3.3 Basin Management

3.3.1 Water Use and Water Quality

(1) Water-use

Groundwater is the main source of the drinking and irrigation (small-scale) water supply system in the study area. The surface water of the Jiboa River is used by the residents along the river for laundry and bathing, and by the animals for drinking. Studies were not carried out on the middle and downstream basin areas where sand extraction is widely carried out. On the 30th of September 1996, this excessive extraction of sand was observed to have caused the El Rosario bridge to tilt, destabilizing the main river course and eroding the river banks.

Ilopango Lake contains arsenic and boron concentrations far exceeding the permissible values specified in the agricultural water standards of FAO. However, the use of the lake water for drinking is currently under investigation especially with the construction of the arsenic and boron removal plant of ANDA well under way. The development plan of ANDA intends to use for drinking 1.0 m^3/sec of the estimated 1.5 m^3/sec of useable lake water. The realization of this plan would stabilize the water supply in the rainy season, but would further reduce the water level in the dry season and consequently affect the ecosystem. Accordingly, it is very important to immediately conduct an EIA for this project.

(2) Water Quality

Water quality surveys were carried out from February to October of 1996 -- twice in February, the dry season, and twice in September and October, the rainy season -- to determine whether the water quality of the Jiboa River, Ilopango Lake and the wells in the basin are suitable for agricultural use and as drinking water for the residents and animals. Sampling was conducted at a total of 27 points: 10 from the river, 6 from the lake, and 11 from wells (see Figure 3.3.1.1). However, the wells were only surveyed twice: once in the rainy and dry seasons. The following 35 parameters were used to survey the water quality of the river, lake and wells, and the results are shown in Table 3.3.11.

Temperature (FAO)	SO_4 (FAO)	NH_3 (FAO)	SS (FAO)
Turbidity (FAO)	RAS	As (FAO, WHO)	TN
Color (FAO)	Ca (FAO)	Cr (WHO)	TP (FAO)
pH (FAO)	Mg (FAO)	Hg (WHO)	PO_4-P (FAO)
E.C (FAO)	Mn (FAO)	Pb (WHO)	CO_3 (FAO)
DO (FAO)	Na (FAO)	Cd (WHO)	HCO_3 (FAO)
Total Coliform (WHO)	K (FAO)	B (FAO, WHO)	Dissolved Solids (FAO)
Cl (FAO)	NO_3 (FAO, WHO)	COD	Total Solids (FAO)
Hardness (FAO)	NO_2 (FAO, WHO)	BOD	

* The items underlined were analyzed by the MAG, and the rest by FUSADES.

Because there are no water quality guidelines in El Salvador, the drinking water guidelines of WHO and the agricultural water guidelines of FAO were used. The drinking water guidelines of WHO specifies 0.30 mg/l as the permissible limit for boron and 0.01 mg/l for arsenic. Likewise, the agricultural water guidelines of FAO specifies 0.70 mg/l as the permissible limit for boron and 0.10 mg/l for arsenic.

1) Water Quality of the Jiboa River

Figure 3.3.1.2 shows the changes in the water quality of the Jiboa River in terms of boron and arsenic concentrations. The boron and arsenic concentrations in the Jiboa River widely exceed the permissible limits established by FAO for agricultural water. Only heavy metals such as chrome, cadmium and lead were detected from the samples taken from the river.

2) Water Quality of Ilopango Lake

Table 3.3.1.3 shows the boron and arsenic concentrations in the lake analyzed during the survey. The concentrations of both properties exceed the permissible limit set by FAO for agricultural water. This phenomena is attributed to the fact that the lake is in a caldera. The Chaguite River, which flows into the lake, is not considered a contaminant source in terms of boron and arsenic properties, as both concentrations in this river are extremely low.

On the other hand, because of the urbanization of the Chaguite River basin, the water of the lake becomes significantly turbid, particularly after rainfall. Soil conservation measures must be adopted in this basin.

The changes in the water quality of Ilopango Lake were studied based on the surveys of ANDA and Fundacion Amigos del Lago de Ilopango. In 1994, ANDA conducted surveys from March to July in Rincon Shuguallo, one of the planned intake points for drinking water. The results indicate that the water in this point contains 0.6 to 0.8 mg/l of arsenic, values exceeding the permissible limits set for drinking and agricultural water. In 1995, the two surveys conducted by Fundacion Amigos del Lago de Ilopango from October to December did not detect any arsenic in the water. However, the water was found to contain 7 to 10 mg/l of boron. Conclusively, even past water quality data of the lake corroborates its unsuitability for agricultural use.

3) Well Water Quality

The water quality surveys conducted on existing wells in the study area from February to October of 1996 indicate that 9 of the 13 wells produce water not suitable for drinking.

Items 1, 2 and 3 above emphatically point out the unsuitability of the water of the Jiboa River and Ilopango Lake for drinking and agricultural use, and the limited number of wells producing drinkable water.

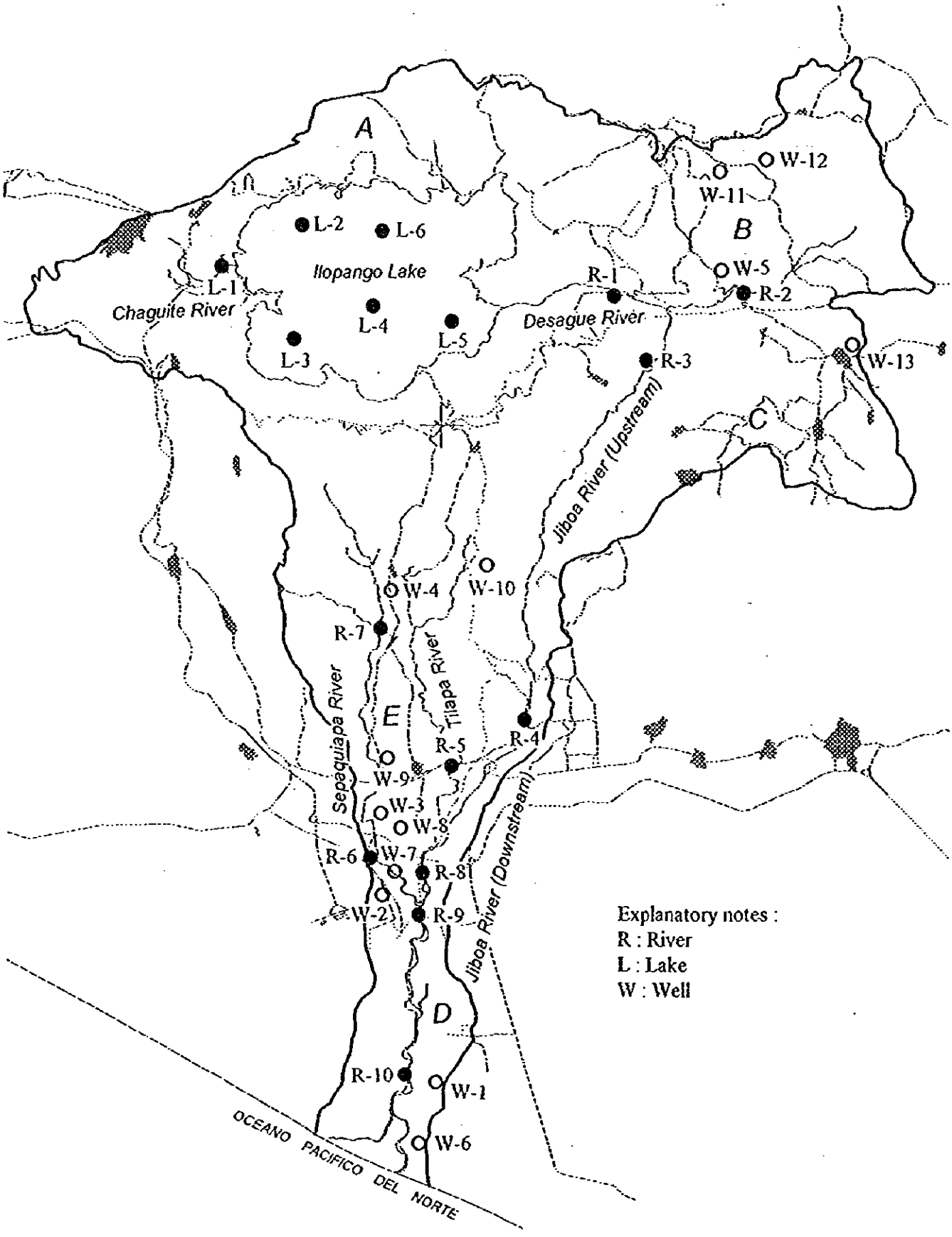


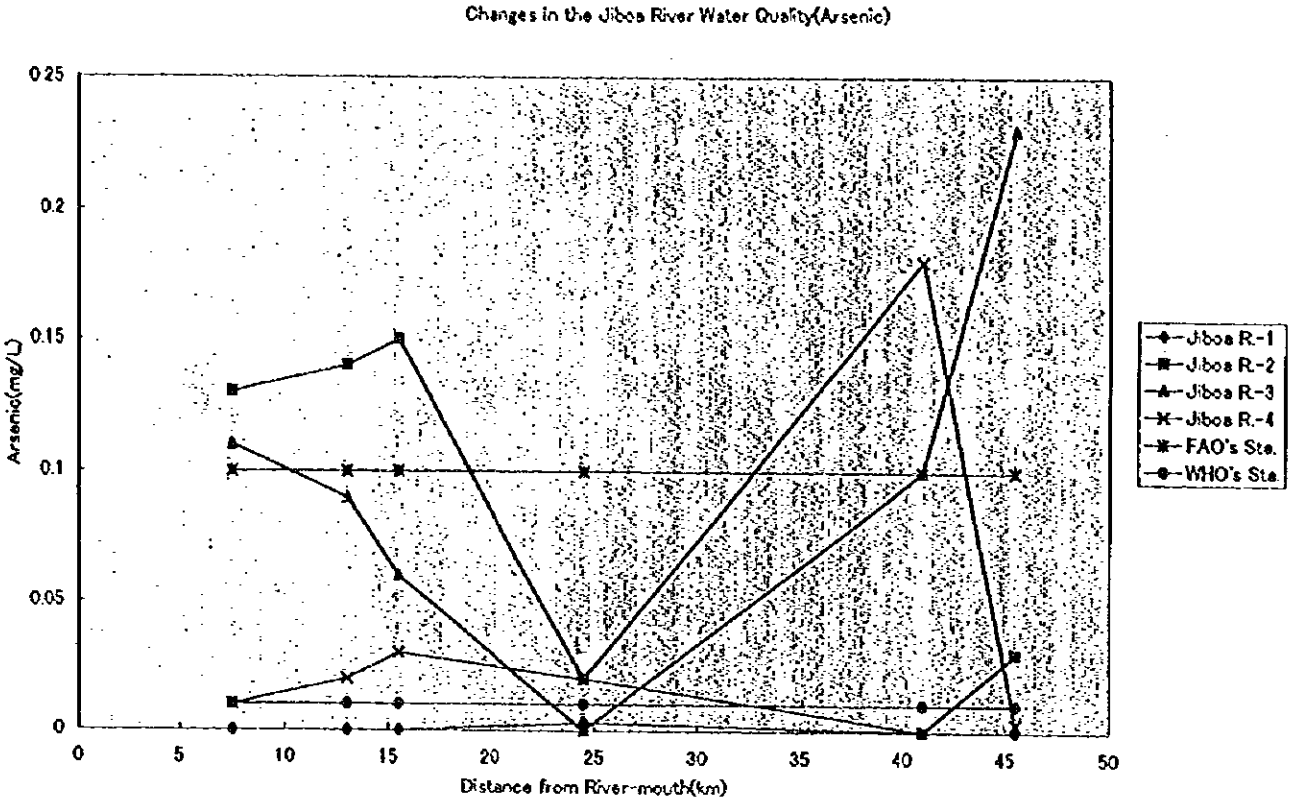
Figure 3.3.1.1 Location of Water Quality Sampling Station

Table3.3.3.1 Evaluation in Water Quality Survey Results

	1st (12-14 Feb. 1996)				2nd (26-28 Feb. 1996)				3rd (24-25 Sep. 1996)				4th (15-17 Oct. 1996)				Evaluation
	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	Who's Standard for Drinking Water		FAO's Standard for Water	irrigation	(for Irrigation Water)
	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	Boron <0.3 mg/L	Arsenic <0.01 mg/L	Boron <0.7 mg/L	Arsenic <0.10 mg/L	
Ilopango Lake	×	×	×	×	×	○	×	○	×	×	×	×	×	×	×	×	×
Desague River	×	×	○	○	○	×	○	×	×	×	×	×	×	×	×	○	×
Jiboa River (Upstream from Montecristo St)	×	○	○	○	×	×	×	○	×	×	×	×	×	×	×	×	×
Jiboa River (Downstream from Montecristo St)	×	○	○	○	×	×	×	×	×	×	×	×	×	×	×	○	×
Tilapa River	×	○	○	○	○	×	○	○	○	×	○	○	○	×	○	○	○
Sepaquiapa River	×	○	○	○	○	○	○	○	○	×	○	○	○	×	○	○	○

Well Water

	1st (12-13 Feb 1996)		2nd (3~4 Oct. 1996)	
	Who's Standard for Drinking Water		Who's Standard for Drinking Water	
	Boron <0.3mg/L	Arsenic <0.01mg/L	Boron <0.3mg/L	Arsenic <0.01mg/L
W-1	○	×	×	×
W-2	×	×	○	×
W-3	○	×		
W-4	○	×		
W-5	○	○	○	○
W-6			○	○
W-7			○	○
W-8			○	○
W-9			○	×
W-10			○	○
W-11			×	○
W-12			○	○
W-13			○	○



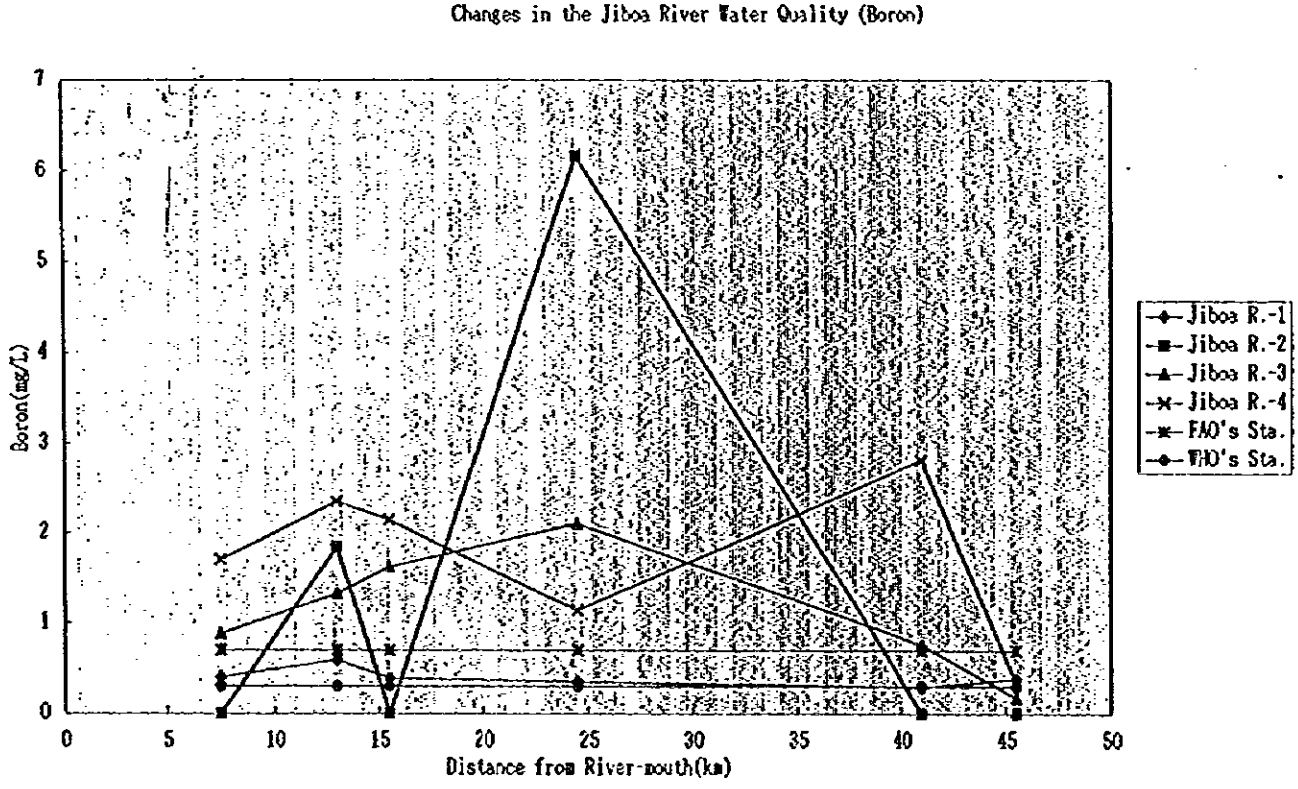
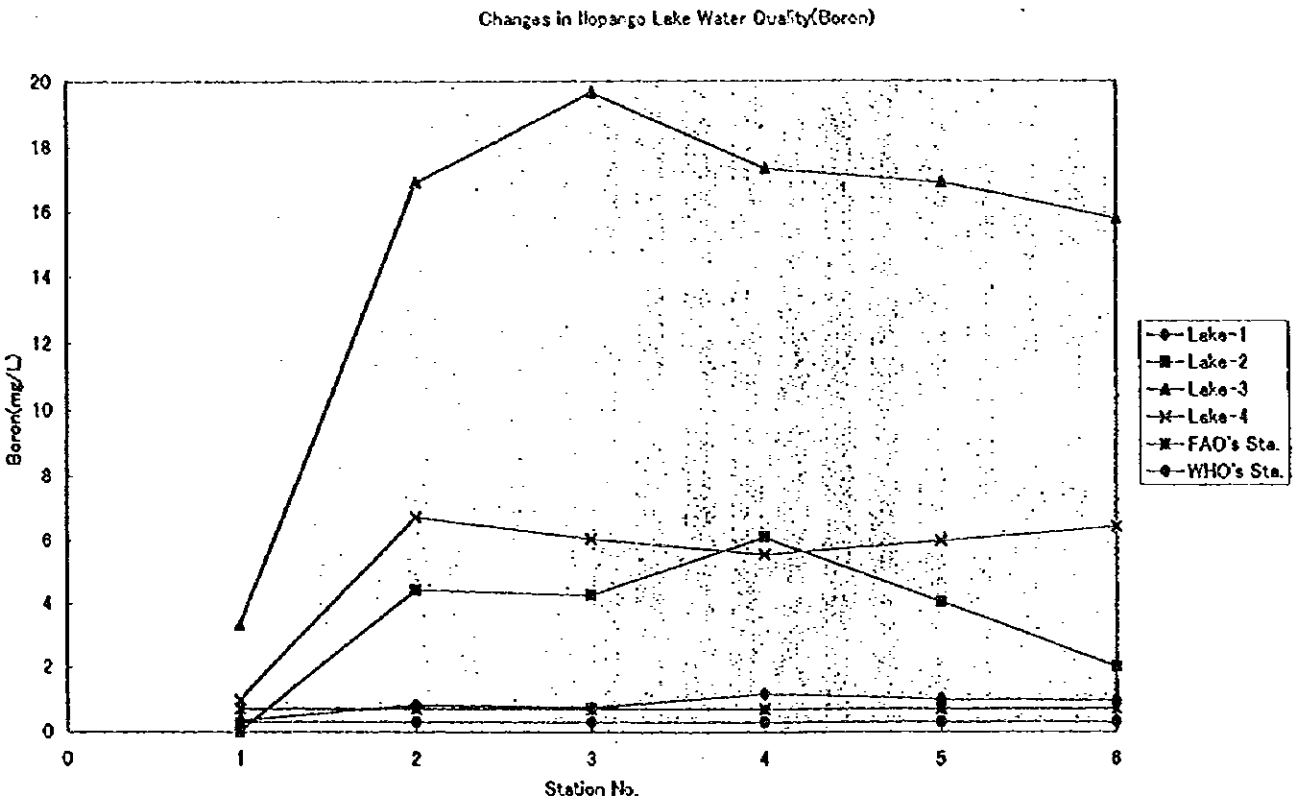


Fig.3.3.1.2 Changes in Jiboa River Water Quality'



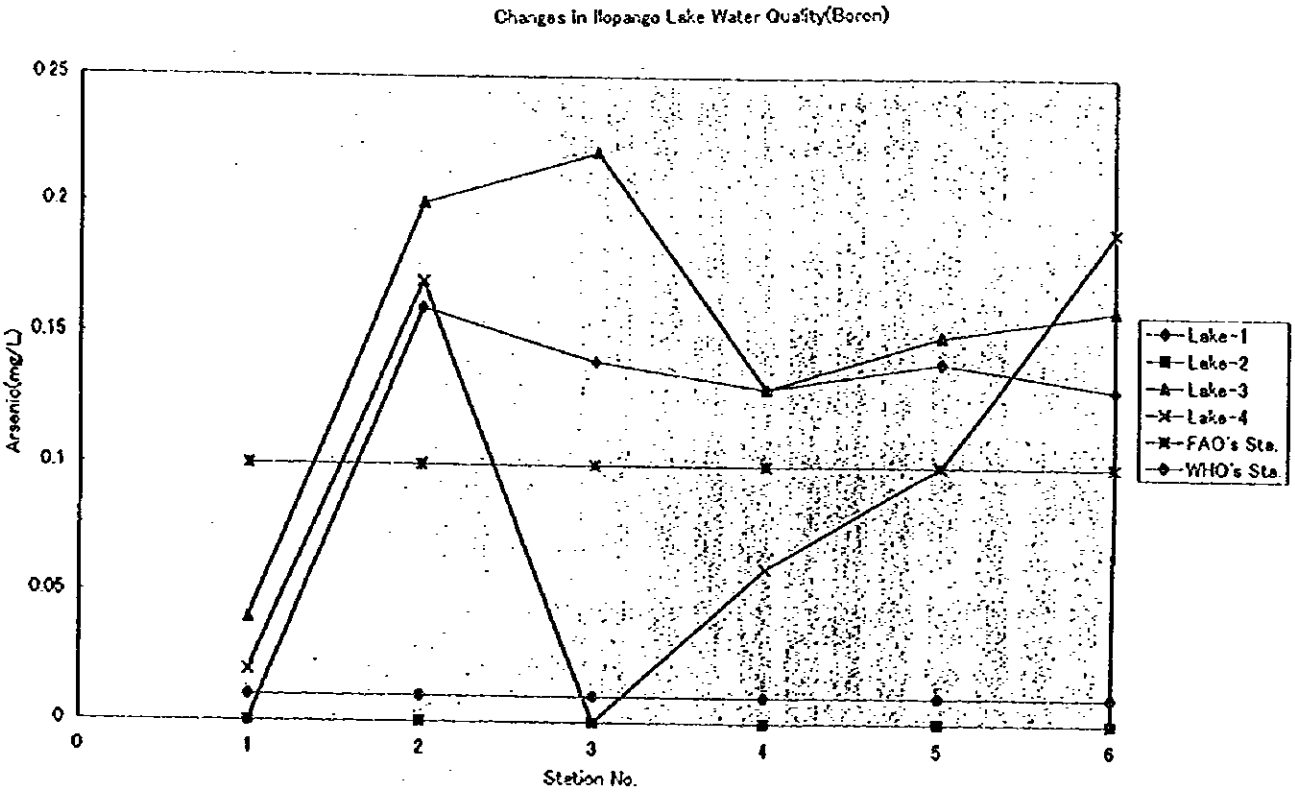


Fig.3.3.1.3 Changes in Ilopango Lake Water Quality

3.3.2 Floods

(1) General

The downstream area of the Jiboa River is flooded every year. Figure 3.3.2.1 shows the flooded planes within the basin determined from aerial photos, field surveys and interviews with residents. Table 3.3.2.1 classifies flooding by depth.

The interviewed residents especially remember the large flood that resulted from the onslaught of hurricane Fifi in 1974, which forced residents from several villages to evacuate their homes in small boats and caused remarkable damage. On the other hand, old members of the community particularly remember the flood that occurred in 1934, which destroyed the village of Las Hojas, caused more than 100 fatalities and washed away numerous livestock.

The map of the flood plain within the basin shows several small perennial streams. The areas mostly flooded are on the right bank of the river, where the river bed is immensely unstable, having shifted at a maximum rate of 1km in 10 years (see Fig. 3.3.2.2). Four or five areas along the right bank were observed to be prone to inundation. Table 3.3.2.2 shows the inundation level, level of sedimentation, and inundation period. As a flood control measure, river mouth widening was done to prevent water retention.

In order to protect the 910 ha of cotton fields downstream, MAG, with overseas technical assistance and funding from the land owners, conducted a river improvement project from 1970 until 1983. However, no signs of the work carried out through this project are visible at present. MAG, again with overseas technical assistance, also implemented other projects involving the construction of soil conservation measures, check dams, and sediment control dams in 1982.

ISTA also formulated a plan in 1982 to stabilize 3 km of the river channel from the river mouth, but never got to the implementation stage. This plan assumed a flood volume of 739 m^3. About 10 similar plans have been formulated recently, but like their predecessors, none have been implemented.

(2) Cause of Flood

The downstream area of the Jiboa River is flooded annually due to ① deficient vegetation cover upstream, ② inability of the river water to flow freely in the downstream area due to sand accumulation and slopes, ③ flat topography, ④ shallow groundwater table, and ⑤ lack of drainage facilities. The factors that cause flooding in the basin are arranged according to the following categories:

a) Topographic, Meteorological, and Hydrologic Conditions

① The area has a steep topography and the river has a large gradient. On top

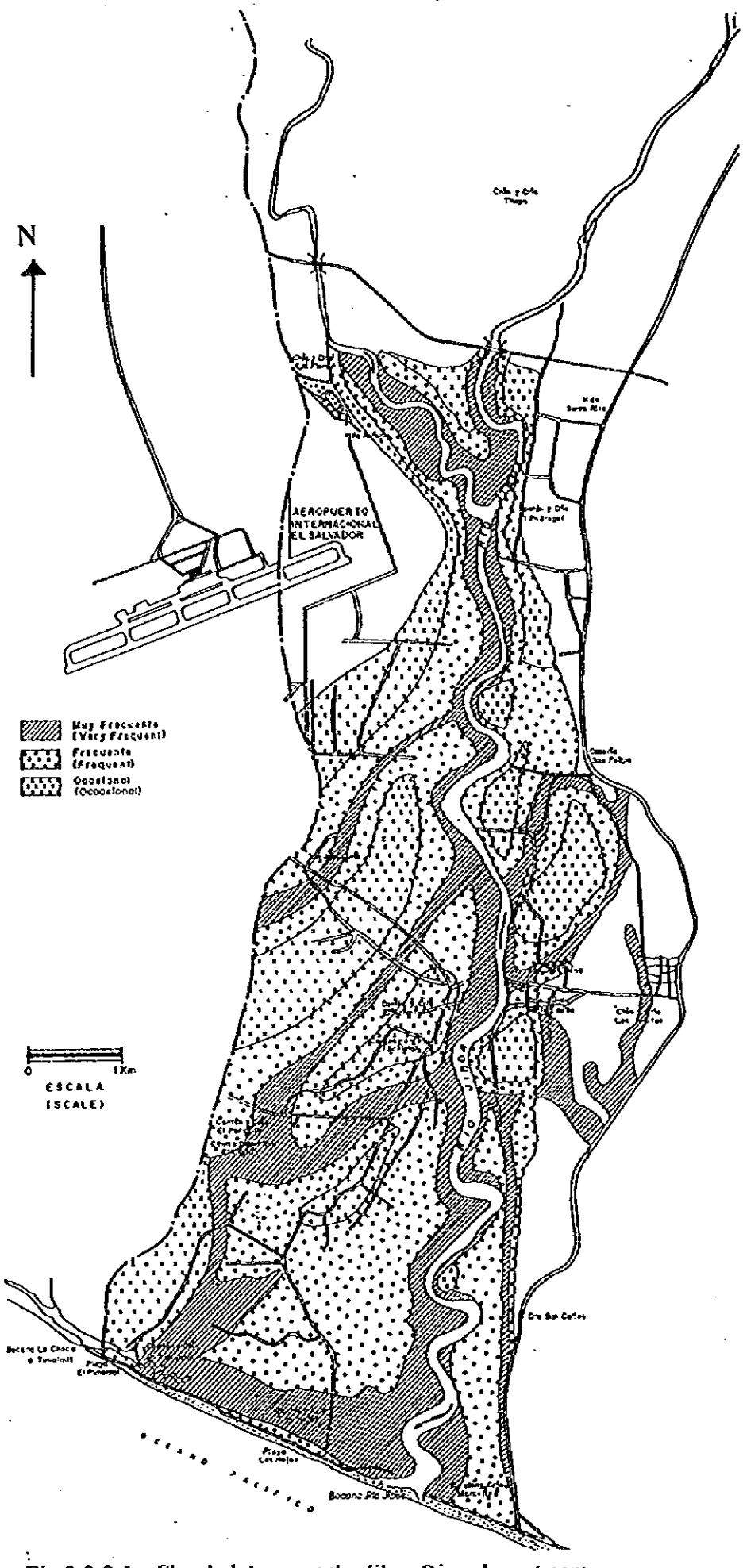


Fig.3.3.2.1 Flooded Areas at the Jiboa River Lowstream

Table 3.3.2.3 Annually Inundated and Evacuated Houses

Place	Inundated Houses	Evacuated Houses
Caserio San Jose Luna	5	1
Campamento San Jose Luna	3	2
Caserio El Porvenir	11	1
Caserio San Marcos Jiboa	3	1
Caserio San Carlos	5	1
Coop. Sta. Maria del Coyol	10	3
Coop. Brisas Marinas (Las Moras)	11	3
Caserio Las Hojas	10	3
Caserio San Marcelino	1	0
Caserio El Pimentel	30	6
Total	89	21

Table 3.3.2.4 Evaluation of Annual Inundation Damage

Items	Number	Damage (colones)	Damage (US$)
Labor loss (89 houses)	3.6	64,080	7,349
Inundated agricultural lands (ha)	840	4,418,400	506,697
Infrastructure:			
- Partial damage to rural roads (km)	18	1,890,000	216,743
- Total damage to rural roads (km)	3	1,050,000	120,413
- Partial damage to farm roads (km)	17	765,000	87,729
- Total damage to farm roads (km)	8	1,200,000	137,615
TOTAL		9,387,480	1,076,546

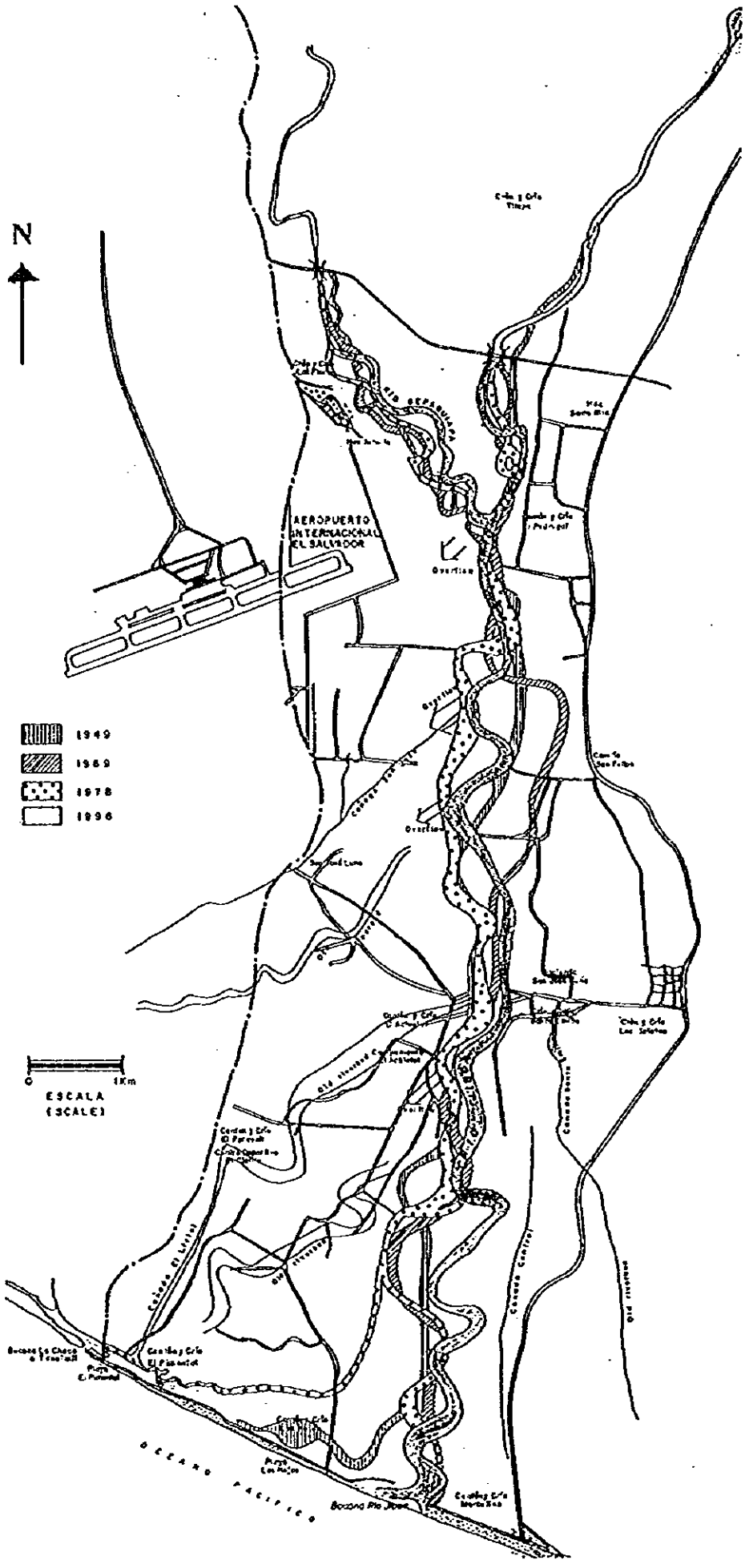


Fig.3.3.2.2 Changes of Course of Jiboa River on the Period 1949-1996

of this, the midstream and downstream river channels have a small flow capacity which cannot cope with the flood peak discharge. The downstream area of the Jiboa River basin forms a delta where frequent changes in the river course occur. Comalapa, which is at the center of the delta, was observed to be prone to inundation.

The cultivated lands managed by agricultural cooperatives in areas on the right bank located in elevations lower than the river bed are occasionally subject to inundation.

② The development and expansion of farmlands reduced the forest area, resulting in the increase in rainfall runoff ratio and flood discharge volume.

b) Geographic Features and Destruction of Hilly Areas

① Because the surface of the hilly area in the Jiboa River basin is covered with pyroclastic sediments susceptible to water erosion, the area produces a huge volume of sediment runoff.

② This trend is further reinforced by the reduction in forest areas resulting in increasing sediment production particularly in the Sepaquiapa and Tilapa river basins.

c) Flow of Sediment Discharge to the River Channel

① The sediment runoff amount from upstream exceeds the capacity of the river channels and raises the level of the river bed.

d) Expansion of Farmlands

① The intensified use of land in the floodplain increases the susceptibility of the floodplain to flood.

e) Poor Flood Control Facilities

① The study area has insufficient flood control facilities and has no comprehensive flood control plan.

f) Lack of highly accurate basic data necessary for the formulation of a highly reliable flood control plan.

(3) Flood Damage

Studies were carried out to determine the extent of flood damage every year, in terms of the number of inundated and evacuated houses, farmlands, and infrastructure in the study area. Tables 3.3.2.3 and 3.3.2.4 detail the results.

Table.3.3.2.1 **Classification of Inundation in Jiboa River Lower Basin**

Inundation Category	Aver.Depth (m)	Total Area (Ha.)	Agricultural Land (Ha)
Very Frequent (1-5 years)	0.41	1,050	840
Frequent (5-20 years)	1.00	2,573	2,060
Occasional (>20 years)	1.81	3,451	2,760

Table.3.3.2.2 **Depth of Inundation / Sediment, and Duration**

PLACE	EVERY YEAR m/m (day) *	1974(HURRICANE FIFI) m/m (day) *
Coop. Astoria	0.50/0.05 (1)	2.50/1.00 (15)
Caserio Pedregal	0.50/0.10 (1)	2.50/1.00 (15)
Caserio Santa Rosa	0.30/0.05 (1)	0.80/0.30 (3)
Caserio San Jose Luna	0.40/0.10 (3)	2.50/2.00 (7)
Campamento San Jose Luna	0.20/0.05 (3)	1.20/0.10 (3)
Coop. San Jose Luna	0.40/0.10 (3)	2.50/2.00 (8)
Caserio El Achiotal	0.30/0.05 (1)	0.80/0.40 (5)
Coop. Achiotales	0.50/0.05 (8)	2.00/1.00 (15)
Caserio El Porvenir	0.20/0.05 (7)	1.00/0.10 (15)
Coop. El Porvenir	0.30/0.05 (4)	1.00/0.30 (15)
Campto. El Cipitio	0.20/0.05 (1)	1.00/0.20 (15)
Caserio San Marcos Jiboa	0.20/0.02 (3)	1.50/0.50 (15)
Caserio/Coop. Santa Emilia	0.50/0.05 (1)	2.00/0.50 (15)
Caserio San Carlos	0.50/0.05 (3)	1.60/1.00 (6)
Coop. Sta. Maria del Coyol	0.50/0.05 (4)	2.50/1.00 (15)
Coop. Brisas Marinas	0.50/0.05 (10)	1.50/0.50 (15)
Caserio Las Hojas	0.50/0.05 (3)	2.50/1.00 (15)
Caserio San Marcelino	0.50/0.02 (3)	2.50/0.10 (15)
Caserio El Pimental	0.70/0.02 (8)	2.50/0.10 (15)
AVERAGE	0.41/0.05 (3.6)	1.81/0.69 (12)

* Inundation depth, in m / sediment depth, in m (duration, in days)

3.3.3 Forestry

(1) Present Condition

Within the Jiboa River basin are two forest zones, hot and cool, generally divided along the 600m elevation line. It is hard to locate the forests in the Study Area because they are small in scale. There are several natural forest lots located partially on the hill zones including steep slope areas around the Ilopango Lake. However, they are composed of thin stands, and most of them are unsuitable for timber production. The main tree species in the natural forest in the area are Caoba (Swietenia humilis), Cedro (Cedrela odrata), Cortez blanco (Cybistax donell-smithii), Laurel (Cordia alliodora), and Volador (Terminalia obovata).

Moreover, private and cooperatives-owned small scale plantations are found almost everywhere in the mountainous areas and the plains. Additionally, residents plant trees around their houses as dividers or in rows along roads for beautification. The tree species planted in the area are Eucalipto camaldulensis (Eucalyptus camaldulensis), Laurel (Cordia alliondora), Leucaena (Leucaena leucocephala), Madrecacao (Gliricidia sepium), Melina (Gmelina arborea), Pino caribe (Pinus caribaea), and Teca (Tectona grandis).

As for the state of forestry in the Study Area, a considerable number of coffee plantations mainly exists in the southern and eastern parts of the Ilopango lake area. The shade trees in these plantations produce fuelwood. Some fields planted with different kinds of fruit trees, e.g. coconuts and banana, also resemble a forest type similar to the coffee plantations. Moreover, fruit trees such as oranges and lemon are also cultivated in the mountainous areas. These farms play quite a remarkable role in soil and water resources conservation in the watershed area.

(2) Land Use Situation

There are no coffee plantations in zones near the Ilopango Lake area nor in the middle of the Jiboa River basin. Further, slash and burn agriculture or other similar cultivation methods are being practised in mountainous areas which should be considered as forest resources. Extensive agriculture is carried out in these fields mainly cultivated with maize and sorghum.

According to the classification of lands in the Study Area (see Table 3.3.4-1) using the USDA standard, about 33,000 ha or 55 % of the total land area fall under Class VI and VII, land categories generally unsuitable for cultivation.

On the other hand, Table 3.3.3-2 classifies the land slopes in the Study Area based on the results of the spot image analysis. About 26,000 ha (42%)of the lands in the Study Area slope at a gradient of 11-55%, and are categorized under Class III and IV. And as

shown in the following table, cultivated lands and fallow make up 10,892 ha of the land, while coffee plantations, fruit farms, forests and brushlands make up 14,286 ha of the woodland.

This information indicates that there is a considerable amount of area requiring reforestation or agroforestry.

(3) Use of Fuelwood

Fuelwood is widely used in the Study Area. According to the results of the questionnaire survey conducted for the Project, the percentage of families using fuelwood for cooking is about 80 %. The survey also states that fuelwood is collected at a distance of 1.07 to 2.82 km.

Block	*A*	*B*	*C*	*D*	*E*
Use of Fuelwood (%)	80	76	87	77	85
Collection Distance (km)	2.06	1.07	1.55	2.82	2.32

Forests and trees are important commodities since they do not only provide the local people with fuelwood for cooking but also timber for the construction of houses and other facilities. However, according to the result of the same questionnaire survey, more than 80 % of the interviewed farmers answered that they do not own any natural forest or plantation. The residents, therefore, generally buy or collect fuelwood from adjacent areas. Accordingly, self-sufficiency in wood production should be established through reforestation, mainly by the resident farmers.

Table 3.3.3.1 Land Classification

Class	*Quantity (ha)*	*Ratio (%)*
I	0	0
II	740	1.2
III	7,030	11.7
IV	8,000	13.3
V	840	1.4
VI	16,940	28.2
VII	16,050	26.8
VIII	1,200	2.0
Residential Area	2,190	3.7
Ilopango Lake	7,000	11.7
Total	60,000	100

Source: Profile on the Maintenance of the Jiboa River Basin (March 1995)

Table 3.3.3.2 Land Slope Classification

Slope Classification	*Incline (%)*	*Quantity (ha)*	*Ratio (%)*
I	0 - 5	22,060	36.4
II	6 - 10	10,562	17.4
III	11 - 25	11,746	19.4
IV	26 - 55	13,995	23.1
V	56 -100	2,160	3.6
VI	> 100	33	0.1
Total		60,557	100

Source: SPOT; Field Survey, the Master Plan Study on the Jiboa Basin Integrated Agricultural Development Project, El Salvador, 1996, JICA

Table 3.3.3.3 Land Use Situation in Slope

Slope Classification	*Land Use Situation*	*Quantity (ha)*	*Ratio (%)*
III	Cultivated Land	2,958	4.9
	Fallow	2,383	3.9
	Woodland	6,089	10.1
	Residential Area	289	0.5
	Lake, River	27	-
	Sub-total	11,746	9.4
IV	Cultivated Land	2,819	4.7
	Fallow	2,732	4.5
	Woodland	8,196	13.5
	Residential Area	227	0.4
	Lake, River	22	-
	Sub-total	13,995	23.1
III + IV	Cultivated Land	5,777	9.5
	Fallow	5,115	8.4
	Woodland	14,286	23.6
	Residential Area	516	0.9
	Lake, River	48	0.1
	Sub-total	25,742	42.5
Total		60,559	100

Source: SPOT. Field Survey, the Master Plan Study on the Jiboa Basin Integrated Agricultural Development Project, El Salvador, 1996, JICA

3.3.4 Soil Conservation

(1) General Condition

Soil erosion (by water) is largely classified into sheet erosion and gully erosion. Soil erosion does not easily occur in the main stream region because the hilltop is gently shaped like a dome. The kind of erosion that takes place in the entire basin area is usually sheet erosion on a small scale. Although gullies and erosion valleys hardly develop in the area, they are evident in the slopes along the Sepaquiapa and Tilapa river banks. However, because most of the farmlands, which account for 44% of the basin (1996), are overlain with pyroclastic flow deposits that are susceptible to water erosion, the ground surface is extensively exposed to erosion.

(2) Slope Division

Land slopes are one of the factors that influence the occurrence of soil erosion. The land use conditions in the Study Area by slope (January 1996) is as shown in Table 3.1.3.1 based on the spot images (see beginning of Report).

(3) Forecast Soil Erosion Volume

Soil conservation is meant to prevent the soil from eroding due to rainfall, and maintain the high productivity of the farmlands. It also prevents the river bed from rising and the flood damage that could incur from it. It is therefore very important to forecast the volume of soil that may be eroded for the formulation of an effective soil conservation plan. Using the Universal Soil Loss Equation (USLE) of the United States Department of Agriculture, Soil Conservation Department, the amount of soil that gets eroded annually was calculated.

The USLE is $E = R * K * L S * C * P$ (See Figure3.3.4.1):

where,

E : Average annual soil loss (ton/acre/year or ton/ha/year)

R : Rainfall and runoff factor (100ft*ton/acre*in/hr or 100m*ton/ha*cm/hr)

K : Soil erodibility factor (ton/acre or ton/ha per unit of R)

LS : Topograhic factor (Slope-length: L、Slope steepness factor: S)

C : Crop factor

P : Conservation practice factor

The results of experienced values and the examination of each coefficient are:

R = 948, K = 0.65, P = 1.00

The value of C varies from 0.003 to 0.6 depending on the kind of covering vegetation.

LS was calculated by analyzing the spot images. Therefore, the USLE is as follows:

$E = 948 \times 0.65 \times LS \times C \times 1 = 616.20 \times LS \times C$ ton/ha/year

The calculation result is shown in Table 3.3.4.1.

(4) Soil Conservation Measures

Soil conservation measures requiring engineering skills, e.g. hillside ditch, sabo dam (masonry, gabion), bench terrace, and channels, are not practised in the Study Area. The measures adopted in some areas only include farm conservation measures (contour cropping, cultivation in the green belt zone, intercropping and mulching), planting of lemon and vetiver grass, and afforestation (including river bank vegetation).

The following are the topics to be addressed concerning the application of soil conservation measures in the Study Area:

1) The government should provide incentives to the farmers to motivate them to apply soil conservation measures on a wider scale.
2) To effectively diffuse soil conservation measures suitable to the area, the farmers and the extension staff should be properly educated on their importance. Together they should observe areas progressively practising these measures to learn the adequate techniques for proper application.
3) In the seventies, a soil conservation demonstration farm was constructed in Analquito and San Martin to develop and diffuse soil conservation techniques. (The San Martin demonstration farm area is now being developed into a residential housing area.) However, not much can be derived from these farms because they have not been in operation since the onset of the civil war due to inefficient maintenance. To gather data necessary for the establishment of soil conservation techniques suitable to the area, these demonstration farms should be restored.

(5) Districts Susceptible to Soil Erosion

Through the interpretation of aerial photos taken at a scale of 1/25,000, the districts susceptible to soil erosion were identified. The results of the interpretation pointed out the Sepaquiapa and Tilapa river basins as areas most in need of soil erosion countermeasures.

3.3.5 Water Management

The following are the items to be considered with regard to water management:

(1) River Water and Rain Water Monitoring System

Due to limited facilities, human resources, funding, and technology, the Jiboa River water

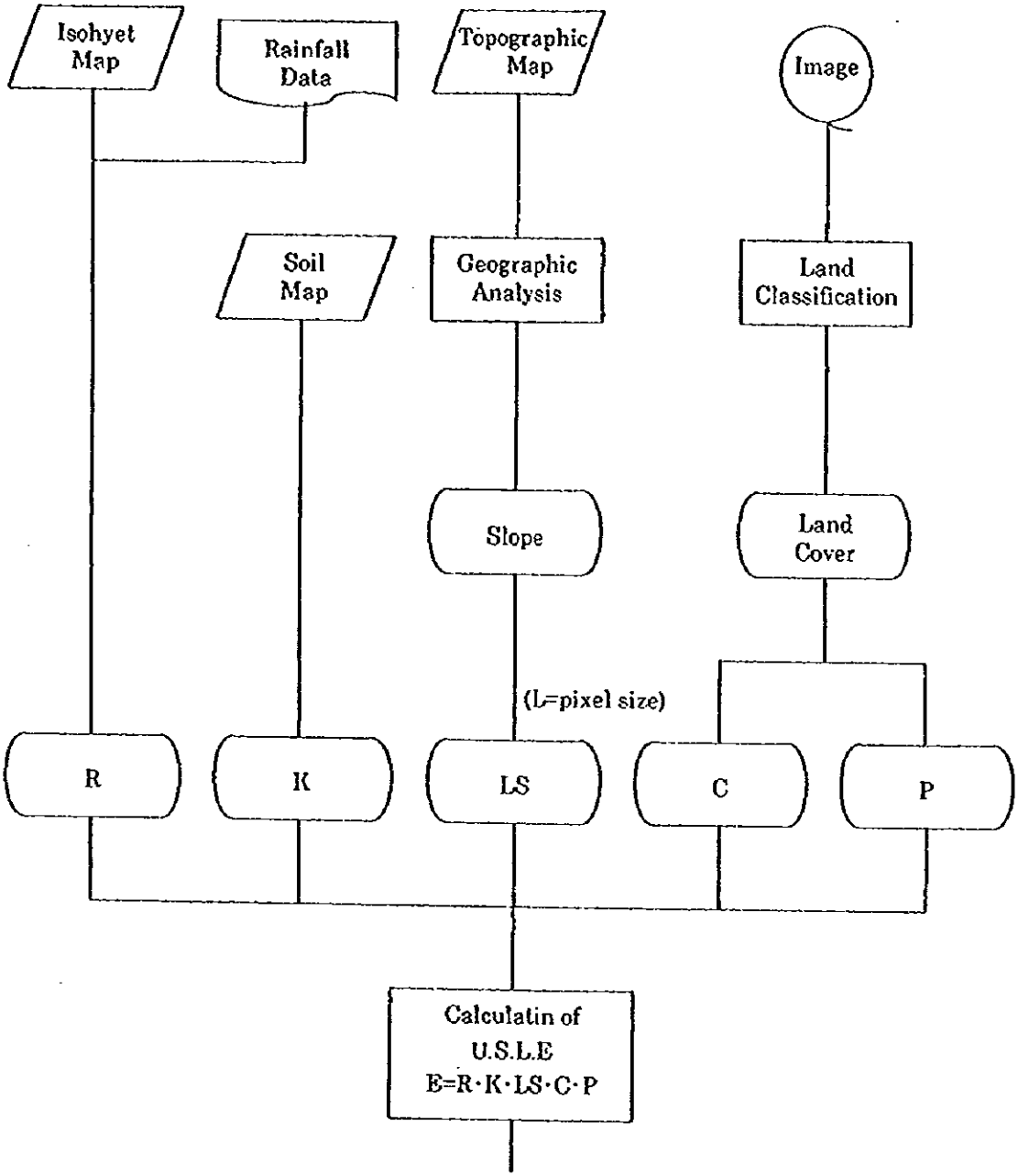


Fig. 3.3.4.1 Average Annual Soil Loss Calculation Method

Table.3.3.4.1 Amount of Presured Soil Erosion after Soil Conservatin Measures

1. Non Measures

A1 district

Unit:Ton

	Classification of Gradient						
	I	II	III	IV	V	VI	Total
1. Farm land	14,000	131,000	379,000	2,055,000	1,070,000	20,000	3,669,000
2. forest	0	3,000	11,000	67,000	47,000	1,000	129,000
3. Urban area. Infracty	16,000	63,000	90,000	360,000	218,000	4,000	750,000
4. Lake, pond & River	0	0	0	0	0	0	0
Total	29,000	197,000	480,000	2,482,000	1,335,000	25,000	4,548,000

All basins (excluding A1)

Unit:Ton

	Classification of Gradient						
	I	II	III	IV	V	VI	Total
1. Farm land	130,000	509,000	1,377,000	5,269,000	1,496,000	20,000	8,901,000
2. forest	0	9,000	23,000	125,000	74,000	4,000	235,000
3. Urban area. Infracty	12,000	42,000	54,000	89,000	26,000	0	223,000
4. Lake, pond & River	0	0	0	0	0	0	0
Total	142,000	660,000	1,454,000	5,483,000	1,596,000	24,000	9,359,000

monitoring operation is not efficiently carried out.

At present there are 3 rainfall observation stations in the Study Area: the Ilopango domestic airport and Cojutepeque observation stations upstream, and the international airport observation station downstream. Data from Cojutepeque is highly unreliable in view of its unfavorable location. The observation station monitoring the water level of the Jiboa River is currently not in operation because the instruments have been stolen.

The Meteorology Section of MAG currently provides the disaster committee with data. Although the function of the section is particularly significant, it is only equipped with few of the required instruments. El Salvador is currently dependent on the Washington (USA) satellite broadcasting system for meteorological information. It is not capable of properly understanding rainfall conditions.

At present only the Monte Cristo station in the midstream basin area monitors water volume and water quality (water level records taken in June 1996 were stolen). The observation station that monitors the water level of Ilopango Lake is currently not in operation due to machinery breakdown. Moreover, the water quality observations for Ilopango Lake and Jiboa River are not carried out regularly.

Conclusively, the rainfall and water volume monitoring facilities and system in the Study Area are extremely inadequate and incapable of forecasting disasters (in terms of rainfall amount, etc.).

(2) Water Quality Monitoring System

The MAG laboratory in Santa Tecla for water quality analysis is not fully equipped with required facilities (most facilities are dysfunctional) and human resources (staff of 4). This restricts the number of parameters for water quality analysis, and made the analysis of harmful substances such as boron and arsenic infeasible. Due to disorganization, the laboratory also finds the effective application of data difficult to conduct.

There is currently a plan to upgrade the laboratory by 1999, with financing from BID. It is, therefore, very important for the authorities concerned to immediately formulate a plan for the rehabilitation and installation of laboratory equipment, particularly for the analysis of boron and arsenic properties.

(3) Generation Source Restriction and Monitoring System

Because of the absence of laws related to the discharge of factory waste, the discharge of industrial effluent is not monitored or restricted. In response to complaints from residents, policemen try to control illegal discharge of waste water and solid waste. However, due to shortage of manpower, they are not successful. The analysis of waste water quality is also not efficiently carried out.

Conclusively, the management of office drainage, household drainage, drainage from

livestock industry, and illegally dumped solid waste in the study area is extremely inefficient.

This inefficiency is particularly evident in the water quality of the Sepaquiapa River downstream, which is adversely affected by discharges from the leather factory and the poultry farm in El Rosario.

3.4 Agriculture

3.4.1 Farming

(1) Crops and field husbandry

1) Main Crops in the Study Area

Main crops in the Study Area are as follows:

Grains:	maize, sorghum, field beans, rice (upland rice)
Fruit trees:	citrus fruits, cashew nut, mango, papaya, avocado, banana
Industrial crops:	sugarcane, sesame, peanut, coffee
Vegetables:	pipián (cucurbita sp.), tomato, cucumber, turnips, cabbage, young maize, young field bean, onions, loroco (Fernaldis pandurata Woodson), guisquil (Guisquil, Sechium edule (jacq.) Swartz)

Cropping season of main crops in the Study Area is shown in Figure 3.4.1.1.

Staple foods in El Salvador are maize, sorghum, field beans, and rice (these crops are classified as basic grains in El Salvador). The area cultivated with basic grains is the largest in the Study Area, and are mainly located on slopes. Intercropping is carried out in these fields as well. Maize is sown when the rainy season starts. When harvest comes, i.e. about 90 days after sowing, the culms of the maize are bent to dry the grains just below the cob. Sorghum is sown in the field at this time. Field beans are sown in between the rows to twine about the culms when sorghum is not sown. Rice is sown as a single crop.

Pipián, loroco, and guisquil are vegetables originally from Central America and it has been understood that their demand is strong. Pipián is a member of the pumpkin family.

Loroco is one of the crops recommended by CENTA since 1992. It is a climbing shrub and the lateral shoots are trained up over the trellis. It is harvested in the early morning when it is cool, when the bud becomes large. Loroco can be harvested for about 5 months without irrigation, and for about 9 months with irrigation. As the trellis is indispensable for cultivation of loroco, the cost of making shelves is high. For example,

it costs as much as 7,400 colones per manzana during the first year when the trellis is made of concrete, and as much as 2,500 colones per manzana during the first year when the trellis is made of bamboo, and then about 100 colones per manzana every year. Moreover the labor costs for the cultivation of this crop is higher than other crops as daily work is required to train loroco shoots on the trellis. The bud is used for Pupusas which is a traditional dish in El Salvador together with cheese. There is also a demand for loroco from foreign countries.

Guisquil, a member of the gourd family, is a permanent crop which creeps on the trellis. These crops can be grown throughout the year in irrigated fields.

Loroco and guisquil are grown under natural conditions (rain-fed) except in areas with small-scale irrigation facilities during the dry season.

The quality of coffee beans is classified by the altitude where the coffee trees are grown, i.e. low (400-800m above sea level), medium (800-1200 m), high (1200-1600 m).

2) Ploughing

The ploughing methods in the study area vary according to geographic conditions.

a) Coastal plains: Tractor and ploughing with two ox (Bueyes)

b) Gently-sloping land: Bueyes and chuzo (a kind of pike: it's a flat plate of steel, hooked on a wooden stick, approximately 1 m long)

c) Steeply-sloping ground: Chuzo

Ploughing with a chuzo is a seeding method which is suitable for inclined grounds. However, ploughing by bueyes will be adopted in view of labor shortage.

3) Fertilization

Fertilizers are applied to basic grains such as maize and rice but not to sorghum and field beans which are cultivated during the maize cropping interval. The amount of fertilizer applied to these crops is not enough to get a good yield. On the other hand, fertilizers are applied to cash crops such as vegetables, fruit trees, and coffee trees (Table 3.4.1.1).

4) Weeding

Herbicide is applied on most of the cultivated lands because of labor shortage. It is also applied to maize when the culms are bent to dry, just before sorghum and field beans are sowed. Manual weeding is carried out when crops are growing.

5) Burning

Fallow fields are usually overgrown with weeds with prickles that interfere with sowing. These weeds and other dead grasses are collected and burned, thereby facilitating rain water ground infiltration and inducing soil erosion.

(2) Classification of farmers in the study area

The farmers in the study area are classified as follows:

① landowners, ② tenant farmers, ③ constituent members of farmer's association, ④ landless laborers, and ⑤ housewives and children.

1) Landowners

The landowners can be divided into 3 groups: those who live in San Salvador, in the area surrounding the city, and those who live on their land. The landowner who lives in San Salvador employs a field manager, called a Colono, to manage his farm, which is usually about 1-15 manzanas.

2) Tenant farmers

Most of the tenant farmers live in villages near the land they tend to. Most people strongly hope to rent lands and work on it themselves rather than be ordinary field laborers. However, most of the lands farmed by tenant farmers are located either on steep slopes or infertile areas. Also, as the tenancy period is limited to one cropping season or one year, the tenant farmers are not motivated to apply agricultural measures that would improve land productivity. Tenant farmers usually lease an area of 1-2 manzanas or less.

3) Constituent members of agricultural cooperatives under the jurisdiction of ISTA

Land transferred to the farmers by agrarian reform is controlled by agricultural cooperatives. Transferred lands are either jointly cultivated by the members of the cooperatives where proceeds are used to repay ISTA, or cultivated (1-2 manzanas) according to the discretion of the cooperative member.

It has been decided by the government that the land of the cooperatives be put up for auction to offset the debt of ISTA. Therefore, the cooperatives are trying to give each member a land title of 2 manzanas. Once the title is transferred to the constituent members, the members are free to sell it. This would further increase the holdings of landowners, the probable buyers, already owning large tracts of land. This process is also foreseen to change the role of the cooperatives and its constituent members.

4) Landless laborers

Most landless laborers live in the town or the villages. They are engaged in farm labor according to the landowner or tenant farmer's demand. They work part time, from 6 in the morning until about noon, at a daily rate of 25-30 colones. On the other hand, the number of agricultural laborers working for cash increased after Maquila (a bond and sewing factory) was constructed in Rosario de La Paz, San Marcos, and Soyapango.

Therefore, labor shortage in the agricultural zone along the main road is becoming a serious problem. Moreover, it has also been found that some of the members of the

cooperatives in the downstream region work at Maquilas. The daily wage in the Maquila is 50 colones, one of the lowest pay rates in El Salvador.

5) Housewives and children

Because of agricultural labor shortage, the role of housewives and children in farming has become significant. Housewives are usually in charge of selling field beans, fruits, and vegetables in the market.

Landless laborers and tenant farmers temporarily move from one location to another to engage themselves in harvesting coffee and/or sugarcane (coffee: November-February; sugarcane: December-April). This is especially true of the laborers who harvest coffee. This is due to ① very little farming during the dry season, ② harvesting continues for several months, and ③ the daily allowance for harvesting is paid on a piecework basis. About 5 to 6 arroba (4 arroba = 1 qq) of coffee can be harvested per laborer per day, and is equivalent to 30 - 36 colones. Moreover, the harvested volume of a laborer's family can be added to his; 2 to 3 tareas of sugarcane harvested per laborer per day would amount to 50 - 75 colones. Women who work as housemaids in San Salvador take their vacation according to the coffee harvest time. The school year also corresponds to the start of the coffee harvest season, ending on October 31 and starting again on February 1.

(3) Relationship of Landowners and Tenant Farmers

The relationship between the landowner and the tenant farmer in the Study Area can be classified as follows:

El Censo:

A form of share cropping: Landowners offer land for free while the tenant farmers offer agricultural materials and manpower free of charge. Then the harvest is halved. In the contract, the tenant farmer is obligated to perform farm labor in the morning, when there is a shortage of agricultural laborers. The majority of tenant farmers grow basic grains, without any motivation to grow more than is needed for private consumption.

Medianero:

A form of share cropping: The conditions are similar to El Censo, but the landowners offer agricultural materials in addition to land. The tenant farmers offer manpower. Then the harvest is halved. This system started many years ago in vegetable producing areas like San Ramón. Medianero starts when an increase in earnings can be expected for extra investment.

Arrendatario:

System where tenant farmers lease lands from landowner. The lease fee is determined according to the expected output which depends on the tenant farmers' efforts. This

system is often used when two or more tenant farmers compete and negotiate for the lease of the land, and access to it from the road. The harvest fully belongs to the tenant farmer. Lease fees range from 200-1,000 colones. The tenant farmer plans his crops to produce more income than the cost of the lease.

Colono:

One of the landowners' forms of field control. This is unlike the normal landowner-tenant relation. The landowner, who usually lives in San Salvador, employs an agricultural laborer as a field manager. In this case, the laborer is paid a salary and has no tenancy rights. Colono originated before the agrarian reform system, and was used to refer to the manager of a coffee plantation.

Farmers' association:

When a constituent member borrows farming capital from the bank, the farmers' association guarantees the member's repayment ability. The constituent member is obligated to work on the land controlled by the farmers' association; any profit obtained is distributed among the constituent members.

(4) Present land use among different land ownership types

1) Land cultivated by landowners: fruit trees such as oranges, avocados, cashew nuts, loroco and Guisquil which need initial investments (trellis making), trees and basic grains.
2) Land cultivated by tenant farmers: annual crops such as maize, sorghum, field beans and rice.

The difference in 1) and 2) is due to the landowners fear of losing the title of their land to the tenant farmers as a result of agrarian reform. However, there is mutual trust between landowners and tenant farmers who have been cultivating the same land for several years.

3) Land jointly controlled by farmers' association:

Small farmers association:	cash crops such as sugarcane, sesame
Big farmers association:	cash crops such as sugarcane, sesame, watermelon, peanuts, maize, pasture (sorghum, natural grass)
Land cultivated by constituent members:	maize for self-consumption, cash crops such as sugarcane, sesame (some constituent members)

(5) **Farming**

1) Production cost of farm products:

Table 3.4.1.2 shows the production costs of the main crops in the Study Area. Administrative expenses (3%), preliminary expenses (5%), and the interest rate (20%/year) are included in the production costs, in addition to the costs of agricultural materials, land preparation, and labor.

The characteristics of crops in view of production cost are as follows:

Since vegetables are intensively cultivated, they need initial investment and have a high labor cost. On the other hand, the production cost of maize grown on slopes with very little labor becomes a deficit, if family labor is included in the cost.

Since market price of basic grains, except for field beans, is considerably near the farm gate price, the production cost becomes a deficit during a good harvest, particularly since the market price has fluctuated due to unfavorable weather and decrease in cultivated areas. When the market price of maize became less than the production cost at sowing time (1996), most farmers refrained from sowing maize. This considerably raised the market price and led to the importation of large amounts of maize from Honduras. The exportation of maize to El Salvador, including the volume imported from the United States, resulted in a major maize shortage in Honduras, which impelled the Government of Honduras to enforce an embargo policy to stop the export of maize from the United States.

Other crops that influence market prices like maize are sesame, coffee, pipián, tomatoes, oranges, and banana. On the other hand, guisquil, sugarcane and watermelon are tolerant to price fluctuations because demand for guisquil has always been domestic, the price of sugarcane is steady, and watermelon is cultivated in the Study Area by contract for export to Europe.

2) Agricultural income of average farm owners in each block:

Table 3.4.1.3 shows farming statistics of farms by block. The average farming area varies from 2 manzanas in D block to 4 manzanas in C block. Agricultural income varies from about 2,000 colones in D block to about 9,000 colones in C block. Farmers in D block cultivate the land loaned from the farmer's association. Association members jointly cultivating the association's land receive a daily allowance and a share of the profit from the crops.

3) Supply and demand for basic grains in the Study Area:

The supply and demand for maize and field beans in the Study Area were calculated and shown in the table below.

Supply and demand for maize and field beans in 1996

Crop	*Population*	*Consumption (kg/person/ day)*	*Total consumption (a) (ton)*	*Total production (b) (ton)*	*Balance (a)-(b) (ton)*	*Ratio (b)/(a) (%)*
Maize	322,644	0.473	55,689	23,216	-32,473	42
Field beans	322,644	0.074	8,725	1,643	- 7,082	19

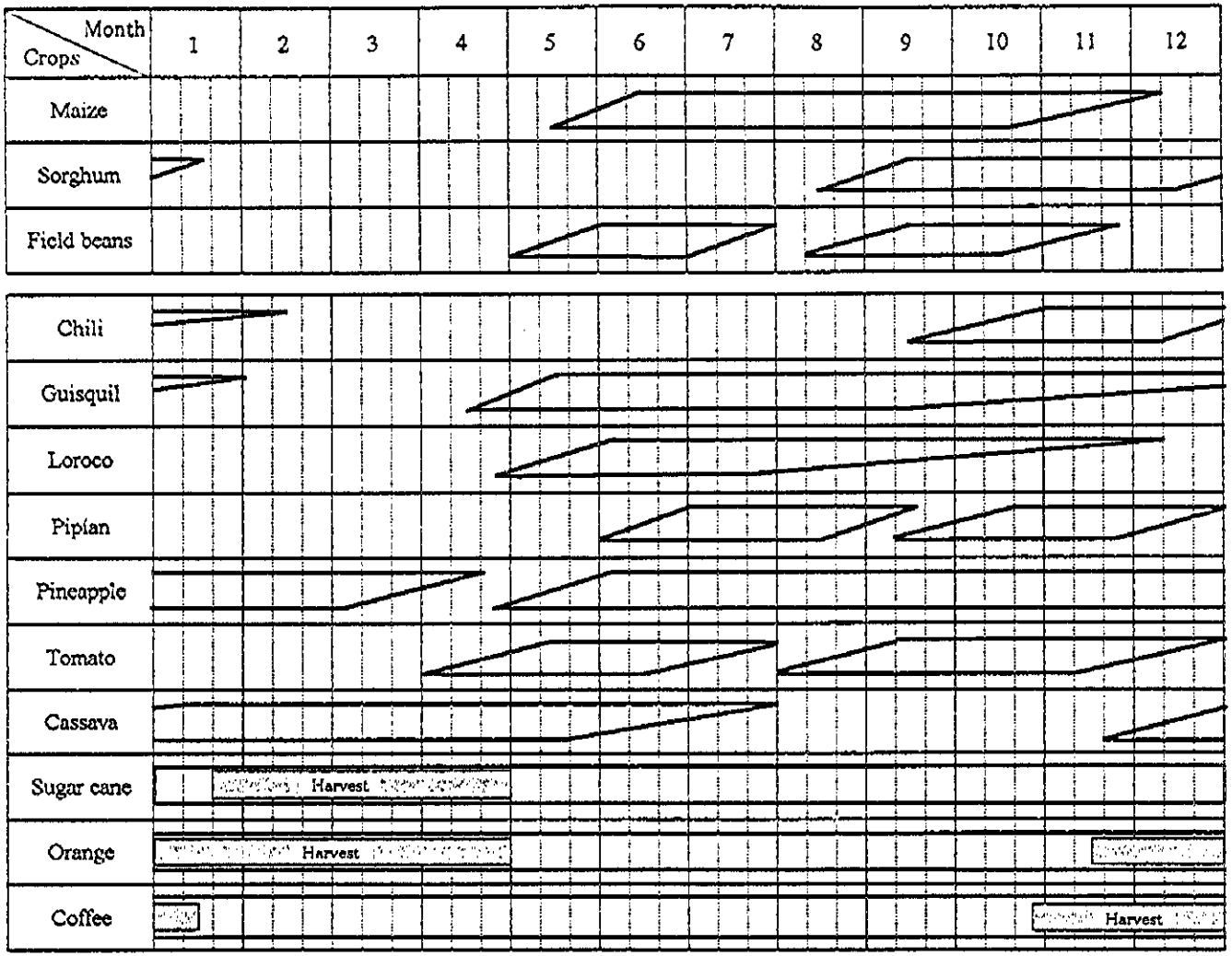
Note: the consumption figures are from POSTCOSECHA-MAG (1995)

The production of maize and field beans is only about 42% and 19% of the total demand in the Study Area, respectively.

4) Problems in cultivation

The table below shows the problems in the cultivation of main crops in the Study Area.

Crops	*Problems*
Maize	The yield decreases. It can not be seeded at the proper time because of Canícula. Local variety is planted widely (differs from place to place by 10 to 40 %); the planting density is low (amount of sowing seeds and sprout rate is low). The fertilizer amount is insufficient; agrochemicals are not sprayed at a suitable time; presence of soil insects (gallina ciega, phyllophaga spp).
Sorghum	Local variety is planted widely (differs from place to place by 55 to 90 %). The planting density is high; the fertilizer amount is insufficient or fertilizer is not applied at all; presence of soil insects (gallina ciega, phyllophaga sp.)
Field beans	Local variety is planted widely (differs from place to place by 60 to 90 %) Mixture of seeds of different varieties; fertilizer amount is insufficient or fertilizer is not applied at all; presence of viral diseases and pests.
Sesame	The planting density is high; a suitable variety cannot be obtained
Orange	Many trees are old; presence of pests (fruit fly, aphid, and green caterpillar) and diseases (mold)
Vegetables	Existence of white flies; rot, downy mildew



Source: Each agricultural extension office in the Study Area and interview survey by JICA Study Team (1996)

Figure 3.4.1.1 Cropping season of main crops in the Study Area

Table 3.4.1.1 Amount of fertilizer to maize and rice in the Study Area

Fertilizer	N %	Maize (slope)		Maize (plain)		Rice (slope)	
		qq/Mz.	N kg/ha	qq/Mz.	N kg/ha	qq/Mz.	N kg/ha
Compound fertilizer (16-20-0)	16	2.20	22.9	2.20	22.9	4.4	45.8
Ammonium sulfate	21	2.20	30.1	1.10	15.0	2.2	30.1
Urea	46	-	-	0.75	22.5	-	-
Total			53.0		60.4		75.9

Source: Each agricultural extension office in the Study Area and interview survey by JICA Study Team (1996)

Table 3.4.1.2 Production Cost (Present condition)

Crops	Agricultural materials	Plowing	Labor cost	Subtotal	Management fee (3 %)	Reserve fund (5 %)	Interest (20 %)	Total	Yield / Mz.	Unit	Unit price (¢)	Income (¢)	Benefit (¢)	Cost per yield (¢)
Basic grains														
1 Maize (slope, interoropping)	617	0	1,045	1,662	50	86	359	2,157	25	qq	75	1,875	-282	86
2 Maize (plain, monoculture)	1,166	200	700	2,066	62	106	447	2,682	45	qq	75	3,375	693	60
3 Field beans (slope, interoropping)	127	0	450	577	17	30	125	749	8	qq	270	2,160	1411	94
4 Sorghum (slope, interoropping)	27	0	545	572	17	29	124	742	16	qq	60	960	218	46
5 Rice (slope, monoculture)	1,420	150	879	2,449	73	126	530	3,178	45	qq	85	3,825	647	71
Industrial crops														
1 Sesame	575	620	932	2,127	64	110	345	2,645	10	qq	300	3,000	355	265
2 Coffee	2,153	0	2,770	4,923	148	254	1,065	6,388	12	qq	700	8,400	2012	532
3 Sugar cane (seedling)	1,215	695	850	2,760	83	142	597	3,582	85	TC	125	10,625	7043	42
4 Sugar cane (ratoon)	855	0	700	1,555	47	80	336	2,018	75	TC	125	9,375	7357	27
Vegetables														
1 Guisquil (bamboo, with irrigation, 1st year)	7,796	1,895	700	10,391	312	535	2,248	13,485	1,400	100 ea	30	42,000	28515	10
2 Guisquil (bamboo, with irrigation, 2nd year)	4,376	0	875	5,251	158	270	1,136	6,815	1,400	100 ea	30	42,000	35185	5
3 Guisquil (bamboo, without irrigation, 1st year	7,656	1,895	875	10,426	313	537	2,255	13,531	800	100 ea	30	24,000	10469	17
4 Guisquil (bamboo, without irrigation, 2nd yea	3,876	0	875	4,751	143	245	1,028	6,166	800	100 ea	30	24,000	17185	9
5 Lorocо (bamboo, with irrigation, 1st year)	7,905	1,975	9,350	19,230	577	990	4,159	24,957	14	qq	2,000	28,800	3843	1,733
6 Lorocо (bamboo, with irrigation, 2nd year)	3,900	0	9,275	13,175	395	679	2,850	17,099	14	qq	2,000	28,800	11701	1,187
7 Lorocо (bamboo, without irrigation, 1st year)	7,905	1,975	5,550	15,430	463	795	3,338	20,025	8	qq	2,000	16,000	-4025	2,503
8 Lorocо (bamboo, without irrigation, 2nd year	3,900	0	5,475	9,375	281	483	2,028	12,167	8	qq	2,000	16,000	3833	1,521
9 Pipian	2,994	650	1,800	5,444	163	280	1,178	7,065	200	qq	60	12,000	4935	35
10 Tomato (with irrigation)	2,208	200	3,755	6,163	185	317	1,333	7,998	400	"	60	24,000	16002	40
11 Tomato (without irrigation)	2,290	200	4,235	6,725	202	346	1,455	8,728	600	"	60	36,000	27272	44
Fruit trees														
1 Orange	1,530	0	1,845	3,375	101	174	730	4,380	350	100 ea	20	7,000	2620	13
2 Pine apple (1st year)	4,950	320	970	5,920	178	305	1,280	7,683	-	-	-	-	-	-
3 Pine apple (2nd year)	1,260	0	1,250	8,430	253	434	1,823	10,940	12,000	ea	2	24,000	5377	1
4 Banana (1st year)	7,204	850	600	8,654	260	446	1,872	10,526	-	-	-	-	-	-
5 Banana (2nd year)	3,164	0	1,150	12,968	389	668	2,805	15,773	700	100 ea	35	24,500	8727	23
6 Water melon	2,840	600	1,825	5,265	158	271	1,139	6,833	70	100 ea	250	17,500	10667	98

Source: Each agricultural extension office in the Study Area and interview survey by JICA Study Team (1996)
qq: quintal = 100 lb = 45.36 kg
TC: short ton = 907.2 kg

Table 3.4.1.3 Present farming condition according to block

Items	Crops	Block				
		A	B	C	D	E
				Area (Mz.)		
Possesion area		2.74	3.42	4.14	2.05	2.93
	Woods land	0.11	0.28	0.26	-	0.16
	Glass land	0.10	0.29	0.27	-	0.32
	Cultivated land	2.02	2.53	2.80	2.05	2.35
Cultivated area		3.48	3.57	4.68	2.14	3.69
Cropping intensity		1.72	1.41	1.67	1.05	1.57
				Planted area (Mz.)		
Basic grains						
	Maize	1.11	1.34	1.22	1.35	1.76
	Sorghum	0.75	0.59	0.46	0.16	0.46
	Field beans	0.21	0.12	0.61	-	0.78
	Rice	0.02	0.03	0.20	-	0.05
	Subtotal	2.08	2.08	2.49	1.51	3.04
Cash crops						
	Sesame	0.00	0.00	0.02	0.58	0.03
	Fruits tree	0.78	0.50	0.70	0.00	0.41
	Sugar cane	0.00	0.40	0.60	-	0.00
	Watermelon	0.00	0.00	0.00	0.06	0.00
	Coffee	0.51	0.33	0.81	-	0.09
	Vegetables	0.11	0.26	0.06	-	0.11
	Subtotal	1.40	1.49	2.19	0.63	0.64
				Cultivation ratio (%)		
Basic grains						
	Maize	32.0	37.4	26.1	63.0	47.7
	Sorghum	21.5	16.7	9.8	7.4	12.3
	Field beans	5.9	3.3	13.1	-	21.3
	Rice	0.5	0.7	4.2	-	1.3
	Subtotal	59.9	58.2	53.3	70.4	82.6
Cash crops						
	Sesame	0.0	0.0	0.3	27.0	0.9
	Fruits tree	22.4	14.1	15.0	0.0	11.1
	Sugar cane	0.0	11.1	12.7	-	0.0
	Watermelon	0.0	0.0	0.0	2.6	0.0
	Coffee	14.5	9.2	17.3	-	2.5
	Vegetables	3.2	7.4	1.3	-	3.0
	Subtotal	40.1	41.8	46.7	29.6	17.4
				Agricultural income (¢)		
Basic grains						
	Maize	-314	-376	-345	936	-496
	Sorghum	163	129	100	34	99
	Field beans	292	168	863	-	1,107
	Rice	10	17	128	-	30
	Subtotal	151	-62	746	971	741
Cash crops						
	Sesame	0	0	5	175	11
	Fruits tree	2,042	1,316	1,842	-	1,069
	Sugar cane	0	2,918	4,385	-	0
	Watermelon	0	0	0	596	0
	Coffee	1,017	659	1,629	-	188
	Vegetables	550	1,305	302	-	542
	Subtotal	3,609	6,198	8,163	991	1,811
Total		3,760	6,136	8,909	1,962	2,552

Source: Each agricultural extension office in the Study Area and interview survey by JICA Study Team (1996)

Table 3.4.1.4 Cultivation area and varieties of vegetables where farmers are trying to establish an association of irrigation in Jarapa River

Producer	Possession	Leased land	Total	Area (tarea)	Crops
Adán Hernandez Gabriel	20.00	0.00	20.00	8.00	Guiscuil
Amadeo Alvarez	64.00	0.00	64.00	2.00	Loroco
Baudilio Alvarez	4.00	0.00	4.00	4.00	Guiscuil
Benito Perez	3.00	0.00	3.00	3.00	Pepino, pipian
Carlos Humberto	4.00	0.00	4.00	3.00	Field beans
Carmelo Martinez	8.00	0.00	8.00	4.00	Pipian
Daniel Alvarez	6.00	0.00	6.00	2.00	Guiscuil, rabano, maize
Domingo Aragón	4.00	0.00	4.00	1.00	Guiscuil
Domingo López	8.00	0.00	8.00	0.50	Guiscuil
Eusebio Angel	8.00	0.00	8.00	2.00	Pipian
Felipe González	4.00	0.00	4.00	2.00	Guiscuil
Felipe Martinez	16.00	0.00	16.00	8.00	Field beans, cucumber, guiscuil
Hilario Martinez Garcia	32.00	0.00	32.00	6.00	Guiscuil, maize
Isidro Menjivar	0.00	8(1)	8.00	8.00	Guiscuil
Jesús Alvarez	4.00	0.00	4.00	1.00	Radish
Jesús Enrique Menjivar	40.00	0.00	40.00	4.00	Guiscuil
Jose Antonio Alvarez	4.00	0.00	4.00	1.50	Guiscuil
Juan Hernandez	6.00	0.00	6.00	4.00	Guiscuil, maize
Juan Suria	8.00	0.00	8.00	4.00	Tomato
Julia Gabriel	4.00	0.00	4.00	1.50	Guiscuil
Luis López	4.00	0.00	4.00	1.00	Guiscuil
Manuel Hernández Gabrie	20.00	0.00	20.00	6.00	Guiscuil, radish, maize
Mario Palacios	12.00	0.00	12.00	0.50	Radish
Martin Perez	16.00	0.00	16.00	8.00	Guiscuil
Miguel Angel Hernández	0.00	2.00	2.00	2.00	Radish
Ovidio Palacios	12.00	0.00	12.00	3.00	Field beans, Pipian, maize
Paco Aguillón	6.00	6.00	12.00	3.00	Guiscuil
Roberto Angel	8.00	0.00	8.00	1.00	Guiscuil
Rosario Perez	16.00	0.00	16.00	8.00	Guiscuil
Santos Gilberto Suria	0.00	8.00	8.00	3.00	Cucumber, green pepper
Santos Suria	0.00	8.00	8.00	2.00	Guiscuil, maize, tomato, cucumber
Toño López	12.00	0.00	12.00	1.50	Guiscuil
Tulio Suria	0.00	8.00	8.00	4.00	Guiscuil
Victor Gabriel	4.00	0.00	4.00	3.00	Guiscuil
Total (tarea)	357.00	32.00	397.00	115.50	
Average area (tarea)	10.50	0.94	11.68	3.40	
Total (ha)	31.10	2.79	34.59	10.06	
Average area (ha)	0.91	0.08	1.02	0.30	

Note: 8 Tarea = 1 Mz. = 0.697 ha
San Pedro and San Pablo village
Source: Materials by agricultural extension office in Cojutepeque are compiled by JICA Study Team

3.4.2 Livestock

(1) Type of Animal Husbandry

Most common animals raised in the Study Area are dairy cattle, beef cattle, and poultry. The commercialised chicken farms are mostly located in the mountainous area upstream. The largest chicken broiler farm (INCOA) in the country and small scale chicken farms are located in El Rosario, in the midstream basin area. Small scale poultry farming is promoted by the CENTA extension office at El Rosario as a WID assistance activity. Thus, around 80 chicken farms breed 50 to 100 chickens for egg production or hatching (hybrids) in El Rosario. Poultry farming is concentrated in the upper basin area because the cool weather conditions are favorable to this industry.

Regarding cattle farming, a large scale dairy farm (Holsteins species) along the north shore of Ilopango Lake and several large scale cooperative beef cattle farms (Indian Zebu in grazing system) in the lower basin exist in the Study Area. Swine breeding (Land race, Duroc, Hampshire, locals) is predominantly carried out in farmyards, although a few small scale commercial swine farms exist along the north shore of Ilopango lake and within the metropolitan periphery. Cattle is also used to till the farms in the Study Area.

(2) Number of Livestock Raised in the Study Area

The statistical data on animal population in El Salvador is an integration of the data of over 4 regions, thus it would be difficult to narrow down the data into the Study Area. Accordingly, the number of animals raised in the Study Area is estimated based on the results of the questionnaire survey to the farmers in the Study Area, and is shown in Table 3.4.2.1. The estimated animal population is broken down into 25,000 cattle, 400,000 poultry, and 1,600 goats, swine, sheep, etc. The estimates did not include the figures of the industrial chicken farms, thus actual figures shall be considered as twice the estimate.

Table 3.4.2.1 Estimated Animal Population in the Study Area in 1996

Livestock / *Basin*	*Estimated Animal Population*		
	Cattle	*Chicken*	*Others*
A	5,125	307,835	191
B	5,088	22,492	328
C	6,160	33,646	395
D	7,500	14,119	591
E	1,599	21,154	135
Total	25,471	399,246	1,640

Note: The number of livestock is estimated based on the result of the questionnaire survey carried out by the JICA Study Team in Phase I. Others refer to swine, sheep and goats

(3) Grazing land

By interpreting the spot images, the grasslands in the Jiboa River basin amount to 33.3 km^2 (see Table 3.1.3.2). Some large scale livestock cooperative farms in the lower basin cultivate pangola grass or sorghum during the dry season through irrigation, to provide forage. However, the majority find it difficult to secure forage during the dry season and are forced to temporarily use sugarcane as a substitute. Due to this problem, the farms are confronted with decrease in cattle live weight. Likewise, acquisition of forage in the upper basin area is a severe problem during the dry season. During this period, live animal market prices tend to fluctuate as livestock farmers are forced to sell their animals.

(4) Animal Health Situation

The Study Area is a jurisdiction of the Animal Health Institute of DGSVA, which is located in San Salvador, as shown in Table 2.4.2.3. Livestock farmers and cooperative farms receive support from several organs such as CENTA, DGSVA, CAB or NGOs. Most commercial poultry farms in the Study Area independently conduct vaccination on a regular basis. On the other hand, large scale livestock cooperative farms like San Jose Luna or Astoria, through connections with CAB or NGOs, receive private veterinary services. However, medium-small scale livestock cooperative farms have a limited access to veterinary services, resulting in poor animal health conditions.

As previously mentioned, local breeding of swine is predominantly carried out in farmyards. Swine raised in this conventional method is always highly considered as parasite carriers. Consequently, pork demand in the study area is low. Animal plagues in the Study Area are compiled in Table 3.4.2.2.

Table 3.4.2.2 Animal Plague in the Study Area

Department	Municipality		Plague	91	92	93	94	95	96	Total
San Vicente	Santo Domingo	B	Rabia	2/29	0	0	0	0	0	3
			Brucelosis	1/30	0	0	0	0	0	1
			Anaplasmosis	0	0	4/83	1/7	0	0	5
		S	Peste orcina	0	0	15/1000	0	0	0	15
		B	Enfermedad.	0	1/5	0	0	0	0	1
			Papilomatosis	0	0	6/43	0	0	0	6
	Verapaz	B	Rabia	1/18	0	0	0	0	0	1
			Anaplasmosis	0	0	1/11	0	0	0	1
	Guadalupe	B	Dermatobiasis	0	1/5	0	0	0	0	1
Cuscatlan	San Rafael	B	Enfermedad.	1/8	0	0	0	0	0	1
	San Pedro Perulapan	B	Anaplasmosis	0	0	0	6/12	0	0	6
San Salvador	Soyapango	B	Mastitis Cronica	3	0	0	0	0	0	3
			Lsterelosis	2/95	0	0	0	0	0	2
			Dermatobiasi	0	0	0	0	0	7/34	7
	Ilopango	B	Enfermedad.	0	0	0	27/341	4/14	0	31
			Antrax	0	0	0	4/364	0	0	4
			Colibacilosis	0	0	0	4/327	0	0	4
			Enfermedad.	0	0	0	0	3/4	0	3
La Paz	El Rosario	B	Leptosipirosis	3/48	0	0	0	0	0	3
			Anaplasmosis	0	0	0	20/452	1/1	0	21
			Enfermedad.	0	0	0	5/584	0	0	5
	San Luis Talpa	B	Listerrelosis	2/95	0	0	0	0	0	2
			Rabia	0	0	0	3/3	0	0	3
			Enfermedad.	0	0	0	1/1	0	0	1
			Brucelosis	0	0	0	0	0	1/55	1
	San Pedro Musahuat	B	Anaplasmosis	0	0	0	13/1027	0	0	13
			Antrax	0	0	0	2/2	0	0	2
			Intoxicacion	0	0	0	3/9	0	0	3
			Rabia	0	0	0	0	6/112	0	6
	Santiago Nonualco	B	Antrax	0	0	0	6/227	1	0	7
			Enfermedad.	0	0	0	21/1012	16/993	0	37
			Drmatobiasis	0	0	0	1/20	0	0	1
			Anaplasmosis	0	0	0	0	1/125	2/21	3
			Babesiasis	0	0	0	0	0	3/77	3
	Tapalguaca	P	Viruela	0	0	0	0	0	30/75	3

Source: Statistical data by DGSVA from 1991 to 1996 in the Study Area.

Note: The numerator of a fraction refers to the number of infected animals including dead animals.

The denominator refers to total number of animals in the area.

B: Bovine, S: Swine, P: Poultry

(5) Slaughterhouses and meat prices in the Study Area

In the San Salvador metropolis, including the Study Area, there are 5 major slaughterhouses: 4 in areas along the Pan American Highway, namely Mejicano, San Martin, Soyapango and, Cojutepeque, and 1 in San Pedro Masahuat in the midstream basin (see Table 3.4.2.2). The first two are slightly outside of the Study Area, but strongly affect the market (tiangue) in the study area for livestock. Among the five, the slaughterhouse in Soyapango, aided by the USA in 1945, is the largest nationwide, slaughtering an average of 3,500 heads of cattle and 1,000 heads of pigs every month.

The slaughterhouse in Cojutepeque is managed by the municipality and slaughters an average of 700 heads of cattle/month; no pigs are slaughtered here as they are privately butchered for the processing of sausages. The one in San Pedro Masahuat is also managed by the municipality and slaughters only one cattle every Saturday due to low local demand.

Table 3.4.2.3 Slaughterhouses in the Study Area

Slaughterhouse	*Location*	*Capacity/Day*		*Charge/Head*	*Heads Slaughtered /Month*
Rastro Municipal de San Salvador	Soyapango	B	250	128.35 ¢ /head	3500
		S	50	19.9 ¢ /h	1000
Rastro Municipal de Mejicanos	Mejicano	B	65~70	16.5 ¢ /h	1200
		S	30	11.19 ¢ /h	1050
Rastro Municipal de San Martin	San Martin	B	10~15	46.10 ¢ /h	300
		S	–	-	-
Rastro Municipal de Cojutepeque	Cojutepuque	B	30	87.34 ¢ /h	700
		S	–	-	-
Rastro Municipal de San Pedro Masahuat	San Pedro Masahuat	B	n.a	12.85 ¢ /h	4
		S	–	-	-

Source: DGSVA/IPOA and JICA Study Team;

Note: B: Bovine, S: Swine

Secondly, the 1994 meat prices in the capital cities of departments within or outside of the Study Area are shown in Table 3.4.2.4. Meat prices range from 8 ¢ /lb to 20 ¢ /lb, with beef as the highest priced, followed by pork and chicken. The study indicated that cheaply priced chicken are very in demand. Meat inspection is carried out by IPOA of DGSVA in collaboration with the Ministry of Health for both live and dead animals. Currently, only 30 % of the pork, 60 % of the beef and 90 % of chicken meat in circulation are inspected.

Table 3.4.2.4 Major Meat Prices in 1994 in the Study Area

(Unit: ¢/lb)

Meat		San Salvador	Cojutepeque	Zacatecoluca	San Vicente	Mean Price
B	Plate	19.75	18.17	19.42	18.42	18.94
	Sirloin	16.42	15.08	16.25	16.08	15.96
	Brisket	14.42	13.00	15.33	15.08	14.46
S	Roast	11.83	11.00	11.00	11.58	11.35
	Bacon	11.25	11.00	8.75	9.0	10.0
P	Egg	0.71	0.62	0.62	0.63	0.65
	Meat	7.75	8.31	8.83	8.67	8.39

Source: DGEA : Anuario de Estadisticas Agropecuarias 1994-1995

Note: B: Bovine, S: Swine, P: Pork

(6) Animal Market

Animal trade is mainly carried out by drovers registered with DGSVA, who purchase animals from farmyards and sell them to meat shops (tiangue). Swine trade is similar but slaughtering of swine is restricted only to improved species. Slaughtering of local varieties such as "Criollo" is not allowed by the Ministry of Health. Table 3.4.2.5 shows the farmyard price of animals compiled based on interviews carried out by the JICA Study Team.

Table 3.4.2.5 Live Animal Prices in the Study Area

Animal	*Weight (lb)*	*Live Price (¢)*
Bovine	500	1200/head
	700	2500 - 3000/head
	800	3500/female
		4500/male
		2000/castrated one
Swine	Piglet (20-23)	17/lb
	Swine(220-230)	5/lb
Poultry		25 - 30/chicken

Source : JICA Study Team/1996

(7) Support organizations for livestock farmers and cooperative farms

1) Semen Bank

DGSVA managed 4 bases nationwide for the storage of cattle semen. The bases are Matazano, Santa Ana, Sonsonate and San Miguel, and they distribute qualified semen to

34 semen banks nationwide in order to promote artificial insemination. There is one semen bank in the Ilopango municipality in the upper basin, and three in the mid-lower basin, in Comalapa, San Vicente, and Zacatecolca, which are located close to the Study Area. These banks sell semen at a cheap price. In the private sector, Inseminar Company Limited supplies semens from the USA but for a remarkable price.

2) Supporting activities of CAB and NGOs for livestock farmers and cooperative farms

Several organs such as CAB financed by the USA, agricultural input suppliers and NGOs are involved in the provision of animal health services in the lower basin. Large scale livestock cooperative farms have some access to regular veterinary services, but medium and small scale cooperative farms have poor access and are confronted with animal health problems.

3) Supporting activities of the agricultural extension office

9 extension offices in the Study Area have played an important role in extending support not only in crop cultivation but also in animal husbandry in terms of animal breeding and health maintenance. Except for the staff in the poultry house at the El Rosario extension office, however, there is quite a limited number of staff well-versed in animal husbandry.

(8) Problems in Livestock Development

(1) Beef cattle management mainly relies on grazing method and is confronted with decreasing animal live weight due to difficulties in securing forage during the dry season.

(2) Animal health services for medium and small scale livestock cooperative farms in the lower basin are very limited in terms of accessibility.

(3) Conventional breeding method of swine is associated with high risk of parasite infection, which consequently suppresses pork demand. Moreover, local swine bred traditionally is mostly illegally slaughtered, an action that generates meat sanitary issues.

(4) Large scale commercial chicken farms widely monopolize the market in El Salvador, making the development of small scale chicken farms difficult.

(5) The slaughterhouse in San Pedro Masahuat is in very poor sanitary condition.

3.4.3 Inland fisheries

(1) Type of Fishery

In the Study Area, fish culture mainly thrives in the west bank of Lake Ilopango, where tilapia culture by cage-breeding is carried out at Amatitan and Hoya Grande by fishermen associations and subsistence fishermen. There are no outstanding fishing activities in the

area apart from the fishing activities in Ilopango Lake, and the local people residing by the river in the upper basin fish for fresh water crab or shrimps for self-consumption. Tables 3.4.3.1 and 3.4.3.2 show the monthly haul by principal species in Ilopango Lake. The harvested fish in 1993 was 152,369 kg, comprising of 7 species which include Ejote (Melaniris gujia), Guapote (Cichlasoma managuense), and Mojara (Cichlasoma guila). Fish haul has been declining every year and as a countermeasure the government releases fingerlings of tilapia (Oreochromis niloticus) into Ilopango Lake every year. The best fishing season is usually from August up to January and accounts for 60 % of the annual haul of fish.

Table 3.4.3.1 Monthly Fish Haul in Ilopango Lake

(Unit: kg)

Month	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*Total*
Haul (kg)	22,723	8,209	8,146	4,706	4,340	5,065	10,834	20,957	20,604	19,600	18,968	8,208	152,360
Ratio (%)	14.9	5.4	5.3	3.1	2.8	3.3	7.1	13.8	13.5	12.9	12.4	5.4	100

Source: CENDEPESCA Annual Report/Vol. 20/1993

Table 3.4.3.2 Fish Haul by Species in Ilopango Lake

(Unit: kg)

Species	*Guapote*	*Mojarra*	*Tilapia*	*Ejote*	*Bagre*	*Plateada*	*Otr. Peces*	*Total*
Haul (kg)	41,885	10,325	2,870	89,333	3,273	288	4,386	152,360
Ratio (%)	27.5	6.8	1.9	58.6	2.1	0.19	2.9	100

Source: CENDEPESCA Annual Report/Vol. 20/1993

(2) Number of Fishermen in the Study Area

Table 3.4.3.3 shows the number of fishermen and Fishermen's Cooperative Associations (FCA) in Ilopango Lake. Ilopango Lake, which extends over 3 Departments namely San Salvador, Cuscatlan, and La Paz, accommodates 117 members of FCA, except for the La Libertad Department. The total number of independent fishermen, including those in the La Libertad department, is 1,886. However, this figure includes fishermen into marine fisheries in La Paz and La Libertad departments. Thus the actual number of fishermen in Ilopango Lake is estimated around 1000 - 1100, 546 of which are officially registered with CENDEPESCA.

Table 3.4.3.3 Number of Fishermen's Cooperative Association (FCA) and Fishermen

Region	Department	Type of Fishery				Total	
		FCA		Individual			
		No of FCA	No of members	Fishermen	Fishing Boats	Fishermen	Fishing Boats
Region II	San Salvador	2	59				
	La Libertad	2	28				
	Cuscatlan	1	21	1,243	834	1,351	1,351
Region III	La Paz	2	36	637	252	673	252
Total		7	145	1,886	1,186	2,030	1,603

Source : CENDEPESCA Annual Report/Vol. 20/1993

(3) Marketing and Fish Price

Fresh fish in the market in the Study Area mainly comes from Lake Ilopango. Prevailing trading sources of fresh fish mainly rely on middlemen who purchase fish at fish farms and sell them at a retail price. No fishery association manages the marketing of fish. The farmyard price of fresh fish ranges from 10 to 12 ¢/lb for 3 tilapias, and 35 to 45 ¢/lb for shrimp.

(4) Major Problems in Inland Fishery

The problems encountered by the fish farms in Ilopango Lake are as follows:

1) Decrease in fish haul due to deterioration in the ecological environment.
2) Over exploitation of fish resources due to illegal fishing activities.
3) Failure of establishing a financing system for fishermen or the fishery association due to incapability to repay debts.
4) Outbreak of fish diseases like inflammation of the body, blindness, torn fins, loose or falling scales and so on.
5) Negative impact of volcanic activity on fish ecosystem.
6) Burglary and its adverse impact on cage-breeding.

3.4.4 Agricultural Infrastructure

(1) Irrigation

1) General

According to the Master Plan for the water resource development, "Plan Maestro de Desarrollo y Aprovechamiento de los Recursos Hídricos", prepared in the 1980s, 274,000 ha of irrigable land exists nationwide(see Fig.3.4.4.1,Table3.4.4.1).

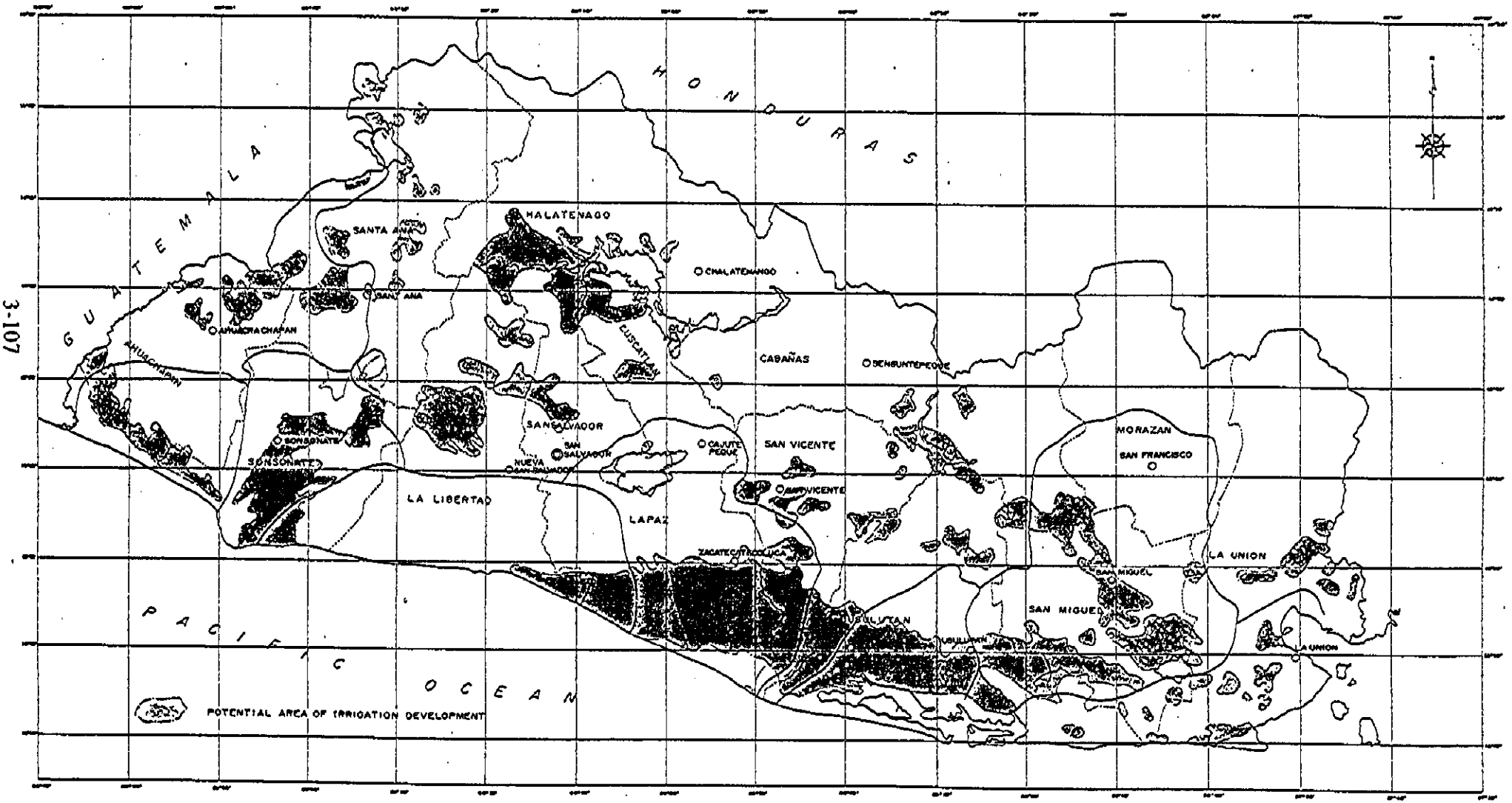


Fig.3.4.4.1 Iirrigable Agricultural Area in El Salvador

Table 3.4.4.1 Irrigable Land

Region	*CLASS*					*Total*
	I	*II*	*III*	*IV*	*V*	*(ha)*
A	295.0	10551.0	34362.0	15182.0	7189.0	67579.0
B		2453.0	2496.0	3856.0	2035.0	10840.0
C	753.0	2425.0	4600.0	2133.0	2341.0	12252.0
D	755.0	4195.0	7186.0	11374.0	5358.0	28113.0
E		2207.0	2121.0	1643.0	734.0	6705.0
F	3100.0	12907.0	21328.0	12623.0	4100.0	54058.0
G	5020.0	10250.0	851.0	3540.0	2650.0	29970.0
H	1264.0	10503.0	12719.0	8696.0	8390.0	40308.0
I		852.0	3603.0	2351.0	2280.0	9086.0
J			3793.0	2518.0	6294.0	12605.0
Total	11187.0	56343.0	100718.0	63916.0	41371.0	273535.0

Source: Documents Básicos "Plan Maestro de Desarrollo y Aprovechamiento de los Recursos Hídricos" (PLAMDARH)

Irrigated agricultural lands total about 35,000 ha, of which 23,000 ha are privately owned and 12,000 ha are government owned. The irrigated agricultural land is distributed as follows: 44 % in the basin of Sensunapan River, the Banderas River and the San Pedro River; 21 % in the basin of Lempa River and its tributaries; and 15 % in the basin of the Comalapa River and the Jiboa River. The gravity irrigation method and the sprinkler irrigation method are commonly used.

Table3.4.4.2 **Irrigated Agricultural Land**

Region	*Superficie Regada (ha)*	*Irrigation System (%)*		*Water Resource*	
		Gravity	*Aspersion*	*Surface Water*	*Groundwater*
A	7100.0				
B	500.0			100.0	
C	780.0		100.0		
D	15069.0				
E	895.0			46.0	54.0
F	3800.0	57.0	43.0		
G	2100.0	64.0	36.0	90.0	10.0
H	3627.0	55.0	45.0		
I	400.0			30.0	70.0
J	100.0				
Total	34371.0				

Source: Documents Básicos PLAMDARH

2) Water Rights

The irrigation and drainage law (Reglamento General de la Ley de Riego y Avenamiento) concerning river water-use is set by the General Department of Renewable Natural Resources of the Ministry of Agriculture and Livestock (Ministerio de Agricultura y Ganadería, Dirección General de Recursos Naturales Renov. -MAG-), and enforced on November 11, 1970. The law stipulates that it is possible to use for irrigation 80 % of the minimum river flow in the dry season (CAPITULO, II Art. 11). However, only 70 % of the water volume can be used for irrigation because it is also used by the inhabitants for domestic purposes or the animals for drinking: intake is carried out at a water intake point downstream.

3) Present Condition of Agricultural Infrastructure

In the Study Area, cultivation is basically dependent on rain for irrigation. There are a lot of crops (maize, sorghum, beans), specially grain and rice, cultivated in the study area. Sugarcane, sesame products and several vegetables (tomato, green pepper, chayote, squash, etc.) are cultivated in some areas because they are well paying cash crops. Sugarcane is cultivated either in flat or mountainous lands and require less water than other crops. In the Study area, few water is used for agriculture and farmers sell their products to sugar mills. As explained in the Inception Report, the Study Area has been divided into five blocks (A, B, C, D, E):

a) Block A

In the vicinity of the eastern part of Candelaria, there are fields either cultivated with

coffee or banana. These are rainfed crops and irrigation and drainage facilities do not exist in this Block.

b) Block B

A set of five hard PVC pipes is installed in the Jiboa River (1 and 2 inches in diameter), and "Wiskiru" and "Chile" are produced downstream under the sprinkler irrigation system, which is about 30 m lower in elevation than the water intake points. Maize and frijol beans are cultivated in the rainy season without irrigation.

c) Block C

The potential area for irrigation in Verapaz, Guadalupe and the Borbollon River valley is presumed to be about 600 ha. Some 20-30 Mz were irrigated before the 1970s. However, after ANDA developed wells for water supply in the upper reaches of the Borbollon River basin, the discharge of the Borbollon River was drastically reduced and agriculture in this block became of the rainfed type.

d) Block D

At present, water from the Jiboa River is not used for irrigation due to the inflow of Ilopango Lake's water upstream. Agriculture in this area (Block D) is managed by cooperatives of 6 "Haciendas". Capital shortage prevents agricultural cooperatives from rehabilitating irrigation and water resource facilities. Consequently, agriculture became dependent on rain water.

e) Block E

Cooperative Hacienda Astoria is located on the plain on the right bank of the Sepaquiapa River. This cooperative has built a temporary earth dam in the river and an earth canal to irrigate about 130 ha of agricultural land during the dry season. The dam is about 1.5 m in height and about 4.0 m in bottom width, while the canal is about 1.5 m in depth and about 2.5 m in width.

Before the civil war, lots or parcels of land in the lower part of the Sepaquiapa River (San Mauricio zone) were irrigated with river water using diesel pump mechanism. When the war began, the farmers stopped cultivating the land out of fear and migrated to other places. 12 years later, the same farmers came back. The water of the Sepaquiapa River, however, has become so contaminated with waste and manure from farms established in 1991 at the left bank of the river.

(2) Drainage

1) Present Condition in the Study Area

Inundation is thought to have damaged about 2,500 ha of land in the lower part of the Jiboa River basin. The inundation period supposedly extends over three weeks or more, at a depth of 30 to 60 cm (see Fig.3.3.2.1).

(3) Rural Roads

1) General

Rural roads are under the jurisdiction of the Road Bureau (DGC) of the Ministry of Public Works, and are classified below based on traffic volume.

CLASS	*EFFECTIVE WIDTH (m)*	*PAVEMENT WIDTH (m)*	*PAVEMENT THICKNESS (m)*
(1) SPECIAL ROAD	30.6	14.6	9.0
(2) FIRST CLASS	12.0	7.3	9.0
(3) SECOND CLASS	9.5	6.5	6.0
(4) Improved THIRD CLASS	8.0	6.0	5.0
(5) THIRD CLASS	6.0	6.0	5.0
(6) RURAL A	5.0		
(7) RURAL B	5.0		

2) Existing Condition of the Roads in the Study Area

The Study Area is located southeast of the capital city, San Salvador, bordered to the north by the Pan American Highway (CA-1) which connects San Salvador, Cojutepeque and San Vicente to the east. National road CA-2 is the main road in the southern part of the Study Area. Both roads are major arteries for the agricultural distribution system of El Salvador. The road network in the Study Area is good, however there are a lot of dirt roads and traffic is usually bad. The existing condition of the road network in the Study Area is as follows:

Table3.4.4.3 Existing Condition of the Roads in the Study Area

CLASS	*Condition L. MB (km)*	*Condition L. B (km)*	*Condition L. R (km)*	*Condition L. M (km)*
(1) SPECIAL ROAD	33.0	15.0	15.2	0
(2) FIRST CLASS	0	40.0	36.9	2.1
(3) SECOND CLASS	0	10.0	20.6	45.7
(4) Improved THIRD CLASS	0	0	0	0
(5) THIRD CLASS	0	26.5	4.9	78.5
(6) RURAL A	0	0	33.3	9.3
(7) RURAL B	0	6.5	13.0	128.5
TOTAL	33.0	98.0	123.9	264.1

MB: Very Good; B: Good; R: Fair; M: Bad

3.4.5 Rural Infrastructure

(1) Education

The citizens of El Salvador are obliged to take 9 years (3 years per term) of education. However, the average schooling only amounts to 3 years because the majority of the citizens have to work to help support the family. According to the 1992 Census, El Salvador has a national illiteracy rate of 22.7%: 13.7% in the department of San Salvador, 29.3% in Cuscatlan, 32.5% in San Vicente and 29.5% in La Paz.

In 1991, the Ministry of Education carried out the EDUCO Project. The project dispatched teachers to remote villages to educate the people, using existing public buildings or private houses.

In 1995, the study area was reported to have a total of 634 schools, 451 of which were public and 183 private. The total number of students was 200,097, and the total number of teachers, 6,665. The average commanding area of each school was 1.64ha and the average population per school was 1,200. The average number of students per teacher was 30.

(2) Health

El Salvador has seven (7) kinds of public health facilities; ① Hospital - a general hospital, ② Centro - a clinic that conducts minor operations but does not accept inpatients, ③ Unidad de Salud - a public health center with resident doctors, ④ Puesto de Salud - a public health center with doctors on call, ⑤ Puesto Communitario - a public health center with nurses and technicians, ⑥ Dispensario - a dispensary, and ⑦ Centro Rural de Nutricion - a nutrition center. In 1995, the basin area was reported to have 1 Hospital, 2 Centros, 18 Unidad de Saluds, 19 Puesto de Saluds, 1 Puesto Communitario, and 1 Dispensario. Each municipality is equipped with at least one Puesto de Salud, with the exclusion of Mercedes La Ceiba which has only 1 Dispensario.

(3) Water supply and sewerage

Water supply pipelines are installed within cities such as San Salvador and Cojutepeque and their surrounding vicinities. In rural areas, wells are the most popular water supply facility. According to the 1992 Census, the average number of families with water supply systems was 78.0% in the whole study area and 49.3% in the rural area. This figure is especially small in the B and E blocks.

Residents using flush toilets amount to 54.2% of the total household population in the basin, while 37.5% use simple lavatories. The remaining percentage (8.3%) have no lavatories. As these values represent a part of the city of San Salvador, they cannot truly account for the actual situation in the rural area where conditions are a lot worse: 24.0% have no lavatories. The occurrence of epidemics, e.g. dysentery, are largely

attributed to deficiency in sewage treatment facilities.

(4) Electrification and fuel

Although electrification has been carried out in the entire basin area, the lines do not extend up to the rural areas at the extreme end where kerosene is mainly used for lighting. The average electrification rate is 81.0% in the basin area and 49.9% in the rural area. Electricity in the basin is mostly used for lighting. The number of families using electricity for fuel is only 6.2% in the entire basin area, and 1.8% in the rural area. The families using firewood and charcoal for fuel is 36.2% in the entire basin area and 79.4% in the rural area. Propane gas and kerosene are mainly used for fuel in the entire basin area (56.7%), while only 17.7% of the families in the rural area use them.

Conditions of Rural Infrastructure (1992 Census)

Item	Nationwide				Basin Area			
	Entire Area	Household Ratio (%)	Rural Area	Household Ratio (%)	Entire Area	Household Ratio (%)	Rural Area	Household Ratio (%)
Total number of households	1100714		501872		167657		47441	
Water supply	511491	46.5	67690	13.5	100077	59.7	7490	15.8
Pipeline	324473	29.5	224433	44.7	30666	18.3	15891	33.5
Well	264750	24.0	209749	41.8	36914	22.0	24060	50.7
None								
Lavatory	436874	39.7	42798	8.5	90854	54.2	5192	10.9
Flush toilet	456143	41.4	277380	55.3	62889	37.5	30877	65.1
Simple toilet	207697	18.9	181694	36.2	13919	8.3	11372	24.0
None								
Lighting	762789	69.3	212152	42.3	136020	81.1	23688	49.9
Electricity	307875	28.0	269840	53.8	26753	16.0	21226	44.5
Kerosene	30050	2.7	19880	4.0	4884	2.9	2637	5.6
Others								
Fuel	64404	5.9	6999	1.4	10453	6.2	868	1.8
Electricity	601290	54.6	432038	86.1	60642	36.2	37647	79.4
Firewood	12242	1.1	5626	1.1	1503	0.9	519	1.1
Charcoal	422781	38.4	57209	11.4	95059	56.7	8407	17.7
Others								

3.4.6 Agricultural Marketing

When products are not sold to intermediaries, farmers' wives market the amount that exceeds what is needed for family consumption. Women's participation is especially relevant in the case of perishables, that is, vegetables, fruits, and eggs. In the Jiboa River basin, women can only market a limited amount per trip as the products are transported in bamboo baskets along difficult-to-walk pathways. The situation is worsened by the fact that most small farms are located in mountain areas or in topographically rough terrain. Lack of roads for vehicular traffic, or poorly maintained roads, compound the problem. There are, however, few buses or pick-up trucks that could take these women at least part of the way to the market.

These women mainly go to markets in Cojutepeque, San Martin, and San Salvador, within the Jiboa River basin, in addition to the small markets in just about any town. It appears that each village (cantón or caserío) chooses the arrival time into the market, perhaps influenced by the availability of public transportation. Farmers' wives seem to know the days of the week when their products command relatively higher prices, which are apparently due to purchasers arriving on specific days from distant cities.

(1) Shipping method

As the farmland area in the Study Area is small, varying from 2 to 4 manzanas, and various crops are grown, farmers can only produce a limited amount of individual crops.

Table 3.4.1.4 shows the farmland area and the cultivation area of farmers attempting to establish an irrigation district in San Ramon with the assistance of the extension office. The vegetable growing area is too small and small trucks (public transport) are used to market vegetables. Maize, and sorghum are purchased by brokers at farmyards.

Field beans, vegetables, and fruits are transported by housewives to the local market, selling them to brokers, wholesalers or retailers depending on the harvested volume. Sometimes housewives sell the products directly to the consumer.

(2) Destination of agricultural products

Vegetables and fruits are marketed in La Tiendona in San Salvador and the local market in Cojutepeque. These products are shipped to the local market in Cojutepeque from San Martín, Santo Domingo, Candelaria, San Ramón, and Santa Cruz Analquito, etc. Vegetables are sold to the transporter and the broker who come from San Miguel. Therefore, some farmers ship them to the market on the day the transporter goes to Cojutepeque.

3.4.7 Financial Assistance

Financial sources accessible to small holders are scarce and interest rates are generally high. However, in the case of non-agricultural activities, high interest rates are less of a deterrent than cumbersome credit application procedures. For instance, a private financial institution gives non-agricultural loans in rural areas at an interest rate of 3% a month, but hands in the credit in 7 days to first time applicants, and in 4 days to repeat customers. A truly interesting financial arrangement is provided by a government institution known as "Bancos del Progreso" (Progress Bank) of the National Family Secretariat, which finances non-agricultural activities in rural areas at an interest rate of 3% a month on the basis of group solidarity. These are specifically set up community groups in which every member is backed up by a guarantor, and the group solidarity pressures every member to fulfill his/her obligations. Most beneficiaries are women (85%). Arrears amount to less than 5%, capital recovery reaches 97%, and the capital turnover ratio is 2.84 times a year.

Another type of financial institution is the so called Cajas de Crédito, which is organized as cooperatives, under an umbrella organization known as FEDECREDITO, which obtains funds from Banco Multisectorial de Inversiones (BMI) and channels them toward Cajas de Crédito. Customers are mainly small borrowers, seeking under 50,000 colones, that are not welcomed by commercial banks due to low profitability. An interesting feature of these Cajas de Crédito is that some of them operate "agroservicios" (farm input shops) as an integrated but independent business. When these Cajas de Crédito are short of funds, they provide farmers seeking loans with their most urgent input needs, which are to be deducted from the loan granted when funds become available.

Banco de Fomento Agropecuario (BFA), or Agricultural Development Bank, is the most important source of financial assistance for agricultural and livestock activities. Some private banks have branch offices in larger rural cities, providing agricultural loans and competing rather aggressively with BFA for big borrowers.

MAG is implementing a project known as PRODAP (Proyecto de Desarrollo Agrícola para Pequeños Productores de la Región Paracentral, or Agricultural Development Project for Small Producers in the Para-Central Region), with main offices in San Vicente and a contact office in San Salvador. PRODAP is financed by FIDA (International Fund for Agricultural Development) headquartered in Rome, and by BCIE (Central American Bank for Economic Integration). PRODAP has many components including technical assistance, farmers' organization, and financial assistance. A remarkable feature of PRODAP loans is that community leaders participate in setting the interest rates, which vary according to the purpose of the loan: 10% for housing, 18% for basic grain

production, 15% for livestock investment, and 6% for natural resource conservation. PRODAP loans are administered by BFA and amount to 30 to 35 million colones a year.

The table presented below outlines the financial assistance provided by financial institutions in the Jiboa River basin.

Location	Unit	Cajas de Credito	BFA	Commercial Banks
Loan Amount				
Zacatecoluca	Colones	40,309,170	55,000,000	60,000,000
Rosario de La Paz	Colones	No branch	38,000,000	No branch
Cojutepeque	Colones	200,000	7,000,000	Not available
Olocuilta	Colones	3,452,600	No branch	No branch
San Vicente	Colones	Not available	20,000,000	Not available
Interest Rate	%	21-25	18-21	18-20
Guarantee	--	Land	Land	Land

Concerning the above table, the following remarks should be made: (a) loan amounts do not refer to the Jiboa River basin, but to the financial institutions with branches serving the area; (b) loan amounts are those budgeted, but are flexibly adapted to credit demand; and (c) these financial institutions have target geographic areas to cover, but serve customers from any area.

3.4.8 Technical Assistance and Farmer's Organization

(1) Technical Assistance

CENTA is the most important provider of technical assistance. Within the Jiboa River basin, CENTA extension offices are supervised from two CDTs located in Santa Cruz Porrillo and San Andres. Other sources of technical assistance are "agroservicios", FUSADES and NGOs.

CENTA Office Location	*No. of Extension Agents*	*No. of CVP*
CDT San Andres		
Olocuilta	3	82
San Martin	8	122
Santo Tomas	3	41
CDT Sta. Cruz Porrillo		
Cojutepeque	5	71

San Rafael Cedros	6	115
Santo Domingo	3	55
Guadalupe	4	59
San Pedro Nonualco	3	35
Rosario de La Paz	4	96

(2) Farmers' Organization

Some selected farmers' organizations, which showed up in the questionnaire survey, are briefly described below.

(1) CVP (Neighboring Producers Circle)

Within the Jiboa River basin excepting Block D, CVPs are the most prevalent farmers' organization. These are the groups through which extension agents provide technical assistance. The number of CVPs assisted by the CENTA offices in the Jiboa River basin is presented above.

(2) Cooperatives

Cooperatives can be classified into those organized within the ISTA agrarian reform, and those unrelated with ISTA, including cooperatives having as beneficiaries ex-combatants discharged after the signing of the Peace Accords in 1992. Details of agrarian reform cooperatives in the Jiboa River basin are as follows.

Agrarian Reform Cooperatives	*Number*	*Beneficiaries*
San Salvador Department	1	67
Soyapango	1	67
La Paz Department	18	1,368
Santiago Nonualco	4	524
El Rosario	2	137
San Pedro Masahuat	11	673
San Francisco Chinameca	1	34
Total	19	1,435

(3) ADESCO (Community Development Associations)

ADESCO are local community associations organized according to Articles 118 to 125 of the Municipal Code of 1986. The purpose is to participate in the study, formulation and implementation of projects to solve the problems and needs of the community. These associations are active in the following fields: social, economic, cultural, religious, civic, education and any other aspect that is legal and beneficial to the community.

Local chapters of ADESCO are juridic persons, in which legal status are conferred upon the group by the corresponding municipal government. In the central government, DIDECO (Community Development Directorate) of the Ministry of Interior channels ADESCO financing requests to institutions such as FIS (Social Investment Fund). Direct international aid has been given to some ADESCO chapters by USAID and the European Union.

(4) ANTA (National Association of Agricultural Workers)

This association of agricultural cooperatives has been active since August 8, 1985 in pursuance of improved living conditions for peasants. Current membership is 11,000 encompassing beneficiaries of all land transfer programs, as well as landless farmers who comprise 30% of the members. ANTA pursues project implementation through cooperatives, but faces financing difficulties as only 12 of 68 affiliated cooperatives are at present implementing some type of projects. ANTA promotes formation of cooperatives, and has at present 74 pre-cooperative farmers' groups.

3.4.9 Land Tenure

There are no precise data on land holdings in the Jiboa River basin as well as nationwide. To solve this problem, a land administration project was started with the support of the World Bank (1996-2002). This project aims to institutionalize a national land registry through CNR (Centro Nacional de Registros). To achieve its goals, CNR started with the implementation of a pilot project in the Sonsonate Department for a period of 2 years. In the department, only 40% of the properties are registered, and only less than a third have cadastral references. The same condition is applicable nationwide. There is no the tax system for land ownership in El Salvador because 40% of the properties are not registered.

Land taxation system is not imposed in El Salvador as the government has no data on land holdings. The successful implementation of the aforesaid project would make the imposition of fixed property taxes feasible. On the other hand, huge landowners are expected to oppose this action. The success of the project would also contribute to the compilation of data on the social stratification of farmers, and the accumulation of information considerably beneficial to agricultural administration.

The agrarian reform program implemented by GOES through ISTA since 1980 is considered to have fulfilled its purpose. The program authorized cooperatives to choose between collective and individual land ownership; the former refers to the operation of lands (cultivation of crops) by group and the latter refers to the individual operation of land. In May 1996, a government decree gave agrarian reform

Table 3.4.8.1 The reason of low income of agricultural producer (1/2).

REASONS

I. LACK OF ADEQUATE CREDITS

1. No opportunity for Credit
2. Very high interest
3. Very short period of repayment
4. Low amount of credit
5. Need for guarantee
6. Not for wages
7. Lack of an accident allowance

II. MARKET PROBLEM

1. Lack of marketing information
2. Quality control of agricultural products
3. Low market price
    - (1) Variedades de baja aceptación
    - (2) Sale to broker
        - 1) Problems of storage
        - 2) High transport fee
        - 3) Bad access to the market
    - (3) Import of agricultural production
    - (4) Facilities for production
        - 1) Lack of irrigated land
        - 2) Irregular rain fall (canícula)

III. SMALL PRODUCTION

1. Farmer's carelessness
2. Farmer's old custom
3. Fall of fruits and/or a fallen tree
    - (1) Inadequate seeding
    - (2) Wind
    - (3)Lack of windbreak forest
4. Drought
    - (1) Deforestation
    - (2) Canícula
5. Low production variety
    - (1) Lack of knowledge of seeds
    - (2) Lack of money
    - (3) Old custom
    - (4) Early harvesting time
    - (5) New farmers
    - (6) Preference of taste
6. Lack of technical assistance
    - (1) Lack transportation for extension workers
    - (2) Many farmers per extension worker
    - (3) Lack of farmer's capital to introduce new technology from extension worker
    - (4) Lack of knowledge of extension workers

Table 3.4.8.1 The reason of low income of agricultural producer (2/2).

REASONS

7. Inadequate Fertilization
    (1) Wrong application
        1) Farmer's carelessness
        2) Lack of soil analysis
    (2) Lack of money
    (3) No understanding of extension worker's guidance
8. Low productivity seeds
    (1) Lack of certified seeds
    (2) Lack of farmer's knowledge
    (3) Luck of money
9. High density of pests and disease
10. Inadequate soil cultivation
    (1) Shortage of land
    (2) Intensive cultivation

IV. HIGH PRODUCTION COST

1. High price of rental fee
2. High price of equipment
3. High price of land preparation fee
4. High price of agricultural input
    (1) High transportation fee
5. Excessive application of agrochemicals
    (1) High density of weeds
    (2) No resistance varieties
    (3) High density of pest and diseases
    (4) Low quality of agrochemicals
        1) Inadequate application of agrochemicals
        2) Alien substance by shops
        3) Wrong storage method of agrochemicals
6. Labor cost
    (1) Payment to a night watchman (thief)

V. EROSION

1. Soil management
    (1) No adequate seeding
    (2) Excess usage of herbicide
        1) Laziness of farmers
    (3) Lack of workers for conservation
        1) Not landowner
    (4) Excess usage of chemical fertilizers
    (5) Lack of soil conservation
        1) Not landowner
    (6) No crop rotation
    (7) Wrong soil preparation
        1) Plowing the sloped land
        2) Burning

VI. LACK OF CULTIVATION AREA

1. Expensive rent
2. Large population
3. Urbanization
4. Extension of neighboring land
5. Landowner (No landowner)
6. Lack of credit to buy land

Fuente: Extension office of Santa Tomás, Processing by JICA

Table 3.4.8 2 List of cities covered by each agricultural extension office

Cities	Extension office	Departament	Altitude m	Number of extension worker	City area (km^2) Inside	Outside	Total	Area (km^2) per each woker
Paraiso de Osorio	?	La Paz	570		7.49	-	7.49	
San Emigdio	?	La Paz	700		10.21	-	10.21	
? Total					17.70	-	17.70	
Candelaria	Cojutepeque	Cuscatlán	650		18.34	-	28.07	
Cojutepeque	Cojutepeque	Cuscatlán	760		22.89	-	22.89	
Monte San Juan	Cojutepeque	Cuscatlán	660		-	26.62	26.62	
San Cristbal	Cojutepeque	Cuscatlán	680		15.05	-	15.05	
San Ramón	Cojutepeque	Cuscatlán	600		12.01	-	12.01	
Santa Cruz Analquito	* **Cojutepeque**	Cuscatlán	630		10.62	-	10.62	
Santa Cruz Michapa	Cojutepeque	Cuscatlán	720		6.74	-	20.96	
Tenancingo	Cojutepeque	Cuscatlán	600		-	38 33	38.33	
Total				5	85.65	64.95	174.55	34.9
El Rosario	Rosario de La Paz	La Paz	105		25.59	31.13	56.72	
San Antonio Masahuat	Rosario de La Paz	La Paz	320		30.13	-	30.13	
San Luis	Rosario de La Paz	La Paz	45		1.26	-	111.93	
San Luis la Herradura	Rosario de La Paz	La Paz	2		-	104.39	104.39	
San Pedro Masahuat	Rosario de La Paz	La Paz	210		80.64	-	96.52	
Santiago Nonualco	Rosario de La Paz	La Paz	160		8.60	-	120.63	
Total				4	146.22	135.52	520.32	130.1
Guadalupe	Guadalupe	San Vicente	740		20.10	-	24 37	
Jerusalen	Guadalupe	La Paz	560		8.95	-	8.95	
Mercedes la Ceiba	Guadalupe	La Paz	570		2.75	-	2.75	
Verapaz	Guadalupe	San Vicente	610		19.83	-	25.07	
Total				4	51.63	-	61.14	15.3
Cuyultitán	Olocuilta	La Paz	380		-	8.61	8.61	
Olocuilta	Olocuilta	La Paz	480		-	89.68	89.68	
San Juan Talpa	Olocuilta	La Paz	200		-	40.74	40.74	
Tapalhuaca	Olocuilta	La Paz	390		20.12	-	28.11	
Total				3	20.12	139.03	167.14	55.7
Apulo	San Martín	San Salvador	450		-	51.84	51.84	
Ilopango	San Martín	San Salvador	658		15.39	-	23.69	
San Martín	San Martín	San Salvador	760		14.75	-	43.44	
San Pedro Perulapán	San Martín	Cuscatlán	640		21.59	-	84.98	
Soyapango	San Martín	San Salvador	625		4.25	-	27.54	
Total				8	55.98	51.84	231.49	28.9
San Pedro Nonualco	San Pedro Nonualco	La Paz	740		16.93	-	38.78	
Santa Maria Ostuma	San Pedro Nonualco	La Paz	620		22 35	-	22.68	
Total				3	39.28		61.46	20.5
El Carmen	San Rafael Cedros	Cuscatlán	680		5.86	-	19.71	
El Rosario	San Rafael Cedros	Cuscatlán	715		-	14.21	14.21	
San Rafael Cedros	San Rafael Cedros	Cuscatlán	716		10.77	-	20.31	
Total				6	95.19	14.21	177.15	29.5
San Sebastián	Santo Domingo	San Vicente	660		-	61.83	61.83	
Santo Domingo	Santo Domingo	San Vicente	685		8.99	-	15.57	
Total				3	8.99	61.83	77.40	25.8
San Francisco Chinameca	Santo Tomás	La Paz	740		22.14	-	39.63	
San Juan Tepezontes	* **Santo Tomás**	La Paz	760		21.18	-	21.18	
San Marcos	Santo Tomás	San Salvador	682		2.97	-	10.59	
San Miguel Tepezontes	* **Santo Tomás**	La Paz	780		18.78	-	18.78	
Santiago Texacuangos	Santo Tomás	San Salvador	720		16.48	-	25.68	
Santo Tomás	Santo Tomás	San Salvador	780		10.30	-	26.77	
Total				3	91.85	-	142.63	47.5

Note: Cities written in boldface have not accepted any assistance of agricultural extension office.
Cities with * mark should be coverd by respective agricultural extension office.

Table 3.4.8.3 Activities of extension office

Oct. 31, 1996

Extension Office	Number of personnel				Transportation		Sector	Route	C.V.P.	C.V.M	C.V.H	C.V. Mixtos	P.E.	P.V.	Total Farmers
	Chief	Worker	Secretary	Janitor	Motorcycle	Truck									
Cojutepeque	1	5	1	1	5	1	4	32	71	6	38	27	71	585	656
Rosario de La Paz	1	4	0	1	4	1	4	32	96	16	29	51	96	948	1,044
Guadalupe	1	4	1	0	4	1	4	26	59	4	44	11	59	453	512
Olocuilta	1	3	1	1	3	1	3	24	82	0	56	26	82	672	754
San Martín	1	8	1	1	7	1	8	64	122	13	60	49	122	1,023	1,145
San Pedro Nonualco	1	3	0	0	2	1	2	16	35	1	29	5	35	278	313
San Rafael Cedros	1	6	1	0	6	1	6	48	115	13	56	46	115	928	1,043
Santo Domingo	1	3	1	1	1(*)	1	3	24	55	1	35	20	55	427	482
Santo Thomás	1	3	1	1	3	1	3	24	42	1	26	15	42	415	457

Source: Each Extension Office in the Study Area

(*): 2 motorcycles broken

C.V.P.: Neighboring farmer's group

C.V.M.: Neighboring women's group

C.V.H.: Neighboring farmer's group

C.V.Mixtos: Neighboring farmer's mixed group

P.E.: Leader of farmers group

P.V.: Neighboring farmers

cooperatives the opportunity to repay only 30% of the land debt, if the amount is paid in cash by June 30, 1997, granting cooperatives the option of selling part of the land to collect the necessary cash. In the Jiboa River basin, there are 19 agrarian reform cooperatives, 18 of which is in La Paz Department (11 in the Municipio of San Pedro Masahuat). Out of a total of 1,436 beneficiaries, 176 (12%) are women.

Aside from ISTA, land transfer has also been implemented in the basin by FINATA for tenants and by Banco de Tierras, as indicated below.

Non-ISTA Land Transfer by Department	*Number of Municipalities*	*Number of Beneficiaries*	*Total Area (mz)*	*Average Farm Size (mz)*
San Salvador	1	17	44.53	2.62
Cuscatlan	1	8	40.36	5.05
San Vicente	1	1	3.00	3.00
La Paz	10	51	176.28	3.46
Total	13	77	264.17	3.48