

6.4 WATER QUALITY IMPROVEMENT PLAN

The water quality improvement plan is divided into: coffee wastes treatment and rural sewage treatment. Bearing the progress of water pollution in rivers and water utilization in down stream, it is proposed to implement coffee wastes treatment in long-term in accordance with the following stages.

<u>Stages</u>	<u>Catchment area</u>
I	Cristales, Roble
II	Espejo, Santo Domingo
III	Buenavista, Quindio, Barragan
IV	Verde, Lejos, Rojo

Among above cited catchment areas, the following four have been identified as priority areas to be implemented under the Master Plan.

Project Area	Actual BOD Load (Assumed)	No. of Farms		
		Small Farm (Below 5 ha)	Medium Farm (5 - 30 ha)	Large Farm (Larger than 30 ha)
Cristales	62 ppm	285	330	55
Roble	50 ppm	535	330	15
Santo Domingo	32 ppm	415	435	50
Espejo	36 ppm	445	360	35
Total		1,680	1,455	155

On the other hand, taking account of the level of river pollution, water use in downstream area and development objectives for the Master Plan (rectification of disparity between advanced and under-developed sub-regions within the Department), the long term development stages for the rural sewage treatment plan have been formulated in the following order:

	<u>Rural area</u>	<u>Urban area</u>
- First stage:	La Tebaida, Circasia, Pijao	Armenia
- Second stage:	Filandia, Montenegro, Quimbaya	Calarca
- Third stage:	Salento, Cordoba	
- Fourth stage:	Buenavista, Genova	

Although sewage treatment in Armenia and Calarca is excluded from projects under the Present Master Plan, it is imperative to present proposal for it in separate program of the Master Plan, because sewage discharged from urban area of Armenia and Calarca constitutes the major source of water pollution in the Espejo and the Quindio Rivers.

The following projects corresponding to the stage I are included in the Master Plan.

- La Tebaida Rural Sewage Treatment
- Circasia Rural Sewage Treatment
- Pijao Rural Sewage Treatment

(1) Coffee Wastes Treatment Plan

The description of the above mentioned seven projects in the water quality improvement plan for the Master Plan is given in the following subsections. Other relevant information such as treatment method is presented in Annex G.

1) Cristales Coffee Wastes Treatment Project

Objective: Enhancement of water quality in the Cristales River

Water Improvement Target: BOD below 5 ppm

Treatment Facilities:

- Small farm: Individual treatment system of land filtration method (285 Nos. - one per farm)
- Medium farm: Centralized UASB treatment plant of coffee wastes collecting by vacuum truck (11 Nos. - one per 30 farms)
- Large farm: Individual treatment plant with UASB method (55 Nos. - one per farm)

2) Roble Coffee Wastes Treatment Project

Objective: Enhancement of water quality in Roble River

Water Improvement Target: BOD below 5 ppm

Treatment Facilities:

- Small farm: Individual treatment system of land filtration method (535 Nos. per farm)
- Medium farm: Centralized UASB treatment plant of coffee wastes collecting by vacuum truck (11 Nos. - one per 30 farms)
- Large farm: Individual treatment plant with UASB method (15 Nos. - one per farm)

3) Santo Domingo Coffee Wastes Treatment Project

Objective: Enhancement of water quality in Santo Domingo River

Water Improvement Target: BOD below 5 ppm

Treatment Facilities:

Small farm: Individual treatment system of land filtration method (415 Nos. - one per farm)
Medium farm: Centralized UASB treatment plant of coffee wastes collecting by vacuum truck (15 nos. - one per 30 farms)
Large farm: Individual treatment plant with UASB method (50 Nos. - one per farm)

4) Espejo Coffee Wastes Treatment Project

Objective: Enhancement of water quality in Espejo River

Water Improvement Target: BOD below 10 ppm
(Industrial usage)

Treatment Facilities:

Small farm; Individual treatment system of land filtration method (445 Nos. - one per farm)
Medium farm; Centralized UASB treatment plant of coffee wastes collecting by vacuum truck (12 Nos. one No. per 30 farms)
Large farm; Individual treatment plant with UASB method (35 Nos. - one per farm)

(2) Rural Sewage Treatment Plan

1) La Tebaida Rural Sewage Treatment Project

This project has an objective to improve water quality in Q. Cristales which is currently polluted by domestic sewage. As a result of alternative study on the treatment of sewage (refer to Annex G), the proposal has been made to introduce a centralized treatment plant equipped with intermittent cyclic process system to urban area in which major population is occupied while land treatment system is advisable for rural area with studded population. Description of the project is as set out below.

Urban Area: Sewage treatment plant (Intermittent Cyclic Process)
- Target population: 21,000 (year 2005)
- River to which treated water is discharged:
Q. Cristales

Rural Area: Land treatment system (trench excavation): target farm - 330 farms (coffee farms are excluded in view of their sewage being treated within coffee wastes treatment projects)

2) Circasia Rural Sewage Treatment Project

This project is proposed to mitigate water pollution affected by domestic sewage in the Espejo and Roble rivers. The treatment proposal shall be as same as that is made in La Tebaida area.

Urban Area: Sewage treatment plant (1) (Intermittent Cyclic Process)

- Target population: 10,500 (year 2005)
- River to which treated water is discharged:
Espejo River

Sewage treatment plant (2) (Intermittent Cyclic Process)

- Target population: 3,500 (year 2005)
- River to which treated water is discharged:
Roble River

Rural Area: Land treatment system (trench excavation): target farm - 500 farms

3) Pijao Rural Sewage Treatment Project

The objective of the project is to improve the quality of water in the Lejos River having been polluted by domestic sewage. The same treatment method as proposed in La Tebaida will be applied.

Urban Area: Sewage treatment plant (Intermittent Cyclic Process)

- Target population: 4,200 (year 2005)
- River to which treated water is discharged:
Lejos River

Rural Area: Land treatment system (trench excavation): target farm - 850 farms

The location of these projects is given in Fig. 6.4.1.

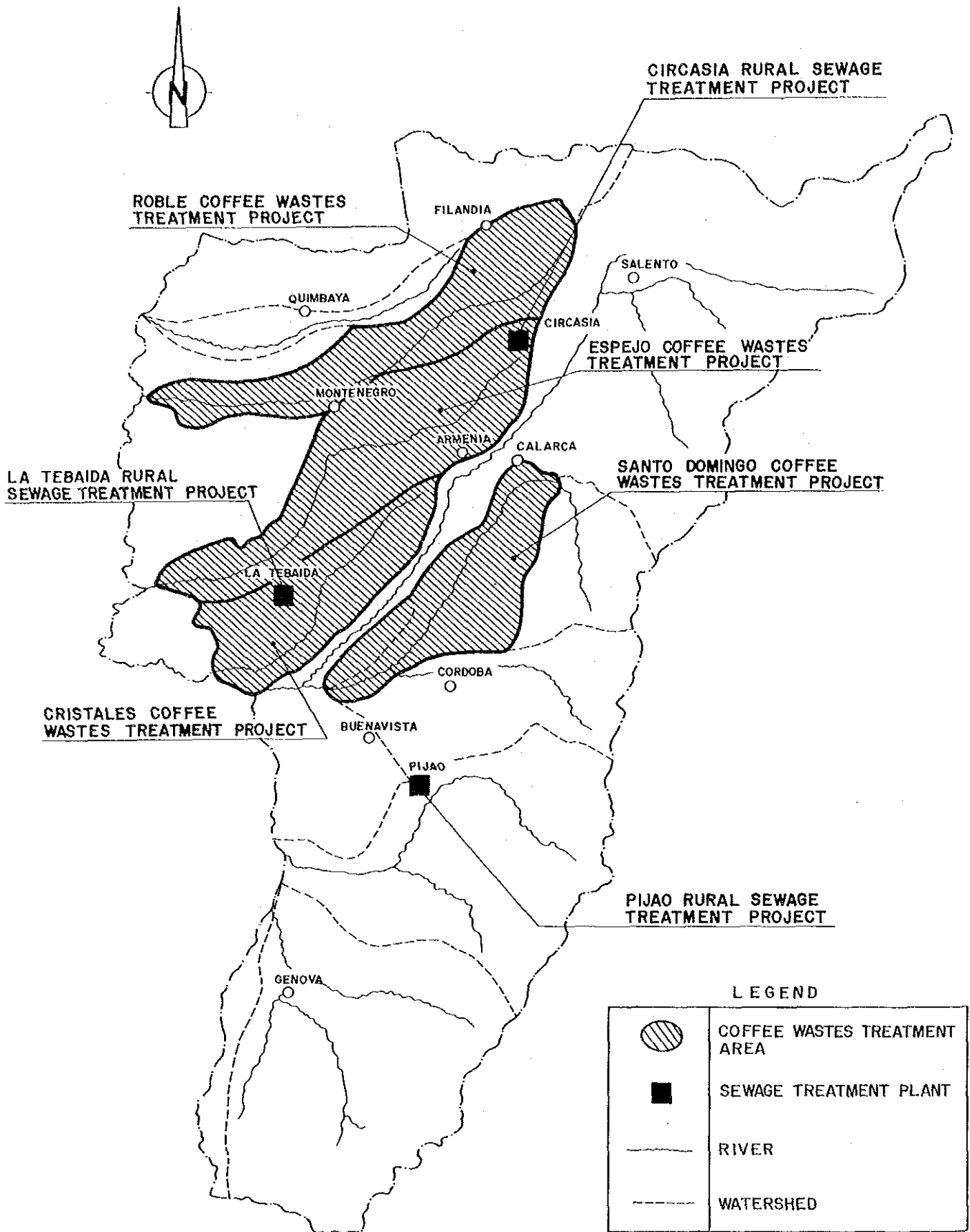


Fig. 6.4.1 PROPOSED WATER QUALITY IMPROVEMENT PROJECTS IN THE MASTER PLAN

6.5 RURAL INFRASTRUCTURE PLAN

The rural infrastructure plan is composed of rural roads, mini-hydroelectric power station and rural water supply development projects.

Taking into account of the development level of rural roads, future traffic volume projection and other sectional development plans of other sections, long-term development stages for rural road improvement plan have been formulated as follows:

Development Stage	Improvement Route	Remarks
First Stage	11 routes 113.7 km	Pavement of the high-priority roads between agricultural development areas and commercial center of the Department (Armenia) within the context of an integrated agricultural development and upgrading under-developed sub-regions.
Second Stage	10 routes 144.5 km	Pavement of the high-priority roads connecting Armenia with other municipalities within the context of an integrated regional development.
Third Stage	8 routes 163.4 km	Pavement of roads in rural and mountain area. In this stage, development of roads envisages to form a ring road network which will be transformed from radial network with hub in Armenia.

Due to the limitation of time allowable and financial resources available for the plan, rural road improvement projects under the Master Plan have been selected as follows:

- Phase I Rural Road Improvement Project: 113.7 km (First Stage)
- Phase II Rural Road Improvement Project: 144.5 km (Second Stage)

The mini-hydroelectric power station improvement plan are projected in view of attaining stable electric supply within the Department.

For this objective, the rehabilitation of existing power stations and installation of new hydraulic power stations equipped with a dam to be proposed in the agricultural development plan have been evaluated their technical and economical viability.

Station	River	Rehabilitation/ New construction	Maximum Output (kWh)	Construction Cost (million Col.\$)	Unit Construction Cost (Col.\$/kWh)	Remarks
Campestre	Quindio	Rehabilitation	1,200	340	32.4	Selected
Bayona	"	"	1,350	470	39.7	"
El Bosque	"	"	2,550	460	20.5	"
Montenegro	Roble	"	250	220	100.5	
Pijao	Lejos	"	300	310	118.0	
Navarco	Navarco	New construction	1,000	480	60.0	
Genova	Gris	"	120	400	380.5	

Note: Unit construction cost = Construction cost/annual electric output

The mini-hydroelectric power station development projects under the Master Plan have been selected due to their producing higher benefits.

- El Bosque Hydroelectric Power Station Rehabilitation Project
- Campestre Hydroelectric Power Station Rehabilitation Project
- Bayona Hydroelectric Power Station Rehabilitation Project

The rural water supply projects under the Master Plan have been selected as follows:

Projects	Reason for Selection
Southwestern Circasia Rural Water Supply Project	Insufficient supply of domestic water due to physical incapability of existing intake facilities.
Western Armenia Rural Water Supply Project	Although intake capacity has no problem, water quality round the intake point is being deteriorated.

The description of seven development projects for the rural infrastructure plan, is given in the following subsections. Their further information is as per Annex L.

(1) Rural Road Improvement Plan

1) Phase I Rural Road Improvement Project

The selection of proposed projects to be implemented in the Phase I has been made with an eye to developing high-priority roads from the viewpoint of agricultural development. The total distance for eleven projected routes reaches 113.7 km as classified below. Their location is shown in Fig. 6.5.1.

Routes	Distance (km)	Width (m)	Expected Traffic Volume in 2005 (vehicle/day)
Barragan - Genova	19.2	9.0	2,084
La Cabana - Buenavista	2.0	9.0	441
Arrayanal - Salento	9.0	9.0	786
Circasia - La Pola	9.5	9.0	-
Circasia - Montenegro	15.0	9.0	797
La Tebaida - El Vergel	13.5	9.0	-
El Vergel - Calama	3.0	9.0	-
Granada - Portogal	11.0	9.0	-
El Vergel - Pescador1	11.5	9.0	-
Salento - La Ceja	10.0	5.0	-
Salento - La Cocora	10.0	5.0	-
Total	113.7		

Note: All routes will be widened and paved.

2) Phase II Rural Road Improvement Project

For the purpose of upgrading less developed sub-regions, an emphasis has been laid on the pavement of such roads as to connect Armenia with other municipalities, and as are existing to joint urban area of each municipality with other ones. Referring to the "Roads Development Plan" elaborated by the Directorate General of Planning, Departmental Office of Quindio, the following ten routes have been selected (refer to Fig. 6.5.1).

Routes	Distance (km)	Width (m)	Expected Traffic Volume in 2005 (vehicles/day)
Genova - Pijao	27.0	9.0	713
Pijao - Cordoba	15.5	9.0	497
Cordoba - Calarca	27.0	9.0	1,220
Filandia - Quimbaya	17.0	9.0	797
Quimbaya - San Felipe	6.0	12.0	2,266
Puerto Tapao - La Tebaida	8.5	9.0	1,944
San Jose - San Pablo	4.0	9.0	676
La Suiza - La Maria	11.5	9.0	242
Baraja - Puerto Samaria	15.0	9.0	242
Quimbaya - Puerto Alejandoria	13.0	9.0	242
Total	144.5		

Note: All routes will be widened and paved.

(2) Mini-hydroelectric Power Station Improvement Plan

1) El Bosque Hydroelectric Power Station Rehabilitation Project

a) Description of the Project:

- Rehabilitation of water intake facility and driving canal (utilized for irrigation purpose)
- Replacement of generator and turbine

b) Design Criteria:

- Discharge: 3.8 m³/s
- Effective head: 80 m
- Maximum output: 2,550 kw

c) Supervising Body: Public Enterprise of Armenia (EPA)

For implementing the project, it is required to coordinate with EPA which is also planning the rehabilitation of the Station.

2) Compestre Hydroelectric Power Station Rehabilitation Project

a) Description of the Project:

- Rehabilitation of driving canal
- Replacement of penstock, turbine, generator and transformer

b) Design Criteria:

- Discharge: 2.4 m³/s
- Effective head: 60 m
- Maximum output: 1,200 kw

c) Supervising Body: Public Enterprise of Calarca (EPC)

3) Bayona Hydroelectric Power Station Rehabilitation Project

a) Description of the Project:

- Rehabilitation of driving canal
- Replacement of penstock, turbine, generator and transformer

b) Design Criteria:

- Discharge: 4.6 m³/s
- Effective head: 35 m
- Maximum output: 1,350 kw

c) Supervising Body: EPC

These three project sites are located as shown in Fig. 6.5.2.

(3) Rural Water Supply Development Plan

1) Southwestern Circasia Rural Water Supply Project

This project aims at overcoming the deficiency of domestic water to be supplied to the south western area in Circasia. The outline of the project is as resumed below:

- Proposed Benefited Area: 10 km²
- No. of Beneficiaries: 170 families
- Water Development Volume: 2.2 lit/s
- Major Facilities: Intake at small stream
Driving canal (L = 5 km)

2) Western Armenia Rural Water Supply Project

The proposal for this project is not made due to the lack of water volume to be supplied to the western area in Armenia but to the inferiority in quality of water. The location of the site from which water will be taken is proposed at the western part of Armenia from which superior water can be captured. The project has the following features.

- Proposed Benefited Area: 10 km²
- Number of Beneficiaries: 160 families
- Water Development Volume: 2.7 lit/s
- Major Facilities: Deep well (depth = 100 m)
Driving canal (L = 5 km)

The proposed sites for these two rural water supply projects are identified in Fig. 6.5.2.

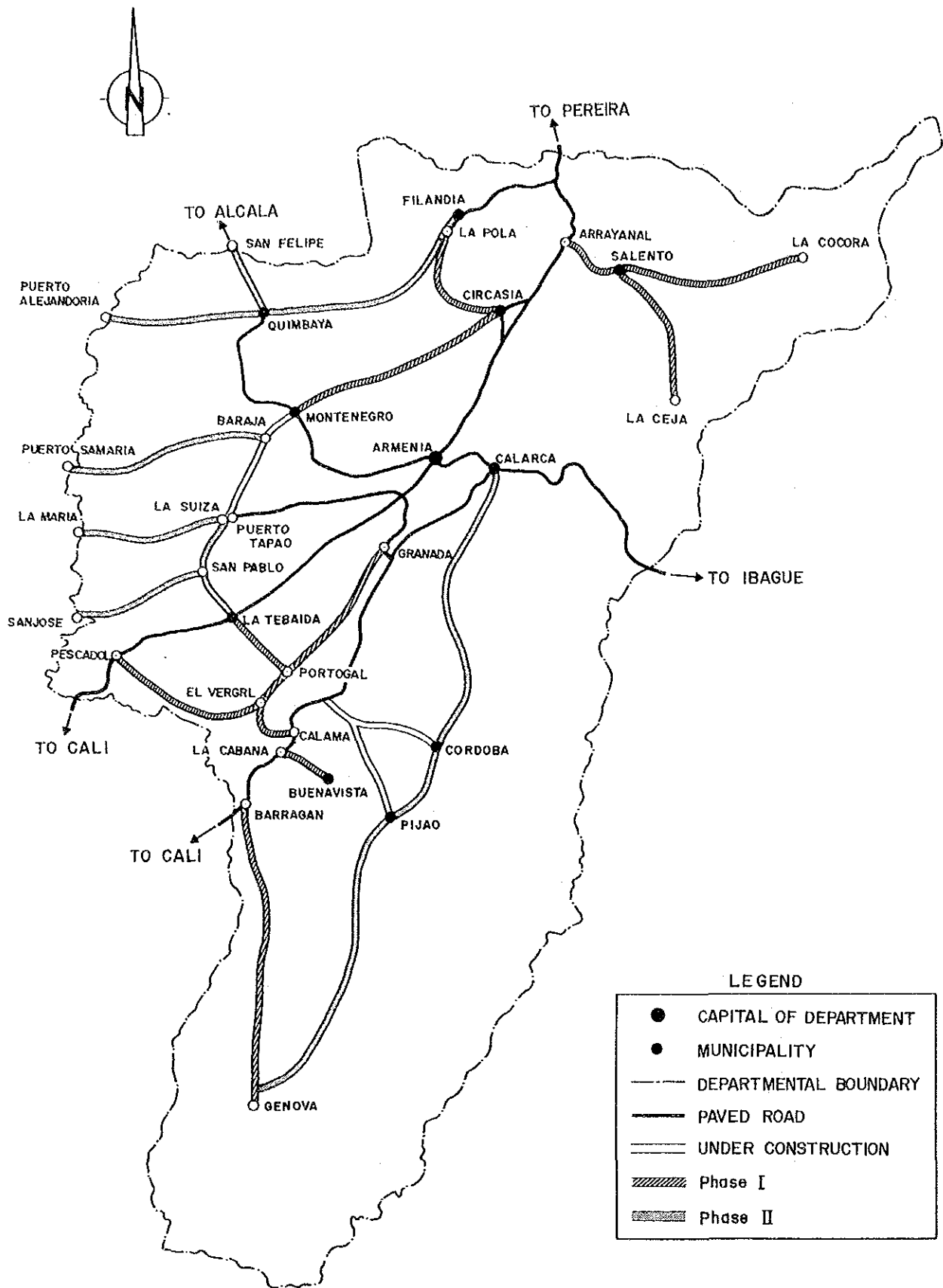


Fig. 6.5.1 PROPOSED RURAL ROAD IMPROVEMENT PROJECTS IN THE MASTER PLAN

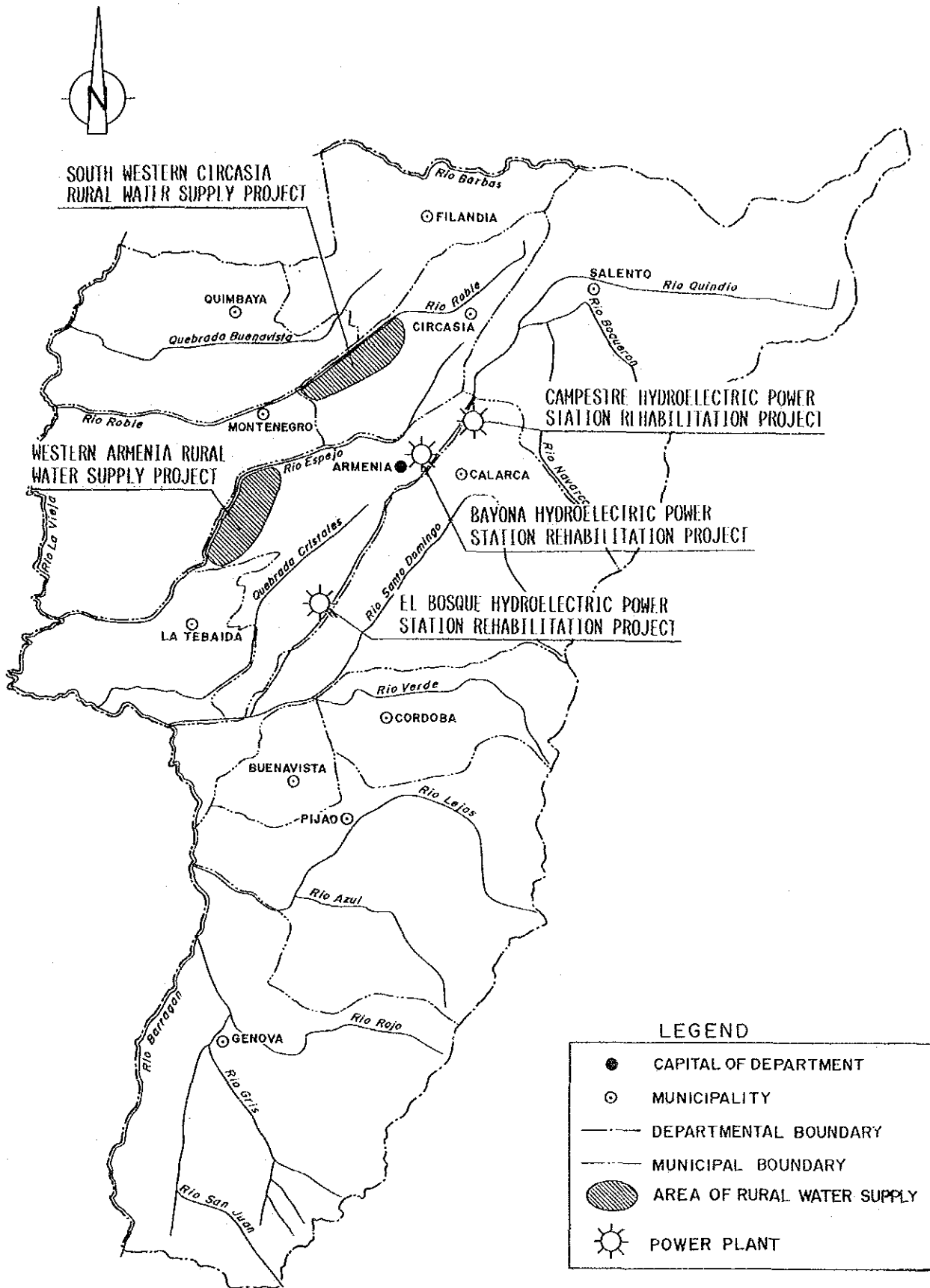


Fig. 6.5.2 PROPOSED RURAL WATER SUPPLY AND HYDROELECTRIC POWER STATION REHABILITATION PROJECT IN THE MASTER PLAN

6.6 COST ESTIMATES OF THE MASTER PLAN

6.6.1 Basic Parameters on Cost Estimate

All costs for each program formulated in the Master Plan have been estimated on the basis of market prices prevailed as of September, 1987. Exchange rates employed for the estimate are as follows:

U.S. Dollar 1 = Colombia Peso 250

For estimating direct cost, the quantity of each work item was first computed, then unit price was multiplied to obtain construction cost (refer to Annexes). This direct construction cost was added to indirect cost and physical contingency to make the total cost of the Master Plan; indirect cost and physical contingency were obtained multiplying each 30% and 20% of the direct construction cost. The price contingency to take account of price fluctuation in the course of project implementation is excluded from the total cost, nor the division of the total cost into foreign currency portion and local one was made.

6.6.2 Cost Estimates

The investment cost required to implement total projects of the Master Plan totalled Col.\$7.5 billion, which is broken down as shown in the following page (Table 6.6.1).

Table 6.6.1 COST ESTIMATES OF DEVELOPMENT PROJECTS
FOR THE MASTER PLAN

(Unit: million of Col.\$)

Projects	Cost
I. <u>Agricultural Development and Promotion Plan</u>	
- Quindio River Left Margin Agricultural Development	1,300
- Quindio River Right Margin Agricultural Development	13,000
- San Jose Agricultural Development	3,200
- Circasia Agricultural Development	1,700
- Genova-Pijao Agricultural Development	450
- Quindio Agriculture Research Center	2,600
- Salento Milk Cooling and Storage Plant	40
Sub-total	22,290 (29.9%)
II. <u>Land Conservation and Disaster Prevention Plan</u>	
- Designating Natural Conservation Area Project	170
- Lejos River Disaster Prevention Project	11,700
- Gris and San Juan Rivers Disaster Prevention Project	6,000
- Santo Domingo River Disaster Prevention Project	4,500
- Espejo River Improvement Project	1,900
- Verde River Improvement Project	70
- La Vieja River Right Bank Area Soil Conservation Project	1,600
Sub-total	25,940 (34.7%)
III. <u>Water Quality Improvement Plan</u>	
- Cristales Coffee Wastes Treatment Project	1,800
- Roble Coffee Wastes Treatment Project	1,800
- Santo Domingo Coffee Wastes Treatment Project	2,300
- Espejo Coffee Wastes Treatment Project	1,900
- La Tebaida Rural Sewage Treatment Project	2,400
- Circasia Rural Sewage Treatment Project	2,900
- Pijao Rural Sewage Treatment Project	1,600
Sub-total	14,700 (19.6%)
IV. <u>Rural Infrastructure Plan</u>	
- Phase I Rural Road Improvement Project	4,000
- Phase II Rural Road Improvement Project	5,900
- El Bosque Hydroelectric Power Station Rehabilitation Project	690
- Campestre Hydroelectric Power Station Rehabilitation Project	510
- Bayona Hydroelectric Power Station Rehabilitation Project	710
- Southwestern Circasia Rural Water Supply Project	30
- Western Armenia Rural Water Supply Project	40
Sub-total	11,880 (15.8%)
TOTAL	74,810 (100%)

6.7 MASTER PLAN IMPLEMENTATION SCHEDULE

The integrated agricultural development plan has a basic aim to obtain maximum benefit with least investment that can bring about the combining, integrating and inter-supplementing each program having a wide range of component, and by expecting multiplied effects through the implementation of them. Bearing this in mind, the Master Plan implementation schedule has been proposed.

In establishing the implementation schedule, the following programs have been given high priority in implementing at earlier stage of the Master Plan (1991 - 1995).

1) Economically feasible and earlier generation of benefits is expected

- Quindio River Left Margin Agricultural Development Project
- Quindio River Right Margin Agricultural Development Project
- Circasia Agricultural Development Project

2) Earlier implementation is imperative so as to coordinate with other related projects

- Quindio Agriculture Research Center Project
- Designating Natural Conservation Area Project

3) Highly expected projects by Colombian Side

- Phase I Rural Road Improvement Project
(The most expected project by local population is the promotion of this section, but to call attention of the private sector for participating in the agro-industry, the development of such infrastructure as road network shall be vital.)
- Cristales Coffee Wastes Treatment Project
- Campestre Hydroelectric Power Station Rehabilitation Project
- Bayona Hydroelectric Power Station Rehabilitation Project

The general implementation schedule to cover the whole of proposed programs has been established in consideration of fund distribution, coordination among these projects, etc. The Fig. 6.7.1 shows the general implementation schedule of the Master Plan.

Fig. 6.7.1 THE MASTER PLAN IMPLEMENTATION SCHEDULE

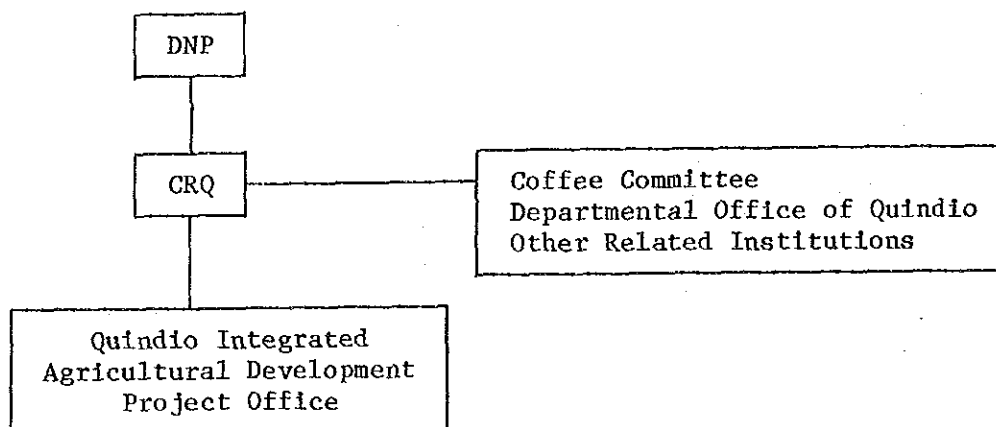
Development Plans and Projects	Cost (x 10 ⁶)	Year			
		1991	1995	2000	2005
Quindío River Left Margin A.D.	1,300				
Quindío River Right Margin A.D.	13,000				
San Jose A.D.	3,200				
Circasia A.D.	1,700				
Genova-Pijao A.D.	450				
Quindío Agriculture Research Center	2,600				
Salento Milk Cooling and Storage Plant	40				
Designating Natural Conservation Area	170				
Lejos River Disaster Prevention	11,700				
Gris & San Juan Rivers Disaster Prevention	6,000				
Santo Domingo River Disaster Prevention	4,500				
Espejo River Improvement	1,900				
Verde River Improvement	70				
La Vieja River Right Bank Area Soil Conservation	1,600				
Cristales Coffee Wastes Treatment	1,800				
Roble Coffee Wastes Treatment	1,800				
Santo Domingo Coffee Wastes Treatment	2,300				
Espejo Coffee Wastes Treatment	1,900				
La Tebaida Rural Sewage Treatment	2,400				
Circasia Rural Sewage Treatment	2,900				
Pijao Rural Sewage Treatment	1,600				
Phase I Rural Road Improvement	4,000				
Phase II Rural Road Improvement	5,900				
El Bosque Hydroelectric Power Station R.	690				
Campestre Hydroelectric Power Station R.	510				
Bayona Hydroelectric Power Station R.	710				
Southwestern Circasia Rural Water Supply	30				
Western Armenia Rural Water Supply	40				

 Preparatory Stage
  Construction Stage
 A.D. = Agricultural Development
 R. = Rehabilitation

6.8 MASTER PLAN IMPLEMENTATION ORGANIZATION

In order to materialize the Master Plan for the Integrated Agricultural Development Plan, it would be necessary to strengthen the capability of implementation agency of the Master Plan, as well as to provide its associated organizations with responsibility, authority, function, and efficient coordination. The maximum possible centralization of the implementation agency is preferable: it is prerequisite for CRQ to play a centric role in making coordination between Coffee Committee, Departmental Office of Quindio and other concerned organs to establish an implementation agency through which the plan policy, instructions and information be transmitted smoothly and efficiently.

In implementing the present Master Plan, the detailed establishment of implementation agency would be required, and the one given below is an example.



The Project Office will be staffed with regular engineers and clerical staffers who perform services related to the implementation of construction works. It should be mandatory that these staffers be selected from among Coffee Committee, Departmental Office of Quindio and other interested institutions as well as CRQ.

6.9 JUSTIFICATION OF THE MASTER PLAN

6.9.1 General

The implementation of the Master Plan which is composed of the individual development plans established through an approach of integrated agricultural development will have various positive effects; the agricultural production and income of the farmers in areas where agricultural development projects are to be carried out will increase so that the gaps with other zones be corrected, as well as in the diversification of crops be facilitated. Simultaneously, this will most probably stimulate private-level development to propagate good effects into the neighboring zones.

Through diverse projects included in land conservation and disaster prevention, water quality improvement and rural infrastructure plans, natural and human environments will be enhanced to make it possible for the farmers to lead healthier and more cultural life as well as touch off private investments in agricultural products processing sector, etc. that the citizens of the Department of Quindio have been longing for, hence resulting in the raising of the economic energies of the Department.

On the other hand, new employment opportunities such as of labor force required for the carrying out of project construction, technicians required for the maintenance of the completed projects, and other type of labor force which will be newly created due to development effects. Of the benefits which will result from the implementation of the Master Plan, agricultural production (refer to 6.1 DEVELOPMENT FRAMEWORK), etc. are tangible, while environmental improvement effects, road traffic facility, new employment opportunities and other indirect benefits are intangible because of their complicated quantification elements. Therefore, the generally established effects of these benefits will be studied in the subsequent paragraphs.

6.9.2 Effects on Employment and Income

Keeping better utilization of land and incorporation of intensive agriculture, labor opportunities in farming will increase as well as new employment such as staffers required for maintaining and managing irrigation facilities, etc. and regular employee to work with farmer's organization, etc. will be created. Likewise, civil engineering works during the project construction period will increase new employment opportunities for both skilled and unskilled laborers.

6.9.3 Environmental Improvement Effects

The implementation of a land conservation and disaster prevention plans will advance the conservation of natural environment in proposed projects area, prevent deforestation, improve farming productivity as well as alleviate flood damage and develop water resources. In addition to these advantages, the implementation of a water quality improvement projects will mitigate water pollution and promise the health and hygiene environment of inhabitants as well as irrigation water for farmland.

6.9.4 Living Conditions Enhancement Effects

The improvement of infrastructure such as roads, power plants, rural water supply services, etc. will enhance living conditions in rural area. Specially, road improvement will reduce the moving time of inhabitants and the transportation time of farm products, prevent farm products from degradation in transit, enhance living conditions of interested inhabitants due to the elimination of dirt dust, and prevent crops from damage resulting from dirt dust. Furthermore, these enhancements will induce private capital investments both inside and outside the Department, leading to the promotion of agro-products processing sector which the local population of the Department have been longing for.

6.9.5 Other Socioeconomic Effects

Other than the above mentioned effects, the following socioeconomic effects can be expected:

- Improvement of well-being of farmers due to income increase, and its propagative effects,
- Propagation of advanced agriculture into other areas adjacent to the developed areas,
- Enhancement of communications between community residents owing to road improvements, and
- Economic activation owing to an increase in the consumption of agricultural inputs.

**CHAPTER 7 HIGH-PRIORITY PROJECT I
(QUINDIO RIVER BASIN INTEGRATED
AGRICULTURAL DEVELOPMENT PROJECT)**

7.1 GENERAL

The high-priority project means a project having high urgency and necessity, and being feasible to be implemented at an earlier stage. The following three projects, located in such areas as have major concentration of projects formulated in each development component and having urgency and highly realizable characteristics, were identified as proposed projects to be evaluated their priority. These projects are combined with various project components and their detailed description is given in ANNEX N.

- Lower Quindio Basin Integrated Agricultural Development Project (Project A)
- Southern Quindio Integrated Agricultural Development Project (Project B)
- Northern Quindio Integrated Agricultural Development Project (Project C)

The table below summarized these three programs with comparison among them.

Projects	A	B	C
Development area (ha)	6,500	400	1,600
Number of beneficiarie (family)	560	30	400
Land conservation area (km ²)	0	187	0
Direct cost for Civil Works (Col\$10 ⁹)	12.93	15.34	3.97
Attainment of development objectives			
- Rectification of disparity	medium	high	high
- Intensification of coffee production per unit of land	high	non	non
- Diversification of crop production	high	low	high
- Better utilization of water resources	high	low	medium
- Conservation of natural environment	medium	high	medium
- Enhancement of living condition in rural area	high	high	high
Basic criteria for selection			
- Expectation of local population	high	medium	high
- Economic benefit	high	low	high
- Proportion of foreign currency portion	high	high	low
Comprehensive evaluation	high	medium	high

The implementation of any single, individual project as a high-priority project will give rise to the problems of coordination with the development objective, expectation of local population and project size. Accordingly, from among Projects A and C the comprehensive evaluation of which is high, plural sub-projects having higher urgency and necessity than others have been chosen and integrated as one preferential project, plus those requiring urgent flood control and rural road pavement in the municipalities of Genova and Pijao have been chosen from Project B and incorporated in the high-priority project. The project thus integrated will be called "Quindio River Basin Integrated Agricultural Development Project."

7.2 PROJECT OBJECTIVES

The objectives of the Quindio River Basin Integrated Agricultural Development Project chosen as a high-priority project are summarized as follows:

- Rectification of disparity among sub-regions within the Department (to raise the levels of small farmers and underdeveloped sub-regions).
- Intensification of coffee production per unit of land (to raise the levels of the heading economic activity of the Department).
- Enhancement of living conditions in rural area (to improve rural infrastructure improvement).

The foregoing objectives meet the development concept of the Master Plan as well as the coordination thereof with the National Development Plan of the Republic of Colombia is also maintained. In addition to the above mentioned objectives, the following objectives, based on which the Master Plan was established, will be included:

- Diversification of crop production
- Better utilization of water resources
- Maintenance of ecological balance

The Project consists of such sub-projects as meet with above objectives, and as have high urgency and necessity with major socio-economic impact.

7.3 PROJECT FORMATION

The High-Priority Project I is composed of more technically and socio-economically viable components which have been selected among candidate projects proposed in respective development plan of the Master Plan. Thus selected projects are those which:

- produce higher economic benefits and their effect are expected in shorter time;
- produce higher social effects and call for urgent implementation;
- are confronted with less constraints for their implementation;
- are highly expected by local inhabitants; and
- are expected to produce more multiple effects in combination with other projects.

The Quindio River Basin Integrated Agricultural Development Project consists of four development plans such as agricultural development and promotion, land conservation and disaster prevention, water quality improvement, and rural infrastructure.

7.3.1 Agricultural Development and Promotion Plan

With relatively high economic benefits and contribution to upgrading farmer's living standard, agricultural land improvement and agricultural promotion plan will be the core plan of the integrated agricultural development project.

(1) Development Area

Out of five candidate areas proposed under the Master Plan, the following three areas have been definitely selected in view of expectation of local population, project benefits, and less constraints for implementation.

- Quindio River Left Margin Area (A=1,500 ha)
- Quindio River Right Margin Area (A=5,000 ha)
 - . Right Margin (1) Area (2,500 ha): marginal area for coffee cultivation
 - . Right Margin (2) Area (2,500 ha): optimum area for coffee cultivation
- Circasia Area (A=1,600 ha)

Followings are reasons for that other two areas were excluded from high-priority project.

- San Jose Area:

Unfavorable location and topographic condition of development area cause high construction cost for water intake facility, farm road, etc. Water source will be the Espejo River which is seriously polluted and additional investment for water quality improvement will be required.

- Genova and Pijao Area:

Severe topographical condition of development area has relatively small number of beneficiaries and needs more development cost.

As a result, total development area of Agricultural and improvement extends 8,100 ha of which cultivated land is 5,810 ha and 960 farm households (assumed).

Detailed descriptions of each development area are tabulated in table below.

SUMMARY OF AGRICULTURAL DEVELOPMENT AREA

Project area	Development area (ha)			No. of 2/ Benefi- ciaries (family)	Objective
	Infrast- ructure	Other use 1/	Total		
Quindio River Left Margin Area	1,110	390	1,500	280	- Development of Marginal area for coffee production
Quindio River Right Margin Area (1)	1,900	600	2,500	140	- Development of Marginal area for coffee production
Quindio River Right Margin Area (2)	1,720	780	2,500	140	- Intensification of coffee production per unit of land
Circasia Area	1,080	520	1,600	400	- Encouragement of small farmers
Total	5,810	2,290	8,100	960	

Note: 1/ includes road, canal, forest, residential area, etc.

2/ Assumed by actual average farm size of proposed development area

(2) Actual and Projected Land Use

The actual and projected land use of 5,810 ha which is to undergo infrastructure improvement as cultivable land are as shown in Table 7.3.1. The basic policy for the projected land use is as described below:

- Quindio River left margin area : Introduction of intensive agriculture for orange, vegetables and other upland crops. Orange will be supplied to the processing facility projected by Coffee Committee.
- Quindio River right margin area (1) : Same as above
- Quindio River right margin area (2) : Emphasis will be laid on improving the productivity of coffee through introduction of irrigation. Therefore, other crops will remain untouched.

- Circasia : Introduction of mixed farming consists of vegetables - fruits, livestock (swine production), and freshwater pisciculture.

(3) Cropping Pattern and Production Projection

Table 7.3.2 shows the types of crops, planting areas, unit yield and output. Fig. 7.3.1 shows cropping pattern. The proposed crops, cropping pattern and planting areas have been chosen after natural conditions (climate, soil, topography, etc.), economic effects, markets, and the labor force of farmers were evaluated. For details, refer to ANNEX H.

TABLE 7.3.1 ACTUAL AND PROJECTED LAND USE IN HIGH-PRIORITY PROJECT I

Unit: ha

Land-use	Quindio River Left Margin Area		Quindio River Right Margin Area (1)		Quindio River Right Margin Area (2)		Circasia Area		Total	
	Actual	Pro- jected	Actual	Pro- jected	Actual	Pro- jected	Actual	Pro- jected	Actual	Pro- jected
Coffee	270	0	1,000	<u>800</u>	1,720	<u>1,720</u>	40	40	3,030	2,560
Upland Crop	350	<u>840</u>	620	<u>800</u>	170	170	0	<u>400</u>	1,140	2,210
Tree Crop	0	<u>270</u>	70	<u>300</u>	20	20	0	<u>680</u>	90	1,270
Pasture	490	0	270	0	190	190	1,300	0	2,250	190
Forest	180	0	140	140	220	220	160	160	700	520
Idle land	210	390	400	460	180	180	100	320	890	1,350
Total	1,500	1,500	2,500	2,500	2,500	2,500	1,600	1,600	8,100	8,100
Infrastructure Development Area 2/		1,110		1,900		1,720		1,080		5,810

Note: 1/ Includes roads, rivers, residential area, idle lands, etc. Projected area will increase 460 ha because some portion of crop productive land will be converted into such non-productive land as on-farm roads, terrace reclamation, etc.

2/ Infrastrucure development area corresponds to net cultivable area which will be benefited by the development of infrastructure (total area summed up projected area of each land use with underline); regarding to coffee only some portion of projected area will be benefited by the provision of irrigation - 80 ha for Quindio River Right Margin Area (1) and 200 ha for Quindio River Right Margin Area (2).

3/ In general terms, existing forestal land including bamboo thicket shall be conserved in view of maintaining ecological balance of the Department, but those found in the left margin area of the Quindio River will be converted into farmland supported by the following reasons:

- Being located topographically plain land, the bamboo thicket produces few effect on mitigating soil erosion.
- It is presumed that there is no alternative area for introducing an advanced agriculture with large-scale machine. Hence, a priority is given to easy farm lot formation.
- Bamboo in the area is not effectively used as a material for construction works on agricultural and livestock purpose.

TABLE 7.3.2. CROP PRODUCTION PLAN IN HIGH-PRIORITY PROJECT I

Project Areas	Crops	Planted Area (ha)	Unit field (ton/ha)	Output Production	Remarks
Quindio River Left Margin Area	Orange	270	25.3	6,800	
	Pineapple	140	33.3	4,700	
	Soybean	700	3.0	2,100	
	Maize	350	6.0	2,100	Secondary crop of Soybean
	Sorghum	350	4.0	1,400	Secondary crop of Soybean
Quindio River Right Margin Area (1)	Coffee (1)	80	2.5	200	Irrigated
	Coffee (2)	720	1.8	1,300	Not Irrigated
	Plantain	800	14.0	11,200	Intercropping with coffee
	Orange	300	25.3	7,600	
	Soybean	400	3.0	1,200	
	Maize	200	6.0	1,200	Secondary crop of Soybean
	Sorghum	200	4.0	800	Secondary crop of Soybean
	Cassava	200	30.0	6,000	
	Tomato	70	52.0	3,600	
	Onion	70	30.0	2,100	
Green Pepper	60	40.0	2,400		
Beans	400	4.8	1,900	Secondary crop of Vegetables	
Quindio River Right Margin Area (2)	Coffee (1)	200	2.5	500	Irrigated
	Coffee (2)	1,520	1.7	2,600	Not Irrigated
Circasia	Tree Crops 1/	680	10.6	7,200	
	Potato	160	19.0	3,000	
	Carrot	80	26.0	2,100	
	Welish Onion	80	38.0	3,000	Annual Cultivation
	Maize	80	6.0	500	
	Beans	240	10.0	2,400	Secondary crop
	Cabbage	80	30.0	2,400	Secondary crop

Note: 1/ Consists of "luro", tree tomato and blackberry

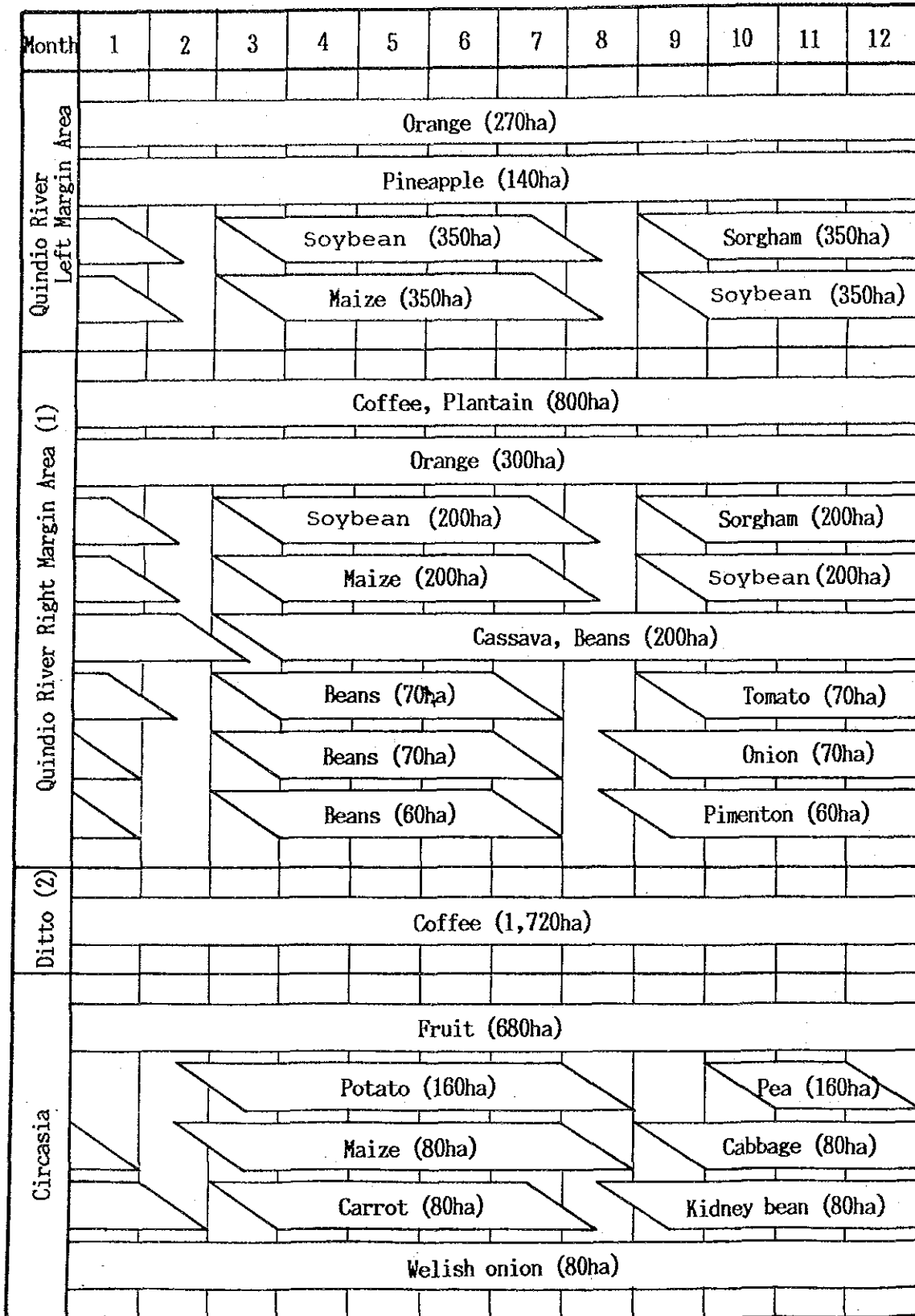


Fig. 7.3.1 CROPPING PATTERN IN HIGH-PRIORITY PROJECT I

(4) Irrigation Plan

The introduction of irrigation system is prerequisite to intensify the Department's rainwater-dependent agriculture, stabilize projected production and output, and improve quality. However, this philosophy is not suitable, if comprehensively introduced, for the Department which is comparatively blessed with high precipitation and has little experienced irrigation system. Accordingly, phased introduction would be necessary, preferably abreast of the Quindio Agriculture Research Center which performs investigation and research on the introduction of irrigation as well as gives technical assistance to the farmers.

From the above mentioned reason, the phased introduction of irrigation will be envisaged to provide irrigation system to those areas having high irrigation requirement and to some more area as a model. Accordingly, the areas to be provided with irrigation will be as shown below:

Development area	Cultivable Area (ha) (A)	Irrigable Area (ha) (B)	(B)/(A)	Remarks
Quindio River Left Margin	1,110	140	13%	Vegetables
Quindio River Right Margin (1)	1,900	280	15%	Vegetables, Coffee
Quindio River Right Margin (2)	1,720	200	12%	Coffee
Circasia	1,080	240	22%	Vegetables
Total	5,810	860	15%	

Other than the above mentioned areas, the irrigation of those which were planned in the planning stage of individual development projects by region will be carried out after completion of the high-priority project, and therefore the Navarco dam and headworks and driving canal of El Bosque will be excepted from this high-priority Project. Irrigation will basically be of the sprinkling system. Maximum water requirement, water sources and water intakes will be as given below:

Development area	Maximum Water Requirement (l/s/ha)	Water Sources	Water Intake Facilities
Quindio River Left Margin	0.7	Small Stream within the Area	Pump
Quindio River Right Margin (1)	0.7	"	Pump, Farm Pond
Quindio River Right Margin (2)	0.7	"	Pump, Weir
Circasia	0.5	"	Pump

Note: The maximum water requirement for Circasia area is smaller because of dissimilar altitude and climatological conditions.

(5) Drainage and Land Reclamation Plan

Drainage improvement and land reclamation will be envisaged for the following areas from the viewpoints of soil characteristics, topography, etc.

Development area	Drainage Improvement Area (ha)	Land Reclamation Area (ha)
Quindio River Left Margin	700 (plain land)	1,500
Quindio River Right Margin (1)	350 (plain land)	2,500
Quindio River Right Margin (2)	0	0
Circasia	0	1,600
Total	1,050	5,600

(6) Livestock Development and Freshwater Fish Culture

With the aim of eliminating pork shortage and improving the farming income of small farmers in the Department of Quindio, swine farming on a contract basis will be introduced to Circasia. This will be run by the Circasia Farmers' Cooperative. The contents of this undertaking will be as given below:

Implementing body : Farmers' Cooperative
(400 farmers)

Breeding pig : 400 heads

Contracted rearing pig : 6,400 heads/year
(approx. 16 heads/farmer)

Ancillary facility : Breeding pig center

In addition, freshwater pisciculture such as Tirapia, etc. should be promoted in parallel with raising swine in Circasia Area. In planning of freshwater pisciculture, a coordination with other areas where similar nature projects are being promoted by DRI-CRQ should be required.

Culture pond : 400 places (200 sqr.m/place)

Number of fingerlings to be cultivated : 600 pcs/pond

(7) Farmers' Cooperative

A farmers' cooperative which jointly procures production inputs, and collects and sells agricultural products will be established both in La Tebaida (520 farmers) and Circasia (400 farmers). The 140 coffee farmers at the right margin area (2) of the Quindio River are excepted from forming new organization because currently they are the members of an existing cooperative. In addition, the Circasia Farmers' Cooperative will perform the management and operation of swine production.

(8) Experimental Farm

The Quindio Agriculture Research Center is an organization essential to the smooth promotion of the high-priority Project and the Master Plan. Based on the project contents, the following undertakings which are required for carrying out of the high-priority Project will be preceded. Accordingly, the undertakings by the Center will be carried out in two stages, Phases 1 and 2, and Phase 1 will be carried out within the high-priority Project. The undertakings in phase 1 will include:

- La Tebaida Slope Land Experimental Farm: 20 ha (Vegetables, fruits and coffee).
- Circasia Slope Land Experimental Branch Farm: 8 ha (Vegetables and fruits).

The above mentioned experimental farms will perform investigations and research on high-brid varieties, cultivating techniques, mechanization, and irrigation technology of proposed crops to be included in the Project, as well as extension service of new technology. These undertakings will be operated singly or jointly by CRQ, Coffee Committee and/or the Departmental Office of Quindio.

(9) Agro-products Processing Facilities

The following facilities will be envisaged for the processing of agricultural products which are subject to an increase or to be newly introduced under the Project. Orange processing plant has been projected by Coffee Committee and since increased products can be treated by this plant, orange processing will be excepted from the Project.

	Location	Implement- ing Body	Capacity	Products
Small Feed Mill	Circasia	Cooperative	500 tons/month	Feed for swine
Meat Processing Plant	Circasia	Cooperative	1 ton/day	Ham, sausage
Vegetable and Fruit Processing Plant	La Tebaida	Cooperative	30 tons/day 1/	Transformation of pineapple and tomato

Note: 1/ volume of transformed raw material

The small feed mill will be installed with a principal objective of supplying fodder to pigs to be newly raised by cooperatives of small farmers in Circacia. Raw materials for the operation of the mill will be collected in the following manner:

- Fodder crops to be produced out of the area: 1.2 kg/head/day (37.5%)
- Agricultural sub-products to be produced within the area: 2.0 kg/head/day (62.5%)

In the vegetable and fruit processing plant, tomato and pineapple will be transformed into juice. An annual processing capacity is estimated as given below.

- Pineapple: 2,400 ton
- Tomato: 4,800 ton

The production of tomato juice, which is not preferably consumed by the local population at present, is proposed with an eye to the rectification of nutritious unbalance represented by major consumption of meat. To the success of the project it is prerequisite to facilitate enlightenment and propaganda to local population as well as to develop new market outside the Department.

7.3.2 Land Conservation and Disaster Prevention Plan

Both Pijao and Genova municipalities where many coffee and other farmers inhabit, suffer from frequent flooding of Lejos and Gris rivers respectively.

The maximum flood damages estimated by relevant authorities are as summarized below.

Items	Unit	Pijao	Genova
Flooded Area			
Urban Area	ha	34	-
Agricultural Land	ha	83	-
Number of human loss	person	603	805
Number of damaged house	nos	136	198
Amount of damaged house	peso	68,000,000	98,500,000
Amount of damaged bridges	peso	50,000,000	-

Among various project components for land conservation and disaster prevention included in the Master Plan, the priority for implementation is given to bank protection works covering ambos rivers (Lejos and Pijao). By implementing these works, it is expected that flood damages would be eliminated against the attack of flooding subject to its return period no longer than 5-years.

The construction works are outlined below.

Sub-projects	Rivers	Improvement Works
Pijao Urgent Flood Control	Lejos	Bank Protection - 7 km Bridge Rehabilitation
Genova Urgent Flood Control	Gris	Bank Protection - 10 km Bridge Rehabilitation

7.3.3 Water Quality Improvement Plan

Cristales Coffee Wastes Treatment Project is identified as the high-priority project for Water Quality Improvement Plan due to reasons stated below:

- The degree of water pollution by coffee wastes is the highest among existing rivers in the department.
- Coffee farmers in its downstream are making use of its stream for processing their products, that is associated with the deterioration of coffee beans.
- Treated water may constitute sources for irrigation water to be supplied to the right margin area of the Quindio River (Proposed agricultural development area).

The outline of plan is summarized below.

Name of the Project: Cristales Coffee Wastes Treatment
Water quality improvement target: BOD value below 5 ppm (for irrigation)

Treatment method

Small farms (below 5 ha - 285 farms):
Individual land treatment by means of trench excavation (285 sites)

Medium farms (5 - 30 ha - 330 farms):
Centralized treatment through collecting wastes by lorry truck (11 plants)

Large farms (more than 30 ha):
Individual treatment through UASB method (55 plants)

Information regarding each treatment system is given in 8.7 of the Chapter 8.

7.3.4 Rural Infrastructure Plan

The pavement of rural roads which are under-developed and the rehabilitation of mini-hydroelectric power stations for the stable electric supply are identified as high-priority projects.

(1) Rural Road Improvement Project

An earlier implementation of pavement for rural road is envisaged in the light of amelioration of living standard among rural inhabitants, as well as facilitating better commercialization of agricultural and livestock products. rural roads corresponding to the category I of the Master Plan shall be implemented in advance to rural roads of the other categories. Proposed pavement roads are as listed below:

Routes	Distance (km)	Width (m)
Barragan - Genova	19.2	9.0
La Cabana - Buenavista	2.0	9.0
Arrayanal - Salento	9.0	9.0
Circasia - La Pola	9.5	9.0
Circasia - Montenegro	15.0	9.0
La Tebaida - El Vergel	13.5	9.0
El Vergel - Calama	3.0	9.0
Granada - Portogal	11.0	9.0
El Vergel - Pescador	11.5	9.0
Sub-total (width = 9.0 m)	93.7	
Salento - La Ceja	10.0	5.0
Salento - La Cocora	10.0	5.0
Sub-total (width = 5.0 m)	20.0	
Total	113.7	

(2) Mini-Hydroelectric Power Station Development Plan

The rehabilitation of the existing power stations located at El Bosque, Campestre, and Bayona are included in the Master Plan from economical point of view; in respect to El Bosque station, only Phase-II program is included, because financial arrangement has been made for the Phase I (dredging of driving canal and rehabilitation of generator) by EPA. Hence, the rehabilitation of Campestre and Bayona stations is identified as components to be included in the High-Priority Project I.

Projects are outlined below.

Item	Campestre Power Station	Bayona Power Station
Rivers	Quindio	Quindio
Design Discharge (m ³ /s)	2.4	4.6
Effective Head (m)	60	35
Maximum Output (kw)	1,200	1,350
Annual Electric Product (kWh)	10 million	11 million

The proposed development plan of above two stations comprises the rehabilitation of the existing driving canal of the Campestre Station and the replacement of penstock, turbine, generator and transformer for both stations.

With the completion of these two stations, an annual product of 21 million kWh is expected. This product is equivalent to about 9% of the total electric volume presently supplied by CHEC and satisfies an annual demand in Calarca.

The location of all sub-projects included in Quindio River Basin Integrated Agricultural Development Project is indicated in Fig. 7.3.2.

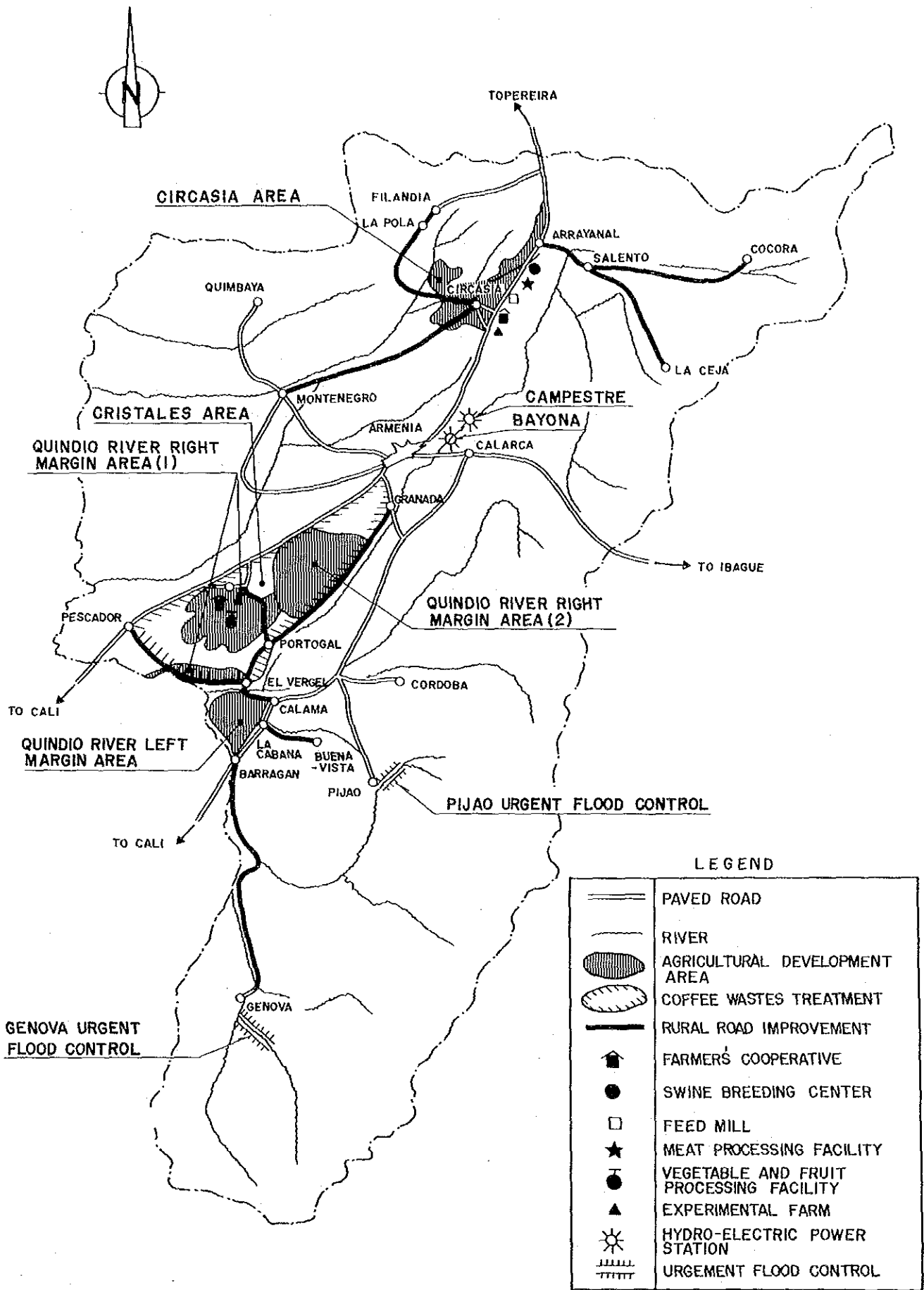


Fig. 7.3.2 COMPONENT OF THE HIGH-PRIORITY PROJECT I

7.4 PROJECT COST

The cost for the Project has been estimated on the basis of market prices prevailed as of September, 1987. For estimating direct cost, the quantity of each work item was first computed, then unit price was multiplied. This direct construction cost was added to indirect cost and physical contingency to make the total cost of the Project; indirect cost and physical contingency were obtained multiplying each 30% and 20% of the direct construction cost. No price contingency is included in the cost of the Project.

(1) Direct Construction Cost

Development Plans and Sub-projects	Quantity	Cost (million of Col.\$)
<u>Agricultural Development and Promotion Plan</u>		
1. Quindio River Left Margin Area Agricultural Development	1,110 ha	450
2. Quindio River Right Margin Area (1) Agricultural Development	1,900 ha	800
3. Quindio River Right Margin Area (2) Agricultural Development	1,720 ha	90
4. Circasia Area Agricultural Development	1,080 ha	780
5. Farmers' Cooperative	2	20
6. Circasia Swine Breeding Center	Lump Sum	20
7. Circasia Small Feed Mill	Lump Sum	40
8. Circasia Meat Processing Facility	Lump Sum	40
9. La Tebaida Vegetable and Fruit Processing Facility	Lump Sum	240
10. La Tebaida Slope Land Experimental Farm	Lump Sum	170
11. Circasia Slope Land Experimental Branch Farm	Lump Sum	100
Sub-total		2,750
<u>Land Conservation and Disaster Prevention Plan</u>		
12. Pijao Urgent Flood Control	Lump Sum	910
13. Genova Urgent Flood Control	Lump Sum	1,280
Sub-total		2,190
<u>Water Quality Improvement Plan</u>		
14. Cristales Coffee Wastes Treatment	Lump Sum	1,170
<u>Rural Infrastructure Plan</u>		
15. Rural Road Improvement (width 9 m)	93.9 km	2,630
16. ditto (width 5 m)	20.0 km	50
17. Campestre Hydroelectric Power Station Rehabilitation	Lump Sum	340
18. Bayona Hydroelectric Power Station Rehabilitation	Lump Sum	470
Sub-total		3,490
Total Cost		9,600

(2) Project Cost

The Project cost has been computed adding indirect cost (30% of the direct construction cost) and physical contingency (20% of the direct construction cost) to the direct construction cost. Thus, the project cost for implementing the Quindio Basin Integrated Agricultural Development Project totalled Col.\$14,400 million, which is composed of Col.\$9,600 million for the direct construction cost, Col.\$2,880 million for the indirect cost and Col.\$1,920 million for the physical contingency.

7.5 PROJECT IMPLEMENTATION SCHEDULE

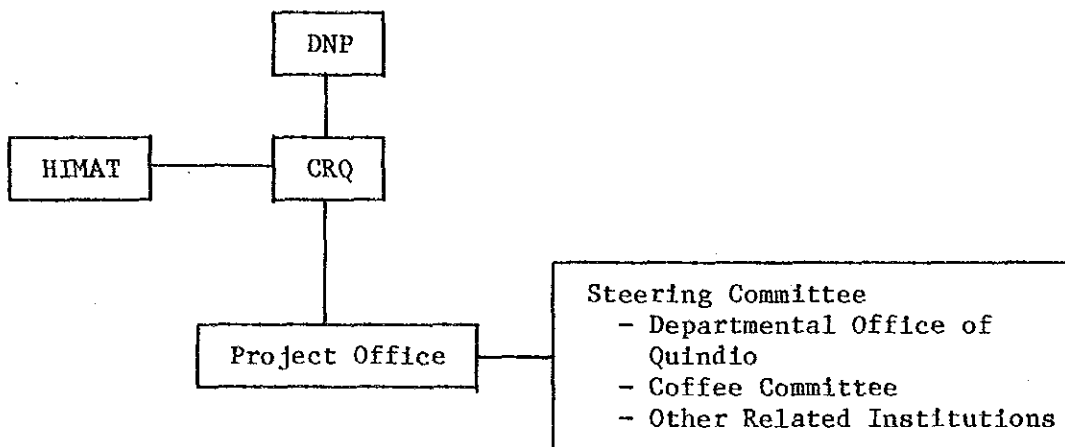
In advance to the implementation of the Project, it is prerequisite to conduct a feasibility study (F/S). It is expected that a preparatory period ranging from 18 to 24 months should be required for the F/S and the loan agreement. Consequently, if the F/S is conducted in the fiscal year of 1989, the Project will start in the fiscal year of 1991. In establishing the Project implementation schedule, a coordination among sub-projects has been made, and sub-projects with higher economic impact have been placed in such manner as to be completed as early as possible. The total Project period is scheduled in 5 years, of which the preparatory stage such as detailed design of construction works and evaluation of tender, etc. covers 1.5 years and the construction stage 3.5 years. Taking these parameters in account, the Project implementation has been delineated as given below:

WORK ITEM		YEAR				
		1	2	3	4	5
Preparation WORKS	Detailed Design and Preparation of Tender Documents	█				
	Tendering and Evaluation of Tenderes		█			
Construction Works	Quindio River Left Margin Area Agricultural Development		█	█	█	
	Quindio River Right Margin Area (1) Agricultural Development		█	█	█	
	Quindio River Right Margin Area (2) Agricultural Development		█	█	█	
	Circasia Area Agricultural Development		█	█	█	
	Farmers' Cooperatives (2 units)			█	█	
	Circasia Swine Breeding Center			█	█	
	Agro-products Processing Facilities (3 sites)				█	█
	Experimental Farm (2 sites)		█	█	█	
	Urgent Flood Control in Pijao		█	█	█	
	Urgent Flood Control in Genova		█	█	█	
	Coffee Wastes Treatment		█	█	█	█
	Rural Road Improvement (W=9m)		█	█	█	█
	Rural Road Improvement (W=5m)					█
Campestre Hydroelectric Power Station Rehabilitation			█	█	█	
Bayona Hydroelectric Power Station Rehabilitation			█	█	█	

Fig. 7.5.1 PROJECT IMPLEMENTATION SCHEDULE

7.6 PROJECT IMPLEMENTATION ORGANIZATION

The service of the Project implementation agency consists of administration and supervision of the construction works and management, operation and maintenance of the Project itself. The preparation and construction of the Project including detailed design and tender evaluation requires five years, and the construction works comprise various type of engineering skills. In light of this, the incorporation of a Project office will be indispensable so that an appropriate administration and supervision of construction works might be realized. The Project Office is proposed to be organized as shown below:



It is prerequisite to station at the Project Office staffers for general administration and land acquisition and engineers of such fields as road, agricultural engineering, river, water quality, power generation, architecture, agronomy, livestock, etc.

It is recommended that this Project Office would be used as Project Management, Operation and Maintenance Office after completion of the construction works.

7.7 PROJECT EVALUATION

7.7.1 Economic Evaluation

(1) Economic Internal Rate of Return (EIRR)

The EIRR is the discount rate at which the streams of costs and benefits, both expressed in the present value, are equal. The EIRR of the Project has been thus obtained at 14.9%. The parameters for calculation of benefits, costs and other factors are described in detail in ANNEX O.

(2) Sensitivity Analysis

The sensitivity analysis has been carried out on the increase of costs, reduction of benefits and delay in construction works. The result of the sensitivity analysis is as follows:

<u>Items</u>	<u>EIRR (%)</u>
Costs increased by 10%	13.4
Benefits reduced by 10%	13.3
Construction works delayed by one year	14.3

7.7.2 Financial Analysis

The financial internal rate of return (EIRR) of the Project is 13.5% which has been obtained applying actual costs in financial terms. Detailed description on benefits, costs, etc. is given in ANNEX O.

7.7.3 Social Evaluation

It is expected that the following effects will be produced with the completion of the Project.

- 1) The agricultural production in areas where infrastructure is to be provided will increase that will contribute to rectify the gaps with optimum coffee production areas and facilitate the diversification of crop production.
- 2) Natural and human environments will be enhanced to make it possible for farmers to lead healthier and more cultural life as well as permanently settle farmers where they live.
- 3) The improvement of infrastructure will touch off private investments in agricultural products processing sector that local population of the Department has been longing for.
- 4) Employment opportunities such as of labor force required for farming activities in intensified farms and for carrying out of project construction and technicians required for the maintenance of the completed projects will be newly created.
- 5) Propagation of advanced agriculture into other areas adjacent to the development areas will be made.

7.7.4 Conclusion

In accordance with the said economic, financial and social evaluations, the implementation of the Quindio River Basin Integrated Agricultural Development Project is justified.

7.8 FINANCIAL PROPOSAL

The implementation of the Project requires a total cost of approximately Col.\$15,000 million. In preparing project cost procurement plan, it is prerequisite to divide the project cost into such categories as to be borne by farmers or cooperatives, by the Department or municipalities, and by the Central Government. In the course of the Feasibility Study, this division will be definitely made, and besides, the division into foreign and local currency portions will be conducted so that the amounts to be loaned by international financing institutions and locally procured would be clearly indicated.

**CHAPTER 8 HIGH-PRIORITY PROJECT II
(COFFEE WASTES TREATMENT PROJECT)**

8.1 GENERAL

The treatment of coffee wastes has been an issue of general concern for not only the Department of Quindio but also other coffee producing departments in the country. Generally speaking, coffee is processed by two principal methods: one is the dry process which is practiced in Brazil and other countries and the other is wet process employed in Colombia and other countries expecting to produce better quality (mild) coffee than dry process coffee. The wet process method is always correlated with water pollution in rivers to which wastes are discharged.

In Quindio, rivers running through coffee production areas are polluted by coffee wastes resulting in serious problem for local population. Although various alternatives have been presented to solve technically coffee wastes-related pollution, they have not been implemented partly because of economic infeasibility for implementation partly because no benefit is expected to coffee growers who are to install treatment plants.

Within the pre-feasibility study for high priority project, in due consideration of local characteristics of the Department of Quindio, the most practical measures for the treatment of coffee wastes have been proposed as explained hereinunder.

It is worth while indicating that Coffee Wastes Treatment Project in Cristales is included in the High-Priority Project I, presented in Chapter 7, with views to supply purified water for irrigation purpose in proposed agricultural development areas as well as for processing coffee berry in downstream areas. In the present chapter, for the purpose of incorporating coffee wastes treatment proposal to cover the whole area of the Department, all related rivers including Cristales will be studied and discussed.

8.2 IMPROVEMENT STRATEGY

The basic and an optimum proposal to improve water affected by coffee wastes is to eradicate polluting matters at the source where they are produced, but this method requires vast investment and longer period because about 8,000 coffee farmers are scattered all over the Department.

Accordingly, setting up comprehensive eradication of pollutants as a final goal, water quality improvement measures shall be taken in phases.

In view of the above, strategies for coffee wastes treatment are as follows:

- Each watershed will be targeted for improvement.
- To set up the goal for improvement by each catchment area.
- The improvement of watershed will be made in such orders as are expected higher impact by alleviating potential sources of pollution.
- The level of improvement will be established according with the size of coffee farms.

8.3 IMPROVEMENT TARGET

Taking account of water usage, improvement targets of water quality of each river have been established as follows:

Purposes	Targets	Rivers
Potable Water	BOD below 1 ppm	Rojo, Verde Upstreams of Lejos, Santo Domingo, Quindio and Roble
Agricultural Usage	BOD below 5 ppm	Barragan, Buenavista, Verde, Q. Cristales, Middle and down streams of Lejos, Santo Domingo, Quindio and Roble
Industrial Usage	BOD below 10 ppm	Espejo

For attainment of above established targets, loads to be reduced by each river are as set out below:

Reduction of load (%)	Rivers
More than 90	Buenavista, Roble, Q. Cristales and Barragan
90 - 80	Santo Domingo and Verde
80 - 70	Espejo and Lejos
70 - 60	Quindio and Rojo

8.4 WATER QUALITY IMPROVEMENT PROPOSAL

8.4.1 Legislative and Institutional Proposal

In order to effectively promote water improvement on river, it is recommended to build up following legislative systems.

- To facilitate education and enlightenment on environmental conservation;
- To improve and expand the systematic study on coffee wastes treatment plants;
- To consolidate operation and maintenance system of treatment plants, and to educate and train engineers who will take charge of these plants;
- To provide adequate supporting services to coffee growers such as subsidy, loan, etc;
- To prohibit by law to dump coffee pulps and other solid wastes into rivers;

- To establish legislatively standard on coffee wastes disposal:
- To establish an allowance limit of water quality in rivers; and
- To provide water quality supervision monitors.

8.4.2 Technical Proposal

As for the treatment of coffee wastes, the following five alternatives have been evaluated.

Alternatives	Contents
1. To stagger the timing of coffee processing	<p>This method aims to level off discharged load of coffee wastes by staggering the timing of peak coffee processing. For this purpose, a coordination presided by administrative authorities will be indispensable. Constraints to develop this alternative are that the reduction of pollution load is limited and that it is not applicable in abnormally droughty period.</p>
2. Dilution	<p>This alternative is feasible where water for dilution is available. Nevertheless, the implementation of the same is constrained from regulations prevailing in Colombia; in addition, polluted water can not be purificated completed but are only mitigated by the introduction of dilution water.</p> <p>2.1 To dilute with water at farm level</p> <p>If coffee wastes are disposed containing BOD element of 100 ppm, they should be diluted with water forty five times more than coffee wastes. Where water resources are deficiently found, the application of the present method will be infeasible.</p> <p>2.2 To secure water for dilution by catchment area</p> <p>This method proposes to control water quality by installing reservoirs for each catchment area. The required water volume will be ten times as much as an average discharge of river water. This method will be in need of high construction cost.</p>

Alternatives	Contents
3. To ameliorate assimilating capacity of rivers	<p>This proposal envisages to ameliorate self-purification capacity of rivers by taking some measures in rivers and streams. But this method has constraint, as it has a limit of cutting down for pollutant load.</p> <p>3.1 To make contact purification by installing stones or other contact materials</p> <p>3.2 To expect aeration effect setting water head</p> <p>3.3 To lower water level and to enhance natural aeration function by expanding cross-section of rivers</p> <p>3.4 To improve sedimentation capacity by settling basin</p>
4. Centralized treatment of coffee wastes	<p>This method contributes to overcome water quality problem, because it envisages to purificate wastes themselves. The constraint on developing this method lies in the procurement of considerable amount investment for both construction and operation and maintenance.</p> <p>4.1 To collect coffee wastes for treatment</p> <p>This system proposes to collect coffee wastes from farmers, to discharge them into exclusive canals for coffee wastes or to transport them by vacuum truck lorry, and to purificate at the final treatment plant.</p> <p>4.2 To collect coffee berry for process</p> <p>This proposal deals with collecting coffee berries from growers so that they could be processed in one plant. For this purpose a coffee processing plant equipped with purification system should be installed. Existing depulping equipments owned by independent farmer will become useless.</p>

Alternatives	Contents
5. Independent treatment	The total amount of coffee wastes will be treated where they are produced. This proposal can be realized by installing additionally purification devices to existing facilities owned by coffee growers. The operation and maintenance will be conducted by farmers, which suggests that a complicated and costly system will not be appropriate.

As mentioned above, each proposal has advantageous and disadvantageous aspects and none of them is considered to be an optimum one if discharged loads are not reduced. In this regard, the installation of a purification facility will be imperative. Accordingly, following alternatives are regarded as suitable ones.

- Centralized treatment of coffee wastes
- Independent treatment of coffee wastes

8.5 TREATMENT METHOD

Characteristics of coffee wastes are high concentration of loads, low pH value and seasonal concentration of their disposal. Candidate alternatives for treatment of coffee wastes are as given below:

- A. Land Filtration
- B. Anaerobic Pond
- C. Aerated Lagoon
- D. Activated Sludge Process
- E. Intermittent Cyclic Process
- F. UASB (Upflow Anaerobic Sludge Blanket) Process

These alternatives are evaluated in the following manner.

Alternatives	A	B	C	D	E	F
1. Treatment Capacity	3	4	5	5	5	5
2. Duration of Treatment Time	2	1	2	4	4	3
3. Efficiency	5	5	5	4	5	4
4. Lot Requirement	3	1	2	3	3	5
5. Investment	5	4	3	2	3	4
6. Electric Consumption	5	5	3	2	3	5
7. Operation and Maintenance	2	3	4	2	3	3
Comprehensive Evaluation	B	E	D	F	C	A

Note: 1 (Advantageous), 2 (Less Advantageous), 3 (Regular)
4 (Less Disadvantageous), 5 (Disadvantageous)

As the result of comprehensive evaluation, the UASB and Land Filtration methods were identified as being appropriate to be employed in the present Study. The former will be employed where abundant effluents are discharged while the latter is for little effluent.

8.6 IMPROVEMENT STAGE

Water quality will be treated by respective river. The proposed stage of improvement was decided by the degree of pollution and purpose of water usage.

Rivers in the Department will be improved in accordance with the following orders.

- First Stage: Cristales and Roble
- Second Stage: Espejo and Santo Domingo
- Third Stage: Buenavista, Quindio and Barragan
- Fourth Stage: Verde, Lejos and Rojo

Large farms with holdings more than 30 ha and produce a greater portion of coffee wastes occupy about 60% of the total coffee plantation area. Therefore, for attaining major effect on reduction of pollutants, it is advisable to implement coffee wastes treatment project to begin with large farmers whose financial capacity can support the introduction of independent treatment plant. On the other hand, for facilitating earlier introduction centralized treatment system will be provided for medium farms (land holdings 5 - 30 ha) who are financially inferior to large farm. Finally, for small farms with holding below 5 ha land filtration method within farm is recommended in view that the amount of coffee wastes produced by them is little. In sum, the treatment method by farm size is proposed as follows.

- First Stage:
Large Farm (larger than 30 ha): Individual treatment through UASB method
- Second Stage:
Medium Farm (5 - 30 ha): Centralized treatment through UASB method
- Third Stage:
Small Farm (below 5 ha): Simple individual treatment by means of land filtration

8.7 MODEL PLANT FOR COFFEE WASTES TREATMENT

8.7.1 Selection of Proposed Area

As proposed area to establish a model plant, the Q. Cristales has been identified considering its higher degree of pollution. The target water quality level will be set as the value of BOD below 5 ppm considering treated water is to be used for agricultural purpose. It is estimated that coffee farms under the influence of the Q. Cristales are distributed in the following manner.

Farm Size Category	No. of Farms	Total Cultivated Area (ha)
Larger than 30 ha	55	4,100
5 - 30 ha	330	2,000
Below 5 ha	285	490
Total	670	6,590

8.7.2 Model Plant

As proposed treatment system of coffee wastes, the system beamed at large farm adopts individual treatment with UASB method and for small farm makes use of simple individual treatment with land filtration method (infiltration of the wastes through a pipe laid underground).

As proposed treatment system for middle farm, the following four alternatives were evaluated so as to select the most practicable and appropriate one.

Alternatives	Facilities	Contraints or implementation
A. Individual Treatment	Individual Plant: 330 (USAB Method) Cost: Col.\$1,020 x 10 ⁶	Small plants are installed in many sites, so this alternative deems to be uneconomical. If the construction cost of plant should be borne by coffee growers themselves, their financial capacity will make it difficult to introduce this system.
B. Centralized treatment through collection of coffee berry	Centralized plant: (USAB Method) Cost: Col.\$720 x 10 ⁶	Coffee growers may complain regarding gradation and purchase practice of coffee berry. Furthermore, depulping plants owned by each coffee grower become useless.
C. Centralized treatment through collection of coffee wastes by canal	Centralized plant: 33 (USAB Method) Channel (km): 165 Cost: Col.\$850 x 10 ⁶	The severety undulating topography makes it costly to install canal and the number of treatment plant becomes numerous.
D. Centralized treatment of coffee wastes through collection of coffee wastes by vacuum truck	Centralized plant: 11 (USAB Method) Vacuum truck: 11 Pit (30 m ³): 330 Cost: Col.\$680 x 10 ⁶	It is required to excavate reservoir to retain coffee wastes for each coffee grower.

Note: Cost is direct construction cost

As a result of above evaluation, it is considered that the centralized treatment system collecting wastes by vacuum truck is the most economical one with an advantage to make use of existing facilities owned by farmers.

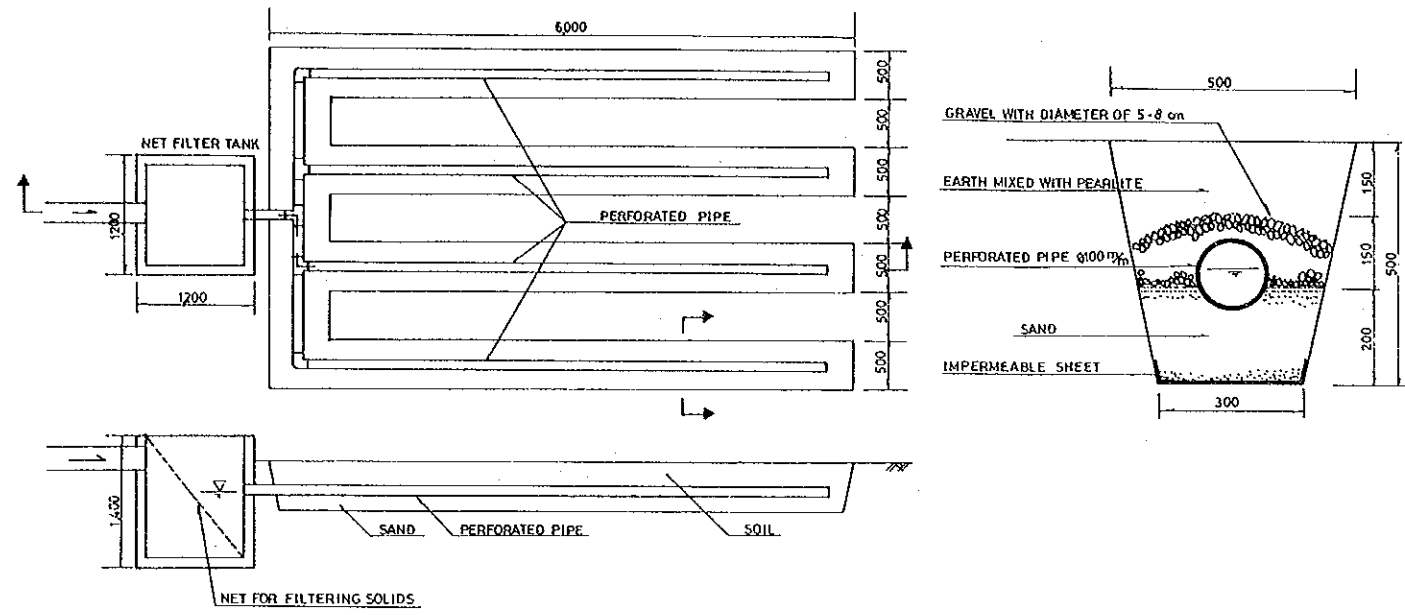
Accordingly, the facilities for the Q. Cristales wastes water improvement will consist of the following components:

For large farm: Individual treatment with UASB Method - 55
 For medium farm: Centralized treatment by vacuum truck - 11
 For small farm: Simple treatment by means of
 land filtration - 285

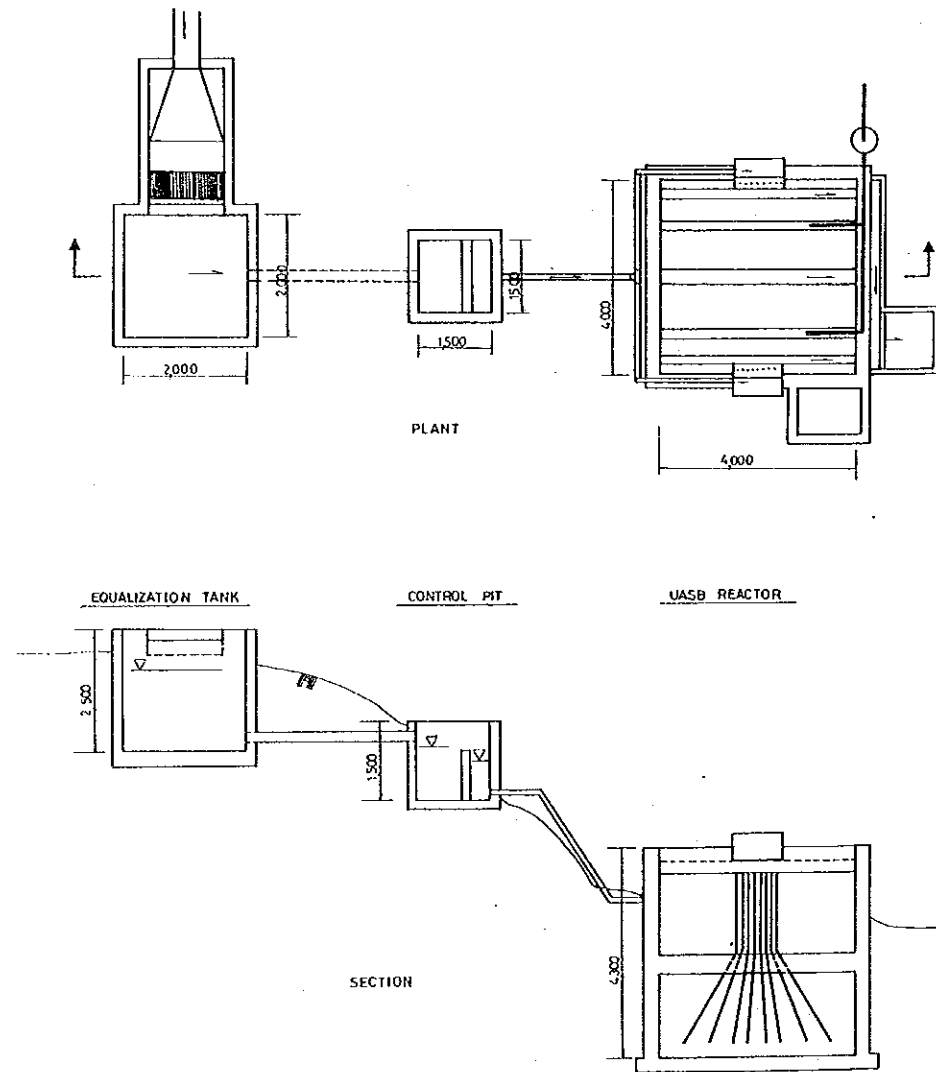
The description of the Cristales Coffee Wastes Treatment Project is as summarized below.

Item	Unit	Small Farm	Medium Farm	Large Farm
Cultivated area	ha	490	2,000	4,110
Coffee farm	number	285	330	55
Unit farm size	ha/farm	1.7	6.1	74.7
Area per 30 farms	ha/30 farms	-	181.8	-
Unit yield	ton/ha	0.25	0.25	0.25
Maximum output	ton/month	0.4	45.5	18.7
Unit discharge of wastes	m ³ /ton	10.2	10.2	10.2
Maximum discharge of wastes	m ³ /month	4.1	464.1	190.7
Treatment frequency	time/month	10	10	10
Discharge par time	m ³ /time	0.4	50.0	20.0
Treatment system		Land Filtration	UASB	UASB
Net filter tank	unit	1	-	-
	size(m)	1.2x1.2x1.4	-	-
Trench	unit	4	-	-
	size(m)	0.5x0.5x6.0	-	-
Storage pit	unit	-	2	-
	size(m)	-	3.0x3.0x1.5	-
Equalization tank	unit	-	1	1
	size(m)	-	4.0x4.0x2.5	2.0x2.0x2.5
Control pit	unit	-	1	1
	size(m)	-	2.5x2.5x1.5	1.5x1.5x1.5
UASB reactor	unit	-	1	1
	size(m)	-	7.5x7.5x4.5	4.0x4.0x4.3

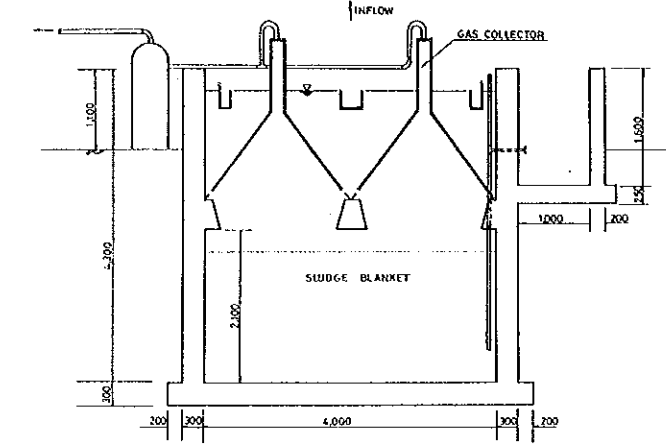
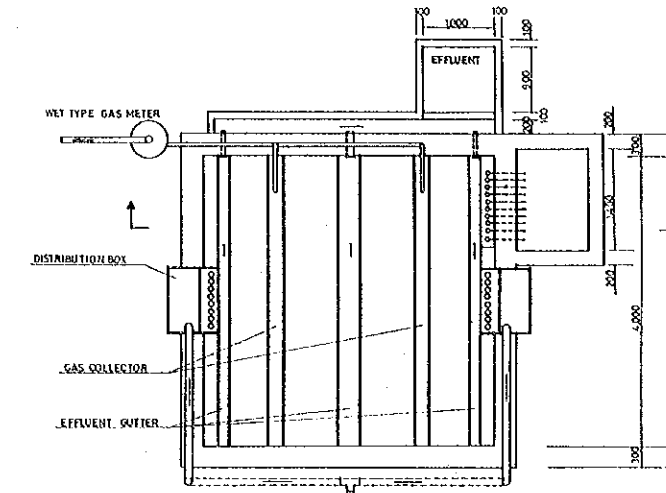
Each treatment system is illustrated in Fig. 8.7.1.



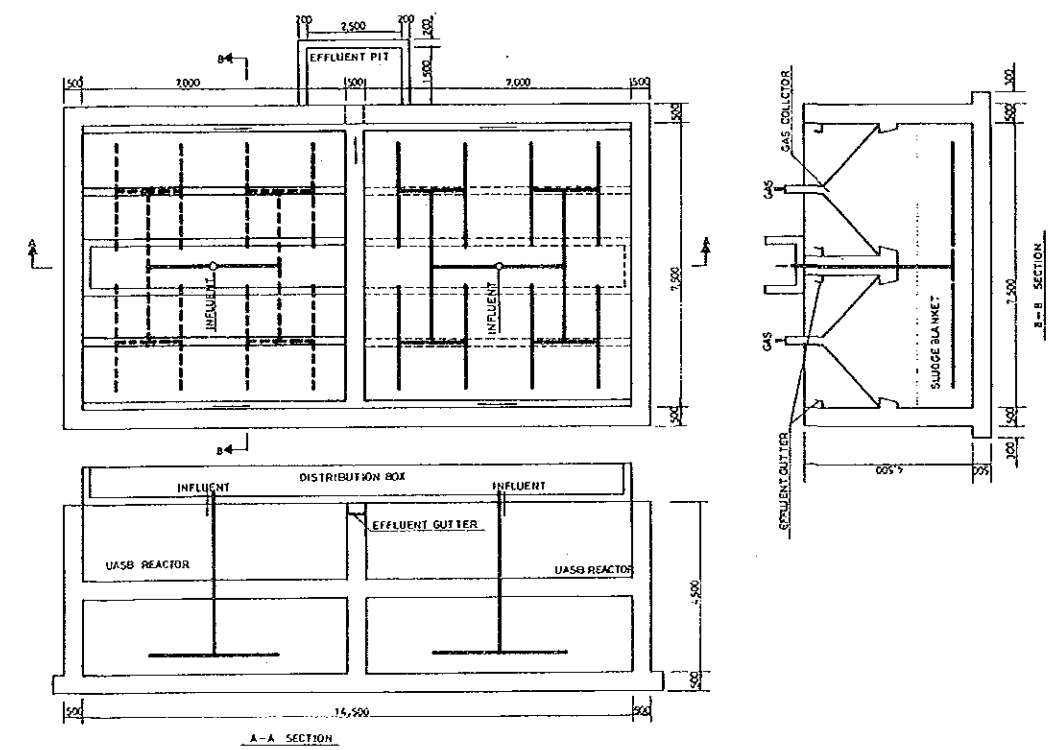
LAND FILTRATION SYSTEM FOR SMALL SCALE FARM



UASB SYSTEM FOR LARGE SCALE FARM



UASB SYSTEM FOR LARGE SCALE FARM



UASB SYSTEM FOR COOPERATIVE TYPE

Fig. 8.7.1 PROPOSED COFFEE WASTES IMPROVEMENT FACILITIES

8.8 COFFEE WASTES TREATMENT PROJECT

The coffee wastes treatment project to cover the whole department is proposed as summarized below.

Stages	Rivers	Water Quality		Reduction of Pollutant Load %	Facilities (Nos.)		
		Present (BOD) ppm	Target (BOD) ppm		Large Farm	Medium Farm	Small Farm
I	Q. Cristales	62.1	5.0	92	55	11	285
	Roble	49.9	5.0	90	15	11	535
II	Espejo	35.8	10.0	72	35	12	-
	Santo Domingto	31.5	5.0	84	50	15	-
III	Buenavista	62.9	5.0	92	15	8	260
	Quindio	13.0	5.0	62	35	-	-
	Barragan	65.6	5.0	92	10	4	60
IV	Verde	25.6	1.0	81	30	8	-
	Lejos	22.8	1.0	78	50	12	-
	Rojo	12.9	1.0	61	15	-	-

Note: Treatment system for large farm: Individual UASB Method
 Treatment system for medium farm: Centralized UASB Method
 (Collection of wastes by vacuum truck)
 Treatment system for small farm: Simple land Treatment

And within the context of the High-Priority Project II, the following four projects included in stages I & II are selected.

- Cristales Coffee Wastes Treatment Project
- Roble Coffee Wastes Treatment Project
- Espejo Coffee Wastes Treatment Project
- Santo Domingo Coffee Wastes Treatment Project

8.9 COST ESTIMATES

The investment cost to cover four projects included in the High-Priority Project II totalled Col.\$7,800 million which has been estimated on the basis of market prices prevailed as of September, 1987. The breakdown of the investment cost is as follows:

Unit: In million of Col.\$

Catchment Areas	Direct Construction Cost	Indirect Cost	Physical Contingency	Total Cost
Cristales	1,170	395	235	1,800
Roble	1,210	350	240	1,800
Espejo	1,280	380	240	1,900
Santo Domingo	1,510	450	340	2,300
Total	5,170	1,575	1,055	7,800

8.10 PROJECT IMPLEMENTATION SCHEDULE

In advance to the implementation of this Project, it is prerequisite to conduct a feasibility study (F/S). It is expected that a preparatory period ranging from 18 to 24 months should be required for the F/S and financial arrangement to get loan for the implementation of Project from international financing agency. Consequently, if the F/S is conducted in the fiscal year of 1989, the Project will start in the fiscal year of 1991. The total Project period is scheduled in 15 years as delineated below.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cristales
Roble			
Espejo							
Santo Domingo										

Note : : Preparation Works (D/D, Tender Documents, etc.)
 ■■■■■■ : Construction Works

8.11 CONCLUSION

Coffee Wastes Treatment Project will have a high social impact in view of maintaining ecological balance and enhancement of living standard of local population, and hence its earlier implementation is highly expected. On the other hand, should construction and operation and maintenance cost be borne by farmers, it would be difficult to proceed with this Project because farmers get no direct benefit from their investment. In this connection, it would be essential that central and local authorities as well Coffee committee and other concerned institutions render coffee growers with financial assistance such as subsidiary, bounty and favorable measures in terms of taxation. Besides, it is imperative to facilitate enlightenment campaign against local inhabitants in such manner as to be able to realize at earlier stage.

The present Project is formulated within the context of the Master Plan, the principle objective of which are to comprehend actual situation and prepare overall and comprehensive planning without incorporating detailed engineering scheme by area. Under the circumstance, it is expected that investigation on water quality of each river, location of existing depulping plants, amount of effluents and timing of wastes disposal be conducted so that the feasibility study may be implemented smoothly in the future.

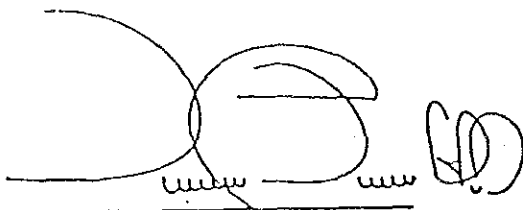
APPENDICES

A. 1 SCOPE OF WORK

SCOPE OF WORK
FOR
THE MASTER PLAN STUDY
ON
THE QUINDIO BASIN INTEGRATED
AGRICULTURAL DEVELOPMENT PROJECT

BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
CORPORACION AUTONOMA REGIONAL DEL QUINDIO

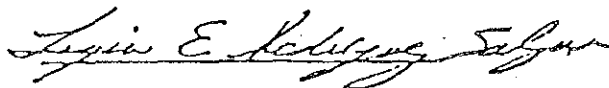
Bogotá
28 de July , 1986



Julián Serna Giraldo
Director General
Corporación Autónoma
Regional del Quindío (CRQ)



Keiji KOIZUMI
Leader of the Preliminary
Survey Team,
Japan International
Cooperation Agency (JICA)



Ligia Rodríguez Salazar
División Of International
Technical Cooperation
Departamento Nacional de
Planeación (DNP)

I. INTRODUCTION

In response to the request of the Government of the Republic of Colombia, the Government of Japan decided to conduct the Master Plan Study on the Quindio Basin Integrated Agricultural Development Project (hereinafter referred to as "the Study"), in accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Republic of Colombia, signed on 22 December, 1976 (hereinafter referred to as "the Agreement").

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programme of the Government of Japan, will undertake the Study in close cooperation with the authorities of the Republic of Colombia.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVE OF THE STUDY

To formulate the Master Plan for the integrated agricultural development in Quindio Basin.

III. STUDY AREA

The study area is whole Quindio province, covering about 200.000 ha. in gross

IV. SCOPE OF THE STUDY

The activities to be undertaken by the Japanese Study Team will be broadly divided into the following three categories;

WORK I :

Diagnosis of the study area by means of remote sensig technique.

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WORK II :

Data collection, field investigation and formulation of the basic concept for the integrated agricultural development.

WORK III :

Formulation of the Master Plan and preparation of the Master Plan report

Major work items of each work category are :

1. WORK I (remote sensing)

The remote sensing work will be carried out mainly in Japan and supplementary survey will be conducted in Colombia Accordingly the land-system-map will be prepared.

2. WORK II (Field work)

(1) To collect and review of the relevant existing data and information including the following items.

- a. Meteorology and hydrology
- b. Topography
- c. Geology and hydrogeology
- d. Soil
- e. Irrigation and drainage
- f. Residual water
- g. Water quality
- h. Agriculture
- i. Agro-regional economy and institution
- j. Others

(2) To carry out field survey in the project area including the following items.

- a. Hydrological survey
- b. Topographic survey
- c. Geological and hydrogeological survey
- d. Soil survey
- e. Small scale dam, irrigation and drainage facilities survey
- f. Residual water survey

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- g. Water quality survey
- h. Land conservation survey
- i. Agronomic survey
- j. Agro-economic survey
- k. Regional economic and institutional survey
- l. Construction materials and cost survey

3. Work III (home office work)

(1) To determine a definite layout of the integrated agricultural development taking into consideration the following components.

- a. Land use plan
- b. Agricultural promotion and development plan
- c. Disaster prevention and land conservation plan
- d. Water quality improvement plan
- e. Rural infrastructure plan

(2) To identify high priority projects

(3) To make evaluation of the said projects

(4) To prepare the implementation schedule of the said projects

V. WORK SCHEDULE

The tentative work schedule is shown in the Annex I .

VI. REPORTS

JICA shall prepare and submit the following reports to the Government of the Republic of Colombia.

- 1. Inception Report
Twenty (20) copies in English at the commencement of the Work I
- 2. Land Cover Map
twenty (20) copies at the commencement of the Work II
- 3. Land Use Map
Twenty (20) copies at the end of the Phase I Study

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4. Plan of Operation
Twenty (20) copies in English at the commencement of the Phase II Study.
5. Interim Report
Twenty (20) copies in English at the end of the Work II.
6. Draft Final Report
Forty (40) copies in English and twenty (20) copies of its summary in Spanish within one (1) month after the home office work.

The Government of the Republic of Colombia shall provide JICA with its comments on the Draft Final Report to JICA office in Bogota within one (1) month after the receipt of the Draft Final Report.
7. Final Report
Fifty (50) copies in English and twenty (20) copies of its summary in Spanish within two (2) months after the receipt of the Colombian Government's comments on Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF COLOMBIA

1. To facilitate smooth conduct of the Study, the Government of Colombia shall accord to the Japanese Study Team and its members such privileges and immunities as provided for in V.2(b), VI (excluding 2(c)), VII and IX of the Agreement.
2. Corporación Autónoma Regional del Quindío (hereinafter referred to as "CRQ") shall act as the counterpart agency to the Japanese Study Team and also as the coordinating body in relation to other governmental and non-governmental organizations for the smooth conduct of the Study.
3. CRQ shall take necessary measures in cooperation with other relevant organizations :
 - (1) To secure the safety of the Japanese Study Team.
 - (2) To secure permission for entry into private properties or restricted areas for the conduct of the Study.
 - (3) To secure permission for the Japanese Study Team to take all data and documents (including photographs) related to the Study out of Colombia to Japan.

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4. CRQ shall, at its own expense, provide the Japanese Study Team with the following in cooperation with other relevant organizations;
- (1) Available data and information related to the Study.
 - (2) Additional survey related to the Study if necessary.
 - (3) Counterpart personnel.
 - (4) Suitable office space with necessary equipments in Quindio.
 - (5) Appropriate number of vehicles with drivers in the project area.
 - (6) Credentials or identification cards.

VIII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1. To dispatch, at its own expense, the Japanese Study Team to Colombia.
2. To pursue technology transfer to Colombian counterparts in the course of the Study.
3. To provide the equipments necessary for the field work.

IX. JICA and CRQ shall consult with each other in respect of any matter that may arise from or in connection with the Study.

X. Present Scope of Work is made both in English and Spanish.

If the discrepancy of interpretation arises between both languages, the English expression shall be employed.

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A.2 LIST OF CRQ PRINCIPALS
AND
COUNTERPART PERSONNEL

APPENDIX 2

LIST OF CRQ
PRINCIPALS AND
COUNTERPART PERSONNEL

<u>Name</u>	<u>Position</u>
Dr. Julian Serna	Director General
Dr. Orlando Jaramillo	Secretary General
Dr. Aureliano Sabogal	Project Coordinator
Dr. Luis Fernando Maya	Marine Biologist
Dr. Ismael Ramírez	Sanitary Engineer
Dr. Francisco A. Uribe	Geologist
Dr. Armando Rodríguez	Pedologist
Dr. Fernando Sánchez	Chemist
Dr. Miguel Angel Gaviria	Agronomist
Dra. Adriana Gutiérrez	Veterinarian
Dr. Fernán Castaño Mejía	Forestry Engineer
Dr. Hugo Cardona	Civil Engineer
Dra. Gloria Inés Betancourth	Economist
Dr. Jorge Enrique Arias	Agro-economist
Dra. Gloria S. López	Sociologist

A.3 LIST OF ADVISORY COMMITTEE MEMBERS

APPENDIX 3

LIST OF ADVISORY COMMITTEE MEMBERS

<u>Field in Charge</u>	<u>Name</u>	<u>Position</u>
Chairman	Mr. Keiji Koizumi	Deputy Director General, Kanto Regional Agriculture Administration Bureau, Ministry of Agriculture, Forestry and Fisheries (M.A.F.F.)
Agricultural Environment	Mr. Kunihiro Fujii	Chief, Water Quality Assessment Laboratory, Division of Water Quality Science, National Institute of Agro-Environmental Science, M.A.F.F.
Agriculture	Mr. Isao Suzuki	Deputy Head, Agricultural Extension Division, Kanto Regional Agriculture Administration Bureau, M.A.F.F.
Land Conservation	Mr. Ikuo Fujimori	Head, Land Improvement Division, Agricultural Administration Department, Gunma Prefecture.
Agricultural Development	Mr. Hideo Agou	Section Chief, Overseas Technical Cooperation Office, Construction Department, Agricultural Land Improvement Bureau, M.A.F.F.
Coordination	Mr. Shin Imai	Section Chief, Project Planning Division, Planning Department, Agricultural Land Improvement Bureau, M.A.F.F.
	Mr. Akihide Enoki	Technical Affairs Division, Agriculture, Forestry and Fisheries Planning and Survey Department, Japan International Cooperation Agency.

A. 4 LIST OF MISSION MEMBERS

APPENDIX 4

LIST OF MISSION MEMBERS

<u>ASSIGNMENT</u>	<u>NAME</u>
Team Leader General Coordination	Mr. Shoji Kanatsu
Sub-Team Leader Irrigation & Drainage	Mr. Shinichiro Matsumoto
Meteorology & Hydrology Water Resources	Mr. Yujiro Itakura
Geology Hydrogeology	Mr. Kazuo Hasegawa
Soil Landuse	Dr. Michiaki Hosono
Water Quality Water Quality Improvement	Mr. Yoshihiko Nishikawa
Agriculture Crop Husbandry	Dr. Masao Yoshida
Livestock	Mr. Toshikazu Nagamitsu
Disaster Prevention Land Conservation	Mr. Nobuya Saruwatari
Rural Infrastructures	Mr. Masatoshi Higashide
Regional Economy Project Evaluation	Mr. Fumiaki Onoda
Agro-Economy Agricultural Institution	Mr. Tamio Ota
Regional Development Plan	Mr. Kunitoshi Ohtsuka

JICA