Sand)
	Great group/ Order	:	Haplaquept/ Inceptisols
c.	Location	:	10 m eastside of Velasco's house (Puguis) 50 m south of the road, 12 m above creek
d.	Elevation	:	1,322.0 m
e.	Land form		
	Physiographic position	:	Mountain footslope
	Surrounding land form	:	Undulating
	Microtopography	:	Terraced
f.	Slope on which profile is sited	:	Gently sloping
g.	Vegetation or land use	:	Farmland; fruit trees(citrus,coffee,papaya and other highland vegetables

2. General Information on the Soil

a.	Parent material	:	Conglomerates
b.	Drainage	:	Well
c.	Moisture condition in profile	:	Topsoil dry; below 35 cm moist
d.	Depth of groundwater table	:	none
e.	Presence of surface stones	:	Few Gravels (2 cm diameter)
f.	Evidence of erosion	:	Slight (sheet)
g.	Human influence	:	Terracing and plowing with inorganic fertilization

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 -10	Dark brown (7.5 YR 3/3) when wet and dull yellow orange (10 YR 6/4) when dry; loamy sand; weak medium subangular blocky; slightly sticky, nonplastic when wet; friable when moist and slightly hard when dry; many fine roots and few gravels, gradual irregular boundary; pH 5.4 [Sample No. I -2(l)].
R	10 -35	Brown (7.5 YR 4/4) when wet and dull yellowish brown (10 YR 5/4) when dry; common medium distinct mottling; sandy loam; moderate medium subangular blocky; slightly sticky, nonplastic when wet; friable when moist and very hard when dry; Common fine roots and few stones; diffuse broken boundary. pH 5.2 [Sample No. I -2(2)]
R	35 -50	Dark reddish brown (5YR 3/3) when wet and dull brown (7.5 YR 5/4) when dry,; common fine distinct mottling; sandy loam; moderate fine granular; slightly sticky, nonplastic when wet; very friable when moist and slightly hard when dry; few fine roots; gravelly with many stones; diffuse broken boundary. pH 5.3 [Sample No. I -2(3)].
R	50-85	Brown (7.5 YR 4/6) when wet and dull yellow orange (10 YR 6/4) when dry; loamy sand; moderate medium granular; slightly sticky, nonplastic when wet; very friable when moist and hard when dry; few very fine roots, gravelly and few stones; clear broken boundary. pH 5.4. [Sample No. I -2(4)].
R	85 -100	Brown (7.5 YR 4/4) when wet and dull reddish brown (5YR 5/4) when dry; many coarse distinct mottling; sand; moderate very fine granular; nonsticky, nonplastic when wet; very friable when moist and loose when dry; common gravels and sandstones .pH 5.4 [Sample No. I -2(5)].

Table A.2.7 (4) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone II - 2
b.	Soil name	:	Tacdian Series (Loamy Sand)
	Great group/ Order	:	Palehumult/ Utisols
c.	Location	:	Bahong; 7 m west of creek.(Owned by Hilario Magastino)
d.	Elevation	:	1,215.0 m
e.	Land form		
	Physiographic position	:	Alluvial fan (Flood deposit)
	Surrounding land form	:	Undulating
	Microtopography	:	None
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland (potato, legumes, rose)

2. General Information on the Soil

a.	Parent material	:	Mixed silty alluvium and limestone fragments
b.	Drainage	:	Moderately well
c.	Moisture condition in profile	:	Surface dry; moist subsoil
d.	Depth of groundwater table	:	None
e.	Presence of surface stones	:	Few gravels
f.	Evidence of erosion	:	Slight
g.	Human influence	:	Plowing with fertilization (organic and inorganic fertilizer with ash application)

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
A3p	0 -15	Dark brown (7.5 YR 3/4) when wet and dull brown (7.5 YR 5/4) when dry; loamy sand; moderate medium blocky; slightly sticky, nonplastic when wet; friable when moist and slightly hard when dry; common fine roots and gravels; clear smooth boundary..pH 7.4. [Sample No. II -2(I)].
AB	15 -47	Brown (10 YR 4/4) when wet and brown (7.5 YR 4/3) when dry; few fine distinct mottlings; loam; moderate medium subangular blocky; slightly sticky, slightly plastic when wet; friable when moist and slightly hard when dry; few fine roots, gravels and tiny ants; clear irregular boundary; pH 7.6. [Sample No. II - 2(2)].
Bb	47 - 95	Dark brown (10 YR 3/4) when wet and brown (7.5 YR 4/4) when dry; loamy sand; weak fine angular blocky; slightly sticky, slightly plastic when wet; very friable when moist and loose when dry; few very fine roots, many gravels and few stones; clear irregular boundary. pH 7.5. [Sample No. II -2(3)].
R	95 - 100	Dark brown (10 YR 3/4) when wet and dull yellowish brown (10 YR 5/4) when dry; few fine distinct mottling; silty loam; moderate medium angular blocky; slightly sticky, slightly plastic when wet; friable when moist and soft when dry; gravelly and many stones; pH 7.7. [Sample No. II -2(4)].

Table A.2.7 (5) Soil Profile Description

1. Information on the Site
   - a. Pit number : Zone II - 4
   - b. Soil name : Tacdian Series (Loamy Sand, eroded)
     Geat group/ Order : Udorthent/ Entisols
   - c. Location : Bahong; 15 m west of road; 6 m east of Robert Pacio's house; 8 m south of tomb
   - d. Elevation : 1,190.0 m
   - e. Land form
     - Physiographic position : Hilly
     - Surrounding land form : Rolling
     - Microtopography : None
   - f. Slope on which profile is sited : Gently sloping
   - g. Vegetation or land use : Farmland (grassland at time of survey)5
2. General Information on the Soil
   - a. Parent material : Shale sandstone with limestone fragments
   - b. Drainage : Moderately well
   - c. Moisture condition in profile : Moderately dry
   - d. Depth of groundwater table : None
   - e. Presence of surface stones : None
   - f. Evidence of erosion : Slight
   - g. Human influence : None

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 - 6	Very dark reddish brown (5 YR 2/4) when wet and dull reddish brown (5 YR 4/3) when dry; loamy sand, strong medium angular blocky; slightly sticky, slightly plastic when wet; very firm when moist and hard when dry; many fine roots; abrupt smooth boundary. [Sample No. II -4(1)].
Ct	6 - 38	Dark brown (7.5 YR 3/4) when wet and brown (7.5 YR 4/4) when dry; few fine faint mottling; silt loam; moderate medium angular blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; common fine and very fine roots; few gravels; abrupt smooth boundary. [Sample No. II - 4(2)].
C	38 - 100	Brown (7.5 4/6) when wet and dull reddish brown (5 YR 5/4) when dry; few medium distinct mottlings; silty clay; moderate medium angular blocky; slightly sticky, slightly plastic when wet; friable when moist and slightly hard when dry; few gravels, few fine and very fine roots. [Sample No. II - 4(3)].

Table A.2.7 (6) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone II - 6
b.	Soil name	:	Tacdian Series (Silt Loam)
	Great group/ Order	:	Palehumult/ Utisols
c.	Location	:	Sadag, Bahong; 200 m southwest below road end; 12 m east of Lolit Tireng hut
d.	Elevation	:	980.0 m
e.	Land form		
	Physiographic position	:	Terraced gardens
	Surrounding land form	:	Undulating
	Microtopography	:	None
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland (vegetables)

2. General Information on the Soil

a.	Parent material	:	Shale sandstone - tuff
b.	Drainage	:	Well
c.	Moisture condition in profile	:	Top 20 cm dry; subsoil moist;below 50 cm wet
d.	Depth of groundwater table	:	100 cm from surface(from irrigation canal)
e.	Presence of surface stones	:	None
f.	Evidence of erosion	:	Slight (sheet)
g.	Human influence	:	Slight (Plowing and inorganic fertilization)

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
A1p	0 - 20	Dark brown (10 YR 3/4) when wet and dull yellow orange (10 YR 6/4) when dry; silty loam; moderate medium angular blocky; slightly sticky, slightly plastic when wet; friable when moist and slightly hard when dry; few gravels and many very fine roots; clear smooth boundary. pH 5.4. [Sample No. II -6(1)].
Bir	20 - 50	Grayish yellow brown (10 YR 4/2) when wet and brownish gray (7.5 YR 4/1) when dry; many fine prominent mottling; silty loam; moderate medium angular blocky; slightly sticky, slightly plastic when wet; friable when moist and slightly hard when dry; many very fine roots and few gravels, clear smooth boundary. pH 6.4. [Sample No. II -6(2)].
Ctg	50 - 100	Olive black (7.5 Y 3/1) when wet and olive black (5 Y 3/2) when dry; many fine distinct mottling; silty loam; strong medium angular blocky; sticky,plastic when wet; firm when moist and extremely hard when dry; few gravels. pH 5.7. [Sample No. II -6(3)].

Table A.2.7 (7) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone II - d
b.	Soil name	:	Tacdian Series (Silt Loam,alluvial deposit)
	Great group/ Order	:	Ochraquult/ Ultisols
c.	Location	:	Alno; 20 m southeast of Julio Terreng's tool house; 50 m below Bonifacio Avelino's house
d.	Elevation	:	1,080.0 m
e.	Land form		
	Physiographic position	:	Hilly
	Surrounding land form	:	Hilly
	Microtopography	:	Terracing
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland (vegetables; peas, beans, cabbage)

2. General Information on the Soil

a.	Parent material	:	Shale sandstone-tuff-fumicetuff
b.	Drainage	:	Moderately well
c.	Moisture condition in profile	:	Topsoil moist; subsoil wet;
d.	Depth of groundwater table	:	None
e.	Presence of surface stones	:	None
f.	Evidence of erosion	:	Slight (sheet)
g.	Human influence	:	Plowing and fertilization

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 -14	Dull yellowish brown (10 YR 5/3) when wet and light yellow (2.5Y 7/3) when dry; silty loam; moderate medium angular blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; few big roots; many fine roots and few gravels; clear to smooth boundary. pH 5.6. [Sample No. II -9(1)].
Bt	14 -81	Yellowish brown (10 YR 5/6) when wet and dark reddish brown (2.5 YR 3/4) when dry; many medium prominent mottlings; silty clay loam; moderate medium angular blocky; very sticky, very plastic when wet; very firm when moist and extremely hard when dry; few stones, few fine roots; pH 5.7. [Sample No. II -9(2)].
C	81 -100	Light gray (5 GY 8/1) when wet and light gray (2.5 Y 8/8) when dry; few medium distinct mottlings; silty loam; moderate medium angular blocky; very sticky, very plastic when wet; very firm when moist and hard when dry; few gravels and very fine roots. pH 5.9. [Sample No. II -9(3)].

Table A.2.7 (8) SOIL PROFILE DESCRIPTION

1. Information on the Site

a.	Pit number	:	Zone III - 2 (W)
b.	Soil name	:	Puguis Series (Loamy Sand)
	Great group/ Order	:	Palehumult/ Utisols
c.	Location	:	Wangal; 25 m west below road; 100 m south of junction(BM); 20 m below east of house.
d.	Elevation	:	1,225.0 m
e.	Land form		
	Physiographic position	:	Mt. Footslope
	Surrounding land form	:	Hilly
	Microtopography	:	None
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland (vegetables and ornamentals)

2. General Information on the Soil

a.	Parent material	:	Conglomerates
b.	Drainage	:	Moderately well
c.	Moisture condition in profile	:	Moist
d.	Depth of groundwater table	:	None
e.	Presence of surface stones	:	None
f.	Evidence of erosion	:	Slight (rill)
g.	Human influence	:	Plowing and fertilization

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 - 10	Brown (7.5 YR 4/4) when wet and dull yellow orange (10 YR 6/4) when dry; loamy sand; weak fine granular structure; slightly sticky, nonplastic when wet; friable when moist and slightly hard when dry; common fine roots; clear smooth boundary. pH 4.7. [Sampe No. III-2W(1)].
Bh	10 - 30	Dark brown (7.5 YR 3/3) when wet and dark brown (10 YR 3/4) when dry; few fine faint mottling; sandy loam;moderate coarse angular blocky; slightly sticky, nonplastic when wet; friable when moist and hard when dry; few fine gravels and very fine roots; clear irregular boundary; pH 4.5. [Sample No. III -2W(2)].
B	30 - 70	Brown (7.5 YR 4/4) when wet and yellowish brown (10 YR 5/6) when dry; few fine faint mottlings; loam; moderate coarse angular blocky; slightly sticky, nonplastic when wet; friable when moist and hard when dry; few fine roots and fine gravels; gradual irregular boundary; pH 5.0. [Sample No. III -2W(3)].
B	70 -130	Brown (7.5 YR 4/4) when wet and bright yellowish brown (10 YR 6/6) when dry; clear fine distinct mottlings; loam; weak coarse blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; presence of cricket tunnels; clear irregular boundary. pH 4.5. [Sample III -2W(4)].
C	130 +	Bright reddish brown (5 YR 5/8) when wet and dull yellowish orange (10 YR 7/4) when dry; common fine distinct mottlings; loamy sand; weak fine crumb; nonsticky, nonplastic when wet; loose when moist and loose when dry; few gravels and sandstones; pH 4.9. [Sample III -2W(5)].

Table A.2.7 (9) Soil Profile Description

1. Information on the Site
   - a. Pit number : Zone III - 5 (B)
   - b. Soil name : Bineng Series (Silt Loam)
     Great group/ Order : Vermudoll/ Mollisois
   - c. Location : Bineng; Approx. 85 m east below road; 120 m northeast below Binay-an's house; 2 m south above rice paddy
   - d. Elevation : 960.0 m
   - e. Land form
     - Physiographic position : Alluvial Fan
     - Surrounding land form : Undulating
     - Microtopography : None
   - f. Slope on which profile is sited : Flat
   - g. Vegetation or land use : Farmland (vegetables)

2. General Information on the Soil
   - a. Parent material : Conglomerates
   - b. Drainage : Well
   - c. Moisture condition in profile : Moderately dry throughout
   - d. Depth of groundwater table : None
   - e. Presence of surface stones : None
   - f. Evidence of erosion : Slight (sheet)
   - g. Human influence : Plowing with fertilization (inorganic and organic)

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 - 20	Dark reddish brown (2.5 YR 3/2) when wet and yellowish brown (10 YR 5/6) when dry; silty loam; weak fine granular; nonsticky, nonplastic when wet; very friable when moist and slightly hard when dry; many fine roots; few big roots' clear smooth boundary; pH 4.9. [Sample No. III - 5B (I)].
Bm	20 - 41	Dark reddish brown (5 YR 3/2) when wet and dull yellowish brown (10 YR 5/4) when dry; few fine distinct mottlings; silty loam; moderate fine subangular blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; few big roots and gravels; cricket tunnels observed; abrupt smooth boundary. pH 5.4 [Sample No. III - 5B(2)].
B	41 - 63	Dull reddish brown (5 YR 4/4) when wet and dull yellow orange (10 YR 6/4) when dry; few fine distinct mottlings; silty clay loam; moderate medium subangular blocky; slightlly sticky, slightly plastic when wet; friable when moist and hard when dry; few big roots and fine roots and stones; cricket tunnels present; abrupt irregular boundary; pH 5.9. [Sample No. III 5B(3)].
C	63 - 100	Brown (7.5 YR 4/6) when wet and dull reddish brown (5 YR 5/4) when dry; few fine distinct mottlings; silty loam; moderate medium subangular blocky; slightly sticky, slightly plastic when wet; friable when moist and slightly hard when dry; few fine gravels. pH 5.4. [Sample No. III -5B (4)].

Table A.2.7 (10) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone III - 2 (B)
b.	Soil name	:	Bineng Series (Silt Loam, eroded)
	Great group/ Order	:	Haplorthox/ Orthox
c.	Location	:	Bineng; about 300 m south of Bineng Elem. Sch.300 m north of water tank; 150 m south of houses
d.	Elevation	:	1,005 m
e.	Land form		
	Physiographic position	:	Mt. footslope
	Surrounding land form	:	Rolling
	Microtopography	:	Terracing
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland (vegetables; beans, peas, rice)

2. General Information on the Soil

a.	Parent material	:	Conglomerates
b.	Drainage	:	Moderately well
c.	Moisture condition in profile	:	Moist throughout from top to bottom
d.	Depth of groundwater table	:	None
e.	Presence of surface stones	:	Few boulders; gravelly
f.	Evidence of erosion	:	Slight (rill)
g.	Human influence	:	Plowing; fertilization (inorganic)

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
Ap	0 - 20	Dark brown (7.5 YR 3/3) when wet and light yellow (2.5 Y 7/3) when dry; silty loam; moderate medium subangular blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; many gravels and fine roots; many ants; few bugs; abrupt broken boundary. pH 4.6. [Sample No. III -2B(1)]
R	20 - 100	Yellowish brown (2.5 Y 5/3) when wet and light yellow (2.5 Y 7/4) when dry; many coarse prominent mottlings; loam; moderate medium blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; presence of hardpan; many stones (sandstones) and gravels; pH 6.5. [Sample No III - 2B(2)].

Table A.2.7 (11) Soil Profile Description

1. Information on the Site
   - a. Pit number : Zone III - 10 (B)
   - b. Soil name : Bineng Series (Loam)
     Great group/ Order : Hapludoll/ Mollisols
   - c. Location : Bineng; about 50 m south of church; approx. 15 m southwest of house
   - d. Elevation : 985.0 m
   - e. Land form
     - Physiographic position : Mt. footslope
     - Surrounding land form : Undulating
     - Microtopography : None
   - f. Slope on which profile is sited : Gently sloping
   - g. Vegetation or land use : Grassland

2. General Information on the Soil
   - a. Parent material : Conglomerates
   - b. Drainage : Moderately well
   - c. Moisture condition in profile : Moist throughout
   - d. Depth of groundwater table : None
   - e. Presence of surface stones : None
   - f. Evidence of erosion : Slight (sheet)
   - g. Human influence : None

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
A	0 - 20	Very dark reddish brown (5 YR 2/3) when wet and brown (7.5 YR 4/4) when dry; loam; moderate medium blocky; slightly sticky, slightly plastic when wet; friable when moist and slightly hard when dry; few fine roots and gravels; abrupt smooth boundary. pH 4.7. [Sample No. III - 10B(I)].
C	20 - 50	Brown (7.5 YR 4/4) when wet and dull brown (7.5 YR 5/4) when dry; few fine distinct mottlings; clay loam; weak moderate subangular blocky; slightly sticky, nonplastic when wet; friable when moist and slightly hard when dry; many gravels; many very fine roots; abrupt wavy boundary. pH 4.9. [Sample No. III - 10B(2)].
R	50 - 100	Dark brown (7.5 YR 3/4) when wet and bright yellowish brown (10 YR 6/6) when dry; few fine distinct mottlings; loam; moderate medium subangular blocky; slightly sticky. nonplastic when wet; friable when moist and slightly hard when dry; many very fine roots; pH 4.9. [Sample No. III -10B(3)].

Table A.2.7 (12) Soil Profile Description

1. Information on the Site

a.	Pit number	:	Zone III - 9 (B)
b.	Soil name	:	Bineng Series (Loamy Sand)
	Great group/ Order	:	Tropudult/ Ultisols
c.	Location	:	Boliweng, Bineng; south of Tayod hill; 10 m
d.	Elevation	:	660.0 m
e.	Land form		
	Physiographic position	:	Along Pako creek
	Surrounding land form	:	Gently sloping
	Microtopography	:	None
f.	Slope on which profile is sited	:	Flat
g.	Vegetation or land use	:	Farmland (irrigated rice paddy; vegetables)

2. General Information on the Soil

a.	Parent material	:	Limestone
b.	Drainage	:	Well drained
c.	Moisture condition in profile	:	Topsoil moist; wet below throughout
d.	Depth of groundwater table	:	None
e.	Presence of surface stones	:	None
f.	Evidence of erosion	:	Slight (sheet)
g.	Human influence	:	Plowing

3. Profile Description

Horizon Symbol	Depth (cm)	Remarkable Features
A	0 - 15	Olive black (5 Y 2/2) when wet and yellowish gray (2.5 Y 5/1) when dry; loamy sand; moderate medium angular blocky; slightly sticky, slightly plastic when wet; firm when moist and slightly hard when dry; many fine and very fine roots; abrupt smooth boundary. pH 6.2. [Sample No. III - 9B(1)].
Bt	15 - 25	Yellowish gray (2.5 YR 4/1) when wet and light olive gray (2.5 GY 7/1) when dry; sand; weak fine single grain; nonsticky, nonplastic when wet; loose when moist and loose when dry; common fine roots; clear broken boundary. pH 6.4 [Sample III - 9B(2)].
B	25 - 35	Brownish black (10 YR 3/1) when wet and gray (10 Y 6/1) when dry; common fine distinct mottlings; sandy loam; moderate fine subangular blocky; slightly sticky, slightly plastic when wet; friable when moist and hard when dry; presence of iron concretions; common fine roots; clear smooth boundary. pH 6.3. [Sample No. III -9B(3)].
2-C	35 - 45	Black (5 Y 2/1) when wet and gray (5 Y 5/1) when dry; loamy sand; single grain; nonsticky, nonplastic when wet; loose when moist and loose when dry; few gravels and fine roots observed; abrupt smooth boundary. pH 6.7 [Sample No. III - 9B(4)]
2-B	45 - 68	Brownish gray (7.5 YR 4/1) when wet and brownish gray (10 YR 6/1) when dry; loamy sand; weak fine single grain; nonsticky, nonplastic when wet; loose when moist and soft when dry; few gravels and roots; abrupt smooth boundary. pH 6.8 [Sample No. III - 9B(5)].

-to be continued-

Horizon Symbol	Depth (cm)	Remarkable Features
3-C	68 - 82	Brownish yellow brown (10 YR 5/2) when wet and brownish gray (10 YR 6/1) when dry; loamy sand; weak fine single grain; nonsticky, nonplastic when wet; loose when moist and loose when dry; abrupt smooth boundary. pH 6.9. [Sample No. III - 9B(6)].
D	82 - 100	Brownish black (10 YR 3/2) when wet and brownish gray (7.5 YR 5/1) when dry; common few distinct mottlings; loam; moderate medium subangular blocky; sticky, very plastic when wet; friable when moist and slightly hard when dry; few gravels and very fine roots. pH 6.9. [Sample No. III - 9B(7)].

Table A.3.1 Optimum Crop Requirement

Crops	Optimum Crop Requirement						Environmental Requirement	Fertilizer Requirement
	Physical Properties				Chemical Properties			
	Texture	Soil depth	Drainage	Slope(%)	pH	Fertility	Temperature(°C)	NPK (Kg/ha)
A. Vegetable								
1 Cabbage / Cauli-flower	Sandy loam	Moderately deep to deep	Mode. well to well drained	0 - 8	6.0 - 7.5	Low to moderate	16 - 24	240 - 60 - 60
2 Lettus	Sandy loam to loam	Shallow to mod. deep	Well drained	0 - 8	4.2 - 8.7	Moderate	15 - 20	240 - 60 - 60
3 Celery	Silty loam	Mode. deep	Well drained	0 - 8	6.0 - 7.0	Moderate	16 - 18	240 - 60 - 60
4 Chinese Cabbage	Sandy and silt loam	Mode. deep	Well drained	0 - 8	4.3 - 7.0	Low to moderate	20 - 25	240 - 60 - 60
5 Strawberry	Clay loam and silt loam	Moderately shallow	Well drained	0 - 8	5.5 - 6.0	Moderate	19.4	200-200-200
6 Cucumber	Sandy loam	Mode. deep	Well drained	0 - 8	4.3 - 8.7	Moderate	18 - 24	120-120-120
7 Green Onion	Sandy loam clay loam	Moderately shallow deep	Mode. well drained	0 - 8	4.3 - 8.2	Moderate	13 - 24	120-240-120
8 Carrot	Sandy loam	Mode. deep to deep	Mode. well to well drained	0 - 8	6.0 - 6.8	None to moderate	15 - 29	90 - 90 - 120
9 Sweet Potato	Coarse loamy to fine clay	Mode. deep to deep	Well drained	0 - 8	6.5 - 7.5	Mode. to high	20 - 30	90 -120 -120
10 White Potato	Sandy loam to silt loam	Mode. deep	Mode. well to well drained	0 - 8	4.5 - 6.0	Low to moderate	10 - 25	150-150-200
11 Garden Pea	Clay loam to sandy loam	Mode. shallow to mode. deep	Well drained	0 - 8	5.5 - 6.0	Moderate	15 - 25	50 - 120 - 50
12 Baguio Beans	Sandy loam to clay	Shallow to moderate deep	Mode. well drained	0 - 8	5.5 - 6.8	Moderate	15 - 25	50 - 120 - 50
B. Cut Flowers								
13 Rose	Clay loam	Mode. deep	Well drained	0 - 8	5.5 - 6.5	Moderate	10 - 25	100-100-100
14 Gladiolus	Clay loam to loam	Well deep	Well drained	0 - 8	6.5 - 7.5	Moderate to high	13 - 25	200-200-200
C. Plantation Crops								
15 Chayote	Loam	Deep	Well drained	12 - 40	5.2 - 8.0	Moderate to high	18 - 24	200-200-200
16 Coffee (Arabica)	Loam	Very deep	Well drained	12 - 40	4.5 - 5.5	Moderate	13 - 26	-
17 Citrus (Orange)	Sandy loam	Very deep	Well drained	12 - 40	5.5 - 6.5	Moderate	13 - 35	-

Source: Environmental Adaptation of Crops, PCARRD, 1986

Table A.3.2 Suitable Rating of Soils and Lands for Vegetables and Cut Flowers

Description	Degree of Limitation	Suitability Rating	Remarks
1. Slope Range (%)			
< 5	None	100 - 90	Flat to very gently sloping
5 - 12	Slight	90 - 80	Gently sloping to undulating
12 - 25	Moderate	80 - 70	Undulating to strongly sloping
25 - 45	Severe	70 - 60	Moderately steep to steep
> 45	Extremely severe	< 60	Very steep to precipitous
2. Effective Soil Depth (cm)			
> 75	None	100 - 90	Very deep
75 - 50	Slight	90 - 80	Deep
50 - 30	Moderate	80 - 70	Moderately deep
< 30	Severe	70 - 60	Shallow
3. Drainage Class			
I	None to slight	100 - 85	Moderately well to well drained
II	Moderate	85 - 70	Imperfect or somewhat poorly drained
III	Severe	70 - 55	Poor, very poor or exclusively drained
4. Available Water Capacity (% by weight)			
> 20	None to slight	100 - 85	High
20 - 10	Moderate	85 - 70	Medium
< 10	Severe	70 - 60	Low

5. Workability

Degree of Limitation	Texture (upper 30cm)	Consistence (upper 30cm)	Structural Stability	Surface Stminess/ Boulders	Suitability Rating
None to slight	Loam	Loose to friable	High	None to few	100 - 85
Moderate	Sandy clay loam loamy sand, silty clay loam	Firm, hard, sticky and plastic	Medium	Fairly stony/ rocky	85 - 70
Severe	Sand, heavy clay	Very hard or very firm or very sticky and plastic	Low	Very stony/ rocky	70 - 55

6. Chemical Soil Limitation

Degree of Limitation	Soil Fertility Class	pH	Organic Matter(%)	Available P (ppm)	Exchange K(me/100g)	CEC (me/100g)	Suitability Rating
None to slight	High or very high	6.5-5.5	> 3	> 10	> 0.3	> 20	100 - 85
Moderate	Medium	5.5-4.5	3 - 1	10 - 2	0.3 - 0.1	20 - 10	85 - 70
Severe	Low to very low	< 4.5	< 1	< 2	< 0.1	< 10	70 - 60

Table A.3.3 Suitable Rating of Soils and Lands for Plantation Crops

Description	Degree of Limitation	Suitability Rating	Remarks
1. Slope Range (%)			
0 - 8	None to slight	100 - 90	Flat to gently sloping
8 - 24	Moderate	90 - 80	Undulating to strong sloping
24 - 40	Severe	80 - 70	Moderately steep to steep
40 - 60	extremely severe	70 - 60	Very steep
> 60	Mountainous	60 - 50	Precipitous
2. Effective Soil Depth (cm)			
> 100	None	100 - 90	Very deep
100 - 75	Slight	90 - 80	Deep
75 - 50	Moderate	80 - 70	Moderately deep
< 50	Severe	70 - 60	Shallow
3. Drainage Class			
I	None to slight	100 - 85	Moderately well to well drained
II	Moderate	85 - 70	Imperfect or somewhat poorly drained
III	Severe	70 - 55	Poor, very poor or exclusively drained
4. Available Water Capacity (% by weight)			
> 20	None to slight	100 - 85	High
20 - 10	Moderate	85 - 70	Medium
< 10	Severe	70 - 60	Low

5. Workability

Degree of Limitation	Texture (upper 50cm)	Consistence (upper 50cm)	Structural Stability	Surface Stoniness/ Boulders	Suitability Rating
None to slight	Loam	Loose to friable	High	None to few	100 - 85
Moderate	Sandy clay loam loamy sand, silty clay loam	Firm, hard, sticky and plastic	Medium	Fairly stony/ rocky	85 - 70
Severe	Sand, heavy clay	Very hard or very firm or very sticky and plastic	Low	Very stony/ rocky	70 - 55

6. Chemical Soil Limitation

Degree of Limitation	Soil Fertility Class	pH	Organic Matter(%)	Available P (ppm)	Exchange K (me/100g)	CEC (me/100g)	Suitability Rating
None to slight	High or very high	6.5-5.5	> 3	> 10	> 0.3	> 20	100 - 85
Moderate	Medium	5.5-4.5	3 - 1	10 - 2	0.3 - 0.1	20 - 10	85 - 70
Severe	Low to very low	< 4.5	< 1	< 2	< 0.1	< 10	70 - 60

Table A.3.4 Land Suitability Classification by Soil Types

Soil Names	Type of Crops	Suitability Class: Slope	Effective Soil Depth	Drainage Class	Available Water Capa.	Workability	Chemical Soil Limit.	Land Class
1 La Trinidad Silt Loam moderately drained	Vegetable	S1	S1	S2	S2	S1/dr	S1/pH,k	S1/pH, k, dr
	Plantaion	S1	S2	S2	S2	S1	S1/o.m.	S1/o.m.
2 La Trinidad Silt Loam poorly drained	Vegetable	S1	S1	S3/fl	S2	S1/sy	S1/pH,k	S2/fl, sy, pH, k
	Plantaion	S1	S1/sh	NS1/fl	S2	S1	S1/k	S3/sh, fl, k
3 La Trinidad Loamy Sand	Vegetable	S1	S2/sh	S1	S1	S2/st	S1/o.m.	S2/sh, st, o.m.
	Plantaion	S1	S2/sh	S1	S2	S2/st	S1	S2/sh, st
4 Tacdian Loamy Sand	Vegetable	S3	S1	S1	S2	S3/st	S1	S2/st
	Plantaion	S2	S1	S1	S2	S2/st	S1	S2/st
5 Tacdian Loamy Sand eroded phase	Vegetable	NS1/e	S2/sh	S1	S2	S3/st	S2/k	S3/e, sh, st, k
	Plantaion	S2/e	S2/sh	S1	S2	S2/st	S1	S2/e, sf, st
6 Tacdian Silt Loam	Vegetable	S3	S2/sh	S1	S1	S2	S2/k,o.m.	S2/sh, k, o.m.
	Plantaion	S1	S2/sh	S1	S1	S1	S1	S2/sh
7 Tacdian Silt Loam alluvial deposit	Vegetable	S1/es	S1	S2	S1	S2	S1	S2/es
	Plantaion	S1	S1	S1	S1	S1	S1	S1
8 Puguis Loamy Sand	Vegetable	NS1/e	S2	S1	S2	S2/st	S2/pH,k	S3/e, st, pH, k
	Plantaion	S3	S2/sh	S1	S2	S2/st	S1	S3/sh,st
9 Bineng Silt Loam	Vegetable	S3	S1	S1	S2	S2	S2/pH,k	S2/pH, k
	Plantaion	S1	S1	S1	S2	S1	S1	S1
10 Bineng Silt Loam eroded phase	Vegetable	NS1/es	S2	S1	S2	S2	S2/pH,k	S3/es, pH, k
	Plantaion	S2	S2	S1	S2	S2	S1	S2
11 Bineng Loam	Vegetable	NS1/e	S2	S1	S2	S1	S2/pH,p	S3/pH, p
	Plantaion	S2	S2	S1	S2	S2	S1	S2
12 Bineng Loamy Sand	Vegetable	S2/es	S1	S1	S2/st	S1	S2	S2/es, st
	Plantaion	S1	S1	S1	S2/st	S1	S2	S2/st

1) Land Classification:	Suitability Class	Suitablity Rating, %	General Description
	S1; Highly suitable	100-90	All soil/land qualities are optimal or none to few limitation.
	S2; Moderately suitable	89-80	One or two soil/land qualities are marginal with few limitation.
	S3; Marginally suitable	79-70	Two or more soil/land qualities are marginal with several limit.
	NS1; Cuurently not suitable	69-60	Soil/land are currently not suitable with several limitations but the limitations can be improved.
	NS2; Permanently not suitable	< 60	Soil/land are permanently not suitable if limitation can not be improved particularly that of slope limitations.

2) Limitation Factors :

st ; Stony
sy ; Sticky
pH ; Acidic (ph< 4.5)
sh ; Shallow soil depth
e ; Erosion hazard
k ; Low potassium
o.m.; Low organic natter (o.m.<2%)
dr ; Poor drainage
es ; Streambank erosion
p ; Low phosphoeus
fl ; Flooding every rainy season

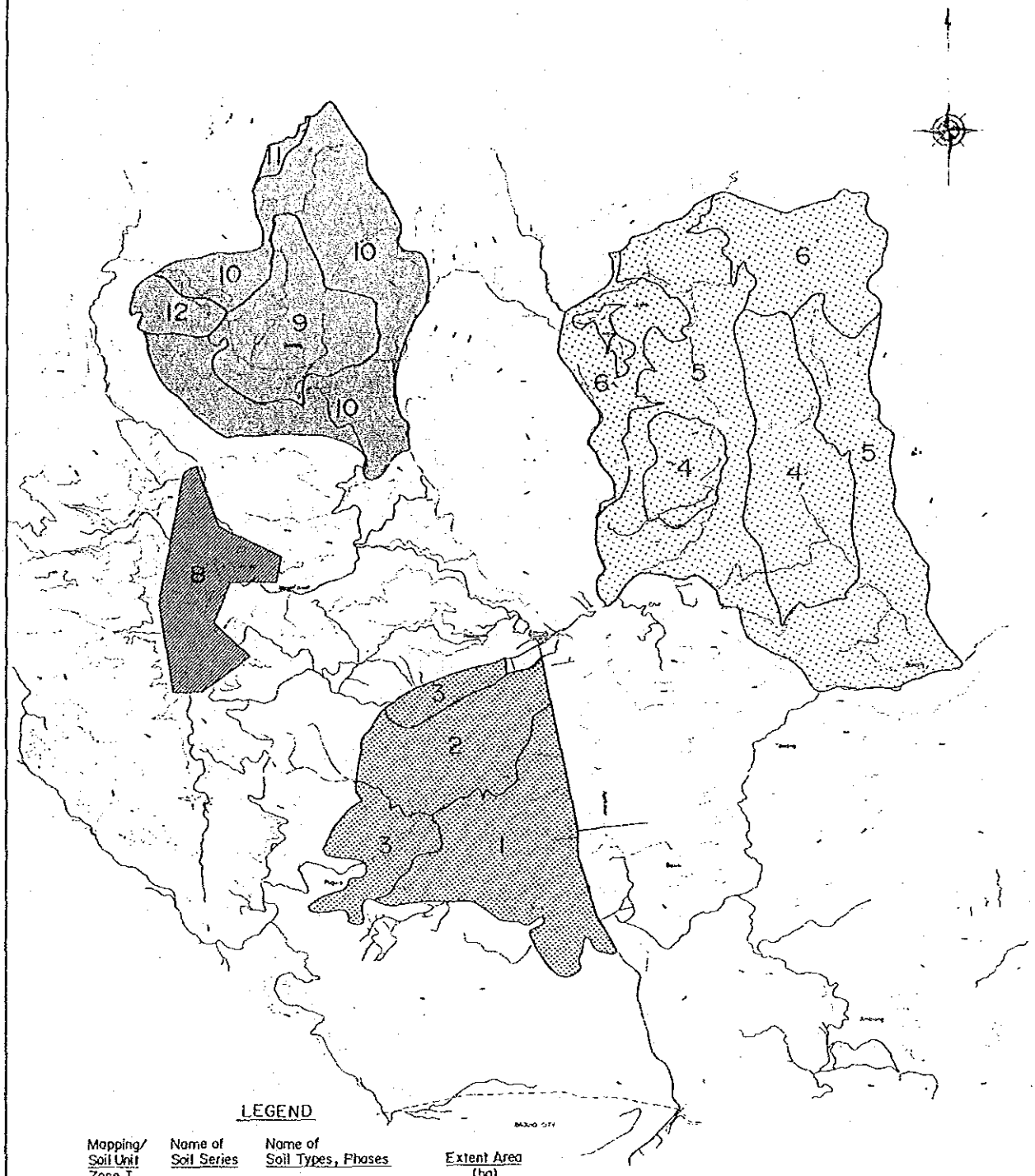
TABLE A.3.5 Land Suitability Classification for Crops

Soil Names	Vegetables Cut Flowers Land Class	Plantation Crops Land Class	Extend Area (ha)
La Trinidad Series			
(1) Silt Loam, moderate	S1	S1	82
drained	NS2	NS2	49
(2) Silt Loam, poor	S2	S3	81
drained	NS1	NS1	4
	NS2	NS2	6
(3) Loamy Sand	S2	S2	47
	NS2	NS2	21
Zone I		Sub-total	290
Tacdian Series			
(4) Loamy Sand	S2	S2	130
	NS1	NS1	13
	NS2	NS2	20
(5) Loamy Sand, eroded	S3	S2	123
	NS1	NS1	32
	NS2	NS2	194
(6) Silt Loam	S2	S2	57
	NS1	NS1	18
	NS2	NS2	84
(7) Silt Loam, alluvial	S2	S1	6
deposit	NS1	NS1	2
	NS2	NS2	1
Zone II		Sub-total	680
Puguis Series			
(8) Loamy Sand	S3	S3	17
	NS2	NS2	83
Bineng Series			
(9) Silt Loam	S2	S1	44
	NS1	NS1	30
	NS2	NS2	18
(10) Silt Loam, eroded	S3	S2	36
	NS1	NS1	30
	NS2	NS2	147
(11) Loam	S	S2	1
	NS1	NS1	1
	NS2	NS2	25
(12) Loamy Sand	S	S2	3
	NS1	NS1	2
	NS2	NS2	13
Zone III		Sub-total	450
The Study Area		Total	1,420

Table A.3.6 Land Classification by Present Landuse Type

Land Class	Agricultural Land		Bush / Forest	Residence / Others	Sub-total
	Upland field	Paddy field			
Zone I					
S 1	82	0	0	0	82
S 2	128	0	0	0	128
S 3	0	0	0	0	0
NS 1	0	0	4*	0	4
NS 2	0	0	0	76	76
Sub-total	210	0	4	76	290
Zone II					
S 1	0	0	0	0	0
S 2	187	6	0	0	193
S 3	123	0	0	0	123
NS 1	0	0	65	0	65
NS 2	0	0	199	100	299
Sub-total	310	6	264	100	680
Zone III					
S 1	0	0	0	0	0
S 2	17	30	0	0	47
S 3	43	10	0	0	53
NS 1	0	0	63	0	63
NS 2	0	0	232	55	287
Sub-total	60	40	295	55	450
Total	580	46	563	231	1,420

Note: 4* ; Swamp area in Zone I will be changed to a pond for irrigation water under the Project condition.



LEGEND

Mapping/ Soil Unit	Name of Soil Series	Name of Soil Types, Phases	Extent Area (ha)
Zone I			
1	La Trinidad	Silt Loam, mod. drained	131
2		Silt Loam, poorly drained	91
3		Loamy Sand	68
			290
Zone II			
4	Tacdian	Loamy Sand	163
5		Loamy Sand, eroded	349
6		Silty Loam	159
7		Silty Loam, alluvial deposit	9
			680
Zone III			
8	Pugis	Loamy Sand	100
9	Bineng	Silt Loam	92
10		Silt Loam, eroded	213
11		Loam	27
12		Loamy Sand	18
			450
		Total Area	1,420

SCALE

0 1,000 2,000

Fig. A.2.1 Soil Map in the Project Area

L E G E N D

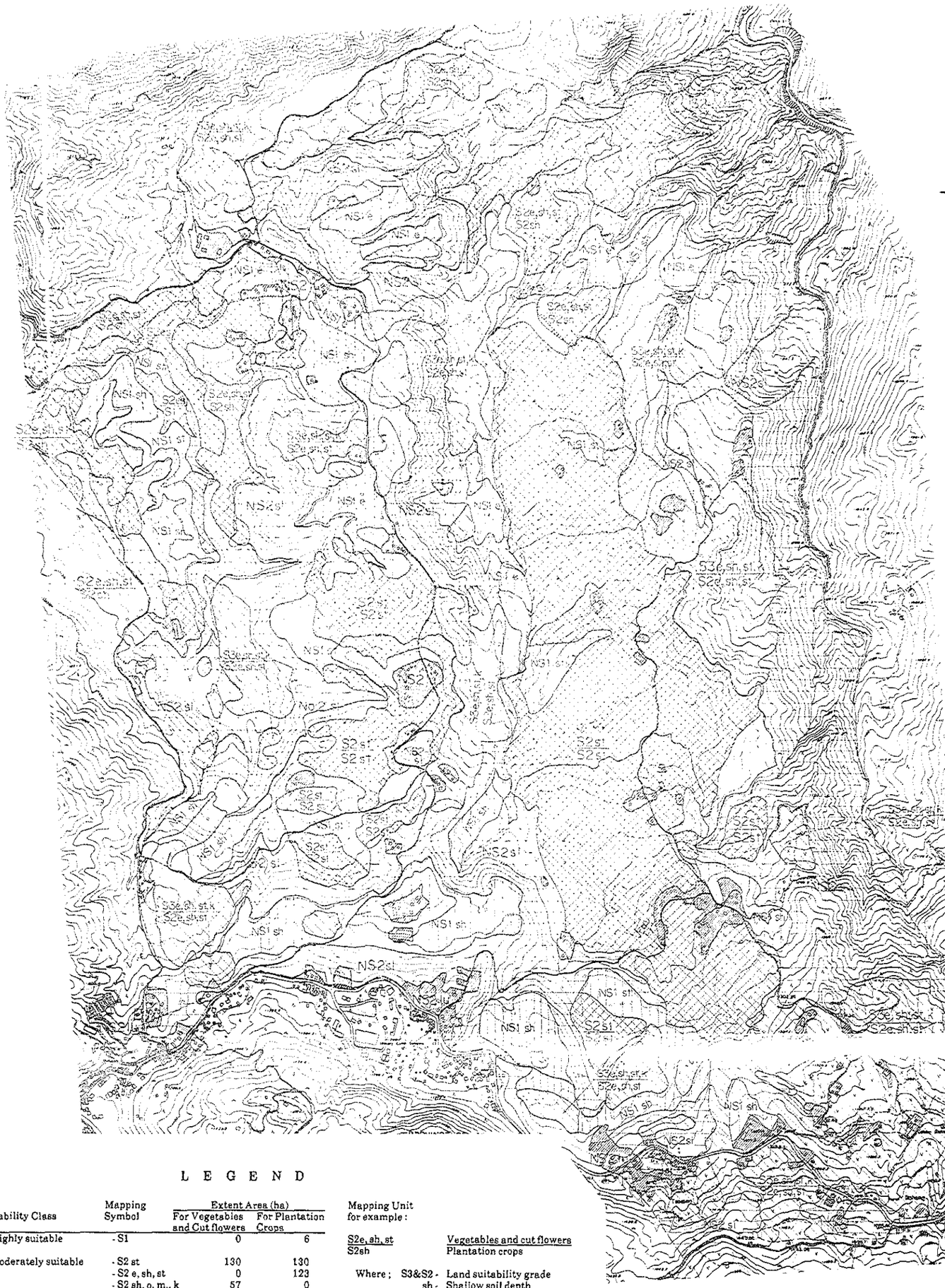
Land Suitability Class	Mapping Symbol	Extent Area (ha) For Vegetables and Cut flowers	Extent Area (ha) For Plantation Crops
S1 : Highly suitable	- S1	82	82
S2 : Moderately suitable	- S2 sh, st	0	47
	- S2 fl, sy, pH, k	81	0
	- S2 sh, st, o. m.	47	0
S3 : Marginally suitable	- S3 sh, fl, k	0	81
NS1 : Currently not suitable	- NS1 fl, dr	4	4
NS2 : Permanently not suitable	- NS2 lu	76	76
ZONE - I	Sub - total	290	290

Mapping Unit for example :

S3sh, pH, k	Vegetables and cut flowers
S3sh	Plantation crops

Where ; S3&S2 - Land suitability grade
sh - Shallow soil depth
sy - Sticky
dr - Poor drainage
st - Stony
pH - Strong acid (<4)
k - Low potassium
p - Low phosphoeus
o. m. - Low organic matter (<2%)
fl - Flooding every rainy season
lu - Present land use (residence, road)

Fig. A.3.1.(1) Land Suitability Classification Map (Zone I)



L E G E N D

Land Suitability Class	Mapping Symbol	Extent Area (ha) For Vegetables and Cut flowers	Extent Area (ha) For Plantation Crops
S1 : Highly suitable	- S1	0	6
S2 : Moderately suitable	- S2 st	130	130
	- S2 e, sh, st	0	123
	- S2 sh, o. m., k	57	0
	- S2 sh	0	57
	- S2 es	6	0
S3 : Marginally suitable	- S3 e, sh, st, k	123	0
NS1 : Currently not suitable	- NS1 st	8	65
	- NS1 sh	13	0
	- NS1 e	44	0
NS2 : Permanently not suitable	- NS2 lu	100	100
	- NS2 sl	199	199
ZONE - II	Sub - total	680	680

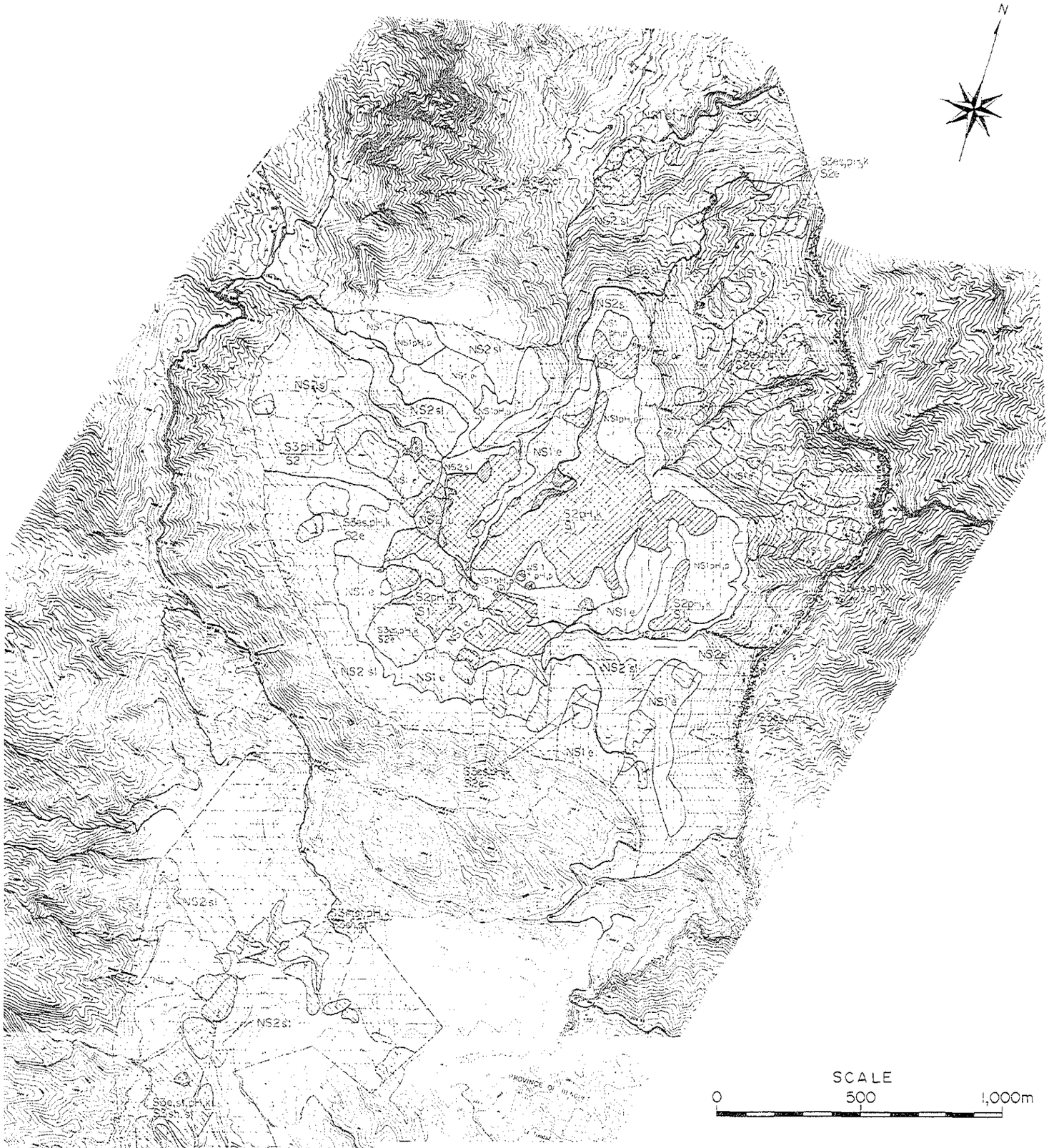
Mapping Unit for example :

S2e, sh, st — Vegetables and cut flowers
S2sh — Plantation crops

Where ; S3&S2 - Land suitability grade
sh - Shallow soil depth
sy - Sticky
dr - Poor drainage
st - Stony
e - Erosion hazard
es - Streambank erosion
pH - Strong acid (<4)
k - Low potassium
p - Low phosphoeus
o. m. - Low organic matter (<2%)
fl - Flooding every rainy season
lu - Present land use (residence, road)
sl - Sreep slope (above 33%)

SCALE 0 500 1,000m

Fig.A.3.1.(2) Land Suitability Classification Map (ZoneII)



L E G E N D

Land Suitability Class	Mapping Symbol	Extent Area (ha) For Vegetables and Cut flowers	Extent Area (ha) For Plantation Crops
S1 : Highly suitable	- S1	0	44
S2 : Moderately suitable	- S2 e		
	- S2 st	0	37
	- S2 pH, k	3	0
	- S2 es, st	44	3
S3 : Marginally suitable	- S3 pH, k	1	0
	- S3 gh, st	0	17
	- S3 es, pH, k	36	0
	- S3 e, st, pH, k	17	0
NS1 : Currently not suitable	- NS1 pH, p	23	33
	- NS1 e	38	2
	- NS1 st	2	28
NS2 : Permanently not suitable	- NS2 lu	55	55
	- NS2 sl	231	231
ZONE - III	Sub - total	450	450

Mapping Unit for example :

S3es, pH, k / S2e — Vegetables and cut flowers / Plantation crops

Where ; S3&S2 - *Land suitability grade*
st - Stony
SH - Shallow soil depth
sy - Sticky
dr - Poor drainage
e - Erosion hazard
es - Strcambank crosion
pH - Strong acid (<4)
k - Low potassium
p - Low phosphoeus
o. m. - Low organic matter (<2%)
fl - Flooding every rainy season
lu - Present land use (residence, road)
sl - Steep slope (above 33%)

Fig. A.3.1.(3) Land Suitability Classification Map (Zone III)

APPENDIX B

AGRICULTURE AND AGRO-ECONOMY

APPENDIX B AGRICULTURE AND AGRO-ECONOMY

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APPENDIX B AGRICULTURE AND AGRO-ECONOMY

1. GENERAL

This report gives a full account of the present agricultural and agro-economic conditions in the Project area with a gross area of 1,420 ha.

Data and information used in this study were provided by the following governmental authorities and private associations.

1) Bureau of Agricultural Statistics (BAS, former BAEcon)
2) National Economic and Development Authority (NEDA)
3) National Food Authority (NFA)
4) National Census and Statistics Office (NCSO)
5) Region I Office, Ministry of Agriculture
6) Fertilizer and Pesticide Authority (FPA)
7) Bureau of Plant Industry (BPI)
8) Provincial Government Office, Benguet
9) Department of Agriculture, Provincial Office
10) Department of Agriculture, Municipal Office
11) University of Philippines, Baguio
12) Benguet State University (BSU)

Aside from data collection, related investigations such as the farm economic survey and field reconnaissance were conducted so as to confirm the collected data with more concrete informations.

2. PRESENT CONDITION

2.1 Location

The Project area is located in the municipality of La Trinidad, Province of Benguet about 250 km north of Metro Manila. La Trinidad municipality is the administrative capital of Benguet Province and composed of 16 barangays. Out of them, the Project area includes 11 barangays with an aggregated gross area of about 1,420 ha.

The Project area is divided into three zones with their respective barangays as follows :

Zone I	Betag, Poblacion, Puguis and Pico
Zone II	Alapang, Alno, Bahong, Cruz and Tawang
Zone III	Wangal and Bineng

2.2 Human Resources

The population of La Trinidad municipality in 1985 was 32,590 comprising 50.5% of male and 49.5% of female as shown in Table B.2.1 and B.2.2. Population density was 394 persons/km^2 which is higher than the average of Benguet Province of 153 persons/km^2. The population growth rate averaged 3.70% between 1975 and 1985. The average family size is 5.3 persons. As for the age distribution in 1985, the young-age group population (ages 0 - 29 years old) represents the biggest age group and accounts for 70% of the total population.

Farm household was estimated at 2,203 or 41.2% of the total household in La Trinidad, i.e. 503 or 24.1% in Zone I, 553 or 55.2% in Zone II and 190 or 68.5% in Zone III. About 55% of the employed labors or 10,000 persons in La Trinidad are engaged in agriculture. The remaining 45% consist of businessmen, labors, government employees, etc., as shown in Table B.2.3.

2.3 Climate

The climate in and around the Project area is characterized by the distinct wet and dry seasons. The wet season, caused by tropical monsoon, extends usually from May to October and the dry season during the remaining months of the year.

In the Project area, the mean annual rainfall is about 3,600 mm, out of which about 90% occur in the wet season. The annual mean temperature is 19.1°C, with a maximum monthly mean of 20.6°C in June and the minimum of 16.8°C in January. The relative humidity varies between about 88% during the wet season and about 76% in the dry season. The monthly mean wind velocity varies from 1.1 m/sec. in November and February to 2.1 m/sec in July with an annual mean of 1.4 m/sec.

Although the monsoon rain is prevalent in and around the Project area, the climatic characteristics are suitable for farming temperate vegetables. General climatic characteristics are summarized in Table B.2.4 and illustrated in Fig. B.2.1.

2.4 Soils

The soils in the Project area are classified into following 4 series according to the soil classification system of the Bureau of Soils, Philippines.

1) La Trinidad Series	:	Zone I
2) Tacdian Series	:	Zone II
3) Puguis Series	:	Zone III (Wangal)
4) Bineng Series	:	Zone III (Bineng)

Soils of La Trinidad Series extend over the flat to gently flat lands located on the lower portion of La Trinidad Valley in Zone I. The soils are deep and are well drained, but the lower elevated area are sometimes affected by flood in the rainy season. The soils generally have high inherent soil fertility, although the acidity of the soils is strong.

Soils of Tacdian Series are found on gently slope and steep areas in Zone II. The land of these soils is moderately drained and is all terraced for crop production. In general, these soils have high inherent fertility and a almost neutral pH value.

Soils of Puguis Series are found in hilly and mountainous areas in barangays Puguis and Wangal. The land of this soil has good drainage condition. The soils are very strongly acid throughout their profile.

Soils of Bineng Series extend over gently sloping land in barangay Bineng with an area of 350 ha. The land of the soils is terraced and planted with rice and vegetables.

2.5 Land Use

The present land use in the Project area was studied based on 1/5,000 scale map of the Study area prepared by JICA at Work I stage, with supplementary reconnaissance in the area. The land use in each Zone is classified into five categories i.e.,upland crop field, lowland rice field, resident/commercial area, forest/grass land and others. The areas in each Zone are illustrated in Fig. B.2.2, B.2.3 and B.2.4, and estimated as shown below:

(Unit:ha)

Land use	Zone I		Zone II		Zone III		Total	
1. Agricultural Land								
Upland field	210	(73%)	310	(46%)	60	(13%)	580	(41%)
Lowland rice field	0	(0%)	0	(0%)	40	(9%)	40	(2%)
2. Swamp	4	(2%)	6	(1%)	0	(0%)	10	(1%)
3. Residential/Commercial	67	(23%)	30	(4%)	5	(1%)	102	(7%)
4. Forest/grass	0	(0%)	264	(39%)	295	(66%)	559	(40%)
5. Others	9	(2%)	70	(10%)	50	(11%)	129	(9%)
Total	290	(100%)	680	(100%)	450	(100%)	1,420	(100%)

The total land area of the Project area is estimated at about 1,420 ha, out of which 44% is agricultural land. Lowland rice fields cover 40 hectares, which are found in Zone III. The other area of the agricultural land consists of upland crop fields. Out of forest/grass land, forest land is mostly distributed on steep slope, and grassland is composed of bush of guava, wild rose and natural grass which is used to feed cattle and buffaloes.

The land in Zone I is characterized by large occupation ratios of upland crop fields (73%) and resident/commercial area (23%). The upland crop field are mainly utilized for production of vegetables and flowers. Zone II is the second most developed area following Zone I, upland crop fields and residential/commercial areas occupy 46%, 4% respectively, and the rest is mostly forest/grass land. In Zone III, lowland rice fields and upland crop fields occupy about 9%, 13% of the area respectively, and the rest is mostly forest/grass land on steep slope.

2.6 Land Tenure and Land Holding System

Presidential Decree 705 launched in 1975 classified land with 18° slope and over as non-alienable and prohibit private ownership of the land in order to reserve the country's land area as forest for ecological purposes. A major portion of the cordillera region devoted to cultivation is non-alienable (slope more than 18°), and occupancy is therefore illegal. Many farmers lost their ancestral land through expropriation by the decree. The government, however, tolerated the occupancy and is in fact levying land tax on the occupants.

In 1985, PD 705 was amended by PD 1998. The amending decree authorized that, regardless of a slope of 18° or over, lands in Cebu and Benguet shall be classified as alienable and disposable only if effective erosion control is practiced, like terracing. However unterraced lands with 18° slope and over are very common in the cordillera region and were excluded from the classification.

Recently, the Government (Bureau of Forest Development) has offered "stewardship" contracts on some of these lands under which an occupant would occupy and cultivate his designated plot on the condition that he observes Government policies relating to land use and soil conservation. The contract is for 25 years, renewable for another 25 years, and is transferable to a heir or any other suitable occupants. The stewardship certificate is not a document of ownership and is not honored as valid collateral for loans.

At present about 70% of the farmers in the Project area is supposed to have the land titles while about 95 % of the farmers are owner-operators based on the results of the farm economic survey and interview with provincial assessor. As for the stewardship contract, only fourteen farmers have obtained the certificate in the Project area.

Average farm size in La Trinidad is estimated at 0.83 ha as shown in Table B.2.1, while they are estimated at 0.87 ha, 0.70 ha and 0.91 ha for Zone I, II, III respectively, based on the result of the farm economic survey. They are summarized a below :

(Unit : No.)

Farm size	Zone-I	Zone-II	Zone-III	Total
Below 0.5 ha	10	10	4	24
0.5 - 1.0 ha	2	21	7	30
1.0 ha and over	5	16	17	38
Total	17	47	28	92
Average farm size (ha)	0.87	0.70	0.91	0.80

Source : Results of farm economic survey

2.7 Cropping Pattern and Farming practices

2.7.1 Cropping pattern

(1) Kind of crops being grown

There are various kinds of cut flowers and vegetables cultivated in La Trinidad. The main vegetables being grown are legumes like string beans which is called Baguio Beans, garden peas, leafy vegetables like Chinese cabbage, pechay, cabbage, lettuce, celery, green onion, cauliflower, broccoli, asparagus, fruit vegetables like cucumber, eggplant, tomato, sweet pepper, tuber crops like white potato, radish, taro, sweet potato, carrot. Chayote is grown as tolerant vegetable against damage by typhoon. There are various minor vegetables which do not appear in statistical data like crown daisy (Chrysanthemum coronium L.) gobou (Great burdock, Arctium Leppa L.), turnip, soybean, nila (Allium odorum L.) honewort (Crypotataenia canadensis DC. var. Japonica), etc.

The main cut flowers produced in the area are roses, gladiolus, chrysanthemum, dahlia, etc. Anthlium has been also introduced recently.

Banana, mango, coffee, avocado, guava are mostly planted in home garden, and large scale plantation of these kinds of crops are not common in the area. Rice is cultivated only in Bineng and Alno barangays in the Project area, rice cultivation including upland rice is not found in any other place in the area. Strawberries, introduced recently, are cultivated mainly in Zone I including the production farm of BSU.

(2) Cropping calendar

La Trinidad municipality lies at altitude between about 500 m - 1,700 m above sea level. Zone I is at about 1,300 m, Zone II is at 800 m - 1,100 m and Zone III is at 800 m - 1,000 m, all of these areas are frost free. The temperature condition of these areas is suitable for year round cultivation of temperate vegetables. Main crop season of rice is the wet season, sowing in July, transplanting in August and harvesting in December. The dry season rice is sown in December - January and harvested in June - July.

The cropping calendar and cultivated area in the Project area are mainly affected by excessive rainfall, strong wind, damages of typhoon in the wet season, and shortage of irrigation water in the dry season. In the mid of the wet season (June to September) roses, gladiolus, green onion, etc. are cultivated in upland fields. Besides , some leafy vegetables like celery, Chinese cabbage are also grown with expectation of no damages by typhoon. Most of these crops could possibly be grown without damage in greenhouse even in the wet season. Chrysanthemum, broccoli, cauliflower are specially cultivated with this method. Green onion

is cultivated all year round because its resurgence ability against the typhoon damages is quite high. The same theory can be applied to roses.

The present planted area of vegetables in La Trinidad fluctuates by season is shown in Fig. B.2.5. The planted area increases around September - October, decreases in March - April due to shortage of water and increases again at the beginning of the wet season in May. The planted area is reduced during July - August due to typhoon. According to these data, there are two cropping seasons in the area, the first is started in May with the onset of the wet season, the other is started at just before the end of the wet season from September to October.

(3) Cropping pattern

The present cropping pattern in the Project area is generalized by each Zone as illustrated in Fig. B.2.6.

In Zone I, strawberry occupies about one third of the area, and the rest is used for vegetables cultivation. In Zone II, roses are introduced with about 40 % of the area, most of the other field can possibly be used for vegetable production for five cropping times a year, through as illustrated in the figures, a part of the field is utilized about three times for vegetable cropping a year on average. In Zone III, lowland rice is cultivated over 40 ha in the wet season while in the dry season, rice cultivation area decreases to about 25 ha mainly due to shortage of irrigation water. Upland crop field cover about 60 ha in Zone III. Out of the 60 ha, about 30 ha is on steep slope and mainly utilized for cultivation of vegetables in the wet season from middle of May to August and the end of the wet season from September to October. The cropping pattern shows that a part of the upland field is utilized for cultivation of vegetables two to three times a year.

On the basis of the presented cropping pattern, cropping intensity in each zone is estimated as follows :

(Unit : ha)

Crops	Zone I	Zone II	Zone III	Total	
(Net farm area)	(170)	(200)	(70)	(440)	
Net Cultivated area					
Vegetables	269	366	96	731	
Strawberry	56	0	0	56	#1
Rose	0	78	0	78	#1
Rice	0	0	50	50	
Intercropping	0	78	0	78	
Total	325	444 #	146	915	#2
Cropping intensity (%)	191	222	209	208	

#1 : Crop area of strawberry and roses are judged to be more than the value mentioned in the statistics, based on the results of the field survey.
#2 : Crop area of intercrop is excluded from the total.

2.7.2 Farming practices

(1) Rice

Rice in the area is cultivated with the ordinary transplanting method. The nursery period is about 30 days. After ploughing and paddling the main field by buffalo, transplanting of seedlings is done by manpower. Usually no fertilizers are applied to rice. Mostly local varieties are dominated. The C 22 variety has been introduced as the short duration variety in the wet season but in a small area. In the dry season local variety of red rice, Kintoman is cultivated. Mechanization farming is not yet practiced. The dry season rice is cut at the upper part of culm and made into bundle, then threshed by pounding with pestle. The wet season rice is cut at the height of about 10 or 20 cm above the ground level and then threshed with treadle thresher or by thrashing against wooden bars.

(2) Vegetables and flowers

The Project area is the most advanced in horticulture especially of vegetables and cut flowers The advanced farming practices of vegetables and flowers have become wide spread in the area, cultivation methods like planting density, fertilization, etc. are mostly in uniform manner all over the area. Most vegetables and flowers are cultivated on ridge. Cabbage, celery are usually grown in transplanting method while Chinese cabbage, pechay are in direct sowing method. Some farmers use a simple covering of vinyl, etc. for seedling in the wet season. Organic manures like chicken manure, mushroom compost, Sagana 100, chemical fertilizer like 14-14-14, urea, ammonium sulfate are applied commonly. Most of farm management work is carried out by manpower. Pests and diseases control is done with knapsack type sprayer. Most vegetables and flowers are grown outdoors, while chrysanthemum, cauliflower and broccoli are grown in greenhouse in the wet season mainly to avoid damages by typhoon and high soil moisture.

Irrigation is required for about 6 months from November to April. Irrigation water is drawn with channel or hose by gravity, the water is usually kept in a pit in the field or water tank and applied to the crops by using watering cans or by furrow method. Sprinklers are used by some farmers. Irrigation by pumps is found in Alno and Zone I areas.

Harvesting of vegetables and cut flowers are done by manpower, and carried to the road which is accessible by vehicles.

Most seed of vegetables are imported and obtainable through stores in the town. Varieties of Chinese cabbage, cabbage are of relatively small size which meet preference of consumers and farmers' requirement as short growing duration of about 60 days.

The present planting density of crops are as follows; and the main pest and diseases are as shown in Table B.2.5.

Crops	Width of ridge	No. of row	Plant to plant
Celery:	60 cm	2	18 cm x 30 cm
Roses:	120 cm	1	120 cm x 120 cm
Green Onion	100 cm	4	20 cm x 25 cm
Chinese Cabbage	60 cm	2	25 cm x 30 cm
Gladiolus	100 cm	8	33 cm x 12 cm
Soybean	60 cm	2	18 cm x 30 cm
Eggplant	60 cm	1	40 cm x 30 cm
Baguio beans	80 cm	4	18 cm x 18 cm
Garden peas	90 cm	2	12 cm x 12 cm
Lettuce	75 cm	2	36 cm x 36 cm

Farm input requirements for the representative crops are summarized in Table B.2.6.

2.8 Agricultural Production

2.8.1 Crop yield and production

(1) Crop area and production

The crop area, unit yield and production of the main crops in La Trinidad for 1984 to 1987 are as shown in Table B.2.7* . The cultivated area of string beans (Baguio beans) is estimated at 346 ha the largest planted area among the main crops, and its production is about 2,600 tons on the average for the past four years. The cultivated areas and production of Chinese cabbage, pechay/mustard seeds, garden peas are 284 ha/4,500 tons, 218 ha/ 1,700 tons, 168 ha/500 tons, respectively. Other vegetables which occupy relatively large areas are green onion and lettuce. The average annual total area and production of vegetables in La Trinidad is estimated at about 1,700 ha and 17,000 tons, respectively. The average annual cultivated area and production of rice is about 110 ha.and 200 tons, respectively. Cut flowers as the second most important products in the area are roses, gladiolus, etc. and their area and production are 43 ha and 480 thousand dozens of roses, 198 ha and 2,920 thousand dozen of gladiolus, 164 ha and 1,100 thousand dozen of the other flowers.

* Crop area of strawberry and roses are judged to be more than the value mentioned in the Table, based on the results of the field survey.

Besides the above mentioned crops, citrus trees have been recently introduced but the planted area is only about 10 ha. The planted area of coffee has decreased to about 10 % during the four years. While, the cultivated area of vegetables has slightly expanded at a rate of 10 % a year and the total production of vegetables increased from 18,600 tons to 22,400 tons during the last three years from 1985 to 1987.

(2) Unit yield of crops

The unit yield of vegetables in the area fluctuate year by year and has not reached a sufficient high level compared with those in Japan. The main factors causing the stagnated and fluctuating level of the unit yield are assumed as damage by typhoon and unstable rainfall patterns. The unit yield of rice is estimated at 1.9 ton/ha (paddy) on average. Unit yield of the main vegetables is summarized and compared with that in Japan as seen below:

Vegetables	Yield /1	Yield in Japan/2	P/J
	(t/ha)	(t/ha)	(%)
String beans (Baguio bean)	7.5	8.0	94
Garden peas	3.0	6.1	49
Chinese cabbage	15.9	40.5	39
Pechay	7.8	-	- /5
Lettuce	11.0	20.4	54
Cabbage	15.9	36.0	44
Cauliflower	15.4	18.0	86
Cucumber	15.6	33.4	47
Tomato	14.4	53.1	29
Potato	15.5	26.1	59
Carrot	15.1	23.3	65
Green onion	7.8	22.9	34
Celery	14.5	47.1	31
Strawberry	9.6	15.0	64
Roses /3	25.0	78.0 /4	32
Gladiolus /3	14.8	15.6 /4	95

<1: The unit yield is of average for 1984, 1985, 1986, 1987
<2: The unit yield is of average for 1975 - 1979 in Japan
<3: The unit yield is in 1,000 dozen
<4: These are of 1981
<5: Data is not available.

The unit yields of string beans and gladiolus in La Trinidad are almost same as those in Japan. The unit yields of most other vegetables are lower than those in Japan, and especially those of the main crops like garden peas, Chinese cabbage, lettuce, green onion and celery.

The present crop production in each zone is estimated for the representative crops based on the present average unit yield described above:

Zone	Crops	Cultivated area	Yield per ha	Production	
		(ha)	(t/ha)	(t/year)	
I	Strawberry	56	9.6	538	
	Vegetables	269	9.9	2,663	
II	Roses	78	25.0	1,950	#
	Vegetables	366	9.9	3,623	
	Intercropping				
	Vegetables	52	5.6	291	
	Flower	26	7.4	192	#
III	Rice	50	1.9	95	
	Vegetables	96	9.9	950	

Vegetables include Baguio bean, Garden pea, C. Cabbage, Lettuce, G. Onion and Celery
Intercropped vegetables include G. Onion and Celery
: Yields and production of roses and flower are presented in 1,000 dozen

2.8.2 Livestock production

The population of livestocks in the Benguet Province by municipality is shown in Table B.2.8. The Table shows that poultry is predominant in La Trinidad and accounts for about 30% of the provincial total. Buffalo, cattle, goat, fowl, horse and swine are the main livestocks in the area.The population of livestocks per farm household in the Project area were estimated as shown below based on the farm survey results:

(Unit: head/household)

Livestock	Zone I	Zone II	Zone III	Average
Buffalo	0.0	0.1	0.1	0.1
Cattle	0.3	0.3	0.1	0.2
Fowl	17.0	4.4	4.8	7.4
Duck	0.6	0.0	0.0	0.1
Goat	0.0	0.0	0.0	0.0
Horse	0.2	0.0	0.0	0.1
Swine	1.0	0.9	0.5	0.8

Source : Farm economic survey

There is no buffalo in Zone I, while in Zone II and Zone III buffalo ownership is 1 head per 10 households. Cattle is raised at the rate of 1 head per 5 households in each Zone, and swine is bred at the rate of 1 head per household. Fowl is raised mainly in backyards at a rate of 4 - 5 heads per household in Zone II and III, while there are 17 heads per household in Zone I where large scale poultry farms are found.

As a result of the farm economic survey, most households in the area keep livestocks for their own use or consumption except for some commercial poultry farms. Cattle, buffalo and goats are usually fed with natural grass in bush and grass lands. Livestock raising is not the mainline industry but it is somewhat important in the study area.

2.9 Marketing and Prices

2.9.1 Marketing systems

There are basically two marketing channels for the disposal of farm products i.e. a) by trader and b) by farmers.

(a) Trader (Middlemen)

Traders visit farmers, make an estimate of the products and procure them before it is harvested. The trader is responsible for the harvesting and hauling and he bears the losses if prices go down. The advantages for the farmers are that they save on labor costs for harvesting and they do not bear the marketing risks.

Farmers are in some case tied-up to private traders who provides them with the necessary inputs on credit. The farmers have to market their crops through the traders. Such tied-up system prevents farmers from maximizing profits.

(b) Farmers

After farmers have harvested and packed the products, they deliver them to the market in Baguio City. In the market, the products are sold to wholesalers who in turn sell to the middlemen from Manila or adjoining provinces. Most farmers have to hire a jeepney for the transportation from farm to market. Higher prices offered in Baguio attract farmers to bring in their own harvest. Sometimes agents wait for the farmers along the Halsema Highway to buy the products.

The bulk of vegetables produced in the area goes to Metro Manila directly or through Baguio wholesale market, some go to Central Luzon such as Pangasinan, Tarlac, Pampanga, Cabanatuan City and Olongapo City. But before vegetables reach these areas, the products pass through several tiers of middlemen. (Fig. B.2.7) Strawberry produced in the BSU compound is delivered to the collection center for packing before distribution to processing centers and markets.

Divisoria wholesale market in Manila handles about 80% of vegetables supplied to Manila. About six wholesalers control about 60% of the market. These wholesalers have a Luzon-wide agency system that finance the producers, buy the products at administered price and transport them to Divisoria. The wholesalers set the price of vegetables by regulating intake from farmers to maintain price levels and profitability.

With regard to farm input supplies, the private sector handles the sale. There are about ten dealers of farm input in La Trinidad. Most of fertilizers, agro-chemicals and vegetable seeds are imported from USA, Indonesia, Korea, Japan, etc.

2.9.2 Marketing facilities

La Trinidad and Baguio City are the main trading centers of vegetables produced in Benguet and Mountain provinces. However, vegetable trading is done along the street, in private warehouse, bus terminals and at any open space due to the lack of permanent organized facilities. These disorderly markets generated several problems like traffic congestion, insufficient distribution of vegetables, etc. To improve these conditions, the following projects were proposed and enforced by the authorities concerned.

The National Food Authority (NFA) is implementing the Agro-Processing and Marketing Project (APM) under ADB loan. The objective is to correct existing distortions in the vegetable and fruit market structure and to promote the efficiency of post-harvest handling with the view of : i) reducing loss (physical and quality) ; ii) improving prices and the marketability of agricultural products ; and iii) maintaining stable prices and availability of fruits and vegetables in consumer markets. In the fruit and vegetable sector, the Fruits and Vegetables Marketing Facilities (FVMF), one of the APM component, was started. The FVMF will set up six farmers' markets in Benguet, San Jose and Nueva Ecija provinces, strengthen the existing trading posts at La Trinidad and Urdaneta which are now owned and managed by their respective municipalities. In these markets, the farmers can sell their products to enable them to get better prices for their products. FVMF will also establish a new wholesale market in Metro Manila.

La Trinidad Trading Post, upgraded in 1983-1985 with financial assistance from USAID was the primary wholesale market for fruit and vegetables produced in Benguet and Mountain provinces. It also served as a meeting place for farmers who sell their products, and for wholesale traders who buy them. It has been strengthened under FVMF by providing facilities for processing (grading), dissemination of marketing information, and possession of light trucks to pick up products directly from the growing areas. NFA has further plan to operate refrigerated trucks for transport of perishable products onward to Metro Manila and temporary storage.

2.9.3 Prices of agricultural inputs and outputs

Prices of vegetables show a distinct seasonal pattern, higher from September to November and lower from January to April as shown in Table B.2.9 and Fig. B.2.8. Two factors determine seasonal price fluctuations : (i) the seasonal availability of products as dictated by climate conditions and (ii) occurrence of typhoons which prevent planting or make it hazardous during a certain period of the year. They also change from year to year depending

on weather conditions and the area planted. In some cases , the prices are manipulated in Manila by some wholesalers.

The present farmgate price of agricultural inputs and outputs are given in Table B.2.10.

2.9.4 Supply and demand of vegetables

Vegetables are supplied to Metro Manila mainly from Ilocos Region such as Benguet, Ilocos Sur, Pangasinan, and Central Luzon Region. Supply and demand for vegetables was examined for Metro Manila, Ilocos Region and Central Region for the year of 1986, as shown below :

(Unit : ton/year)

Region / Items	Leafy Vegetables	Fruit Vegetables	Leguminous Vegetables	Root and Bulb crops
Metro Manila				
Demand #1	114,980	140,770	34,890	89,970
Supply #2	0	0	0	0
Surplus/Deficit	-114,980	-140,770	-34,890	-89,970
Ilocos Region				
Demand #1	71,500	79,710	23,160	37,130
Supply #2	88,130	98,910	18,200	144,800
Surplus/Deficit	16,630	19,200	-4,960	107,670
Central Luzon Region				
Demand #1	68,850	100,530	22,500	54,090
Supply #2	5,960	54,580	17,100	71,000
Surplus/Deficit	-62,890	-45,950	-5,400	16,910
Total				
Demand	255,330	321,010	80,550	181,190
Supply	94,090	153,490	35,300	215,800
Surplus/Deficit	-161,240	-167,520	-45,250	34,610

#1 : Demand = per capita consumption x population in 1986
#2 : Production in 1986
Details are presented in Table B.2.11

Metro Manila is the largest consumer area for vegetables, and its total demand in 1986 is estimated at 114,980 tons for leafy vegetables, 140,770 tons for fruit vegetables, 34,890 tons for leguminous crops and 89,970 tons for root and bulb crops. Ilocos Region has surplus of 16,630 ton of leafy vegetables, 19,200 ton of fruit vegetables and 107,670 tons of root and bulb crops, and a deficit of 4,960 tons of leguminous vegetables. Production of these vegetables in Ilocos Region contribute to more than 60 % of the production in Philippines, and

are shipped not only to Metro Manila but also to Mindanao and other regions. Although the production in Ilocos and Central Luzon Regions are far below the demand of the three regions, it can be said that Ilocos Region plays an important role as a supply source of temperate vegetables.

Recently varieties of the temperate vegetables especially cabbage have been improved to be able to cultivate in lowland areas. But lowland vegetables are not competitive with highland vegetables mainly due to (i) seasonal difference in crop marketing and (ii) quality differences. So, it was concluded that the vegetables productions in the highland had to be expanded to meet the demands.

2.10 Agricultural Support System

2.10.1 Research institutes

La Trinidad is the capital municipality of Benguet Province. Many research institutes are located around the municipality. They are ;

(1) Highland Agricultural Research and Resources Center (HARRC)

Agricultural research works in and around the Project area are coordinated by HARRC in collaboration with the Philippine Council for Agriculture and Resources Research and Development (PCARRD). HARRC was established in the campus of Benguet State University (BSU) at La Trinidad in 1978 by PCARRD to serve the research and development needs of highland agriculture. There are now the following 8 regular member institutions in HARRC:

- Baguio Experiment Station (BES) of the Bureau of Plant Industry (BPI)
- West Central Luzon Forest Research Center (WCLFRC) of the Forest Research Institute (FORI)
- Baguio Dairy Farm (BDF) of the Bureau of Animal Industry (BAI)
- Cordillera Studies Center (CSC) of the University of the Philippines College Baguio City (UPCB)
- The Northern Philippines Root Crops Research and Training Center (NPRCRTC)
- Sericulture Research and Training Center (SRTC) of the Philippines Textile Research Institute (PTRI)
- Department of Agriculture (DA) Region I
- Benguet State University (BSU)

HARRC, through the consortium, has the primary responsibility for research on fruit crops, ornamental horticultural crops, root crops, vegetable crops, farming systems, soil resources, macro-economics, and applied rural sociology. The primary function of HARRC include planning, coordinating, implementing and monitoring of agricultural research programs designed in support of development of the highland area in the country. Besides technology generation and development, HARRC is assigned to undertake packaging and dissemination of research results via applied communication channels. But there appears poor links with extension and little on-farm verification work.

(2) Benguet State University (BSU)

Benguet State University (BSU), located in La Trinidad valley, has teaching, research, extension and production functions. It occupies 124 ha of vegetable farms and 50 ha of forest in the area. The research programme focuses on various commodities such as vegetables, fruits, ornamentals, root crops, farming systems and soil resources. Support for research comes from BSU budget, PCARRD, the Ford Foundation and other sources associated with special project. Equipments and supplies for research, however, are scarce and are served not only as instructional facilities for students but also shared by the instruction and production programmes.

(3) Baguio Experimental Station (BES)

BES is a research agency under the Bureau of Plant Industry (BPI) of MAF. BES, established at Baguio City in 1934, has a total land area of about 9.4 ha. It conducts research and production activities on any commodities which may be profitably grown in the highlands. Such commodities are : vegetable crops, ornamental and medicinal plants, beverages (coffee and tea), root crops, triticale, fruit crops and silkworm rearing. The station has also produced seeds and planting materials of the above commodities.

(4) Northern Philippines Root Crops Research and Training Center (NPRCRTC)

The NPRCRTC is a sub-unit of BSU created in 1977 by Presidential Decree. The primary functions of NPRCRTC are to conduct investigations, trainings and extension work to improve not only the root crop production and utilization systems but to improve and elevate the root crop subsistence farmers. The Center consists of five sections i.e. crop improvement, crop management, crop protection, socio-economics and postharvest and utilization. Current and past research include on true potato studies, rapid multiplication studies, plant density studies, economic analysis of production costs and storage technology for seed table potatoes.

In addition to above, there are Cordillera Study Center (CSC) and Baguio Dairy Farm (BDF) around the Project area.

2.10.2 Agricultural extension

(1) National extension institutes

The Department of Agriculture (DA) has the primary responsibility for agricultural extension in the country. DA Region I Office in San Fernando, La Union is charged with implementing extension at the regional and provincial levels. The region has a regional chief of extension and subject matter specialists. The organization chart of DA Region I office is presented in Fig. B.2.9.

The Office of Benguet Provincial Agricultural Officer is responsible for the planning, coordination and implementation of extension activities in the province. The office has a provincial agricultural officer, seven technical staff and administrative and support staff.

The Municipal Agricultural Office (MAO) of La Trinidad has the responsibility for agricultural extension in the Project area. The number of the staff is eight consisting of a municipal agricultural officer and seven Agriculture and Food Technicians (AFTs). Number of farmers charged for one AFT in the municipality is about 280 farmers which is higher than that of 680 in the whole Benguet Province. Technical support is provided to MAO from the regional office and the provincial agricultural office (PAO) of Benguet. However, the effectiveness of the extension service has been hampered by a number of limiting factors in the fields of : (a) experience in extension works ; (b) equipments and facilities for training and demonstration ; (c) extension staff ; (d) coodination between extension and research ,etc. As for equipment, all MAOs do not have any vehicle. Only four old jeeps are available in the provincial office for extension activities covering an area of about 2,500 km2 with about 20,000 farmers. Further, printing machine and stationeries are limited that prevent the effective transfer of technologies to the farmers.

(2) Office of the provincial agriculturist

This office is under the Benguet Provincial Government with the function of planning, supervising and coordinating all agricultural project and activities of the provincial government which are not totally aligned to the national programs. Technical assistance is extended to individuals and groups of farmers through such activities as farm visits as resource person or lecturer, office consultations, distribution of technical bulletins, pamphlets and leaflets on agriculture and social development, etc. The office has also conducted nursery/seedling production and distributed them to farmers. The office has six technical staff consisting of a Provincial Agriculturist, three extension workers and two nursery foreman. They have mostly undergone specialized training in Japan on vegetable production, flower production, tea production and honeybee production. Their activities have been restricted in view of the limited

allocation of manpower and travelling expenses, and lack of vehicles. The organization structure of the office is given in Fig. B.2.10.

(3) Other agencies

The National Training Center - Agricultural Training Institutes (NTC-ATI) have provided seminars and training program to farmer-leaders and extension workers who are implementing priority government programs and projects in the field of rural and agricultural development. BSU also conducts similar training programs in response to the request of provincial government and municipalities. Their activities, however, are hampered by the shortage of equipments and facilities for training, and lack of budget.

2.10.3 Agricultural credit

Vegetable farming requires relatively large capital expense each season due to high application amount of fertilizers, agro-chemicals and labors. There are a number of formal credit channels in and around the Project area which extend agricultural loans. They are the Philippine National Bank (PNB), Development Bank of the Philippines (DBP), the Land Bank of the Philippines (LBP) and Rural Banks. The formal credit, however, is not an important source of funds in meeting rural farmers' needs because (a) the credit needs long administrative procedure, (b) most of bank lending have to be secured by land title, tax declaration, survey plan, chattel mortgage, etc., (c) the banks finance the limited portion of the production costs and (d) the interest rate is high (21 - 30 % per annum). Among the formal credit sources, Rural banks are the most important. There are two rural banks in the Project area. In 1987, the banks extended loans to a total of 289 farmers in La Trinidad amounting to 1.8 million pesos.

The farmers also rely on traders or middlemen for the supply of their farming credit needs. This informal credit system is linked closely with the marketing system, and most often involves provision of agricultural inputs and even consumption credit against crop failure. The procedural requirements are minimal, debts can be carried over and additional credit gained in the event of crop failure, inputs are provided close to farmgate and products are picked up there. The traders and middlemen obtain much profits by extracting a commission from the price of vegetables. The commission charged varies with the prevailing price at the time of sale. During periods of low prices, only 10-20 % of the prevailing price per kg may be extracted as commission since they want to keep their clientele in operation. During periods of high price which may occur during typhoon and holiday seasons, the commission extracted per kg by traders is much higher.

The Tomay Credit Union has been operated in Tomay area in Zone-II from 1965 by the farmers' investment. The union members can be financed to a maximum amount of twice of their investments. The interest rate is 1 % per month for the first 6 months and 3 % per month afterward.

The results of the farm economic survey show that about 20 % of farmers availed of loans. Their sources are trader/middlemen (55%), relatives (20%), Rural Banks (15%), credit union (5%) and PNB (5%). The farmers use the credit for procurement of farm inputs.

(Unit : peso)

Source	Farmers	Average amount
Rural Banks	3	10,000
PNB	1	8,000
Credit union	1	2,000
Trader / middlemen	11 (6)#	2,750
Relatives	4	8,000
Total/Average	20	5,110

Source : Farm Economic Survey
Supplied in kind

2.10.4 Farmer's organization

The government has stepped up efforts to organize farmers into cooperatives or associations. Samahan Nayons were organized in 15 barangays in La Trinidad under the guidance of the provincial or municipal agricultural office. The objectives were to promote farmer's participation to cooperative activities through farmer's institutions and to provide agricultural services. However, almost all of the Samahan Nayons are inactive or have collapsed due to shortage of funds and less willingness from farmers to risk cooperative involvement, despite the fact that farmers felt the need for mutual support organization.

The Benguet Farmer's Development Cooperative (BFDC) is the only active farmer's cooperative in the Project area. BFDC was established in 1983 with 73 farmers as members from Alapang and Bahong in Zone II area. The main objective is to uplift farmer's income level through joint marketing system. The system is as follows : 1) In response to order from restaurants and Japanese consumers in Metro Manila, the cooperative portion out the orders to individual farmers, 2) farmers bring the products to the collection center on a specific day (once a week), 3) these products are packed and sent to Metro Manila by the cooperative's own light

truck. BFDC has plans to expand the joint marketing activity and to introduce joint purchasing system of farm inputs and farmer's credit system.

2.11 Farmer's Economy and Intention

2.11.1 Farm economic survey

A farm economic survey was carried out to collect data and information relating to the present economic situation of farmers in the Project area. These data and information provide the present condition of farmers for formulating the development plan as well as basic data for project benefit monitoring and evaluation

For the purposes, items investigated in the survey included family structure and composition, land tenure and holding, irrigation condition, crop and livestock production, extension services, agricultural credit, farmer's organization and farmer's intention toward the development.

(1) The survey

In order to improve the quality of data, farm households were visited twice both in the wet and dry seasons. In this study, the results of the first survey (wet season) were combined with the second survey (dry season). The first survey was carried out in nine barangays, i.e. Betag, Pico, Poblacion, Puguis, Alapang, Bahong, Alno, Wangal and Bineng during the period from 10th to 31st of August, 1987. The second survey was done in the same way over two weeks from 25th January to 5th February.

(2) Sampling design

Random sampling was adopted in this survey. There are about 1,200 farm households in the barangays related to the Project area. The sample size was determined for each barangays based on the number of farm households. In total, 92 farmers were interviewed both in the wet and dry seasons. The sampled farmers were about 8% of all the farm households in the barangays.

The results of the farm economic survey were summarized in Table B.2.12.

2.11.2 Farmer's economy

In order to grasp economic condition of farmers in the Project area, farm budget analyses were made on typical farmers with average farm areas in each Zone based on the results of the farm economic survey. The results are presented below :

(Unit : Peso)

Farm Income	Zone-I	Zone-II	Zone-III
Farm Size (ha)	0.87	0.70	0.91
Family size (persons)	5.8	6.0	5.6
Income (A)	41,200	30,500	24,800
Farm income	37,000	27,400	19,200
Non-farm income	4,200	3,100	5,600
Expenditure (B)	33,600	24,700	21,600
Food	15,600	10,800	11,200
Non-food	18,000	13,900	10,400
Balance (A)-(B)	7,600	5,800	3,200

Source : Farm economic survey

The characteristics of the farmer's economy are summarized as follows :

i) In Zone I and II, a considerable amount of income is derived from farm income which accounts for about 90% of the total income. Non-farm income mainly consisting of salary from private and government employment, remittance from families working in other cities, etc...

ii) In Zone III, farm income is considerably lower than Zone-I and II, because existing rice field is not suitable for profitable vegetable farming due to poor drainage and the farmers prefer rice cultivation only for home consumption. Non-farm income accounts for about 20 % of the total income. Net income of the farmer in Zone III is 24,800 pesos. This is lower than the poverty line of the Philippines (28,600 pesos/family/year).

iii) According to the results of Family Income and Expenditures Survey in 1985, the average annual income and expenditure of a family in Benguet Province are 48,200 pesos and 39,600 pesos, respectively. Comparing with these, economic condition of farmers in the Project area is poor.

iv) Food expenses account for some 50% of total living expenses

2.11.3 Farmer's intention for development

In order to achieve an effective development plan, the farmers' intentions were inquired through the farm economic survey. The questionnaire included the following items :

i) Constraints for crop production
ii) Stress on the improvement of present condition
iii) Preferred crops after implementation of the Project

Item	Zone-1	Zone-2	Zone-3
Constraints for development	Insufficient irrigation water	Insufficient drinking water	Insufficient drinking water
	Marketing	Insufficient irrigation water	Insufficient irrigation water
	Land size	Lack of technical information	Incomplete rural road
Stress on improvement	Irrigation water supply	Drinking water supply	Irrigation supply
	Drainage of excess water	Irrigation water supply	Drinking water supply
	Prevention of pests and diseases	Agricultural extension services	Rural road improvement
Preferred crops			
Wet season	C. Cabbage Lettuce, onion	Rose Garden pea	Paddy Baguio beans
Dry season	Lettuce Strawberry	Rose Garden pea	Baguio beans Cabbage, C. cabbage

The results of the survey show clearly that farmers consider the availability of irrigation and drinking water to be most important. Also, but to a lesser extent, they would need more assistance with regard to road improvement and technical advice on agricultural matters. With regard to kinds of crops, farmers preferred to cultivate existing vegetables and flowers even after completion of the Project, mainly due to easiness of the farming, high profitability and soil suitability.

2.12 Agriculture and Food Program

In the Medium-Term Philippine Development Plan (1987-1992), the development of agriculture is given the highest priority in keeping with the goals of alleviating poverty and increasing employment opportunities and income in the rural sector. In line with these objectives, there are two special projects which cover Benguet Province : a) Highland Agriculture Development Project (HADP) and b) Agro-Processing and Marketing Project (APM).

(1) HADP

The project started from September 1987 by ADB loan aiming at resolving critical constraints to agricultural productivity in the highlands and uplifting the socio-economic conditions of the highland farmers. The objective areas are Benguet and Mountain Provinces. The project includes the following components :

a) Construction and rehabilitation of communal irrigation system (CIS)
b) Construction and rehabilitation of rural roads and bridges
c) Strengthening of agricultural support services

One barangay road and one CIS in the outside of the Project area will be rehabilitated by HADP.

(2) APM

This project is also implementing under ADB loan. The objective is to correct existing distortions in the vegetable and fruit market structure and the efficiency of postharvest handling, with the end view of : i) reducing loss, ii) improving prices and marketability of agricultural products, and iii) maintaining stable prices and availability of fruits and vegetables in consumer markets. In the Project area, La Trinidad Trading Post has been strengthened under APM by providing facilities for processing, dissemination of market information, and possession of light trucks to pick up products directly from growing areas.

3. AGRICULTURAL DEVELOPMENT PLAN

3.1 General

3.1.1 Basic concept for agricultural development

The project area has been developed as a major supply source of profitable temperate vegetables and flowers in the Philippines. These products are transported to Metro manila as well as Mindanao and other regions. However, the full agricultural potential in the Project area has never been realized for several reasons including : (a) insufficient drainage facilities, (b) poor rural road conditions, (c) inadequate irrigation facilities and shortage of good quality irrigation water, (d) poor farming techniques, and (e) a marketing system which is disadvantageous to farmers. Low and unstabilized farmer's incomes have resulted from these constraints.

The Project aims at uplifting incomes and living standard of farmers which is in line with the Government's agricultural development policies and strategies. Improvement of the prevailing farming system is set up as the basic agricultural development concept to increase productivity and profitability of the existing crops like vegetables and flowers, taking into consideration of present agricultural conditions and farmer's intention for development in the project area.

3.1.2 Strategy for agricultural development

In order to accomplish the basic concept mentioned above, the strategies for agricultural development are formulated as follows :

1) Unit yield and production of crops should be increased and stabilized through the introduction of improved technologies and farm management practices, coupled with strengthening of agricultural extension systems.

2) Planted area of crops should be expanded in as large as possible with reduction of flooded area in the wet season and provision of available irrigation water in the dry season.

3) Regular and continuous supply of crops with even qualities should be attained through the guidance of extension team to minimize the variation of the crop prices.

4) Promote farmer's cooperative activities for marketing to get better bargaining power in the market.

5) Marketable amount of crops should be increased through reduction of transportation loss by rehabilitating of rural roads.

6) Extension activities should be activated through provision of vehicles, motorcycles and office equipments, and training of extension workers.

3.2 Benefit Area

There is no significant area of land for expansion of farm in the Project area, except for steep land, and development of lands with a slope of more than 18° is prohibited since these lands are classified as non-alienable by the Presidential Decree. Therefore, the agricultural development concept of the Project is set up to improve the productivities of the existing crop cultivation. There is no notable change on land use in the Project area.

Out of the total gross agricultural land in the Project area of 620 ha, about 540 ha or 86 % were selected as the benefit area of the irrigation development works from economical and technical considerations. The benefit area in each zone are delineated below :

(Unit : ha)

Land use	Zone I		Zone II		Zone III		Total	
	P	B	P	B	P	B	P	B
Agricultural Land								
Upland field	210	200	310	240	60	60	580	500
(Net area)	(170)	(160)	(200)	(155)	(40)	(40)	(410)	(355)
Lowland rice field	0	0	0	0	40	40	40	40
(Net area)	(0)	(0)	(0)	(0)	(30)	(30)	(30)	(30)
Total	210	200	310	240	100	100	620	540
(Net area)	(170)	(160)	(200)	(155)	(70)	(70)	(440)	(385)

Remarks : P : Project area B : Benefit area

3.3 Proposed Cropping Pattern

The project area has been established as the major producer of temperate vegetables and cut-flowers with intensive farming system, and the farmers have much experience on irrigation farming of these crops. The present study clarified promising marketability of vegetables and cut-flowers, and the farmers' preference to continue and to improve present farming practices of these present crops. Under these circumstances, the proposed cropping pattern is formulated fundamentally based on the present cropping pattern prevailing in the project area.

The proposed cropping pattern of each zone is shown in Fig. B.3.1. The proposed cropping pattern is formulated for full reflection of the project benefits like flood elimination in Zone I, irrigation development in all Zones. By the flood elimination, all of the Zone I area is expected to become possible to grow crops even in the rainy season. Irrigation development will increase productivity of crops and extend crop cultivation area to the maximum extent depend on the availability of irrigation water.

The cultivated area under the with and without project conditions are described below:

(Unit : ha)

Zone / Crops	Without Project	With Project	Increment by the Project
Zone I			
Strawberry	56	40	-16
Vegetables	249	500	251
Sub-total	305	540	235
Zone II			
Roses	60	59	-1
Vegetables	283	266	-17
Sub-total	343	325	-18
Intercropping vegetables & flowers	60	60	0
Zone III			
Rice	50	50	0
Vegetable	96	180	84
Sub-total	146	230	84
Total	794	1,095	301
(Intercropping)	60	60	0

Remarks; The cropping pattern for without project condition is assumed as same of the present patterns.

In Zone I, cultivated area of strawberry is decreased to 40 ha or 25 % of the whole area to generate maximum benefit maintaining the present production level. In Zone II, cultivated area of vegetables is decreased due to change of irrigation method (furrow irrigation) which require much irrigation water but increase crop productivity. In Zone III, cultivated area of crops is expected to increase 84 ha for vegetables in the dry season.

To assess the practicability of the cropping pattern, a labor balance study was made based on estimated workable persons per family. The number of families presently engaged in farming was estimated for typical farmers with average farm size, based on the results of farm economic survey. They are 2.4 persons per farm household in Zone I and 2.6 persons in Zone II and III. The results of the labor balance study are given in Table B.3.1. The present cropping pattern would be changed to intensive one, especially for Zone I, so that daily labor requirement would exceed the available family labor force. The following Table shows the

estimated annual hired labor requirement for typical farmers under the present and with project conditions.

(Unit : man-day)

Zone	Present #1		With Project #2	
	Total	Hired	Total	Need to be hired
Zone I	501	125	910	277
Zone II	406	102	447	27
Zone III	342	85	647	124

#1 : See Table B.3.2
#2 : See Table B.3.1

Typical farmers in Zone I will have to employ 277 man-days/year of labor or 2.2 times of the present hired labor under with project condition. It is estimated that about 400 hired labor will be necessary daily in Zone I in the busiest term, June. That is 72 persons in Zone II in September and 100 persons in Zone III in January. However, farmers in the Project area commonly use hired labors who come from other provinces to look for job, and the number has been increasing. While it is also considered that family members, who normally do not conduct farm operation, could work on farm in the busiest term. Consequently, these labor deficit would be overcome by use of the increased hired labor and family members. In other words, the Project creates the farm working opportunity to non-employed workers.

3.4 Proposed Farming Practices

In order to realize full exploitation of agricultural potential and to attain high land productivities in the project area, appropriate farming practices are essentially required.

The farmers in the project area have made earnest endeavor to maintain soil fertility by applying organic manures and chemical fertilizers. In spite of the farmers' effort, the soil fertility has not improved satisfactorily for cultivation of vegetables and cut-flowers, and the yield of vegetables in the area still remains stagnant.

It is recommended to apply proper amount and kind of fertilizers to improve soil fertility depending on the soil condition in each farm. The results of soil chemical analysis on the representative soils in the project area are shown in Table B.3.3. Nutrient conditions of the soils, especially for pH, potassium, nitrogen and organic matters, have to be improved for growing most kind of vegetables. As seen in the table, most soils in the project area requires raising the pH to the levels of between 5.5 and 6.5. Liming should be designed based on the result of the further detailed soil survey. As the same manner, fertilizers of phosphorous,

potassium and nitrogen should be applied carefully based on the soil chemical conditions. To determine the application amount of fertilizers, a combination of crops and soil conditions is considered to obtain the best yield of crops and also to manage economical farming. However, the result of soil chemical analysis is merely one of indicators to improve soil fertility, the most important matter to attain the best yield is experience based on the crop cultivation in the particular farmers' land for long time.

While it is rather impractical to design the proposed farming practices for a variety of crops growing on a various types of soil without the result of well managed research and experiences in the area, some tentative farming practices for major crops are prepared as shown in Table B.3.4 for desirable yield and return .

Besides the above mentioned improvement, a crop rotation system should be established to avoid damages by soil born diseases and nematodes which generally increase by continuous cropping of the same kind or family of crops in a particular field.

Deep plowing of soils up to 25-30 cm or more is desirable for vegetable cultivation. Mulching is also one of effective practices for soil conservation, saving of irrigation water, reduction of some diseases infestation from the soil to plants, etc.

As regards to plant protection, insecticides and fungicides have to be applied. The main insects and diseases found in the area are shown in Table B.2.5. To control these pests and diseases, 3 to 4 times chemical of application are necessary during one cropping season. In selecting suitable agro-chemicals, the chemical toxicity which directly or indirectly affects human beings, should be taken into consideration. For safe and effective use of agro-chemicals and prevention of environmental pollution, it is recommended to duly guide and train the farmers through agricultural extension services for the choice of the pesticides and their storage, application technics, as well as protective measures and safe disposal of containers.

3.5 Anticipated Unit Yield and Production

3.5.1 Anticipated unit yield

In the without project condition, the future anticipated unit yield of crops are set as the same levels of the present unit yield which are estimated on the average from 1984 to 1987 in La Trinidad. It is considered that the present constraints in farming practices, agricultural infrastructure and agricultural supporting services remains unchanged.

After completion of the Project, it is expected that the unit yield of crops would increase on account of increasing supply of irrigation water, introduction of improved farming practices and enhancing the farmer's incentive by improvement of accessibility. However, little data are available on the experimental results under the full irrigated condition and proper fertilization in and around the Project area. The anticipated unit yields with project condition are estimated with reference to the unit yield of crops in La Trinidad during 1984 - 1987 and in Japan which was obtained under the similar climate conditions, as described in Section 2.8.1.

The unit yields of Baguio beans, garden peas, strawberry and gladiolus have already attained desirable level, so that the anticipated unit yield of these crops are set as the same level of the past maximum yields in La Trinidad.

Among the main crops in the area, the present unit yields of Chinese cabbage, green onion, celery and roses are still at stagnant level. It is necessary to raise yields of these crops for increasing farmers' income under the project condition. The target yields of these crops are projected higher than these of the past, but still rather conservatively. The anticipated unit yield under the future with and without project conditions are summarized below;

(Unit : ton/ha)

Crops	Unit Yield	Present	Without Project	With Project
Rice	ton/ha	1.9	1.9	2.5
Chinese cabbage	ton/ha	15.5	15.5	20.0
Lettuce	ton/ha	11.0	11.0	15.0
Baguio bean	ton/ha	7.5	7.5	9.0
Garden pea	ton/ha	3.0	3.0	4.5
Green onion	ton/ha	7.8	7.8	11.5
Strawberry	ton/ha	9.8	9.8	14.0
Celery	ton/ha	14.5	14.5	24.0
Rose	1,000 doz/ha	25.0	25.0	39.0
Gladiolus	1,000 doz/ha	14.8	14.8	15.0
Average of vegetables	ton/ha	9.9	9.9	14.0

In order to achieve the anticipated unit yield in the future under the with project condition, it is very necessary that the farmers should be informed and trained on the improved farming practices supported by the research and extension services. The unit yields will increase gradually from the present level, and assumed to reach the target yield around the 10th year after completion of the Project.