

CHAPTER 3 : THE STUDY AREA

CHAPTER 3 THE STUDY AREA

3.1 Political Administration and Population

The Study Area comprises eight (8) municipalities of the Department of Quindio, which are distributed in the following manner:

TABLE 3.1.1 ESTIMATED POPULATION IN THE STUDY AREA

Area	Estimated Population	Corresponding Municipalities
Circasia	2,261	Circasia
Salento	57	Salento
Quindio River Right Margin Area	463	La Tebaida
Quindio River Left Margin Areas (1) and (2)	442	Calarca
Pijao	116	Pijao, Cordoba
Geneva	90	Genova
Cristales River Area	28,060	Armenia
Total	31,489	

As of 1989, the total population of these municipalities excluding Cordoba (some portion of the pijao area is located within the municipal territory of Cordoba, but there live only a couple of families; this leads to neglect taking population of Cordoba into consideration) reached 343,256 (Inventarios Municipales, Caja Agraria), of which 59,524 (17.3%) lived in rural areas. Due to no reliable information, the population of the Study Area is calculated in a preliminary method; inhabitants of each area are estimated multiplying the proportion of the extension of the area against the total rural area of corresponding municipality by the population of the rural area of the same municipality.

3.2 Physical Features

3.2.1 Location and Topography

There are six (6) study areas (Circasia, Salento, Quindio River Right Margin, Quindio River Left Margin, Pijao, Genova) in the Study Area, and Quindio River Left Margin Area was divided into two areas, Quindio River Left Margin Area(1) and (2).

The physical features by area are summarized as follows:

(1) Circasia Area

This area extends over the western plain of Circasia, located approximately 10 km northeast of Armenia which is the capital of the Department, covering 2,735 ha of land at 1,600 to 1,900 m a.s.l. In the northeastern part of this area, comparatively flat and fertile grass land can be found. However, a large scale of canyon can be observed in its southwestern part. The area divided by slope is shown in Table 3.2.1 and the steep sloped land (more than 35%) shares about 35% of the area. The Robre river is flowing down from northeast to southwest and there are only two bridges on this river in this area, and it is quite difficult to find out the access from north to south.

(2) Salento Area

This area extends over the Alto Canaan, located approximately 5 km east of Circasia; covering a mountainous area of 645 ha at 1,600 to 2,100 m a.s.l. The steep sloped land shares about 36% of the area and comparatively flat hilly area extends in its northeastern part. This area is surrounded by the rural roads, but there is no road for vehicles inside of the area.

(3) Quindio River Right Margin Area

This area is located in the southwestern part of La Tebaida which is located approximately 15 km southwest of Armenia in the southern part of the national road leading to Cali covering 2,040 ha of the undulating margin of alluvial fan at 1,000 to 1,200 m a.s.l. The eastern part of this area located around at 1,200 m a.s.l. is comparatively flat. However, in the western part of the area at 1,000 m a.s.l. some valleys are developing. Almost all the rural roads are on the ridge from east to west and quite a few roads crossing the valley north to south exist in the western part of this area.

(4) Quindio River Left Margin Area (1)

This area extends over the low land area between the Quindio and the Barragan rivers and covers 610 ha of flat land, ranging from 1,000 to 1,200 m a.s.l. The land slopes gently from south to north and this is one of the causes for poor drainage of this area. This area is located 20 km of Armenia on the National Road Root 29 and the condition of transportation for the goods to the central area is good. However, there is few roads inside the area .

(5) Quindio River Left Margin Area (2)

This area extends between the Quindio and the Verde rivers and covers 175 ha of flat land, ranging from 1,000 to 1,200 m a.s.l. There is small hills at northeastern part of the area and alluvial flat land exists as V shaped along the rivers. Only one rural road connects this area to the National Road and there is no road to cross over the Quindio and Verde rivers.

(6) Pijao Area

This area extends over the upper area between Pijao which is located 20 km south of Armenia and Cordoba which is 17 km south

of Armenia, covering 800 ha mountainous area at 1,600 to 2,200 m a.s.l. The land slopes steeply from east to west and 73% of the area is steep sloped land. A lot of small valleys are developed by small streams and its topography is not simple.

(7) Genova Area

This area extends in the upper land and covers the valley located in the northern part of Genova which is located approximately 35 km south of Armenia, covering 595 ha of mountainous area at 1,400 to 2,200 m a.s.l. level. The Tamborales river flows down at the center of the area from northeast to southwest and a lot of small streams flow into the river from both sides, forming a quite undulating land inside of the valley. The steep sloped land shares 86% of the area. There are two rural roads on ridge of both sides of the area connecting to Pijao. However, there is no road to cross the valley.

TABLE 3.2.1 TOPOGRAPHY OF THE STUDY AREA

Area	Altitude (m)	Area by Slope(%)					Total Area (ha)
		<3%	8	15	35	35<	
Circasia	1,600~ 1,900	12	24	9	10	35	2,735
Salento	1,600~ 2,100	-	21	30	13	36	645
Quindio River Right Margin	1,000~ 1,200	21	26	9	15	19	2,040
Quindio River Left Margin(1)	1,000~ 1,200	64	31	3	-	2	610
Quindio River Left Margin(2)	1,000~ 1,200	48	19	14	14	5	175
Pijao	1,600~ 2,200	5	7	-	15	73	800
Genova	1,400~ 2,200	-	-	4	10	86	595

3.2.2 Meteorology and Hydrology

(1) Observation data

From the seventeen (17) meteorological stations established in and around the Study Area, meteorological data of the following six (6) stations were adopted to the study considering their locations, observation periods and accuracy of data. (Details are shown in Annex B).

TABLE 3.2.2 METEOROLOGICAL STATIONS BY AREA

Area	Rainfall	Temperature	Humidity
Circasia	Bremen	Bremen	Bremen
Salento	Salento	Salento	Bremen
Quindio River Right Margin	El Eden	El Eden	El Eden
Quindio River Left Margin	Paraguaycito	Paraguaycito	Paraguaycito
Pijao	Pijao	Gibraltar	Gibraltar
Genova	Gibraltar	Gibraltar	Gibraltar

As a hydrological data, the data of the La Vieja, Cristales, Quindio and Verde rivers were applied for the study.

(2) Meteorology

Characteristics of hydrology by area are summarized in Table 3.2.4 and rainfall pattern is shown in Fig. 3.2.1. Annual rainfall in the Study Area differ in different area, from 1,600mm to 2,800mm. From the data, each two rainy and dry seasons were identified in the area.

TABLE 3.2.3 SUMMARY OF METEOROLOGICAL CONDITIONS

Area	Altitude (m)	Annual Rainfall (mm)	Temperature(C)			Relative Humidity (%)
			Mean	Max.	Min.	
Circasia	1,600-1,900	2,800	15	16	14	72
Salento	1,600-2,100	2,300	18	22	14	72
Right M.	1,000-1,200	2,000	22	31	13	80
Left M.	1,000-1,200	2,100	22	28	17	77
Pijao	1,600-2,200	2,200	18	23	15	75
Genova	1,400-2,200	1,600	18	23	15	75

(3) Hydrology

Data on annual rainfall, effective rainfall, maximum 24-hour rainfall, continuous drought days, drought river discharge, mean river discharge and flood discharge were analyzed for the return period of 2, 5, 10 and 20 years. The results of the analysis are shown in Annex B.

(4) Necessity of irrigation

The necessity of irrigation were evaluated in consideration of the water balance between water requirements and effective rainfall for respective area. Generally, the effect of irrigation is not great considering the high rainfall in the

Study Area of 1,600 - 2,800 mm/year. However, the effects of irrigation may be expected during dry season for some crops.

The water requirements were estimated based on potential evapotranspiration and crop coefficient. The potential evapotranspiration was calculated with the Garcia Lopez Method and the crop coefficient was determined based on field survey and the criteria of US Bureau of Land Reclamation. The water balance was calculated for the return period of 2, 5, 10 and 20 years and the result is shown in Annex H(Table H.1.2). As a result, the necessity of irrigation by area is summarized as follows:

1) Circasia Area

In general, there is no need to irrigate the farm land because the water requirements are very little considering the annual effective rainfall. Annual crop is cultivated in accordance with expected rainfall pattern. For perennial crop, there is no report on the crop damages caused by water shortage. The field capacity is good enough comparing the estimated irrigation water requirements (maximum 1.8 mm/day). Therefore, in general it is not necessary to introduce an irrigation system to this area. However, the some effect of irrigation may be expected in the case of annual crop cultivation to be made through the year.

2) Salento Area

Annual rainfall is less than that of the Circasia Area and irrigation may be required during the dry season(June, July and August) according to the result of water balance analysis. However, the volume of irrigation water requirements are so small(maximum 0.7 mm/day). The remarkable effect of irrigation can not be expected due to the same reason as that of the Circasia Area.

3) Quindio River Right Margin Area

The water requirements of this area are more than that of the Circasia Area because of high temperature, even though the annual rainfall is comparatively large (about 2,000 mm). The irrigation is required at two dry seasons (June-August and December-February), according to the result of water balance analysis. Therefore, the some effect of irrigation can be expected in the case of annual crop cultivation to be wade through the year.

4) Quindio River Left Margin Area (1), (2)

The natural condition of these areas is similar to that of the Right Margin Area. Therefore, the effect of irrigation can be expected depending on the kind of crops.

5) Pijao Area

Irrigation may be required during the dry season (June to August) in the area. However, the volume of irrigation water requirements is quite a little (maximum 0.3 mm/day). The crop damage caused by the water shortage is not reported at present.

6) Genova Area

Annual rainfall of this area is about 1,600 mm and according to the result of water balance analysis, the area may require the irrigation during the dry seasons (June-August and December-February). Even though the water requirements are quite a little, the some effects for annual crops can be expected.

3.2.3 Soil

(1) Soil

The soil analysis was conducted based on the soil map prepared by IGAC in 1990. Soil maps for the respective study areas, acreage and physical and chemical characteristics by soil series are shown in Fig. 3.2.1, Tables 3.2.5 and 3.2.6 respectively. Ten (10) soil series are identified in the Study Area and volcanic ash soil shares 75 % of the total area.

General characteristics of the soils are:

- Medium fertility
- Good soil physical conditions
- Moderate soil pH(5-6)

The symptom of nutrient deficiency of the crops was not found in the study Area during the survey period. Soils having limitation against crop cultivation are as follows:

Limitation	Soil Series
Poor Drainage	CE, QU
Thin Soil Layer	AL

The characteristics of soils in the respective study areas are as follows. USDA classification of soil series in the Study Area is shown in Annex C.

- Circasia Area

Soils in the area consist of CI and LC series, parent material of which is volcanic ash. Characteristics of these soil series are medium-high fertility and good physical

conditions. Limitation of soil against crop cultivation is not found.

- Salento Area

LC and SH series, volcanic ash soil, are identified in the area. Fertility of these soils is medium-high and there is no limitation against crop cultivation.

- Quindio River Right Margin Area

There are 4 soil series, CI, TB, AL and CE in the area. TB series is the most predominant soil series, sharing 90 % of the total area. Characteristics of TB series are medium fertility and there is no limitation against crop cultivation. However, the soil layer of AL series is thin and CE series are alluvial soil with poor drainage.

- Quindio River Light Margin Area(1)

Only CE series, alluvial soil, is identified in the area. Soil characteristics are medium fertility and poor drainage.

- Quindio River Light Margin Area(2)

CI series share 70 % of the total area and their representative characteristics are medium-high fertility and good physical conditions. The remaining 30 % is QU series, which is limited against agricultural land use because of thin soil layer.

- Pijao Area

Soil series identified in the area are CC, HG and GE. Volcanic ash soil shares 30 % of the total area and the remaining soil is originated from metamorphic rock. General characteristics of these series are medium fertility and good physical conditions.

- Genova Area

The area consists of GE series, parent material of which is metamorphic rock. General characteristics of the series are high cation exchange capacity, good physical conditions and medium fertility. There is no limitation against crop cultivation.

(2) Land classification

Land capability for agricultural use is evaluated in accordance with the standard of IGAC. General description of the land capability is summarized as follows (the land classification map and area by land class are shown in Fig. 3.2.2 and Table 3.2.7., respectively):

Class-I : Soils well suited for crops, having no significant limitations that restrict their use.

Class-II : Soils well suited for crops, having slight limitations that restrict their use.

Class-III : Soils moderately suited for crops, having moderate limitations that require the selection of suitable crops and/or special management of soils.

Class-IV : Soils poorly suited for crops, having severe limitations that restrict crops and/or require very careful management of soils.

Class-V : Soils with no erosion hazard, but having other limitations making them unsuited for crops that are impractical to remove.

Class-VI : Soils having severe limitations that make them generally unsuited for cultivation and that limit their use to pasture and perennial crop.

Class-VII : Soils having very severe limitations that make them unsuited for cultivation and pasture and that restrict their use to woodland and wildlife food with good management of them.

Class-VIII: Soils and land types having limitations that preclude their use for commercial plant production and restrict their use to recreational purposes, wildlife food and cover and water supply.

To indicate the kind of predominant limitations or of the management practices and corrective measures required for agricultural land use, the following sub-classes are shown with their symbol.

(e) - Susceptibility to erosion

Slope, erodibility of the soil and past erosion damage are the major soil factors considered.

(d) - Poor drainage

Excess water caused by a high ground water level, low permeability or slow surface drainage, or a combination of them.

(s) - Soil limitation in the root zone

Such features as shallowness, unfavorable texture, low water holding capacity, stoniness and low fertility that are difficult to correct are included.

Predominant limitation in the study Area is land slope. The standard of slope for respective land classes is shown in following table:

TABLE 3.2.4 STANDARD OF SLOPE BY CLASS

Class	II	III	IV	VI	VII	VIII	
Sub-class				1	2		
Slope(%)	0-7	7-12	12-25	25-35	35-50	50-75	75<

Source : IGAC

As the result of land classification, VII and VIII classes, which are unsuited for agricultural land use, share more than 50 % in Salento, Pijao and Genova areas, and 30% in Circasia area. However, the limitation of these areas is not soil's characteristics but land slope. These areas are mainly used for grazing land or coffee cultivation at present. Especially in the grazing land, soil erosion due to poor management is the severe problem.

Therefore, appropriate cropping system considering soil conservation should be introduced into these steep sloped areas.

TABLE 3.2.5 AREA BY SOIL SERIES

(Unit: ha)

Symbol	CI	LC	SH	TB	AL	CE	QU	CC	HG	GE	Total
Circasia	694	2,041	0	0	0	0	0	0	0	0	2,735
(%)	25	75	0	0	0	0	0	0	0	0	100
Salento	0	527	118	0	0	0	0	0	0	0	645
(%)	0	82	18	0	0	0	0	0	0	0	100
Right M.	76	0	0	1,734	210	20	0	0	0	0	2,040
(%)	4	0	0	85	10	1	0	0	0	0	100
Left M.	0	0	0	0	0	610	0	0	0	0	610
(1) (%)	0	0	0	0	0	100	0	0	0	0	100
Left M.	121	0	0	0	0	0	54	0	0	0	175
(2) (%)	69	0	0	0	0	0	31	0	0	0	100
Pijao	0	0	0	0	0	0	0	240	216	344	800
(%)	0	0	0	0	0	0	0	30	27	43	100
Genova	0	0	0	0	0	0	0	0	0	595	595
(%)	0	0	0	0	0	0	0	0	0	100	100

TABLE 3.2.6 SOIL CHARACTERISTICS

Soil Symbol	Parent Material	pH	CEC	Texture	Drainage	Soil Depth	Fertility
CI	V	M	H	M	W	P	M-II
LC	V	M	H	M	W	P	M-II
SH	V	M	H	M	W	M	M
TB	V	M	M	M	W	M-P	M
AL	S	M	M	M	M	S	L-M
CE	A	M	M	F-M	P	S-M	M
QU	A, V	M	M	F-M	P	S-M	M
CC	V, M	M	M-II	M	W	M-P	M
HG	V, M	M	M-II	M	W	M	M-II
GE	M	M	H	M	W	S-M	M

- Soil Symbol and Name:

Symbol	Name	Symbol	Name
CI	Chinchina	CE	Complex of Ceilan and Danubio
LC	Libano	QU	Complex of Quindio and Guarino
SH	Complex of Santa Isabel and Herveo	CC	Complex of Chinchina and EL Cedral
TB	Complex of Tebaida and Alejandria	HG	Complex of Herveo and Guacas
AL	Complex of Alejandria and Isabel	GE	Complex of El Cedral and Pedregales

- Parent Material

M: Metamorphic Rock V: Volcanic Ash S: Sedimentary Rock
A: Alluvial Soil

- pH

L: Low(<5.0) M: Moderate(5.0-6.0) H: High(6.0<)

- CEC

L: Low(<10 meq/100g) M: Medium(10-20 meq/100g) H: High(>20 meq/100g)

- Texture

F: Fine(FC, Sic) C: Coarse(S, SL) M: Medium(Others)

- Drainage

P: Poor M: Moderate W: Well

- Soil Depth

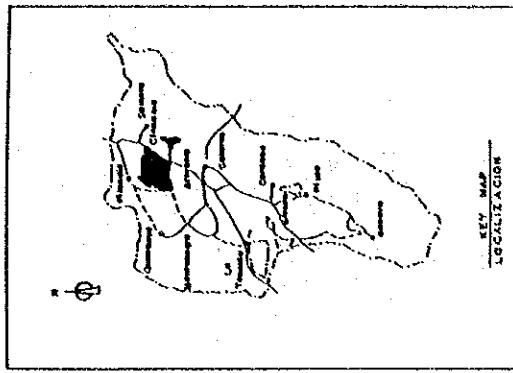
VS: Very Superficial(<25 cm) S: Superficial(20-50 cm)
M: Moderately Profound(50-90 cm) P: Profound(90-150 cm)

- Fertility (Evaluated based on ligend of IGAC)

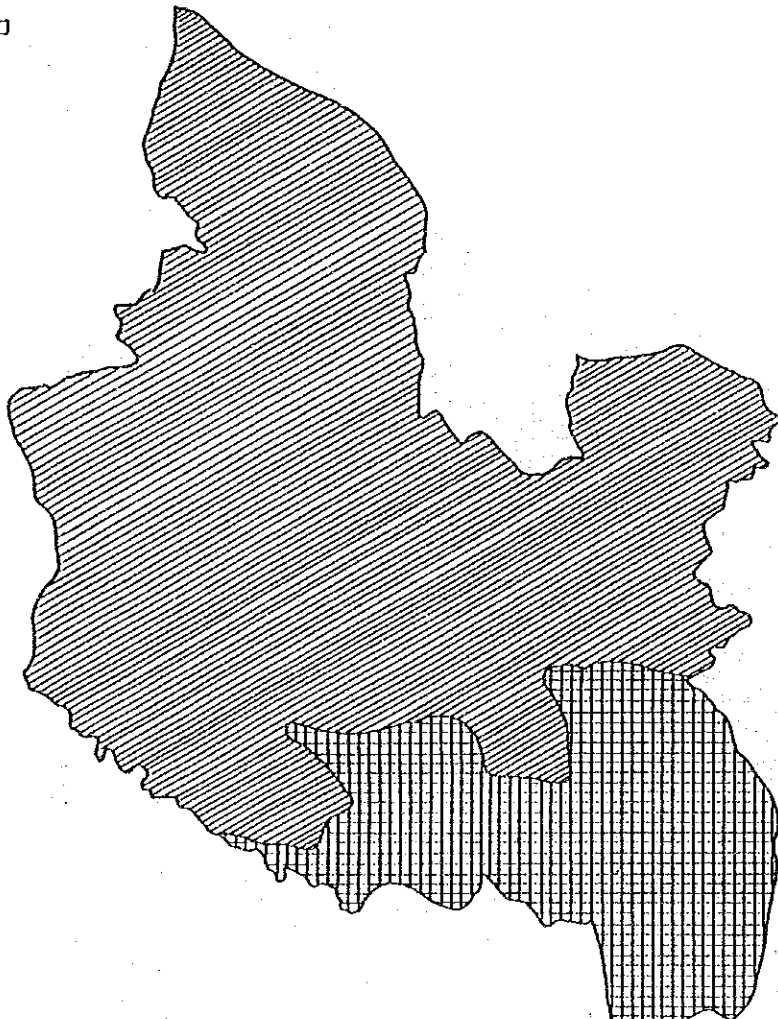
L: Low M: Moderate H: High

TABLE 3.2.7 AREA BY LAND CLASSIFICATION

Class	Sub-class	Circasia (ha)	Salento (ha)	Right M. (ha)	Left M.-1 (ha)	Pijao (ha)	Genova (ha)
		(%)	(%)	(%)	(%)	(%)	(%)
II	e	111	7	702	7	5	0
		4	1	35	1	18	0
III	e	82	6	42	0	5	0
		3	1	2	0	5	0
IV	Sub-total	1.244	78	598	598	44	0
	e	1.244	78	554	0	44	0
	es	0	0	30	0	0	0
	d	0	0	14	598	0	0
VI	Sub-total	445	217	452	5	237	139
	e-1	283	109	288	3	38	87
	es-2	0	0	12	0	0	0
	e-2	182	108	131	2	199	52
	es-2	0	0	21	0	0	0
VII	Sub-total	316	120	246	0	359	212
	e	316	120	99	0	359	212
	es	0	0	147	0	0	0
VIII	e	537	217	0	0	150	244
		20	34	0	0	4	19
		7	4	19	7	4	41
Total		2.735	100	2.040	100	610	100
		175	100	175	100	800	100
		595	100	595	100	595	100

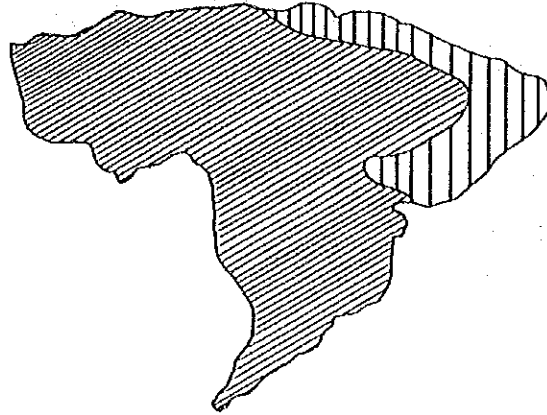


LEGEND	
SYMBOL	SOIL
	CI
	LC
	SH



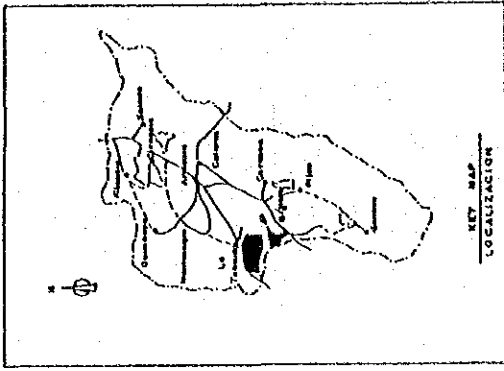
CIRCASIA
CIRCASIA

SCALE 1:40,000
ESCALA 1:40,000



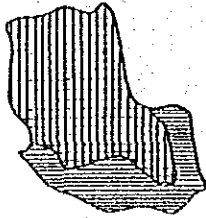
SALENTO
SALENTO

FIG 3.2.1 SOIL MAP(1)

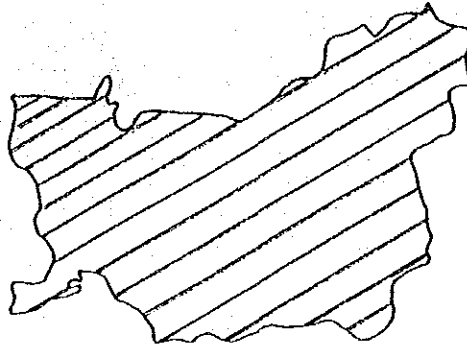


LEGEND

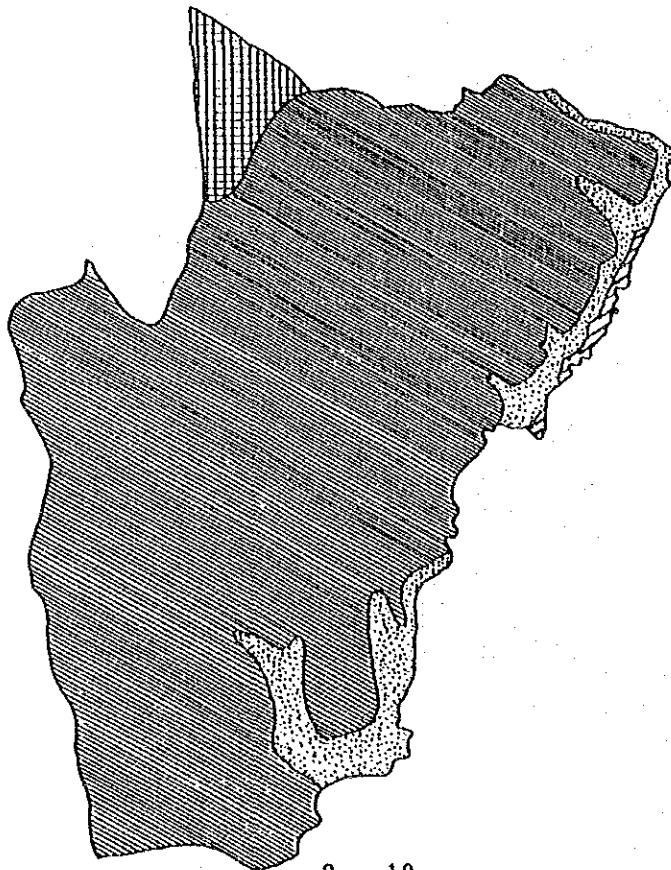
SYMBOL	SOIL
	CI
	TB
	AL
	CE
	QU



QUINDIO RIVER LEFT MARGIN (2)
MARGEN IZQUIERDA DEL RIO QUINDIO (2)



QUINDIO RIVER LEFT MARGIN (1)
MARGEN IZQUIERDA DEL RIO QUINDIO



QUINDIO RIVER RIGHT MARGIN
MARGEN DERECHA DEL RIO QUINDIO

SCALE 1:40,000
ESCALA 1:40,000



FIG 3.2.1 SOIL MAP (2)

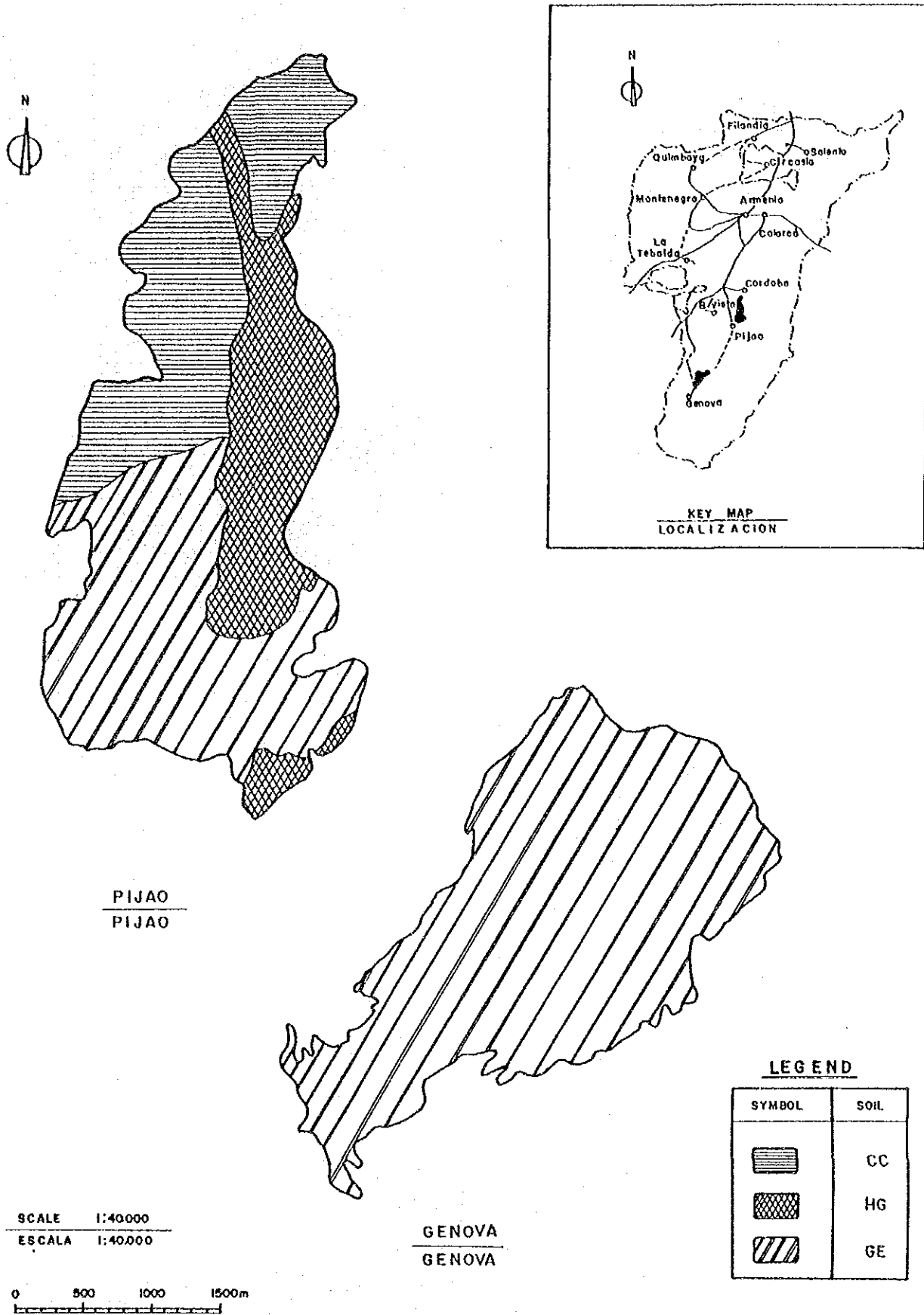
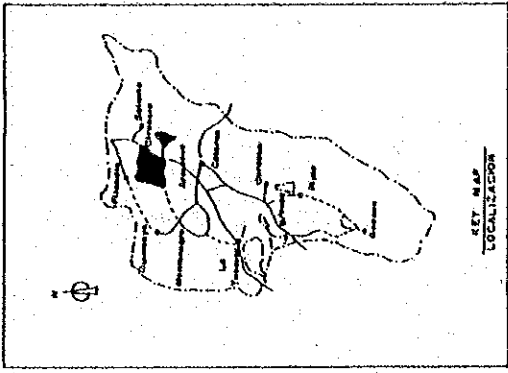


FIG 3.2.1 SOIL MAP(3)

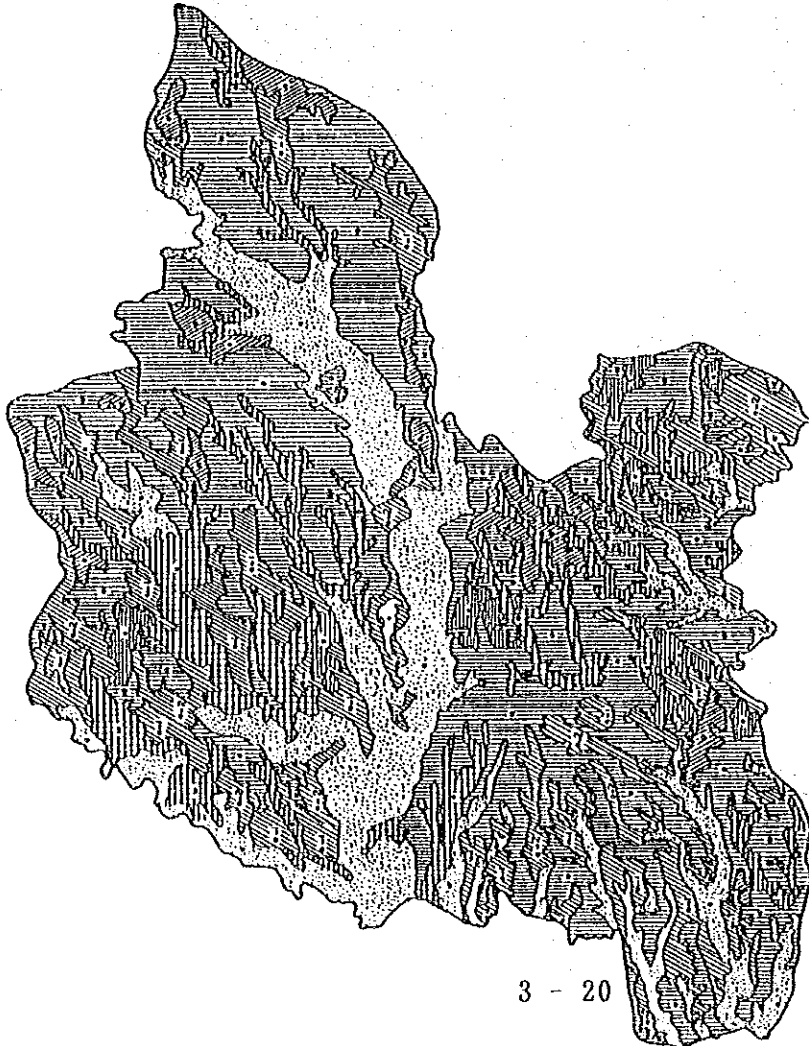


LEGEND

SYMBOL	CLASS
[Diagonal lines /]	II
[Diagonal lines \]	III
[Horizontal lines]	IV
[Vertical lines]	V
[Stippled pattern]	VI
[Cross-hatch pattern]	VII
[Dotted pattern]	VIII

SUB-CLASS

- 1 - E. Forest
- 2 - D. Forest
- 3 - Soil



SCALE 1:40000
Escala 1:40000



3 - 20

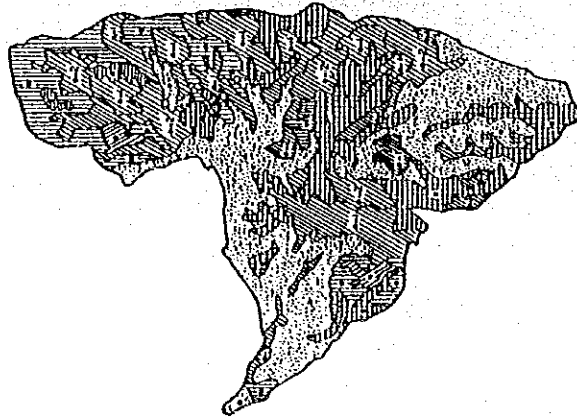
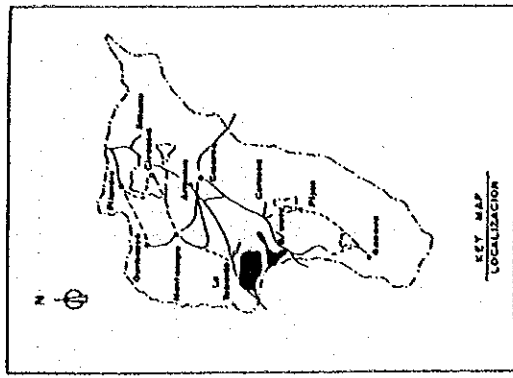


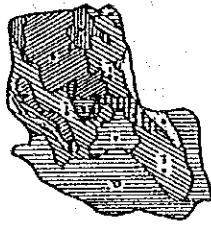
FIG 3. 2. 2 LAND CLASSIFICATION MAP(1)



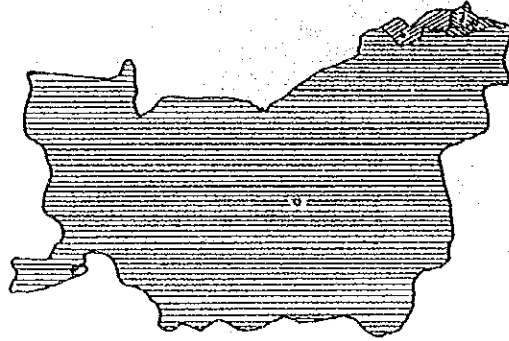
LEGEND

SYMBOL	CLASS
	I
	II
	III
	IV
	V
	VI
	VII
	VIII

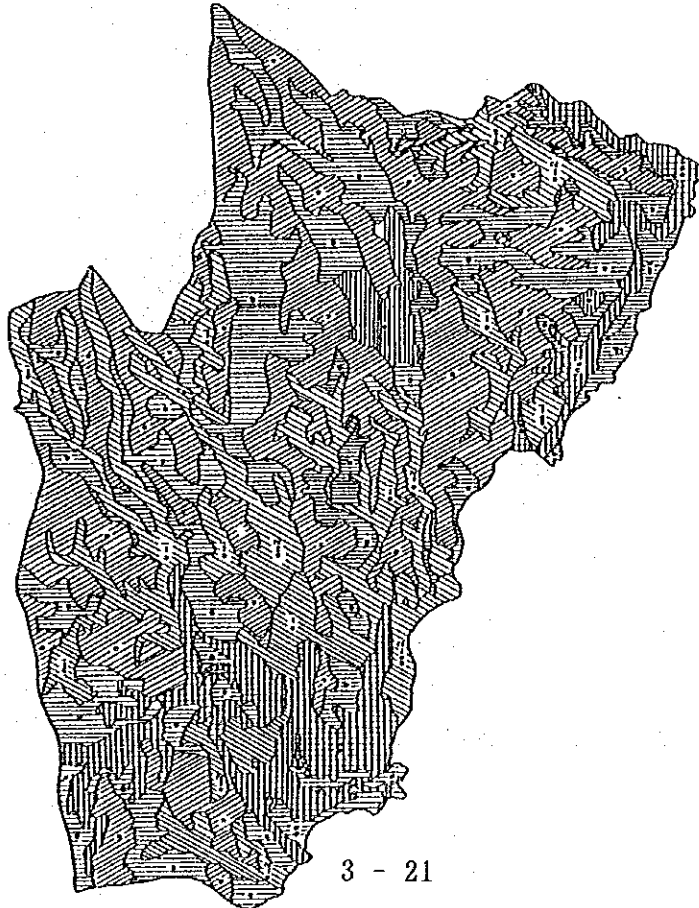
SUB CLASSES:
 1 - Forests
 2 - Shrublands
 3 - Pasture
 4 - Salt



QUINDIO RIVER LEFT MARGIN (2)
 MARGEN IZQUIERDA DEL RIO QUINDIO (2)



QUINDIO RIVER LEFT MARGIN (1)
 MARGEN IZQUIERDA DEL RIO QUINDIO (1)



QUINDIO RIVER RIGHT MARGIN
 MARGEN DERECHA DEL RIO QUINDIO

SCALE 1:40000
 ESCALA 1:40000

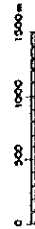


FIG 3.2.2 LAND CLASSIFICATION MAP (2)

3.3 Land Use and Land Tenure

3.3.1 Existing Land Use

Land use map, on a scale of 1 to 25,000, was prepared based on the aerophotographs (from 1983 to 1986) and the reconnaissance survey conducted by the Study Team. Existing land use map (1/40,000) and area by land use are shown in Fig. 3.3.1 and Table 3.3.1, respectively. Distribution and specific features of existing land use is summarized as follows:

(1) Upland crop area

Upland crop area is mainly distributed in Quindio River Right Margin and Left Margin(1) areas, and cassava, soybean and sorghum are cultivated on large scale. In the other areas vegetables, kidney bean and maize are cultivated as inter-crop of coffee or for self consumption on small scale.

(2) Coffee area

Coffee is widely cultivated in the Study Area except for the Quindio River Left Margin(1) Area. Especially, in Quindio River Right Margin and Left Margin(2) , Pijao and Genova areas, coffee area share 40 percent of the each area. Of these areas, the Quindio River Right Margin area is a prominent coffee production area in Quindio. Salento, Pijao and Genova areas are mainly cultivated with traditional local varieties, characterized low yield, because of low temperature due to high altitude. In Circasia area, main coffee cultivated area is concentrated in the southern and western areas. Main variety of the southern area is improved variety and in the western area traditional variety is cultivated with other inter-crops.

(3) Fruit area

Fruits such as citrus, passionfruit and pitahaya are cultivated on a large scale in the Quindio River Right Margin Area. In the other areas fruits such as lulo and tree tomato are cultivated only for self consumption or on a small scale.

(4) Grazing area

Grazing land is most predominant, sharing 44 percent of the total Study Area, and distributes in mountainous area where coffee cultivation is unsuitable. Especially, in Circasia and Salento areas, grazing area shares more than 60 percent.

(5) Forest area

Forest area shares only 13 % of the total Study Area even though more than 30 % of the area is steep sloped land (more than 50 % slope). Most forest area distribute in sloped area along the streams. It shows that almost all the easily developable forest has been utilized.

3.3.2 Land Tenure

Land tenure data for the four study areas; Circasia, Quindio River Right Margin Area and Quindio River Left Margin Area(1) and (2), are available and the other three areas are under preparation by IGAC. An average size per holding is 11.3 ha. The largest average size (61.0ha) exists in Quindio River Left Margin Area and the smallest average size (6.3 ha) in Circasia area.

Land tenure of respective study areas is summarized as follow:

(1) Circasia

The holdings of less than 0.1 ha are mostly for from laborers. Fifty four (54) percent of the holdings in the area belong to the category of small-scale farmers (from 0.1 ha to 10.0 ha) but they account for only 11 percent of the total area. The small-scale farmers mainly distribute in steep sloped area. On the other hand, 7 percent of large-scale farmers who hold the farm of more than 30 ha share 66 percent of the total area.

(2) Quindio River Right Margin Area

The small-, medium-, and large-scale holdings account for 30 percent, respectively. Most of the holdings of less than 10 ha are joint holders of farm.

(3) Quindio River Left Margin Areas (1) and (2)

Most holdings of the areas are the large-scale formers and the small-scale farmers are few.

(4) Salento, Pijao and Genova Areas

Number of farmers in these areas is estimated based on the topographic map prepared by the Study Team. Number of farmers and average farm size are shown as follows.

Area	Salento	Pijao	Genova
No. of Farmers	30	51	36
Total Area	645	800	595
Average	21.5	15.7	16.5

TABLE 3.3.1 EXISTING LAND USE

(Unit:ha)

Area	Upland Crop	Coffee (Single Cropping)	Coffee (Mixed Cropping)	Fruit	Grazing	Forest	Idle Land *	Others**	Total
Circasia	5	243	424	0	1,660	370	25	8	2,735
(%)	-	9	15	0	61	14	1	-	
Salento	2	40	85	0	425	89	4	0	645
(%)	-	6	13	0	66	14	1	0	
Right M.	213	347	487	336	330	321	6	0	2,040
(%)	10	17	24	16	16	16	-	0	
Left M. (1)	276	0	0	0	267	56	11	0	610
(%)	45	0	0	0	44	9	2	0	
Left M. (2)	0	47	17	1	82	27	1	0	175
(%)	0	27	10	-	47	15	-	0	
Pijao	3	28	270	2	361	97	20	19	800
(%)	-	4	34	-	45	12	3	2	
Genova	1	38	242	0	210	63	41	0	595
(%)	-	6	41	0	35	11	7	0	
Total	500	743	1,525	339	3,335	1,023	108	27	7,600
(%)	7	10	20	4	44	13	1	-	

*: Including secondary forest

**: Urban area and river etc.

TABLE 3.3.2 LAND TENURE

Size (ha)	Circasia			Right Margin Area			Left Margin(1)			Left Margin(2)		
	No. of Farmers	Share (%)	Area	No. of Farmers	Share (%)	Area	No. of Farmers	Share (%)	Area	No. of Farmers	Share (%)	Area
< 0.1	96	22.3	0.1	1	0.9	-	0	0	0	0	0	0
- 1	125	29.0	1.7	10	8.9	0.3	0	0	0	0	0	0
- 3	74	17.2	4.4	16	14.3	1.5	0	0	0	0	0	0
- 5	33	7.6	4.4	8	7.1	1.6	0	0	0	0	0	0
- 10	44	10.2	10.4	14	12.5	5.1	0	0	0	1	25.0	4.4
- 15	16	3.7	5.7	14	12.5	8.0	0	0	0	0	0	0
- 20	11	2.6	6.5	12	10.7	9.8	0	0	0	1	25.0	10.2
- 30	11	2.6	8.8	11	9.8	14.0	1	10.0	3.3	0	0	0
- 50	8	1.8	10.8	20	17.9	34.6	3	30.0	15.2	0	0	0
- 100	7	1.6	16.6	3	2.7	9.0	5	50.1	52.0	2	50.0	85.4
100 <	6	1.4	29.6	3	2.7	15.1	1	10.0	29.5	0	0	0
Total	431	100.0	100.0	112	100.0	100.0	10	100.0	100.0	4	100.0	100.0
Average	5.3			18.2			61.0			43.8		

Reference: ICAC

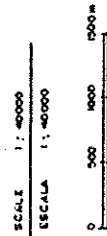
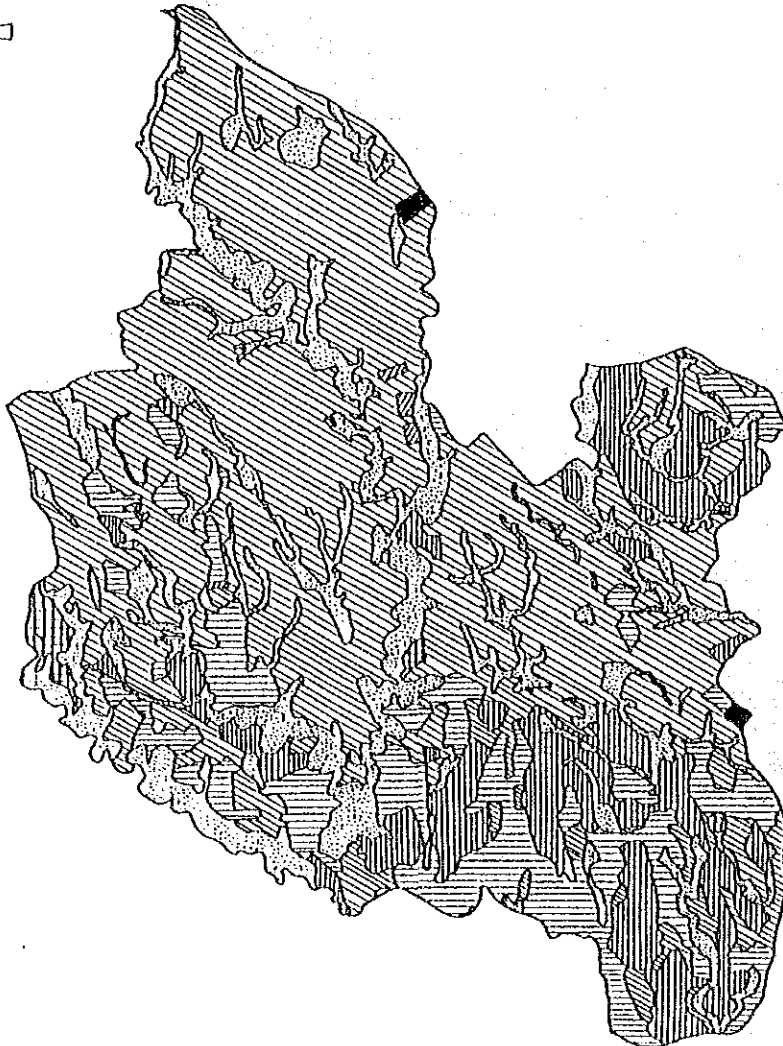
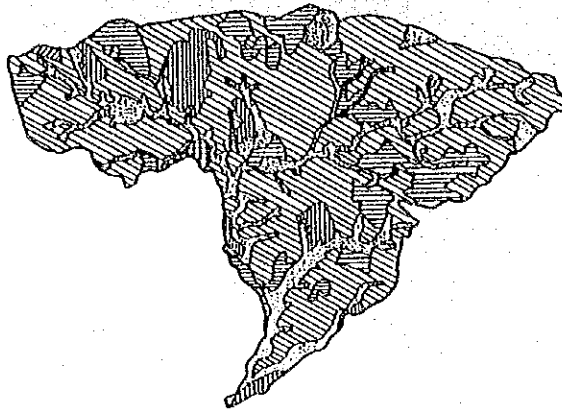
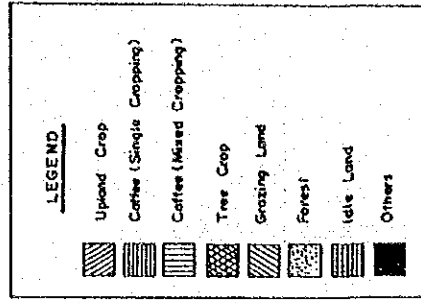
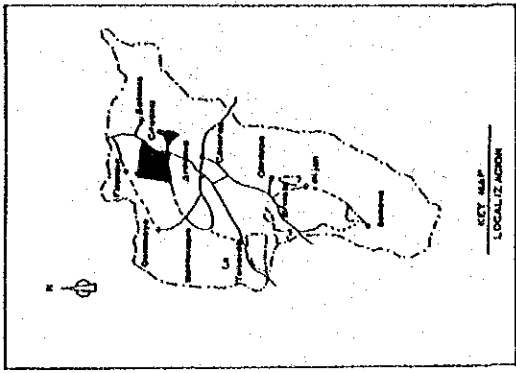
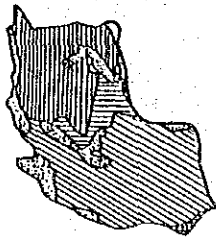
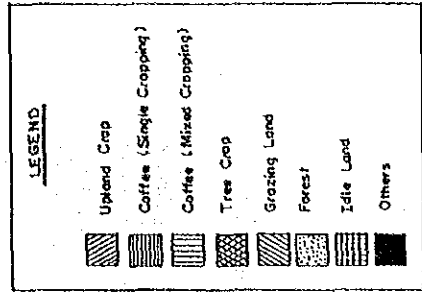
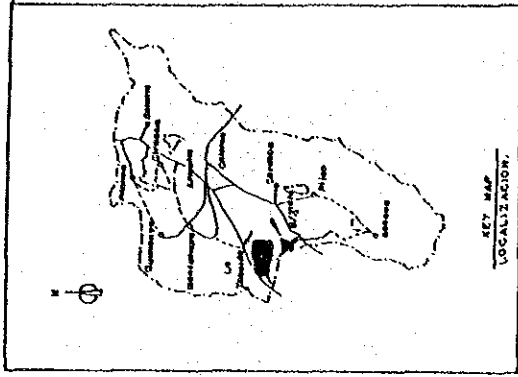
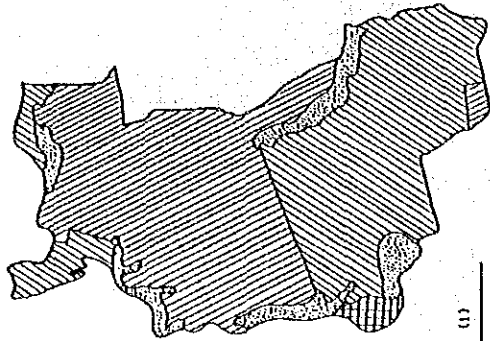


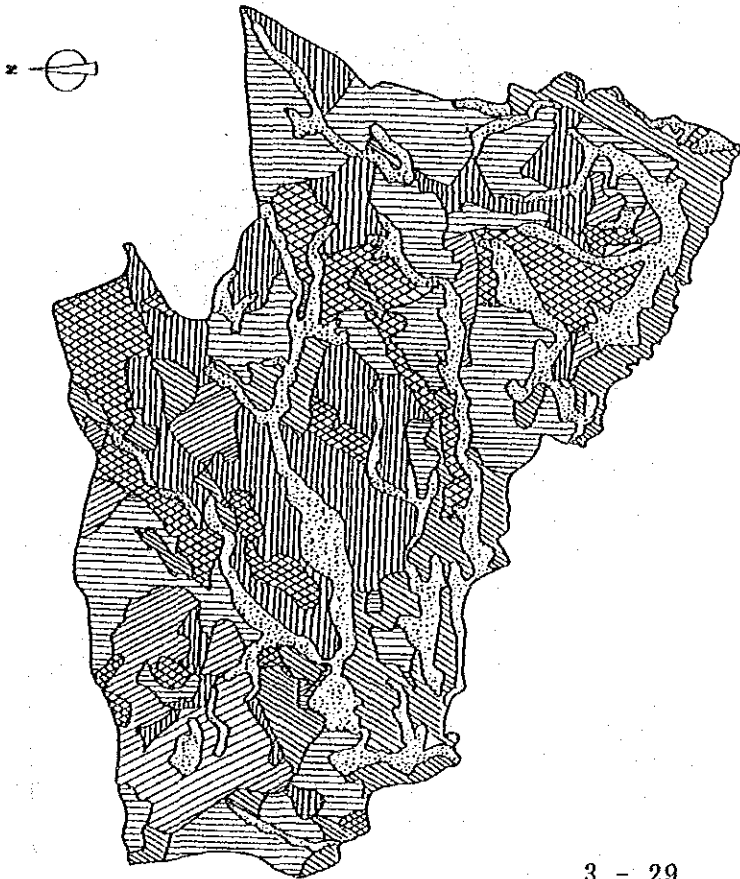
FIG 3.3.1 EXISTING LAND USE MAP (1)



QUINDIO RIVER LEFT MARGIN (2)
MARGEN IZQUIERDA DEL RIO QUINDIO (2)



QUINDIO RIVER LEFT MARGIN (1)
MARGEN IZQUIERDA DEL RIO QUINDIO



QUINDIO RIVER RIGHT MARGIN
MARGEN DERECHA DEL RIO QUINDIO

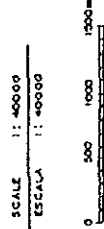
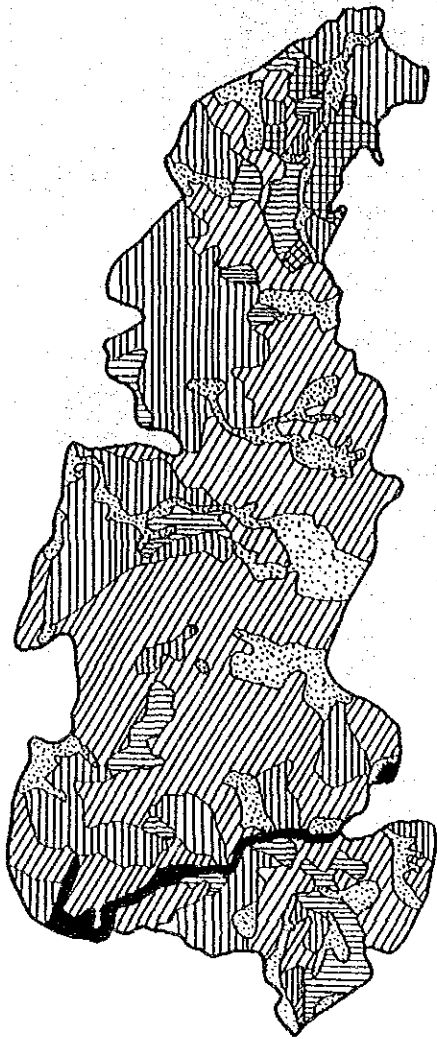
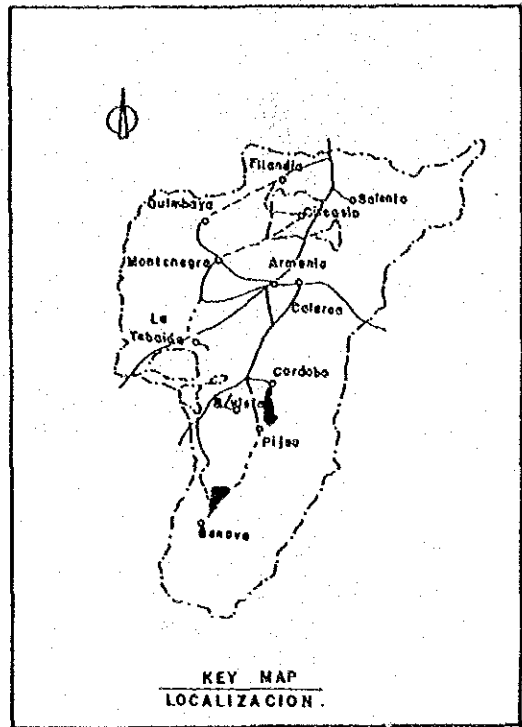


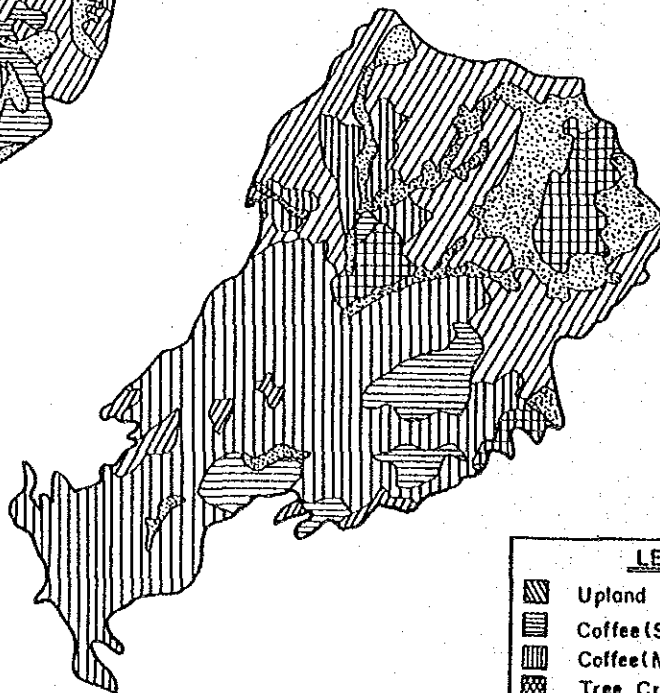
FIG 3. 3. 1 EXISTING LAND USE MAP (2)



PIJAO
PIJAO



KEY MAP
LOCALIZACION



GENOVA
GENOVA

SCALE 1:40000
ESCALA 1:40000

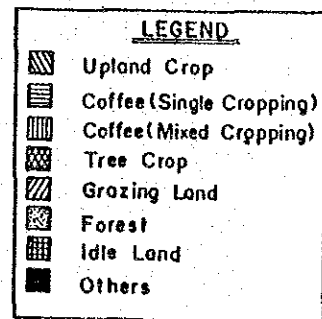
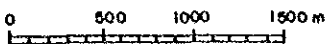


FIG 3.3.1 EXISTING LAND USE MAP(3)

3.4 Agriculture

3.4.1 Farming Practices

(1) Farming practices by Area

The outline of farming practices by area is shown in Table 3.4.1. The specific features of farming practices are as follows:

1) Circasia Area

Approximately 60 percent of this area is covered by pasture, and unused grassland is also located at many places. Ninety(90) percent of all the bred cattle are of milk and meat combined type. The coffee cultivation area occupies approximately one quarter of the area and 60 percent of which are used for cultivating improved varieties. The southern part of the area is located in a place suitable for coffee cultivation, where improved varieties are cultivated and a lot of immature nursery plants are also observed. There is such a trend that production of improved varieties is increasing. The areas of cultivation of traditional varieties with low productivity almost coincide with the areas of small-scale farmers. As the upland crop, tomato is cultivated as an inter-crop of coffee during coffee pruning period because its profitability is high. Besides, kidney bean, plantain, maize and vegetables are cultivated. But they are cultivated for own consumption with minor exceptions. Fruit trees such as tree tomato, lulo and fig trees are cultivated, mainly for own consumption.

2) Salento Area

Grassland occupies approximately 65 percent of this area, and 93 percent of the grassland is natural pasture. As for

bred cattle, 60 percent are milk cows and 40 percent are of milk and meat combined type. Because unused grassland such as steep sloped land exists at many places, productivity is low for both meat and milk cows. The coffee cultivation area occupies 20 percent, 60 percent of which are occupied by traditional varieties. Mixed cultivation of coffee and plantain is also observed. Other crops are cultivated for own consumption only.

3) Quindio River Right Margin Area

This area is one of the prominent coffee cultivation areas in Quindio, and productivity of coffee is high. However, fruit trees of high profitability such as pitahaya and passion fruit, which are suitable to the weather conditions of this area, have been recently introduced and thus diversification of crops is in progress. The coffee cultivation area occupies approximately 40 percent, more than 90 percent of which is of improved varieties. The coffee cultivation in this area characterized by mixed cultivation together with plantain. Inter-cropping with cassava is also made at the time of transplanting coffee trees by many farmers. The fruit tree cultivation area occupies 16 percent, one half of which are occupied by citrus fruits.

This area is located in the "fruit juice raw materials production expansion project area" planned by the Coffee Federation, and there is such a trend that production of fruit juice raw materials increase. The immature plants of citrus trees are currently mixed with passion fruits. Pitahaya and plantain are cultivated as single crops. The grassland area occupies 16 percent, where both meat cattle and cattle of milk and meat combined type are bred. The productivity of livestock in this area is high compared with that of other areas, as the carrying capacity is high

because some of the farmers are irrigating the grassland. The upland crop cultivation area occupies 10 percent, and soybeans, sorghum and corn are cultivated in large scale with mechanized manner.

4) Quindio River Left Margin Area(1)

This area is composed of the lands of large-scale farmers possessing land of 50 ha or more per household. The upland crop area occupies 45 percent, and sorghum and soybeans are cultivated in large scale as mechanized. The upland crops are cultivated with continuous cropping manner. The grassland occupies 44 percent and its majority is natural grassland. Sixty (60) percent of the bred cattle are of milk and meat combined type.

5) Quindio River Left Margin Area(2)

Only four (4) farmers exist in the area, two of which are of medium-scale and two are of large-scale. The grassland occupies 47 percent, and cattle of milk and meat combined type is mainly bred. The coffee cultivation area occupies 37 percent, one quarter of which are of mixed cultivation with plantain. Ninety (90) percent of coffee are of improved varieties.

6) Pijao Area

The grassland occupies 45 percent, 60 percent of which are natural pasture. Cattle of milk and meat combined type are mainly bred. However, productivity of the land is extremely low, and since steep slopes are observed at many places, it is estimated that unused grassland occupies a considerable area.

The coffee cultivation area covers 38 percent, 90 percent of which are as mixed with plantain. Ninety (90) percent of cultivated varieties are traditional varieties which low productivity plantain, which is cultivated as mixed with coffee, is also of conventional varieties by 70 percent. Besides, vegetables, beans and fruit trees such as tree tomato and lulo are cultivated in small scales. However, some farmers are earning high profits these days by cultivating tree tomato with technical guidance and free distribution of nursery plants in compliance with the diversification project in areas not suitable for coffee cultivation promoted by the Departmental Bureau of Agriculture.

7) Genova Area

The coffee cultivation area occupies about one half of this area, 90 percent of which is occupied by mixed cultivation with plantain. Eighty-five (85) percent of cultivated varieties are traditional varieties and their productivity is extremely low. Forty-five (45) percent of plantain cultivated as mixed plant with coffee are of traditional varieties. The grassland area occupies 35 percent, 70 percent of which are natural pasture. Many of bred cattle are milk cows occupying approximately 40 percent. And cattle of milk and meat combined type occupy 30 percent and meat cattle occupy another 30 percent. However, productivity of the land is extremely low. Since steep slopes are observed at many places, it is estimated that unused grassland occupies a considerable area like in Pijao Area. Cultivation of other crops is of the trend identical to that of the Pijao Area.

(2) Farming practices by crop

1) Coffee

Main varieties cultivated in the Study Area are the traditional varieties (Tipica and Borbon) and the improved varieties (Caturra and Colombia). Characteristics of improved varieties are summarized as follow:

Variety	Character
Colombia	High resistance to leaf rust
Caturra	High tolerance to high temperature

Generally, yield of these improved varieties is about double of the traditional varieties.

The area suitable for coffee cultivation is mainly in the areas from 1,100 to 1,600 m a.s.l. in Quindio. However, coffee cultivation is encroached into the areas higher than 1,600 m a.s.l. in the Study Area. Coffee is cultivated both with and without shade trees. In the case of shading cultivation, plantain is mainly used as a shade tree. Guamo is also cultivated with coffee in comparatively high altitude area.

Average vegetative period of the improve varieties, which differs by variety, is from 17 to 20 months. It is recommended to make collar cutting of coffee tree in 8th year from the transplanting because the yield decreases. However, the actual collar cutting is made in 11th year by the farmers in Quindio.

There are two harvesting times and it is different by altitude as follows:

Altitude(m) Primary harvesting Secondary harvesting

1,600-more	April-May	October-November
1,000-1,500	October-November	April-May

The compound fertilizer (15-15-15) is mainly applied for coffee after harvestings. In the case of shading cultivation with plantain, the leaves and stems of plantain are used as organic fertilizer and mulching materials of the farm. Weeding is made by using herbicide or man power. Leaf rust is most popular and serious disease of coffee in the area. To the control this disease, it is recommended to plant resistant varieties and to constantly apply fungicide (MANEB etc.). The recommended application method of the fungicide is as follows:

Young tree : Every 15 days
Adult tree : 4 or 5 times per year

In the case of the traditional variety, collar cutting, transplanting, application of fertilizer and fungicide are not common. Therefore, the trees are old and the yield is less than one half compared with the improved variety. Usually the traditional variety is planted in the areas not suitable for coffee cultivation and managed by small-scale farmers.

2) Plantain

Plantain is a special product of Quindio because of its high quality. The main variety cultivated in Quindio is Dominico Harton; sharing 90 % of total plantain planted in the area, and the remaining is Dominico Emano. The suitable area, for plantain cultivation is the region up to 2,000 m a.s.l. (Optimum altitude for Dominico Harton). In the case of the cultivation outside of the suitable area, the yield is

decreased. The vegetation period; from the transplanting of young tree to the first harvesting time, is 15-18 months, and the economic life is 5-10 years. As the transplanting materials sucker or old stump is used.

The cultivation method and the share of planted area in Quindio surveyed by URPA as follows:

Method	Share(%)
Mixed cultivation with coffee	30
Single cultivation	41
Extensive cultivation	29

The roles of plantain in mixed cultivation with coffee are shading, windbreaker, supplying of organic manure for coffee and additional income to the frames. The average cropping density of single cultivation is 3.5 m X 3.5 m. Yield is much different by cultivation method and variety; single cultivation: 5.9 ton/ha/year and mixed cultivation : 2.6 ton/ha/year. Serious disease of plantain is Sigatoca Amarilla, which affects its yield severely. To control the disease, application of fungicide is uncommon in the area, even though its application is recommended, because the chemicals are expensive.

3) Cassava

Cassava is popular agricultural products in Quindio and its quality is high as same as plantain. The main variety is Chirosa Armenia, and the others are Llanera and Guajira. Generally, the marginal altitude for cassava cultivation is 1,500 m a.s.l. In general stem cutting of Cassava is transplanted on March and April, beginning of rainy season. The recommended planting density is 1.2 m X 0.8 m-1.0 m. The

cultivation period is 10 - 14 months. Continuous cropping of cassava decreases the yields severely because of serious fertility loss of soil. Therefore, CRQ prohibits the cultivation of cassava for 5 years after its continuous cropping of 2 years.

Application of agricultural chemicals for disease and insect control is uncommon, because cassava has comparatively strong resistance against them. Fertilizer application to cassava is also uncommon and weeding is done 2 to 3 months after its transplanting. In the light of conservation of agricultural land, CRQ is extending technology of soil management on cassava farming to the farmers.

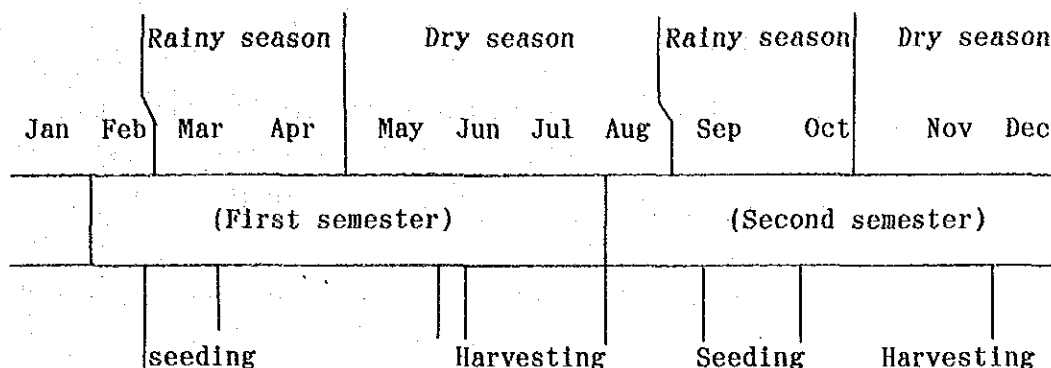
4) Other crops

The other main crops than three main crops mentioned above which are cultivated in the Study Area are kidney bean and tomato. However, their share of planted area is not large. Extension services of fertilizer application, disease and insect control and weeding of these crops are insufficient. Fruits, mainly citrus, are also cultivated in small-scale for supplying raw materials supply to agro-industry. However, demand of these fruit product is expected to increase because the agro-processing program is progressing in Quindio. Only in the flat land, upland crops such as sorghum and soybean are cultivated in large-scale by using machines.

(3) Cropping pattern

The irrigation is not applied in the Study Area except for irrigation systems being found in some pasture cultivation fields. Therefore, cultivation is made based on the natural weather conditions.

General farming practice in the area is as follows:



The typical cropping patterns for the existing upland cultivation are show in Fig 3.4.1. The following are the general features of farming:

- a) Continuous cultivation is common in the case of mechanized a upland field (damages due to continuous cultivation, disease and insect are severe)
- b) In Circasia area, tomato and vegetables are cultivated during caller cutting period of coffee. However, the cultivation is not systematic because it is performed depend on the natural rainfall.
- c) In the mountainous area, the vegetable cultivation for self consumption is made using the drained water from the cattle house.

3.4.2 Agricultural Production

(1) Agricultural production

The crop cultivation area, yield and production by area are as shown in Tables 3.4.2, 3.4.3 and 3.4.4, respectively. The figures in the tables are estimated based on the following:

- a) Crop cultivation area: Based on the land use area and results of field survey
- b) Yield : Based on the yield by city provided by URPA, and partial correction was made in consideration of natural conditions (mainly altitude) of each area.
- c) Crop production : Based on the crop cultivation area and yield estimated above.

The following conclusions are obtained from the tables:

- A. The principal crop cultivated in the Study Area is coffee, and its production volume is equivalent to three (3) percent (improved varieties : 2.3%, traditional varieties : 0.7%) of all the production in Quindio.
- B. As for the varieties of coffee and plantain, improved varieties are mainly cultivated in Quindio River Right and Left Margin (2) Areas, and traditional varieties are in other areas.
- C. The yields of almost all the crops in Quindio River Right and Left Margin Areas are higher than that of other areas.

(2) Problems on farm management and cultivation and feasibility of development

The productivity of coffee in Quindio is high because the coffee cultivation technology has been extended at places which are suitable for cultivation of coffee. In areas other than those suitable for cultivation of coffee, however, the present productivity of land is low as the majority of the land is used as natural grassland, even though there is a feasibility of cultivation of other crops of high profitability. Therefore, how to introduce crops which are suitable for the individual natural conditions to the areas other than those suitable for cultivation of coffee and how to increase the productivity of respective lands are important subjects.

The problems in the farm management and cultivation in Study Area can be summarized as follows:

A. Unimproved agriculture support organizations for crops other than coffee

Almost no studies for cultivation of crops other than coffee and no activities for extension of cultivation technology are made in Quindio.

B. Non effective use of land.

Because of the fact that agriculture support organizations have not been improved, crops which are suitable for the natural conditions of the respective areas have not been introduced, and the majority of the land other than the land that is suitable for cultivation of coffee is mostly used as natural grassland.

C. Worsening of land resources

Because no land use or cultivation technology suitable for natural conditions of the areas has been extended, erosion occurs in many places frequently.

D. Low profitability of land which is unsuitable for cultivation of coffee

The productivity of coffee at land which is unsuitable for cultivation of coffee is extremely low as traditional varieties are mostly used. Therefore, the income of farmhouses cultivating coffee of traditional varieties is extremely low compared with others.

Valuable attempts stated below have been recently made in many areas under such situations, and these attempts have greatly increased profitability of farmhouses.

- a) Introduction of highly profitable fruit trees such as pitahaya and passion fruit into Quindio River Right Margin Area
- b) Cultivation of tree tomato in Pijao Area under the guidance provided by the Bureau of Agriculture, Quindio
- c) Inter-cropping of tomato during coffee collar pruning period in Circasia Area

The matters stated above suggest that high profitability can be obtained by introduction of crops other than coffee. Furthermore, it can be said that the fact that vegetables, beans, corn, etc. are cultivated for own consumption by farmhouses in each area suggests feasibility of diversification of crops and increase of income of farmhouses by the production of these crops.

3.4.3 Livestock and Pisciculture

(1) Livestock

1) Cattle

Cattle is widely raised in pastures in the Study Area. They are mainly fed on the natural grass and concentrated feed is not usually made. HOLSTEIN is kept as a milk cow. BROWN SWISS and NORMANDY are for double purposes, and ZEBU is for meat. The meat oxen are raised mainly along the Vieja river, and milk cows are kept more on mountainous areas. The cows for double purposes are mainly in Circasia area. Farm sizes are middle to large scale. As the cattle is grazed on the natural pastures which are not maintained well, feeding capacity of pasture is low; i.e. about one cattle per hectare of pasture. Therefore, the profitability is not high.

Most of grazing land lie on the slope land, and cattle paths and footprints induce gully erosion in some places. It may be caused from continuous grazing. As there is no data of cattle heads in each study area, the heads in Table 3.4.3 were estimated based on the available data concerned and site survey.

2) Others

Pigs and chicken (meat, egg) are raised in the Study Area other than cattle. Pigs are not raised much in the Study Area though the demand is high, because the production cost is too high. The demand of egg and chicken meat is filled by a few large-scale chicken farmers in other areas in Quindio. Therefore, their production is large enough for the farmers in the Study Area to raise chicken for own consumption or for selling chicken meat and egg in a small quantity to the

towns nearby. Other animals as horse, goat and rabbit are fed just for home use.

3) Pasture

The pastures in the Study Area are natural, and there are only a few farms where nutritive grass is grown. KING GRASS and IMPERIAL 60 are grown mainly as grass for cattle. The natural pasture is mostly of rich reaping and low-nutritive, and its feeding capacity is therefore low.

At present, one hectare of pasture feeds about one cattle. Although the pastures are not managed and given free-growing, grass grows generally well because of enough rainfall. Cattle is grazed by rotating it from a portion to another in a pasture land.

(2) Pisciculture

There are few farmers raising fish in the Study Area. A few farms with a very small pond keep carp or cachama in extremely small scale. Farmers are interested in pisciculture, but financial constraints discourage farmers to construct the facilities like pond. In Quindio, Fond-DRI has been promoting pisciculture for small-scale farmers with less than 20 ha and C.R.Q. also carries out research on pisciculture by itself in its own facilities. Moreover, a private firm raises trout in a big scale at the upstream section of the Quindio river. As mentioned above, pisciculture may be promoted more in the future, but it requires financial assistance to farmers, particularly the assistance to their initial investment.

TABLE 3.4.1 SUMMARY OF FARMING PRACTICES BY AREA

Item Area	Area (ha)	Coffee * Suitable Area(%)	Coffee Planted Area(%)		Grazing Land (%)	Livestock**	Other Farming Practices	Others
			Imp. V	Tra. V Mixed** Cropping				
Circasia	2.735	7	11	14 15	61	Double purpose (meat & milk)(90%), Improved pasture(76%).	Tomato(mixed cropping with coffee), Small scale upland farming, Vegetable for self-consumption. Fruit(tree tomato)	Small scale farmer (86%), Damage of high humidity and hailstorm. Considerable unused grazing land.
Salento	645	0	7	12 13	66	Dairy cattle(60%), Double purpose(40%), Natural pasture(93%).	Fruits and vegetables for self-consumption.	Considerable unused grazing land
Quindio River Right Margin	2.040	92	37	3 24	16	Beef cattle(57%), Double purpose(43%), Improved pasture (100%).	Cassava(mixed cropping with coffee), Large scale upland farming with mechanization. Citrus, Fruits(Pitahaya etc.)	Juice material expansion area. Expanding fruits. Thin soil layer(7%).
Quindio River Left Margin(1)	510	-	0	0 0	44	Double purpose(58%), Beef cattle(22%), Dairy cattle(20%), Natural pasture(89%).	Large scale upland farming with mechanization(Soybean and sorghum)	Poor drainage land(100%)
Quindio River Left Margin(2)	175	57	33	3 10	47	Double purpose(58%), Beef cattle(22%), Dairy cattle(20%), Natural pasture(89%).	Citrus.	Poor drainage land(31%)
Pijao	800	-	4	34 34	45	Double purpose(97%), Natural pasture(59%).	Small scale upland and fruits, Vegetable for self-consumption.	Considerable unused grazing land
Genova	595	20	7	40 41	35	Beef cattle(41%), Double purpose(31%), Natural pasture(69%).	Small scale upland and fruits, Vegetable for self-consumption.	Considerable unused grazing land

*:1.1, 100-1.600m A.S.L. **:Mainly plantain *** :Source: Caja Agraria(1989)

TABLE 3.4.2 PLANTED AREA BY CROP

(Unit:ha)

Crop Area	Coffee		Plantain*		Cassava	Soybean	Sorghum	Maize	Kidney Bean	Tomato	Citrus	Other Veg.**	Fruits Land ***	Other Grazing
	Improved Variety	Local Variety	Mixed Imp.V.	Local V.										
Circasia	197	337	14	179	-	0	0	2	6	16	-	10	-	761
Salento	37	63	17	2	-	0	0	-	-	-	-	1	2	122
Quindio River	610	57	325	65	184	54	104	28	10	5	85	3	75	1,673
Right Margin	0	0	0	0	0	142	4	-	-	-	-	-	***	351
Quindio River	46	5	9	2	1	0	0	-	-	-	1	-	-	64
Left Margin(1)	29	210	23	51	0	0	0	2	2	2	-	2	3	324
Quindio River	34	190	18	43	0	0	0	-	2	-	-	1	-	288
Left Margin(2)														
Pijao														
Genova														
Total	953	862	406	342	185	196	309	36	20	23	86	17	80	3,583

*: The ratio of improved variety to traditional variety is quoted the statistic of agricultural production by Agropecuaria

** : Cabage, onion, welish onion and carrot etc. *** :Guamo, lulo, Gallaba and tree tomato etc.

*** : Passion fruit and pitahaya **,**: Production mainly for self-consumption

- : Negrigible but not zero

TABLE 3.4.3 UNIT YIELD BY CROP

(Unit: ton/ha)

Area	Crop	Coffee		Plantain		Cassava	Soybean	Sorghum	Maize	Kidney Bean	Tomato	Citrus
		Impruved Variety	Local Variety	Mixed Imp.V.	Single Local V.							
Circasia		2.00	1.00	4.5	1.8	-	-	-	1.05	0.70	30.0	-
Salento		1.87	0.75	4.0	0.8	-	-	-	-	-	-	-
Quindio River Right Margin		2.16	1.13	7.0	2.5	15.0	18.0	4.2	1.90	0.80	28.5	19
Quindio River Left Margin(1)		-	-	-	-	-	2.25	4.1	2.00	-	-	-
Quindio River Left Margin(2)		2.10	1.10	7.0	2.6	-	-	-	-	-	-	19
Pijao		1.60	0.88	4.0	1.8	-	-	-	1.40	0.60	20.0	-
Genova		1.44	0.64	4.0	1.4	-	-	-	-	0.60	-	-

Source: URPA(1989)

TABLE 3.4.4 ESTIMATED MAIN CROP PRODUCTION

(Unit: ton)

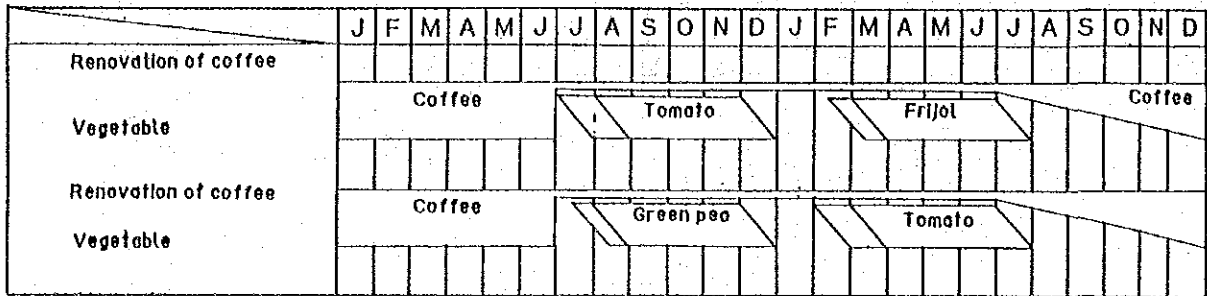
Crop Area	Coffee		Plantain		Cassava	Soybean	Sorghum	Maize	Kidney Bean	Tomato	Citrus	
	Improved Variety	Local Variety	Mixed Imp. V. Local V.	Single								
Circasia	394.0	337.0	63.0	322.2	-	0	0	2.1	4.2	480.0	-	
Salento	69.2	47.3	68.0	1.5	-	0	0	-	-	-	-	
Quindio River Right Margin	1,317.6	64.4	2,275.0	169.0	2,760.0	1,224.0	239.2	226.8	53.2	8.0	142.5	1,615.0
Quindio River Left Margin(1)	0	0	0	0	0	0	461.3	582.2	8.0	-	-	-
Quindio River Left Margin(2)	96.6	5.5	63.0	5.2	-	-	-	-	-	-	-	19.0
Pijao	46.4	184.8	92.0	91.8	-	-	-	2.8	1.2	40.0	-	-
Genova	49.0	121.6	72.0	60.2	-	-	-	-	1.2	-	-	-
Total	1,972.8	760.6	2,633.0	650.0	2,760.0	1,224.0	700.5	809.0	66.1	14.6	662.5	1,634.0

TABLE 3.4.5 NUMBER OF CATTLE AND LIVESTOCK PRODUCTION*

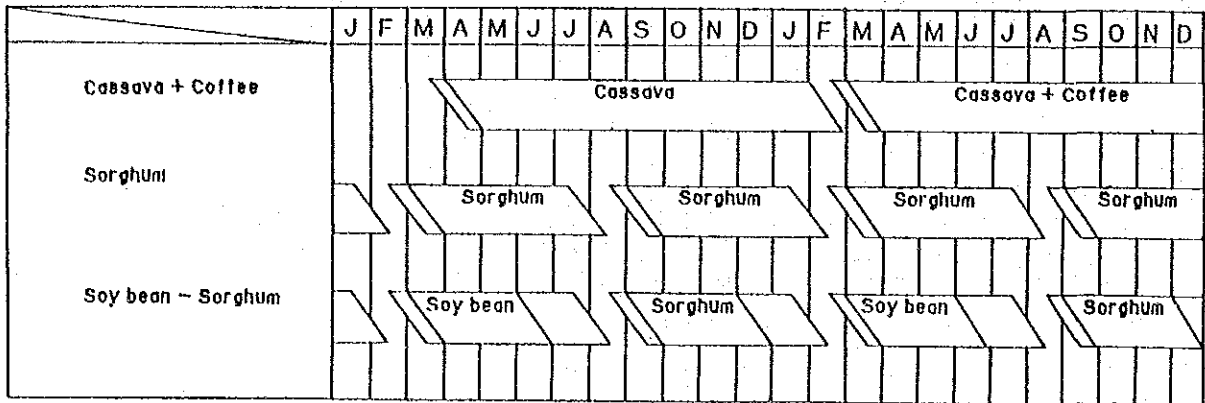
Item	Area	Circasia	Salento	Right M.	Left M.(1)	Left M.(2)	Pijao	Genova
Pasture Area(ha)**	1,494	383	297	240	74	325	189	
Number of Cattle(Head)	1,289	255	580	438	152	162	113	
Meat Production(ton)***	147.9	7.8	47.6	7.1	2.2	9.5	6.9	
Milk Production(Kl)	1,787	98	238	119	36	10	11	
<hr/>								
Carrying Capacity (Head/ha)	0.86	0.67	2.00	1.83	2.05	0.50	0.60	
<hr/>								
Ratio of Natural Pasture(%)	24	93	0	89	89	59	69	

*: Source: Estimated based on the Statistics of Caja Agraria(1989) **: 90% of existing land use

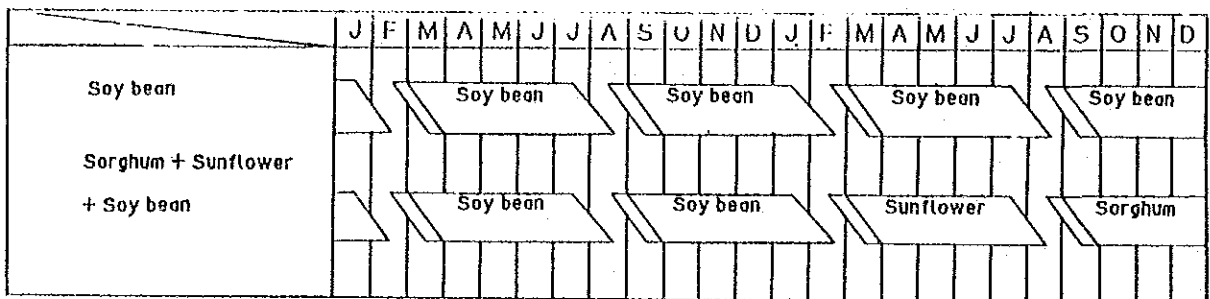
***: live weight X 0.6



Circasia Area



Quindio Right Margine Area



Quindio Left Margine(i) Area

FIG 3.4.1 EXISTING CROPPING PATTERN

3.4.4 Socio-economic Conditions of Farmers

(1) Socio-economic Survey

With an eye to disclosing social and economic situations of the farmers in the Study Area, a field survey was conducted by means of direct interview to the farmers. The number of farmers who were interviewed accounted for 74 which are divided into 43 for Circasia, 13 for Salento to, 14 for both margins of the Quindio river and 4 for Pijao and Genova. The questionnaire for the survey included the following major items:

- Composition of family members and living conditions
- Land tenure and land use
- Cultivated crops and their marketing
- Technical assistance, credit and other services rendered
- Problems relevant to farming and future intention on farm management

According to what the survey revealed, the number of family members among interviewed farmers is 5.4 in average; superior to the Departmental average of 4.6. One of the common phenomena taken place among farmers in Quindio is that there are not a few "absent" farmers who live in urban areas entrusting farming activities in their farms to farm administrators; the survey disclosed that 66% of interviewers correspond to "absent" farmers. The Department of Quindio is one of those Departments which have attained the highest level of socio-economic development in Colombia, and this is especially true area, in the rural area, in which, owing to the attention of the Coffee Committee, more adequate social infrastructures are provided than other parts of the country. Of farmers interviewed, all but two (2.7%) are provided with electric service, close to 80% have access to water supply system (the remainder takes water from wells or small streams) and one for every ten farmers has sewage treatment system constructed by himself.

Every interviewee owns his farm (in the Study Area, there are some tenant farmers who cultivate soybean, sorghum, cassava and other crops mainly on the right margin of the Quindio River). The farm size among interviewed farmers averages at 27 ha (Circasia: 22.1 ha, both margins of the Quindio River: 38.2 ha and Salento Pijao, Genova: 28.0 ha), which surpasses an average size of the Department as a whole (8.1 ha). Nevertheless, this fact can not lead to the conclusion that the farmers in the Study Area are regarded to be wealthy judging from their size of holding. This is to say that with an exception of both sides of the Quindio river, farm lands in the Study Area are generally under-developed or used in extensive manner as grazing land because of their being located in mountainous zone with steep slope. Consequently, productivity in these farm lands is low and farmers income is accordingly inferior despite of their larger land.

The small-scale farmers are concentrated in the Circasia area and one-third of the farmers hold the farm land of less than 5 ha. On the other hand in the mountainous areas and the marginal areas in both sides of the Quindio River, almost all the farms are of medium- or large- scale (only one out of 31 interviewed farmers was of small scale). Especially, in the marginal areas in both sides of The Quindio River, most of the farmers are of large-scale and 64% of farmers hold the farm land of more than 30 ha.

(2) Intention of farmers surveyed by SENA

The intention of the farmers in the Study Area were surveyed by SENA in order to grasp their intentions and/or desire for the future agricultural development and to reflect them in the formulation of the Project. The survey was conducted with the following manner:

- To invite the farmers to the meeting;
- To explain about the Project and objectives of the survey;
and
- To collect the data by means of questionnaires.

Through the survey, the following points have been clarified:

- a) The farmers understand that their land resources are not utilized enough and they have strong intention to change or improve their present farming practice.
- b) However, they feel anxiety about the marketing and transportation systems for the new crops to be introduced, and they are thinking that the feasibility study about the new crops is indispensable for the crop diversification.
- c) Further more, they are requesting the strong supporting services for their improvement activities, especially they think that the following two services are indispensable:
 - financial assistance that is available when-ever they need
 - : and
 - field test of new crops at the actual farm level.
- d) Many farmers have interest about cooperative activities. However, they will not be positive about the participation in a cooperative if the following be cleared:
 - what crops to be introduced by the cooperative
 - how to organize the marketing system for those crops

In order to reflect the farmers intentions about to the Project, the following points should be considered:

- A. The improvement of basic requirements is very important in orders to promote the organization of the farmers. That is, the strengthening and improvement of supporting services such as marketing, finance and technical assistance, especially an organization that can provide more effective supporting services by combining the activities presently conducted by respective organizations independently, is essential.
- B. For the success of the Project, it is very important to collect the confidence of the farmers to the Project by executing the following:
- To make the organization of agricultural supporting services participate directly in the Project;
 - To make clear the functions and roles of respective organizations to be performed in the Project; and
 - To show the positive attitude to realize the Project plan through these organizations.

One-third of interviewed farmers had income from activities other than crops and animal husbandries, and an average size of holding of these farmers are 18.9 ha. It is supposed that these farmers engage in non-agricultural activities not because they seek for other source of income due to low income, but because they have disposal time by employing administrators who take charge of routine farming. These farmers get income from such activities as commerce, employees of bank or public enterprise, agricultural extensionist, lawyer and driver .

Fifty five (55%) of interviewee answered that they are rendered with technical assistance services, but that the great majority of these services are provided by the Coffee Committee. Therefore, technical services for farming other than coffee cultivation are scarcely rendered, which constitutes one of the factors that prevent farmers from diversifying their crops. One for every ten farmers receive technical assistance of private

sector.

Approximately 20% of farmers who were interviewed expressed that they have no objection to sell their lands (the highest proportion was in the Salento area with 38%). Actual value of lands assessed by farmers in the Study Area is around Col\$ 2,500,000/ha for both margins of the Quindio River and Col\$ 1,000,000/ha for Circasia-Pijao-Genova.

Major problems associated with farming are climatic factors and disease and pest control, which together represented about 70% of the total. Other problems, inadequate technical assistance, inferior quality of seed and low productivity. On the other hand, constraints relevant to transportation of products are significant fluctuation of prices and lack of appropriate distribution system and infrastructure. Coffee growers, in their greater portion, replied that no constraint is identified in term of marketing of coffee.

3.4.5 Marketing and Transportation of Agro-products

(1) General

The agricultural products in Quindio are represented by such traditional areas coffee, plantain, cassava and citrous fruits. These products are also the main ones in the Study Area and occupy 80 percent of the total cultivated area. Soybeans and sorghum are a little remarkable other than those products in the area. Therefore, a lot of agricultural products consumed in Quindio are imported from other Departments. For instance, only potato, tomato and banana, out of top ten vegetables and fruits that are consumed most in Quindio, are produced in Quindio enough for self-sufficiency. (Annex G table G-1-1). The prices of most the foodstuffs in Armenia are more expensive than those in Bogota, Medellin and Cali (big cities of the country) and Manizarez and Pereira (suburban cities of Armenia). (Annex G Fig G-1-1).

One of the reasons of the price difference above other than lack of self-supply of products is the complicated marketing system that exists between the growers and the consumers. This is clear from the fact that even the main products in Quindio such as plantain, cassava, tomato and citrus fruits are more expensive in Armenia than in other main cities mentioned above. The small-scale farmers who produce those agricultural products have no vehicles for transporting them to the market. Thus, the those products are provided to the consumers through inter mediaries, increasing the prices of those products.

The reasons of lack of vegetables and fruits in Quindio are summarized as follows:

- a) The prices of these products are not stable compared with those of coffee and grains which have departmental supporting price. (Annex G table G-1-2)

b) The marketing system of these products is not improved.

(2) Distribution system

Major agro-products produced in the Study Area are coffee, plantain, cassava, orange, passion fruit, soybean, sorghum, maize, kidneybean, snap bean, tomato, tree tomato, black berry, luro, meats and dairy products.

Coffee is almost the only exportable product among those cited above and it contributes 99% of foreign exchange earning of the Department (5% of the country's exportation value of coffee in 1989). Harvested coffee cherry are pulped and dried by growers themselves. Seventy (70) % of dried coffee beans are sold to cooperatives organized by coffee growers and the rest to intermediaries, and these two agencies in turn sell the product to Almacafe (an affiliated organization of Fedecafe) or privately owned threshing factories (Trilladora). Afterward threshed coffee beans are distributed to an international market (to Europe and Japan by threshing factories and to U.S.A. by Almacafe) or to domestic market (milling factories). Being the largest contributor for foreign exchange earning, coffee has a guaranteed marketing channel (nearly 100% of the product are purchased). Under the circumstances, there are not a few farmers who cultivate coffee in marginal areas from viewpoints of topography and altitude, and the majority of coffee growers persist in its cultivation despite of disadvantageous marketing conditions caused by stagnation of producer's price.

Together with coffee, plantain and cassava constitute staple agro-products in Quindio to have a high reputation in such major markets of the country as Bogota, Medellin and Cali. Close to 85% of these two products are consumed out of the Department. Around 30% of plantain produced in Quindio are traded in the channel of grower-intermediary-wholesaler and the

remaining 70% in the channel of grower-wholesaler. Cassava in its 60-70% of the departmental production are also distributed to major markets through grower-intermediary-wholesaler.

Citrus is one of those crops the production of which is promoted by the Coffee Committee in their diversification plan and its cultivated area is thus expanding mainly in both margins of the Quindio River. An expected operation of a processing plan in Quindio accelerates this tendency. At present, without having local wholesale market, the fruit is purchased by intermediaries and directly distributed to Bogota and other large cities wholesale markets. It is estimated that about 80% of the production are consumed out of Quindio. It is reported that there is substantial loss (30% of the output) in the course of post-harvest due to inadequate handling, packing and transportation method.

The processing factories of passion fruits in the Departments of Valle and Cardas have started their operation. Therefore, its production is increasing because of such incentive as finance, supply of inputs and supporting price. At present, the product are transported directly from the growers to the factories and processed to concentrated juice. All the juice produced are exported to other Development.

Soybeans and sorghum are produced under mechanized farming in relatively lower plain lands located in both sides of the Quindio River. Soybeans is the second crop next to wheat which is imported in farms of volume of agro-products in Colombia and the government of Colombia places emphasis on increasing its production in view of saving foreign exchange. The soybean produced in the Study Area is totally purchased by oil extracting factories or these agents located in the Department of Valle (the leading producing department in Colombia), thus no major constraint on marketing is presented. Sorghum, on the other hand, is generally sold to intermediaries in Armenia or

other cities nearby and it is thereafter processed for producing animal feed. In the national level, soybean and sorghum are included in a crops which are to be purchased by IDEMA on the basis of supporting prices (other crops are sesame, paddy, barley, wheat, kidneybean, maize and cassava), but IDEMA's regional office in Armenia has not entered in the grain's trade for the last four years.

Almost all the maize and beans are cultivated in the spaces between coffee plants in time of these plants being small. Much of the produced maize and beans are consumed by farmers themselves, whereas grains purchased by intermediaries are traded at local market or sold to retailers in Armenia.

The production of vegetables and fruits in marginal area for coffee production is currently promoted by the Coffee Committee, the Bureau of Agriculture in Quindio and other concerned institutions, because their output in Quindio corresponds as low as 35% and 5% each of the local demand (Encuesta a Mayorista FDQ 1986). More than half of local demand for vegetables are satisfied with supply from the Department of Cundinamarca through intermediaries or retailers; meanwhile fruits consumed in Quindio are supplied in their 60% from valle and 20% from Tolima. Within the Department of Quindio, vegetables are traded in the following two major channels, viz:

- Small-scale retailers purchase the products at sites where they are produced and distribute them directly to consumers.
- Farmers transport their products directly to supermarkets, retailers' market, restaurants, etc.

Vegetable and fruits except citrus produced in the Department do not have duly organized transportation system; production is very inconsistent, because farmers cultivate products on speculation, which provokes notable fluctuation of prices.

Cattle consumed in Quindio depends its major portion of supply from other Departments by eight wholesalers exclusively. Source of supply comprises not only neighboring Departments such as Valle, Tolima, and Antioquia, but also Sucre and Cordoba, Departments facing with the Atlantic Ocean. The animal's trade within the Department is also made through these wholesalers, and it is distributed to consumers by means of other wholesalers stationed in areas other than Armenia, retailers, supermarket, etc.

The rate of self-sufficiency of milk is very low-about 8% and the lacking portion is satisfied with distribution from Valle and other sources. The leading marketing channel of milk at the local level is that intermediaries called "Crudero" purchase crude milk directly from livestock farmers and distribute it to processing agent.

(3) Price of agro-products

The international price of coffee has been hanging low for a long time since the "coffee boom" in 1986 passed. The average price of coffee (Jan. - Sept.1990) was lower than one US\$ per pound (0.95 US\$/pound), the lowest price since 1976. On the other hand, the domestic price was raised from col\$604/kg to 680 on Sept. 4, 1990, 30% raise for the past twelve months. With this reverse tendency of market price movement, the actual price difference between international and domestic ones was US\$0.87/pound in 1990, one third of the price difference in 1986. (Annex G, Table G-1-3)

An evolution of farm-gate price for the period of 1982-1988 in respect of major agro-products explained in the previous subsection is given in Fig. 3.4.2. This figure indicates that the most significant rise in price was made by cassava. Boosted by this upsurge, more farmers wished to cultivate this root crop

and this phenomenon has enforced CRQ a regulation to control its cultivation in terms of conservation of soil fertility and prevention of land erosion (since April 1986 farmers have been required to get permission from CRQ to cultivate cassava). Other crops which raised their price in higher proportion are Kidneybean and plantain; meanwhile prices of tomato, maize and sorghum were stagnated adversely.

Fig. 3.4.3. shows a seasonal fluctuation of wholesale prices at Corabastos in Bogota. Prices of coffee, soybean, sorghum and maize, supporting prices of these products are established by IDEMA Fedecafe, presented more drastically month by month.

It is doubtful that the domestic price of coffee will increase continuously with the pace up to the present due to the worsened financial situations of Coffee Committee because of the depreciated international market. Regarding the crops, their market is not so attractive due to the following inflation control policy announced by the Barco government:

- a) No increase of supporting price (Dec.1990-May1991) for rice, wheat, kidney bean and maize .
- b) within 5% increase of supporting price for sorghum, soybean, barley and sesame.

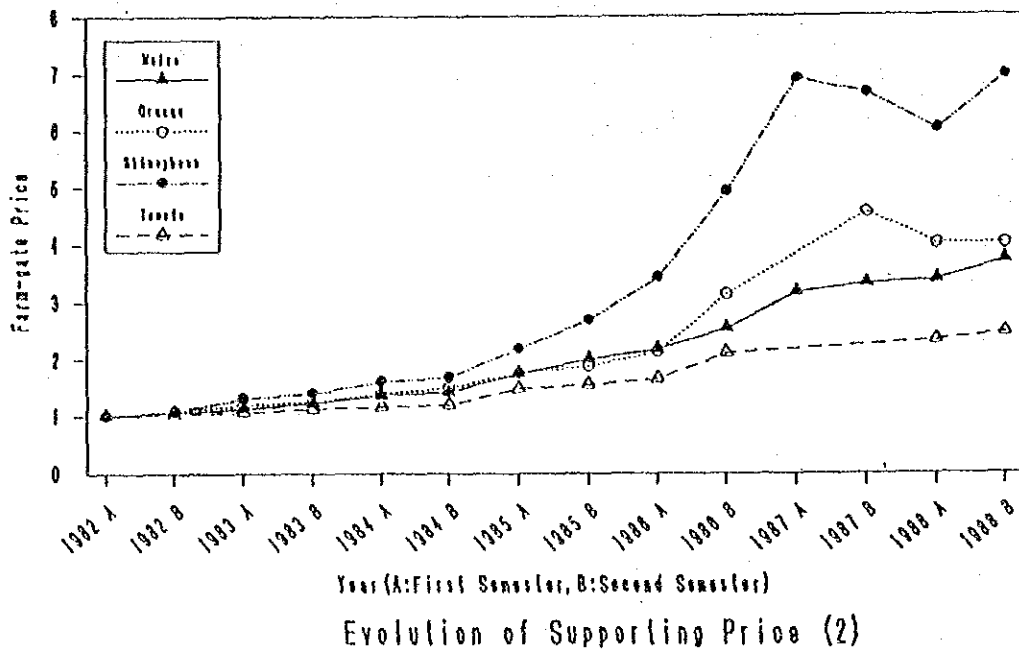
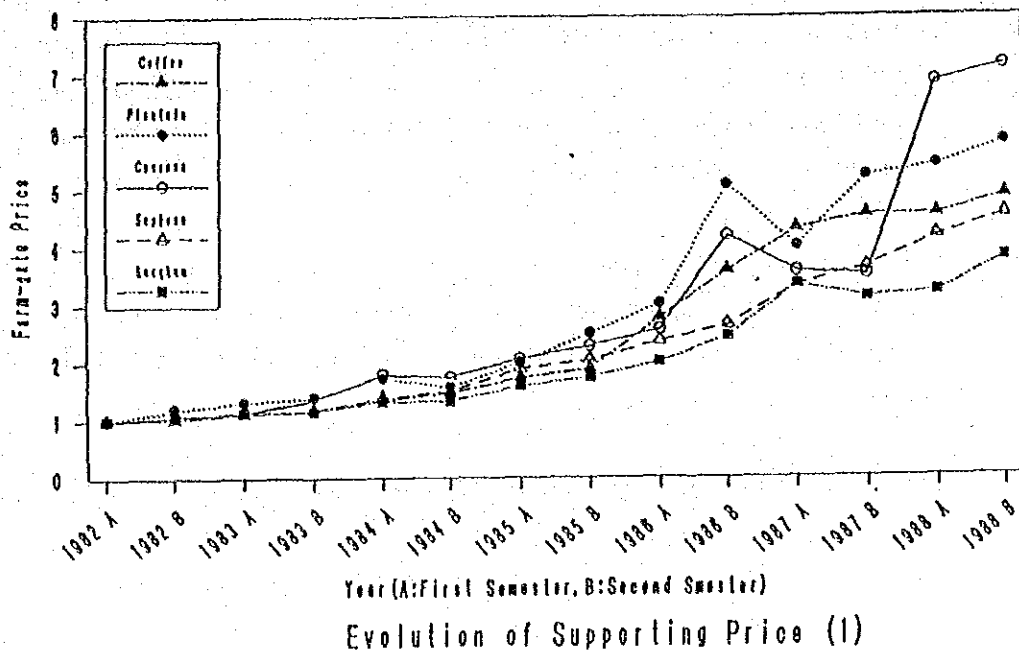
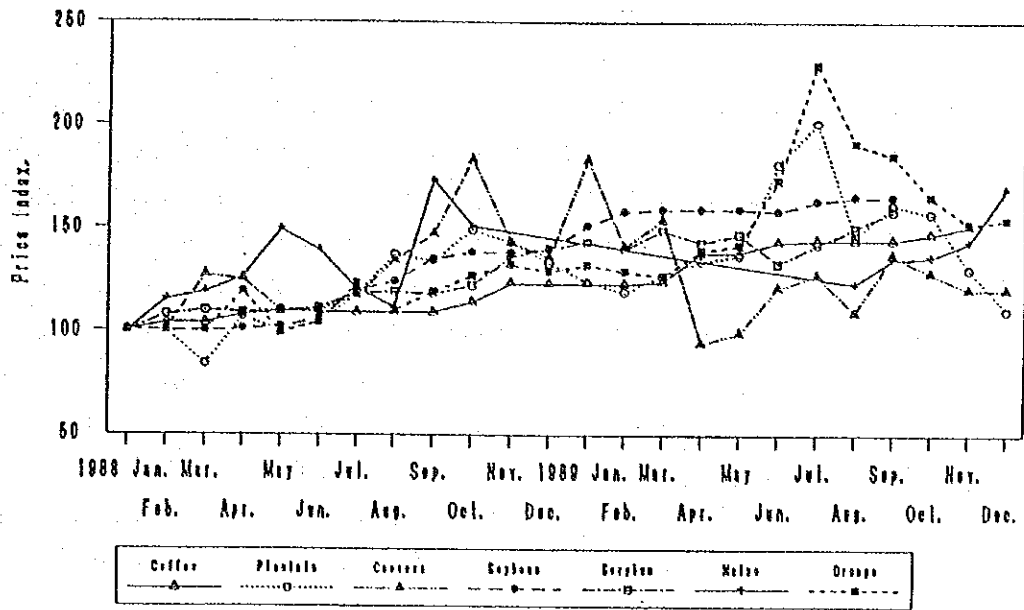
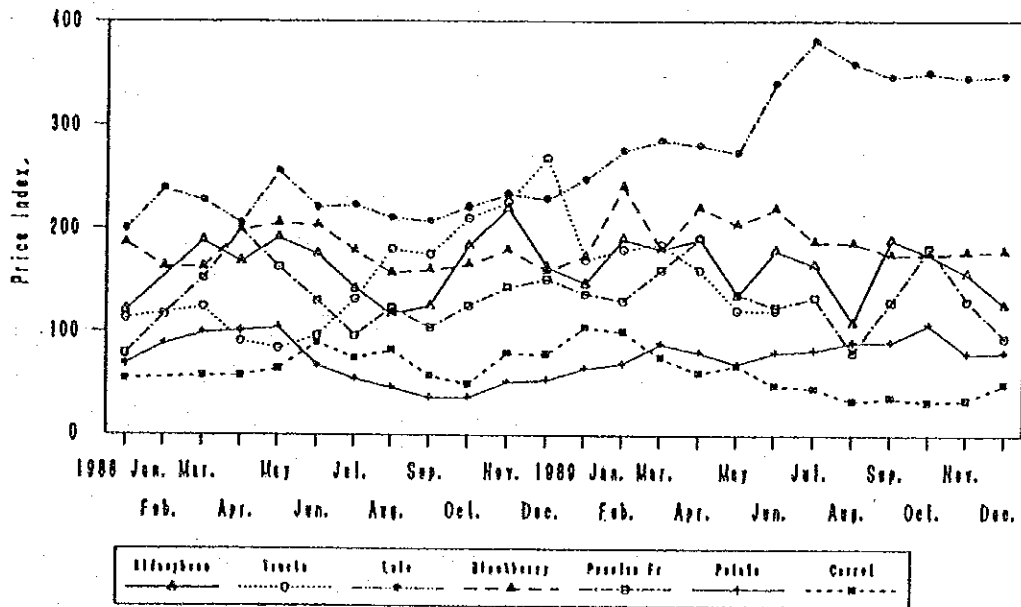


FIG 3.4.2 EVOLUTION OF SUPPORTING PRICE



Fluctuation of Wholesale Price (1)



Fluctuation of Wholesale Price (2)

FIG 3.4.3 FLUCTUATION OF WHOLESALE PRICE

3.4.6 Marketing Infrastructure and Agro-industry

(1) Existing infrastructures

All municipalities covering the Study Area except for Salento have small-scale retail markets for agricultural products. There are two retail markets (Galeria Central and Plaza Gabriel Mejia) in Armenia. However, these two markets are narrow and old, and not functioned well. No substantial agricultural processing facilities are found within the Study Area. Coffee produced in the Study Area is processed at threshing factories to distribute for both international and domestic markets. In Armenia, there are two milling factories of coffee, but they don't have enough capacity to process the whole coffee beans produced in Quindio. It is said that about half of milled coffee retailed in Armenia are processed out of Quindio.

Excepting those consumed locally, plantain is collected at the market (Plaza del Retiro) in Armenia for distributing the product to wholesale markets of Bogota and the country's other major consumption centers.

Having no wholesale nor collecting market for agro-products but plantain within the Departments, cassava, orange and other products which are consumed finally out of the Department are transported by intermediaries to wholesale markets of respective regions. Crops which are consumed locally are either retailed where they are produced or distributed to two retailing markets (Galeria Central and Plaza Gabriel Mejia) located in Armenia.

Apart from coffee threshing and milling factories, there are some examples of agro-industry which consists of powder production plant of plantain and cassava, factories to manufacture sweets, animal feed, herb tea and brown sugar, mushroom culture factory, etc., but all of these facilities are

small in scale. General description of agro-industry in Quindio is given in Table 3.4.3.

In Armenia there is one pork meat processing factory to produce ham, sausage and other related products, but these products are manufactured only once a week due to insufficient supply of raw materials (more than half of them are provided from departments other than Quindio). Furthermore, three (two in Armenia and one in Calarca) dairy products processing plants are located in Quindio, but these plants' capacity do not meet to process the total volume of milk produced in the region. Consequently, one-third of the regional output of milk are processed in other departments (the majority are in Risaralda).

(2) Marketing infrastructure and agro-industry development plan

Leaders and directors in the Department of Quindio have agreed that the critical factor to attain further development of the agricultural sector as well as the regional economy is to facilitate an improvement and development of agro-products marketing system and agro-industry, and in this connection various policies and measures have been taken for that purpose. The faculty of agro-industry was created at the University of La Gran Colombia where students are educated technical and managerial expertise of agro-industry and related subjects. On the other hand, various feasibility and similar type of studies have been conducted by Promocaldas (financing institute for industrial and agricultural development projects implemented in departments of Quindio, Caldas and Risaralda) to assess the development of agro-industry in Quindio. In pursuance of an integration of policies and strategies at the regional level together with promoting development of agro-industry, the "Agro-industry Promotion Committee" has been established with a participation of universities of La Gran Colombia and Quindio and public and quasi-governmental institutions concerned with agricultural and agro-industrial sectors. As an initial step of

the activity, the Committee is expected to elaborate an agro-industry development plan for the Department of Quindio setting the target year of the plan as 2005.

At present, two important projects of the sector are being implemented or projected in Quindio.

1) Citrus transformation plant

The project, which is implemented by Cicolsa (Citrus Colombia Co.,Ltd), envisages to transform fresh fruits of citrus into concentrated juice. Raw materials for the project are expected to be supplied from four Departments of Quindio, Caldas, Risaralda, and Valle; with implementation of promotion program under the diversification plan conducted by the Coffee Committee, it is forecasted that the cultivated area of citrus in the said four departments would be expanded in double from 4,200 ha to 8,400 ha.

The plant is under construction at present and its operation will start in June 1991. Concentrated fruits juice to be produced at the plant is to be traded to Meal S.A, one of shareholders of the company. Equipment of the plant is designed to process both orange and passion fruits at the rate of 7.5 t/hr for the former and 4.0 t/hr for the latter both calculated on the basis of fresh fruits.

2) Wholesale market Armenia

The executing agency of the project is Mercar S.A. which is formed with a participation of the public sector consists of Departmental Office of Quindio, Municipal Office of Armenia, Coffee Committee and Public Enterprise of Armenia, and the private sector represented by wholesalers. The nuclear objective of the project is to develop and improve the marketing system at wholesale level. At the initial stage of

the project, it is proposed to cover the city of Armenia and its influence range, and later on to expand the marketing channel to other regions so as to establish nation-wide marketing network. The location of the wholesale market is projected on the outskirts of Armenia. A total of eight warehouses are designed in the market to be constructed in two phases. Warehouses are divided into the following categories:

- Two warehouses for plantain, cassava and orange: about 850 t/week
- Two warehouses for fruits, vegetables, meat and eggs: about 655 t/week
- Four warehouses for grains and processed products: 825 t/week

The total investment cost of the project is estimated to be US\$ 5,000 thousand at 1990's market price. Actually, the project seeks for financing agency through F.F.D.U(Financing Fund for Urban Development); some portion of the investment is covered by this fund and contact with other public and private agencies interested in investment for the remaining cost is in progress.

Besides, promotion for development of agro-industry is conducted by Promocaldas (Cooling and refrigerating plant for milk and transformation plant of tomato) and Proexpo (production and processing of non-traditional products oriented to international market).

3.4.7 Institutional Supporting Services to Farmers

(1) Institutions in charge

In the Department of Quindio the following institutions are rendering farmers with supporting services.

- Institutions affiliated with the Ministry of Agriculture (ICA, INCORA, IDEMA, Caja Agraria)
- CRQ
- Bureau of Agriculture, Departmental Government Office
- Departmental Coffee Committee
- SENA
- Fondo-DRI
- Banco Cafetero, Banco Ganadero, etc.

(2) Research, investigation and extension of cropping technologies

ICA (National Agricultural Institution) is in charge of research, investigation and extension of cropping and livestock technology (production and certification of seeds, hybrid varieties, disease control, fertilizers, animal feeds, chemicals, appropriate technology, etc.) in the national level. With regional offices throughout the country, it has been developed technologies suitable for respective region. Furthermore, through CRECED (Regional Center for Extension, Training and Diffusion) attached to regional offices, it engages in extension of appropriate technologies to farmers and collection and diagnosis of agricultural performance in regions.

The Departmental Coffee Committee is responsible for study and extension of adequate technologies for coffee production, in particular, introduction of improved varieties and control of

Investigation Center), which is located in Chinchina-Department of Caldas, there exist five experimental farms of coffee in Quindio. And, technology transfer, provision of inputs and credit services to coffee growers are conducted through municipal coffee committees established in 12 municipalities of the Department. In addition, the Committee takes charge of planning, study and formation of projects relative to "Diversification Program"-promotion of agricultural production other than coffee in coffee productive regions of the country, promoted by FEDECAFE.

The Bureau of Agriculture of the Departmental Government Office's responsibilities cover planning and formulation of agricultural policies and plans, study on cropping technologies and their extension to farmers and its local offices are incorporated in Circasia, Genova, Pijao and Salento for realizing intimate supporting services to farmers. Presently, special attention of the Bureau is paid to promotion and activation of farming activities in marginal areas for coffee production and, in this connection, efforts are made to facilitate production of fruits and vegetables.

(3) Education

Studies on development of agroindustry and education of students to be engaged in this industry are realized at universities of Quindio and La Gran Colombia.

Practical and professional knowledge and technique are taught by SENA for workers including farmers with provision of a variety of courses. SENA's Agricultural Center is offering 2-year professional education for high-school graduates.

(4) Agricultural credits

The greater portion of agricultural credits in Colombia are rendered by FFA (Agricultural Financing Fund) and Caja Agraria. The FFA, which was established in 1973 following the Decree 5, is managed and supervised by the central bank (Banco de la Republica).

The FFA procures resources necessary for credit service and determines credit conditions, but disbursement to beneficiaries is made through intermediate institutions, both public and private commercial banks. Credit conditions are determined in accordance with financial capacity of beneficiaries and purposes for use.

Besides being an intermediate agency for the FFA, Caja Agraria renders farmers with credits with its own resources.

In 1988, of total credits of the FFA approved in Quindio, 52% was directed to crop production (seeding, maintenance and stumping), 22% for livestock, and the rest for installation of coffee processing facilities, land improvement, purchase of agricultural equipment and machinery, land acquisition, etc. Credits to crop production are represented by 38% for coffee, 24% for soybean, and 13% for sorghum. On the other hand, the proportion of credits coverage in comparison with the cultivated areas is the highest (96.8%) for sorghum, which is followed by 64.8% for soybean and 57.9% for maize. By contrast, the same proportion to other crops is extremely low (below 10%) except for cassava and sugarcane, which accounted for 27.5% and 15.9%, respectively; it is worth while to indicate that the coverage proportion for coffee is as low as 7.6%.

Although for financially handicapped farmers agricultural credits are indispensable for realizing crop and animal husbandries, the coverage ratio of credits by the FFA remains

low. This fact may be rooted in troublesome procedure and rigid examination for getting credits and unavailability of timely credits for seeding and planting that prevents farmers from approaching to the FFA's credits and enforces them to ask for other sources of credits services.

Under the circumstances, the FFA has undertaken to simplify the procedure for getting credits-once application for credits is accepted the bankbook is presented, beneficiaries of credit can get subsequent credits only with the presentation of the bankbook.

So as to implement credit services effectively and continuously it is of importance to eliminate that beneficiaries fail to repay their credits. In this context, it is expected that banking institutions should render more intensified supporting services (technical assistance for cropping) to farmers that enables them to attain anticipated production.

As mentioned above, credit conditions vary according with financial capacity and purpose for use. The following is an example of credit condition for crop production.

- Beneficiary : Small farmers
- Crop to be covered : Tomato
- Ceiling amount : Col\$ 530,000/ha
- Period : 6 month
- Interest rate : D.T.F. (Average cost through deposits for fixed period) + 1%

(5) Distribution of agro-products

IDEMA is a public institution which intervenes in the distribution of agro-products. In the national level, IDEMA purchases crops from farmers with established supporting prices and distributes them, meanwhile in Quindio its sub-regional office located in Armenia has not entered into the trade of grains for the last four (4) years except for sale of dairy foodstuff to consumers. This is partly due to deficient production of crops with supporting price (rice, sorghum, wheat, barley, soybean, sesame, kidneybean, maize) in the region. Another reason for that is attributable to the unfavorable condition of payment (prolonged period for the settlement of account), and growers of these crops thereby prefer to negotiate with private merchants who offer the payment instantly despite their prices are inferior to those of IDEMA.

Finally, it will be worth while to point out that supporting prices, which were hiked drastically during the administration of the President Barco (1987-1990) following the Selective Supply Plan (Plan de Oferta Selectiva), are determined to be raised slightly (between 2.6% and 4.79%) or to be frozen under the economic policy of the administration of the President Gaviria which started in August 1991.

(6) Development of infrastructure

Development of infrastructure such as roads, water supply system, electric network, schools and health centers in coffee producing areas are executed by the Coffee Committee, whereas Fondo-DRI in collaboration with other agencies is implementing various projects consist of small-scaled agricultural, infrastructure and agroindustry development, organization of rural population, enhancement of rural environment, etc. in less developed municipalities of the Department of Quindio

(Cordoba, Filandia, Genova, Pijao and Salento).

(7) Environmental conservation

CRQ is responsible entity for conservation, supervision and rational utilization of natural resources in Quindio which functions are entrusted by INDERENA. For accomplishment of these functions CRQ takes charge of water quality improvement including treatment of coffee-related wastes, control of soil erosion under a guidance of an adequate cropping technology, cultivation of water resources owing to reforestation, etc.

Apart from the said activities, in view of enlightening local population with respect to environmental conservation, CRQ carries out environmental education and other activities relative to environmental conservation.

3.4.8 Farmers' Organization

It is said that Quindio people are characterized by "individualism" and unwillingness to belong to any organizations for working together. This fame is identified by the fact that farmers' organization does not prevail in the Department; there are only five cooperatives consist of four formed by coffee growers (Armenia, Calarca, Quimbaya and Montenegro) and one formed by growers of vegetables and fruits.

The number of members affiliated with coffee growers' cooperatives is 6,443 (1988), which is equivalent to close to 80% of all coffee growers in Quindio. In general, services of farmers' cooperative are summarized in the following three items:

- 1) Purchase and distribution of inputs and other materials and products relevant to tillage
- 2) Marketing of products
- 3) Provision of credit for farming and related activities

Nevertheless, as far as coffee growers are concerned, services mentioned in items 1) and 3) above are rendered by Coffee Committee. Therefore, cooperatives' services are focused on the item 2). Services responsible for cooperatives in the course of marketing coffee are to purchase pulped and dried coffee beans from farmers and distribute them to threshing factories or Almacafe. The cooperatives, with financial assistance rendered by Almacafe, account for 70% of share in the trade between farmers and threshing factories or Almacafe in Quindio. Owing to the intervention of cooperatives in marketing, coffee growers are not faced with major drawback on sale of their products.

The cooperative of growers for vegetables and fruits was established in 1987 supported by the Bureau of Agriculture of the Departmental Office in promoting production of vegetables and fruits. The headquarters of the cooperative is located in Armenia

and a total of 23 farmers from Calarca, Cordoba, Filandia, Pijao and Salento are participated to form the cooperative.

Unfortunately, the cooperative has not functioned adequately as expected up to date because of unsteady organization in terms of management and financial resources, which has been aggravated by lack of experience in marketing of products. Under the circumstances, the cooperative is compelled to suspend its operation at present and solicits the Financiacoop (Financing institution for cooperatives) for proposal for reconstructing its organization. It is understood that one of the reasons why the cooperative had to stop its operation before it was set in the right direction was uncertainty of objective of the cooperative. Therefore, Fondo-DRI is now proposing to set the objective crops (plantain, tomato, tree tomato, luro and mora) and to transport these crops effectively through cooperative by improving marketing channel.

In addition to the said cooperatives, there exist six rural organizations formed under initiative of Fondo-DRI in municipalities of Cordoba, Filandia, Genova, Pijao and Salento. These organizations are engaging in ameliorating activities of rural life, distribution of living necessities, small-scale agro-industry (production of jam, sweets, etc.) but persons affiliated with these organizations are as few as 110 in total.

Referring to the survey conducted by the Study Team in the course of the field work, only one-tenth of interviewed farmers are members of some rural organizations. The greater portion of farmers replied that they did not belong to such organizations because they did not have time to act in any organizations; another reasons were that they were not interested, they were not invited, they felt no need to participate in any organization, etc. At present, the organization of farmers is promoted by Fondo-DRI, but the significance of organization has not yet been understood by the farmers.

3.5 Existing Infrastructure Facilities

3.5.1 Irrigation and Drainage Facilities and Farm Road

(1) Irrigation facilities

Few irrigation systems exist in the Study Area. Usually farmers manage their farming depending on the natural rainfall. Annual rainfall of 1,600 - 2,800 mm can be expected, and irrigation is not always required, even though there may be continuous drought days of more than 15 days in some time.

(2) Drainage facilities

Due to the poor drainage caused by the soil characteristics, some drainage system can be observed in the lower part of the Quindio River Left Margin Areas. There are existing drainage canals of approximately 5 km made by individual farmers.

There are a few culvert with a short drainage canal made by the Coffee Committee to drain rain water. However, these facilities are not systematically installed.

(3) Farm road

The farm roads in the Study Area have been constructed and maintained by the Coffee Committee or individual farmers. Most of the farm roads have their width of 2 - 3 m and are unpaved. It can not be said that the condition of these farm roads is quite good. There are few facilities crossing the river in the Study Area, and some places can not be passable during the heavy rain.

3.5.2 Road System and Transportation Facilities

(1) Road system

The road system of Quindio is maintained by the Ministry of Public Works and Transportation (hereinafter referred to as the "MOPT") and has been improved by main office of the MOPT in the Department, by the Secretariat of Public Works of the Department and County Road Division (Camino Vecinales) of the MOPT. The national road is under the jurisdiction of the MOPT and the rural road connecting to the national road is under the Secretariat of Public Works of the Department financed by the Coffee Committee. The rural road connecting with the national road of Quindio has been improved according to the 5 year road improvement plan of the Secretariat of Public Works of the Quindio Department (1988-1992). Concerning the Study Area, the roads from El Balso to Pijao and from Arrayanal to Salento have already been paved. All there construction works have been financed by the Coffee Committee and, after 1992, the rural road net work project in the coffee cultivation area will be started.

(2) Transportation system

There are eighteen (18) taxi companies and eight (8) bus companies in Quindio, offering transportation as a means for the main traffic between downtown of Armenia and other towns. The transportation in the Study Area is also represented by taxi service by jeep.

3.5.3 Water Supply, Sewerage and Electricity

(1) Water supply and sewerage

In the Study Area, there is no large-scale water supply system. However, most of the farmers have a water supply service by the Coffee Committee or have their own water supply system. Therefore, quite a few farmer has no water supply system.

In connection with sewerage, with the exception of some farms where the sewage is simply treated by infiltration method, the sewage is directly discharged into the rivers.

(2) Electricity

The entire electric power supply and demand of Colombia are controlled by the Electricitg Corporation (ISA), and electric power is supplied to Quindio by ISA. In the Study Area, almost all the farmers have electricity service except those who cannot pay for the service.

3.6 Coffee Processing Waste Water Treatment

3.6.1 General

At present, Colombia is the second largest coffee producing country after Brazil in the world, and as to the production of mild coffee, Colombia is the largest country, too. In Colombia, Antioquia is the largest coffee producing department and Quindio objective department of this feasibility study is the 5th one which produces coffee of 88,000 tons in annually. This amount of coffee occupied 15% of the total production in 1988, and its yield per unit area, is the best in Colombia.

An characteristic in coffee producing method in Colombia is that water is used in a coffee processing after harvesting, which is different from a method in Brazil, and this is said to wake quality of coffee mild. On the other hand, the waste water from, this process, which contains many organic substance, is discharged directly into rivers, thus degradation of water quality in rivers are caused, which become a big problem such as destruction of the environment.

3.6.2 Outline of Study Area

The watershed of the Cristales river of 9,400 ha which is located in the central part Quindio is selected as the Study Area for the coffee waste water treatment(Fig.3.6.1).

The outline of the Study Area is as follows:

(1) Topography and climate

The topography of the Study Area is mostly gentle sloped heights with some steep sloped land.

Table 3.6.1 shows the climate conditions of the area.

TABLE 3.6.1 TOPOGRAPHY AND CLIMATE CONDITIONS

Altitude (a.s.l.)	900 m to 1,400 m
Average temperature	21.9°C
Annual average rainfall	2,000mm

(2) Streams

Features of the Cristales river are as follows:

- 1) It flows out from the southern edge of Armenia and the total length of it is 39 km.
- 2) There are 18 branch streams in the Cristales river basin and the river flows down from origin (1,400 m a.s.l.) to Pisamal (900 m a.s.l.) where the river joins to the La Vieja river.
- 3) The width of the Cristales river is only 3 m even at the confluence section. Its discharge for 5 year return period is 1.8 m³/s during rainy season.
- 4) The Cristales basin is the good water supplying area and the water quality in the area is good enough for drinking originally because of low content of dissolved solid of 100 mg/l.

(3) Characteristics of the Cristales basin

The Cristales basin is the most coffee productive area in Quindio and 75% (7,095ha) of the total basin (9,400ha) are cultivated for coffee production. The coffee waste water in addition to the sewage from the urban area is the main source of contamination of river water because of no industrial and mining drain discharge in the area.

(4) The present situation of coffee production

All the farmers (670 farmers) in the Cristales basin cultivate coffee plant. Table 3.6.2 shows the composition of farms in the Cristales.

TABLE 3.6.2 COMPOSITION OF COFFEE FARMS

Size	No. of Farm	Cultivation Area
30 Ha or more	55 Farms	4,100 Ha
5 - 30 Ha	330 Farms	2,000 Ha
5 Ha or less	285 Farms	995 Ha
Total	670 Farms	7,095 Ha

The present condition of coffee production in the study area is shown in Table 3.6.3.

TABLE 3.6.3 COFFEE PRODUCTION IN THE STUDY AREA

Parameter	Study Area (Cristales Basin)		Quindio	
		Share*		Share**
Cultivated area (ha)	7,095	11 %	64,601	6 %
Amount of production (ton/year)	17,012	17 %	88,265	15 %
Unit yield(ton/ha)	2.40	164 %	1.44	228 %

* Share of whole Quindio

** Share of whole Country

The main harvesting season is August to December (62.0 % of the annual production is harvested in this period) and the sub-harvesting season is March to May. In the area over 1,500m a.s.l., the main harvesting season and the sub-harvesting season invert each other, however, there is not such an area in the study area.

3.6.3 Coffee Preparation and Waste Water

(1) Waste water provided by coffee processing

1) Morphology of coffee cherry

Fig 3.6.2 shows the structure of coffee cherry. The coffee beans are protected by slimy mucilage which makes bad effect upon the quality of coffee beans. Therefore, fermentation of depulped parchment coffee is carried out for 12 to 24 hr normally. Thus, water used for washing fermented coffee beans has high organic and muddy substance.

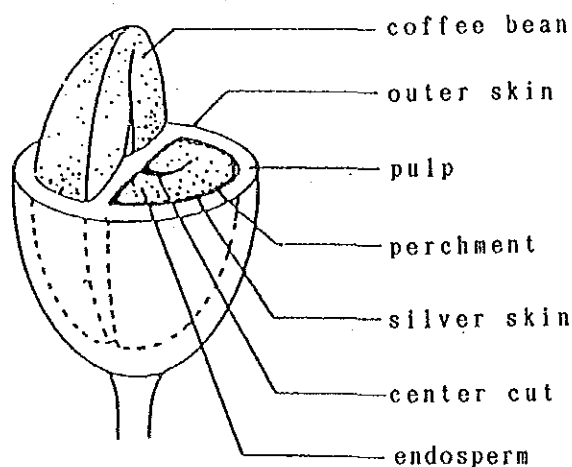


FIG. 3.6.2 STRUCTURE OF COFFEE CHERRY

2) The process of coffee preparation

Fig 3.6.3 shows the typical wet method of coffee preparation sequence in order to understand the preparation processes adopted in respective farms which are little different each other.

3) Coffee processing waste water

The kinds of waste water produced through the processing (Fig 3.6.3) are classified into the following:

- a) Fermented beans washing waste water
- b) Fermentation pit waste water
- c) Depulping waste water
- d) Weather beaten depulpe waste water
- e) Coffee beans convenience water
- f) Miscellaneous waste water such as machine cleaning and floor cleaning.

(2) Characteristics of coffee processing waste water

1) Waste water quality

In the waste water quality of coffee processing, there is a much differences between respective farmers. In accordance with site survey, an average values of the parameters for the waste water quality of the coffee processes in the studied area are shown below.

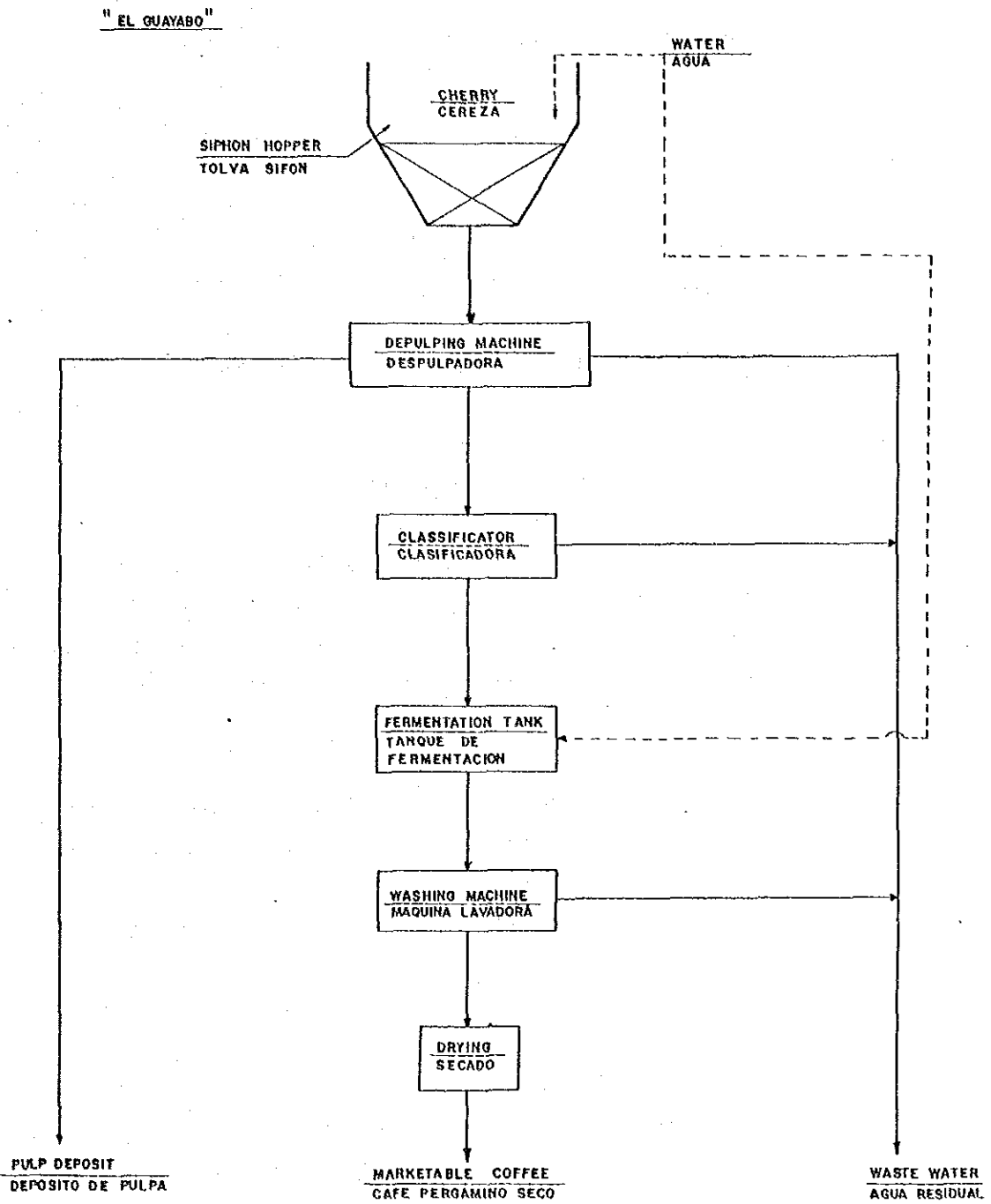


FIG 3. 6. 3 REPRESENTATIVE COFFEE TREATMENT FLOW

TABLE 3.6.4 QUALITY OF COFFEE WASTE WATER

Item	Value
BOD5	3,000 - 10,000 mg/l
CODcr	5,000 - 15,000 mg/l
pH	3.5 - 4.7
Suspended Solid	2,000 - 3,000 mg/l

2) Quantity of waste water quantity

Quantity of waste water quantity from coffee processing plant is different due to its processing method and worker's experimental judgment on water consumption. In accordance with site survey, coffee farms can be classified into the following three groups:

- a) Relatively few water consuming farm 8-10 l/kg-dry coffee
- b) Average water consuming farm 15-30 l/kg-dry coffee
- c) Much water consuming farm or centralized coffee processing factory 80-100 l/kg-dry coffee

(3) Pulp

As shown in Fig. 3.6.2, coffee beans are covered with thick pulp. This pulp is eliminated from coffee fruits during the process for taking coffee beans out of coffee cherry. The amount of eliminated pulp is 1.8 kg per 1 kg of dry coffee beans, composed of 88% of sarcocarp and 12% of water. Composition of sarcocarp is shown in Annex J. The fresh pulp is piled on the ground or transferred into wooden or bamboo made silos to form compost. When the pulp is piled on the ground, sewage comes out from the piles by rainfall causing highly concentrated waste water, which is one of the factors degrading

water quality of the rivers.

For the effective use of waste pulp, it is considered to use for the fertilization, livestock (fish) feeding and raw materials of alcohol production. Presently, the pulp is used as fertilizer, however, its utilized ratio is quite low because of high cost of transportation. In the future, it is necessary to study on effective use of the pulp.

3.6.4 Water Contamination in the Cristales Basin

(1) General

The main causes of water contamination in the Cristales basin at present are the discharges of waste water produced by the wet processing of coffee beans in harvest seasons and domestic effluents through the year. They are discharged to small streams directly without any treatment. The volume of organic pollutants (converted to COD) arising from the domestic effluents is estimated to be 512 ton/year based on the population of the Cristales river basin being 28,060 (1990). On the other hand, that of coffee waste water is estimated as 2,565 ton/year based on the production of coffee in the basin being 17,012 ton/year. Therefore, the pollutant load of coffee waste water is 5 times that of domestic effluents.

(2) Water quality of the Cristales river in harvest season

1) Coffee harvesting season

In general, the harvest season of coffee differs according to the altitude of cultivated area. It further changes due to the variety of coffee and period and volume of rainfall. As coffee fruits ripens during rainy season, the harvesting period is shifted depending upon the period of rainy season. The altitude for coffee cultivation is 1,100 - 1,400m a.s.l.

In the Cristales basin(900 - 1,400m). The monthly coffee production at 1,200m a.s.l., the main coffee cultivated area is as shown in Table 3.6.5.

TABLE 3.6.5 MONTHLY COFFEE PRODUCTION
(at an average altitude 1,200m
in the Cristales basin)

Month	Production Rate(%)	Remarks
JAN	0.00	
FEB	0.75	
MAR	20.43	
APR	14.10	Sub harvest season
MAY	1.50	
JUN	0.28	
JUL	1.24	
AUG	3.80	
SEP	9.40	
OCT	11.78	Main harvest season
NOV	22.91	
DEC	14.11	
Total	100.00	

Source: FEDECAFE 1987

2) River water contamination in the harvest seasons

Due to the constant discharge of waste water arising from coffee processing in the harvest seasons, the quality of the river water changes as follows:

- a) CODcr raises to 120 mg/l or more
- b) BOD5 raises to 70 mg/l or more
- c) D.O. decreases 2 mg/l or less
- d) pH becomes 6.2 - 6.5

Usually, in the Cristales basin depulping of coffee fruits is done at night and washing fermented coffee beans is started early in the morning. Therefore, the waste water is discharge intensively early in the morning around 4 AM to 7 AM, and the pollution level of river water reaches to its peak at this time. It takes 10 and some hours for flowing down from the upper stream to down stream in the Cristales river, therefore, the high pollution level continues all day long except midnight. The value of data observed in harvesting season at Diamante is shown are Table 3.6.6 and it can be understand pollution level of quality of river water is quite high.

TABLE 3.6.6 RIVER WATER QUALITY IN HARVEST SEASON

Items	Value	Unit
Color	38	degree
Suspended Solid	210	mg/l
Volatile Suspended Solid	125	mg/l
pH	6.38	
Alkalinity	36	mg/l
Acidity	14	mg/l
Ammonium Nitrogen	1.46	mg/l
Dissolved Oxygen	1.77	mg/l
BOD5	71.20	mg/l
CODcr	125	mg/l

(at Diamante, October a.m.4:00)

(3) River water quality in non-harvest seasons

The original water quality of small streams in the Cristales basin is clean and has low dissolving salts content. The result of water quality at several points of the Cristales river during non-harvesting season are shown in Table 3.6.7.

TABLE 3.6.7 RIVER WATER QUALITY IN NON-COFFEE HARVEST SEASON

	Cristales Alto	Diamante	Pisamal	
Turbidity (mg/l)	10	12	45	36
Color(degree)	8	8		
pH	7.33	7.30	6.70	6.80
Alkalinity(mg/l)	40	40	28	34
Hardness(degree)	22	22	24	30
Fe(mg/l)	0.4	0.5		
N-NH4(mg/l)	0.12	0.32	0.30	0.30
N-NO2(mg/l)			<0.1	<0.1
Conductivity(us/cm)	72	62	85	110
Cl(mg/l)	1.0	1.0	3.0	3.0
DO(mg/l)	7.6	7.9	6.9	5.2
CODcr(mg/l)		15		
BOD5(mg/l)	0.4	1.0	1.4	2.2
Coliform Index	+	+	+	+

note:Sampling point

Cristales Alto	2 km from origin
El Diamante	15 km "
Pisamal	28 km "

(4) Sewage in the Cristales basin

In the urban area, the sewer system is well equipped, but the sewage is discharged to the rivers together with rainwater

without any treatment. In the farm area, the sewer from the farmhouse is connected to the stream near by or to the open ditch along the road. The sewage volume from a farmhouse differs greatly in accordance with the number of the seasonal laborers.

(5) Influence of the contamination of river basin

- 1) Due to the contamination of the Cristales river, the water intake at Diamante for La-Tebaida (population in 19,640) could not work now, so that a deep well pump supplies ground water to the city in stead of river water.
- 2) Due to the river contamination and the extension of water supply system to the Cristales area, the utilization of river water for coffee treatment has been decreased, and some of the farmers are using domestic water. Originally, river water does not cost for running, because the river water is pumped up by using hydraulic power pump (RAM). For some farmers, coffee treatment cost has increased accordingly.
- 3) Even in the domestic area (out side the Cristales basin), the quality of the river water is not suitable for domestic use and it is estimated that the cost for city water supply has been increased because of costly water treatment and development of new water resources. The vegetables and fruits in the downstream plain are irrigated with contaminated water not-suitable for irrigation. It is supposed that the continuous bad influence to human body due to the increased high-molecule organic substance produced by coffee processing, bacillus such as colon bacillus in the sewage and organic chloride produced by chloride of sewage water has been increased.

4) The Quindio Hospital has reported the relationship between rainy season (coffee harvest season) and the diarrhea.

5) The following conclusions are led from the above:

- It is very difficult to operate water dam due to an accumulation of suspended solids and organic substances in river water.

- Because of unsanitary fishery environment, fish breeding is impossible.

- Because of of unsanitary and rich organic substances, the river water without treatment is unsuitable every for agricultural use.

- It is very difficult to apply to the water sources of potable water.

- Because of unhealthy residential environment, it is not desirable to install leisure facilities.

- There is no original biological and zoological living in there watershed.

3.6.5 Water Pollution Control Law in Colombia

The regulations against waste water discharge are included in the law of the Ministry of Health and Welfare. The articles in connection with this study are as follows:

(1) Article 72(Effluent regulation against normal water zone)

Every effluent towards any streams or water shall meet at least the following rules:

Item	Existing Users Value	New Users Value
pH	5 - 9	5 - 9
Temperature	40°C or below	40°C or below
Floating material	None	None
Fats and oil	80% removal	80% removal
Domestic or industrial solid	50% removal	50% removal
Biochemical oxygen demand (BOD)		
For Domestic	30% removal	80% removal
For Industrial	20% removal	80% removal

(2) Article 73(Effluent regulation against public sewer)

Every effluent towards any public sewer shall meet at least the following rules:

Item	Value
pH	5 - 9
Temperature	40°C or below
Acid base or acidic solution which may cause contamination	Non
Explosive or flammable substance	Non
Sedimentable solids	10ml/l or less
N-hexane extract	100mg/l or less

	Existing users	New users
Suspended solid from domestic waste or	50% removal	80% removal

Industrial waste Biochemical oxygen demand (BOD)		
Domestic waste	30% removal	80% removal
Industrial waste	20% removal	80% removal
Maximum flow	150% of the average flow	

(3) Article 74(Substances concentration controlled for sanitary)

This article is common regulation for Articles 72 and 73.

Item	Value(mg/l)
As	0.5
Ba	5.0
Cd	0.1
Cu	3.0
Cr ⁺⁶	0.5
Phenol	0.2
Hg	0.02
Ni	2.0
Ag	0.5
Pb	0.5
Se	0.5
CN ⁻	0.1
D.D.T.	Not detectable
Organic Mercury	Not detectable
T.C.E.	1.0
Extracted Ccl4	1.0
Dichloro ethylene	1.0
CS2	1.0
Organic C.C.	0.05
Organic P.C.	0.1
Carbamatos	0.1

(4) Related laws for coffee processing waste water

In the Cristales basin, the waste water is generally discharged into rivers or stream. Therefore, Articles 72 and 74 are applicable to this case. However, in the case that collective processing factories and farms in Armenia and La Tebaida discharge waste water into sewers, Articles 73 and 74 are applicable. There is no laws and regulations against discharging coffee processing waste water in Quindio, but in Cauca, the adjacent department, the laws against waste water have already been established. In Quindio, there are some actions for establishing regulations/laws against waste water as well.

3.6.6 Existing Coffee Processing Waste Water Pilot Plant in Quindio

Several anaerobic-type waste water treatment plants have been installed as pilot projects and the study and examination have been performed in Quindio and adjacent departments. They are listed in Table 3.6.8.

TABLE 3.6.8 EXISTING WASTE WATER TREATMENT PILOT PLANT

Location	Institution in charge	Kinds of waste water	Treatment method	Capacity
Cali	CVC	Coffee	UASB	10 m ³ /d
Caralca	Quindio Univ.	Coffee	UASB+AF	18 m ³ /d
Chinchina	CENICAFE	Coffee	AF	10 m ³ /d
Armenia	CRQ	Coffee	Anaerobic Tank	6 m ³ /d
	CRQ	Coffee	AF	6 m ³ /d
Holanda	CRQ	Coffee	A.S	25 m ³ /d

The most of the plants above apply the system of the anaerobic treatment due to economic operation cost. From the investigation on the existing plants in the Departments of Quindio and Cauca, Many of them are out of operation now. The removal ratio of CODcr is more or less 50 % according to information collected and it is not sufficient for water use. It is necessary to carry out further investigation for the study of disadvantages, however, the main reasons of the disadvantage are the following items in a reference to the anaerobic reactor.

- 1) Insufficient acclimation of anaerobic sludge
- 2) Wash out of anaerobic sludge i.e. poor condition of SGS system
- 3) Insufficient knowledge of aerobic treatment
- 4) Low level of the techniques for the operation

CHAPTER 4 : DEVELOPMENT CONCEPT

CHAPTER 4 DEVELOPMENT CONCEPT

4.1 Objective

The objective of this study is to formulate the integrated agricultural development plan and coffee waste water treatment of mainly the basin of the Quindio River. The objective of each plan is described below:

4.1.1 Agriculture Development Plan

The objective of the study in this sector is to solve the problems on farm management and cultivation of the Study Area which are mentioned above, and to develop the Study Area and further to contribute to the agricultural development of Quindio by achieving the following development targets:

- a) Rationalization of land use through diversification of crops
- b) Rectification of differences of farmhouse income between areas
- c) Bottom up of income of medium-and small-scale farmers
- d) Environmental conservation of soil and water resources

This agricultural development study is made for seven areas which represent different natural environment of Quindio and have different agricultural problems. The targets of development by area are as shown in Table 4.1.1.

4.1.2 Coffee Waste Water Treatment Plan

The study area in this sector is the basin of the Cristales River where contamination caused by coffee waste water is particularly conspicuous. The objective of the study is to measure the polluting load of the Cristales River, to grasp the situations of contamination and to propose the following matters:

- a) To establish the water quality improvement standard for river water
- b) To examine the current method for treatment of treatment waste water and to propose a suitable method for treatment
- c) To select a pilot area and to propose suitable treatment facilities
- d) To construct a model plant for verification of the proposed treatment method
- e) To feedback the results obtained through running of the model plant to the treatment method and facilities planning

4.2 DEVELOPMENT CONCEPT

4.2.1 Basic Concept for Agricultural Development

The development concept in establishing the proposed integrated agricultural development plan is as follows:

(1) Rationalization of land use by means of crop diversification

By introducing high remunerative crops which are suitable for natural conditions of respective areas to the low-productive pastures and coffee cultivation lands where its conventional varieties are planted, the rationalization of land use is considered.

For the promotion of diversification of crops, the improvement or introduction of the following are necessary:

- 1 Improvement of organizations which support extension, tests and studies, agriculture finance, etc. for the crops other than coffee
- 2 Establishment of producer's unions
- 3 Improvement of cultivation environment such as improvement

of poor drainage

4 Improvement of transportation system

5 Improvement of crop gathering and transporting facilities

(2) Rectification of income imbalance of farmers

The rectification of income imbalance between areas and farm sizes is improved by rationalization of land use mentioned above.

(3) Preservation of environment

Preservation of soil and upkeep / uplift of water resources build-up capabilities are essential for supporting continuous agricultural production activities. Crop selection and farming system that take into account preservation of soil, upkeep/uplift of water resources build-up capabilities and supply of firewood to farmhouses for maintaining current forest area are considered as a measures for preservation of the environment of the area.

(4) Facility planning

In establishing this Integrated Agricultural Development plan, the approach to the project with the viewpoint of the integrated rural development in addition to the agricultural development is taken in mind in consideration of the existing specific features of the Study Area such as topography, land use and availability for future development/improvement and the development target.

Therefore, in planing the agricultural water development, not only irrigation water but also domestic water supply is considered in view of its importance for the farmers in the

area. In planing farm road system, the overall transportation system in and around the Study Area is also taken in mind.

4.2.2 Basic Concept for Coffee Waste Water Treatment plan

The development concept in establishing the proposed integrated agricultural development plan is as follows:

(1) Standard of water quality improvement

The standard of water quality of the treated coffee waste water to be discharged to the rivers is proposed in consideration of the standard which is adopted in Colombia presently and the utilization of river water at the downstream section for irrigation, domestic water, inland fishery, etc.

(2) Water treatment system

The proposed treatment system is finalized in consideration of the easiness of operation and maintenance and applicability of the system to other areas as well as its technical and economic validity. The proposed system is examined for its adaptability in a laboratory.

(3) Pilot area

The pilot area is selected from the Cristales river basin in consider of the following factors:

- To represent the whole study area of the Cristales river basin as a pilot area
- To cover a whole water shed that makes it possible to show the effect of treatment clearly
- To have the effect for demonstration

(4) Model plant

In order to verify the effectiveness of the proposed waste water treatment system, two model plants are constructed at the selected coffee farms in the pilot area. The scale of the plants are of small and medium, and two sites are selected in consideration of the following:

- To be located within a watershed and near-by each others
- To be cooperative for the treatment
- To have a reasonable technical level

(5) Others

A proposal for the treatment of waste of depulping and excess sludge generated from waste water treatment is discussed.

TABLE 4.1.1 DEVELOPMENT TARGETS BY AREA

Target	Area	Circasia	Salento	Quindio River Right Margin	Quindio River Left Margin(1)	Quindio River Left Margin(2)	Pijao	Genova
- Rationalization of Land Use		⊙	⊙	○	△	△	⊙	⊙
- Income Disparity Between Areas		⊙	⊙	○	△	△	⊙	⊙
- Increase of Income of Small- and Medium-Scale Farmer		⊙	△	△	-	○	△	△
- Environmental Conservation		⊙	⊙	○	△	△	⊙	⊙

Importance : ⊙ > ○ > △

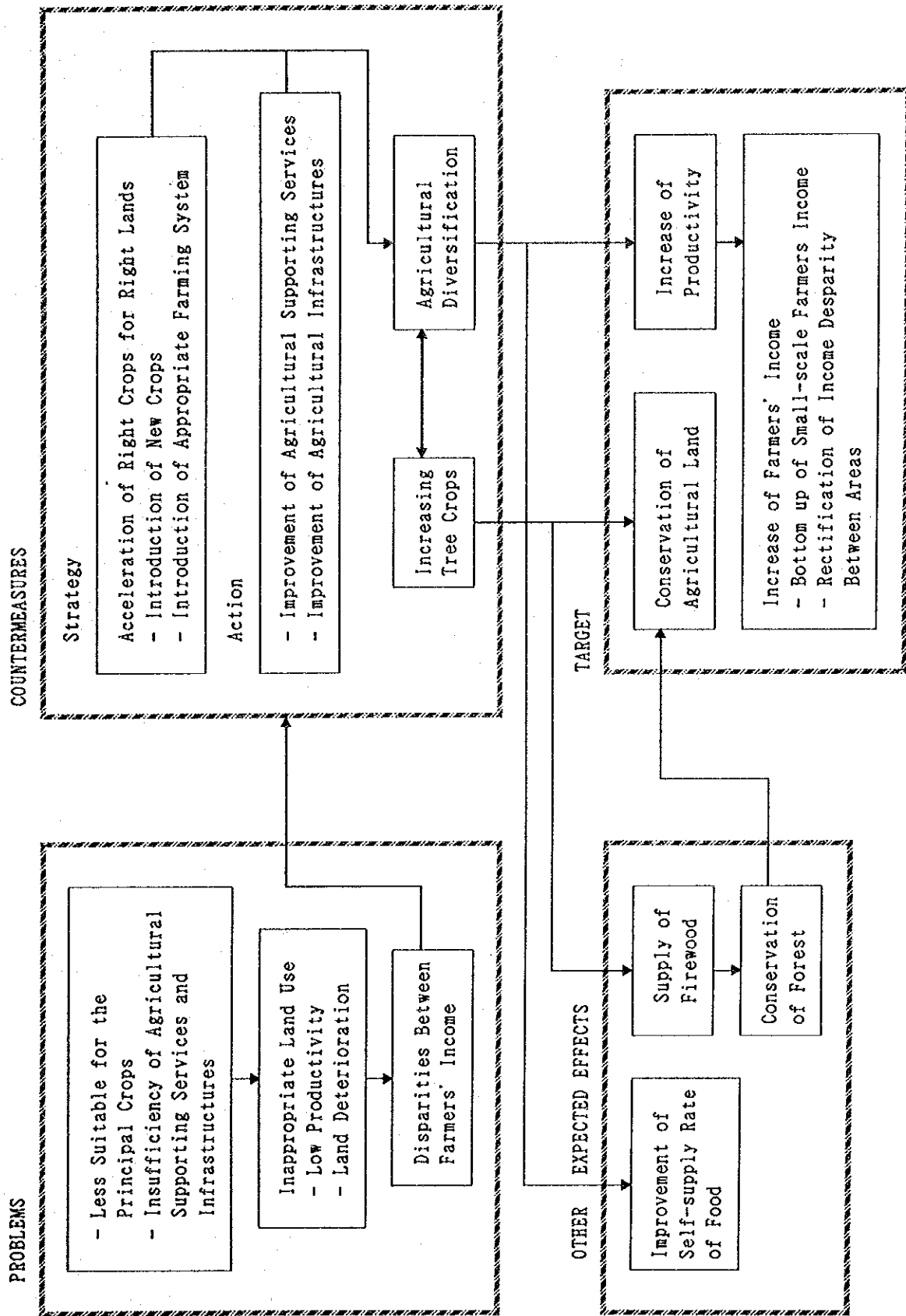


FIG. 4.1.1 BASIC STRATEGY FOR AGRICULTURAL DEVELOPMENT

CHAPTER 5 : AGRICULTURAL DEVELOPMENT PLAN

CHAPTER 5 AGRICULTURAL DEVELOPMENT PLAN

5.1 Land Use Plan

The basic concept for the future land use plan are as follows:

(1) Accelerating of appropriate land use

The present inappropriate land use has resulted in loss of top soil and other disasters such as flood. Considering there situations, the land use plan is proposed mainly in accordance with the land classification.

(2) Conservation of existing forest area

Forest area including bamboo area shares only 13 percent of the total Study Area. In the light of maintenance of ecological balance and water resources, the existing forest area is conserved.

(3) Maintaining the coffee area planted with its improved variety

Basically, the coffee area planted with its improved variety is kept unchanged in consideration of its good marketing situation, and stable income for farmers.

(4) Converting from grazing land and traditional coffee planted area into high productivity crop area

The areas where the coffee area planting is not suitable are mainly used for grazing lands or coffee areas with its traditional variety. The productivity of these area is low. To improve the income of the farmers in coffee unsuitable area, the plants of these coffee unsuitable areas are converted into other suitable crops and farming systems suitable for respective areas are planned. However, the conversion of

grazing land into high-productivity crop area is limited to the range that make it possible to maintain the present livestock production level.

(5) Maintaining existing upland crop cultivation area

Though upland crop cultivation area in Quindio River Right Margin Area is possible to convert into high productive crop area such as fruits area, the area is maintained because the farmers in the area have invested much to the agricultural mechanization.

Based on the concept above, land use plan, area by zone and proposed land use map are shown in Tables 5.1.1 and 5.1.2, and Fig. 5.1.1, respectively.

In the land use plan, land is divided into six zones by its characteristics based on the land classification, and future land use and means of soil conservation by zone are proposed. Characteristics by zone are as follows:

Zone 1 : Slope 0-12 %	Zone 4 : Slope 25-50%
Zone 2 : Slope 12-25 %	Zone 5 : Thin soil layer
Zone 3 : Poor drainage	Zone 6 : Slope >50 %

Area of proposed land use by zone except for the existing improved coffee planted area, forest and others which are not changed in the plan is shown in Table 5.1.2.

TABLE 5.1.1 LAND USE PLAN

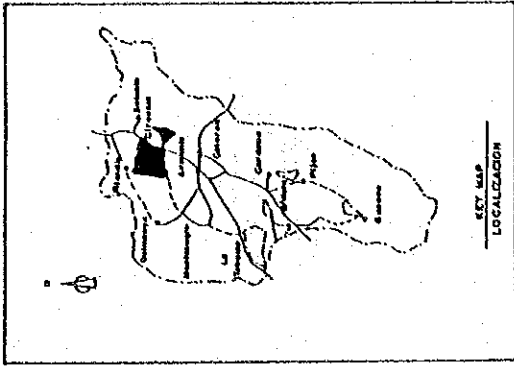
Zone	Class	Circasia Target:Vegetable,Fruits	Right M. and Left M. (2) Target: Juice Materials	LeftM. (1) Target: Intensive Upland Crop	Salento, Genova and Pijao Target:Fruits
1	II, III	Intensive Vegetable Production, Grazing with contour planting	Intensive Upland Crop and Vegetable Production, Grazing with Contour Planting		Grazing, Small Scale Vegetable Production
2	IV-e	Vegetable Production and Grazing with Windbreaker and Contour Planting, Fruits	Mixed Cropping with Fruits (Pitahaya and Maracuya), Upland Crop (Beans etc.) and Vegetables Grazing with Windbreaker and Contour Planting,	-	Fruits, Grazing with Windbreaker Mixed Cropping (Fruit+Vegetable) with Contour Planting
3	IV-d	-	Intensive Upland Crop and Vegetable Production, Grazing with Drainage	Intensive Upland Crop Production and Grazing with Drainage	-
4	VI-e	Fruits and Pasture Production with Windbreaker, Barrier Crops and Contour Planting	Fruit (Citrus) with Barrier Crops and Contour Planting, Pasture with Windbreaker	-	Fruits with Windbreaker, Contour Planting and Barrier Crop,
5	IV, VI VII-s	-	Pasture	-	-
6	VII, VIII-e	Agroforest, Fruits and Pasture with Windbreaker and Barrier Crop, Forest	Agroforest, Fruits and Pasture with Windbreaker and Barrier Crop, Forest	-	Agroforest, Fruits and Pasture with Windbreaker, and Barrier Crop, Forest

Pasture: Pasture for feeding, Class: Land classification

(Unit:ha)

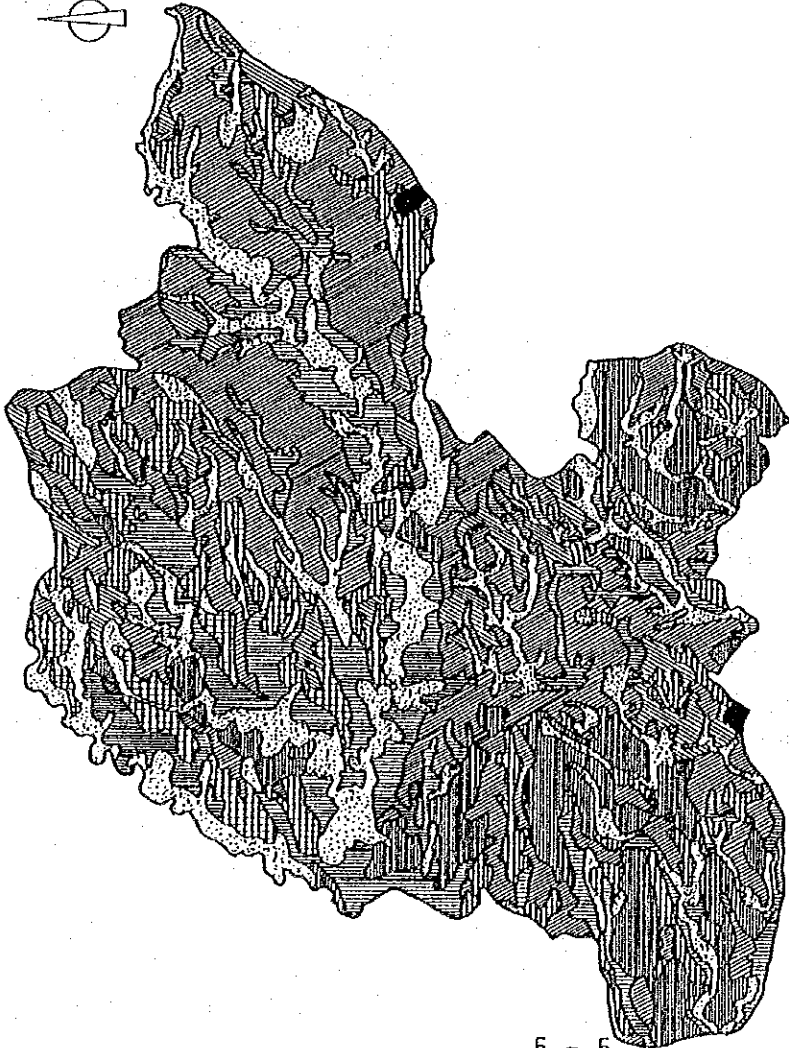
TABLE 5.1.2 AREA BY ZONE

Zone	Area	Circasia (ha) (%)	Salento (ha) (%)	Right M. (ha) (%)	Left M. (1) (ha) (%)	Left M. (2) (ha) (%)	Pijao (ha) (%)	Genova (ha) (%)	Remark	
Zone 1	111	4	13	2	7	1	10	1	Development Area	
Zone 2	1,058	39	48	15	0	0	34	4		
Zone 3	0	0	0	1	542	89	0	0		
Zone 4	346	13	174	4	5	1	191	24		
Zone 5	0	0	0	6	0	0	0	0		
Zone 6	596	22	275	2	0	0	413	52		
Sub Total	2,111	77	510	47	554	91	648	81	Preservation Area	
Coffee	246	9	46	7	0	0	36	5		
Forest	370	14	89	16	56	9	97	12		
Others	8	0	0	0	0	0	19	2		
Total	2,735	100	645	100	610	100	800	100	595	100



LEGEND

SYMBOL	ZONE
	1
	2
	3
	4
	5
	6
	COFFEE
	FOREST
	OTHERS



SCALE 1:40000
ESCALA 1:40000

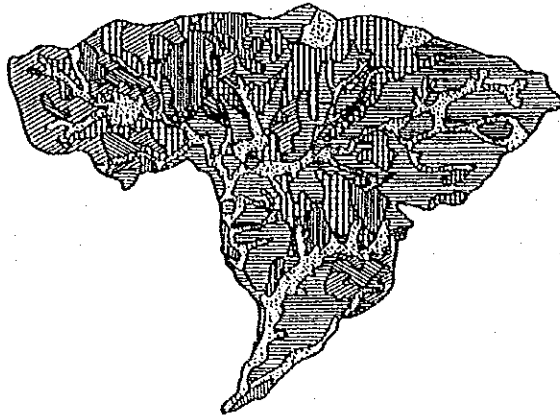
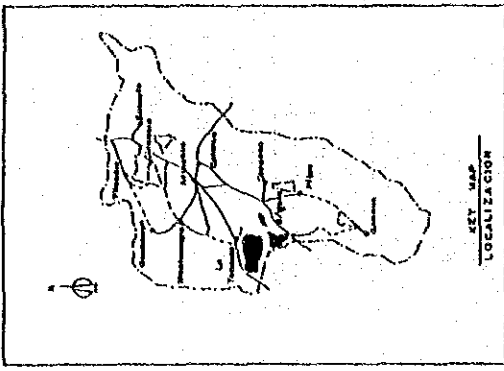
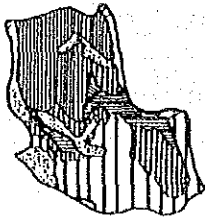


FIG 5.1.1 PROPOSED LAND USE MAP (1)

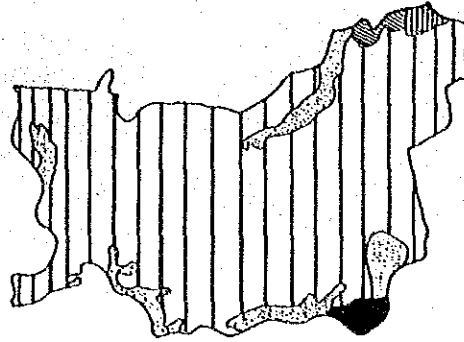


LEGEND

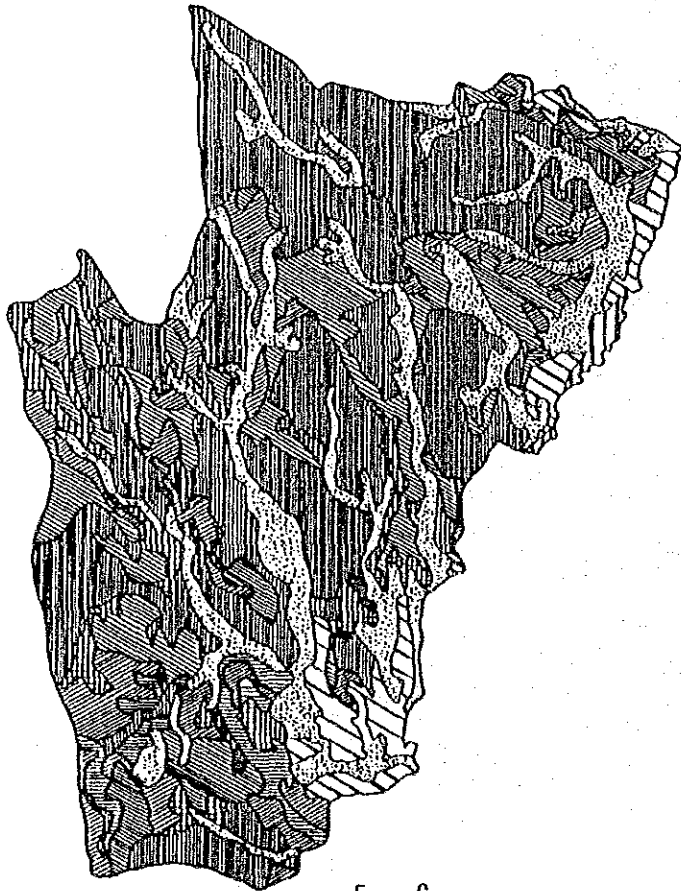
SYMBOL	ZONE
	1
	2
	3
	4
	5
	6
	COFFEE
	FOREST
	OTHERS



QUINDIO RIVER LEFT MARGIN (2)
MARGEN IZQUIERDA DEL RIO QUINDIO (2)



QUINDIO RIVER LEFT MARGIN (1)
MARGEN IZQUIERDA DEL RIO QUINDIO (1)



QUINDIO RIVER RIGHT MARGIN
MARGEN DERECHA DEL RIO QUINDIO

SCALE 1 : 40000
ESCALA 1 : 40000

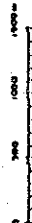
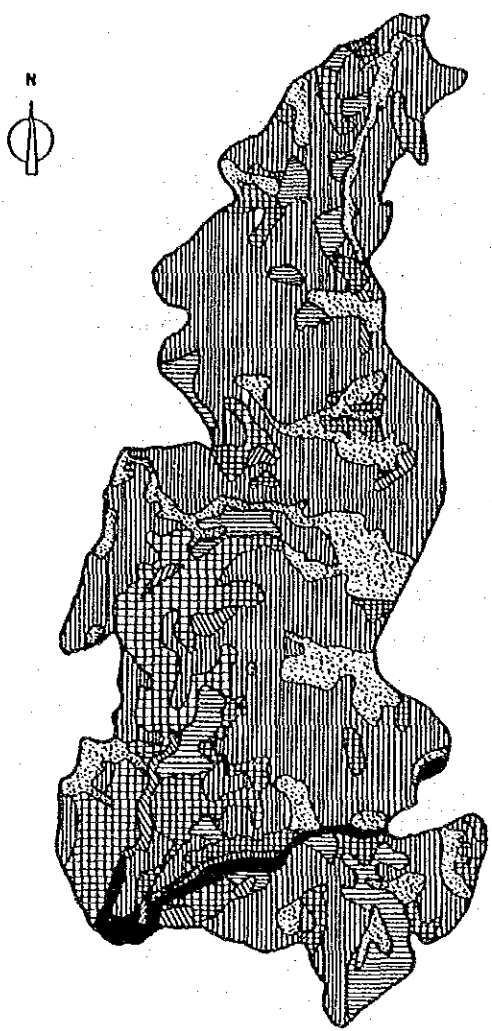
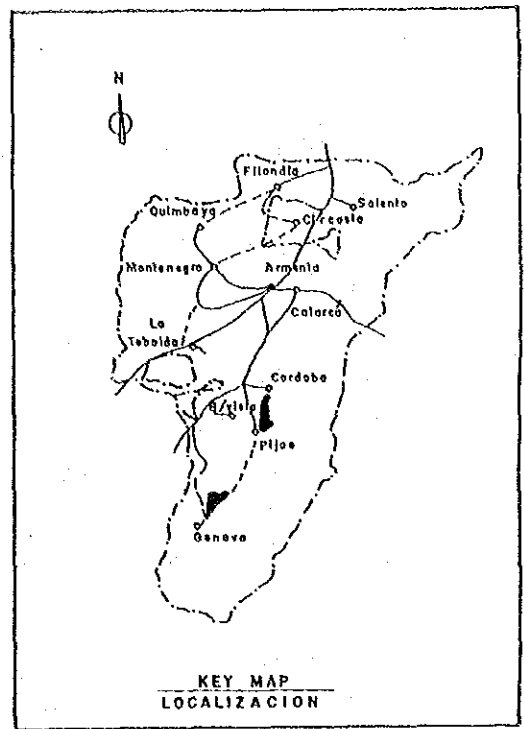


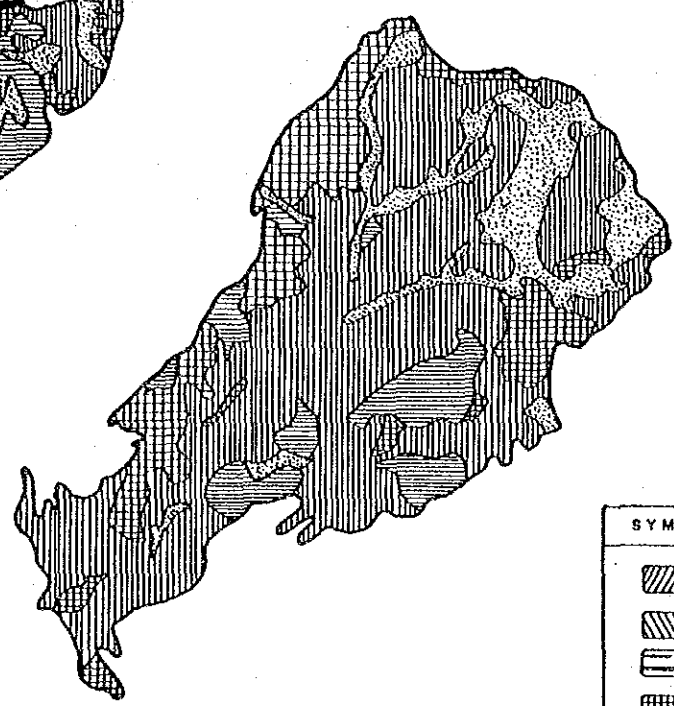
FIG 5.1.1.1 PROPOSED LAND USE MAP (2)



PIJAO
PIJAO

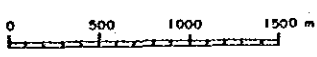


KEY MAP
LOCALIZACION



GENOVA
GENOVA

SCALE 1:40000
ESCALA 1:40000



LEGEND

SYMBOL	ZONE
	1
	2
	3
	4
	5
	6
	COFFEE
	FOREST
	OTHERS

FIG 5.1.1 PROPOSED LAND USE MAP(3)

5.2 Agricultural Production Plan

5.2.1 Basic Strategy

The objective of this plan is to increase the farmers' income by converting grazing lands and coffee local variety planted areas to those of crops of high productivity. The basic concept related to crop production is described below:

(1) Maintaining the present livestock production level

With the conversion of the existing pasture into the other crop areas, the hectarage of the pasture is reduced. However, the present livestock production level is maintained by the introduction of the improved breeding technique and improved varieties of grass in compliance with the high demand of livestock products in the market.

(2) Improvement of self-sufficiency of agro-products in Quindio

Through diversification of crops "Crop Diversification Program in Coffee Unsuitable Area by Bureau of Agriculture, Quindio" is promoted in the Project. Most of vegetables and fruits consumed in Quindio are imported from the other Departments. By promoting this plan, the self-sufficiency of vegetables and fruits in Quindio will be improved.

(3) Production of raw materials materials for agro-industry

A plant of citrus fruit is under construction in Armenia and expected to complete in June 1991. The Coffee Committee is promoting the production of raw materials for this plant. Quindo River Right Margin and Left (2) Margin areas are included in promotion area by the Committee. Therefore, in the Project, the production of raw materials for the plant in these areas is planned.

(4) Preservation of environment

In the Project, the prevention of soil erosion and improvement of water resources build-up capabilities by introducing crop production and farming system suitable for natural conditions of the respective areas are planned. Furthermore, the supply of firewood to farm houses by planting forage tree and wind-breaker is also proposed in order to preserve the existing forest resources.

(5) Basic concept of crop production

Seven areas in the Study Area are classified into four groups based on the natural conditions of the respective areas. Target for crop diversification by group is shown in Table 5.2.1.

TABLE 5.2.1 AGRICULTURAL PRODUCTION INCREASE ITEMS BY GROUP

Group	Area	Natural Conditions	Target Crops
1	Circasia	High rainfall, Low temperature	Vegetables, Fruits
2	Right M, Left M.(2)	Coffee suitable area	Juice material
3	Left M.(1)	Flat area, Poor Drainage	Upland crops
4	Salento, Pijao Genova	Steep slope area,	Fruits

5.2.2 Selection of Crops to be Introduced

The profitability and suitability of crops by group are shown in Table 5.2.2, and principal crops which may be introduced by group are shown in Table 5.2.3. The crops to be introduced are selected in consideration of crops promoted in the diversification program by the Bureau of Agriculture Quindio and Coffee Committee, their basic policy of the crops production program as well as the following matters:

- (1) Natural conditions (weather, hydrology, topography, soil, etc.)
- (2) Technical capabilities of farmers (experience of cultivation, farm size, etc.)
- (3) Marketability (demand, profitability)

Most of the crops to be introduced are currently cultivated in the Study Area, but few of them are cultivated with the intention of shipping to the market. Therefore, it is necessary to establish the cultivation method of the crops to be introduced with cultivation tests by a research center under respective natural conditions.

5.2.3 Environmental Conservation Plan

Most of the Study Area are sloped except for Quindio River Left Margin (1) Area. Soil erosion is currently observed at many places of both cultivated land and grazing land. Forest area has been reduced due to supply of firewood in mountainous areas which are principal water sources, and damage such as flooding occurs in the downstream areas.

It is necessary to promote environmental conservation by implementing enlightening education to farmers through technical extension of crops suitable for the natural conditions, farming system and farming technology such as cultivation method, in

order to conserve fertile soil, to permit permanent use of farm land and to maintain recharging capacity of water sources.

Improvement of soil management based on selection of crops to be cultivated, cropping pattern to combine crops and the cultivation method is the principal subject of study at the agriculture research center proposed in this study. The countermeasures which can be considered at the present time are indicated below.

Upland fields : To expand contour cropping and to promote such a with gentle slope farming system that the length of time when the soil surface is exposed is minimized by promotion of mixed cropping and intercropping.

Coffee fields : Weeding is currently made with sickles even on steep slopes, and it causes soil erosion. Erosion is extremely minor when weeding is made with machetes. However, if weeding is made with machetes, it is necessary to perform weeding once every two months. Therefore, such weeding is rarely performed because of high labor cost. It is necessary to promote extension activities so as to cause farmers to understand the importance of conservation of soil. Furthermore, since the length of time when the soil surface is exposed is long during the coffee collar pruning and transplanting it is necessary to prevent occurrence of soil erosion by covering the soil surface by mixed cropping of other crops.

Grassland : The majority of the grassland is located on slopes. Renewal of pasture is almost none in the current situations and natural pasture is growing at the majority of the grassland. Soil erosion is often observed because of such insufficient grassland management and also because of continuous grazing. Provision of erosion protection belt using forage tree and pasture for cutting is required as a countermeasure against soil erosion. As for renewal of pasture, it is necessary that sequential renewal is made in band form along the contour line, instead of renewal of the entire area at a time.

Upland fields with steep slope : Loss of surface soil caused by water erosion and wind erosion has become a problem at fields with steep slope. It is necessary to promote provision of erosion protection belt like in grassland in order to prevent occurrence of both of water erosion and wind erosion. The erosion protection belt shall be provided along the contour lines. A model of an erosion protection belt is shown in Fig. 5.2.1.

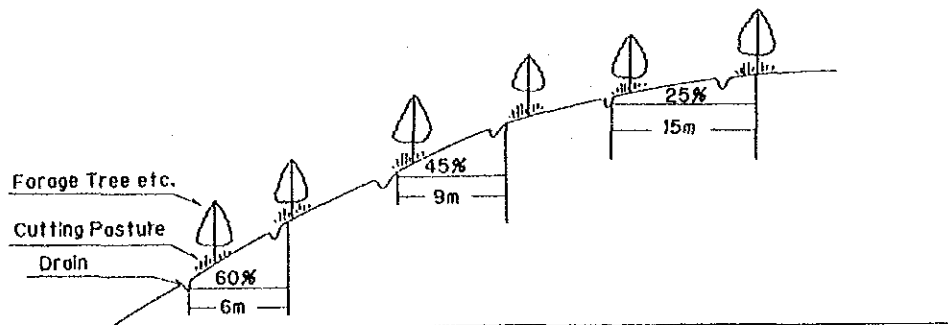


FIG. 5.2.1 MODEL OF EROSION PROTECTION BELT