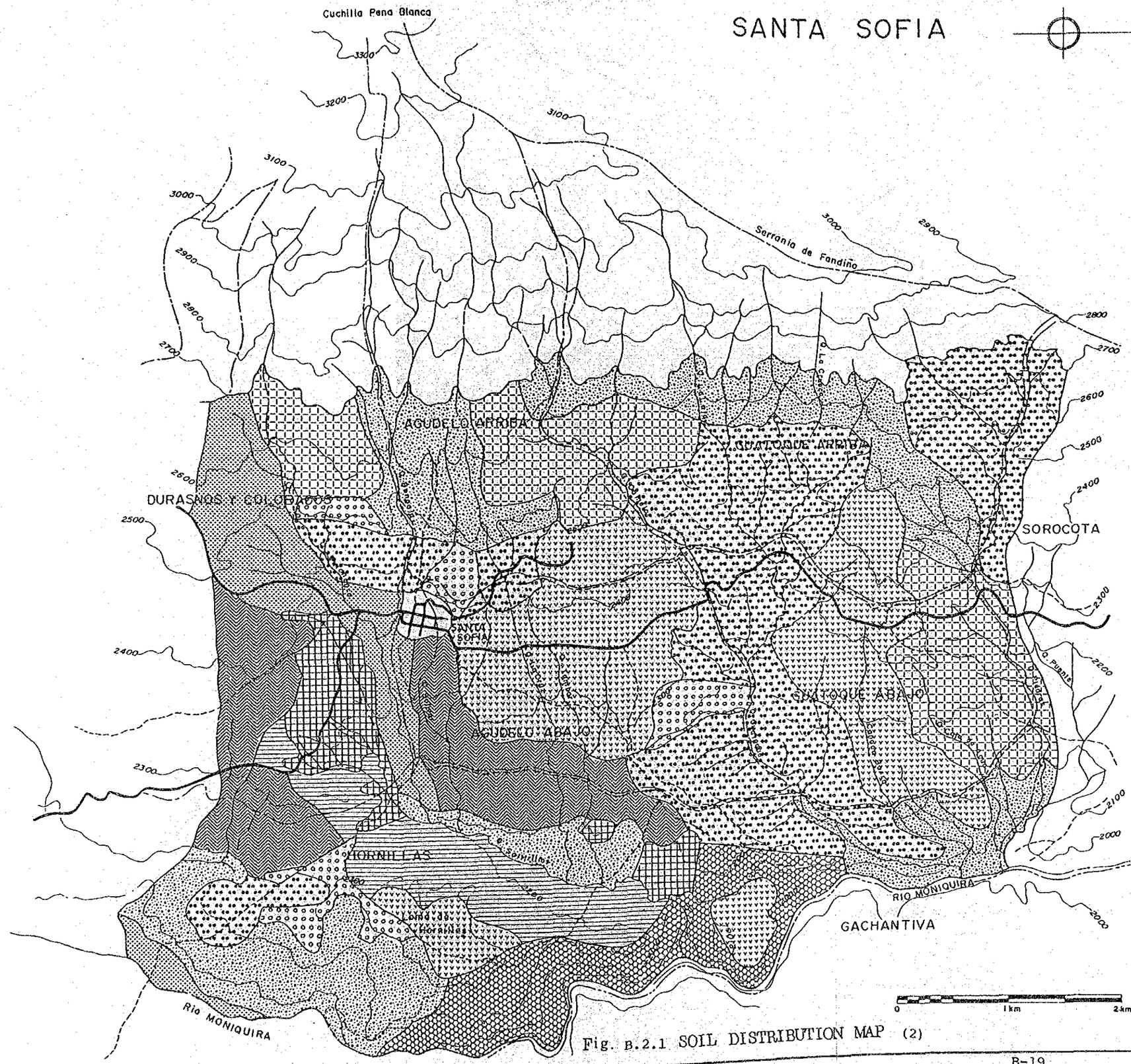
SANTA SOFIA



Legend

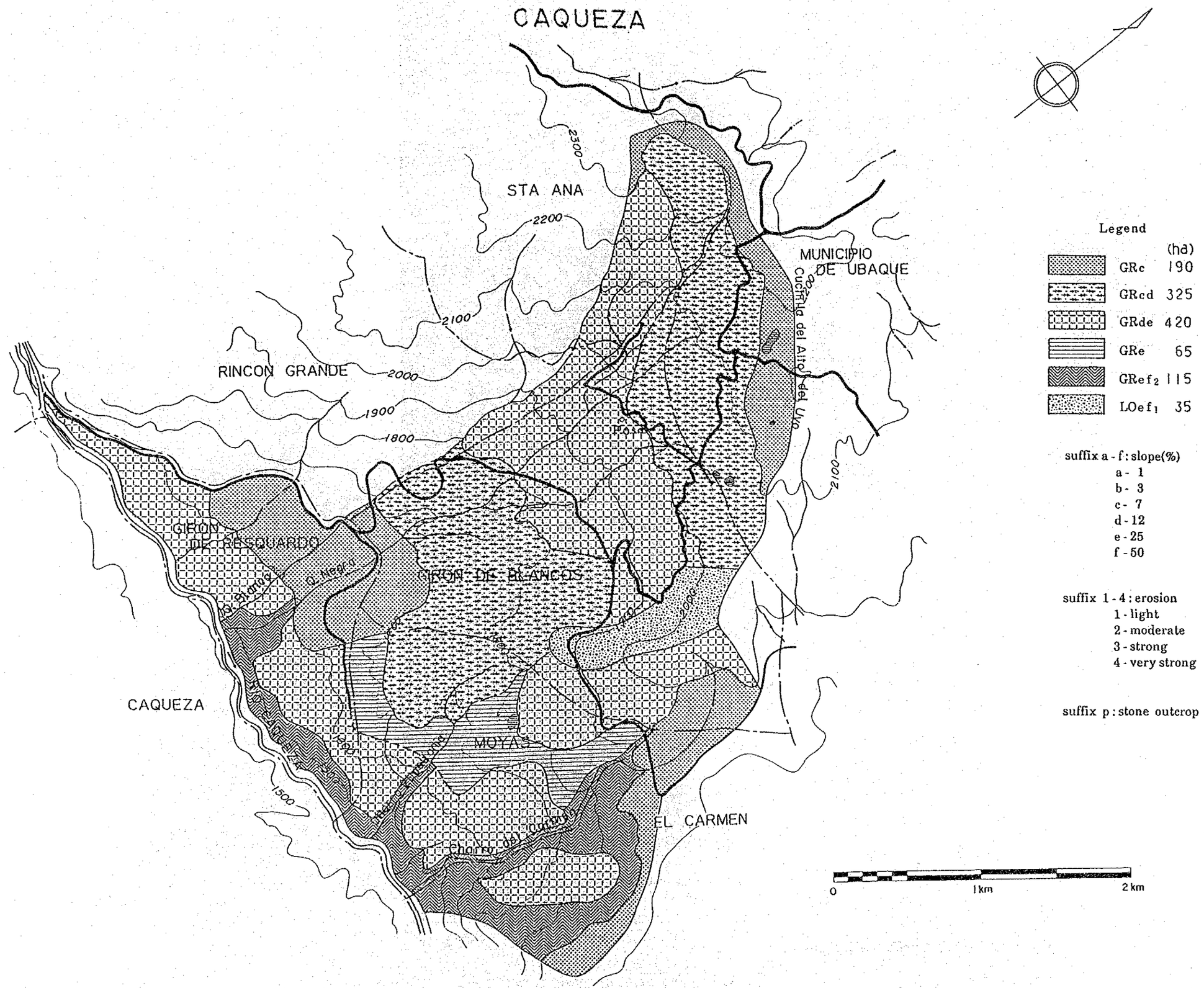
		(ha)
SIc$_1$		240
SIbc		640
SIcd		445
SIcd$_1$		200
SIcd$_1$p		340
SIde		855
SIde$_2$		90
SIef		680
SIef$_2$		230
SIef$_4$		160

suffix a - f : slope(%)
- a - 1
- b - 3
- c - 7
- d - 12
- e - 25
- f - 50

suffix 1 - 4 : erosion
- 1 - light
- 2 - moderate
- 3 - strong
- 4 - very strong

suffix p : stone outcrop

Fig. B.2.1 SOIL DISTRIBUTION MAP (2)



Legend

	(ha)
GRc	190
GRcd	325
GRde	420
GRe	65
$GRef_2$	115
$LOef_1$	35

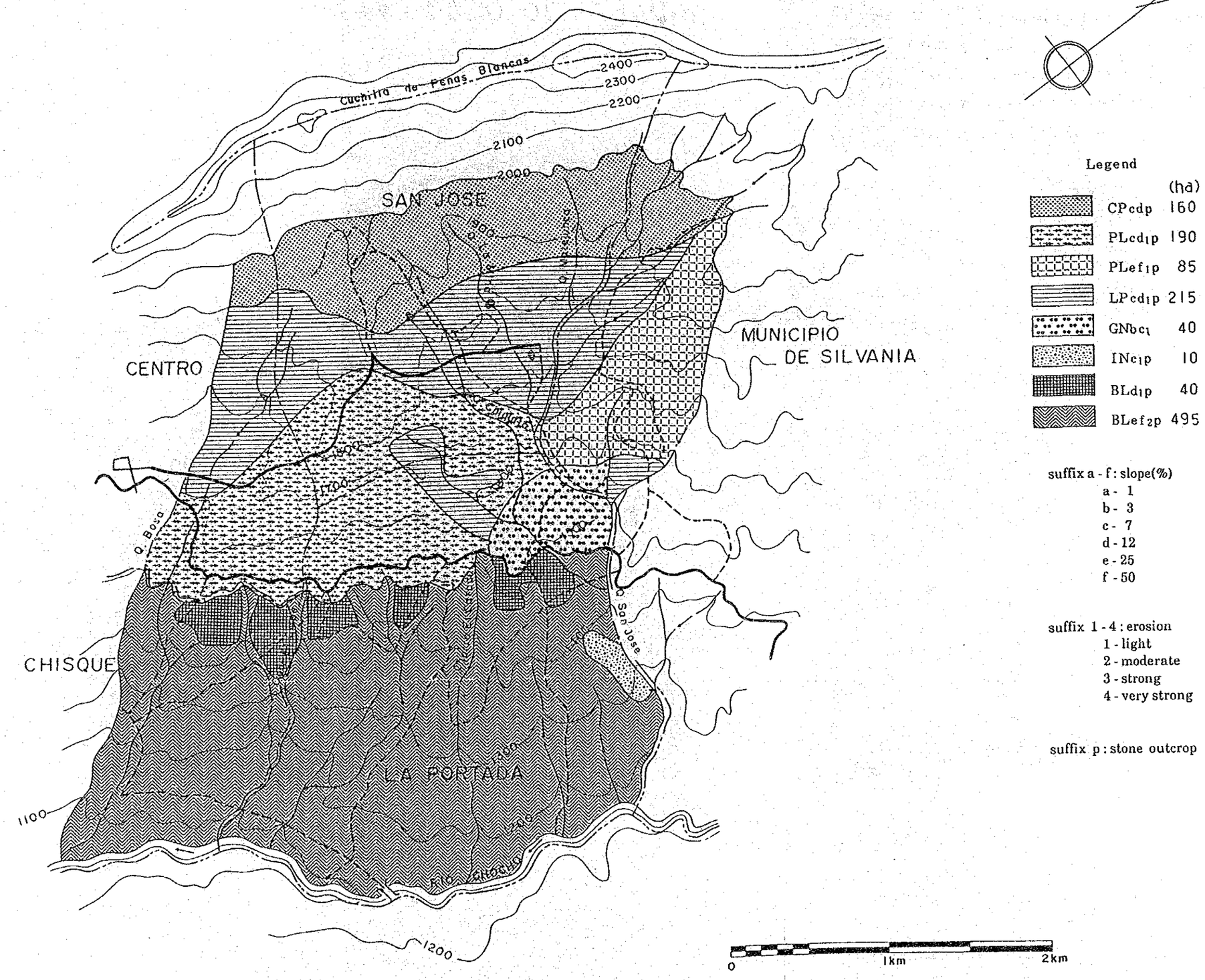
suffix a - f: slope(%)
- a - 1
- b - 3
- c - 7
- d - 12
- e - 25
- f - 50

suffix 1 - 4: erosion
- 1 - light
- 2 - moderate
- 3 - strong
- 4 - very strong

suffix p: stone outcrop

Fig. B.2.1 SOIL DISTRIBUTION MAP (3)

TIBACUY



Legend

	(ha)
CPcdp	160
PLcd1p	190
PLef1p	85
LPcd1p	215
GNbc1	40
INc1p	10
BLd1p	40
BLef2p	495

suffix a - f: slope(%)
- a - 1
- b - 3
- c - 7
- d - 12
- e - 25
- f - 50

suffix 1 - 4: erosion
- 1 - light
- 2 - moderate
- 3 - strong
- 4 - very strong

suffix p: stone outcrop

Fig. B.2.1 SOIL DISTRIBUTION MAP (4)

SAN PEDRO DE IGUAQUE

Legend

			(ha)
▨	Class 3	Marginally suitable for cropping	1300
▨	Class 4	Limited arable and special use	1080
▨	Class 6	Unsuitable for cropping	780
▨	Class 7	Unsuitable for cropping	220
▨	Class 8	Unsuitable for cropping	310

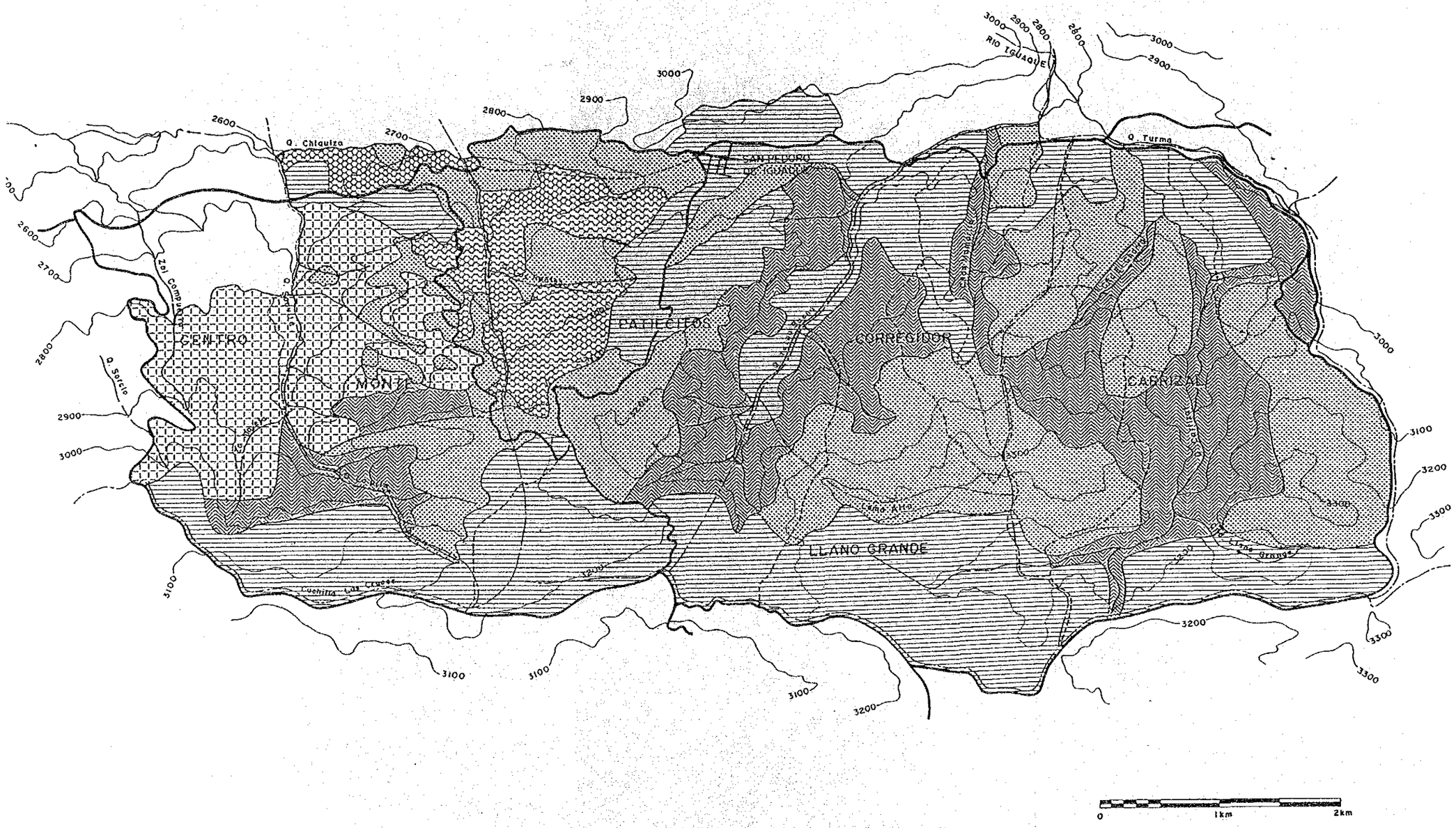
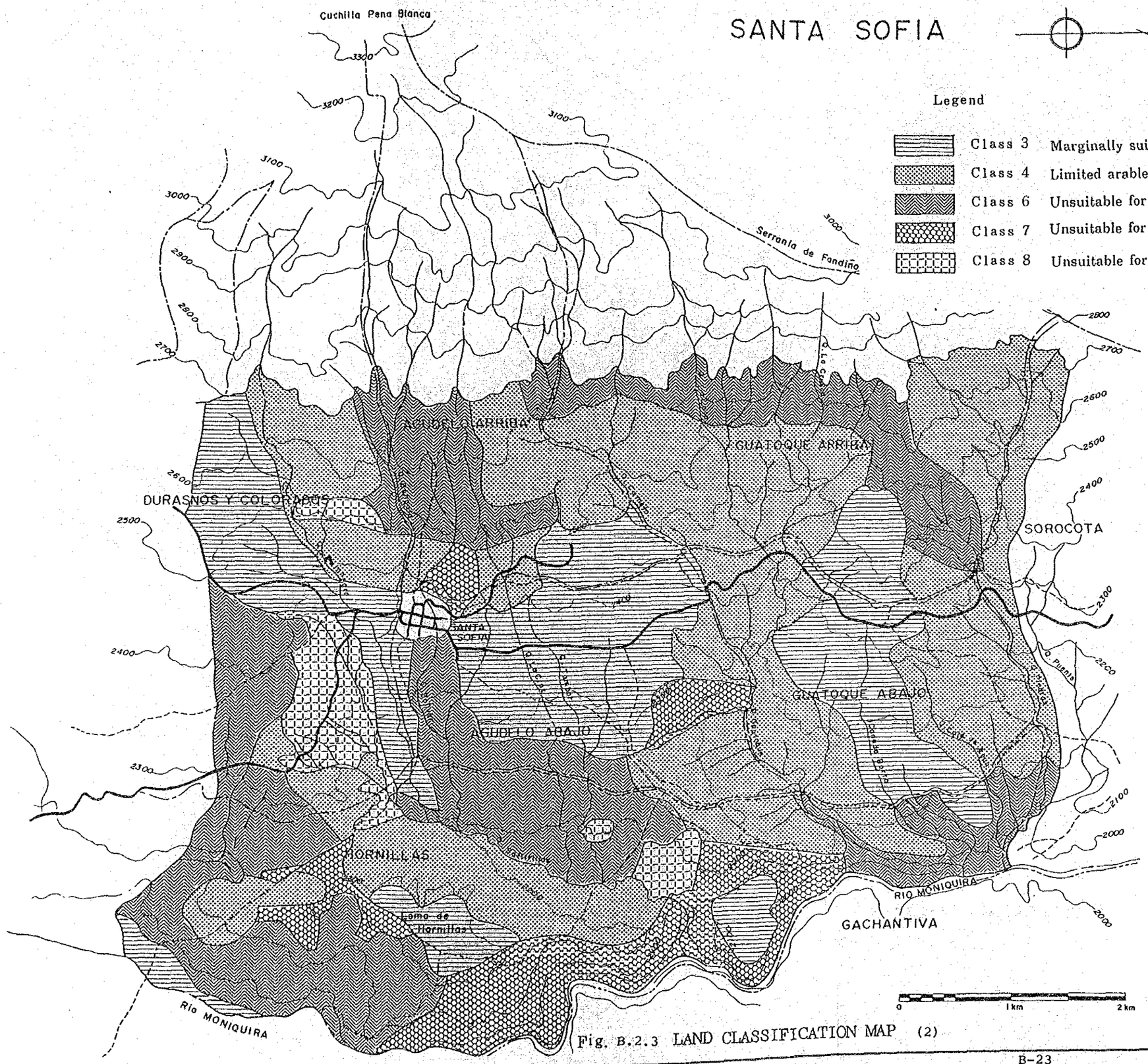


Fig B.2.3 LAND CLASSIFICATION MAP (1)

SANTA SOFIA



Legend

		(ha)
Class 3	Marginally suitable for cropping	880
Class 4	Limited arable and special use	1500
Class 6	Unsuitable for cropping	1020
Class 7	Unsuitable for cropping	320
Class 8	Unsuitable for cropping	160

Legend

- Class 3
- Class 4
- Class 6
- Class 7
- Class 8

Fig. B.2.3 LAND CLASSIFICATION MAP (2)

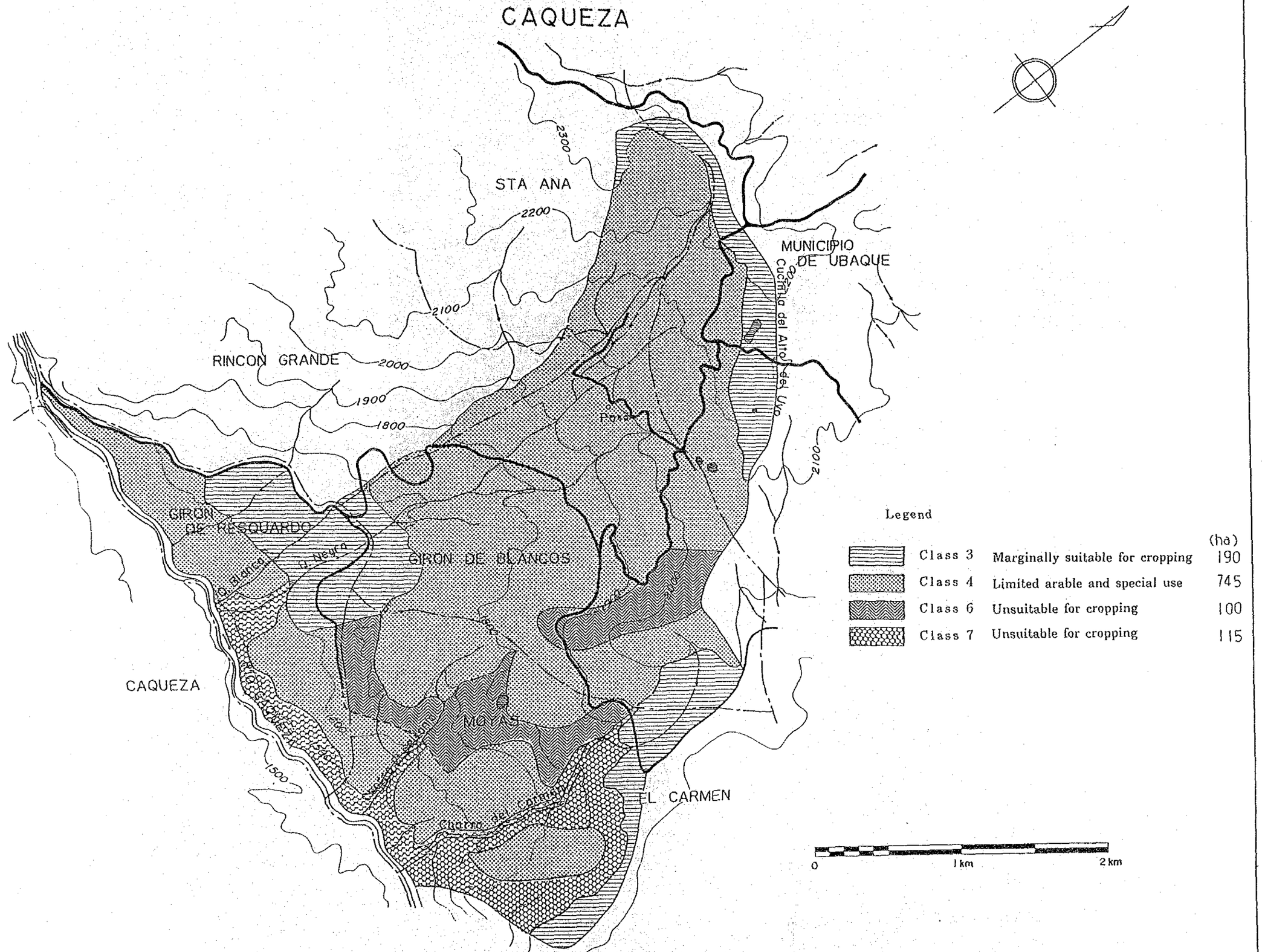
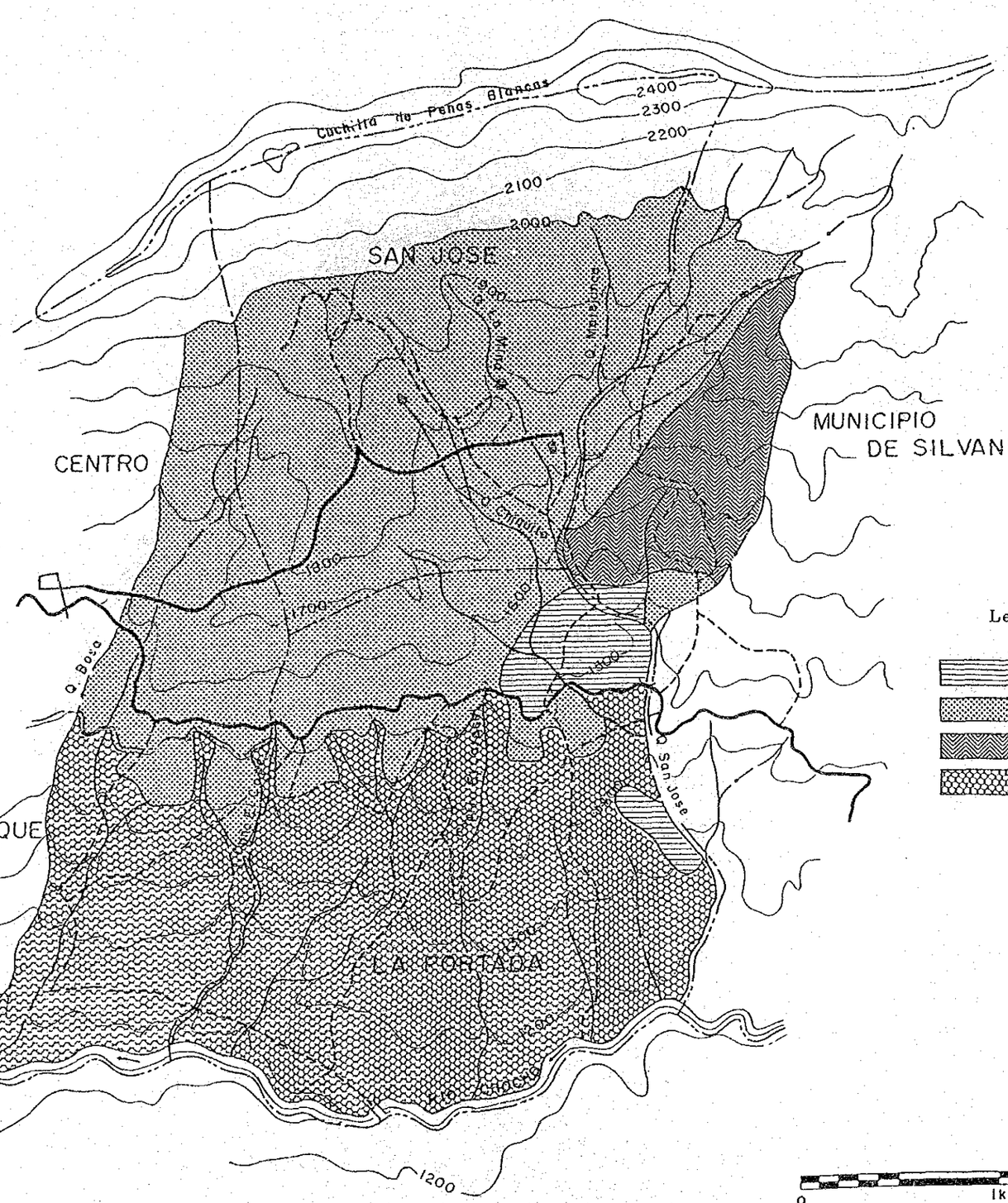


Fig. B.2.3 LAND CLASSIFICATION MAP (3)

TIBACUY



Legend

- Class 3
- Class 4
- Class 6
- Class 7

Legend

		(ha)
Class 3	Marginally suitable for cropping	50
Class 4	Limited arable and special use	605
Class 6	Unsuitable for cropping	85
Class 7	Unsuitable for cropping	495

0 1km 2km

Fig. B.2.3 LAND CLASSIFICATION MAP (4)

ANNEX C AGRICULTURE AND AGRICULTURAL ECONOMY

Table of Contents

	Page
1. Cropping Pattern	C- 1
2. Estimation of Crop Yield	C- 3
2.1 Condition of Present Yield	C- 3
2.2 Target Yield	C- 3
2.3 Tendency to Increase Yield	C- 6
3. Prices of Farm Products and Farm Inputs	C- 7
3.1 Prices of Agro-Products	C- 7
3.2 Prices of Farm Inputs	C- 8
4. Model Farmer's Economy	C- 9
4.1 Farm Size and Proposed Farm Operation	C- 9
4.2 Cultivated Area	C-11
4.3 Cropping Techniques	C-11
4.4 Labor Requirements and Its Distribution	C-14
4.5 Income and Expenditure of Farmers	C-16
5. Production Plan for Sub-Project Areas	C-21
5.1 Production	C-21
5.2 Irrigation Benefit and Incremental Benefit	C-21
5.3 Marketing	C-24
6. Agricultural Support Services	C-28
6.1 Present Conditions of Agricultural Support Services	C-28
6.2 Recommendation to Strengthen Agricultural Support Services	C-36
7. Recommendation on Improvement of Cropping Techniques	C-38
7.1 Fruits Cultivation	C-38
7.2 Animal Husbandary	C-38

List of Tables

		Page
C.1.1	Crop Name	C-39
C.2.1	Crop Yields	C-41
C.2.2	Crop Yields	C-43
C.2.3	Drip Irrigation Evaluation	C-44
C.2.4	Productivity Comparison Between Modern Method	C-45
C.3.1	Wholesale Prices of Farm Products in CORABASTOS	C-46
C.3.2	Financial and Economic Prices of Farm Products	C-47
C.3.3	Economic Parity Price of Farm Products	C-48
C.3.4	Financial and Economic Prices of Farm Inputs	C-53
C.4.1	Number of Farmers and Hectarage of Farmland of Per Farm Size	C-54
C.4.2	Average Farm Size Per Farmer	C-58
C.4.3	Planted Area of Model Farm	C-59
C.4.4	Recommended Varieties	C-60
C.4.5	Main Disease and Insects	C-62
C.4.6	Application Volume of Insecticide and Fungicide per Crop	C-68
C.4.7	Production Inputs	C-69
C.4.8	Labor Requirements Per Crop	C-72
C.4.9	Monthly Labor Balance	C-75
C.4.10	Production Volume	C-77
C.4.11	Farm Budget of Model Farm Under With Project and Without Project Condition	C-79
C.4.12	Profit and Loss Statement of Model Farmer	C-83
C.4.13	Cash Flow of Model Farmer	C-87
C.4.14	Gross and Net Production Value of Farm Products in Model Farm	C-91
C.4.15	Input Amount of Farm Inputs in Model Farm	C-95
C.4.16	Financial Net Return Per Hectare Under Without Project Condition	C-96

C.4.17 Financial Net Return Per Hectare Under With Project Condition C-116

C.5.1 Production Plan Under Irrigated Area C-142
C.5.2 Economic Net Return Per Hectare Under Without Project Condition C-144
C.5.3 Economic Net Return Per Hectare Under With Project Condition C-153
C.5.4 Gross and Net Production Value of Farm Products in Sub-Project Area Except Pilot Area C-168
C.5.5 Gross and Net Production Value of Farm Products in Pilot Area C-172
C.5.6 Gross Production Value and Gross Production Cost Per Hectare of Farm Products C-175
C.5.7 Amount of Marketed Major Farm Products from Project Areas C-179
C.5.8 Amount of Self Consumption in the Project Area C-180
C.5.9 Marketed Amount and Total Amount of Transaction in CORABASTOS C-181
C.5.10 Transaction Amount of Major Farm Projects in CORABASTOS Under Future Condition C-182
C.5.11 Amount of Transaction of Vegetables in CORABASTOS, 1985 ..... C-183
C.5.12 Population Trend in Bogota D.E. C-184
C.5.13 Amount of Farm Input in the Project Area C-185

C.6.1 Staffs in Each ICA District C-186
C.6.2 Summarized Credit Condition - Caja Agraria - C-187
C.6.3 Summarized Credit Condition - FEDECAFE - C-188
C.6.4 Participants of Caja Agraria in 1983 ..... C-189

List of Figures

		Page
C.1.1	Cropping Calendar - Type A	C-190
C.1.2	Cropping Calendar - Type B	C-194
C.2.1	Present Cropping Calendar	C-198
C.4.1	Labor Balance	C-199
C.5.1	Marketing Flow in Department of Boyaca	C-201
C.5.2	Marketing Flow in Department of Cundinamarca	C-202
C.5.3	Market Location	C-203
C.5.4	Seasonal Fluctuation of Wholesale Prices of Farm Products in CORABASTOS	C-204
C.5.5	High Transaction Season in CORABASTOS	C-208
C.6.1	Organization Chart of ICA	C-216

ANNEX C Agriculture and Agricultural Economy

1. Cropping Pattern:

According to a field survey, cropping is largely restricted by the shortage of water during the dry season. This development project is aimed at improving the productivity of the existing land (cultivated area) by focussing on irrigation water supply during the dry season.
It will be difficult, however, to ensure that a sufficient amount of water becomes available over the entire area because of the different amounts of water available according to the river or canal system. In planning the cropping pattern based on the undermentioned concept (Fig. C 1.1 and C 1.2) two patterns, have been established: in fields where irrigation water is easily available and in fields where irrigation water is not easily available respectively. These two patterns are hereinafter called Pattern - A and Pattern - B.

1 For Pattern - A, a cropping pattern which realizes the cultivation of highly profitable crops throughout the year is recommended.

2 For Pattern - B, a cropping pattern which realizes the highest possible planting ratio by selecting crops of relatively high dry resistance and profitability and avoiding species that must be sown in the dry season is recommended.

3 For either cropping pattern, rotation planting is recommended to avoid continuous planting of the same crops.

4 Also, each pattern is based on household agriculture, and the work and crops are timed for marketing at the best possible price.

Based on the above-mentioned principals, (refer to the preceding paragraphs for the basic concepts), water use plan was studied and economically efficient, cropping patterns were evaluated and the final cropping patterns to be applied to the land under the irrigation project have been selected, as follows:

San Pedro de Iguaque	: Pattern - A (Fig. C.1.1 - A.1)
Santa Sofia	: Pattern - A (Fig. C.1.1 - A.2)
Caqueza	: Pattern - A (Fig. C.1.2 - B.3)
Tibacuy	: Pattern - A (Fig. C.1.1 - A.4)

Especially, in Caqueza sub-project area ,pattern - B is applied because of shortage of available irrigation water. In result, irrigation water under pattern - B is applied mainly during dry weather periods in the rainy season.

2. Estimation of Crop Yield:

2.1 Condition of Present Yield:

The present yield condition is indicated in the Table C.2.2 by referring to the opinions of leading institutes including ICA - Tibaitata, ICA local office, HIMAT and FEDECAFE as well as.

2.2 Target Yield:

Two factors such as the effects of irrigation improve d cultivation techniques are accounted for estimating the target yield.
Table C.2.3 shows the result of irrigation test carried out by ICA.
Table C.2.4 shows comparison between conventional agricultural methods and modern agricultural methods. On the other hand, the results of the local ICA office's technical assistance are indicated in the Table C.2.4 and C.2.5.

From these tables, it is pointed out that an increase in yield is expected as a result of the improved irrigation and cultivation techniques, however, the effect of the cultivation techniques depends on the technical assistance, the degree of the farmer's willingness to adopt them and their acquisition. Precise prediction of the effects is therefore difficult.

Here the maximum yield in the case of the required water based on the FAO manual's estimating formula (as mentioned later) being available is estimated. The result is shown in Table C.2.2.

The maximum yield in Table C.2.2 is for the case of the water requirement being satisfied. The survey for the long term demand and supply of water in corresponding sub-project area confirmed that a shortage of water will occur in the near future. The decrease rate in yield due to this shortage is taken into account and the actual target yield after adjustment is shown in Table C.2.2.

Hereafter the adjusted amount is the target yield with project. The formula for estimating the decrease in yield, according to the FAO manual (Irrigation and Drainage Paper No.33 - Yield response to water -) is as followed:

$$Ym = \frac{YA}{1 - Ky\ (\ 1 - ETa/ETm)}$$

where, Ym : Maximum yield
Ya : Present yield
Ky : Yield response factor (shown in next Table)
ETa : Actual evapotranspiration
ETm : Maximum evapotranspiration

Yield Response Factor (ky)

Crop	Vegetative period (1)			Flowering period (2)	Yield formation (3)	Ripening (4)	Total growing Period
	early (1a)	late (1b)	total				
Alfalfa			0.7 - 1.1				0.7 - 1.1
Banana							1.2 - 1.35
Bean			0.2	1.1	0.75	0.2	1.15
Cabbage	0.2				0.45	0.6	0.95
Citrus							0.8 - 1.1
Cotton			0.2	0.5		0.25	0.85
Grape							0.85
Groundnut			0.2	0.8	0.6	0.2	0.7
Maize			0.4	1.5	0.5	0.2	1.25
Onion			0.45		0.8	0.3	1.1
Pea	0.2			0.9	0.7	0.2	1.15
Pepper							1.1
Potato	0.45	0.8			0.7	0.2	1.1
Safflower		0.3		0.55	0.6		0.8
Sorghum			0.2	0.55	0.45	0.2	0.9
Soybean			0.2	0.8	1.0		0.85
Sugarbeet							
beet							0.6 - 1.0
sugar							0.7 - 1.1
Sugarcane			0.75		0.5	0.1	1.2
Sunflower	0.25	0.5		1.0	0.8		0.95
Tobacco	0.2	1.0				0.5	0.9
Tomato			0.4	1.1	0.8	0.4	1.05
Water melon	0.45	0.7		0.8	0.8	0.3	1.1
Wheat							
winter			0.2	0.6	0.5		1.0
spring			0.2	0.65	0.55		1.15

The concept for estimation is 1) although for cropping in each sub-project area the dry season is preferred to the rainy season, as shown in present cropping calendar (Fig. C.2.1) from the yield survey, a part of the planting is also carried out also in the rainy season due to cultivation timing. Also, there is shortage of dry weather time during the rainy season. Accordingly, the present yield condition does not reflect a satisfactory water supply. 2) the shortage ratio is calculated with regard to the demand for the water supply and the rainfall amount based on the current crop calendar. 3) finally the actual target yield is estimated from the above mentioned formula for the increase of present yield in the case of a satisfactory water supply being made available.

2.3 Tendency to increase yield:

An increase of the yield ought to be expected from the installation of an irrigation system, hence the yield should be gradually improved as the farmers acquire the irrigation control techniques as follows:

First step (first year of the the project): Increase in the yield is not feasible because of unskilled irrigation techniques.

Second step (second - third year): Increase 70 - 80 % of the target yield as their irrigation techniques improve.

Third step (after fourth year): Reaching the target yield as they master the irrigation techniques and become more keen to increase the yield . (Improvement in their irrigation techniques may bring about further increases, which, however, are not taken into account here.)

3. Prices of Farm Products and Farm Inputs

3.1 Prices of Agro-Products

3.1.1 Financial Prices

Farm gate prices of farm products in this sub-project area is estimated based on average wholesale prices in CORABASTOS for the past three years and expenses such as transportation cost, margins and so on. Wholesale prices of farm products is shown in Table C.3.1. That expenses are estimated at 30% of wholesale price depending on the study of Fondo-DRI, so that farm gate prices of farm products in this sub-project area is given in Table C.3.2.

3.1.2 Economic Prices

Parity price as economic price is adopted to following farm products, while as for another farm products, financial farm gate price is adopted to economic price.

Parity Price

Import parity price :	Maize
	Kidny Bean
	Wheat
	Pea
Export parity price :	Coffee

As a result, economic price of agro-products are shown in Table C.3.2 and C.3.3. Economic parity prices of said farm products are shown as follows;

Economice Parity Price (Col.$/kg)

Maize	28
Bean	148
Wheat	35
Pea	106
Coffee	892

3.2 Prices of Farm Inputs

3.2.1 Financial Prices

Farmers usually parchase farm inputs such as fertilizer, agro-chemicals, seeds and so on from Provision Agricora which is a distributing sector of Caja Agraria. The prices of farm inputs which are provided from Provision Agricora, are set under Caja Agraria Control.

Prices of farm inputs are shown in Table C.3.4.

Taking account of the result of farm economic survey, it is estimated that labor cost is Col.$600 per day, while price of draft-animals in Col.$1,500 per day for a pair of bullocks.

3.2.2 Economic Prices

Economic prices of farm inputs are calculated by multiplying shadow exchange price factor (1.2) to the import portion of farm inputs. Import protions are shown as follows;

Seed	:	0%
Insecticide	:	20
Fungicide	:	20
Fertilizer	:	40

Economic prices for farm inputs are shown in Table C.3.4.

4. Model Farmer's Economy:

For evaluating the benefit of the Project on the farmer's level, a model farmer is assumed for each sub-project area. The model farmer is defined here as an average farmer in each sub-project area under the irrigation project.

4.1 Farm Size and Farm Operation Proposal

This development project aims at improving the productivity of the cultivation areas of small scale farmers, which account for the majority in the sub-project areas. The farm sizes of a model farmer are based on similar levels.

4.1.1 Farm Size

For establishing the farm size and the model farmer, the number of farmers and the area of land respective agricultural operation based IGAC's land registry, were referred to.

Table C.4.1 indicated the number and the area of land of farmers for each farm size in each respective sub-project area. Farmers with less than 5 ha are dominant in every sub-project area and those with land areas less than 10 ha also account for a considerable portion. Holding of more than 10 ha mostly rely on animal husbandaries. Since this project focuses on the improvement of cultivated land, the model farmer should be based on the prevailing small farmer operating both upland crop and animal husbandaries. Because farmers with land of less than 10 ha fall into the above-mentioned classification, the farm size of the model farmer is based on the median land area of the farmers with less than 10 ha of and summarized as follows are shown in Table C.4.2.

San Pedro de Iguaque	3.0 ha
Santa Sofia	2.4 ha
Caqueza	1.4 ha
Tibacuy	2.0 ha

4.1.2 Proposed Farm Operation

In accordance with the results of the survey on farmers and the land use survey in the study area under the irrigation project, land distribution by land use was estimated. The number of family members (eligible for farming) and the head of animals are based on the surveys without alteration. Based on the above the farm operation proposal of the model farmer for each sub-project area was determined to be as follows:

Proposed Farm Operation

Item / Sub-project Areas		San Pedro de Iguaque	Santa Sofia	Caqueza	Tibacuy
No. of family members		6	6	6	4
(Eligible for farming)		(4)	(3)	(3)	(3)
Farmland (ha)	Upland	2.0	0.8	1.1	0.5
	Grazing Land	1.0	1.5	0.3	0.5
	Fruit trees	-	0.1	-	0.1
	Coffee Plantation	-	-	-	0.9
	Total	3.0	2.4	1.4	2.0
Livestock (head)	Cattle	4	6	2	3
	(Incl. calves)	(2)	(3)	(1)	(2)
	Sheep	5	2	2	
	Pigs	2	2		
	Asses or horses	1	1	1	1

4.2 Cultivated area:

The cropping patterns for each respective sub-project area have already been shown in section 1, and these patterns are to be applied to the cultivated land of the model farmer to be irrigated. The study on the availablility of water on the land included in the project resulted in obtained the following irrigable areas.

San Pedro de Iguaque	60 %
Santa Sofia	100 %
Caqueza	100 %
Tibacuy	100 %

As shown above, the entire cultivated area of all sub-project areas will be irrigable except for San Pedro de Iguaque, where 40 % of the cultivated area presents constraints for irrigation. Therefore, the cropping pattern for the lack of an available water supply (Fig. C.1.2) is applied to these areas. Table C.4.3 shows the cultivated area of the model farmer when the above-mentioned cropping patterns are applied.

Comparing the current cropping intensity with that proposed under project, remarkable improvements can be seen as follows:

	Without Project	With Project
San Pedro de Iguaque	110 %	157.5 %
Santa Sofia	110 %	187.5 %
Caqueza	100 %	160.0 %
Tibacuy	160 %	220 %

4.3 Cropping techniques:

Problems and their countermeasures with regard to the cropping techniques will be as follows:

4.3.1 Annual Crops

a) Renewal of Seeds and Introduction of Improved Varieties.

The current conditions are such that the renewal of seeds for such traditional crops as potatoes, maize, wheat, kidneybeans, etc., is seldom seen. They should be renewed at least once every few years, and also appropriate varieties should be introduced as much as possible. Table C.4.4 shows the varieties recommended by ICA.

b) Soil Improvement and Application of Fertilizers

The analysis indicated that the soil is highly acidic and less fertile. It is desirable that the soil undergo various improvement processes, including addition of organic compounds, improving agents and other kinds of fertilizers. In this project, it is proposed to apply soil improving agents and organic compounds twice for each cultivation cycle of potatoes, onions and tomatoes. The volume of this fertilizer is to be matched to the extent of irrigation for increasing the yield.

c) Pest Control

The vegetables, including the newly planned crops, are likely to be subject to damage by insects. The insects likely to create problems are indicated in Table C.4.5. The field survey revealed that pest control is generally not frequent, however, excessive spraying with chemical mixtures is seen occasionally.
ICA recommended the chemicals listed in Table C.4.6, which, however, include some items under international restriction due to their residual toxicity (e.g. Furadan). It is advisable that the pest control be carried out under the technical assistance of the ICA,

using proper chemicals, spraying amounts and timing. In this project, it is proposed that exterminations be carried out 1~2 times in view of the local conditions.

d) Weeding

Application of herbicides may relieve the labor required for weeding, however, in this project, it is not proposed the use of herbicides because the additional manpower for weeding can be well accommodated within the household labor as had been studied the redistribution of annual manpower (Fig. C.4.1).

4.3.2 Coffee

FEDECAFE has plans to maintain the current coffee output by improving the productivity through new techniques and diversifying their products by utilizing the areas so saved for new products.

a) Removal of Old Trees and Introduction of New Varieties

Trees older than 20 years shall be systematcically removed and new varieties recommended by FEDECAFE introduced.

b) Application of Fertilizer

Usually, many farmers are not applying fertilizer , however , the yield shall be improve by carrying out application of fertilizer at least one or two times a year.

4.3.3 Production Inputs:

Based on the abovementioned measures for cultivation techniques, major production inputs are listed in Table C.4.7.

4.4 Labor Requirements and its distribution

4.4.1 Means of Production and Operation Techniques

The agricultural equipment owned by the farmers are, excluding cattle hauling equipment, manual tools only such as spades, sickles, knapsack type chemical sprays, etc. Therefore, the cultivating work is carried out manually except for the harrowing, the plowing by draft animals, and the transportation by ass or horse drawn carriages. Occasionally some farmers with gentle sloped land rent mechanical systems for land on complicated slopes will remain the same for the time being. Transportation to local markets of the crops mainly is depended on ass or horse and on trucking companies for the major markets in Bogota and other cities. The operation system is predicted and summarized as follows:

Recommendations on Cropping Practice

Cropping Activities	Actual Practices	Recommendations
Raising of Seedleng	By manual	Renewal of seed and selection of appropriate seed
Land Preparation	By a couple of draft animal	
Harrowing & Levelling	〃	
Soil improvement	By manual	Application of lime for main crops
Application of Organic Materials	〃	Application for main crops
Application of Fertilizers	〃	Increment in volume of fertilizers, additional application for main crops
Seeding and transplanting	〃	Renewal of seed and selection of appropriate seed
Weeding	By manual with a hoe	Intensify weeding frequency
Pest Control	〃 With a sprayer	Intensify application frequency of pesticide
Harvesting	〃 With a soickle and a hos	
Collection and Packing	By manual, and by threshing machine for wheat(on contract basis)	
Transportation	By draft animal (horse,ass,etc.), By trucks for far market.	

4.4.2 Labor Requirements

In accordance with the field survey, the labor requirements for each work category on the current conditions is indicated in Table C.4.8. The labor requirements is assumed to match the potential requirements for increases in fertilization, extermination and improvement in the yield (Table C.4.8). The labor requirement for irrigation is estimated on 1) the trip between the residence and the farm (twice per day x 0.5 hours per trip) 2) manpower required for moving the supply pipes and sprinklers (twice per day x 15 minutes) and 3) other manpower for management (0.5 hour in average per day).

4.4.3 Distribution of Manpower

Fig. C.4.1 indicates the monthly distribution of the manpower based on the proposed cropping patterns, cultivated areas and labor requirements for farming under the project planning. The cattle is to be put to pasture or tethered, and the manpower required for keeping the cattle is estimated on 1) manpower for the trip for re-tethering 3 times a day (0.5 hour x 3 trips) 2) manpower for re-tetherning (0.1 hour per head x 3 times) and 3) manpower for other routines (1 hour per day in average for breeding, hygenics, marketing, etc.).

As shown in Fig. C.4.1, the household manpower can be better utilized compared to the current condition. (see Table C.4.9)

4.5 Income and Expenditure of Farmers

4.5.1 Production

The abovementioned target yield is applied to the land to be irrigated. The land in San Pedro de Iguaque, were

water for irrigation is unavailable and hence is not benefitted by the irrigation, is assumed to maintain the current yield level. In the first year of the Project, the yield is assumed to remain at the current level since the irrigation techniques will still in an unsatisfactory condition, as already mentioned in "2.3 tendency to increase yield". Table C.4.10 shows the production plan of the model farmer.

4 5.2 Farm Economy

In order to evaluate the irrigation project from farmer's economy viewpoint, analysis of farm budget for model farm is examined under between without project and with project conditions in each sub-project area.

After implementation of this irrigation project, the project will provide some bases for introduction of improved irrigation farming through year round irrigation. Furthermore, increase of unit yield of crops and improvement of cropping intensity will be widely expected under proposed condition of farming practices as mentioned in Section 2.2, Table C.2.6.

Farm input under with project condition would be given in order to attainment of irrigation efficiency. Table C.4.15 shows amount of farm input under without and with project conditions. Accordingly, gross production cost in model farm will increase effectively under with project condition as shown in Table C.4.14 while farmers will be able to work constantly through year round depending on increase of workable days as shown in Table C.4.9 and Fig. C.4.1.

Under situations mentioned above, drastic increase of farm income under with project condition will be expected in the project area. Besides, substancial increase on farm income will not be expected under without project condition. The farm budget for model farm under without project and with project conditions is shown in Table C.4.11 and summarized as follows:

With Project Condition

(Unit: 1,000 Col.$)

	San Pedro de Iguaque	Santa Sofia	Caqueza	Tibacuy
I. Gross Income	858	668	721	668
1) Agriculture	748	518	721	668
2) Livestock and Others	110	150	-	-
II. Gross Outgo	653	371	433	441
1) Production Cost	443	168	230	201
2) Living Expenses	210	203	203	240
III. Net Reserve	205	297	288	227
IV. Net Farm Income/1	305	350	491	467

Remark) /1: Net farm income = Agricultureal gross income - Production Cost

Without Project Condition

(Unit: 1,000 Col.$)

	San Pedro de Iguaque	Santa Sofia	Caqueza	Tibacuy
I. Gross Income	426	272	303	340
1) Agriculture	316	122	303	340
2) Livestock and Others	110	150	-	-
II. Gross Outgo	420	268	296	320
1) Production Cost	210	65	93	80
2) Living Expenses	210	203	203	240
III. Net Reserve	6	4	7	20
IV. Net Farm Income/1	106	57	210	260

Remark) /1: Net farm income = Agricultural gross income - Production Cost

Gross income of model farm under with project condition will be expected to become about 2 to 2.5 times of that under without project condition, so that net farm income under with project condition will be expected to be about 2 to 6 times of that under without project condition. Accordingly, the incredsed net reserve would offer incentives for further development to the farmers.

On the other hand, Table C.4.12 and C.4.13 show future conditions of benefit and loss and cash flow statement of model farm under with project condition, respectively.

5. Production Plan for Sub-project Areas

5.1 Production

Based on the field survey on the availability of water, the areas of land for each sub-project area included in the irrigation project are determined as follows:

San Pedro de Iguaque	162 ha
Santa Sofia	239 "
Caqueza	417 "
Tibacuy	48 "

The area to be irrigated for coffee cultivation at Tibacuy is 210 ha.
Assuming that the cropping patterns mentioned in clause 1) are applied to these farmlands, the corresponding cultivated areas will be as shown in Table C.5.1. The current cultivated areas are based on the assumption that the crops as ascertained by the field survey are mainly cultivated. The production is based on the yield mentioned in Table C.2.2. Table C.5.1 is a comparison of the production, for the without Project, the 1st year, and the 5th year with Project.

5.2 Irrigation Benefit and Incremental Benefit

The irrigation benefit to be expected is defined as the difference of yield of farm products between without project and with project conditions. On the basis of estimated production cost and production value, net production value of farm products is accounted both with project and without project conditions.

Table C.5.6 shows gross production value, gross production cost and net production value per ha and summarized as follows;

Net Production Value of Major Farm Products

(Unit: 1,000 Col. $/ha)

	San Pedro de Iguaque	Santo Sofia	Caqueza	Tibacuy
With Project				
Potato	39	-	-	39
Onion	-	287	257	287
Beans	69	69	90	97
Tomato	-	-	339	363
Cucumber	-	-	-	34
Beet	-	-	-	-
Carrot	-	-	-	-
Coffee	-	-	-	736
Without Project				
Potato	6	20	-	29
Maize	-12	-	-	-
Wheat	-1	1	-	-
Beans	-	45	76	68
Coffee	-	-	-	602

Irrigation benefit of each sub-project area is conservatively estimated based on the proposed cropping pattern, target yield, etc. mentioned in Section 2 and 4. The irrigation benefits at full development stage in each sub-project area except pilot area and pilot area are summarized as follows: (Details are given in Tables C.5.4 and C.5.5).

(Unit: 1,000 col. $)

Sub-Project Area	Net Production Value		Benefit at
	Without Project	With Project	Full Target
San Pedro de Iguague			
a. Whole area except pilot area	68	14,161	14,093
b. Pilot area	14	2,707	2,693
Santa Sofia			
a. Whole area except pilot area	7,495	65,781	58,286
b. Pilot area	995	8,728	7,733
Caqueza	42,388	122,182	79,794
Tibacuy			
a. Whole area except pilot area	125,889	161,244	35,355
b. Pilot area	6,020	8,993	2,973

On the other hand, the incremental irrigation benefit will be expected to increase year by year and attain full benefit after 4 years from commencement of irrigation farming as described in Section 4.3.

5.3 Marketing

5.3.1 Present Condition

Based on farm economic survey and data collected from institutes concerned with the project, present condition of marketing is cleared in the project area as mentioned hereinafter.

There are following marketing centers around the project area of which the most important centers are Bogota D.E., the capital of Colombia and Tunja, the capital of Department of Boyaca (See Fig. C.5.3).

Project Area	Market
San Pedro de Iguaque	Bogota, Tunja, Bucaramanga
Santa Sofia	Botota, Tunja, Moniquira, Chiquinquira
Caqueza	Botota, Caqueza, Villavicencio
Tibacuy	Bogota, Fusagasnga, Girardot, Ibague

Source: Farm Economic Survey

Marketing channels of agro-products which are producted in and around the project areas are shown in Figs. C.5.1 and C.5.2 by DRI (Fondo de Desarrollo Rural Integrado). Fig. C.5.1 shows general marketing channel in and around Tunja, capital of Department of Boyaca. On the other hand, Fig. C.5.2 shows general marketing channel in and around Municipio of Fusagasuga where is adjacent to Municipio of Tibacuy.

In each sub-project area, agro-products from the sub-project area to the markets are usually transported by bus, jeep or truck. Besides, there are some cases which wholesalers or middleman come and buy the agro-products directly from farmers at farmgate.

On the other hand, in the project area, crops mentioned in Section 4.3 are producted in the project area under present condition.

Table C.5.7 shows marketed amount of farm products in the project area under present condition, considering the amount of self-consumption (Table C.5.8) in the farm, and summarized as follows;

Marketed Amount of Major Farm Products (ton)

	San Pedro de Iguaque	Santo Sifia	Caqueza	Tibacuy	Total
Potato	1,326	672	-	31	2,039
Maize	43	31	289	4	367
Beans	-	136	722	143	1,001
Onion	-	-	509	-	509
Tomato	-	-	632	133	765

Table C.5.9 shows marketed amount of farm products and total amount of transaction in CORABASTOS which is the one wholesale market in Bogota, D.E and supply around 60% of required amount of farm products. Marketed amounts from the project area are small amount compared with total amount of transaction in CORABASTOS as follows;

	Share From the Project Area(%)
Potato	1.1
Maize	2.4
Onion	1.4
Beans	2.2
Tomato	1.5

5.3.2 Future Condition at Full Development Stage

Amount of crop production in the project area will raise up as shown in Table C.2.6, according to the proposed cropping calendar and farming practices. Table C.5,2 show amount of crop production in each sub-project area.

Marketed amount of farm products under with project condition is estimated as shown in Table C.5,7 considering consumed amount of farm products in the project area. On estimating this marketed amount, following items are assumed:

- Future population in the project area will be almost never increased
- Per-capita consumption of farm products in the project area is given as shown in Table C.5.8 .

On the other hand, transacted amount of farm products, especially vegetables, in CORABASTOS is shown in Table C.5.11 . Furthermore, amount of transaction of farm products in CORABASTOS will increase as shown in Table C.5.10 , taking account of growth rate of population in BOGOTA, D.E (See Table C.5.12 .)

However, even if it's assumed that total marketed farm products from the project area are transported to CORABASTOS, supplied amount of farm products will be slightly as shown in Table C.5.7 .

In addition, it is cleared that marketed amounts of farm products from the project area don't cover demand in Bogota, D.E (See Table C.5.10).

Besides, wholesale prices in Bogota, D.E fluctuate seasonally according to relationship between supply and demand as shown in Fig. C.5.4.

As a result, it is indispensable to effectively ship farm products to markets when the wholesale price is higher, due to increase of profitability and productivity of agriculture.

In fact, in the project area, farm products will be shipped to markets depending on proposed cropping pattern as shown in Fig. C.1.1.

On preparing proposed cropping pattern, harvesting period of farm products was setted up, considering seasonal fluctuation and period of high price in Bogota, D.E as shown in Fig. C.5.5.

As a result, it will be expected sufficiently to ship farm products during the period of high price compared with without project condition and thereby raise up profitability and productivity of farm products.

5.3.3 Amount of Farm Inputs

Under with project condition, farm inputs such as fertilizer, agro-chemicals, organic matters, etc. will be applied effectively in order to taking out irrigation efficiency and thereby increasing crop production.

Table C.5.13 shows applied amount of farm input under without project and with project condition.

6. Agricultural Support Services

6.1 Present Conditions of Agricultural Support Services

6.1.1 Agricultural Extension Services

a) Structure and Staffing

In Colombia, ICA (Instituto Colombiano Agropecuario) under Ministry of Agriculture has an overall responsibility of agricultural extension services. The General Manager of ICA is technically supported by three (3) Deputy Director General who are representatives of Department such as (1) Formentation and Services, (2) Administration and (3) Agricultural Investigation and Technology Transfer. Under the Director General, there exist Districts for Rural Development, Technology Transfer, Experimental Centers and Stations, Laboratories and Regions (See Fig. C.6.1).

This project area is included with ICA Region I which is consisted of eight (8) Districts such as (1) Caqueza, (3) Fusagasuga, (3) Tunja, (4) Chiquinquira, (5) Duitama, (6) Garagoa, (7) Guayabaru and (8) La Paluma. These district is composed for four (4) Departments, such as (1) Cundinamarca, (2) Boyaca, (3) San Andres y Providencia and Amazonas, so that there are 222 Municipios in Region I.

On the other hand, head office of Region I is located at Tibaitata which there exists three (3) sections under General Manager such as Administration, Investigation/ Technology Transfer and Extension Services.

The each ICA district office is headed by district director under regional director. The each distric office has usually a few Junior Technicians (Procticos Agricoras) under Senior Technicians who are in regular government services. Junior Technicians are assisted by some agricultural assistants (Auxil Desarrollo Campesino).

Agricultural extension services in and around the Project area are served by ICA district office of Tunja, Chiquinquira, Caqueza and Fusagasuga. Among four (4) sub-project areas, San Pedro de Iguaque and Caqueza are included with ICA district of Tunja and Caqueza, respectively, while Santa Sofia and Tibacuy not included. However, Santa Sofia sub-project area shall be included with ICA district of Chiquinquira from 1987.

No. of Municipios which are registered in each ICA district is shown as follows;

District	No. of Municipios
Tunja	38
Chiquinquira	4
Caqueza	8
Fusagasuga	7

Staffs in each ICA district amount to about 120 as shown in Table C.6.1.

b) Present agricultural extension services

The present activities of agricultural extension services in the project area are implemented by extension workers such as Junior Technicians and Agricultural Assistans as follows;

- Variety Test and cultivation experiments
- Extension of imporved varieties
- Extension of efficient farming techniques
- Supporting concerned with rural development program of DRI

In general, duty area in charge of one extension officer covers several Municipios. Each officers conduct extension services to a group of farmers or from farmer to farmer in each Municipio. Definite ICA's programs of activities to the farmers as well as extension services are summerized as follows;

- Extension of some agricultural informations by means of radio, newspaper, pamphlets and so on
- Farm production Plans for credit applications
- Campaigns for disease and insect control
- Guidance of practical farming techniques in the farmer's plot

As mentioned above, Municipio of Chiquiza and Caqueza are belonged to the target areas for ICA's extension services, while Municipios of Santa Sofia and Tibacuy aren't belonged to the target area at present. However if farmers request some services to ICA, ICA conducts extension services to them in non-target area as well as target area of ICA. Furthermore, protection compaigns concerned with specific deseases or insects in spite of non-periodic extension services are conducted to general farmers in each Municipio. Usually, extension services of ICA are given priority to the target area for services of, Fondo-DRI.

Fondo-DRI is under Ministry of Agriculture and conducts following activities in order to improvement of living standards in rural area.

1. Production
   - Adjustment and extension of technology
   - Formentation of agricultural production
   - Operation and maintenance of small river basin, fish culture and forest development

2. Commercialization (in rural area)

   - Promotion and organization of rural cooperatives for marketing
   - Technical assistance in marketing
   - Formulation of project for marketing

3. Social development and communication

   - Health,
   - Education,
   - Rural development, etc.

4. Infrastructure

   - Improvement and rehabilitation of conditions of road, electrification, etc.

In department of Cundinamarca and Boyaca, districts of Fondo-DRI are shown as follows;

Cundinamarca	:	Caqueza
		Fusagasuga
		Villeta
Boyaca	:	Tunja
		Duitama
		Soata
		Valle de Tenza

Among four sub-project areas, two sub-project areas of San Pedro de Iguaque and Caqueza are included with districts of Tunja and Caqueza of Fondo-DRI, respectively. At present, in two sub-project areas mentioned above, supporting services concerned with management of farmers' group as well as agricultural extension services have been carried out cooperated with ICA.

On the other hand, FEDECAFE has also conducted following activities to general farmers as well as coffee producers.

- Distribution of coffee seedling
- Extension services
    - On-farm guidance
    - Preparation of coffee production manual
    - Technical assistance

6.1.2 Credit

Caja Agraria mainly provide agricultural credit to general farmers in the Project area for wide ranging objectives as follows;

- Food production
- Livestock production
- Fruits production
- Purchase of agricultural equipments and machines
- Improvement of living standard
- Fisheries development
- Development of agro-industries

Caja Agraria has six (6) regions in Colombia such as (1) Sur Occidental, (2) Sur Ardina, (3) Oriental, (4) Norte Occidental, (5) Norte and (6) Central. Branch office of Caja Agraria in each regions distribute credit to the farmers directly. Four sub-project areas are included in Central Region.

In and around the project area, there exists some branches as follows;

Sub-project area	Branch office
San Pedro de Iguaque	Villa de Leyva
Santa Sofia	Santa Sofia
Caqueza	Caqueza
Tibacuy	Fusagasuga, Cumaca

As mentioned in Table C.6.4, participants to credit of Caja Agraria in rural area of Municipios of Chiquiza and Santa Sofia are more than 50% as 1983, while, in Municipios of Caqueza and Tibacuy, less than 50%. At present, based on the farm economic survey, it leaved that farmers in the project area don't almost utilize this credit.

The interest rate of Caja Agrarias credit is shown in Table C.6.2.

Besides, credit of FEDECAFE is applied to general farmers as well as coffee producers. Objectives of this credit are summarized as follows;

- Improving of agricultural production
- Purchase of agricultural equipments and machines
- Improvement of living standard

The interest rate of FEDECAFE's credit is shown in Table C.6.3.

6.1.3 Farmers' Group

In the project area, there exists following three farmer's groups.

a) Cooperativa Agropecuaria Multiactiva de San Pedro De Iguaque

Crop : Potato

Area : Municipio of Chiquiza, Department of Boyaca

Objectives :
- Improvement of distribution channel
- Increase of living standard of potato farmers
- Diminishing of marketing cost

Summary : This farmers' group was established in 1981. At present, number of members are 126 farmers in 7 Veredas concerned or (1) Centro Rural, (2) Cerro, (3) Vergara, (4) Rio Abajo, (5) Pita y Chone, (6) Salvial and (7) Corregidor. Marketed amount of potato is about 900 tons. Usually, middleman come and buy potatoes at farm gate.

Besides, they manage one storage for potato, or 120 m^2 in Vereda Centro.

b) Cooperativa Multiactiva de Santa Sofia y Stamarchan

Crop : Curuba

Area : Municipios of Santa Sofia and Stamarchan, Department of Boyaca

Objectives : - Diminishing of number of middle men
- Increase of Curuba production

Summary : In 1976, this shipping cooperative of Curuba was established. At present, members are around 80 farmers.

This cooperative purchase curuba from non-members of farmers as well as members and ships them to some supermarkets in Bogota D.E.

c) Cooperativa de Production y Mercade de Oriente Ltda

Crops : Vegetables (Onion, Tomato, Red Pepper, etc.)

Area : Municipio of Caqueza, Department of Cundinamarca

Objective : Stable supply of high quality vegetables to Bogota D.E.

Summary : In 1981, this cooperative was established in order to stable supply of high quality vegetables to Bogota D.E., especially major supermarkets. At present, members are 38 farmers in 10 Veredas concerned. Supply system of vegetables has not been operated sufficiently. In result, at present, improvement of cooperative management is conducting under supporting services of Fondo-DRI.

6.2 Recommendation to Strengthen Agricultural Support Services

The present agricultural support services in the project area are limited to be provided to small farmers or susbistance farmers according to following major factors;

- Municipios of Santa Sofia and Tibacay are not included with ICA district.
- Trained extension staffs of ICA is not sufficient in order to increase of agricultural production and improvement of living standard
- Lack of supporting staffs for management and/or formulation of farmers' cooperative (or farmers' group)

The major objectives of this project are to increase the agricultural production through the irrigation development and thereby to improve and raise the level of living standard and welfare of the inhabitants.

For this purpose, the Project will provide irrigation facilities, or sprinkler facilities. However, for smoth realization of the Project objectives, there would remain some suplemental works which should be carried out mainly by the institutions concerned and farmers themselves, in parallel with the Project construction, in order to exclusion of above factors. As a result, it is hoped that following requirements will be covered in order to support of this irrigation development project;

1) To augment the extension staffs of ICA so as to sufficiently and widely carry out extension services of production increase to general farmers

2) To improve the practical irrigated cultivation technique of the farmers through practical training and demonstration of irrigated farming conducted by extension staffs of ICA

3) To make farmers understand the necessity and advantage of establishing farmers' group for shipping

4) To strengthen supporting services for management of farmers' cooperative (or farmers' group)

7. Recommendations on Improvement of Cropping Techniques:

The improvement of annual upland crops and coffee has already been discussed in the preceeding clauses of "Model farmer". Here the problems, requiring improvement and recommendations on fruit trees and animal husbandary are summerized.

7.1 Fruits Cultivation

Those engaged in the cultivation of Curuba at Santa Sofia strongly desire production under the stabilized distribution system of the Curuba Agriculture Cooperative, and more intensive management compared to other fruit tree farming. The ICA has pointed out several problems requiring improvement, including fertilization and pest control. For items affecting other kinds of fruit trees, there are farms scattered around the Tibacuy highland intensively cultivating Mora, Lulo and Tomate de Arbol. It is advisable that these farms conduct fertilization and pest control at least twice a year for improving the productivity. Although it may be difficult to sufficiently control other kinds of fruit trees because they are sparsely planted, the trees should at least be trimmed for promoting their growth.

7.2 Animal Husbandary:

The present condition is such that the cattle are put to pasture or tethered year-round in rough grazing lands. Accordingly, the breeding has become stagnated, and dairy production and growth rates tend to fall as the grass disappears during the dry season. For improving the productivity, it will be necessary to take proper measure including at least the establishment of feeding methods and improvements in depasturing the cattle to be marketed.

Table C.1.1 Crop Name

Spanish	English	Japanese	Scientific name
Papa	Potato	ジャガイモ	*Solanum tuberosum ssp andigena*
Maiz	Maize	トウモロコシ	*Zea mays L.*
Trigo	Wheat	コムギ	*Triticum vulgare L.*
Frijol	Kidneybean	インゲンマメ	*Phaseolus vulgaris L.*
Haba	Broadbean	ソラマメ	*Vicia faba L.*
Arveja	Pea	エンドウマメ	*Pisum sativum L.*
Habichuela	Snapbean	ドジョウインゲン	*Phaseolus vularis L. var humilis*
Cebolla cabezona	Onion	タマネギ	*Allium cepa L.*
Cebolla Rama	Welsh Onion	ナガネギ	*Allium fistulosum L.*
Ajo	Garlic	ニンニク	*Allium sativum L.*
Remolacha	Beet	ビート	*Beta vulgaris L. var rapacea dumort*
Zanahoria	Carrot	ニンジン	*Dacus carota L.*
Pepino cohombro	Cucumber	キュウリ	*Cucumis sativus L.*
Arracacha	Peruvian carrot	—	*Arracacia xanthorrihiza bancr*
Ahuyama	Pumkin	カボチャ	*Cucurbita mazima Duch*
Yuca	Cassva	キャッサバ	*Manihot esculenta crantz*
Cana Panelera	Sugar cane	サトウキビ	*Saccharum officinarum L.*
Curuba	Passion fruit	クルーバー	*Passilora mollissina bailey*
Mora de castilla	Black Berry	木イチゴ	*Rublus gluaucus benth*
Lulo	Quito orange	ル ロ	*Salanum quitoense lam*
Tomate de Arbol	Tree tomate	トマテ・デ・アルボール	*Cyphomandra betacea sendt*

Spanish	English	Japanese	Scientific name
Durazno	Peach	モ モ	*Prunus perisicae L. Batsch*
Manzana	Apple	リンゴ	*Malus pumila MILLER var. domestia SCHNEIDER*
Guayaba	Guava	グァバ	*Psidium guajava L.*
Papaya	Papaya	パパイヤ	*Carica papaya L.*
Guanabana	Soursop	トゲバンレイシ	*Annona montana maciac*
Platano	Cooking banana	料理用バナナ	*Musaceae paradisiaca L.*
Citricos	Citrus	柑橘類	
Naranja	Orange	オレンジ	*Citrus sinesis L.*
Limon	Lemon	レモン	*Citrus limonon L.*
Mandarina	Mandarin	密 柑	*Citrus reticulata*
Taugero	Tangerina	タンジール	*Citrus paradisi Macof*

Table C-2-1 Crop Yields

(1) -Surveys of Various Institutions

Unit : t/ha

	1/ Caja		2/ Caja	3/ ICA	4/ ICA	5/ ICA	6/ FEDECAFE	7/ HINAT
	Traditional Farming	Modern Farming	Boyaca	Tunja	Caqueza	Fusagasuga		
Potato	13	19	12	16	20	16		10
Maize	1.3	2.5	1.6	2.0			6.0	1.5
Wheat	1.3	2.3	1.9	2.0				2.3
Onion	15	20	19	20	20		32	15
Welsh onion		30					43	
Garlic			8	6				
Broadbean			1.9	1.3				1.3
Kidneybean	0.6	1.3		1.0	4.0		2.4	0.8
Pea		5.0			3.8	7.0	17.5	
Snapbean					14	12	30	
Tomato					25	30		
Beet					15			
Carrot		20	32	20				

Note : 1/ Costos de Produccion por Hectarea : Caja de Credito Agrario

2/ 〃 : Caja de Credito Agrario, Boyaca

3/ 〃 : ICA, Tunja

4/ 〃 : ICA, Cagueza

5/ 〃 : ICA, Fusagasuga

6/ Bases tecnologicas Costos E Ingresos de Cultivos de Diversificacion 1985 : FEDECAFE

7/ Diagnositico de La situacion Actual del Proyecto de Riego En Ladera "San Pedro de Iguaque" : HINAT

(2) Agricultural Statistics

Unit : t/ha

	1/ National Level	1/ Department Boyaca	1/ Department Cundinamarca	2/ Region Andiana
Potato	14	13	14	13
Maize	1.5	1.3	1.7	1.5
Wheat	1.7	1.6	1.7	1.4
Kidneybean	0.8	0.5	0.9	0.6

1/ ANUARIO ESTADISTICAS DEL SECTOR AGROPECUAR10. MINISTERIO DE AGRICULTURA 1986

2/ SECTOR AGROPECARIO COLOMBIANO Diagnostico Tecnologico, ICA 1980

(3) Standard for Technical Assistance

Unit:t/ha

	1/ ICA	2/ FEDECAFE
Potato	20~35	
Maize	4.3~6.0	
Onion	20~30	
Welsh Onion	30~50	
Garlic		6~10
Broadbean	2~4	
Kidneybean	1.5~3.0	
Pea	1.5~5.0	6~ 8
Snapbean	8~12	8~12
Tomato	20~60	14~30
Cucumber	15~20	
Beet	20	
Carrot	30~70	

Note : 1/ HORTALIZAS manual de asistencia tecnica, ICA

2/ EL CULTIVO DE LA AJO, ARVEJA, HABICHUELA, TOMATO, FEDECAFE 1986

Table C.2.2 Crop Yields

Sub-project Area / Crops	San Pedro de Iguaque			Santa Sofia			Caqueza			Tibacuy		
	Yields without Project 1/	Goal Yields 2/	Target Yields with Porject 3/	Yields without Project	Goal Yields	Target Yields with Porject	Yields without Project	Goal Yields	Target Yields with Porject	Yields without Project	Goal Yields	Target Yields with Porject
Potato	12	20	19	13	20	19				13	20	19
Maize	1.3	2.3	2.2	1.4	2.3	2.2	2.2	3.0	2.6	1.4	2.3	2.2
Wheat	1.3	2.2	2.1	1.4	2.2	2.1						
Onion				12	18	17	14	19	16	12	18	17
Welsh onion	18	32	30									
Garlic				5	8	7						
Broadbean	1.3	2.2	2.1	1.4	2.2	2.1						
Kidneybean				0.7	1.1	1.0	1.1	1.5	1.3	1.0	1.5	1.4
Pea	2.0	3.5	3.3	2.2	3.5	3.3	3.0	4.0	3.4	2.6	4.0	3.8
Snapbean							9	12	10	8	12	11
Tomato							17	23	20	15	22	21
Cucumber							14	18	15	12	18	17
Beet	13	16	15	13	16	15						
Carrot	13	16	15	13	16	15						
Arracacha							10	12	10			
Pumkin							13	15	13	13	15	14
Cassava				10						10		
Sugarcane				15						15		
Coffee										1	1.4	1.4

Note : 1/ : Based on field Survey on farmers
2/ : Maximum yield obtained under perfect irrigation rationally
3/ : In order that there is a possibility of tentative water shortage forl long range of time, the anticipated yield is estimated lower than the maximum yieled. Rate of reduction to the case of 2/ is shown below.

San Pedro de Iguaque	5%	Caqueza	15%
Santa Sofia	5%	Tibacuy	5%

Table C.2.3 DRIP IRRIGATION EVALUATION

Unit : ton

Crops	Places	Ordinary Productivity	Experiments result
Tomato	Caqueza	12.0	21.7
	San Juan de Cesar	17.0	28.9
Cucumber	San Juan de Cesar	15.0	16.0
Beet	Caqueza	11.9	14.0
Lettuce	Tunja	15.0	38.4
	Tibaitata	37.7	54.6
Cauliflower	Cota	24.0	24.0
Onion	Caqueza	13.0	24.0
Potato	Tunja	16.4	33.2
Carrot	Tibaitata	20.9	35.0
Cabbage	Tibaitata	88.5	172.1

According to PROGRAMA DE PEQUENA IRRIGACION
- RIEGO EN LADERA Y PEQUENOS LAGOS - HIMAT 1985

Table C.2.4 PRODUCTIVITY COMPARISON BETWEEN MODERN METHOD

Unit : ton

	Oridinary method	Modern method	Domestic average
Potato	9.66	18.00	12.57
Maize	0.95	2.65	1.39
Wheat	1.36	2.13	1.41
Barley	0.77	2.10	1.56
Bean	0.71	1.20	0.78
Cassava	8.21	18.01	10.35
Sugar Cane	4.83	7.19	5.00

According to PROGRAMA DE PEQUENA IRRIGACION
- RIGO EN LADERA Y PEQUENOS LAGOS - HIMAT 1985

Table C.2.5 EXTENSION SERVICE EFFECTS

Unit : ton

	Bean	Tomato	Snap bean	Strawberry
1978	6.5	12.74	7.91	—
79	7.79	15.00	9.40	6.0
80	8.50	17.28	9.35	6.1
81	9.70	18.42	10.80	7.3
82	10.50	18.61	11.41	8.2
83	11.00	19.21	12.38	9.4
84	10.60	19.61	14.80	10.6
85	10.62	18.80	11.66	10.41

According to Distrito Transferencia Tecnologia : Fusagasga ICA

Table C.3.1 WHOLESALE PRICES OF FARM PRODUCTS IN CORABASTOS

(Unit: Col.$/kg)

Farm Product	1983/1984 /1	1984/1985 /1	1985/1986 /1	Average
Potato	15	21	35	24
Maize	29	37	46	37
Onion	41	37	55	44
Welsh Onion	22	27	24	24
Garlic	94	221	127	147
Kidny Bean	222	275	326	274
Pea	55	90	96	80
Tomato	35	47	60	47
Cucumber	17	23	26	22
Beet	18	35	38	30
Carrot	16	22	23	20
Peruvian Carrot	23	34	40	32
Pumpkin	18	33	26	26

Remark) /1: Yearly average price (June to July of the next year)

Table C.3.2 FINANCIAL AND ECONOMIC PRICES OF FARM PRODUCTS

(Unit: Col.$/kg)

Farm Products	Wholesale Price/1	Farm Gate Price	
		Financial/2	Economic/6
Potato	24	17	17
Maize	37	26	28
Wheat	43/3	43	35/5
Onion	44	31	31
Welsh Onion	24	17	17
Garlic	147	103	103
Kidny Bean	274	192	148/5
Pea	80	56	106/5
Tomato	47	33	33
Cucumber	22	15	15
Beet	30	21	21
Carrot	20	14	14
Peruvian Carrot	32	22	22
Pumpkin	26	18	18
Coffee	-	264/4	892/5

Remarks) /1: Data informed from CORABASTOS
(Average price for past three years)
/2: Considered 30% of some expenses (margins, transportation cost, etc.)
/3: Controlled price of IDEMA
/4: Data informed from FEDECAFE
/5: Economic parity price (See Table C.3.3)
/6: Economic prices of farm producty except Maize, Wheat, Kidny Bean, Pea and Coffee adopt financial price

Table C.3.3 (1) ECONOMIC PARITY PRICE OF FARM PRODUCT

(Import Parity Price: Maize) (Unit: Col.$/ton)

Item	US$	Col.$
1. World Market Price /1	65.51	
2. Freight and Insurance	13.73	
3. CIF Price (1+2)	79.24	
4. Equivalent in Col.$/ton /2		18,423
5. Landing and Port Charges		7,244
6. Transport to Market in Bogota		4,600
7. Transport to Farm Gate /3		2,000
8. Economic Price at Farm Gate (4+5+6-7)		28,267

Remarks) /1: Price in June 1986

/2: US$ 1 = Col.$193.76 x 1.2 = Col.$232.5
(Shadow exchange rate is 1.2)

/3: According to field survey

Table C.3.3 (2) ECONOMIC PARITY PRICE OF FARM PRODUCT

(Import Parity Price: Wheat) (Unit: Col.$/ton)

Item	US$	Col.$
1. World Market Price/1	92.45	
2. Freight and Insurace	13.85	
3. CIF Price (1+2)	106.3	
4. Equivalent in Col.$/ton/2		24,715
5. Landing and Port Charges		7,810
6. Transport to Market in Bogota		4,600
7. Transport to Farm Gate/3		2,000
8. Economic Price at Farm Gate (4+5+6-7)		35,125

Remarks) /1: Price in June 1986

/2: US$ 1 = Col.$193.76 x 1.2 = Col.$232.5
(Shadow exchange rate is 1.2)

/3: According to field survey

Table C.3.3 (3) ECONOMIC PARITY PRICE OF FARM PRODUCT

(Import Parity Price: Kidny Bean) (Unit: Col.$/ton)

Item	US$	Col.$
1. World Market Price/1	496.16	
2. Freight and Insurace	74.87	
3. CIF Price (1+2)	571.03	
4. Equivalent in Col.$/ton/2		132,764
5. Landing and Port Charges		12,762
6. Transport to Market in Bogota		4,600
7. Transport to Farm Gate/3		2,000
8. Economic Price at Farm Gate (4+5+6-7)		148,126

Remarks) /1: Price in June 1986

/2: US$ 1 = Col.$193.76 x 1.2 = Col.$232.5
(Shadow exchange rate is 1.2)

/3: According to field survey

Table C.3.3 (4) ECONOMIC PARITY PRICE OF FARM PRODUCT

(Import Parity Price: Pea) (Unit: Col.$/ton)

Item	US$	Col.$
1. World Market Price/1	314.00	
2. Freight and Insurance	88.87	
3. CIF Price (1+2)	402.87	
4. Equivalent in Col.$/ton/2		93,667
5. Landing and Port Charges		10,186
6. Transport to Market in Bogota		4,600
7. Transport to Farm Gate/3		2,000
8. Economic Price at Farm Gate		106,453

Remarks) /1: Price in June 1986

/2: US$ 1 = Col.$193.76 x 1.2 = Col.$232.5
(Shadow exchagne rate is 1.2)

/3: According to field survey

Table C.3.3 (5) ECONOMIC PARITY PRICE OF FARM PRODUCT

(Export Parity Price: Coffee) (Unit: Col.$/ton)

Item	US$	Col.$
1. FOB Price	3,875.71	
2. Equivalent in Col.$/ton /2		901,103
3. Port Handling Charge		621
4. Transport from Factory to Port		2,350
5. Processing Cost in Factory		3,429
6. Transport from Collecting Center to Factory		1,500
7. Transport from Farm Gate to Collecting Center		980
8. Economic Price at Farm Gate		892,223

Remarks) /1: Price in June 1986

/2: US$ 1 = Col.$193,76 x 1.2 = Col.$232.5

(Shadow exchange rate is 1.2)

Table C.3.4 FINANCIAL AND ECONOMIC PRICES OF FARM INPUTS

(Unit: Col.$/kg)

Farm Inputs	Financial /1	Economic /3
Seed		
Potato	17 /2	17
Wheat	70	70
Maize	150	150
Kidny Bean	330	330
Onion	7,710	7,710
Welsh Onion	17 /2	17
Beet	2,400	2,400
Cucumber	4,070	4,070
Tomato	12,110	12,110
Carrot	3,700	3,700
Peruvian Carrot	22 /2	22
Pumpkin	18 /2	18
Garlic	103 /2	103
Insecticide		
Furadan	230	239
Lannate	1,150	1,196
Sevin	1,200	1,248
Roxin	790	822
Fungicide		
Manzate	480	499
Dithane	470	489
Benlate	4,700	4,888
Breslanid	3,360	3,494
Duter	1,000	1,040
Fertilizer		
10-30-10	50	54
13-26-6	50	54

Remarks) /1: Data informed from Caja Agraria

/2: Applied financial farm gate price

/3: See Section 3.2 (Price of farm-inputs)
For example: Economic price of Furadan (Insecticide)
230 x 0.8 + 230 x 0.2 x 1.2 = 239

Table C.4.1 Number of Farmers and Hectarage of Farmland of Per Farm Size

(1) San Pedro de Iguaque

No. of Farmers

Unit : Farm

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
Carrizal	31	32	14	28	16	7	13	8	2	151
Corregidor	1	8	13	10	7	7	9	0	4	59
Llano Grande	19	24	11	9	12	6	8	4	—	93
Patiecitos	49	31	36	29	25	14	21	13	7	225
Monte	21	43	16	24	17	8	14	8	—	151
Centro	72	39	28	36	24	11	23	5	4	242
Total	193	177	118	136	101	53	88	38	17	921
	20.9	19.2	12.8	14.8	11.0	5.8	9.6	4.1	1.8	100

Hectarage of Farmland

Unit : ha

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
Carrizal	20.6	53.0	34.8	118.0	100.2	65.0	168.6	205.8	289.9	1,055.9
Corregidor	1.0	10.0	31.1	39.8	45.9	57.2	113.5	—	320.3	618.8
Llano Grande	9.9	35.5	29.8	35.0	77.8	53.2	99.7	107.6	—	448.5
Patiecitos	35.9	46.4	92.6	124.0	153.1	123.1	301.6	432.3	622.9	1,931.9
Monte	8.9	63.5	39.9	96.6	104.5	68.2	197.8	246.6	—	826.0
Centro	33.6	60.9	70.1	143.3	146.2	94.5	323.2	159.3	373.0	1,403.8
Total	109.9	269.3	298.3	556.4	627.7	461.2	1,204.4	1,151.6	1,606.1	6,284.9
	1.7	4.3	4.7	8.9	10.0	7.3	12.9	18.3	31.9	100

(2) Santa Sofia

No. of Farmers

Unit : Farm

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
Sorocota	190	112	74	74	31	13	13	2	—	509
Guatoque Arriba	165	115	48	58	28	11	10	6	—	441
〃 Abajo	66	29	13	21	17	5	5	1	—	157
Agudelo Arriba	75	63	50	45	19	8	7	2	—	269
〃 Abajo	62	47	29	28	11	6	5	1	—	189
Duraznos Y Colorados	86	63	36	53	30	18	16	10	—	312
Hornillas	39	45	22	49	34	18	22	7	3	239
Total	683	474	272	328	170	79	78	29	3	2,116
	32.4	22.4	12.8	15.5	8.0	3.7	3.7	1.4	0.1	100

Hectarage of Farmland

Unit : ha

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
Sorocota	104.4	163.9	184.7	284.8	193.3	111.1	159.2	67.3	—	1,268.7
Guatoque Arriba	91.8	168.7	117.3	228.5	174.5	92.8	145.1	126.5	—	1,145.2
〃 Abajo	33.1	44.9	34.2	83.7	104.3	41.3	69.5	21.0	—	432.0
Agudelo Arriba	47.4	92.8	123.5	186.7	119.6	82.1	100.3	45.1	—	797.5
〃 Abajo	34.6	68.0	73.9	110.4	68.2	45.5	62.6	22.6	—	485.8
Duraznosy Colorados	47.0	94.0	88.2	210.1	195.3	152.7	234.0	285.4	—	1,306.7
Hornillas	24.9	69.6	54.4	205.3	211.7	155.5	330.3	158.9	263.0	1,473.6
Total	383.2	701.9	676.2	1,309.5	1,066.9	681.0	1,101.0	726.8	263.0	6,909.5
	5.5	10.1	9.8	19.1	15.4	9.9	15.9	10.5	3.8	100

(3) Caqueza

No. of Farmers

Unit : Farm

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
Giron de Blancos	314	74	49	31	16	3	10	1	—	498
Moyas Giron de Resguardo El Carmen	116	64	34	21	11	5	12	2	—	265
Total	430	138	83	52	27	8	22	3	—	763
	56.4	18.1	10.9	6.8	3.5	1.0	2.9	0.4	—	100

Hectarage of Farmland

Unit : ha

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
Giron de Blancos	129.4	107.5	122.1	120.4	96.9	25.7	143.8	40.6	—	786.4
Moyas Giron de Resguardo El Carmen	56.3	94.0	85.0	80.2	63.8	43.1	166.5	44.9	—	633.8
Total	185.7	201.5	207.1	200.6	160.7	68.8	310.3	85.5	—	1,420.2
	13.1	14.2	14.6	14.1	11.3	4.8	21.9	6.0	—	100

(4) Tibacuy

No. of Farmers

Unit : Farm

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
San Jose	51	19	11	18	10	5	6	1	—	121
Centro	82	37	18	11	5	1	5	2	—	161
La Portada	11	8	6	14	2	4	11	1	—	57
Chisque	40	22	13	22	11	2	11	10	4	135
Total	184	86	48	65	28	12	33	14	4	474
	39.1	18.1	10.1	13.7	5.9	2.5	6.9	2.9	0.8	100

Hectarage of Farmland

Unit : ha

Farm size / Vereda	~1ha	1~2	2~3	3~5	5~7.5	7.5~10	10~20	20~50	50~	Total
San Jose	24.8	25.4	27.7	67.3	58.6	42.6	72.5	27.9	—	346.8
Centro	30.8	54.7	44.9	42.0	30.3	8.5	74.9	54.3	—	340.4
La Portada	3.9	13.3	16.3	48.4	12.4	34.9	151.6	45.4	—	326.2
Chisque	17.1	31.3	31.5	93.2	69.8	19.7	156.7	324.3	243.4	987.0
Total	76.6	124.7	120.4	250.9	171.1	105.7	455.7	451.9	243.4	2,000.4
	3.8	6.2	6.0	12.5	8.5	5.2	22.9	22.7	12.2	100