

## **SUMMARY**



## SUMMARY

### Purpose of the Study

- (1) To formulate a master plan for the integrated agricultural development project in the Jiboa River basin (about 60,000ha), which is adjacent to San Salvador, with due consideration of basin conservation and in accordance with the request of the Government of El Salvador.
- (2) To carry out technology transfer to the counterpart personnel concerning the methods of the study and formulation of the project.

### Study Area

Jiboa River basin is located almost at the center of El Salvador, between 13° 21' - 13° 24' of the north latitude and 88° 50' - 89° 10' of the west longitude. The basin measures about 60,000ha and is adjacent to the capital city, San Salvador. In the upstream area is the Ilopango Lake. With a total population of about 320 thousand, the basin is one of the densely populated areas in the country. The number of farm households in the basin is estimated at about 25 thousand.

### 1. Background and Details of the Study

The civil war in El Salvador continued for 12 years and concluded with the armistice agreement in 1992. The national economic reconstruction plan adopted thereafter is considered to be steadily making progress. Remittances from overseas presently make up about 15% of the GNP. However, this is foreseen to decrease. Therefore, the country needs to develop agriculture, its basic industry, for economic reconstruction.

The agricultural sector makes up 13.8% of the GDP, after manufacture and commerce. However, because it contributes to half of the manufacturing share in GDP (half of the manufactured products are made from agricultural produce), its total GDP contribution amounts to more than 23%. Agricultural products make up 32.8% of the total export amount and the sector employs 35.5% of the economically active population. This sector does not only support national economic development but the growth of other industries as well.

The agricultural sector holds the key to the solution of various national problems such as over population, concentration of population in cities, huge earning differentials, and environmental

deterioration, through the conduct of rural development, supply of food, creation of job opportunities, and proper use and conservation of natural resources. The five-year Socioeconomic Development Plan gave emphasis to the development of the agricultural sector to increase productivity with due attention to the conservation of natural resources, to rectify huge earning differentials and support other industries.

The Jiboa River is one of the 3 biggest water resources in El Salvador. The basin is adjacent to the capital and is expected to become a base for the production of exports and food supply. Also, because it includes a part of San Salvador City, it is deeply immersed with national problems such as population concentration, soil erosion caused by excessive cultivation and felling, deforestation, inundation, decrease in soil productivity, huge gap between the rich and poor, among others. The conduct of an agricultural development project would serve as a model project that would pave the way for the solution of the above.

Almost all farmers in the basin are peasants farming on steep slopes. The impoverished conditions in the rural area can be alleviated by improving the agricultural structure through crop diversification, which could increase the farmers' income as well as stimulate rural and national economy. This measure could also contribute to public peace.

As a result of the situation mentioned above, the Government of El Salvador requested to the Government of Japan in 1990 technical cooperation for the formulation of the Jiboa River Basin Integrated Agricultural Development Project. In response, the Government of Japan sent a preliminary study team in 1995. The S/W and M/M were signed on 5 September 1995, and the Study commenced in January 1996 and will end in March 1997.

The purpose of the Study is to formulate a master plan on the Integrated Agricultural Development Project in the Jiboa River basin, considering natural resources conservation, and to carry out technology transfer to the counterpart personnel concerning the methods of the Study. The Study is divided into two phases: Phase I during the dry season, and Phase II during the rainy season. Both phases comprise work in El Salvador and in Japan. A preliminary master plan will be formulated in the first phase, and the master plan and model projects will be carried out in the second phase.

## **2. Present Condition in El Salvador**

El Salvador covers a total area of 21,040km<sup>2</sup>, with a population of 5,118,599 (1992). The population density is very high at 243 persons/km<sup>2</sup>. Although the growth rate of GDP in 1994, using the 1990 fixed price, was estimated at 6.0%, the agricultural sector showed a negative growth of -2.4%. In 1995, the share of the agricultural sector in total GDP was only 13.7% but because it also made up 9.3% of the share of the manufacturing industry, it totaled 23%. Agricultural products make up 32.8% of the total export amount and the sector employs 35.5% of the economically active population. This sector is important to national economic

development.

The five-year Socioeconomic Development Plan (1994-1999) considers the agricultural sector as a constitutive basis for the promotion of rural development, increase in production, sustainable growth, decrease of poverty, and support to other industries. This plan also focuses on increase in agricultural income by reforming the agricultural structure (crop diversification), strengthening agricultural systems, expanding irrigation areas, improving water resources and soil management, promoting investment initiatives by reinforcing the land ownership system, improving the rural credit system, and preserving natural resources in harmony with agricultural development.

The Government promoted trade liberalization, administrative reforms, and increased the value-added tax in 1995. These restricted agricultural activities as it increased agricultural imports and relative production costs, and decreased the budget and personnel of MAG.

The national economy is characterized by a GNP that is 15% reliant on remittances from abroad and a GDP that only contributes 4% of the internal savings. As the former is forecast to decrease, internal savings should be fortified starting with rectifying the huge earning differentials and the stabilization of public peace.

According to the FAO 1993 data, the rate of farmlands and pastures to the national territory is comparatively high at 64.7%. However, the farmland area per farmer and pasture area, at 1.16ha and 0.97ha, respectively, are the smallest in Central America. The farming trend in the area shows a decrease in annual crop cultivation and natural pasture, and an increase in permanent crop cultivation and improved pasture. The comparison of the 1991 and 1994 production figures shows no changes in coffee and sugarcane production, and an increase in non-traditional crop production. However, the 1994 cotton production was half the 1992 figure. Production of basic cereals has decreased due to meteorological conditions, and increase in cheap cereal importation have decreased the self sufficiency rate.

Livestock is an important industry, making up 30% of the total agricultural production. The annual supply of beef has been reliant on imports since 1991. The domestic supply of pork and poultry, however, still satisfies national demand. Meat consumption in El Salvador is classified as 64.5% chicken, 26.3% beef, and 9.3% pork.

Though forest covered 80% of the territory in the past, at present it covers only 9% according to the FAO. The shade trees in coffee plantations have the same functions as forests, e.g. firewood production, water retention, soil conservation. Therefore, forest coverage rate, including areas planted with shade trees, is 12%. It is said that the total slope area which should be preserved as forests makes up 48% of the whole country. Rampant deforestation in the area has induced soil erosion, which deteriorated soil productivity, decreased water retention capabilities, aggravated meteorological conditions, and ruined ecological biodiversity.

The total demand for wood is broken down as 93.5% for firewood and 6.5% for other use. Forty five (45) percent of the national energy relies on the use of firewood. Eighty (80) percent of timber for the manufacturing industry is imported. Given this situation, the government has established policies that focus on the creation of a forest protection system, reinforcement of management systems for afforestation and conservation areas, conduct of public education programs on forest conservation, and development and extension of agro-forestry techniques.

There are no legislation established for water resource development and management. Groundwater developments (waterworks and sewerage systems) are under the supervision of ANDA, surface water developments (irrigation and drainage systems) are managed by MAG, and electrification by CEL. Therefore, the establishment of a national committee on water resources and a coordinating technical committee, and the amendment and enactment of water-use legislation must be promoted for the integrated management of water resources.

As for environmental administration, the draft comprehensive environmental law prepared by SEMA is currently under examination. SEMA is also preparing an Environmental Impact Assessment Law. The San Salvador Metropolitan Area Planning Office has already imposed mandatory EIA regulations on 17 municipalities in the metropolitan area.

### **3. Present condition of the Jiboa River basin**

With 4 departments and 35 municipalities, the basin measures 605.6km<sup>2</sup> including the Ilopango Lake area (70.5km<sup>2</sup>), and 535.1km<sup>2</sup> excluding the lake. The estimated population in 1996 is 32,644, and the population density, excluding the Ilopango Lake area, is 602.9 persons/km<sup>2</sup>, which is more than double the national average.

The ratio of farmers to the economically active population is 24.5%, which is lower than the national average. This is attributed to the fact that the basin holds a part of the San Salvador Department where the ratio of farmers to the population is extremely low at 6.4%.

The ratio of farmers in Cuscatlan Department is 36.3%, San Vicente Department 69.4%, and La Paz Department 58.8%. The number of farmers in 1996 was estimated at 25,562: 11,971 (46.8%) were independent farmers and the rest tenants and seasonal field laborers. The independent farmers were further divided into landowners (40.1%), plantation owners (3%) and members of cooperatives (6.4%).

There are two seasons: the rainy season from May to October, and the dry season from November to April. The average annual rainfall is 1,753mm. The annual average temperature is 26.5°C at the New International Airport downstream and 23.0°C at the Ilopango Lake in the upstream hilly area. Montecristo station, located in the midstream basin of the Jiboa River (catchment area of 429.4km<sup>2</sup>), has been taking hydrological data since 1978 (no

data from 1985 to 1992). The average annual discharge at this station is 142.6MCM, while runoff percentage amounts to 19%.

The topography of the basin is roughly divided into the mountainous or hilly areas to the north and the plains to the south. These areas are divided at an elevation line of about 100m. The former makes up the outer rim of the Ilopango caldera, its southern piedmonts, piedmonts of San Vicente volcano, and the hilly areas in the upstream basin of the Jiboa River. Terraces 1-2m in height, old river channels and floodplains form the downstream area along the river.

The geology of the river basin is made up of volcanic sedimentary deposits from the Tertiary to the Quaternary period. The geological structure, in the ascending order, is as follows: Balsamo Formation (Tertiary), Cuscatlan Formation (Tertiary-Quaternary), and San Salvador Formation (Quaternary). Pleistocene and alluvium layers of sand, gravel and clay are distributed in the downstream plains. The geological structure is characterized by faults running in ① an E-W direction in the northern parts of Ilopango Lake and San Vicente Volcano, ② a NE-SW direction in the Jiboa River midstream basin, and ③ a NW-SE direction upstream and midstream.

According to the electric prospecting and existing well study results, the areas in the basin are identified by aquifer potential as follows:

- Areas with comparatively high aquifer potential: circumference of Rosario, northern side of Ilopango Lake, piedmont of San Vicente Volcano
- Areas with medium aquifer potential: hilly areas midstream, coastal areas downstream
- Areas with comparatively low aquifer potential: areas upstream on the right bank of Jiboa River, circumference of the International Airport downstream

In the downstream basin area, groundwater reserves are found 2-5m deep. Upstream and midstream, the reserves were 20-30m deep. Aquifers in the upstream and midstream basin area are either free or unconfined. Downstream, they are either confined or unconfined.

The water quality of Ilopango Lake and Jiboa River is not suitable for drinking and irrigation, according to the drinking water and irrigation water standards of WHO and FAO, respectively. Samples taken from nine of the existing thirteen wells in the study area both in the rainy and dry season were also analysed to be unsuitable for drinking. Further studies should be carried out.

The lack of vegetation upstream, and the lack of flow capacity (due to gradients and sedimentation), flat topography, shallow groundwater level, and shortage of drainage facilities downstream cause floods every year, which destabilize the river channels.

Soil erosion, except for small scale sheet erosion, is hardly observed in the hilltops that gently

slope. However, gullies and ravines have developed in steeply sloping areas along the Sepaquiapa and Tilapa rivers. Farmlands, which make up 44% of the basin area, are susceptible to erosion because they are distributed in zones made up of volcanic sediments that have low tolerance to erosion.

The soils in the basin are classified as Regosol, Ritosol, Latosol and alluvial soils. Regosol covers most of the basin. Except for alluvial soils, these soils are not well developed, resulting in high permeability and poor fertility. Because these soils are very permeable, sprinkler or drip irrigation is more suitable than furrow irrigation.

Lands with a gradient of less than 10% have no soil erosion problems, lands with a gradient of 10 - 25% are classified as slope lands, and those with a gradient of more than 25% as steep slope lands. The table below shows the present land use conditions in the basin by slope classification.

unit: km<sup>2</sup> (%)

Land Use Conditions	Flat Lands (less than 10%)	Slopes (10-25%)	Steep Slopes (more than 25%)	Total
Farmlands	113.4 (34.8)	46.1 (39.3)	55.7 (34.4)	215.2 (35.5)
Grasslands	38.8 (11.9)	7.3 (6.2)	5.5 (3.4)	51.6 (8.5)
Forests	83.5 (25.6)	60.9 (51.8)	97.8 (60.4)	242.1 (40.0)
Lands with facilities	16.7 (5.1)	2.9 (2.5)	2.6 (1.6)	22.2 (3.7)
Rivers and lakes	73.8 (22.6)	0.3 (0.2)	0.2 (0.2)	74.4 (12.3)
Total	326.2 (53.9)	117.5 (19.4)	161.9 (26.7)	605.6 (100.0)

The table below shows the cultivated areas in the basin by crop.

unit: ha

Block \ Crops	A	B	C	D	E	Total
Basic grains	4,591	2,420	4,880	1,354	7,313	20,346
Sugarcane	0	462	1,168	1,214	0	2,844
Other cash crops	245	308	150	861	339	1,903
Fruit trees	1,717	586	1,377	47	980	4,708
Coffee	1,483	400	1,841	6	285	4,015
Cropping area	8,037	4,177	9,415	3,482	8,918	33,817
Cultivated area	4,451	2,944	5,478	2,995	5,654	21,523
Cropping intensity	1.81	1.42	1.72	1.16	1.58	1.57



The crops mainly cultivated in the basin are as follows:

Grains:	maize, sorghum, beans, paddy
Fruits/citrus trees:	cashew nuts, mangoes, papaya, avocados, banana
Industrial crops:	sugar cane, sesame, peanuts, coffee
Vegetables:	pipian, tomatoes, chili, cucumbers, red radishes, cabbages, corn, string beans, onions, loroco, chayote

The staple food maize, sorghum and field beans monopolize a huge part (63%) of the cultivated area. Intercropping is conducted in the area cultivated with maize for sorghum or field bean production and either of these two is sown before maize is harvested. The domestic demand for pipian and chayote is high and CENTA has been trying to expand the cultivation of loroco since 1992.

The land tenure system significantly affects the selection of crops to cultivate. Independent farmers plant permanent crops, e.g., loroco, chayote, which need initial investments, in addition to basic grains for self-consumption. These farmers use surplus lands for pasture. Tenants only cultivate annual crops, e.g., basic grains. Cooperatives mainly plant sugarcane and cash crops, e.g., sesame, watermelon, peanuts, maize.

Fluctuating market prices for basic grains remarkably affect the revenues, especially with maize, because there is hardly any difference between the production cost and the producer's market price. The same apply to sesame, coffee, pipian, tomatoes, oranges and banana. The market prices of chayote, sugarcane and watermelon are stable due to popular demand for these products. The net income from agricultural production by block averages 2,000 - 9,000 colones. Self-sufficiency in the production of maize and field beans in the basin only meets 42% and 19%, respectively, of the demand in the basin.

Livestock raised in the basin mainly consists of dairy cattle, beef cattle and poultry. Commercial poultry farms, probably due to the weather, are concentrated in the hilly areas upstream. Large poultry farms and family run poultry farms also exist in El Rosario downstream. Dairy cattle raising along the north shore of Ilopango Lake is carried out by private enterprises, while beef cattle raising is carried out by cooperatives downstream. Cattle is also used for cultivation. Swine production is mainly carried out within house yards upstream and midstream. Piggsties are not constructed at all. Few small scale commercial piggeries exist along the north shore of the Ilopango Lake and circumference of the capital city. The estimated number of cattle, poultry and pigs in the basin amount to 25,500, 399,200, 1,600, respectively.

Aside from the Agricultural Development Bank, the main agricultural credit organizations in the basin are Cajas de Crédito, which conducts small scale credit and operates a farm implements shop, and PRODAP, where interest rates vary according to the nature of the loan.

Nonetheless, farmers hardly use the credit system.

The following are the farmers' organizations in the basin:

- CVP (Neighboring Producers Circle)

These are groups made up of about 10 farmers through which CENTA provides technical assistance.

- Cooperatives

These are organized through agrarian reform, and they aim to fully activate farming activities.

- ADESCO (Community Development Association)

This organization was formed in accordance with the agricultural bill enacted in 1986. Local chapters of ADESCO are judicial organizations. This organization conducts studies on how to solve problems in various fields and meet the needs of the people, and formulates and implements relevant projects.

- ANTA (National Association of Agricultural Workers)

This organization was established in 1985 to help improve the farmers' standard of living. It is composed of landowners by the agrarian reform system and landless farmers. ANTA promotes the formation of cooperatives and pursues project implementation through the cooperatives.

There are 35,000ha of irrigated farmlands nationwide. However, in the basin, only 2ha in B block are irrigated during the dry season using the gravity system (vinyl pipes), and 130ha in D block are irrigated with the water from Sepaquiapa River. The irrigable area in D block is decreasing every year as the river bed declines.

The Pan American Highway runs on the northern end of the basin, while a national highway in the south of the basin runs from east to west. These are the main arteries in the country. Although there are many roads in the basin, a lot are dirt roads, some of which are impassable.

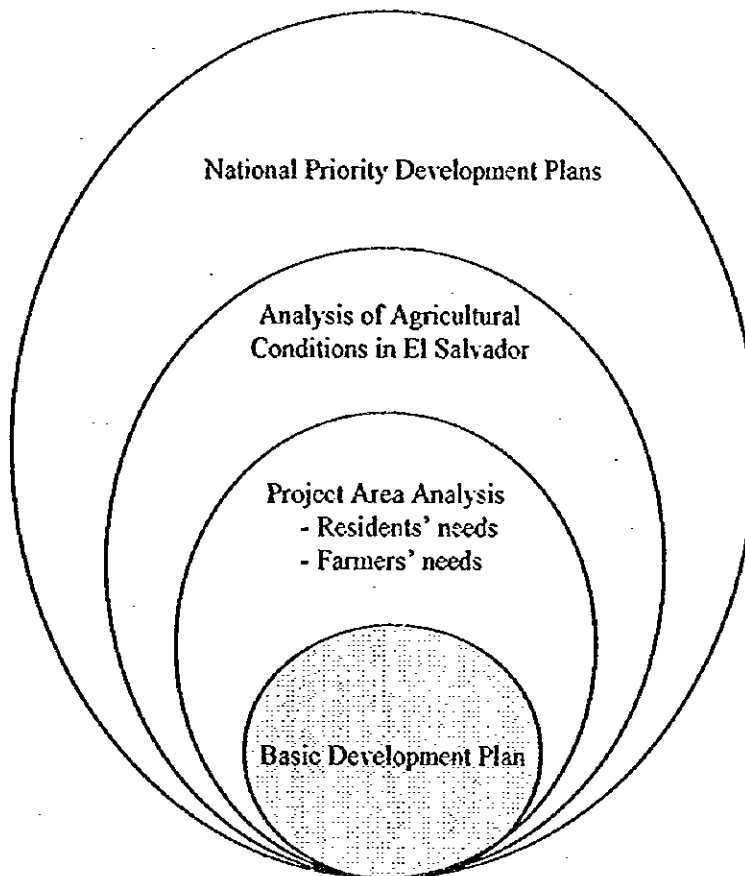
The total number of private and public schools in the basin is 634. In 1995, the number of teachers in the basin totaled 6,665. Regarding public health facilities, the basin has one general hospital, two clinics that conduct minor operations, 18 public health centers with resident doctors, 19 public health centers with doctors on call, a public health center with nurses and specialists, and a dispensary. According to the 1992 Census, the families equipped with water supply facilities, lavatories and electricity was 78%, 92% and 81%, respectively, of the total number of households in the basin.

Forests are very few in the Study Area and none are for commercial use. Comparatively large coffee plantations make up the eastern and southern parts of Ilopango Lake, and these plantations also contribute to firewood production. Many fruit trees planted in the

mountainous areas also contribute to soil conservation. In some areas in the basin, particularly in towns and villages, afforestation activities are conducted with the cooperation of FONAES, volunteer students and NGOs.

#### 4 Basic Approach to Development

As illustrated in the figure below, the basic development plan was formulated by first understanding the priority development plan of the government and then the agricultural conditions in El Salvador. Thereafter, the development potential of the project area, the needs of the residents, particularly the farmers, were analyzed, including the factors that could impede development.



## **4.1 Analysis of the National Development Plan and Present Agricultural Conditions**

### **4.1.1 Current Agricultural Conditions**

#### **(1) Importance of Agriculture in the National Development Plan**

The development strategies of the 5 Year Socioeconomic Development Plan (1994-1999) for the agricultural sector entailed crop diversification, improvement of productivity, agrarian reforms, expansion of agricultural financing system for small-scale farmers, prevention of environmental pollution by agricultural chemicals, and increase in drainage facilities. The element that could render the national reconstruction plan unstable is the government's capability or incapability to provide the war guerrillas and soldiers with jobs for them to be able to start anew. The government gives priority to the conduct of programs that would help the soldiers assimilate the rural agricultural way of life, as a means to restore agricultural production.

The policies of the Development Plan are as follows:

- a) To develop the agricultural sector to make it suitable to a market system and globally competitive by conducting programs that would contribute to improvement of production.
- b) To make use of agricultural loans for agricultural development.
- c) Introduce irrigation facilities in irrigable areas for the modernization and diversification of agriculture. To establish relevant laws and regulations, support agricultural financing, and extend guidance in technical training.
- d) To eliminate worries/instabilities in the socioeconomic conditions in the rural area, and establish safety by introducing a legal system that would improve and reinforce the land registration system and legal agricultural negotiations.
- e) To improve a commercial system that entails information services, marketing organizations and facilities, to properly market agricultural products of good quality.
- f) To reinforce sanitary measures for the prevention of epidemics among livestock and agricultural produce, and improvement of quality control and marketing measures.
- g) To activate production activities and improve earning power to establish a globally competitive agricultural and livestock industry.
- h) To strengthen the organizational structure of CENTA for the improvement of technological research activities for the agricultural and livestock sector, and to expand technical extension activities.

## **(2) Problems in the Agricultural Sector**

A lot of the agricultural infrastructure was destroyed during the war resulting in the suspension of agricultural production and remarkable delays in agricultural development. In particular, the retarded conditions of rural areas have rendered farmers impoverished. The following are the problems in the present agricultural conditions in El Salvador:

- a) Monocultural practices (traditional crop cultivation)
- b) Dependence on agricultural exports significantly influenced by international market prices
- c) Destruction of agricultural production facilities and capital during the war
- d) Disintegration of rural community due to massive migration to urban areas
- e) Agricultural reforms and inadequate land use system
- f) Inadequate use of natural resources

The extensive impacts of the progressive degradation of environmental conditions have also generated the following problems which are urgently in need of attention:

- a) Soil erosion extensively affects 3/4 of the national land area, and is particularly progressive in the hilly areas in San Salvador. Unless countermeasures are immediately and aggressively taken, this could affect 50% of the national territory.
- b) About 90% of the rivers are contaminated with agricultural chemicals and industrial wastes, thereby requiring the conduct of water quality analysis and the reinforcement of anti-pollution legislation.
- c) Deforestation is particularly rampant in the rural areas where firewood is extensively used.

## **(3) Agriculture in El Salvador**

### **a) Agricultural Structure**

After the civil war, the policy of the government is focused on national reconstruction. The civil war is considered to have been caused by economic disparity. To prevent the civil war from recurring, the government aims to create job opportunities for the poor through industrial development, mainly agricultural development. It is, therefore, very important and urgent to conduct programs that would aid in stabilizing the economic conditions of the majority of the small scale farmers.

### **b) Agricultural Problems**

#### **• Development and Extension of Agricultural Techniques for Small Scale Farmers**

It would be considerably difficult to install new and modern infrastructure that would fully

contribute to the improvement of the economic conditions of small scale farmers with current problems in funding. Accordingly, the extension of agricultural techniques is considered an effective measure to improve productivity and introduce crop diversification in an agricultural system that promotes the effective use of natural resources. The development and extension of agricultural techniques are significantly important for farmers (most of which are inexperienced) benefiting from the agrarian reform system.

- **Improvement of the Distribution System**

The acquisition of routes for the distribution of agricultural produce is as important as the improvement of production techniques to medium and small-scale farmers, since failure in selling the products would mean no income and delays in the importation of sophisticated and excellent techniques. The processing of agricultural products into manufactured products expands the distribution route and entails a certain proportion of value added -- factors that significantly contribute to income increase and employment. This undertaking would, however, require the development of an efficient market system. The formulation of a system that would provide the farmers with a stable production and a distribution route is without doubt vital to agricultural development nationwide.

- **Irrigation Facilities Improvement**

The improvement of irrigation facilities is one of the focal points in the government's agricultural policy. Because agriculture is concentrated in one season due to climatic conditions in the area, the installation and improvement of irrigation facilities are considered highly necessary as a means of stabilizing the economic conditions of medium and small scale farmers. These works require tremendous funding. However, it is impossible for the government to allocate the majority of the budget for this endeavor, as almost every sector demanding development and improvement necessitate significant spending.

With the exclusion of one project, irrigation development projects are in a state of immobility due to ongoing retrenchments in the DGNR and other departments related to irrigation. Therefore, it is very important to conduct studies to determine facilities suitable to the area in consideration of their use as a model for future irrigation development.

- **Farmers' Organization**

The formulation of a farmers' organization (a system outside of the administrative system) is important for the dissemination of the measures, e.g., agricultural techniques extension and distribution system improvement, adopted by the government to the farmers. In the past, farmers were organized by groups for the conduct of extension activities. This

time around however it is necessary to build an autonomous farmers' organization.

Farmers' organizations were previously thought of as antigovernment organizations and were rejected politically, thereby making farmers hesitant about the idea at present. Nonetheless, developments in this area can be felt nationwide.

Guidance in the application of suitable techniques and the granting of farming loans are also considered necessary for the development of the economic conditions of small scale farmers. Because loan applications of most farmers are rejected due to lack of trust, the forming of a farmers' organization should be expedited.

- **Natural Resources Conservation**

Due to El Salvador's high population density, population increase rate, poverty problems, and the disorganized utilization and development of natural resources, the recoverable natural resources far outweigh the sustainable volume. And further developments have radically destroyed the country's natural resources. The government is currently pressed with the need to counter-act land devastation problems resulting from soil erosion and deforestation. The preservation of natural resources is seen as an important factor for the realization of a sustainable agricultural development.

## **4.2 Analysis of the Study Area**

The Study Area was analyzed in terms of development potential and development constraints.

### **4.2.1 Development Potential**

#### **(1) Water Resources (Surface Water and Groundwater)**

##### **a) Surface Water (Utilizable Volume and Water Quality)**

The surface water resources in the Jiboa River basin consist of the Jiboa River and Ilopango Lake. Annual rainfall in the basin ranges from 1720 mm ~ 2060 mm, and the total surface runoff is estimated to be 20% of this amount. Surface water flow is extremely small. Therefore, the river discharge that can be utilized in the dry season is estimated at about 1.5 m<sup>3</sup>/sec.

As for Ilopango Lake, the results of the study conducted by ANDA for the use of the lake as water supply source for the eastern part of San Salvador estimate 1.5m<sup>3</sup>/sec as the usable discharge of the lake. Putting aside problems in water quality, the development of the lake and the river as water resources would not be practical as only a total discharge of 2m<sup>3</sup>/sec can be used.

Ilopango Lake and the Jiboa River cannot be used as effective drinking and agricultural water resources as they contain concentrations of arsenic, boron, and cadmium that significantly

exceed the guidelines of WHO for drinking water quality, and FAO for agricultural water quality.

b) Groundwater

Groundwater development potential (aquifer potential) in the Jiboa River basin is comparatively high based on the specific capacity of existing wells. The groundwater level was observed to be 2 ~ 5 m from the ground surface, and mostly 20 ~ 30 m in the ridges upstream and midstream. Accordingly, developments in the ridges of mountains and hills would not be suitable as well, even with a high aquifer potential, because the groundwater reserves are too deep below the ground.

(2) Land resources

The classification of lands in the Study Area is shown below. Lands categorized under classes II and III are suited to mechanized farming. Lands categorized from class IV onwards are not suited to this farming practice and have always relied on manpower and animals for cultivation. On the other hand, it is necessary to take protective measures for lands categorized under class VI (gradient of over 26%) against erosion which is very progressive in these areas.

Lands categorized under classes II, III, and V are free from soil erosion problems.

Lands categorized under class IV are characterized as: ① not suited to mechanized agriculture, ② susceptible to soil erosion, ③ suited to traditional farming practices such as the intercropping of maize, sorghum, and frijol beans.

**Land Classification**

unit: ha

Classification (gradient %)								
	II 3-4	III 5-12	IV 13-25	V 0-6	VI 26-35	VII 36-70	VIII >70	Total
Total	2,405	4,497	7,829	507	12,938	21,437	1,257	5,0898
Percentage								
Total	5	9	15	1	25	42	2	100



#### 4.2.2 Development Constraints

##### (1) Constraints in Natural Resources

- a) **Water quality:** Ilopango Lake and Jiboa River shall not be developed as water resources because their arsenic and boron contents far exceed the set acceptable limits. For the lake, this concentration is attributed to the geochemical characteristics of the caldera.
- b) **Water-Use Cost:** Because the Jiboa River forms a deep gorge, the utilization of its water for irrigation would be tremendously costly. Irrigation is hardly carried out in the area even with abundant groundwater reserves, because groundwater utilization would require huge capital and highly advanced technology.
- c) **Land Resources:** The mountain area is too densely populated and has a shortage of land resources. Small scale farmers in the area cultivate the steep slopes and less arable areas.
- d) **Human Resources:** Almost all farmers in the study area have had more than 10 years of traditional farming experience (mainly grain cultivation). There is a shortage of farmers well informed of the proper techniques and ways of improving the agricultural structure and natural conservation.

##### (2) Socioeconomic Constraints

- a) **Unsuitable Land Use:** Shortage in land resources and population increase led to the inadequate use of the land, e.g., excessive cultivation and over felling, and the destruction of land resources. These conditions further exacerbated land shortage problems, and yet the government has not established any relevant countermeasure.
- b) **Insufficient Development and Diffusion of Farming Techniques:** More than half of the farm households do not receive guidance in farm technology. Therefore, productivity in lands cultivated by these farmers is low.
- c) **Inadequate Credit System and Shortage in Funds:** The tenancy system and the financing system in the

area discourage farmers to make investments, hence impeding improvements in farmers' income and in land productivity. This also impedes farmers' from undertaking soil conservation measures.

d) **Inadequate Marketing System and Facilities:**

Insufficient marketing system and facilities impede the timely shipment of good quality products, thereby lowering the producer's market price.

e) **Poor Living Environment:**

The rural farmers are not well educated and live in poor sanitary conditions.

**(3) Basin Characteristics**

The Jiboa River basin is divided into 5 blocks (small basins) based on hydrological conditions. The natural and socioeconomic characteristics of each block are shown in the following table.

**4.3 Basic Development Plan**

**4.3.1 Development Objectives**

The final objectives of the integrated agricultural development plan shall be the ① establishment of an agricultural system that would supply San Salvador with food, ② improvements in farmers' living conditions, ③ improvements in farmers' income, ④ continuous improvement of the residents' economic conditions and environment, and ⑤ adequate management of natural resources.

**4.3.2 Development Method**

**(1) Development Approach**

The aforementioned objectives aim for agricultural diversification, the development of an agricultural system based on improved productivity and a sustainable environment, development and extension of agricultural techniques in harmony with basin conservation measures and the farmers' education level.

The following five methods shall be applied:

- a) Promote afforestation through the production and distribution of saplings to the farmers and the conduct of tree planting activities with the participation of the land owners, primary and secondary students, government organs, and residents.

### Natural and Socioeconomic Characteristics of Each Block

Items	Unit	A Block	B Block	C Block	D Block	E Block
Area Coverage	km <sup>2</sup>	223.73	74.57	131.11	56.86	119.32
Population Density	person/km <sup>2</sup>	1040	571	242	193	181
Number of Farmers	%	38.4	59.6	68.8	97.5	59.9
Terrain	%					
Plains (less than 10%)		36.2	45.4	39.0	100.1	52.7
Steep slopes (11 - 25%)		23.7	31.5	26.0	3.9	18.0
Steep slopes (more than 25%)		40.1	23.1	35.0	4.6	29.3
Cultivated Land	%					
Annual Crops		32.5	47.9	48.4	84.7	58.4
Fruit Trees		12.5	9.5	12.2	0.7	10.1
Coffee		9.7	5.4	14.1	0.1	2.4
Cultivated lands in steep slopes	%	31.7	46.0	42.2	77.9	48.9
Forest Area	%	55.9	3.5	23.6	9.5	25.9
Number of Tenant Farmers	%	29.7	8.4	43.8	22.9	12.1
Size of Farms	ha	1.9	2.4	2.9	1.4	2.1
Farmers' Association	%	22.5	29.9	27.6	80.0	30.3
Farmers' Needs	%					
Irrigation		36.5	67.3	48.6	54.3	36.4
Soil Conservation		69.7	79.4	72.4	57.1	74.2
Afforestation		57.3	82.3	79.1	91.4	87.9
Flood Control		14.6	13.1	11.9	31.4	13.6
Topics		<ul style="list-style-type: none"> <li>• soil conservation</li> <li>• afforestation</li> <li>• water quality</li> <li>• pollution control</li> <li>• tourist-agriculture</li> <li>• road improvement</li> </ul>	<ul style="list-style-type: none"> <li>• soil conservation</li> <li>• afforestation (agroforestry)</li> <li>• cash crop introduction</li> <li>• livestock (domestic pigs, poultry)</li> <li>• inland fisheries</li> <li>• road improvement</li> <li>• reinforcement of farmers' organization</li> </ul>	<ul style="list-style-type: none"> <li>• soil conservation</li> <li>• afforestation (agroforestry)</li> <li>• groundwater for irrigation</li> <li>• road improvement</li> </ul>	<ul style="list-style-type: none"> <li>• cash crop introduction</li> <li>• livestock development</li> <li>• flood control measures</li> <li>• groundwater for irrigation</li> <li>• road improvement</li> </ul>	<ul style="list-style-type: none"> <li>• soil conservation</li> <li>• afforestation (agroforestry)</li> <li>• cash crop introduction</li> <li>• groundwater for irrigation</li> <li>• road improvement</li> </ul>

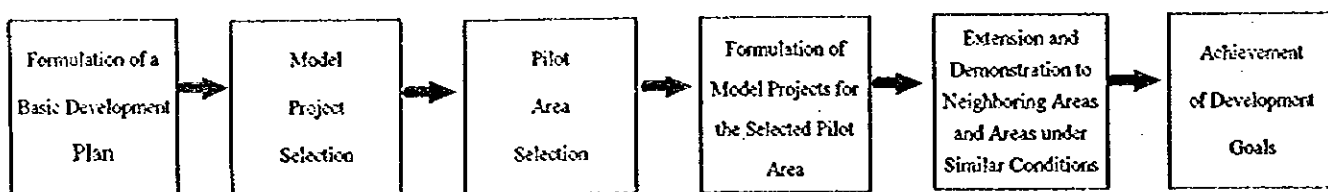
- b) The extension of soil conservation techniques to farmers to prevent soil runoff and to maintain land productivity. To simultaneously control soil runoff upstream to stabilize river bed conditions and reduce flood damage downstream.
- c) Introduction of vegetables, cash crops, fruit trees for cultivation, livestock raising, and inland fisheries for agricultural diversification.
- d) Guidance in groundwater irrigation techniques and farm management to improve land productivity, and to shift to a sustainable agricultural practice. In addition, roads and collection and loading areas shall be improved for a better distribution of agricultural products.
- e) Reinforcement of extension offices and collection and loading areas; extension of agricultural techniques to farmers and the reinforcement of the farmers' organization; expansion of the agricultural financing system for the benefit of all farmers in the area.

**(2) Development Method**

The implementation of the project shall commence with the formulation of the basic development plan, the implementation of model projects, and the extension of the results of the model project to neighboring areas and areas under similar conditions.

The following are the reasons behind the chosen implementation process for the project:

- a) The majority of the farmlands in the study area are located in hilly areas and are small in scale.
- b) The kind of agricultural development suitable to El Salvador has not been established yet.
- c) The farmers' capability to carry out this type of development has not yet been ascertained.



**Model Development Method**

### **4.3.3 Development Plan Component and Formulation Policy**

#### **(1) Development Plan Component**

Based on the results of the analysis of the agricultural conditions in El Salvador, which covered the national development plan previously mentioned, the development potential of the study area and the factors that could impede development, the basic development plan shall entail: (a) basin management for the conservation of natural resources, (b) agricultural development in terms of effectively using natural resources and improving land and labor productivity, to improve farmers' income, and (c) the granting of agricultural support for the implementation of items (a) and (b).

These components shall consist of the following:

- (a) Basin Management: land use, soil conservation, afforestation and agroforestry, flood control, water management
- (b) Agricultural Development: agricultural diversification through the introduction of cash crops, livestock raising and inland fisheries, improvements in farm management methods, introduction of irrigation and drainage systems, improvement of roads, formulation of a farmers' organization, and improvement of the distribution system
- (c) Agricultural Support/  
Farmer's Organization: development and extension of technologies in agriculture, livestock, forestry, and fisheries, improvement of the tenancy system and financing system, collection, analysis and publication of meteorological, hydrological, and marketing information, improvement of farmers' standard of living

#### **(2) Basic Development Plan Formulation Policy**

##### **a) Target Year**

With due consideration of the significant socioeconomic changes right after the civil war, the master plan period was set for 15 years, targetting the year 2010.

##### **b) Basin Conservation Plan**

This plan shall entail the conservation, practical use, and management of water and soil, the most important resources for agricultural development. This plan shall also positively promote the participation of the farmers in the project.

c) **Agricultural Development Plan**

This plan aims to increase farmers' income by establishing a diversified agriculture through the introduction of cash crops suitable to the area and livestock raising. Through improvements in farm management methods, expansion of the irrigation system, formation of a farmers' organization, and improvement of the distribution system, the plan intends to improve agricultural productivity.

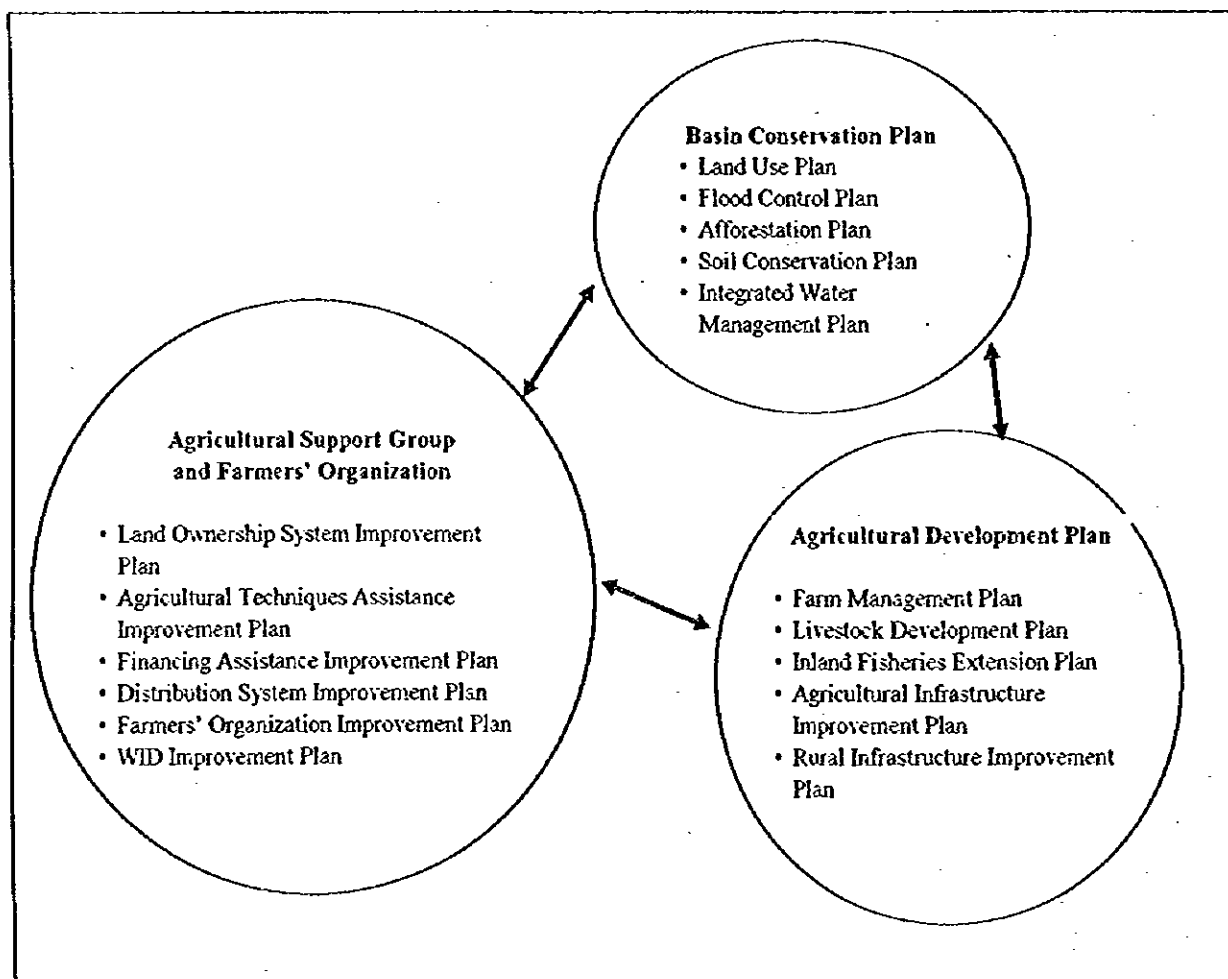
d) **Agricultural Support Group and Farmers' Organization Plan**

This plan aims to extend assistance in the fields of technology, system improvement, and financing, to encourage the farmers to participate in the project.

Model projects will be formulated for the verification, demonstration, extension of methods and effects, and the promotion of the project.

5. **Master Plan**

The master plan shall constitute the following:



## 5.1 Basin Conservation Plan

### 5.1.1 Land Use Plan

The land use plan based on the master plan is as follows:

Land Use Classification	Present Coverage (km <sup>2</sup> )	Land Use Plan (km <sup>2</sup> )
Cultivated lands	215.23	209.28
Grasslands	51.61	5.16
Forests	154.91	154.91
Fruit tree and coffee plantations	87.23	133.68
Facilities	22.23	28.18
Lake, swamps and rivers	74.36	74.36
<b>Total</b>	<b>605.57</b>	<b>605.57</b>

The land use plan shall not affect the present forest coverage, which constitutes sparse woodlands, groves of miscellaneous trees, and shrubbery, as it intends to use the same areas for afforestation.

### 5.1.2 Flood Control Plan

The river improvement works shall cover approximately 13.0km downstream (13.0km on the right bank, 12.5km on the left bank). The design flood discharge under a rainfall probability of 1/100 years was set at 735.8 m<sup>3</sup>/s.

### 5.1.3 Afforestation Plan

The afforestation plan shall cover 15,000ha: 7,500ha for afforestation and 7,500ha for agroforestry.

#### (1) Afforestation

Afforestation in fallows within farmlands and pastures, grasslands, hedges and sparse forests, shall be conducted with the landowners' full cooperation. Afforestation shall cover a total of 7,500ha: 2,573 ha in A block, 1,084ha in B block, 2,036ha in C block, 299ha in D block, and 1,508ha in E block. The selection of tree species shall be based on the future use of the area.

#### (2) Agroforestry

The slope areas in the upper and midstream areas of the basin should have been preserved as forests, but instead they are cultivated by small scale farmers at present. Given this condition, it would be difficult to conduct afforestation in the area. Therefore, agroforestry shall be

introduced in these cultivated slope lands for soil conservation, supply of fertilizer, feed (pasture), and firewood, and to increase the income of the farmers through the cultivation of cash crops like fruit trees. Agroforestry shall cover 7,500ha and the methods and tree species to be adopted shall depend on the future use of the land.

1) **Agroforestry on Cultivated Lands**

Tree planting on cultivated lands, contour cropping, array cropping, tree planting in gardens, planting on fallows.

2) **Agroforestry on grasslands and pasture**

Tree planting for the production of feeds, for soil stabilization and fertilization, and land conservation.

3) **Agroforestry on other lands**

Planting to create hedgerows, boundary lines and windbreak. Trees shall also be planted along canals, flood plains and roads, and around houses and public lands.

The tree planting density shall be 1,600/ha for afforestation and 800/ha for agro-forestry. Accordingly, the total number of saplings required shall amount to 18,000,000, approximately 1,200,000 per year.

Because it is very important to select suitable tree species and to grow excellent saplings, the provision of facilities necessary for the development and extension of relevant techniques shall be incorporated in this plan.

It is very important to acknowledge that the smooth and successful conduct of afforestation and agroforestry activities significantly rely on the community. The government should implement policies and activities in the subject areas that would positively encourage public participation. Therefore, the plan intends to conduct the following: provide monetary incentives, loan privileges, necessary materials (saplings, pots, seeds, insecticides, fertilizers, etc.), tax exemption, and technical transfer.

#### **5.1.4 Soil Conservation Plan**

(1) **Soil Conservation Measures**

The following soil conservation measures shall be applied in the Study Area:

a) **Soil conservation measures for farmlands**

The reinforcement of guidance and extension activities is expected to enable the farmers to independently control runoff velocity, accelerate rain water filtration into the ground, conserve surface soil, and improve soil fertility, through contour cropping, agroforestry, mulching, intercropping.



## b) Civil works

- Hillside ditch:** this method shall be acceptable to the farmers because it is inexpensive and easy to manage; vetiver grass shall be planted on the slope for protection.
- Stone masonry:** this is more suitable than hillside ditch in hilly areas with thin surface soils.
- Terrace:** this is most effective in controlling erosion in slopes with a gradient greater than 45%; but because this method is costly and requires advanced technology it is recommended in areas cultivated with valuable crops.
- Gully erosion control measures:** sabo dam shall be constructed to control erosion in gullies and valleys, either using gabions, stone or concrete depending on the scale of the works.

In order to effectively implement soil conservation, the following plans will be carried out putting priority on soil conservation technology and the demonstration of the techniques with the farmers' participation.

### **(2) Soil Conservation Technology Development Plan**

This plan shall entail the reconstruction of the abandoned demonstration farm in Santa Cruz Analquito, the collection of basic data, and the development and extension of soil conservation techniques.

### **(3) Soil Conservation Technology Extension Plan**

This plan shall entail the provision of vehicles and facilities required for the farmers' training program which shall include observation tours in developed areas. The conduct of civil works for soil conservation in seriously eroded areas (San Antonio Masahuat, Ilopango Lake basin) shall be given priority. Because these works shall be conducted by the farmers themselves, the importance and advantages of such countermeasures should be fully explained. The supply of necessary machinery and materials is also included in this plan. To reduce soil erosion to about 50% by 2010, soil conservation measures shall be fully introduced in lands (11,000 ha) within the basin that slope from 11~55%.

### **(4) Machinery and Materials for Soil Conservation**

This plan shall establish three bases in the basin to hold the required machinery and materials the farmers' will need for the implementation of the project.

### **(5) Sabo Dam Plan**

Eleven (11) sabo dams (3m in height) shall be constructed in rivers where soil runoff is significant.

### **5.1.5 Integrated Water Management Plan**

In order to strengthen the meteorology and hydrology sections of DGRNR, which supervises meteorological and hydrological observations nationwide, the necessary observation facilities and equipment (meteorology and groundwater level surveys) shall be provided to be able to warn and protect the residents of and from imminent calamities, and for water resources management.

The facilities to be provided or improved are as follows:

- a. Rainfall and water level discharge observation stations  
(9 meteorological & 8 hydrological stations)
- b. Meteorological and hydrological center  
(1 center)
- c. Water quality observation and analysis system

## **5.2 Agricultural Development Plan**

### **5.2.1 Farm Management Plan**

Farming is carried out on a small scale in the basin, and the cost of production is high. To compete with agricultural imports, the farmers should produce crops suitable to the area and strive to improve crop quality. The following are the suitable crops cultivated in the basin:

#### **a) Field Beans**

Field beans are cultivated in Guadalupe and are famous for their good quality: they soften immediately even when boiled for just a short period. It is necessary to examine fully the quality of the seeds at the sowing stage.

#### **b) Citrus Fruits**

Citrus fruits are cultivated in Candelaria. Because this product is a native to the area, most of the trees are old. Some producers conduct hybridization to produce good tasting oranges, and prolong the shipment term for the planting of varieties with different maturing periods.

#### **c) Cashew Nuts**

The slope areas from Rosario de la Paz to San Pedro Nonualco are suited to cashew nut cultivation. The fruit of this crop is used to manufacture jam and fruit juices.

This plan aims to increase the yield of maize and paddy by increasing the volume of the nitrogen

fertilizer. This is also foreseen to increase the yield of field beans and sorghum cultivated during the maize cropping interval.

The crops to be cultivated are basic grains (maize, sorghum, field beans, paddy), industrial crops (sugar cane, sesame, coffee), fruits (avocados, mangoes, cashew nuts, pineapple, citrus trees), and vegetables (pepper, chayote, loroco, cucumber, watermelon).

Based on the farm management plan, the cropping area and revenues per farm household are shown in the table below according to basin block. The increase in total planting area is attributed to cultivation in grasslands.

Blocks		A	B	C	D	E
<b>Items</b>						
<i>Average Cropping Area (Mz)</i>						
Basic Grains	Present	2.08	2.08	2.49	1.51	3.04
	Plan	2.18	2.29	2.71	1.51	3.42
Industrial Crops	Present	0.51	0.73	1.43	0.49	0.12
	Plan	0.51	0.76	1.47	0.53	0.13
Vegetables	Present	0.11	0.26	0.06	0.06	0.11
	Plan	0.15	0.38	0.07	0.06	0.12
Fruit Trees	Present	0.78	0.50	0.70	0.08	0.41
	Plan	0.91	0.81	1.01	0	0.75
<b>Total</b>	Present	3.48	3.57	4.68	2.14	3.69
	Plan	3.75	4.24	5.26	2.09	4.42
<i>Gross Income (colones)</i>						
Basic Grains	Present	151	- 62	746	971	741
	Plan	922	774	1,868	1,768	2,180
Industrial Crops	Present	1,017	3,577	6,019	175	199
	Plan	1,017	3,876	6,403	90	194
Vegetables	Present	550	1,305	302	596	542
	Plan	1,825	3,160	699	596	1,297
Fruit Trees	Present	2,042	1,316	1,842	220	1,069
	Plan	10,009	8,942	14,072	0	16,176
<b>Total</b>	Present	3,760	6,198	8,909	1,962	2,552
	Plan	13,773	16,751	23,042	2,455	19,848

### 5.2.2 Livestock Development Plan

This plan aims to improve livestock health services for farmers and cooperatives into livestock raising, as a means of increasing the income of small scale farmers and to stabilize farmers' supply of protein.

**(1) Livestock Health Services Improvement Plan**

A livestock (cattle, pigs, chickens) health services improvement center shall be established in the downstream basin. The office shall conduct seminars on animal disease prevention, regular check up of animals in the area, and collect samples from disease-infected animals for laboratory analysis in DGSVA in San Salvador. The center shall also function as an animal sperm bank.

**(2) Swine Production Extension Plan**

Pork demand is low due to fear of tape worm infestation. Therefore, intensive small scale swine farming, which will entail the building of pigsties and the use of formula feed, shall be introduced. The gist of the plan is to produce and market promising piglets, market fattening pigs, and domestic processing of pork meat. Swine farming is suitable in the upstream and midstream basin areas because they are equipped with water supply facilities and electricity, and access to consumption areas is favorable.

**(3) Poultry Farming Development Plan**

Poultry farming, either by the collection of eggs or the use of broilers, is an industry effective in the hilly areas upstream and midstream where land resources are limited. However, because the poultry market in El Salvador is monopolized by several large poultry enterprises, poultry production in the study area shall only be limited to the local market.

**5.2.3 Inland Fisheries Development Plan**

The impact of the water quality of the Ilopango Lake on humans and the ecosystem is not clear. However, in response to the request of small scale farmers in the upstream basin, small scale intensive inland fisheries shall be introduced in the upstream and midstream areas which are not affected by the lake's water quality. Technological training and extension mainly on the breeding of tilapia and shrimp shall be conducted in the area to ① raise the income of the farmers, ② improve their diet, and ③ to create job opportunities.

- a) CENDEPESCA shall be responsible for the conduct of site surveys, construction supervision, acquisition of fries, and guidance in fish breeding methods.
- b) Using surface flow or spring water resources, farmers shall construct a fish breeding pond which shall also be used to provide livestock with drinking water.
- c) The use of livestock excreta as fish food is also possible especially by constructing small livestock barns above breeding ponds.

- d) Verapaz, San Ramon, El Carmen, Mercedes La Ceiba, San Antonio Masahuat, San Pedro Masahuat, and Santa Maria Ostuma, are the possible sites for the development of inland fisheries.

#### 5.2.4 Agricultural Infrastructure Development Plan

##### (1) Irrigation Plan

The water quality of Ilopango Lake and Jiboa River basin is unsuitable for irrigation. Surface water irrigation is also not possible because the discharge of the tributaries in the dry season is too small. Accordingly, the plan shall mainly use groundwater resources for irrigation. Based on geological and groundwater studies, the areas with high groundwater development potential are the northwestern part of the foot of Mt. San Vicente (660ha), the central and southern parts of San Pedro Masahuat Municipality (655ha and 785ha, respectively). Irrigable areas in El Salvador total 2,100ha.

Because the soil in the study area is very permeable and water is expensive, fallow irrigation is not recommendable. Therefore, sprinkler or drip irrigation shall be adopted. According to the modified Penman method, the required water volume is estimated at 7.1 to 7.4 mm/day, at an irrigation interval of 4 days. Sixty or seventy percent of this amount shall be the required water volume for drip irrigation.

##### (2) Drainage Plan

Flood damages downstream shall be reduced through the improvement of river channels. It is however important to install an underdrainage because the area is shaped like a shallow tray.

Drainage Canal	Main Canal	Secondary Canal
El Lirial	7,250	10,700
Central	4,300	1,500
<b>Total</b>	<b>11,550</b>	<b>12,200</b>

##### (3) Road Improvement Plan

The road improvement plan shall be carried out to enable the timely transportation of agricultural products and implements, for the conduct of extension and training activities, and to establish a means of communication between villages. The plan shall cover the third class roads (83.4km), rural road A (42.6km), and rural road B (48.0km). The construction of farm roads (4m in width, 25m/ha) is also planned; these roads shall be paved in gravel.

### **5.2.5 Rural Infrastructure Development Plan**

In order to improve the farmers' sanitary environment, the use of unsanitary river water and the discharge of human excreta into the river shall be eliminated. This plan shall be implemented by ANDA. The number of households that shall benefit from the water supply improvement plan, which shall be done by 2010, totals 35,684, 18,670 of which are in the rural area. The lavatory construction plan shall cover 28,838 households, 14,242 of which are in the rural area.

The formation of a farmers' organization is very important in order to smoothly carry out extension of agricultural techniques, acquisition of agricultural implements, adequate use of financing systems, operation and maintenance of facilities, and the marketing of agricultural products. Aside from a farmers' organization, the villages in the study area also need to organize a youth association, a soccer team, or construct an assembly place which will be useful for the conduct of WID activities. Assembly places shall be constructed in 40 villages with a population of over 500.

## **5.3 Agricultural Supporting Group and Farmers' Organization Plan**

### **5.3.1 Land Tenure Improvement Plan**

The biggest development constraint in the study area is the existence of tenant farmers. As most of their land leases are short-term, they have no interest in investing their money in the lands. Therefore, it is necessary to increase the trust between land owners and tenants to encourage long-term leases, and to establish appropriate credit systems to enable farmers to buy land where land is available. Accordingly, the following are recommended:

- a) Governmental measures that would encourage long-term leases.
- b) Intervention of a trusted third-party, the church, or an NGO.
- c) Strengthening of land banks or establishment of a financing organ that would help peasants purchase land.
- d) Establishment of a credit line similar to FOCAM, which allows a 25 year reforestation credit at an annual rate of 6%.

### **5.3.2 Agricultural Techniques Extension and Support Plan**

#### **(1) CENTA**

CENTA shall be responsible for agricultural technical research and extension activities.

- a) **Research Improvement Plan**  
CENTA conducts soil analysis and guidance in the proper use of fertilizers. However, because it handles 7000 samples a year, by the time the results are ready, they are no

longer applicable. The two regional agricultural research institutes (CDT), one in Santa Cruz Porrillo and the other in San Andres, shall be improved by installing modern soil analysis facilities so as to extend timely advice on fertilization.

**b) Agricultural Extension Improvement Plan**

There are nine (9) extension agencies in the study area. Each agency shall be assigned 10 staffs and shall be equipped with the necessary facilities. In addition, the personnel shall also be trained in baking, food processing and sewing, to be able to extend these techniques to the women in the study area.

**(2) DGRNR/CENTA**

Farmers' participation is very important to the smooth implementation of the project. The farmers can independently conduct the soil conservation works, construct the farm roads, small scale irrigation facilities, fish ponds, etc. as long as they have sufficient guidance from DGRNR, CENTA, and CENDEPESCA, and are provided with the necessary machinery and materials. The maintenance of constructed facilities (irrigation facilities and farm roads) shall be mostly delegated to the farmers as well. This plan also proposes leasing machinery to the farmers.

**5.3.3 Financial Assistance Improvement Plan**

The problems in the current credit system are the high interest rates, short term loans and the complicated procedures involved. Solving this problem requires governmental and administrative interference for the implementation of measures that would help increase farmers' understanding of the credit system, improve line of credit according to the frequency of loans, and establish flexible interest rates. The solidarity of the farmers' group may be used also as a loan guarantee.

**5.3.4 Marketing Improvement Plan**

The plan aims to improve agricultural products loading and shipping facilities, and establish a marketing information system. The loading and shipping facilities shall be constructed at San Ramon, Verapaz, Rosario de La Paz, and Santiago Texacuangos. Each extension office shall be installed with a marketing information system to remain in close contact with DGEA.

**5.3.5 Farmers' Organization Improvement Plan**

Regulations and administrative measures are necessary to expedite the formation of a farmer's organization and to smoothly conduct production and marketing activities. A good basis to start with is the formation of a group of about 10 farmers assisted by an extension agent (CVP),

followed by the merging of these groups until they can be officially organized into an agricultural cooperative.

### **5.3.6 Women's Organization Improvement Plan**

As previously mentioned in the Agricultural Techniques Extension Improvement Plan section, the extension offices shall be installed with the equipment and facilities necessary for the establishment of a women's organization and the promotion of activities that would improve their living conditions.

## **6 Model Project and Pilot Area Selection**

### **6.1 Model Project Selection**

Because this project is very extensive, involving the introduction of various new concepts and techniques which are both vital to its successful implementation, small scale model projects shall precede its implementation. The model projects should be able to investigate for the project, establish a supporting system, and conduct demonstration and extension activities to the farmers.

The selection of the model projects was based on economic benefits, importance to the area, implementation restrictions, and farmers' needs. The selected model projects are basin conservation (afforestation, soil conservation), agricultural development (agricultural diversification, improvement of productivity), and agricultural support group and farmer's organization.

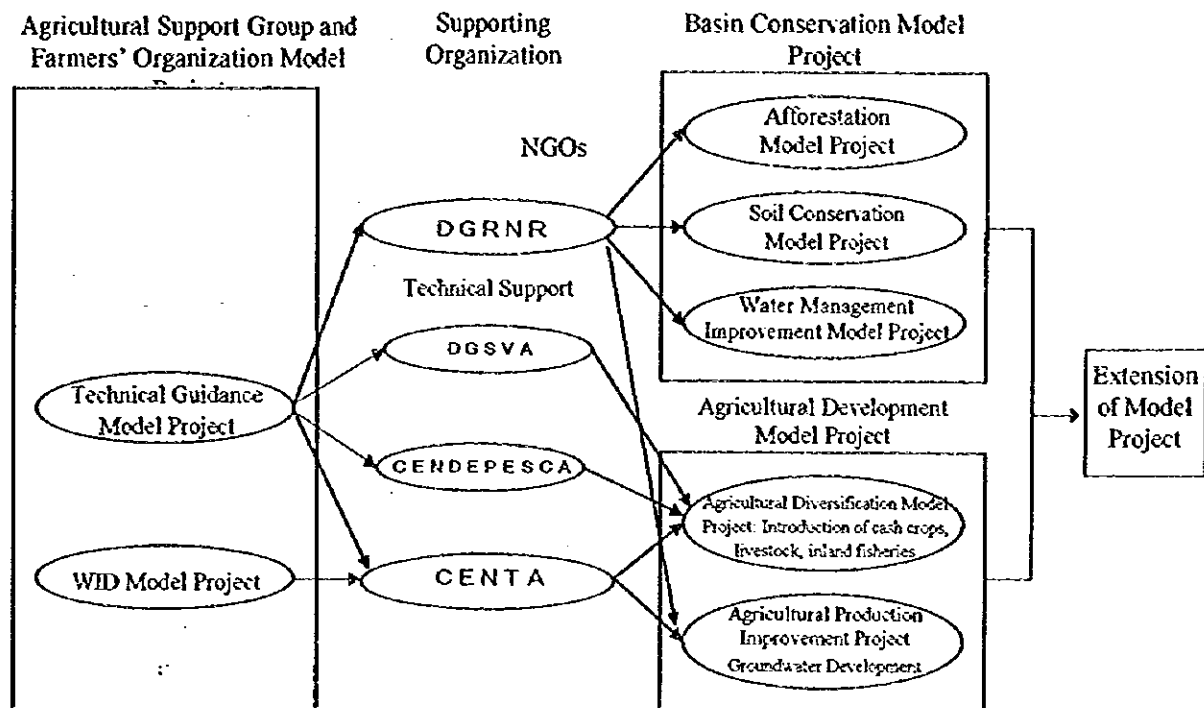
### **6.2 Selection of Pilot Areas**

The selection of pilot areas was based on agricultural development potential in terms of agricultural sustainability, importance of the model projects, and their feasibility in the pilot areas. The model projects were formulated with due consideration of the characteristics of each pilot area and in accordance with the conditions that could significantly contribute to solving the problems prevailing in these pilot areas. The selected pilot areas are San Cristobal, San Pedro Masahuat, San Antonio Masahuat and Ilopango Lake basin area. To anticipate smooth implementation, the model projects shall be formulated, as much as possible, in areas already established with a farmers' organization. The agricultural support group and farmers' organization model project shall entail plans that are in correlation with the basin conservation and agricultural development projects.



## 7. Model Project Plan

The model project mainly consists of a basin conservation model project, an agricultural development model project, and an agricultural support group and farmers' organization formulation model project, as shown below.



### 7.1 Basin Conservation Model Project Plan

#### 7.1.1 Afforestation Model Project Plan

##### (1) Afforestation technology development project plan

This plan aims to conserve basin environment by aggressively promoting reforestation through afforestation and agroforestry. The plan aims to conduct transfer of sapling production techniques to the residents of the area, and to reconstruct the nursery within the compound of the DGRNR so it can be used as a base for the production of tree saplings.

##### (2) Afforestation extension project plan

Reforestation shall be carried out to conserve the environment of the Ilopango Lake, which is mostly made up of slopes and seriously eroded, and the Sepaquiapa and Tilapa river basins. This shall be done by the extension of technologies relevant to nursery construction and sapling production.

### **7.1.2 Soil Conservation Model Project Plan**

#### **(1) Soil conservation technology development model project plan**

This project aims to control soil erosion and conserve the environment in the basin to realize a stable agriculture. This shall be carried out by the development and extension of soil conservation techniques, and the rehabilitation of the Analquito experiment and demonstration farm within the DGRNR property.

#### **(2) Soil conservation extension model project plan**

Soil conservation works, torrent works, and afforestation (3ha) shall be carried out to conserve the environment of Ilopango Lake which is mostly made up of slopes and seriously eroded.

### **7.1.3 Water Management Improvement Model Project Plan**

#### **(1) Meteorology and hydrology observation system improvement project plan**

In order to study the actual water use (including groundwater), flood and draught conditions, and to determine what adequate countermeasures to take, the equipment and instruments of the existing meteorological and hydrological observation stations shall be rehabilitated. Some observation stations (9 meteorological and 7 hydrological stations) shall be constructed where necessary. These observation stations shall be equipped with telemeters. The existing laboratory shall be equipped with the necessary instruments and facilities for the conduct of water quality analysis.

## **7.2 Agricultural Development Model Project**

### **7.2.1 Agricultural Diversification and Productivity Improvement Model Project in the Upstream and Midstream Basin Areas**

#### **(1) Agricultural structure improvement project in San Francisco**

This project is formulated for the agricultural cooperatives (32 members) in San Cristobal in the San Francisco area. Agricultural diversification and improvement of land and labor productivity is planned for this area through the introduction of cash crops and swine production. The activities shall be carried out with the help of the Cojutepeque extension office.

#### **(2) Inland fisheries model project**

The introduction of inland fisheries is also a means of diversifying agriculture in the study area. The sites to be used for this project are the two properties owned by ADESCO in Los Encoentros Canton of the municipality of Verapaz. Inland fisheries shall be introduced to the

municipality with the guidance of CENDEPESCA.

**(3) Agricultural structure improvement project in El Socoro**

This project shall be conducted on 400 Mz of lands owned by the "Cooperative 30 de Octubre" (64 members) on slopes located about 2km north of San Antonio Masahuat. This improvement project shall entail soil erosion control, farm management improvement, introduction of cash crops, fruit trees and poultry farming, and farm road construction, under the guidance of DGRNR and the El Rosario extension office.

**7.2.2 Agricultural Structure Improvement Model Project in the Lower Basin**

**(1) El Carmen irrigation agricultural development project**

Four pump wells shall be constructed in an area of 120ha in El Carmen Canton, which is located approximately 1km west of El Rosario, for groundwater development for irrigation. El Carmen is considered to have abundant groundwater reserves. Groundwater irrigation techniques shall be diffused in the area with the guidance of the DGRNR El Rosario extension office, for the cultivation of cash crops in the dry season.

**(2) Agricultural structure improvement model project in the lower basin**

The flat area downstream mostly covered by the agricultural cooperatives is mainly used for the contractual cultivation of sugarcane, which provides the farmers with a stable income. A very small part of the land is cultivated with cash crops. As a measure against the risks inherent to monocultural practices, livestock raising shall be promoted by improving the health services for the 5,000 cattle raised by the cooperatives under the guidance of DGSVA.

**7.3 Agricultural Support and Farmers' Organization Model Project Plan**

**7.3.1 Extension Office Reinforcement Model Project Plan**

The 3 extension offices of CENTA (Cojutepeque, El Rosario, Santiago Texacuangos), which supervise the study area, shall be expanded and strengthened for the effective extension of agricultural techniques and soil conservation methods, the activation of WID activities, and the leasing of machinery required to promote the projects.

**7.3.2 Project Promotion Plan**

Farmers' participation is very important to the smooth implementation of the project. The farmers can independently conduct the soil conservation works, construct the farm roads, small scale irrigation facilities, fish ponds, etc. as long as they have sufficient guidance from MAG

and CENTA, and are provided with the necessary machinery and materials. The maintenance of constructed facilities (irrigation facilities and farm roads) shall be mostly delegated to the farmers as well. Accordingly, DGRNR shall be installed with the equipment and materials relevant to the design, supervision and conduct of these activities.

Road improvement, establishment of marketing system, and the construction of marketing facilities are essential to the establishment of a sophisticated marketing system. However, because the pilot areas shall only market a limited volume of agricultural products, and because the above system and facilities should be established and constructed several years after the model project facilities are completed, the temporary use of small facilities and existing space shall have to suffice in the beginning.

Although the construction of marketing facilities is not included in the model project, the training of marketing personnel, collection and analysis of market information shall be carried out. The facilities to be constructed for this model project shall be limited to a small scale and shall be urgently carried out in consideration of the changes in production trend as a result of the implementation of the model projects.

## 8 Project Cost and Schedule

The project cost was estimated using the exchange rate of US\$ 1 = 8.7  $\phi$  = ¥113.2.

(unit: US\$ 1,000)		
Project Plans	Master Plan Cost	Model Project Cost
<i>Basin Conservation Plan</i>		
River Improvement Plan	315,816	
Afforestation Technology Development and Extension Plan	4,309	4,309
Soil Conservation Technology Development and Extension Plan	556	556
Meteorologic and Hydrologic Observation System Development Plan	3,981	3,708
Sabo Dam	360	
<i>Agricultural Development Plan</i>		
Diversification Plan	474	474
Irrigation and Drainage Plan	23,607	1,272
Demonstration Farm Roads Plan	2,599	956
Rural Infrastructure Improvement Plan	10,356	
Road Improvement Plan	112,908	
<i>Agricultural Support Group and Farmers' Organization Plan</i>		
Technical Extension Reinforcement Plan	7,989	2,422
Project Promotion Plan	1,306	1,306
<i>Marketing System Improvement</i>		
	1,239	
<b>Total</b>	<b>485,500</b>	<b>15,003</b>

The implementation of the project is as shown in the Project Implementation Plan Table.

## **9. Project Evaluation**

The expected benefits of the project can be fully attained if implementation is adequately carried out. Judging from the EIRR of each model project, this integrated development project is feasible in the Study Area. Although the river improvement project was estimated to have a considerably low EIRR, it needs to be technically evaluated in view of its impact on the stabilization of the residents' standard of living and its importance to public welfare.

The project will not have any adverse effect on the environment. However, particular care should be given to relationship with landowners, existing historical ruins, excessive groundwater utilization, and water quality.

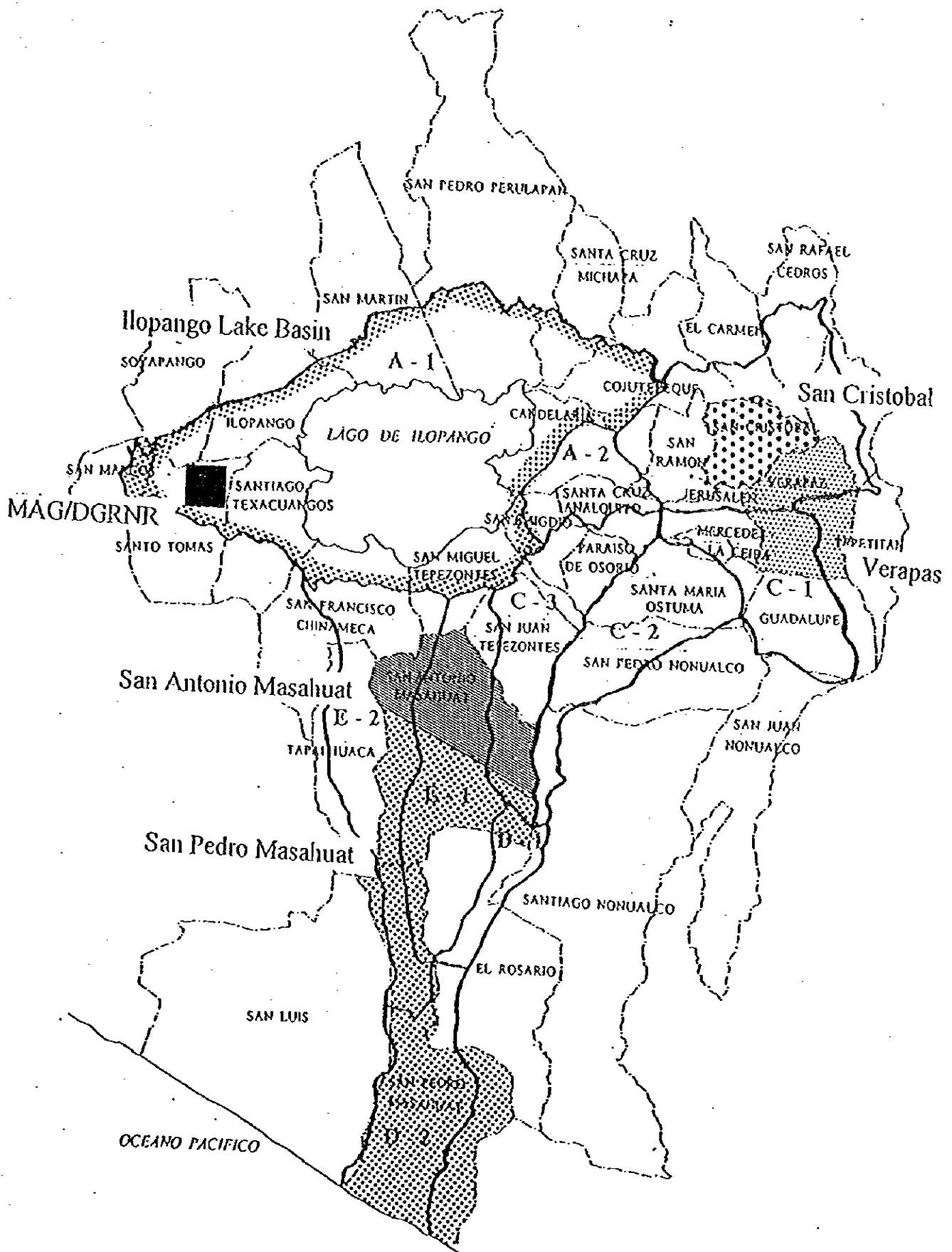
## **10 Recommendations**

As the Project is expected to solve the current problems in El Salvador, urgent implementation is desirable. Therefore, the following are recommended:

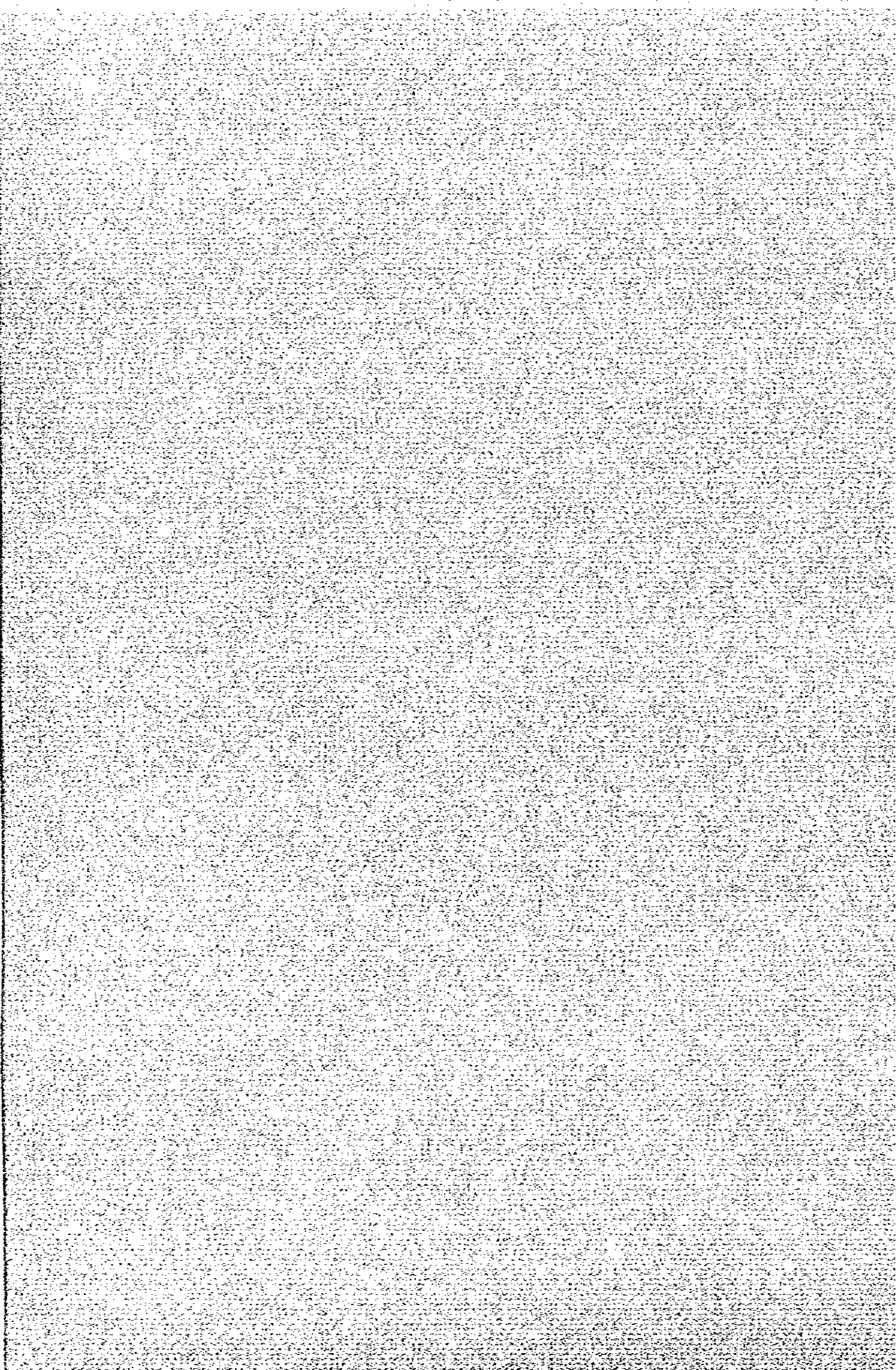
- Determine a financial plan, which includes foreign aid, for the implementation of the Project
- Establish the executing agency
- Train staffs concerned
- Prepare laws and systems related to land tenure, financing, farmer's organization, taxation, etc.
- Maintain close relationship with agencies concerned
- Promote farmers' participation by making farmers' fully understand the importance of the Project

# MODEL PROJECT AND MODEL AREAS

PROJECT NAME	MODEL PROJECTS	SUPPORTING ORGANIZATIONS					MODEL AREAS			
		DGRNR	CENTA	GENEPECSA	DCSVA	San Cristobal	Verapaz	San Antonio Masahuat	San Pedro Masahuat	Ilopango
Basin Conservation Model Project	Afforestation Model Project Plans									
	Afforestation Extension Model Project									
	Soil Conservation Model Project Plans									
	Soil Conservation Techniques Extension Model Project									
Agricultural Development Model Project	Water Management Improvement Model Project									
	Agricultural Diversification Model Project	Swine Production Model Project								
		Poultry Farming Model Project								
		Inland Fisheries Model Project								
	Agricultural Production Improvement Model Project	Improvement of Farming Methods and Introduction of Cash Crops								
		Livestock Health Services Improvement Model Project								
		Improvement of Farming Methods and Introduction of Cash Crops								
		Upstream Basin: Slope Farming Model Project								
	Agricultural Techniques Extension and Reinforcement Model Project	Downstream Basin: Groundwater Irrigation Development Model Project								
		Agricultural Support Improvement Model Project (CENTA)								
Project Promotion and Extension Model Project (MAG)										
WID Model Project	Assistance to Women's Organization Model Project									



**PILOT AREA OF THE MODEL PROJECT**





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## ABREVIATURAS

## ABBREVIATIONS

AMSS	Área Metropolitana de San Salvador	AMSS	Metropolitan Area of San Salvador
ANEA	Administración Nacional de Acueductos y Alcantarillados	ANEA	National Administration of Water Supply and Sewage
ARENA	Alianza Republicana Nacionalista	ARENA	Nationalist Republic Alliance
BCIE	Banco Centroamericano de Integración Económica	BCIE	Central American Economic Integration Bank
BCR	Banco Central de Reserva	BCR	Reserve Central Bank
BDT	Banco de Tierra	BDT	Bank of Lands
BFA	Banco de Fomento Agropecuario	BFA	Agricultural Promotion Bank
BID	Banco Interamericano de Desarrollo	BID	Inter-American Development Bank
BIRF o BM	Banco Internacional para Reconstrucción y Fomento / Banco Mundial	IBRD or WB	International Bank of Reconstruction and Development or World Bank
CAESS	Compañía de Alumbrado Eléctrico de San Salvador	CAESS	Electric Light Company of San Salvador
CAMINOS	Dirección General de Caminos	CAMINOS	General Directorate of Roads
CAPRE	Comité Coordinador Regional de Instituciones de Agua Potable y Saneamiento de Centroamericana	CAPRE	Regional Coordination Committee of Institutions of Potable Water and Sanitary in Central America
CATIE	Centro de Agricultura Tropical de Investigación y Enseñanza	CATIE	Tropical Agriculture Center for Research and Training
CDT	Centros de Desarrollo Tecnológico	CDT	Technical Development Center
CEE	Comunidad Económica Europea	EEC	European Economic Community
CEL	Consejo Ejecutivo del Río Lempa	CEL	Executive Company for the Lempa River
CENDEPESCA (DIGEPESCA)	Dirección General de Desarrollo Pesquero	CENDEPESCA	Fishery Development Center
CENTA	Centro Nacional de Tecnología Agropecuaria y Forestal	CENTA	National Center of Agricultural Technology
CEPA	Comisión Ejecutiva Portuaria Autónoma	CEPA	Autonomous Executive Commission for Ports
CEPRODE	Centro De Prevención Desastres	CEPRODE	Disaster Prevention Center
CIG	Centro de Investigaciones Geo técnicas	CIG	Center of Geotechnical investigations
COSERHI	Comisión Coordinadora de la Reforma Sectorial de	COSERHI	National water Resource Reorganizing Committee

Recursos Hídricos			
COEN	Comité de Emergencia Nacional	COEN	National Emergency Committee
CONAMA	Consejo Nacional del Medio Ambiente	CONAMA	National Council of Environment
CONACYT	Comité Nacional de Ciencias y Tecnología	CONACYT	National Commission of Science and Technology
CONARA	Comité Nacional de Restauración de Áreas	CONARA	National Commission for the Rehabilitation of Areas
CONCULTURA	Consejo de Cultura	CONCULTURA	Committee of Culture
CVP	Círculo Vecinal de Productores	CVP	Neighboring Producers Circle
DDCI	Dirección de Desarrollo y Control Industrial	DDCI	Directorate for Development and Control of Industry
DAIP	Dirección de Administración de Inversión Pública	DAIP	Directorate for Public Investment Administration
DGAC	Dirección General de Aeronáutica Civil	DGAC	General Directorate of Civil Aviation
DGEA	Dirección General de Economía Agropecuaria	DGEA	General Directorate of Agricultural Economy
DGEC	Dirección General de Estadísticas y Censos	DGEC	General Directorate of Statistics and Census
DGP	Dirección General de Presupuesto	DGP	General Directorate of Budget
DGRD	Dirección General de Riego y Drenaje	DGRD	General Directorate of Irrigation and Drainage
DGRNR	Dirección General de Recursos Naturales Renovables	DGRNR	General Directorate of Renewable National Resources
DGSVA	Dirección General de Sanidad Vegetal y Animal	DGSVA	General Directorate for Vegetation and Animal Health
DOB	Demanda Biológica de Oxígeno	BOD	Biological Oxygen Demand
DUA	Dirección General de Urbanismo y Arquitectura	DUA	General Directorate of Urbanism and Architecture
EDO	Extensión Dirigida a Objetivos	EDO	Extension Directed to Objectives
ENA	Escuela Nacional de Agricultura	ENA	National School of Agriculture
FCI	Fondo de Crédito para El Salvador	FCI	Credit Fund for El Salvador
FEDECREDITO	Federación de Cajas Rurales de Crédito	FEDECREDITO	Federation of Rural Savings Banks
FENADESAL	Ferrocarriles Nacionales de El Salvador	FENADESAL	National Railroad of El Salvador
FIAES	Fondo Iniciativa para las Américas	FIAES	Inactive Fund for the Americas
FINATA	Financiera Nacional de Tierras Agrícolas	FINATA	National Financier for Agricultural Lands
FIS	Fondo de Inversión Social de El Salvador	FIS	Social Investment Fund for El Salvador
FMI	Fondo Monetario Internacional	IMF	International Monetary Fund
FONAES	Fondo Ambiental de El Salvador	FONAES	Environmental Fund for El Salvador
FUSADES	Fundación Salvadoreña para el Desarrollo Económico y Social	FUSADES	Foundation for economic and social development in El Salvador
GOES	Gobierno de El Salvador	GOES	Government of El Salvador
GOJA	Gobierno de Japón	GOJA	Government of Japan

IEA	Impacto de la Evaluación Ambiental	EIA	Environmental Impact Assessment
IEE	Examen Inicial de Ambiente	IEE	Initial Environmental Examination
IGN	Instituto Geográfico Nacional	IGN	National Geographic Institute
IICA	Instituto Interamericano de Ciencias Agrícolas	IICA	Inter-American Institute for Agricultural Science
INSINCA	Industrias Sintéticas de Centro América	INSINCA	Synthetic Industries of Central America
ISTA	Instituto Salvadoreño de Transformación Agraria	ISTA	Salvadoran Institute for Agricultural Reform
ISTU	Instituto Salvadoreño de Turismo	ISTU	Salvadoran Institute for Tourism
IVU	Instituto de Vivienda Urbana	IVU	Institute for Urban Housing
JICA	Agencia de Cooperación Internacional del Japon	JICA	Japan International Cooperation Agency
MAG	Ministerio de Agricultura y Ganadería	MAG	Ministry of Agriculture and Livestock Farming
MEC	Ministerio de Economía	MEC	Ministry of Economy
MED	Ministerio de Educación	MED	Ministry of Education
MIF	Ministerio de Finanzas	MIF	Ministry of Finance
MI	Ministerio de Interior	MI	Ministry of Internal Affairs
MIPLAN	Ministerio de Planificación y Coordinación de Desarrollo económico	MIPLAN	Ministry of Planning and Coordination of Economic Development
M/J	Minuta de Junta	M/M	Minutes of Meeting
MMC	Millón de Metros Cúbicos	MCM	Million of Cubic Meter
MOP	Ministerio de Obras Públicas	MOP	Ministry of Public Works
MSPAS	Ministerio de Salud Pública y Asistencia Social	MSPAS	Ministry of Public Health and Social Assistance
MVDU	Ministerio de Vivienda y Desarrollo Urbano	MVDU	Ministry of Housing and Urban Development
Mz	Manzana	Mz	0.7 ha
OAA	Organización para la Agricultura y la Alimentación de las Naciones Unidas	FAO	Food and Agriculture Organization of United Nations
OAPA	Oficina de Análisis de Políticas Agropecuarias	APAO	Agricultural Policies Analysis Office
ODA o ODM	Administración de Desarrollo de Ultramar o Ministerio de Desarrollo de Ultramar, Reino Unido	ODA or ODM	Overseas Development Administration or Ministry of Overseas Development, United Kingdom
O/M	Operación y Mantenimiento	O & M	Operation and Maintenance
OMS	Organización Mundial de Salud	WHO	World Health Organization
ONG	Organización No Gubernamental	NGO	Non-Governmental Organization
OPAMSS	Oficina de Planificación de Área Metropolitana de San Salvador	OPAMSS	Office of Planning of Metropolitan Area of San Salvador

OPES	Oficina de Planificación Estratégica	OPES	Office of Strategic Planning
OPOR	Oficina de Pequeñas Obras de Riego	OPOR	Office of Small Scale Works of Irrigation
OPS	Organización Panamericana de la Salud	PHS	Pan-American Health Organization
OSPA	Oficina Sectorial de Planificación Agropecuaria	OSPA	Sectorial Office for Agricultural Planning
PAE	Población de Actividad Económica	EAP	Economically Active Population
PIB	Producto Interno Bruto	GDP	Gross Domestic Products
PLANSABAR	Plan Nacional de Saneamiento Básico Rural	PLANSABAR	National Plan of Rural Basic Sanitary
PMA	Programa Mundial de Alimentario	WFP	World Food Program
PMB	Producto Nacional Bruto	GNP	Gross National Products
PNUD	Programa de las Naciones Unidas para el Desarrollo	UNDP	United Nations Development Program
POSRA	Proyecto de Ordenación de la Subcuenca del Río Acelhuate	POSTA	Management Project for the Acelhuate River Sub-Catchment
PREALC	Programa Regional de Empleo para América Latina y el Caribe	PREALC	Regional Program of Employment for Latin America and Caribbean
PRISA	Programa de Reforma e Inversión Agraria	PRISA	Program of Agrarian Reform and Investment
PROMESA	Programa de Medio Ambiente Salvadoreño	PROMESA	Salvadorian Environment Program
qq	Quintal	qq	100 lb.
SEMA	Alcance de Trabajo	S/W	Scope of Work
SIG	Secretaría Ejecutiva de Medio Ambiente	SEMA	Executive Secretary of Environment
SISAP	Sistema de Información Geográfica	GIS	Geographical Information System
SOCHCS	Sistema Salvadoreño de Areas Protegidas	SISAP	Salvador Protected Areas System
UEDA	Servicio de Ordenación de Cuenas Hidrográficas y de Conservación de Suelos	SOCHCS	Service for River Basin Planning and Soil Conservation
USAID	Unidad Especializada del Agua	UEDA	Special Unit of Water
USDA	Agencia para Desarrollo Internacional de Los Estados Unidos	USAID	Agency for International Development of United States
VAT(IVA)	Departamento de Agricultura de Estados Unidos	USDA	Department of agriculture of United states
WID	Impuesto al Valor Agregado	VAT(IVA)	Value-Added Tax
	Mujeres en Desarrollo	WID	Women in Development