

All the system is operated and maintained by CRM, except Caza Lagartos Plant, which is by EMAPAM.

A schematic layout of the system is shown in Fig. C.2.1. There exist two major conduction pipelines. One is from Caza Lagartos Plant extending to Manta and Jaramijo, through Portoviejo City and Montecristi; and the other is aligned from Guarumo Plant through the Loma Blanca Pumping Station to Portoviejo and the northern municipalities of Rio Chico, Rocafuerte, Charapoto, San Clemente, Crucita, etc. Major water consuming area is centered on both Portoviejo City and Manta City.

Construction of a new conduction pipeline from Lodana to Jipijapa has been completed and supply to Jipijapa is expected to start in 1992.

### **2.3 La Estancilla System**

La Estancilla Treatment Plant with a production capacity of 9,000 m<sup>3</sup>/day (Raw water from the Carrizal River) is located at La Estancilla and supplies water to major municipalities in the La Estancilla System: Calceta, Junin, Canuto, La Estancilla, Tosagua, Bachillero, San Vicente and Bahia de Caraquez.

A new treatment plant with an additional capacity of 18,000 m<sup>3</sup>/day is presently under construction at the side of the existing plant and its commissioning is scheduled in 1992.

Water source is the Carrizal River. The natural flow of the river, however, is only sufficient to supply raw water to the existing plant. The future water source to the system will be supplemented by the La Esperanza Dam to be constructed at the upper reach of the Carrizal River.

A schematic layout of the system is given in Fig. C.2.2, together with the following Chone System.

### **2.4 Chone System**

The Chone System is served by a treatment plant located in Chone City with a production capacity of 5,300 m<sup>3</sup>/day, and supplies mainly Chone City/vicinity and San Antonio. To meet an increasing water demand, CRM is presently constructing a new plant with an additional capacity of 5,300 m<sup>3</sup>/day.

The water source is the natural flow of the Chone River which is only sufficient to supply raw water to the existing plant. A new source of water should be introduced for future expansion of the system.

### **3. WATER DEMAND FORECAST**

#### **3.1 General**

Water demand consists of those for domestic use, industrial water and for tourism. Future water demand is forecasted by the following procedure.

- i) Projection of future population by each municipality in the service area to be covered by the regional water supply systems.
- ii) Projection of future tourism population in resort areas in the service area.
- iii) Projection of unit water demand for the service area.
- iv) Water demand forecast in the service area.

#### **3.2 Projection of Future Population**

Future population in the service area was estimated by PHIMA based on the 1990-census record of INEC and is shown in Table C.3.1 by each municipality.

The population of the service area was 697,500 in the 1990-census and is forecasted to reach 854,300 in the year 2000, 1,039,800 in 2010 and 1,257,600 in the planning horizon of 2020.

The population of the whole Manabi Province was 1,031,900 in the 1990-census, and the service area (697,500) had a share of 67.6 % of the whole province in population. The future population of the Manabi Province is estimated at 1,227,500 in the year 2000, 1,454,000 in 2010 and 1,721,400 in 2020.

Summary of population projection is given below:

Year	1990	2000	2010	2020
Population in Manabi Province (A)	1,031,927	1,227,473	1,454,003	1,721,359
Annual Increasing Rate of above	1.63 % (1982-90)	1.75 % (1990-2000)	1.71 % (2000-10)	1.70 % (2010-20)
Service Area Population (B)	697,478	854,306	1,039,799	1,257,606
(Urban)	397,787 (57.0%)	514,966 (60.3%)	654,647 (63.0%)	817,178 (65.0%)
(Rural)	299,691 (43.0%)	339,340 (39.7%)	385,152 (37.0%)	440,428 (35.0%)
Annual Increasing Rate of above		2.05 % (1990-2000)	1.98 % (2000-10)	1.92 % (2010-20)
Share of Service Area in Population (B/A)	67.6 %	69.6 %	71.5 %	73.1 %

### 3.3 Projection of Tourism Population

According to DITURIS, the coastal zone of the Manabi Province is recommended as a prosperous area for tourism development.

Tourism population was estimated for each tourism area which contains beaches or other tourism attraction by PHIMA as shown in Table C.3.2. The tourism population in the service area is estimated at 57,600 in the year 2000, 72,300 in 2010 and 78,900 in 2020.

### 3.4 Unit Water Demand

#### (1) Domestic Water Demand

Unit water demand recommended by IEOS in the year 1991 is used as a basis to estimate future water demand for domestic use. It varies in accordance with the local climate and the number of population in a municipality, ranging from 150 l/person/day to 450 l/person/day as shown in Table C.3.3(1).

The unit water demand recommended by IEOS is considered the target one. The actual unit supply capacity per person in the area, as of the year 1990, was about 50%-60% of the above. It should be increased gradually year by year towards the target one. The increasing rate ( development factor ) in the service area is proposed as follows:

Year	1990	2000	2010	2020
Factor	55 %	70 %	85 %	100 %

Unit water demand to be employed in the service area is given in Table C.3.3(2).

#### (2) Industrial Water Demand

In order to estimate industrial water demand, a questionnaire survey was conducted by PHIMA for Portoviejo and Manta in 1988.

In Portoviejo City, by 19 major industrial firms, industrial water demand and actual consumption totaled to 7,520 m<sup>3</sup>/day and 3,460 m<sup>3</sup>/day, respectively. This industrial water demand/consumption corresponded to 37%/17% of the actual domestic water consumption in Portoviejo City.

In Manta City where 43 industrial firms were surveyed, water demand and actual water consumption amounted to 2,360 m<sup>3</sup>/day and 1,190 m<sup>3</sup>/day, respectively. This water demand/consumption corresponded to 10%/5% of the domestic water consumption of Manta City. Although a considerable amount of groundwater is

reportedly consumed by industrial firms privately, no data on the use of groundwater for industrial purpose were made available .

Taking the survey results into account, the industrial water demand is assumed to be 20% of the domestic water demand in both cities of Portoviejo and Manta, having a population more than 100,000. For municipalities with population of 5,000 - 100,000, industrial water is assumed to be 10% of the domestic water demand. For smaller towns, industrial water is not considered due to less possibility of future industrialization.

The total unit water demand for domestic and industrial uses thus calculated is also given in Table C.3.3(2).

### (3) Tourism Water Demand

Unit water demand for tourism population is estimated based on the domestic unit water demand.

## 3.5 Water Demand Forecast in the Service Area

Future water demand in the service area to be covered by the regional water supply system is estimated by each regional system and each municipality for the years of 2000, 2010 and 2020.

In the process of the forecast, the coverage rate, that is, percentage of population to be covered and served by the public regional water supply systems was projected, taking the current conditions into consideration, as follows:

System	Year	1990	2000	2010	2020
Poza Honda System		80%	85%	90%	95%
Estancilla System		70%	80%	90%	95%
Chone System		70%	80%	90%	95%

As a result of the demand forecast, water demand in the horizon year of 2020 in the whole service area, being consisted of the three regional water supply systems is estimated at:

- 512,290 m<sup>3</sup>/day (= 5.93 m<sup>3</sup>/sec) at Daily Average basis,
- 768,430 m<sup>3</sup>/day (= 8.89 m<sup>3</sup>/sec) at Daily Maximum basis, and
- 806,860 m<sup>3</sup>/day (= 9.34 m<sup>3</sup>/sec) in Treatment Plant capacity.

Breakdown of water demand forecast is given in Table C.3.4, and summarized as follows:

<u>Daily Average Water Demand</u>					
Regional Water Supply System	Water Demand (Daily Average)				
	Year	1990	2000	2010	2020
		m <sup>3</sup> /d	m <sup>3</sup> /d	m <sup>3</sup> /d	m <sup>3</sup> /d
Poza Honda System		89,950	155,470	252,730	395,800
Chone System		8,780	17,260	27,510	39,570
La Estancilla System		12,500	30,760	52,180	76,940
		m <sup>3</sup> /d	m <sup>3</sup> /d	m <sup>3</sup> /d	m <sup>3</sup> /d
Total (Daily Average)		111,230	203,480	332,420	512,290
	(m <sup>3</sup> /sec)	( 1.29 )	( 2.36 )	( 3.85 )	( 5.93 )
Unit Demand (l/person/d)		161	238	320	407

Daily Maximum Water Demand = (Daily Average ) x 150%

Regional Water Supply System	Water Demand (Daily Maximum)				
	Year	1990	2000	2010	2020
		m3/d	m3/d	m3/d	m3/d
Poza Honda System		134,930	233,200	379,090	593,680
Chone System		13,170	25,900	41,270	59,350
La Estancilla System		18,750	46,130	78,270	115,410
		m3/d	m3/d	m3/d	m3/d
Total (Daily Maximum)		166,850	305,230	498,630	768,430
	(m3/sec)	( 1.93 )	( 3.53 )	( 5.77 )	( 8.89 )
Unit Demand (l/person/d)		239	357	480	611

Treatment Plant Capacity = (Daily Maximum) x 1.05 %

Regional Water Supply System	Treatment Plant Capacity				
	Year	1990	2000	2010	2020
		m3/d	m3/d	m3/d	m3/d
Poza Honda System		141,670	244,860	398,040	623,360
Chone System		13,830	27,190	43,330	62,320
La Estancilla System		19,690	48,440	82,180	121,180
		m3/d	m3/d	m3/d	m3/d
Total (Treatment Plant)		175,190	320,490	523,560	806,860
	(m3/sec)	( 2.03 )	( 3.71 )	( 6.06 )	( 9.34 )

#### 4. SYSTEM EXPANSION PLAN

##### 4.1 General

The target for system expansion is set at the years of 2000, 2010 and 2020. The system expansion will be planned with consideration of effective use of the

existing facilities and the current CRM's development plan. The regional water supply systems are proposed to be expanded in the way described hereinafter. The expansion plan has been chiefly studied from a point of production/supply capacity of treatment plants. Needless to mention, other facilities such as conduction pipelines, pumping stations, service reservoirs, distribution networks, service pipes, etc. will have to be expanded in accordance with increase of supply capacity and service population.

The capacity to be expanded in the future years is summarized in Table C.4.1.

## **4.2 Poza Honda Water Supply System**

### **4.2.1 On-going plan**

CRM currently proceeds to construct two new treatment plants in the Poza Honda System.

They are:

i) Cuatro Esquinas Treatment Plant :

- Production capacity : 90,000 m<sup>3</sup>/day
- Supply area : Central part and eastern part of the system, majority to Portoviejo
- Plant location : Cuatro Esquinas in Portoviejo
- Water intake/source : Cuatro Esquinas / Portoviejo River
- Treatment process : Rapid sand filtration method
- Year of completion : 1993 (Scheduled)

and,

ii) El Ceibal Treatment Plant :

- Production capacity : 90,000 m<sup>3</sup>/day
- Supply area : Northern part and western part of the system, majority to Manta
- Plant location : El Ceibal in Rocafuerte
- Water intake/source : El Ceibal / Portoviejo River, downstream confluence with Chico River
- Treatment process : Rapid sand filtration method
- Year of completion : 1993 (Scheduled)



#### 4.2.2 Direction of the system expansion

In the future years, treatment plants and their service areas will be in principle as follows :

Treatment Plant	Service Area and Capacity Expansion
- Cuatro Esquinas	Service Area : Central/Eastern parts in the System ( Portoviejo, Rio-Chico, Pueblo-Nuevo, Alhajuella, Abdon-Calderon, San-Placido ) Capacity : 90,000 m <sup>3</sup> /d in 1993, to be expanded in future to large extent.
- El Ceibal	Service Area : Western/Northern parts in the System ( Manta, Jaramijo, Rocafuerte, Charapoto, San-Clemente, Crucita ) Capacity : 90,000 m <sup>3</sup> /d in 1993, to be expanded in future to large extent.
- Guarumo	Service Area : Southern part in the System ( Jipijapa, Sucre, Santa-Ana, Ayacucho, Honorato-Vasquez ) Capacity : 43,200 m <sup>3</sup> /d in 1991, future expansion not required.
- Caza Lagartos	Service Area : Western part in the System ( Montecristi and Manta ) Capacity : 20,000 m <sup>3</sup> /d in 1991, future expansion not required.

(Note 1):

Guarumo Plant (43,200 m<sup>3</sup>/d) is currently a key production source of the Poza Honda System and supplies to most part of the service area. In the future, after completion of the new plants of Cuatro Esquinas and El Ceibal, this Guarumo Plant will have a role of supply to southern part of the service area; namely, Jipijapa, Sucre, Santa-Ana, Ayacucho and Honorato-Vasquez. The plant would

not need to be expanded in capacity. The present conduction pipelines from the plant to Lodana via Santa Ana also would not need to be supplemented.

(Note 2):

Caza Lagartos Plant (20,000 m<sup>3</sup>/d) operated by EMAPAM was constructed for exclusive use in Manta area, including Montecristi. This plant will continue to supply to Manta area also in future years with present production capacity. Although the future demand for Manta area will surely exceed the capacity of Caza Lagartos Plant, the deficit will be covered by and supplied from El Ceibal Plant.

(Note 3):

In addition, there exist other two small treatment plants, namely, Las Pulgas Plant (3,000 m<sup>3</sup>/d) taking Portoviejo River water, located in Portoviejo City, and Los Bajos Plant (600 m<sup>3</sup>/d) taking groundwater in Montecristi City. They presently supplement to the system locally but effectively. However, their each capacity is comparatively small, and they would not be necessarily considered for the future system expansion planning from a viewpoint of supply capacity. They would have a role of local emergency/ supplementary source. Such local production source will be very useful in case of emergency, even with small capacity; therefore, they are recommended to remain as they are, as local emergency sources.

(Note 4):

Jipijapa is presently supplied from the Pajan System located south outside of the project area and operated by JRH; however, Jipijapa is to be connected to and included in the Poza Honda System by 1992. It is anticipated that Jipijapa will be supplied by both the Poza Honda System and the Pajan System for the time being during 1990's and finally be fully integrated into the Poza Honda System by the year 2000.

### 4.2.3 Expansion in future years

Production expansion in future years will be achieved in the following schedule:

Plant	Year	Production Capacity (Daily Maximum) m <sup>3</sup> /day		
		1993	1994-2000	2001-2010
Cuatro Esquinas	84,500	84,500 (No addition)	to 163,600 (Add 79,100)	to 272,300 (Add 108,700)
El Ceibal	85,500	85,500 (No addition)	to 152,300 (Add 66,800)	to 245,400 (Add 93,100)
Guarumo	43,200	43,200 (No addition)	43,200 (No addition)	43,200 (No addition)
Caza Lagartos	20,000	20,000 (No addition)	20,000 (No addition)	20,000 (No addition)
m <sup>3</sup> /d Total	m <sup>3</sup> /d 233,200	m <sup>3</sup> /d 233,200 (No addition)	m <sup>3</sup> /d 379,100 (Add 145,900)	m <sup>3</sup> /d 580,900 (Add 201,800)

A schematic layout of the Poza Honda System in the years of 2000, 2010 and 2020 is shown in Figs. C.4.1 to C.4.3. Conduction pipelines proposed for future years are listed in Table 4.2.

### 4.2.4 Water source

Present water source is the Poza Honda Dam, located upstream of the Portoviejo River. The capacity of the dam will be able to meet water supply demand up to the year around 2000; thereafter, however, a new water source should be developed for the Poza Honda System. It will be achieved by the transbasin from the existing Daule Peripa Dam Reservoir to the Portoviejo River basin. The any alternative transbasin plan is required to convey necessary quantity of raw water for the Poza Honda System, to the Portoviejo River, along which intake pumping stations for treatment plants will be constructed.

The Portoviejo River flow which should be secured for the purpose of water supply for the year 2020 is estimated as:

in the point of Portoviejo City, for Cuatro Esquinas Plant's intake,

- 286,000 m<sup>3</sup>/day ( = 3.31 m<sup>3</sup>/sec ) on the daily maximum basis ( equivalent to Cuatro Esquinas Treatment Plant capacity ), and,
- 69.6 MCM/year ( = 181,600 m<sup>3</sup>/day x 1.05 x 365 days ) on the daily average basis;

furthermore, in the point of downstream of the confluence with the Chico River, for El Ceibal Plant's intake,

- 257,700 m<sup>3</sup>/day ( = 2.98 m<sup>3</sup>/sec ) on the daily maximum basis ( equivalent to El Ceibal Treatment Plant capacity ), and,
- 62.7 MCM/year ( = 163,600 m<sup>3</sup>/day x 1.05 x 365 days ) on the daily average basis.

### **4.3 Chone-Estancilla Water Supply System**

#### **4.3.1 Integration of the two systems**

The Chone System and the La Estancilla System are currently being operated independently, having respective water source/ treatment plant; that is, Chone Plant by the Chone River and La Estancilla Plant by the Carrizal River. The both rivers, however, has little natural run-off in dry seasons; unless new additional water source would be available, water supply capacity could not be increased in the future.

For the purpose of water resource development in the Carrizal River basin, it is scheduled that a new dam, the La Esperanza Dam be constructed in the near future. The dam water to be released into the Carrizal River will be able to supply the both water supply systems. As far as the Chone River basin would not be developed, the future water demand increase in the Chone System would have to depend on the Carrizal River to be fed by the new dam. Accordingly, the Chone System would have to receive water from the La Estancilla System. It is thus proposed that the Chone System be integrated with the La Estancilla System by a pipeline connection to receive treated water through La Estancilla Plant.

(Note 1):

The present water source of the Chone System is the natural run-off of the Chone River. It is anticipated, however, that the water demand of the system will exceed the available run-off of the river in the near future. The daily maximum water demand will be 25,900 m<sup>3</sup>/day (0.30 m<sup>3</sup>/sec) in the year 2000, 41,300 m<sup>3</sup>/day (0.48 m<sup>3</sup>/sec) in 2010 and 59,300 m<sup>3</sup>/day (0.69 m<sup>3</sup>/sec) in 2020, while the available river run-off with 95% guarantee is estimated to be less than 0.1 m<sup>3</sup>/sec (8,640 m<sup>3</sup>/day) during the dry season.

(Note 2):

The present Estancilla System depends in its water source on the run-off of the Carrizal River. The river run-off at La Estancilla with 95% guarantee is estimated at 0.2 - 0.3 m<sup>3</sup>/sec during the dry season. Water demand, on the other hand, will increase, in the daily maximum demand basis, to 46,100 m<sup>3</sup>/day (0.53 m<sup>3</sup>/sec) in the year 2000, 78,300 m<sup>3</sup>/day (0.91 m<sup>3</sup>/sec) in 2010 and 115,400 m<sup>3</sup>/day (1.34 m<sup>3</sup>/sec) in 2020. This means that water demand will exceed the available river run-off in the near future.

(Note 3):

In case the Chone River basin would be developed in future by a new dam, the Rio Grande Dam for an example, the Chone System would not need to depend on the La Estancilla System. That case would give an easier solution to the Chone System.

#### 4.3.2 Direction of the system expansion

In the future years, treatment plants and their service areas will be in principle as follows :

Treatment Plant	Service Area and Capacity Expansion	
- La Estancilla	Service Area	: Calceta, Junin, Canuto, Tosagua, La Estancilla, Bachillero, Bahia de Caraquez, San Vicente, Napo, Chone, San Antonio
	Capacity	: 9,000 m <sup>3</sup> /d in 1991, to be expanded in 1992 to 27,000 m <sup>3</sup> /d, and in a future to large extent.
- Chone	Service Area	: Chone
	Capacity	: 10,600 m <sup>3</sup> /d in 1991, future expansion not required.

### 4.3.3 Expansion in future years

Production expansion in future years is proposed in the following schedule:

Year	Production Capacity (Daily Maximum) m <sup>3</sup> /day			
	1993	1994-2000	2001-2010	2011-2020
<b>Plant</b>				
La Estancilla	27,000	to 61,400	to 108,900	to 164,200
	(Additional 34,400)	(Add 47,500)	(Add 55,300)	
Chone	10,600	10,600	10,600	10,600
	(No addition)	(No addition)	(No addition)	
<b>Total</b>	<b>37,600</b>	<b>72,000</b>	<b>119,500</b>	<b>174,800</b>
	(Additional 34,400)	(Add 47,500)	(Add 55,300)	

A schematic layout of the Chone-Estancilla System in the years of 2000, 2010 and 2020 is shown in Figs. C.4.4 to C.4.6, respectively. Conduction pipelines proposed for future years are listed in Table 4.2.

### 4.3.4 Water source

Present water source is the Carrizal River for La Estancilla Plant and the Chone River for Chone Plant. The both rivers have natural run-off only meeting the existing treatment plants' capacity during dry seasons; being insufficient for future demand increase. The increasing water demand in the Chone-Estancilla System is proposed to be taken from the Carrizal River, through La Estancilla Plant, while Chone Plant will be operated with the present capacity, taking raw water from the Chone River run-off, as it is. An additional water source, therefore, should be developed for future water supply. It will be secured by completion of the proposed La Esperanza Dam, located upstream of the Carrizal River. Water released from the dam will flow to the Carrizal River along which an intake pumping station for La Estancilla Plant is located.

The Carrizal River flow which should be guaranteed for the purpose of water supply for the year 2020 is estimated at:

- 172,400 m<sup>3</sup>/day ( = 2.00 m<sup>3</sup>/sec ) on the daily maximum basis ( equivalent to La Estancilla Treatment Plant capacity ),
- and,
- 41.9 MCM/year ( = 109,400 m<sup>3</sup>/day x 1.05 x 365 days ) on the daily average basis.

## 5. SYSTEM EXPANSION COST

The system expansion cost is estimated as breakdown in Tables C.5.1 and C.5.2. The cost, consisting of costs for construction, administration, engineering and contingencies, as of the year 1991 price, is summarized below.

( 1991 Price )			
System to be Expanded	Expansion Years	Local Currency portion Million x S/.	Foreign Currency portion (1,000 x US\$ )
Poza Honda System	( 1994-2000 )	34,980	+ 31,594
- ditto -	( 2001-2010 )	91,829	+ 87,272
- ditto -	( 2011-2020 )	146,615	+ 152,425
Total of Poza Honda System		273,424	+ 271,291
Chone-Estancilla System	( 1994-2000 )	30,022	+ 35,040
- ditto -	( 2001-2010 )	39,976	+ 42,475
- ditto -	( 2011-2020 )	37,452	+ 37,600
Total of Chone-Estancilla System		107,450	+ 115,115
		( Million x S/.)	( 1,000 x US\$ )
Grand Total of Poza Honda System and Chone-Estancilla System		380,874	+ 386,406

(Note):

Foreign Exchange Rate : US\$ 1.00 = S/.1,150- (November 1991)

## 6. WATER PRICE

The unit cost of water production is tentatively estimated at S/.450- /m<sup>3</sup>, as of 1991's price (Refer to Table C.6.1), as summarized below :

1) Facilities' depreciation cost	= S/. 185.8 /m <sup>3</sup>
2) Facilities' repair cost	= S/. 57.0 /m <sup>3</sup>
3) Operation and maintenance cost	= S/. 108.2 /m <sup>3</sup>
4) Administration cost (25%)	= S/. 87.8 /m <sup>3</sup>

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Total = S/. 438.8 /m<sup>3</sup>  
Say, S/. 450- /m<sup>3</sup>

(Note 1):

The above does not include the raw water cost ( consisting of water source development cost, raw water transmission facilities cost, operation and maintenance cost of raw water, etc. on raw water supply ). Water sales price, therefore, is recommended to include the raw water cost, in addition to the above production cost, as far as water supply system business is based on the self-supporting concept.

(Note 2):

For reference, the present water tariff of CRM is given below. The domestic use rate is judged comparatively low; which is considered not to reflect the actual production cost, but to depend on the public policy.

### Water Tariff Table

( Valid from : October 1991, CRM )

Water Use ( m <sup>3</sup> /month )	Water Tariff ( S/. per m <sup>3</sup> )		
	Domestic	Commercial	Industrial
0 - 10 m <sup>3</sup>	25	150	500
11 - 25 m <sup>3</sup>	30	190	500
26 - 50 m <sup>3</sup>	66	250	500
51 - 100 m <sup>3</sup>	90	325	500
101 - 500 m <sup>3</sup>	120	425	500
501 -1000 m <sup>3</sup>	150	500	500

Source : CRM (Oct. 1991)



## 7. WATER SALES

By the analysis of the recent records on water sales of the Poza Honda System operated by CRM, the following figures were found:

- (1) Number of connections as of April 1991 totaled 19,909, as brokendown below:  
(Refer to Table C.7.1.)

- Domestic -----	19,742 Nos.	( 99.16 % )
- Industry/Commercial -----	65 "	( 0.33 % )
- Preference (*1) -----	98 "	( 0.49 % )
- Especial (*2) -----	4 "	( 0.02 % )
<hr/>		
Total	19,909 Nos.	( 100.0 % )

(Note): (\*1): School, University, Institute, Hospital,  
Military complex, Sport stadium,  
Police station, Prison, etc.

(\*2): Small towns such as Valdez, Sosote  
and San Francisco.

- (2) During the year 1990, from January to December, the sold water amounted 6,471,311 m<sup>3</sup>; of which domestic use shared 5,928,491 m<sup>3</sup>, that was 93.1% (91.6%+1.5%) of the total, as brokendown below:  
(Refer to Table C.7.2.)

Domestic -----	5,928,491m <sup>3</sup> /year	( 91.6 % )
Industry/Commercial -----	349,105 "	( 5.4 % )
Preference -----	96,620 "	( 1.5 % )
Especial (for domestic) --	99,095 "	( 1.5 % )
<hr/>		
Total	6,473,311m <sup>3</sup> /year	( 100 % )

(Note): Especial : Domestic use in small towns.

- (3) Rate of the billed water was 55.3 % in the year 1990 (Jan.-Dec.), remaining the unaccounted for water rate of 44.7 %.

(Note):

The billed water totaled 6,473,311 m<sup>3</sup>/year in the year 1990. On the other hand, production of treatment plants amounted 11,715,000 m<sup>3</sup>/year in the same period. Thus, the rate of the billed water was  $6,473,311 / 11,715,000 \text{ m}^3 = 55.3\%$ .

(Refer to Table C.7.2.)

- (4) The annual income of CRM by sale of water amounted S/.125,043,526 in the year 1990. The unit price of the sold water was S/.19.32 /m<sup>3</sup> in the average.(Refer to Table C.7.2.)
- (5) In October 1991, the water tariff was revised as shown in Table C.6.1. By the new tariff, the unit sales price is estimated at S/.86.76 /m<sup>3</sup> on the average. (Refer to Table C.7.3.)

## **T A B L E S**





Table C.3.1 Population Projection in the Service Area (1/2)

Municipality by System	Population				
	Year	1990	2000	2010	2020
<u>Poza Honda System</u>					
Honorato Vasquez		7,478	7,478	7,478	7,478
Ayacucho		7,159	7,267	7,267	7,267
Santa Ana		6,368	6,828	7,141	7,322
- do - Periferia		15,364	15,753	15,832	15,832
Sucre		4,442	4,883	5,261	5,558
- do - Periferia		10,471	10,471	10,471	10,471
Jipijapa		32,225	39,090	46,495	54,226
- do - Periferia		10,004	11,485	12,812	14,083
Portoviejo		132,937	179,525	237,775	308,854
do - Periferia		20,528	20,528	20,528	20,528
Rio Chico		9,542	13,395	18,444	24,908
Pueblo Nuevo		2,736	3,067	3,371	3,633
Abdon Calderon		12,066	14,073	16,092	17,952
Alhajuela		7,029	7,029	7,029	7,029
San Placido		9,006	9,006	9,006	9,006
Rocafuerte		6,958	7,461	7,842	8,080
- do - Periferia		19,063	20,953	22,579	23,852
Charapoto		14,370	17,261	20,330	23,478
Crucita		8,268	11,833	16,611	22,872
Montecristi		9,642	11,697	13,913	16,226
- do - Periferia		19,994	23,549	27,195	30,792
Manta		125,505	163,660	209,294	261,742
do - Periferia		4,184	5,595	7,338	9,439
Jaramijo		8,024	10,322	13,021	16,108
Poza Honda System Total		503,363	622,209	763,125	926,736
<u>Chone System</u>					
Chone		41,439	52,271	64,661	78,436
- do - Periferia		22,359	22,691	22,691	22,691
San Antonio		6,859	7,120	7,120	7,120
Chone System Total		70,657	82,082	94,472	108,247

Table C.3.1 Population Projection in the Service Area (2/2)

Municipality by System	Population				
	Year	1990	2000	2010	2020
<u>La Estancilla System</u>					
Calceta		12,122	15,700	19,355	23,295
- do - Periferia		17,818	18,507	18,509	18,509
Junin		3,870	4,514	5,162	5,787
- do - Periferia		14,122	14,122	14,122	14,122
Canuto		9,815	9,914	9,914	9,914
La Estancilla		5,137	5,137	5,137	5,137
Tosagua		7,074	9,647	12,908	16,924
do - Periferia		15,859	19,238	22,883	26,688
Bachillero		3,708	5,056	6,762	8,869
Bahia de Caraquez		15,208	19,691	24,840	30,728
do - Periferia		6,113	9,910	15,762	24,595
San Vincente		12,612	18,579	26,848	38,055
Estancilla System Total		123,458	150,015	182,202	222,623
Grand Total ( Whole Service Area )		697,478	854,306	1,039,799	1,257,606

Table C.3.2 Tourism Population

Year	Tourism Population ( Persons/day )			
	1990	2000	2010	2020
Crucita	500	1,190	1,900	2,822
Charapoto	1,427	3,514	5,690	8,450
- San Clemente	283	1,134	1,890	2,811
- San Jacinto Norte	572	1,190	1,900	2,822
- San Jacinto Sur	572	1,190	1,900	2,822
Manta	2,672	6,891	9,247	9,247
- Los Esteros	1,086	2,544	3,478	3,478
- Tarqui	1,086	2,917	3,889	3,889
- El Murcielago	500	1,410	1,880	1,880
Bahia	8,830	46,005	57,444	58,355
- San Vicente	6,410	12,820	12,820	12,820
- Bahia de Caraquez	283	1,134	1,890	2,811
- Napo	2,137	32,051	42,734	42,734
<b>Total</b>	<b>13,429</b>	<b>57,600</b>	<b>74,281</b>	<b>78,874</b>

Source : PHIMA



Table C.3.3(1) Unit Water Demand (Target)

Population	( Daily Average Basis )		
	Unit Water Demand ( l/person/day )		
	Domestic Use (Target)	Industrial Use	Total (Target)
Less than 1,000	150	-	150
1,000 - 5,000	180	-	180
5,000 - 20,000	225	23	248
20,000 - 50,000	300	30	330
50,000 - 100,000	375	38	413
100,000 and more	450	90	540

Source : IEOS, 1991

(Note) :

- To be applied in the hotter zones, annual mean temperature in which exceeds 18 degree centigrade (C), such as the Manabi Province ( 25.9 C of annual mean temperature in Portoviejo ).
- Including commercial use water.
- Including water loss and unaccounted-for water in the system.
- Daily maximum demand = 150% of the daily average demand.

Table C.3.3(2) Unit Water Demand (Proposed)

Population	( Daily Average Basis )			
	Unit Water Demand ( l/person/day )			
	Year 1990 (55%)	Year 2000 (70%)	Year 2010 (85%)	Year 2020 (100%)
Less than 1,000	83	105	128	150
1,000 - 5,000	99	126	153	180
5,000 - 20,000	136	173	210	248
20,000 - 50,000	182	231	281	330
50,000 - 100,000	227	289	351	413
100,000 and more	297	378	459	540

Source : PHIMA, 1991

(Note) :

- To be applied for projection in the service area.
- Including commercial use water.
- Including water loss and unaccounted-for water in the system.
- Daily maximum demand = 150% of the daily average demand.

Table C.3.4 Water Demand Projection (1/3)

Municipality by System	Daily Average Demand (m <sup>3</sup> /day)				
	Year	1990	2000	2010	2020
<u>Poza Honda System</u>					
Honorato Vasquez		814	1,100	1,413	1,762
Ayacucho		779	1,069	1,373	1,712
Santa Ana		693	1,004	1,350	1,725
- do - Periferia		1,672	2,316	2,992	3,730
Sucre		352	718	994	1,309
- do - Periferia		830	1,121	1,979	2,467
Jipijapa		4,691	7,676	11,759	21,276
- do - Periferia		1,088	1,689	2,421	3,318
Portoviejo		31,586	57,681	98,225	158,442
- do - Periferia		2,989	4,031	5,192	6,436
Rio Chico		1,038	1,970	3,486	7,809
Pueblo Nuevo		217	328	637	856
Abdon Calderon		1,313	2,070	3,041	4,229
Alhajuela		765	1,034	1,328	1,656
San Placido		979	1,324	1,702	2,122
Rocafuerte		757	1,098	1,482	1,904
- do - Periferia		2,074	3,081	4,267	5,620
Charapoto		1,563	2,538	5,141	7,360
Turismo					
- San Clemente		34	174	306	481
- San Jacinto Norte		69	182	308	483
- San Jacinto Sur		69	182	308	483
Crucita		899	1,740	3,139	7,170
Turismo - Crucita		60	182	308	483
Montecristi		1,049	1,720	2,630	3,823
- do - Periferia		2,175	3,462	5,140	7,255
Manta		29,819	52,584	86,459	134,274
- do - Periferia		331	821	1,387	2,224
Turismo					
- Los Esteros		156	389	563	595
- Tarqui		156	446	630	665
- El Murcielago		60	216	305	321
Jaramijo		873	1,518	2,461	3,795
<u>Poza Honda System</u>					
<b>Total</b>		<b>89,951</b>	<b>155,466</b>	<b>252,726</b>	<b>395,785</b>

Table C.3.4 Water Demand Projection (2/3)

Municipality by System	Year	Daily Average Demand (m <sup>3</sup> /day)			
		1990	2000	2010	2020
<u>Chone System</u>					
Chone		5,279	12,085	20,426	30,774
- do - Periferia		2,849	4,193	5,739	7,114
San Antonio		653	985	1,346	1,677
Chone System Total		8,781	17,263	27,511	39,565
<u>Estancilla System</u>					
Calceta		1,154	2,173	3,658	7,303
- do - Periferia		1,696	2,561	3,498	4,361
Junin		268	455	976	1,363
- do - Periferia		979	1,954	2,669	3,327
Canuto		934	1,372	1,874	2,336
La Estancilla		489	711	971	1,210
Tosagua		673	1,335	2,440	3,987
- do - Periferia		1,510	2,663	4,325	6,288
Bachillero		257	700	1,278	2,090
Bahia de Caraquez		1,448	2,725	6,282	9,663
- do - Periferia		582	1,372	2,979	7,711
Turismo					
- Bahia de Caraquez		30	163	306	481
- Napo		269	7,692	11,538	12,179
San Vicente		1,201	2,571	6,790	11,930
Turismo - S. Vinc.		1,010	2,308	2,596	2,740
Estancilla System Total		12,500	30,755	52,180	76,939

Table C.3.4 Water Demand Projection (3/3)

Grand Total

Daily Average Water Demand

Year	1990	2000	2010	2020
Total (Daily Average)	111,232	203,484	332,417	512,289
(m3/sec)	( 1.29 )	( 2.36 )	( 3.85 )	( 5.93 )
Unit Demand (l/person/d)	161	238	320	407

Daily Maximum Water Demand = (Daily Average ) x 150%

	m3/d	m3/d	m3/d	m3/d
Total (Daily Maximum)	166,848	305,226	498,626	768,434
(m3/sec)	( 1.93 )	( 3.53 )	( 5.77 )	( 8.89 )
Unit Demand (l/person/d)	239	357	480	611

Treatment Plant Capacity = (Daily Maximum) x 1.05 %

	m3/d	m3/d	m3/d	m3/d
Total (Treatment Plant)	175,190	320,487	523,557	806,856
(m3/sec)	( 2.03 )	( 3.71 )	( 6.06 )	( 9.34 )

Table C.4.1 Capacity Expansion Schedule (1/2)

Unit : m3/day )

Year/Period	Existing Capacity 1991	Capacity to be Supplemented		
		1993-2000	2001-2010	2011-2020
<b>Poza Honda System</b>				
Daily Average	44,533	+110,931	+97,262	143,059
" (Accumulated)	(44,533)	(155,464)	(252,726)	(395,785)
Daily Maximum	66,800	+166,399	+145,890	+214,589
" (Accumulated)	(66,800)	(233,199)	(379,089)	(593,678)
Treatment Plant	66,800	+178,059	+153,184	+225,318
" (Accumulated)	(66,800)	(244,859)	(398,043)	(623,361)
<b>La Estancilla System</b>				
Daily Average	18,000	+12,755	+21,425	+24,759
" (Accumulated)	(18,000)	(30,755)	(52,180)	(76,939)
Daily Maximum	27,000	+19,132	+32,138	+37,139
" (Accumulated)	(27,000)	(46,132)	(78,270)	(115,409)
Treatment Plant	27,000	+21,439	+33,745	+38,995
" (Accumulated)	(27,000)	(48,439)	(82,184)	(121,179)
<b>Chone System</b>				
Daily Average	7,067	+10,196	+10,248	+12,054
" (Accumulated)	(7,067)	(17,263)	(27,511)	(39,565)
Daily Maximum	10,600	+15,295	+15,372	+18,081
" (Accumulated)	(10,600)	(25,895)	(41,267)	(59,348)
Treatment Plant	10,600	+16,590	+16,110	+18,985
" (Accumulated)	(10,600)	(27,190)	(43,330)	(62,315)

Table C.4.1 Capacity Expansion Schedule (2/2)

( Unit : m3/day )

Year/Period	Existing Capacity 1991	Capacity to be Supplemented		
		1993-2000	2001-2010	2011-2020
<b>Total ((Poza Honda) + (La Estancilla) + (Chone))</b>				
Daily Average	69,600	+133,884	+128,933	+179,872
" (Accumulated)	(69,600)	(203,484)	(332,417)	(512,289)
Daily Maximum	104,400	+200,826	+193,400	+269,808
" (Accumulated)	(104,400)	(305,226)	(498,626)	(768,434)
Treatment Plant	104,400	+216,087	+203,070	+283,299
" (Accumulated)	(104,400)	(320,487)	(523,557)	(806,856)
<b>(Reference)</b>				
<b>Total of (Chone + Estancilla) System</b>				
Daily Average	25,067	+22,951	+31,673	+36,813
" (Accumulated)	(25,067)	(48,018)	(79,691)	(116,504)
Daily Maximum	37,600	+34,472	+47,510	+55,220
" (Accumulated)	(37,600)	(72,027)	(119,537)	(174,757)
Treatment Plant	37,600	+38,029	+49,855	+57,980
" (Accumulated)	(37,600)	(75,629)	(125,514)	(183,494)

Table C.4.2 List of Conduction Pipelines Proposed

Poza Honda System

Route of Pipeline	Distance Years	Diameter to be Supplemented		
		1994-2000	2001-2010	2011-2020
	(km)	(mm)	(mm)	(mm)
C. Esquinas - Portoviejo	5.0	800	900	1,000
Portoviejo - Junction	10.0	400	200	350
Junction - Junction	2.5	350	300	-
Junction - Calderon	4.0	350	-	200
Calderon - Alhajuela	8.0	250	-	200
Alhajuela - San Placido	4.0	200	-	150
Junction - Pueblo Nuevo	8.5	150	-	150
Junction - Rio Chico	5.0	-	250	250
River Intake - El Ceibal	2.2	800	800	800
El Ceibal - Junction	22.5	800	800	800
Junction - Manta	9.0	800	800	800
Junction - Jaramijo	3.3	-	250	150
El Ceibal - Crucita	14.0	300	-	300
El Ceibal - Rocafuerte	5.0	400	300	350
Rocafuerte - Charapato	17.6	-	350	250
Charapato - San Clemente	13.0	-	150	-
Lodana - Junction	3.6	350	400	400
Junction - Sucre	13.0	-	250	-
Junction - Jipijapa	29.5	-	400	400

Chone-Estancilla System

Route of Pipeline	Distance Years	Diameter to be Supplemented		
		1994-2000	2001-2010	2011-2020
	(km)	(mm)	(mm)	(mm)
La Estancilla - Tosagua	5.2	500	600	700
Tosagua - Bachillero	4.2	500	350	500
Bachillero - San Antonio	10.5	500	350	500
San Antonio - Chone	9.0	400	400	500
La Estancilla - Calceta	9.0	350	300	350
Calceta - Canuto	7.0	200	-	-
Calceta - Junin	13.0	200	250	-
Tosagua - Junction	8.4	-	400	500
Junction - B.d.Caraquez	26.5	-	-	250
Junction - San Vicente	36.5	400	500	-
San Vicente - Napo	5.0	350	350	-

Table C.5.1(1) Cost Estimate of Water Supply System Expansion  
Poza Honda System ( Year : 1994-2000 )

( 1991 Price )						
Work Item	Unit	Q'ty	Unit Cost		Amount	
			Local (1,000S/.)	Foreign (US\$)	Local (Million S/.)	Foreign (1,000US\$)
<b>A. Direct Cost</b>						
(1) Preparatory work (10% of (2) to (6))					2,033	1,974
(2) Treatment plant						
(- El Ceibal Plant	m <sup>3</sup> /d	89,800 )*			(-)*	(-)*
(- 4 Esquinas Plant	m <sup>3</sup> /d	88,700 )*			(-)*	(-)*
(3) Conduction pipeline						
(- Dia. 800 mm	m	38,700 )*			(-)*	(-)*
- Dia. 400 mm	m	15,000	67	139	1,005	2,085
- Dia. 350 mm	m	10,100	56	118	566	1,192
- Dia. 300 mm	m	14,000	46	97	644	1,358
- Dia. 250 mm	m	8,000	37	77	296	616
- Dia. 200 mm	m	2,000	28	57	56	114
- Dia. 150 mm	m	8,500	21	44	179	374
- Others (10% of (3))			275	574		
(4) Pumping station	kh	3,350	1,520	1,640	5,092	5,494
(5) Service reservoir	m <sup>3</sup>	36,700	00	21	3,670	771
(6) Distribution network	m <sup>3</sup> /d	115,500	74	62	8,547	7,161
(7) Miscellaneous (10% of (2) to (6))					2,033	1,974
<b>Total of A</b>					<b>24,396</b>	<b>23,687</b>
<b>B. Administration cost</b> (5% of A)			L.S.		2,641	-
<b>C. Engineering cost</b> (10% of A)			L.S.		2,113	2,641
<b>D. Contingencies</b> (20% of A+B+C)			L.S.		5,830	5,266
<b>Grand Total (Poza Honda System, Year: 1994-2000 )</b>					<b>34,980</b>	<b>31,594</b>

(Note): The item marked with (-)\* has been already financed and being under construction as of 1991; hence, the cost is excluded from this table.

(Note): Foreign Exchange Rate : US\$ 1.00 = S/.1,150- (November 1991)



Table C.5.1(2) Cost Estimate of Water Supply System Expansion  
Poza Honda System ( Year : 2001-2010 )

( 1991 Price )						
Work Item	Unit	Q'ty	Unit Cost		Amount	
			Local (1,000S/.)	Foreign (US\$)	Local (Million S/.)	Foreign (1,000US\$)
<b>A. Direct Cost</b>						
(1) Preparatory work (10% of (2) to (6))					5,309	5,467
(2) Treatment plant						
- El Ceibal Plant	m3/d	70,100	96	44	6,730	3,084
- 4 Esquinas Plant	m3/d	83,100	96	44	7,978	3,656
(3) Conduction pipeline						
- Dia. 900 mm	m	5,000	271	522	1,355	2,610
- Dia. 800 mm	m	33,700	231	444	7,785	14,963
- Dia. 400 mm	m	33,100	67	139	2,218	4,601
- Dia. 350 mm	m	17,600	56	118	986	1,707
- Dia. 300 mm	m	7,500	46	97	345	728
- Dia. 250 mm	m	21,300	37	77	788	1,640
- Dia. 200 mm	m	10,000	28	57	280	570
- Dia. 150 mm	m	13,000	21	44	273	572
- Others (10% of (3))				1,403	2,739	
(4) Pumping station	kh	4,440	1,520	1,640	6,749	7,282
(5) Service reservoir	m3	48,600	100	21	4,860	1,021
(6) Distribution network	m3/d	153,200	74	62	11,337	9,498
(7) Miscellaneous (10% of (2) to (6))					5,519	5,878
<b>Total of A</b>					<b>63,705</b>	<b>65,605</b>
<b>B. Administration cost</b> (5% of A)			L.S		7,122	-
<b>C. Engineering cost</b> (10% of A)			L.S		5,696	7,122
<b>D. Contingencies</b> (20% of A+B+C)			L.S		15,305	14,545
<b>Grand Total (Poza Honda System, Year: 2000-2010 )</b>					<b>91,829</b>	<b>87,272</b>

(Note): Foreign Exchange Rate : US\$ 1.00 = S/.1,150- (November 1991)

Table C.5.1(3) Cost Estimate of Water Supply System Expansion  
Poza Honda System ( Year : 2011-2020 )

							( 1991 Price )		
Work Item	Unit	Q'ty	Unit Cost		Amount		Local (Million S/.)	Foreign (1,000US\$)	
			Local (1,000S/.)	Foreign (US\$)	Local (Million S/.)	Foreign (1,000US\$)			
<b>A. Direct Cost</b>									
(1) Preparatory work (10% of (2) to (6))						8,391	9,590		
(2) Treatment plant									
- El Ceibal Plant	m3/d	97,800	96	44	9,389		4,303		
- 4 Esquinas Plant	m3/d1	14,200	96	44	10,963		5,025		
(3) Conduction pipeline									
- Dia. 1,000 mm	m	50,000	316	605	15,800		30,250		
- Dia. 800 mm	m	33,700	231	444	7,785		14,963		
- Dia. 400 mm	m	33,100	67	139	2,218		4,601		
- Dia. 350 mm	m	15,000	56	118	840		1,770		
- Dia. 300 mm	m	14,000	46	97	644		1,358		
- Dia. 250 mm	m	34,600	37	77	1,280		2,664		
- Dia. 150 mm	m	15,800	21	44	332		695		
- Others (10% of (3))					2,890		5,630		
(4) Pumping station	kh	6,150	1,520	1,640	9,348		10,086		
(5) Service reservoir	m3	67,300	100	21	6,730		1,413		
(6) Distribution network	m3/d	212,000	74	62	15,688		13,144		
(7) Miscellaneous (10% of (2) to (6))					8,391		9,590		
<b>Total of A</b>						100,689	115,082		
<b>B. Administration cost</b> (5% of A)			L.S.			11,939	-		
<b>C. Engineering cost</b> (10% of A)			L.S.			9,551	11,939		
<b>D. Contingencies</b> (20% of A+B+C)			L.S.			24,436	25,404		
<b>Grand Total (Poza Honda System, Year: 2010-2020 )</b>							<b>146,615</b>	<b>152,425</b>	

(Note): Foreign Exchange Rate : US\$ 1.00 = S/.1,150- (November 1991)

Table C.5.2(1) Cost Estimate of Water Supply System Expansion  
Chone-Estancilla System ( Year : 1994-2000 )

( 1991 Price )							
Work Item	Unit	Q'ty	Unit Cost		Amount		
			Local (1,000S/.)	Foreign (US\$)	Local (Million S/.)	Foreign (1,000US\$)	
<b>A. Direct Cost</b>							
(1) Preparatory work (10% of (2) to (6))					1,693	2,216	
(2) Treatment plant							
- Estancilla Plant	m3/d	36,100	96	44	3,466	1,588	
(3) Conduction pipeline							
- Dia. 500 mm	m	19,900	90	186	1,791	3,701	
- Dia. 400 mm	m	45,500	67	139	3,049	6,325	
- Dia. 350 mm	m	14,000	56	118	784	1,652	
- Dia. 200 mm	m	20,000	28	57	560	1,140	
- Others (25% of (3))					1,546	3,205	
(4) Pumping station	kh	1,260	1,520	1,640	1,915	2,066	
(5) Service reservoir	m3	11,500	100	21	1,150	242	
(6) Distribution network	m3/d	36,100	74	62	2,671	2,238	
(7) Miscellaneous (10% of (2) to (6))					1,539	1,895	
Total of A					20,318	26,589	
B. Administration cost (5% of A)		L.S.			2,611	-	
C. Engineering cost (10% of A)		L.S.			2,089	2,611	
D. Contingencies (20% of A+B+C)		L.S.			5,004	5,840	
<b>Grand Total (Chone-Estancilla System, Year:1994-2000)</b>					<b>30,022</b>	<b>35,040</b>	

(Note): Foreign Exchange Rate : US\$ 1.00 = S/.1,150- (November 1991)

Table C.5.2(2) Cost Estimate of Water Supply System Expansion  
Chone-Estancilla System ( Year : 2001-2010 )

( 1991 Price )						
Work Item	Unit	Q'ty	Unit Cost		Amount	
			Local (1,000S/.)	Foreign (US\$)	Local (Million S/.)	Foreign (1,000US\$)
<b>A. Direct Cost</b>						
(1) Preparatory work (10% of (2) to (6))					2,154	2,681
(2) Treatment plant						
- Estancilla Plant	m3/d	49,900	96	44	4,790	2,196
(3) Conduction pipeline						
- Dia. 600 mm	m	5,200	116	240	603	1,248
- Dia. 500 mm	m	36,500	90	186	3,285	6,789
- Dia. 400 mm	m	17,400	67	139	1,166	2,419
- Dia. 350 mm	m	19,700	56	118	1,103	2,325
- Dia. 300 mm	m	9,000	46	97	414	873
- Dia. 250 mm	m	13,000	37	77	481	1,001
- Others (25% of (3))					1,763	3,664
(4) Pumping station	kh	1,750	1,520	1,640	2,660	2,870
(5) Service reservoir	m3	15,800	100	21	1,580	332
(6) Distribution network	m3/d	49,900	74	62	3,693	3,094
(7) Miscellaneous (10% of (2) to (6))					2,154	2,681
<b>Total of A</b>					<b>25,846</b>	<b>32,173</b>
<b>B. Administration cost</b> (5% of A)			L.S.		3,223	-
<b>C. Engineering cost</b> (10% of A)			L.S.		2,578	3,223
<b>D. Contingencies</b> (20% of A+B+C)			L.S.		6,329	7,079
<b>Grand Total (Chone-Estancilla System, Year:2001-2010)</b>					<b>39,976</b>	<b>42,475</b>

(Note): Foreign Exchange Rate : US\$ 1.00 = S/1,150- (November 1991)

Table C.5.2(3) Cost Estimate of Water Supply System Expansion  
Chone-Estancilla System ( Year : 2011-2020 )

( 1991 Price )						
Work Item	Unit	Q'ty	Unit Cost		Amount	
			Local (1,000S/.)	Foreign (US\$)	Local (Million S/.)	Foreign (1,000US\$)
<b>A. Direct Cost</b>						
(1) Preparatory work (10% of (2) to (6))					2,152	2,362
(2) Treatment plant - Estancilla Plant	m3/d	58,000	96	44	5,568	2,552
(3) Conduction pipeline						
- Dia. 700 mm	m	5,200	195	371	1,014	1,929
- Dia. 500 mm	m	32,100	90	186	2,889	5,971
- Dia. 350 mm	m	9,000	56	118	504	1,062
- Dia. 250 mm	m	26,500	37	77	981	2,041
- Others (25% of (3))					1,347	2,751
(4) Pumping station	kh	2,030	1,520	1,640	3,086	3,329
(5) Service reservoir	m3	18,400	100	21	1,840	386
(6) Distribution network	m3/d	58,000	74	62	4,292	3,596
(7) Miscellaneous (10% of (2) to (6))					2,152	2,362
<b>Total of A</b>					<b>25,825</b>	<b>28,341</b>
<b>B. Administration cost</b> (5% of A)					2,992	-
<b>C. Engineering cost</b> (10% of A)					2,393	2,992
<b>D. Contingencies</b> (20% of A+B+C)					6,242	6,267
<b>Grand Total (Chone-Estancilla System, Year:2011-2020)</b>					<b>37,452</b>	<b>37,600</b>

(Note): Foreign Exchange Rate : US\$ 1.00 = S/.1,150- (November 1991)

Table C.6.1 Water Production Cost Estimate

( 1991 Price )

(1) Tentative Estimate of Facilities' Depreciation Cost

$$\begin{aligned} \text{Total Project cost} &= \text{S}/.380,874,000,000 + \text{US\$ } 386,406,000 \\ &= \text{S}/.380,874,000,000 + \text{S}/.444,367,000,000 \\ &\quad (\text{at US\$1.00}=\text{S}/.1,150-) \\ &= \text{S}/.825,241,000,000 \dots\dots\dots (P) \end{aligned}$$

$$\begin{aligned} \text{Incremental capacity} &= (\text{Total capacity}) - (\text{Existing capacity}) \\ &= ( 512,290 - 164,533 ) \text{ m}^3/\text{day (Daily Average)} \times 365 \text{ days} \\ &= 126,931,000 \text{ m}^3/\text{year} \dots\dots\dots (Q) \end{aligned}$$

$$\begin{aligned} \text{Depreciation period} &= 35 \text{ years} \dots\dots\dots (R) \\ &(\text{Life span of water supply facilities on the average}) \end{aligned}$$

$$\text{Depreciation cost} = (P)/(Q \times R) = \text{S}/.185.8 /\text{m}^3$$

(2) Facilities Repair Cost

$$\begin{aligned} &= \text{Annualy } 1\% \text{ of the facilities' cost} \\ &= ( \text{S}/.380,874,000,000 \times 85\% + \text{US\$ } 386,406,000 \times 90\% ) \times 1\% \\ &= ( \text{S}/.323,743,000,000 + \text{US\$ } 347,765,000 ) \times 1\% \\ &= ( \text{S}/.323,743,000,000 + \text{S}/.399,930,000,000 ) \times 1\% \\ &\quad (\text{at US\$1.00}=\text{S}/.1,150-) \\ &= ( \text{S}/.723,673,000,000 ) \times 1\% \\ &= \text{S}/.7,236,730,000- \text{ annually} \dots\dots\dots (S) \end{aligned}$$

$$\text{Unit cost for repair} = (S)/(Q) = \text{S}/.57.0 /\text{m}^3$$

(3) Operation and maintenance cost  
( in the case of the existing Chone Treatment Plant )

$$\text{Production} = 5,300 \text{ m}^3/\text{day} \times 30 \text{ days} = 159,000 \text{ m}^3/\text{month} \dots\dots (A)$$

Operation and Maintenance cost :

- 1) Power cost  
= 55 kwh x 24 hours x 30 days x S/.80- = S/.3,168,000 -/month
- 2) Chemical cost
  - (a) (SO<sub>4</sub>)<sub>3</sub>Al<sub>2</sub> = 5,200 kg/month x S/.210- = S/.1,092,000-
  - (b) (SO<sub>4</sub>)Cu<sub>2</sub> = 30 kg/month x S/.2,000- = S/. 60,000-
  - (c) CAL = 1,500 kg/month x S/. 60- = S/. 90,000-
  - (d) Chlorine gas = 907 kg/month x S/.750- = S/. 680,250-
- 3) Personnel cost = S/.10,509,900-/month
- 4) Repair cost = S/. 1,000,000-/month
- 5) Laboratory cost = S/. 106,650-/month
- 6) Gasoline = S/. 500,000-/month

$$\text{Total (1+2+3+4+5+6)} = \text{S}/. 17,206,800- \dots\dots\dots (B)$$

$$\text{Operation and maintenance cost} = (B)/(A) = \text{S}/.108.2 /\text{m}^3$$

Table C.7.1 Water Sales Record of CRM  
( Poza Honda System of CRM, Jan.-Apr. 1991 )

Category	January 1991			February 1991		
	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )
Domestic	19,660	542,836	10,326,335	19,660	544,771	10,360,220
Industry/Commerce	65	33,838	1,341,779	65	34,765	1,380,144
Preference(*1)	97	7,496	107,913	97	7,494	107,796
Especial(*2)	4	7,906	94,872	4	7,774	93,288
<b>Total</b>	<b>19,826</b>	<b>592,076</b>	<b>11,870,899</b>	<b>19,826</b>	<b>594,804</b>	<b>11,941,448</b>

Category	March 1991			April 1991		
	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )
Domestic	19,742	484,361	9,967,560	19,742	519,785	9,945,855
Industry/Commerce	65	30,205	1,185,921	65	31,046	1,223,000
Preference(*1)	98	7,299	103,845	98	7,284	103,710
Especial(*2)	4	7,934	92,208	4	7,755	93,060
<b>Total</b>	<b>19,909</b>	<b>529,799</b>	<b>11,349,539</b>	<b>19,909</b>	<b>565,870</b>	<b>11,366,625</b>

Source : CRM, 1991

(Note) : (\*1) : School, University, Institute, Hospital, Military complex,  
Sport stadium, Police station, Prison, etc.

(\*2) : Small towns such as Valdez, Sosote, San Francisco.

One Month Average ( January-April 1991 )			
Category	No. of Connection	Billed Water ( m3/month )	Water Sale ( S./month )
Domestic	19,742 (99.16%)	522,938 (91.6%)	10,149,992 (87.3%)
Industry/Commerce	65 ( 0.33%)	32,464 ( 5.7%)	1,282,711 (11.0%)
Preference(*1)	98 ( 0.49%)	7,394 ( 1.3%)	107,066 ( 0.9%)
Especial(*2)	4 ( 0.02%)	7,842 ( 1.4%)	93,357 ( 0.8%)
<b>Total</b>	<b>19,909 ( 100% )</b>	<b>570,637 ( 100% )</b>	<b>11,633,126 ( 100% )</b>

Table C.7.2 Water Sales Record of CRM (1/3)  
( Poza Honda System, Year : 1990 )

Category	January 1990			February 1990		
	No. of Con- tion	Billed Water ( m3 )	Water Sale ( S/.)	No. of Con- tion	Billed Water ( m3 )	Water Sale ( S/.)
Domestic	17,831	454,809	7,822,685	17,834	453,129	7,821,335
Industry/Commerce	63	29,328	1,155,259	63	29,453	1,160,420
Preference(*1)	97	7,262	104,880	97	7,258	105,105
Especial(*2)	4	8,707	104,484	4	7,370	88,440
<b>Total</b>	<b>17,995</b>	<b>500,106</b>	<b>9,187,308</b>	<b>17,995</b>	<b>497,210</b>	<b>9,175,800</b>

Category	March 1990			April 1990		
	No. of Con- tion	Billed Water ( m3 )	Water Sale ( S/.)	No. of Con- tion	Billed Water ( m3 )	Water Sale ( S/.)
Domestic	17,982	457,745	7,865,690	17,982	455,585	7,854,120
Industry/Commerce	65	27,892	1,090,781	65	27,910	1,091,290
Preference(*1)	98	7,114	101,526	98	7,110	101,751
Especial(*2)	4	7,583	90,996	4	7,863	94,356
<b>Total</b>	<b>18,149</b>	<b>500,334</b>	<b>9,148,993</b>	<b>18,149</b>	<b>498,475</b>	<b>9,141,517</b>

Category	May 1990			June 1990		
	No. of Con- tion	Billed Water ( m3 )	Water Sale ( S/.)	No. of Con- tion	Billed Water ( m3 )	Water Sale ( S/.)
Domestic	18,316	469,739	8,110,080	18,316	468,978	8,128,140
Industry/Commerce	66	28,071	1,100,693	66	28,184	1,105,572
Preference(*1)	99	7,464	109,668	99	7,747	110,658
Especial(*2)	4	7,986	95,832	4	7,588	91,056
<b>Total</b>	<b>18,465</b>	<b>513,260</b>	<b>9,416,273</b>	<b>18,485</b>	<b>512,497</b>	<b>9,435,426</b>

Source : CRM

(Note) : (\*1) : School, University, Institute, Hospital, Military complex,  
Sport stadium, Police station, Prison, etc.

(\*2) : Small towns such as Valdez, Sosote, San Francisco.



Table C.7.2 Water Sales Record of CRM (2/3)  
(Poza Honda System, Year : 1990)

Category	July 1990			August 1990		
	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )
Domestic	18,662	509,608	9,834,715	18,662	504,534	9,790,380
Industry/Commerce	65	27,297	1,064,103	65	27,270	1,063,276
Preference(*1)	100	8,237	119,316	100	8,262	119,847
Especial(*2)	4	8,897	106,764	4	9,390	112,680
<b>Total</b>	<b>18,831</b>	<b>554,039</b>	<b>11,124,898</b>	<b>18,831</b>	<b>549,456</b>	<b>11,086,183</b>

Category	September 1990			October 1990		
	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )
Domestic	19,067	515,187	9,853,395	19,067	563,407	10,878,215
Industry/Commerce	65	29,246	1,146,446	65	32,109	1,264,818
Preference(*1)	101	9,129	133,629	101	8,862	128,547
Especial(*2)	4	8,527	102,324	4	8,369	100,428
<b>Total</b>	<b>19,237</b>	<b>562,089</b>	<b>11,235,794</b>	<b>19,237</b>	<b>612,747</b>	<b>12,372,008</b>

Category	November 1990			December 1990		
	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )	No. of Connec- tion	Billed Water ( m3 )	Water Sale ( S/. )
Domestic	19,285	563,407	10,878,215	19,285	563,856	10,942,255
Industry/Commerce	65	32,109	1,264,818	65	33,041	1,305,112
Preference(*1)	101	8,862	128,547	101	8,957	130,350
Especial(*2)	4	8,369	100,428	4	8,403	100,836
<b>Total</b>	<b>19,455</b>	<b>612,747</b>	<b>12,372,008</b>	<b>19,455</b>	<b>614,257</b>	<b>12,478,553</b>

Source : CRM

(Note) : (\*1) : School, University, Institute, Hospital, Military complex,  
Sport stadium, Police station, Prison, etc.

(\*2) : Small towns such as Valdez, Sosote, San Francisco.

Table C.7.2 Water Sales Record of CRM (3/3)  
( Poza Honda System, Year : 1990 )

Total of the Year 1990 ( January - December )					
Category	No. of Connection	Billed Water		Water Sale	
Domestic	19,285	5,928,491 m <sup>3</sup> /year (= 494,041 m <sup>3</sup> /month) 91.6 %		108,757,520 S./year (= 9,063,127 S./month) 87.0 %	
		Billed water per connection = 25.6 m <sup>3</sup> /month		Billed rate = S/.18.3 /m <sup>3</sup>	
Industry /Commercial	65	349,105 m <sup>3</sup> /year (= 29,092 m <sup>3</sup> /month) 5.4 %		13,696,372 S./year (= 1,141,364 S./month) 11.0 %	
		Billed water per connection = 447.6 m <sup>3</sup> /month		Billed rate = S/.39.2 /m <sup>3</sup>	
Preference	101	96,620 m <sup>3</sup> /year (= 8,052 m <sup>3</sup> /month) 1.5 %		1,400,494 S./year (= 116,708 S./month) 1.1 %	
		Billed water per connection = 79.7 m <sup>3</sup> /month		Billed rate = S/.14.5 /m <sup>3</sup>	
Especial	4	99,095 m <sup>3</sup> /year (= 8,258 m <sup>3</sup> /month) 1.5 %		1,189,140 S./year (= 99,095 S./month) 0.9 %	
		Billed water per connection = 2,064.5 m <sup>3</sup> /month		Billed rate = S/.12.0 /m <sup>3</sup>	
Total	19,455	6,473,311 m <sup>3</sup> /year 539,443 m <sup>3</sup> /month 100 %		125,043,526 S./year 10,420,294 S./month 100 %	
		Billed water per connection = 27.7 m <sup>3</sup> /month		Billed rate = S/.19.32 /m <sup>3</sup>	

- Water production :

= Guarumo Plant + Las Pulgas Plant  
 = 10,650,000 m<sup>3</sup>/year (30,000 m<sup>3</sup>/day x 355 days,  
 (with remaining 10 days of non-service))  
 + 1,065,000 m<sup>3</sup>/year (3,000 m<sup>3</sup>/day x 355 days)  
 = 11,715,000 m<sup>3</sup>/year  
 = 976,250 m<sup>3</sup>/month

- Rate of billed water = 6,473,311 / 11,715,000 = 55.3 % ( in 1990 )  
 ( Rate of unaccounted-for water = 44.7 % )

Table C.7.3 Estimation of Water Sales of Poza Honda System, CRM

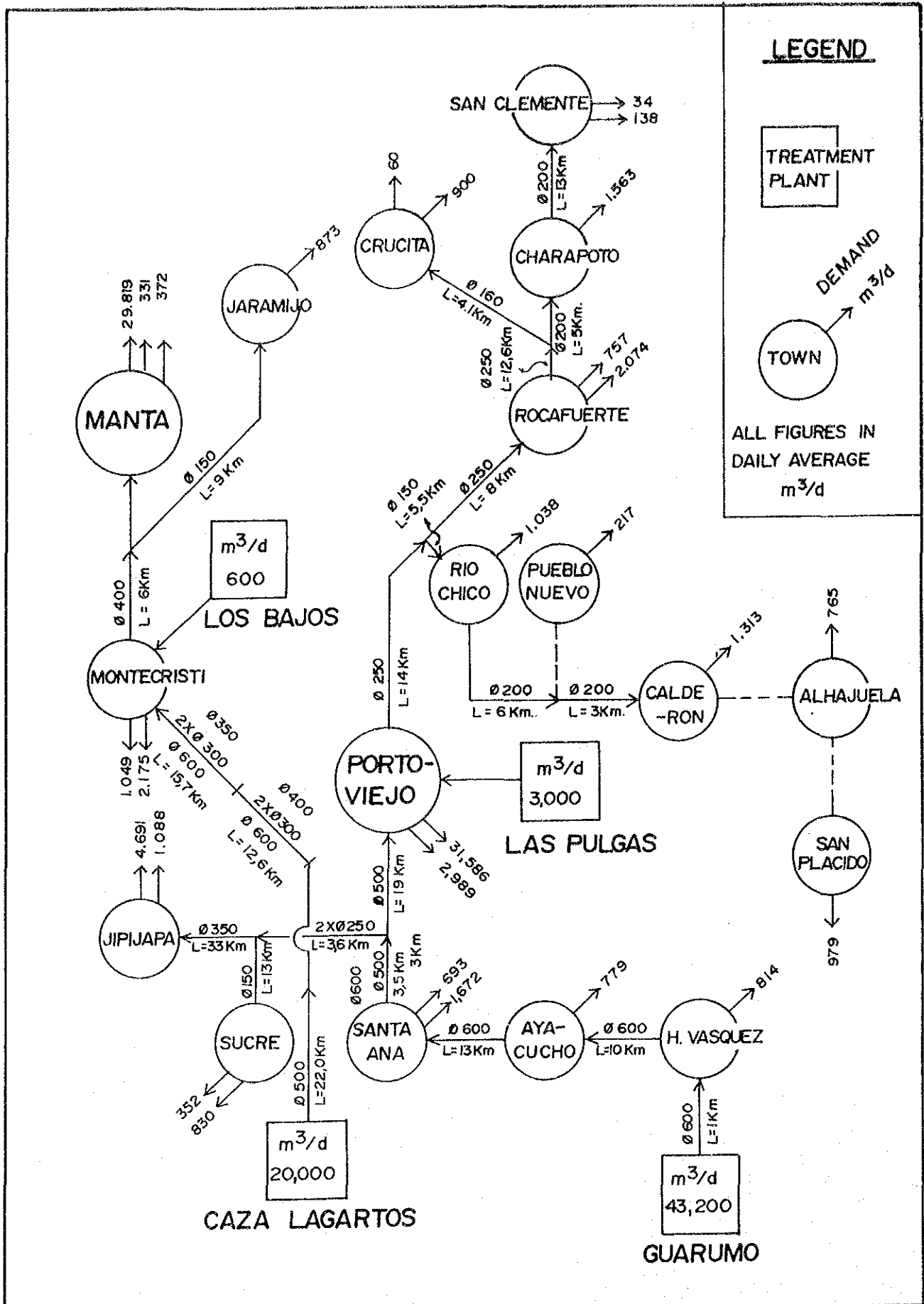
( Monthly Basis, After October 1991 )

Category	Billed Water	Unit Price	Sales
<b>Domestic ( Total= 522,938 m3 )</b>			
0 -	10 m3 7.3 %= 38,175 m3	S/. 25	S/. 954,375-
11 -	25 32.8 %= 171,524 m3	S/. 30	S/. 5,145,720-
26 -	50 29.2 %= 152,698 m3	S/. 66	S/. 10,078,068-
51 -	100 17.2 %= 89,945 m3	S/. 90	S/. 8,095,050-
101 -	500 12.7 %= 66,413 m3	S/.120	S/. 7,969,560-
501 -	1000 0.8 %= 4,183 m3	S/.150	S/. 627,450-
Sub Total = 522,938 m3			S/ 32,870,223-
			( Average = S/.62.86 /m3 )
<b>Commercial/Industry (Total = 32,464 m3)</b>			
<b>Commercial</b>			
0 -	10 m3 0.1 %= 32 m3	S/.150	S/. 4,800-
11 -	25 0.1 %= 32 m3	S/.190	S/. 6,080-
26 -	50 0.9 %= 292 m3	S/.250	S/. 73,000-
51 -	100 2.6 %= 844 m3	S/.325	S/. 274,300-
<b>Industry</b>			
101 -	500 12.9 %= 4,188 m3	S/.500	S/. 2,094,000-
501 -	1000 24.7 %= 8,019 m3	S/.500	S/. 4,009,500-
1001 -	58.7 %= 19,056 m3	S/.500	S/. 9,528,000-
Sub Total = 32,464 m3			S/. 15,989,680-
			( Average = S/.492.5 /m3 )
Preference	Total = 7,394 m3	S/.47.15	S/. 348,627-
Especial	Total = 7,842 m3	S/.38.34	S/. 300,662-
<hr/>			
Total	570,637 m3		S/. 49,509,192-
			( Average = S/.86.76 /m3 )



## FIGURES





**LEGEND**

TREATMENT PLANT

TOWN

DEMAND  $m^3/d$

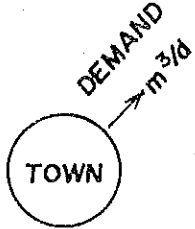
ALL FIGURES IN DAILY AVERAGE  $m^3/d$

FIG. C.2.I. POZA HONDA SYSTEM (Year : 1,991)

$\Sigma Q = 89,951 \text{ m}^3/d$   
DAILY AVERAGE DEMAND

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THE FEASIBILITY STUDY ON THE WATER  
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**LEGEND**



ALL FIGURES IN  
DAILY AVERAGE  
 $m^3/d$

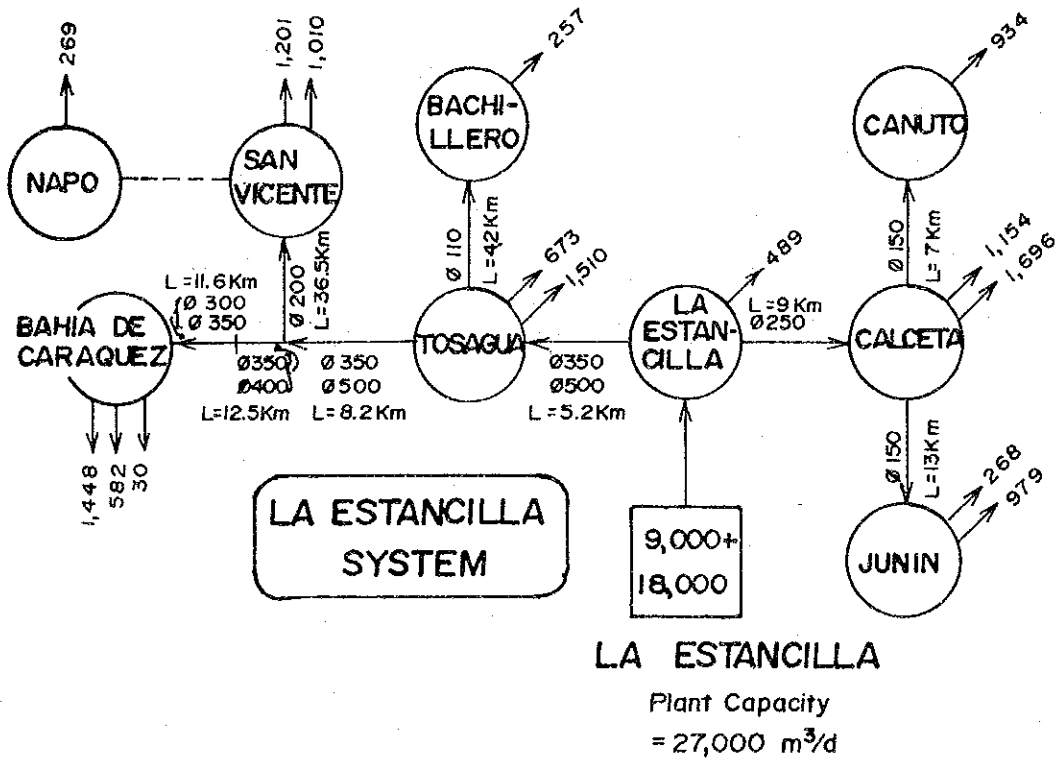
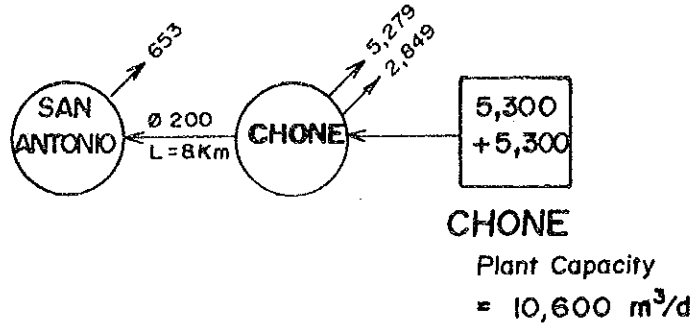
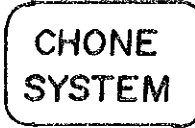


FIG. C.2.2 CHONE-ESTANCILLA SYSTEM (Year: 1,991)

$\Sigma Q = 21,281 m^3/d$   
DAILY AVERAGE DEMAND

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CHONE-PORTOVIEJO RIVER BASINS

JAPAN INTERNATIONAL COOPERATION AGENCY



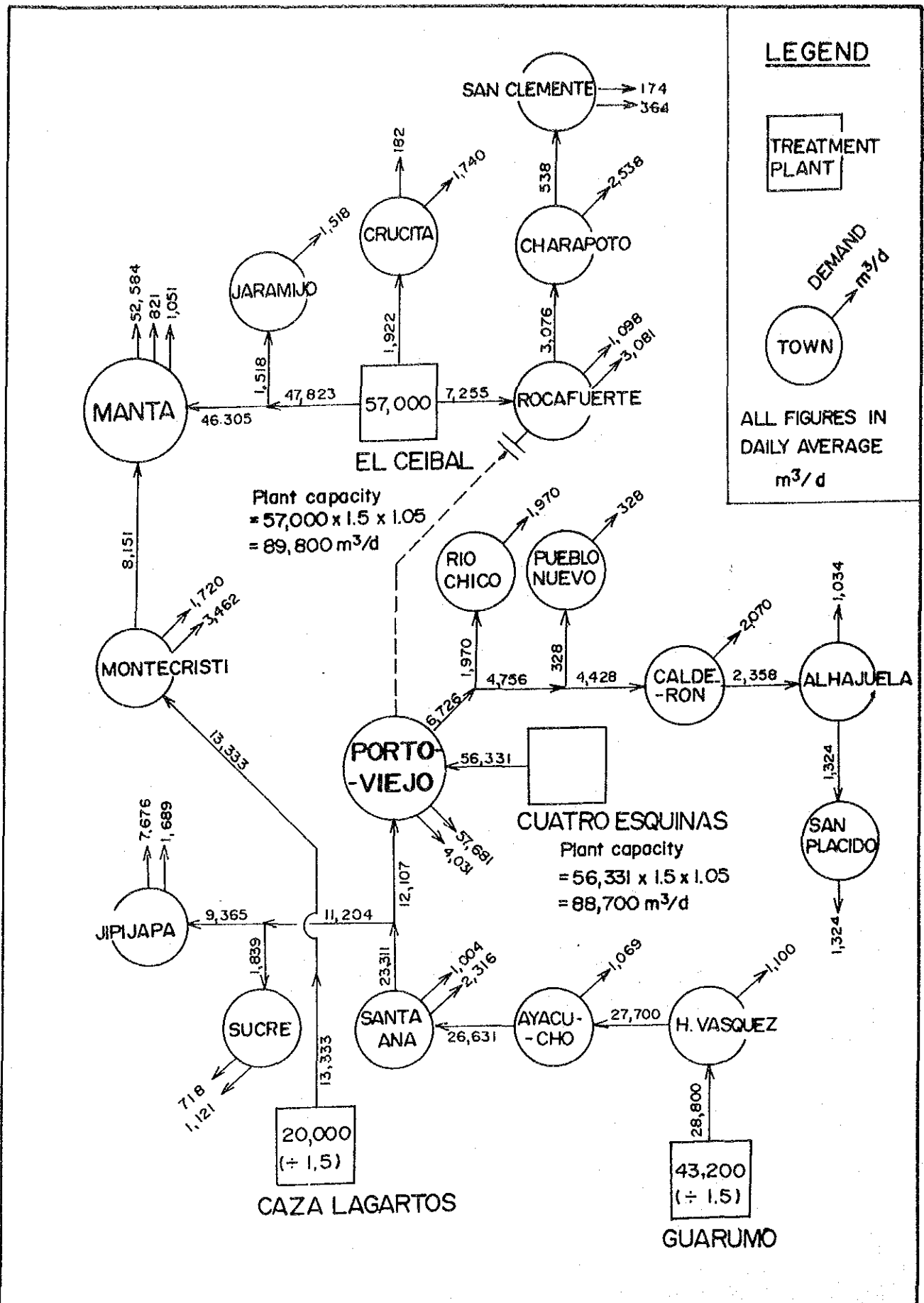


FIG. C.4.1. POZA HONDA SYSTEM (Year: 2,000)

$\Sigma Q = 155,464 \text{ m}^3/\text{d}$   
DAILY AVERAGE

GOVERNMENT OF THE REPUBLIC OF ECUADOR  
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THE FEASIBILITY STUDY ON THE WATER  
RESOURCES DEVELOPMENT FOR  
CHONE-PORTOVIEJO RIVER BASINS  
JAPAN INTERNATIONAL COOPERATION AGENCY

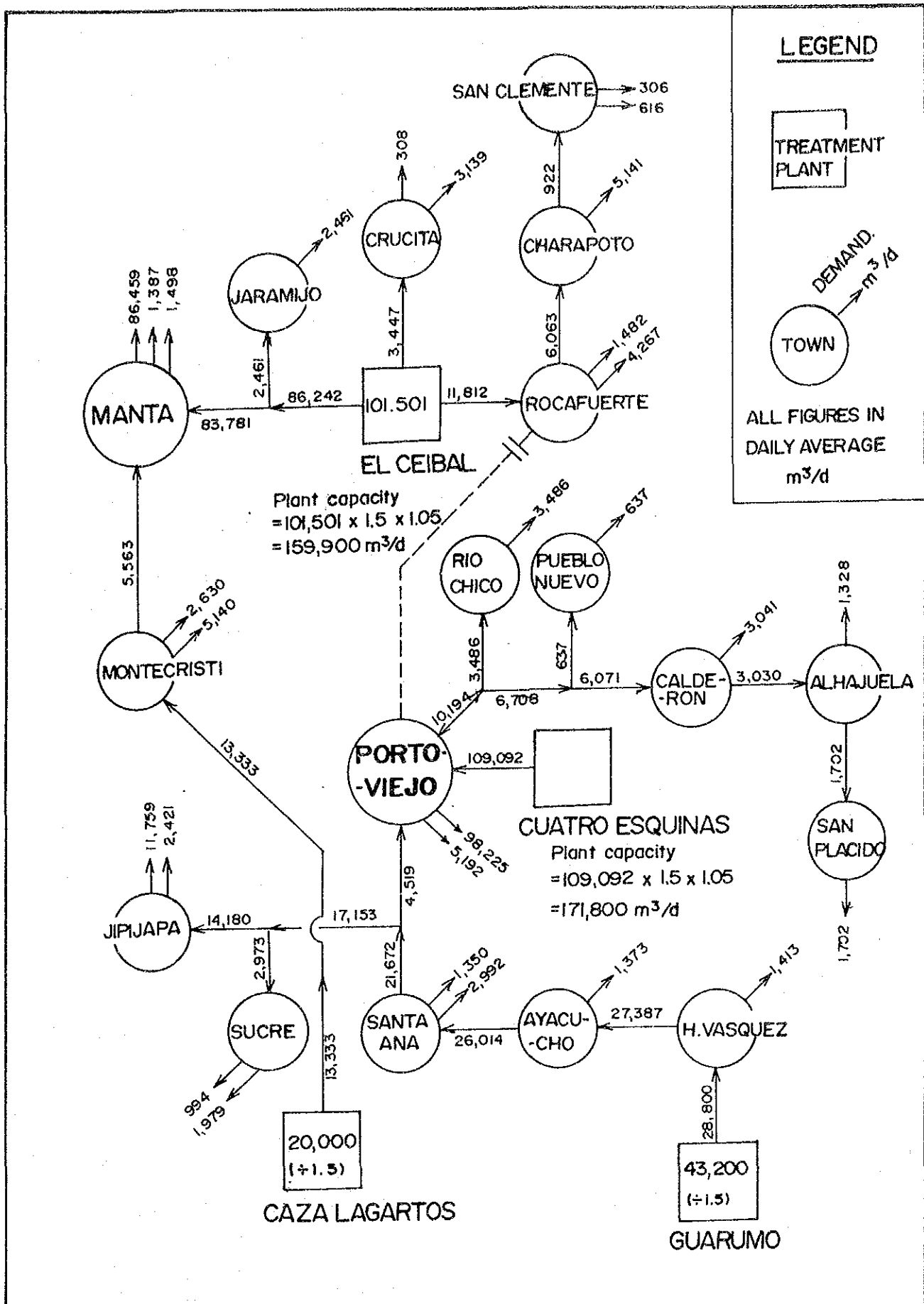


FIG. C.4.2 POZA HONDA SYSTEM ( Year : 2,010 )

$\Sigma Q = 252,726 m^3/d$   
DAILY AVERAGE

GOVERNMENT OF THE REPUBLIC OF ECUADOR  
CENTRO DE REHABILITACION DE MANABI (CRM)  
THE FEASIBILITY STUDY ON THE WATER  
RESOURCES DEVELOPMENT FOR  
CHONE-POR TOVIEJO RIVER BASINS  
JAPAN INTERNATIONAL COOPERATION AGENCY

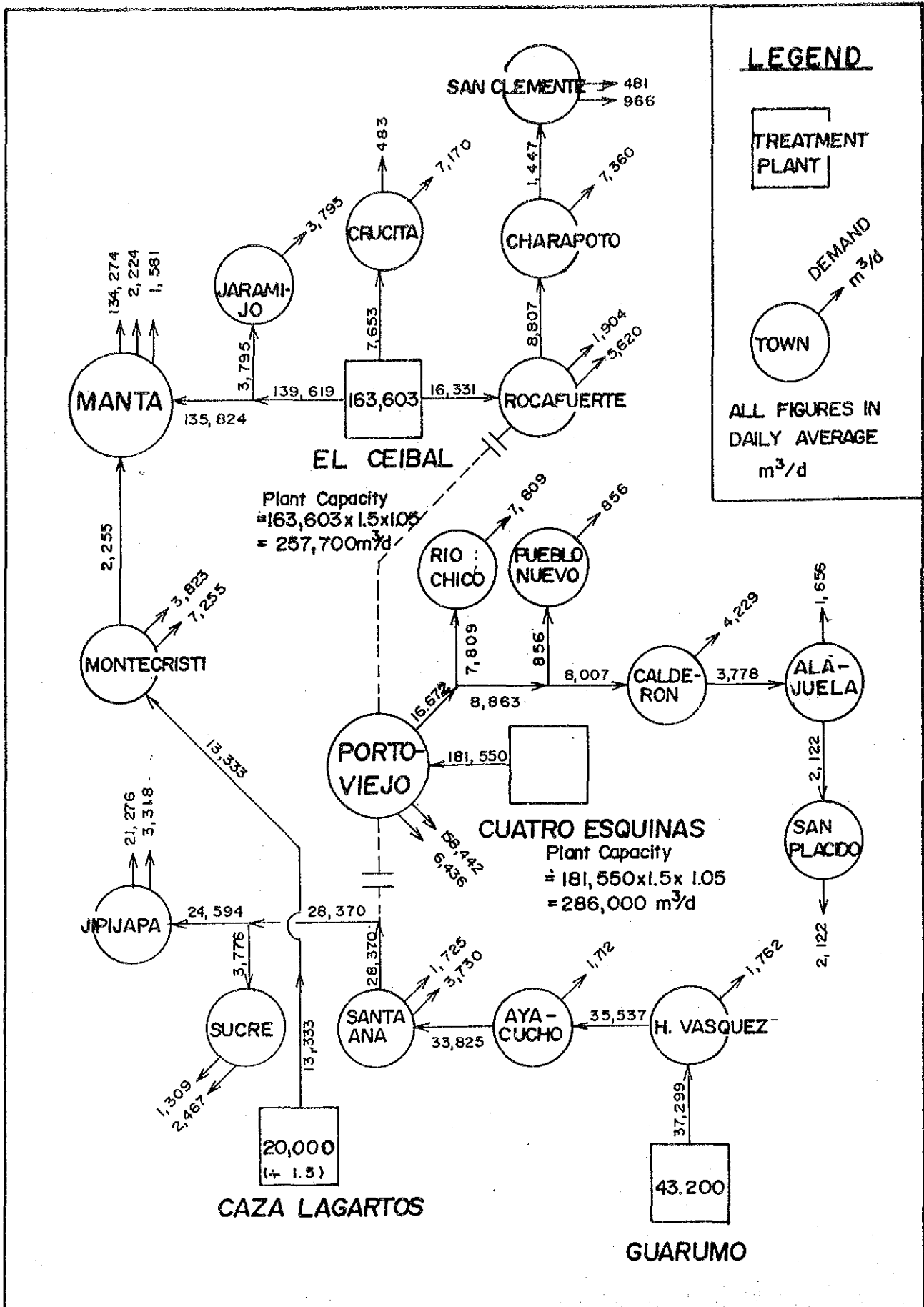


FIG. C.4.3 POZA HONDA SYSTEM (Year: 2,020)

$\Sigma Q = 395,785 \text{ m}^3/\text{d}$   
DAILY AVERAGE

GOVERNMENT OF THE REPUBLIC OF ECUADOR  
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THE FEASIBILITY STUDY ON THE WATER  
RESOURCES DEVELOPMENT FOR  
CHONE-PORTOVIEJO RIVER BASINS  
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**LEGEND**



ALL FIGURES IN DAILY AVERAGE  $m^3/d$

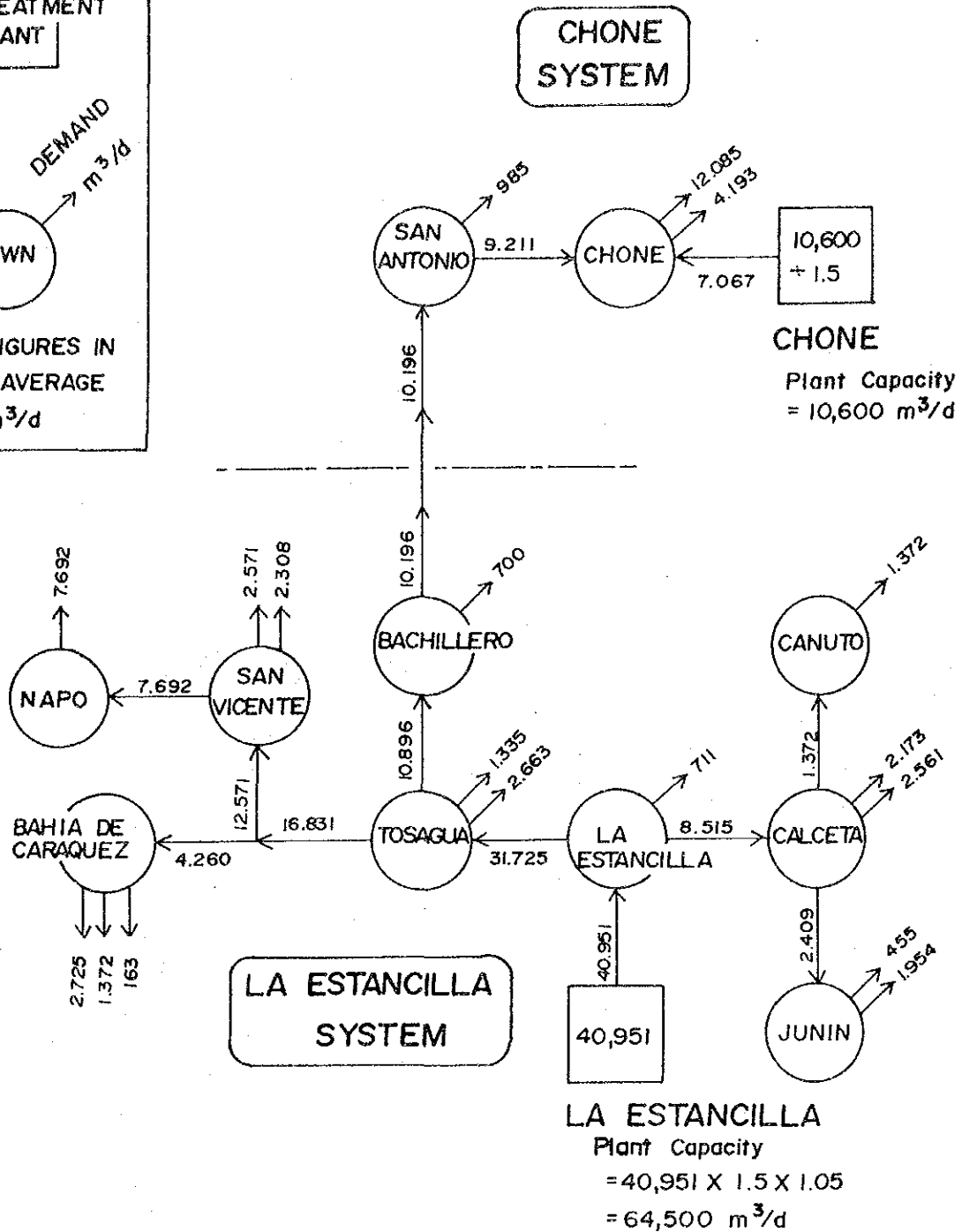
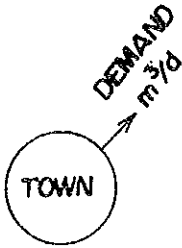


FIG. C.44. CHONE-ESTANCILLA SYSTEM (Year: 2,000)

$\Sigma Q = 48,018 \text{ m}^3/d$   
DAILY AVERAGE

GOVERNMENT OF THE REPUBLIC OF ECUADOR  
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THE FEASIBILITY STUDY ON THE WATER  
RESOURCES DEVELOPMENT FOR  
CHONE - PORTOVIEJO RIVER BASINS  
JAPAN INTERNATIONAL COOPERATION AGENCY

**LEGEND**



ALL FIGURES IN DAILY AVERAGE  $m^3/d$

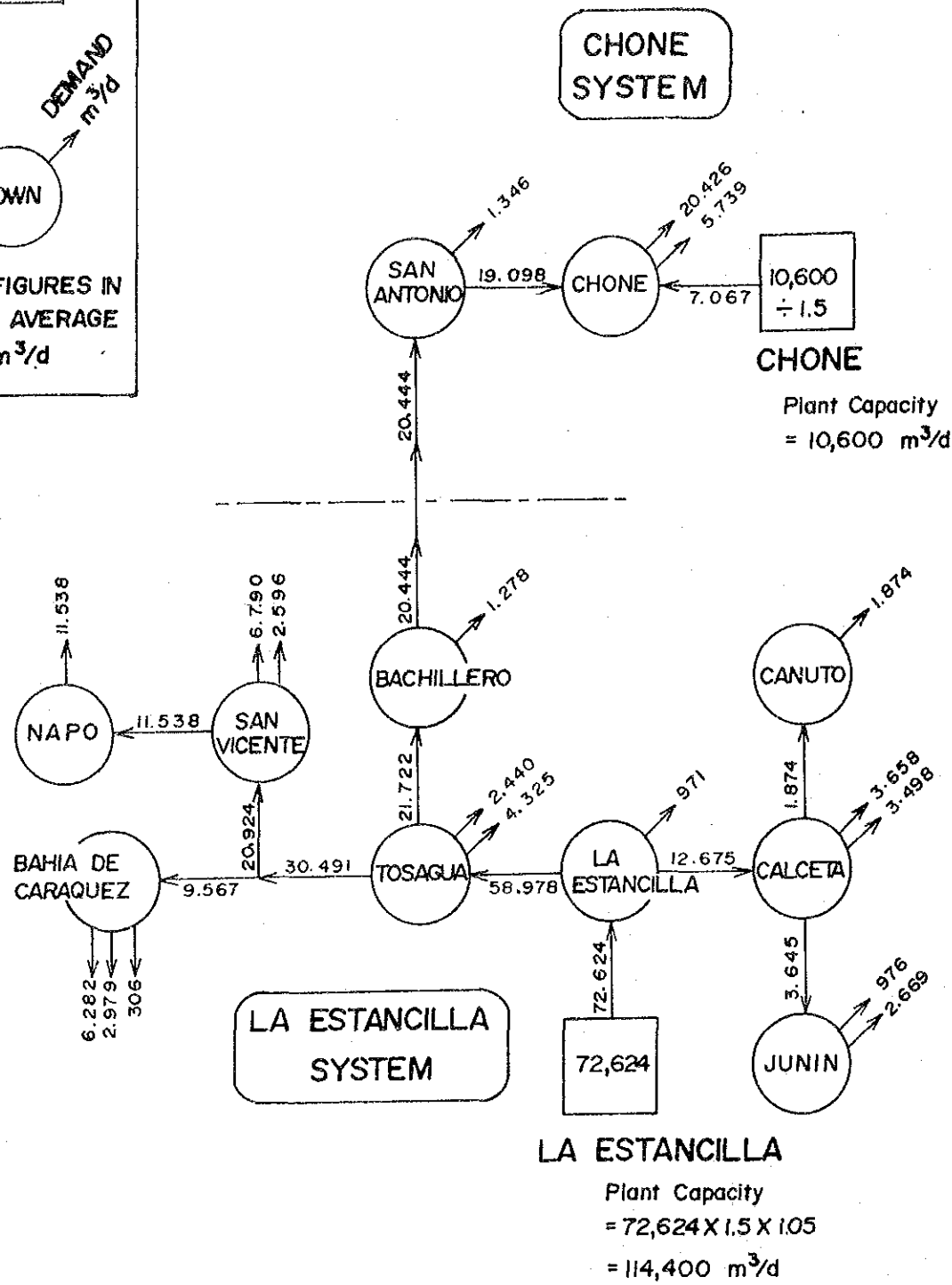
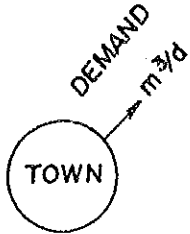


FIG. C. 4.5. CHONE-ESTANCILLA SYSTEM (Year 2010)

$\Sigma Q = 79,691 m^3/d$   
 DAILY AVERAGE

GOVERNMENT OF THE REPUBLIC OF ECUADOR  
 CENTRO DE REHABILITACION DE MANABI (C.R.M)  
 THE FEASIBILITY STUDY ON THE WATER  
 RESOURCES DEVELOPMENT FOR  
 CHONE-PORTOVIEJO RIVER BASINS  
 JAPAN INTERNATIONAL COOPERATION AGENCY

# LEGEND



ALL FIGURES IN  
DAILY AVERAGE  
 $m^3/d$

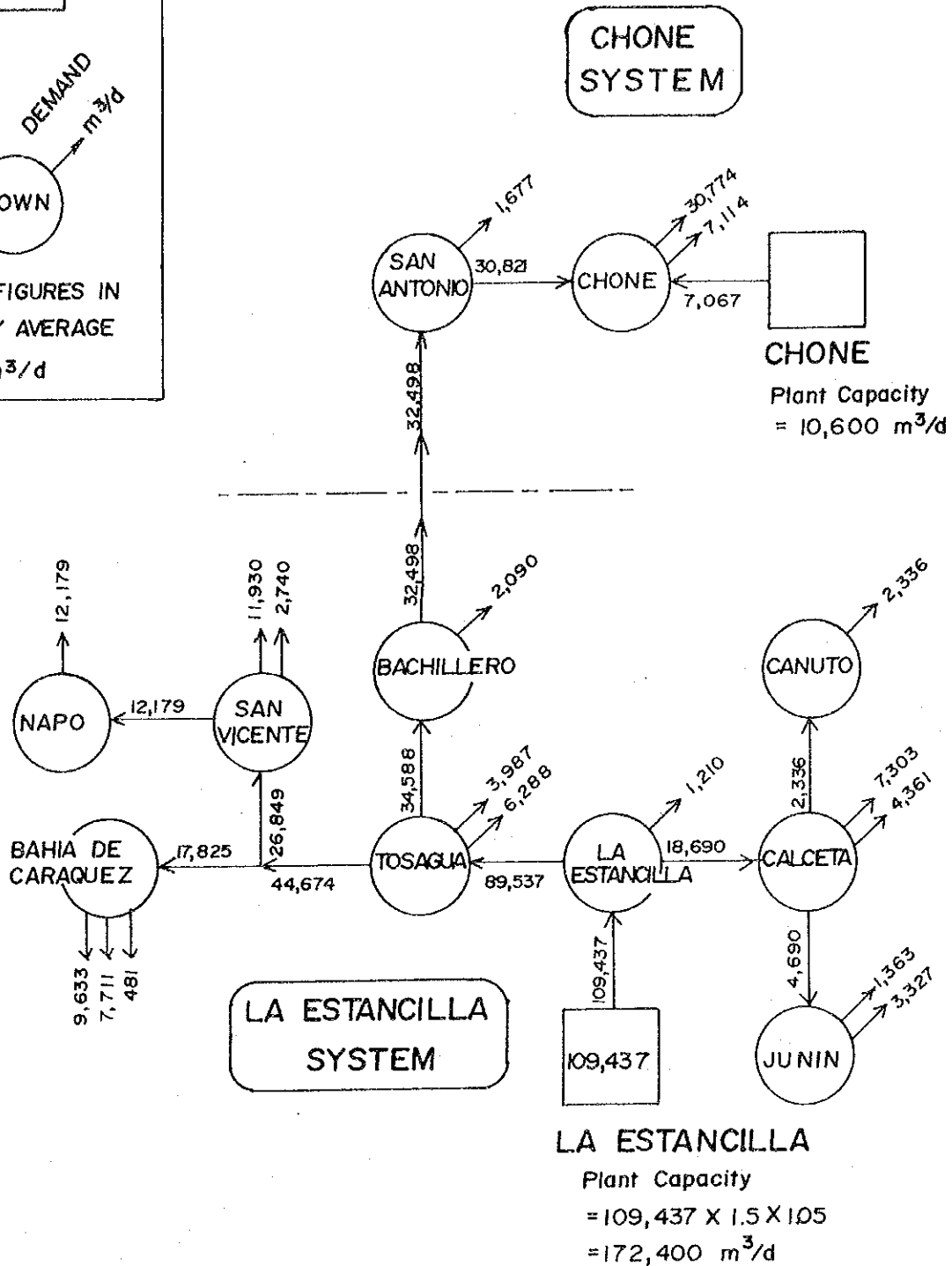


FIG. C.4.6. CHONE-ESTANCILLA SYSTEM (Year:2,020)

$\Sigma Q = 116,504 m^3/d$   
DAILY AVERAGE

GOVERNMENT OF THE REPUBLIC OF ECUADOR  
CENTRO DE REHABILITACION DE MANABI(C.R.M.)  
THE FEASIBILITY STUDY ON THE WATER  
RESOURCES DEVELOPMENT FOR  
CHONE-PORTOVIEJO RIVER BASINS

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**Annex D**

**IRRIGATION**





## ANNEX D IRRIGATION

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## **1. INTRODUCTION**

The main objective of the study on irrigation sector is to establish overall irrigation development plan, to estimate the irrigation water demand and irrigation benefit in Chone-Portoviejo river basins.

In the study area, there are PHIMA study which shows the water resource development plan of Manabi province and on-going irrigation development plan such as the Proyecto Multiple Carrizal-Chone which feasibility study has finished in 1989. And also the Poza Honda irrigation project is under operation partly. Therefore, the main point of this study is limited to review and update these studies considering conditions of existing irrigation systems.

## **2. EXISTING IRRIGATION SYSTEMS**

### **2.1 General**

In the Chone River basin (No.8) and the Portoviejo River basin (No.9), there are eleven(11) existing irrigation systems. Out of eleven sub-systems, seven(7) sub-systems are located in the Portoviejo River basin and these are generally called Poza Honda irrigation system. Another three(3) sub-systems are in the Chico River basin which is tributary of the Portoviejo River, and One(1), La Estancilla system, is in the Carrizal River basin. The location of existing irrigation systems and those diversion dams are shown in Fig.D.2.1 and Fig.D.2.2 respectively.

In 1988, 7,750 ha was irrigated by these irrigation systems. The detail is shown in Table D.2.1. Out of 7,750 ha, 4,850 ha of Poza Honda irrigation system was more or less dependent upon regulated flow from the Poza Honda dam which has constructed at 26 km upstream from Santa Ana on the Portoviejo River. The remaining 2,900 ha was irrigated by the diversion dam utilizing natural stream-flow of the Chico River and the Carrizal River.

It is found during this field investigation in October 1991 that no water can be introduced to the canals except some sub-systems of Poza Honda irrigation system in this month because of water shortage in the river. In other words, only some area which is located in upstream of the Portoviejo River can be irrigated throughout a year, and most of the area can be irrigated in early dry season only. The area being able to irrigate whole season are the Santa Ana, Lote 5A, Mejia and a part of Ceibal Sub-



systems of the Poza Honda irrigation system estimating at 3,200 ha out of 7,750 ha in 1988.

## 2.2 Poza Honda Irrigation System

Poza Honda irrigation system extends along the Portoviejo River from Santa Ana town to the coast. The system consists of seven(7) sub-systems, Santa Ana, Lote 5A, Mejia, Ceibal, La Jagua, El Cerrito and La Guayaba. The service area and irrigated area in 1988 of each sub-system are as below:

Name of sub-system	Commanding area (ha)	Irrigated area in 1988 (ha)
Santa Ana	2,750	1,170
Lote 5A	200	190
Mejia	830	580
Ceibal	2,700	1,790
La Jagua	1,570	660
El Cerrito	400	350
La Guayaba	300	110
Total	8,750	4,850

Source: Report of PHIMA, Evaluacion Preliminar de Los Sistemas de Riego de Poza Honda y La Estancilla, 1988

Poza Honda Dam has constructed for the purposes of supply potable water and irrigation water and has started the operation in 1971. Poza Honda irrigation system was planed and designed in 1970's aiming to irrigate 10,500 ha in net.

Construction of irrigation system has divided into four(4) stages. Santa Ana diversion dam and main canals have constructed at the first stage and started operation partially in 1983. The secondary canal systems is planed to construct at 2nd, 3rd and 4th stages. However, only left main canal of Santa Ana sub-system and Lote 5A sub-system have equipped with secondary canal systems now in 1991. Other sub-systems, Mejia, Ceibal, Jagua, Cerrito and Guayaba, are still irrigated by those old systems utilizing remain flow of the Portoviejo River. The general map of the Poza Honda irrigation system is shown in Fig.D.2.3. The main feature of present system is presented in Table D.2.2.

### **2.3 Irrigation Systems on the Chico River**

There are three(3) existing irrigation systems, La Cienega, Pechiche and Pasaje, and four(4) existing diversion dams, La Cienega, Pechiche, Pasaje and Alajuella in the Chico River basin. Alajuella irrigation system is presently under construction.

These areas are generally cultivated in rainy season and are irrigated in May and June only due to no stream-flow of the Chico River during late dry season.

#### **(1) La Cienega system**

This system is located between the town of Calderon and Rio Chico. It consists of La Cienega diversion dam and three(3) unlined major canals. The total length of major canals is 8.1 km and these can irrigate an area of 300 ha.

#### **(2) Pechiche system**

Originally, the service area of this system was 650 ha expanding left bank of the Chico River between 1.5 km downstream from Rio Chico town and confluence with the Portoviejo River. However, irrigable area of 350 ha get water from the right canal of Mejia system at present. Accordingly, service area of Pechiche system now is only 300 ha. Actual irrigated area in 1988 is 610 ha out of above 650 ha. This area is served by two(2) major canals of 2.7 km long in total which is delivering irrigation water from Pechiche diversion dam.

#### **(3) Pasaje system**

Pasaje diversion dam has constructed at about 1.5 km upstream from the confluence with the Portoviejo River. Irrigable area of 500 ha is located in the right bank of the Portoviejo River between confluence and Rocafuerte town. This area is irrigated by a major canal of 1.3 km long.

### **2.4 La Estancilla Irrigation System**

Aiming at the supply of potable and irrigation water, La Estancilla diversion dam has constructed on the Carrizal River at La Estancilla in 1966. The irrigation canal system can irrigate to the area of 2,150 ha. However, actual irrigable area is only from 1,400 ha to 1,600 ha due to shortage of water resource. Actual irrigated areas from 1979 to 1988 are tabulated as follows:

Year	Irrigated area (ha)	Year	Irrigated area (ha)
1979	1,465	1984	1,591
1980	973	1985	1,642
1981	1,363	1986	1,451
1982	1,676	1987	1,195
1983	211	1988	1,516

Source: Report of PHIMA, Evaluacion Preliminar de Los Sistemas de Riego de Poza Honda y La Estancilla, 1988

The irrigation system is composed of three(3) main canals of 28 km long in total with design capacity of 5.0 m<sup>3</sup>/s each and secondary canals of 18.5 km long.

It is found from above table that actual irrigated area widely fluctuates every year because this area depends only natural stream-flow of the Carrizal River. This area cannot be irrigated during late dry season due to shortage of stream-flow. The secondary canal network are not equipped sufficiently comparing with the length of main canal.

Whole the area of this system is including in the project area of the "Proyecto Multiple Carrizal-Chone".

## 2.5 Irrigation Systems Under Construction

At present, two(2) irrigation systems are under construction by CRM itself. There are:

Name of system	Water Source	Diversion Dam	Canal system	Service area (ha)
Alajueta	Rio Chico	Completed	Under construction	600
Canuto	Rio Canuto	Completed	Under construction	580

The locations of these systems are shown in Fig.D.2.1.

### 3. DELINEATION OF IRRIGATION DEVELOPMENT AREA

#### 3.1 Present Land Use

The present land use of the study area (river basin No.7, No.8 and No.9) is shown in Fig.D.3.1 and Table D.3.1 and is summarized below:

Land Category	(Unit: km <sup>2</sup> )				
	No.7 Bahia	No.8 Chone	No.9 Portoviejo	Total	Manabi province
1) Agricultural lands					
- Crop and horticulture	9.4	552.5	604.0	1,165.9	3,545.0
Annual crop	7.2	100.1	204.2	311.5	572.9
Perennial crop	2.2	452.4	399.8	854.4	2,972.1
- Pasture	33.2	869.4	450.7	1,353.3	6,371.7
- Complex of crops and pasture	160.8	617.7	481.4	1,259.9	3,327.4
Sub-total	203.4	2,039.6	1,536.1	3,779.1	13,244.1
2) Non-agricultural land	340.6	227.4	523.9	1,091.9	5,755.9
Total	544.0	2,267.0	2,060.0	4,871.0	19,000.0

Source: Report of PHIMA, Recurso Suelo, 1988

The Chone and Portoviejo river basin having an area of 487,100 ha occupy 26 % of the area of Manabi province. Out of total area of these river basin, the agricultural lands including cultivated land and pasture land amount to 377,900 ha. It reaches 76 % of the land. Remaining 26 % is the natural vegetation land such as forest and bush, and non-vegetation area such as villages and lakes.

From view point of land classification, the land suitable for cultivation amounts 130,000 ha consisting of Category A and B as mentioned in next section. On the other hand, actual cultivated land exists 242,600 ha which is deducted the pasture land of 135,300 ha from the agricultural land of 377,900 ha. It means that a part of crop cultivation is practicing in the low productivity land. In other words, the land suitable for agriculture in Chone and Portoviejo River basin is fully utilized as agricultural land.

Pasture land spreads over mainly the hilly area. The lands of annual crops expands in plain land and this area amounts to 54 % of the annual crop land of Manabi province.

### 3.2 Potential Irrigation Area

The studies on soils and land classification of Manabi province were carried out by CRM and OAS in 1988, based on the soil maps (1:200,000 scale) prepared by PRONAREG (Departamento de Geomorfologia y Teledeteccion) and ORSTOM (Office de la Recherche Scientifique et Technique OUTRE-MER). Based on above study, land suitability analysis for irrigation also has executed at the same time. They classified the land into five(5) categories, A,B,C,AC and X. The result is presented in Fig.D.3.2 and is tabulated as below:

(Unit: km <sup>2</sup> )						
Basin	A	B	C	AC	X	Total
Bahia	58.0	60.0	46.0	-	380.0	544.0
Chone	317.9	341.7	611.0	-	996.4	2,267.0
Portoviejo	339.0	113.0	367.8	-	1,240.2	2,060.0
Total	714.9	514.7	1,024.8	-	2,616.6	4,871.0

Category A : Potentially irrigable land without any limitation or with slight limitation

Category B : Potentially irrigable lands with moderate limitation

Category C : Potentially irrigable lands with severe limitation

Category AC: Mixture of A and C

Category X : Non-irrigable lands

The total irrigable area categorized in A, B, C and AC amounts to 2,254.4 km<sup>2</sup> in gross which is 46 % of the land.

### 3.3 Delineation of Irrigation Development Area

In the potential irrigation area of 225,440 ha mentioned in Section 3.2, irrigation development area is delineated by following manner.

- a) Delineation is made based on topographic maps of 1:50,000 scale.

- b) Irrigation development area is located downstream of existing or proposed dam and diversion dam site.
- c) The area is irrigated by a gravity system form its dam/diversion dam site.
- d) The area delineated by the existing irrigation development plan is followed its plan.
- e) The gross area is converted into a net area with a conversion factor of 80 % for the category "A", 70 % for "B",30 % for "C".

Thus the irrigation development area is delineated into eight (8) schemes in total net area of 29,250 ha as follows:

<u>Name of scheme</u>	<u>River basin</u>	<u>Area(ha)</u>
Carrizal-Chone	Carrizal river	15,000
Amarillos	Carrizal river	1,000
Guarango	Portoviejo river	1,500
Rio Chico	Chico river	1,700
Pechiche-Pasaje	Chico river	850
Santa Ana	Portoviejo river	3,300
Mejia	Portoviejo river	1,250
Ceibal-Guayaba	Portoviejo river	4,650
<b>Total</b>		<b>29,250</b>

The details of the potential area by each scheme are presented in Table D.3.2 and Table D.3.3. The locations of each scheme are shown in Fig.D.3.3.

#### **4. IRRIGATION WATER REQUIREMENT**

##### **4.1 Methodology of Water Requirement Estimation**

The elements to estimate irrigation water requirement are crop consumptive use, effective rainfall and irrigation efficiency. The method of calculation is as below and this method is used in the previous PHIMA study also:

$$ET_{crop} = ET_p * K_c$$

$$IR = ET_{crop} + (LP) - ER$$

$$DWR = IR / E_f$$

where,  $ET_{crop}$  : Crop evapotranspiration (mm/month)  
(crop consumptive use)  
 $ET_p$  : Potential evapotranspiration (mm/month)  
 $K_c$  : Crop coefficient  
 $IR$  : Net irrigation requirement (mm/month)  
 $LP$  : Water requirement for land preparation  
of paddy field (mm/month)  
 $ER$  : Effective rainfall (mm/month)  
 $DWR$  : Diversion water requirement (mm/month)  
 $E_f$  : Irrigation efficiency

(1) Potential evapotranspiration ( $ET_p$ )

$ET_p$  at five(5) meteorological stations, Portoviejo, Rocafuerte, Santa Ana, La Estancilla and Calceta, are estimated by the modified Penman method. Meteorological data at each station, the  $ET_p$  estimated and data employed to estimate  $ET_p$  are presented in Table D.4.1, Table D.4.2 and Table D.4.3 respectively.

(2) Crop coefficient ( $K_c$ )

$K_c$  value of annual crops such as maize, cotton and vegetables are calculated by Grassi-Christiansen formula as below:

$$K_c = 0.0942 + 0.02774 * t - 0.0002126 * t^2$$

where,  $t$ : Percentage of growth period (0% at planting stage  
and 100% at harvesting stage)

$K_c$  value of citrus, platano and rice are quoted from the feasibility report on the "Proyecto Multiple Carrizal-Chone" as follows:

Crop	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Citrus	0.75	0.77	0.78	0.80	0.82	0.83	0.83	0.87	0.82	0.81	0.79	0.76
Platano	0.70	0.75	0.90	1.02	1.03	1.02	1.02	1.00	0.94	0.85	0.75	0.70
(Growing stage)	(11.0%)	(33.0%)	(55.6%)	(77.8%)	(100.0%)							
Rice		1.10	1.10	1.10	1.05	0.95						

(3) Water requirement for land preparation

For rice cultivation, water for puddling and ponding is required at the initial stage. The water requirement of 120 mm is added to estimate irrigation requirement for paddy field.

(4) Effective rainfall

Effective rainfall is related to actual rainfall and ET<sub>crop</sub>. The SCS method that is established by USDA (U.S. Department of Agriculture's Soil Conservation Services) is applied to estimate effective rainfall. In estimating effective rainfall, probable monthly rainfalls corresponding to 5-year return period of drought are employed. In other words, irrigation water will be guaranteed at 80%. The probable rainfall estimated and mean monthly rainfall at seven (7) stations, Portoviejo, Santa Ana, Rocafuerte, Alajuela, Pechiche, Calceta and La Estancilla, are shown in Table D.4.4 and Table D.4.5.

(5) Irrigation efficiency

Following irrigation efficiencies are applied to take account of losses of water incurred during conveyance and application to the field:

	(Paddy)	(Upland crop)
Conveyance efficiency :	0.90	0.90
Distribution efficiency :	0.85	0.85
Application efficiency :	0.70	0.60
<b>Total</b>	<b>0.53</b>	<b>0.46</b>



## 4.2 Irrigation Water Requirement

Irrigation water requirements of eight(8) schemes are calculated on monthly basis in accordance with proposed cropping pattern. The meteorological and rainfall data employed to estimate it for eight(8) schemes are shown below:

Scheme	Name of meteo/rainfall station	
	ETp	Rainfall
Carrizal-Chone	Calceta	Calceta
Amarillos	Estancilla	Estancilla
Guarango	Rocafuerte	Rocafuerte
Rio Chico	Santa Ana	Alajuela
Pechiche-Pasaje	Rocafuerte	Pechiche
Santa Ana	Portoviejo	Portoviejo
Mejia	Portoviejo	Portoviejo
Ceibal-Guayaba	Rocafuerte	Rocafuerte

Proposed land use and proposed cropping pattern for each scheme are shown in Table D.4.6 and Fig.D.4.1. These are quoted from PHIMA study report prepared by JICA in 1990, forecasting the agricultural production in 2020.

Total amount of irrigation water requirement for whole schemes in total area of 29,250 ha is estimated at 571 MCM/year with 80% guarantee and a peak requirement occur in September. The details are presented in Table D.4.7. Irrigation water requirements in an average year are also estimated and are shown in Table D.4.8.

To design the irrigation canal systems, diversion water requirements in terms of discharge (m<sup>3</sup>/sec) and unit discharge (l/sec/ha) are calculated on the basis of 24 hours/day operation and 13 hours/day operation. The results are presented in Table D.4.9 - D.4.12.

## 5. ALTERNATIVES OF IRRIGATION SYSTEMS

In the study area, there are one(1) existing irrigation project and two(2) irrigation development plans.

The Carrizal-Chone, Amarillos and Guarango schemes constitute the project area of the Proyecto Multiple Carrizal-Chone which feasibility study has finished in 1989. The Rio Chico scheme corresponds to the pre-feasibility study on the Rio Chico. The remaining four(4) schemes constitute the Poza Honda irrigation project, and a part of these schemes are irrigated by this canal system at present.

Considering above conditions, three(3) cases of integrated irrigation development plan are studied corresponding to six(6) transbasin alternatives. Correspondence between irrigation development plans and transbasin alternatives, and water sources for each irrigation scheme are shown below:

Irrigation scheme	Water source		
	Case-1	Case-2	Case-3
Carrizal-Chone	La Esperanza dam	La Esperanza dam	La Esperanza dam
Amarillos	La Esperanza dam	La Esperanza dam	La Esperanza dam
Guarango	La Esperanza dam	La Esperanza dam	La Esperanza dam
Rio Chico	Chico river	Chico river	Chico river
Pechiche-Pasaje	Poza Honda dam	Chico river	La Esperanza dam
Santa Ana	Poza Honda dam	Poza Honda dam	Poza Honda dam
Mejia	Poza Honda dam	Poza Honda dam	La Esperanza dam
Ceibal-Guayaba	Poza Honda dam	Chico river	La Esperanza dam
Corresponding Transbasin Alternatives	No.1, 2, 5, 6	No.3	No.4

Total irrigation water demand for 29,250 ha is estimated at 571 MCM/year as mentioned in Section 4.2. Water demand for each water source, those are La Esperanza dam, Chirijos dam/Rio Chico and Poza Honda dam, is estimated as follows and the detail is shown in Table D.5.1.

Water source	Irrigation Area (ha)	Water Demand (1,000m <sup>3</sup> /year)
<u>Alternative-1, 2, 5 &amp; 6</u>		
- La Esperanza dam	17,500	307,930
- Rio Chico	1,700	31,340
- Poza Honda dam	10,050	231,760
Total	29,250	571,030
<u>Alternative-3</u>		
- La Esperanza dam	17,500	307,930
- Rio Chico	7,200	161,838
- Poza Honda dam	4,550	101,262
Total	29,250	571,030
<u>Alternative-4</u>		
- La Esperanza dam	24,250	466,153
- Rio Chico	1,700	31,340
- Poza Honda dam	3,300	73,537
Total	29,250	571,030

The irrigation development plan and irrigation flow diagram for six(6) transbasin alternatives are schematically shown in Fig.D.5.1 to D.5.6 and D.5.7 to D.5.9 respectively. Irrigation system is shaped in consideration of following points.

- Canal alignment for Carrizal-Chone, Amarillos and Guarango schemes is left as it is proposed in the feasibility study on Proyecto Multiple Carrizal-Chone.
- The existing Poza Honda irrigation canal system is maximally utilized in all alternative plans.

The principal features for each alternative plan are shown in Table D.5.2.

## 6. COST ESTIMATE

### 6.1 Project Cost

The project cost comprises direct cost, administration cost and engineering cost. The direct cost is estimated on the basis of preliminary facility plan and unit costs that are presented in Table D.5.2 and Table D.6.1 respectively. Administration cost and engineering cost are assumed to be 5 % and 10 % of direct cost respectively.

Based on above condition, the project cost for each transbasin alternative is estimated as shown below and the detail is shown in Table D.6.2 to D.6.4.

	Project Cost	
	Amount (US\$)	Unit cost (US\$/ha)
Alternative-1	87,181,000	2,981
Alternative-2	87,181,000	2,981
Alternative-3	86,919,000	2,972
Alternative-4	97,782,000	3,343
Alternative-5	87,181,000	2,981
Alternative-6	87,181,000	2,981

### 6.2 Operation, Maintenance and Replacement Cost

Annual operation and maintenance cost (O & M cost) comprise salaries of O&M office staff, material and labor costs for repairing facilities. It is assumed to be 1 % of direct construction cost. Some of the facilities such as mechanical and electrical works should be replaced at a certain interval. Durable period and replacement cost of the gate which is installed in Intake, check and Turnout structures is assumed to be 20 years and to be 10 % of direct construction cost on related structure respectively. Annual O&M cost and replacement cost are estimated as follows:

	O & M cost (1,000 US\$)	Replacement cost (1,000 US\$)
Alternative-1	758	1,426
Alternative-2	758	1,426
Alternative-3	756	1,429
Alternative-4	850	1,595
Alternative-5	758	1,426
Alternative-6	758	1,426

## **7. IRRIGATION BENEFIT**

### **7.1 General**

The irrigation benefits consist of direct benefits which are accrued from increase of agricultural production. To estimate it, the data of economic prices of farm inputs and outputs are collected. The irrigation benefits are estimated based on following conditions:

- 1) The exchange rate of Ecuadorian Sucre (S/.) to U.S.Dollar (US\$) is taken to be S/1,150 equivalent to US\$1.0 as of November 1991.
- 2) Constant prices at 1991 level are used.
- 3) Economic prices are applied to all of inputs and outputs, instead of financial prices. Taxes and levies are excluded from these economic prices.

## 7.2 Economic Prices of Farm Inputs and Outputs

Economic prices of trade goods such as rice, maize, cotton, soybean, peanut, beef, coffee, cacao, coconut and fertilizers are estimated on the basis of the projected world market prices. These prices are derived from the World Bank report on commodity price forecast. The details are presented in Table D.7.1 and Table D.7.2.

Non-trade goods such as vegetables, cassava, fruits and seeds are valued at financial prices which are estimated on the basis of current farm gate prices in the project area in August 1991.

Economic and financial prices of farm inputs and outputs used for estimating benefit are summarized in Table D.7.3.

## 7.3 Irrigation Benefit

The irrigation benefits are defined as the difference in net return from crops between the future with project and the future without project. The net returns per hectare of each crop under future with and future without project conditions are estimated as shown in Table D.7.4 and Table D.7.5. Annual net return of cow raising is presented in Table D.7.6.

Applying net returns of each crop to those harvested area, the total net returns for each irrigation scheme are calculated on both with and without project conditions. Then, annual irrigation benefits at full development stage for each scheme are estimated as shown in Table D.7.7 and are summarized as below:

Scheme	Area (ha)	Benefit	
		(S/.10 <sup>6</sup> )	(US\$/ha)
Carrizal-Chone	15,000	18,400	1,067
Amarillos	1,000	1,144	955
Guarango	1,500	1,746	1,012
Rio Chico	1,700	1,927	986
Pechiche-Pasaje	850	722	739
Santa Ana	3,300	3,237	853
Mejia	1,250	1,215	845
Ceibal-Guayaba	4,650	4,558	852
Total	29,250	32,949	980

## **T A B L E S**







Table D.2.1 Existing Irrigation Systems

Year : 1988				
Irrigation system	New/Old system	Water source	Irrigated area (ha)	Diversion structure
<b>1. Poza Honda system</b>				
- Santa Ana	New	Rio Portoviejo	1,170	Santa Ana D.W.
- Lote 5A	New	Rio Portoviejo	190	Pump
- Mejia	Old	Rio Portoviejo	580	Mejia D.W.
- Ceibal	Old	Rio Portoviejo	1,790	Ceibal D.W.
- La Jagua	Old	Rio Portoviejo	660	La Jagua D.W.
- El Cerrito	Old	Rio Portoviejo	350	El Cerrito D.W.
- La Guayaba	Old	Rio Portoviejo	110	La Guayaba D.W.
		Sub-total	4,850	
<b>2. Rio Chico system</b>				
- La Cienega	Old	Rio Chico	290	La Cienega D.W.
- Pechiche	Old	Rio Chico	610	Pechiche D.W.
- Pasaje	Old	Rio Chico	480	Pasaje D.W.
		Sub-total	1,380	
<b>3. La Estancilla system</b>				
	Old	Rio Carrizal	1,520	La Estancilla D.W.
		<b>Total</b>	<b>7,750</b>	

Source: Report of PHIMA, Evaluacion Preliminar de Los Sistemas de Riego de Poza Honda y La Estancilla, 1988

Table D.2.2 The Main Feature of Poza Honda Irrigation System

Name of Sub-system	Diversion Structure	Main Canal			Secondary Canal (km)
		Canal	Length (km)	Discharge* (m <sup>3</sup> /sec)	
Santa Ana	Santa Ana diversion dam	Right M.C.(Lote No.1)	24.85	12.25	16.2
		Left M.C.(Lote No.4)	13.76	1.45	19.3
Lote 5A	Pump at San Jose de Picoaza (Capacity: 0.250 m <sup>3</sup> /sec max.)	Left M.C.(Lote No.5)	4.70	3.25	5.3
Mejia	Mejia diversion dam	Right C.	2.00	2.30	3.5
		Left C.	7.50	4.50	8.0
Ceibal	Ceibal diversion dam	Right C.(Guabital)	2.10	3.20	5.4
		Right C.(Las Maravillas)	7.20	3.70	3.0
		Left C.(Canal Mesias)	17.00	12.00	14.9
La Jagua	La Jagua diversion dam	Right C.(San Eloy)	3.50	4.80	--
		Right C.(Canal Rio Viejo)	16.20	6.50	--
El Cerrito	El Cerrito diversion dam	Right C.	3.80	8.50	0.7
La Guayaba	La Guayaba diversion dam	Right C.	5.00	3.50	1.3
Total			107.61		77.6

\* : Design Discharge

Source: Report of PHIMA, Evaluacion Preliminar de Los Sistemas de Riego de Poza Honda y La Estancilla, 1988

Table D.3.1 Present Land Use

							(Unit: km <sup>2</sup> )	
Basin No. :	(No.7)	(No.8)	(No.9)	Total		Manabi		
Name of basin :	Bahia	Chone	Portoviejo	(A)	(A)/(B)	(B)		
1. Cultivated land	9.4	552.5	604.0	1,165.9	33%	3,545.0		
(1) Perennial crops	2.2	452.4	399.8	854.4	29%	2,972.1		
C11	0	112.7	61.6	174.3	36%	487.8		
C12	2.2	217.4	338.2	557.8	66%	841.2		
C13	0	0	0	0.0	0%	369.2		
C14	0	70.2	0	70.2	15%	457.9		
C15	0	51.5	0	51.5	7%	689.9		
C16	0	0	0	0.0	0%	3.2		
C17	0	0.6	0	0.6	1%	116.1		
C18	0	0	0	0.0	0%	6.8		
(2) Annual Crops	7.2	100.1	204.2	311.5	54%	572.9		
C21	0	0	114.3	114.3	100%	114.3		
C22	0	0	0	0.0	0%	14.4		
C23	1.8	0	4.1	5.9	52%	11.3		
C24	0	0	0	0.0	0%	5.6		
C25	5.4	100.1	85.8	191.3	45%	427.3		
2. Pasture land	33.2	869.4	450.7	1,353.3	21%	6,371.7		
P1	2.0	0	0	2.0	1%	150.4		
P2	31.2	850.6	450.7	1,332.5	21%	6,202.5		
P3	0	18.8	0	18.8	100%	18.8		
3. Complex land	160.8	617.7	481.4	1,259.9	38%	3,327.4		
F1	1.6	0	199.8	201.4	71%	282.8		
F2	117.7	362.3	180.0	660.0	84%	790.3		
F3	41.5	255.4	101.6	398.5	18%	2,254.3		
4. Natural vegetation land	337.4	223.4	521.1	1,081.9	19%	5,709.9		
V1	8.0	82.8	33.4	124.2	5%	2,673.4		
V2	181.1	112.6	74.8	368.5	34%	1,083.3		
V3	45.8	0	406.5	452.3	38%	1,180.5		
V4	0.9	19.2	1.2	21.3	14%	149.2		
V5	0	0	0	0.0	0%	414.8		
V6	58.0	4.4	3.6	66.0	41%	159.1		
V7	43.6	4.4	1.6	49.6	100%	49.6		
5. Non-vegetation land	3.2	4.0	2.8	10.0	22%	46.0		
X1	0	0	2.8	2.8	9%	30.8		
X2	3.2	4.0	0	7.2	47%	15.2		
<b>Total</b>	<b>544.0</b>	<b>2,267.0</b>	<b>2,060.0</b>	<b>4,871.0</b>	<b>26%</b>	<b>19,000.0</b>		

Source: Report of PHIMA, Recurso Suelo, 1988

Table D.3.2 Irrigation Potential Area in Gross

(Unit: ha)

Name of scheme	Category of Land			Total
	A	B	C	
Carrizal-Chone	15,080	4,200	--	19,280
Amarillos	920	370	--	1,290
Guarango	1,710	180	--	1,890
Rio Chico	2,080	50	40	2,170
Pechiche-Pasaje	1,060	--	--	1,060
Santa Ana	3,650	560	--	4,210
Mejia	1,600	--	--	1,600
Ceibal-Guayaba	2,720	3,520	--	6,240
<b>Total</b>	<b>28,820</b>	<b>8,880</b>	<b>40</b>	<b>37,740</b>

Table D.3.3 Irrigation Potential Area in Net

(Unit: ha)

Name of scheme	Category of Land			Total
	A	B	C	
Carrizal-Chone	12,060	2,940	--	15,000
Amarillos	740	260	--	1,000
Guarango	1,370	130	--	1,500
Rio Chico	1,650	40	10	1,700
Pechiche-Pasaje	850	--	--	850
Santa Ana	2,910	390	--	3,300
Mejia	1,250	--	--	1,250
Ceibal-Guayaba	2,190	2,460	--	4,650
<b>Total</b>	<b>23,020</b>	<b>6,220</b>	<b>10</b>	<b>29,250</b>

Conversion factor from gross to net value

- Category A: 80%
- Category B: 70%
- Category C: 30%

Table D.4.1 Meteorological Data (1/3)

Station: Portoviejo		(EL=44 m, 80-27'34"W, 01-02'03"S)												Code No.M005, INAMHI	
Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period
Mean temperature	°C	25.7	25.8	26.0	26.0	25.4	24.5	23.9	23.8	23.9	24.1	24.4	25.1	24.9	'59-'90
Relative humidity	%	76.8	80.0	80.6	79.6	77.8	78.0	77.8	76.4	75.9	75.8	74.9	73.6	77.3	'59-'90
Precipitation	mm	88.4	111.0	109.3	58.1	27.8	21.6	11.1	2.3	4.5	2.7	4.8	17.0	458.6	'63-'90
Evaporation (Class A-pan)	mm	131.4	114.1	133.7	132.9	137.4	116.7	128.3	148.2	150.7	150.1	146.7	149.1	1,639.3	'64-'90
Wind velocity at 10 m height	m/sec (km/day)	1.9 164.2	1.4 121.0	1.4 121.0	1.4 121.0	1.8 155.5	1.7 146.9	1.7 146.9	2.0 172.8	2.1 181.4	2.2 190.1	2.0 172.8	2.2 190.1	1.8 157.0	'62-'90
Sunshine hours	hrs	89.1	93.5	129.3	138.3	123.9	91.7	110.8	136.1	128.6	118.6	114.1	116.2	1,390.2	'63-'90
Cloudiness	oktas	7	7	7	7	7	7	7	6	6	7	7	7	7	'62-'90

Station: Santa Ana		(EL=50 m, 80-22'20"W, 01-12'13"S)												Code No.M034, INAMHI	
Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period
Mean temperature	°C	25.8	26.1	26.4	26.6	26.1	25.2	25.1	25.2	25.4	25.5	25.6	25.9	25.7	'62-'84
Relative humidity	%	79.7	81.0	82.2	81.6	81.1	81.6	80.3	78.8	78.6	78.3	77.8	77.0	79.8	'62-'84
Precipitation	mm	133.8	168.7	206.2	117.6	67.4	50.4	18.8	5.8	10.4	4.0	8.5	36.9	828.5	'63-'84
Evaporation (Class A-pan)	mm	142.4	101.8	134.4	137.3	133.5	141.4	135.9	162.9	154.6	151.3	145.7	146.4	1,687.6	'79-'84
Wind velocity at 10 m height	m/sec (km/day)	2.1 181.4	1.9 164.2	2.0 172.8	2.0 172.8	2.0 172.8	2.1 181.4	2.2 190.1	2.4 207.4	2.4 207.4	2.2 190.1	2.4 207.4	2.2 190.1	2.2 186.5	'62-'78
Sunshine hours	hrs	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cloudiness	oktas	7	7	6	6	6	7	6	6	6	6	6	7	6	'62-'84



Table D.4.1 Meteorological Data (3/3)

Station: Estancia		(EL=40 m, 80-13'00"W, 00-49'00"S)											Code No.M296, CRM		
Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period
Mean temperature	°C	25.7	26.2	26.6	26.6	25.8	25.1	24.6	24.6	24.7	25.1	25.4	25.8	25.5	'84-'90
Relative humidity	%	79.9	81.9	80.4	81.0	81.0	80.8	79.6	77.6	76.2	75.6	75.6	74.3	78.7	'76-'90
Precipitation	mm	156.6	194.6	171.6	141.2	49.4	25.6	20.4	5.7	10.0	8.0	12.4	32.1	827.6	'64-'90
Evaporation (Class A-pan)	mm	107.9	100.4	139.6	116.1	115.8	99.9	115.2	133.1	138.6	131.1	146.8	129.5	1,474.0	'87-'90
Wind velocity at 10 m height	m/sec (km/day)	1.9	1.7	1.7	1.7	1.8	1.9	2.0	2.3	2.6	2.3	2.3	2.1	2.0	'76-'90
Sunshine hours	hrs	66.3	88.8	120.5	108.0	81.0	64.6	72.5	104.8	88.3	74.5	105.0	85.6	1,059.9	'85-'90
Cloudiness	oktas	6	6	6	6	6	6	6	5	6	6	6	6	6	'76-'90



Table D.4.2 Potential Evapotranspiration (ETp) (1/2)

(Unit: mm/day)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Portoviejo	3.86	3.86	4.17	4.19	3.86	3.40	3.53	4.04	4.23	4.17	4.13	4.21	3.97
Santa Ana	3.45	3.46	4.03	3.94	3.68	3.03	3.59	3.89	4.07	4.12	4.13	3.58	3.75
Rocafuerte	3.87	3.95	4.58	3.83	4.10	3.89	3.89	4.23	4.41	4.47	4.46	4.41	4.17
Calceta	3.59	3.70	3.77	3.65	3.35	3.21	3.25	3.51	3.72	3.78	3.75	3.80	3.59
Estancilla	3.48	3.82	4.18	3.93	3.38	3.14	3.25	3.85	3.98	3.88	4.16	3.95	3.75

Table D.4.2 Potential Evapotranspiration (ETp) (2/2)

(Unit: mm)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Portoviejo	119.7	108.1	129.3	125.7	119.7	102.0	109.4	125.2	126.9	129.3	123.9	130.5	1,450
Santa Ana	107.0	96.9	124.9	118.2	114.1	90.9	111.3	120.6	122.1	127.7	123.9	111.0	1,369
Rocafuerte	120.0	110.6	142.0	114.9	127.1	116.7	120.6	131.1	132.3	138.6	133.8	136.7	1,524
Calceta	111.3	103.6	116.9	109.5	103.9	96.3	100.8	108.8	111.6	117.2	112.5	117.8	1,310
Estancilla	107.9	107.0	129.6	117.9	104.8	94.2	100.8	119.4	119.4	120.3	124.8	122.5	1,368

Table D.4.3 Data Employed to Estimate Potential Evapotranspiration by Penman Method

Station		Temperature	Relative Humidity	Wind Speed	Sunshine Hours	Cloudiness
Name	Code					
Portoviejo	M005	X	X	X	X	
Santa Ana	M034	X	X	X		X
Rocafuerte	M165	X	X	X		X
Calceta	M164	X	X (M296)	X	X	
Estancilla	M296	X	X	X	X	

Table D.4.4 Mean Monthly Rainfall

(Unit: mm)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Period
Portoviejo	88.4	111.0	109.3	58.1	27.8	21.6	11.1	2.3	4.4	2.7	4.8	17.0	459	'63-'90
Santa Ana	133.8	168.7	206.2	117.6	67.4	50.4	18.8	5.8	10.4	4.0	8.5	36.9	828	'63-'84
Rocafuerte	74.0	110.8	93.3	43.7	26.9	13.8	9.0	1.2	3.5	1.7	2.6	15.0	396	'63-'90
Alajuela	150.6	174.1	187.7	130.9	51.5	34.1	21.8	8.2	8.3	8.9	9.6	37.0	823	'68-'85
Pechiche	88.8	145.9	113.1	69.5	52.6	59.9	23.6	13.1	12.2	15.2	13.3	41.9	649	'72-'85
Calceta	189.2	216.3	261.1	151.5	56.2	45.1	31.9	8.2	13.6	8.6	11.4	46.1	1039	'63-'85
Estancilla	156.6	194.6	171.6	141.2	49.4	25.6	20.4	5.7	10.0	8.0	12.4	32.1	828	'64-'90

Table D.4.5 Probable Monthly Rainfall  
(5-Year non-exceedance)

(Unit: mm)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Period
Portoviejo	18.6	46.8	50.9	22.8	1.9	0.2	0.0	0.0	0.1	0.0	0.0	1.6	143	'63-'90
Santa Ana	46.1	88.3	121.7	45.1	5.7	0.8	0.0	0.0	0.0	0.0	0.0	1.8	310	'63-'84
Rocafuerte	17.4	36.6	37.3	10.8	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.2	103	'63-'90
Alajuela	55.7	105.5	111.5	70.2	4.8	3.5	0.1	0.0	0.8	0.1	0.0	1.8	354	'68-'85
Pechiche	20.0	75.6	58.5	15.5	2.4	0.0	0.0	0.0	0.0	0.1	0.0	3.6	176	'72-'85
Calceta	64.7	137.5	131.5	67.0	7.5	3.2	0.7	0.0	1.0	0.3	0.0	6.1	420	'63-'85
Estancilla	54.0	102.7	81.9	73.3	5.0	1.2	0.1	0.0	0.1	0.0	0.1	2.7	321	'64-'90

Table D.4.6 Proposed Land Use for Each Scheme

(Unit: ha)

	Carrizal- Chone	Amarillos	Guarango	Rio Chico	Pechiche- Pasaje	Santa Ana	Mejia	Ceibal- Guayaba	Total
1. Physical area	15,000	1,000	1,500	1,700	850	3,300	1,250	4,650	29,250
2. Cropping area									
Maize	1,480	100	150	180	80	330	120	460	2,900
Rice	11,940	800	1,190	1,360	680	2,620	1,000	3,700	23,290
Melon	180	10	20	20	10	35	20	60	355
Green pepper	420	20	40	50	20	90	30	130	800
Water melon	1,180	80	120	130	60	260	100	360	2,290
Tomato	40	0	0	0	0	10	0	10	60
Pumpkin	360	20	40	40	20	80	30	110	700
Cotton	2,320	150	230	260	130	510	190	720	4,510
Peanut	1,160	80	120	130	80	260	100	360	2,290
Soybean	120	10	10	10	10	30	10	40	240
Citrus	2,220	150	220	250	130	490	180	690	4,330
Platano	3,010	200	300	340	170	660	250	930	5,860
Others	340	30	40	40	20	75	30	110	685
Total	24,770	1,650	2,480	2,810	1,410	5,450	2,060	7,680	48,310

Source: Report of PHIMA, Informe Final Volumen II Informes Sectoriales (1), JICA 1990

Table D.4.7 Irrigation Water Demand in Volume  
(5-year return period)

(Unit: 1,000 m3)

Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Carrizal-Chone	15,000	8,316	2,388	10,204	18,692	27,048	19,220	23,694	28,529	36,603	34,133	26,874	17,526	253,227
Amarillos	1,000	627	449	1,475	1,260	1,830	1,261	1,582	2,089	2,616	2,334	1,983	1,276	18,782
Guarango	1,500	1,784	1,906	3,526	3,192	3,456	2,380	2,705	3,325	4,258	4,039	3,185	2,165	35,921
Rio Chico	1,700	1,032	596	1,661	2,226	3,406	1,991	2,885	3,542	4,542	4,197	3,292	1,970	31,340
Pechiche-Pasaje	850	997	648	1,726	1,749	1,925	1,357	1,547	1,896	2,417	2,288	1,808	1,195	19,553
Santa Ana	3,300	3,810	3,589	6,364	7,230	7,172	4,582	5,468	7,018	9,001	8,289	6,522	4,492	73,537
Mejia	1,250	1,438	1,357	2,402	2,719	2,696	1,722	2,066	2,656	3,413	3,142	2,419	1,695	27,725
Ceibal-Guayaba	4,650	5,550	5,921	10,938	9,893	10,727	7,396	8,415	9,773	13,209	12,520	9,878	6,725	110,945
<b>Total</b>	<b>29,250</b>	<b>23,554</b>	<b>16,854</b>	<b>38,296</b>	<b>46,961</b>	<b>58,260</b>	<b>39,909</b>	<b>48,362</b>	<b>58,828</b>	<b>76,059</b>	<b>70,942</b>	<b>55,961</b>	<b>37,044</b>	<b>571,030</b>

Table D.4.8 Irrigation Water Demand in Volume  
(Average year)

(Unit: 1,000 m3)

Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Carrizal-Chone	15,000	0	0	0	3,424	16,522	10,353	14,988	26,639	33,558	32,302	24,225	9,406	171,417
Amarillos	1,000	0	0	416	435	1,189	919	1,269	2,003	2,462	2,209	1,801	867	13,570
Guarango	1,500	785	658	2,268	2,458	2,855	2,084	2,432	3,313	4,201	4,027	3,155	1,850	30,086
Rio Chico	1,700	0	0	469	940	2,260	1,294	2,131	3,344	4,341	3,944	3,047	1,150	22,920
Pechiche-Pasaje	850	352	143	1,078	1,075	1,294	663	1,225	1,732	2,272	2,091	1,637	737	14,299
Santa Ana	3,300	1,314	1,321	3,749	5,449	5,833	3,611	4,684	6,914	8,800	8,173	6,185	3,782	59,815
Mejia	1,250	496	502	1,420	2,051	2,194	1,357	1,767	2,617	3,341	3,098	2,342	1,427	22,612
Ceibal-Guayaba	4,650	2,443	2,047	7,038	7,618	8,864	6,479	7,565	10,291	13,032	12,483	9,785	5,749	93,394
<b>Total</b>	<b>29,250</b>	<b>5,390</b>	<b>4,671</b>	<b>16,438</b>	<b>23,450</b>	<b>41,011</b>	<b>26,760</b>	<b>36,061</b>	<b>56,853</b>	<b>72,007</b>	<b>68,327</b>	<b>52,177</b>	<b>24,968</b>	<b>428,113</b>

Table D.4.9 Diversion Water Requirement  
(24 hours operation)

Scheme	Area (ha)	(Unit: m <sup>3</sup> /sec)												
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Max.
Carrizal-Chone	15,000	3.10	0.99	3.81	7.21	10.10	7.42	8.85	10.65	14.12	12.74	10.37	6.54	14.12
Amarillos	1,000	0.23	0.19	0.55	0.49	0.68	0.49	0.59	0.78	1.01	0.87	0.77	0.48	1.01
Guarango	1,500	0.67	0.79	1.32	1.23	1.29	0.92	1.01	1.24	1.64	1.51	1.23	0.81	1.64
Rio Chico	1,700	0.39	0.25	0.62	0.86	1.27	0.77	1.08	1.32	1.75	1.57	1.27	0.74	1.75
Pechiche-Pasaje	850	0.37	0.27	0.64	0.67	0.72	0.52	0.58	0.71	0.93	0.85	0.70	0.45	0.93
Santa Ana	3,300	1.42	1.48	2.38	2.79	2.68	1.77	2.04	2.62	3.47	3.09	2.52	1.68	3.47
Mejia	1,250	0.54	0.56	0.90	1.05	1.01	0.66	0.77	0.99	1.32	1.17	0.93	0.63	1.32
Ceibal-Guayaba	4,650	2.07	2.45	4.08	3.82	4.01	2.85	3.14	3.65	5.10	4.67	3.81	2.51	5.10
<b>Total</b>	<b>29,250</b>	<b>8.79</b>	<b>6.97</b>	<b>14.30</b>	<b>18.12</b>	<b>21.75</b>	<b>15.40</b>	<b>18.06</b>	<b>21.96</b>	<b>29.34</b>	<b>26.49</b>	<b>21.59</b>	<b>13.83</b>	<b>29.34</b>

Table D.4.10 Unit Diversion Water Requirement  
(24 hours operation)

Scheme	Area (ha)	(Unit: l/sec/ha)												
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Max.
Carrizal-Chone	15,000	0.21	0.07	0.25	0.48	0.67	0.49	0.59	0.71	0.94	0.85	0.69	0.44	0.94
Amarillos	1,000	0.23	0.19	0.55	0.49	0.68	0.49	0.59	0.78	1.01	0.87	0.77	0.48	1.01
Guarango	1,500	0.44	0.53	0.88	0.82	0.86	0.61	0.67	0.83	1.10	1.01	0.82	0.54	1.10
Rio Chico	1,700	0.23	0.14	0.36	0.51	0.75	0.45	0.63	0.78	1.03	0.92	0.75	0.43	1.03
Pechiche-Pasaje	850	0.44	0.32	0.76	0.79	0.85	0.62	0.68	0.83	1.10	1.00	0.82	0.52	1.10
Santa Ana	3,300	0.43	0.45	0.72	0.85	0.81	0.54	0.62	0.79	1.05	0.94	0.76	0.51	1.05
Mejia	1,250	0.43	0.45	0.72	0.84	0.81	0.53	0.62	0.79	1.05	0.94	0.75	0.51	1.05
Ceibal-Guayaba	4,650	0.45	0.53	0.88	0.82	0.86	0.61	0.68	0.78	1.10	1.01	0.82	0.54	1.10
<b>Total</b>	<b>29,250</b>	<b>0.30</b>	<b>0.24</b>	<b>0.49</b>	<b>0.62</b>	<b>0.74</b>	<b>0.53</b>	<b>0.62</b>	<b>0.75</b>	<b>1.00</b>	<b>0.91</b>	<b>0.74</b>	<b>0.47</b>	<b>1.00</b>

Table D.4.11 Diversion Water Requirement  
(13 hours operation)

(Unit: m <sup>3</sup> /sec)														
Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Max.
Carrizal-Chone	15,000	5.73	1.82	7.03	13.31	18.64	13.69	16.33	19.66	26.07	23.53	19.14	12.08	26.07
Amarillos	1,000	0.43	0.34	1.02	0.90	1.26	0.90	1.09	1.44	1.86	1.61	1.41	0.88	1.86
Guarango	1,500	1.23	1.45	2.43	2.27	2.38	1.70	1.86	2.29	3.03	2.78	2.27	1.49	3.03
Río Chico	1,700	0.71	0.45	1.14	1.59	2.35	1.42	1.99	2.44	3.24	2.89	2.34	1.36	3.24
Pechiche-Pasaje	850	0.69	0.49	1.19	1.25	1.33	0.97	1.07	1.31	1.72	1.58	1.29	0.82	1.72
Santa Ana	3,300	2.63	2.74	4.39	5.15	4.94	3.26	3.77	4.84	6.41	5.71	4.65	3.10	6.41
Mejia	1,250	0.99	1.04	1.66	1.94	1.86	1.23	1.42	1.83	2.43	2.17	1.72	1.17	2.43
Ceibal-Guayaba	4,650	3.83	4.52	7.54	7.05	7.39	5.27	5.80	6.74	9.41	8.63	7.04	4.64	9.41
<b>Total</b>	<b>29,250</b>	<b>16.24</b>	<b>12.86</b>	<b>26.40</b>	<b>33.45</b>	<b>40.16</b>	<b>28.43</b>	<b>33.33</b>	<b>40.55</b>	<b>54.17</b>	<b>48.90</b>	<b>39.86</b>	<b>25.53</b>	<b>54.17</b>

Table D.4.12 Unit Diversion Water Requirement  
(13 hours operation)

(Unit: l/sec/ha)														
Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Max.
Carrizal-Chone	15,000	0.38	0.12	0.47	0.89	1.24	0.91	1.09	1.31	1.74	1.57	1.28	0.81	1.74
Amarillos	1,000	0.43	0.34	1.02	0.90	1.26	0.90	1.09	1.44	1.86	1.61	1.41	0.88	1.86
Guarango	1,500	0.82	0.97	1.62	1.52	1.59	1.13	1.24	1.53	2.02	1.86	1.51	0.99	2.02
Río Chico	1,700	0.42	0.27	0.67	0.93	1.38	0.83	1.17	1.44	1.90	1.70	1.38	0.80	1.90
Pechiche-Pasaje	850	0.81	0.58	1.40	1.47	1.56	1.14	1.25	1.54	2.03	1.86	1.51	0.97	2.03
Santa Ana	3,300	0.80	0.83	1.33	1.56	1.50	0.99	1.14	1.47	1.94	1.73	1.41	0.94	1.94
Mejia	1,250	0.79	0.83	1.32	1.55	1.49	0.98	1.14	1.46	1.94	1.73	1.38	0.93	1.94
Ceibal-Guayaba	4,650	0.82	0.97	1.62	1.52	1.59	1.13	1.25	1.45	2.02	1.86	1.51	1.00	2.02
<b>Total</b>	<b>29,250</b>	<b>0.56</b>	<b>0.44</b>	<b>0.90</b>	<b>1.14</b>	<b>1.37</b>	<b>0.97</b>	<b>1.14</b>	<b>1.39</b>	<b>1.85</b>	<b>1.67</b>	<b>1.36</b>	<b>0.87</b>	<b>1.85</b>

Table D.5.1 Irrigation Water Demand in Volume for each water resource

(Transbasin Alternative-1, 2, 5 & 6) (Unit : 1,000 m3)

Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
<b>(1) La Esperanza Dam</b>														
- Carrizal-Chone	15,000	8,316	2,388	10,204	18,692	27,048	19,220	23,694	28,529	36,603	34,133	26,874	17,526	253,227
- Amarillos	1,000	627	449	1,475	1,260	1,830	1,261	1,582	2,089	2,616	2,334	1,983	1,276	18,782
- Guarango	1,500	1,784	1,906	3,526	3,192	3,456	2,380	2,705	3,325	4,258	4,039	3,185	2,165	35,921
Sub-total	17,500	10,727	4,743	15,205	23,144	32,334	22,861	27,981	33,943	43,477	40,506	32,042	20,967	307,930
<b>(2) Río Chico</b>														
- Río Chico	1,700	1,032	596	1,661	2,226	3,406	1,991	2,885	3,542	4,542	4,197	3,292	1,970	31,340
<b>(3) Poza Honda Dam</b>														
- Santa Ana	3,300	3,810	3,589	6,364	7,230	7,172	4,582	5,468	7,018	9,001	8,289	6,522	4,492	73,537
- Mejía	1,250	1,438	1,357	2,402	2,719	2,696	1,722	2,066	2,656	3,413	3,142	2,419	1,695	27,725
- Pechiche-Pasaje	850	997	648	1,726	1,749	1,925	1,357	1,547	1,896	2,417	2,288	1,808	1,195	19,553
- Ceibal-Guayaba	4,650	5,550	5,921	10,938	9,893	10,727	7,396	8,415	9,773	13,209	12,520	9,878	6,725	110,945
Sub-total	10,050	11,795	11,515	21,430	21,591	22,520	15,057	17,496	21,343	28,040	26,239	20,627	14,107	231,760
<b>Total</b>	<b>29,250</b>	<b>23,554</b>	<b>16,854</b>	<b>38,296</b>	<b>46,961</b>	<b>58,260</b>	<b>39,909</b>	<b>48,362</b>	<b>58,828</b>	<b>76,059</b>	<b>70,942</b>	<b>55,961</b>	<b>37,044</b>	<b>571,030</b>

Note: Based on 5-year return period

(Alternative-3) (Unit : 1,000 m3)

Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
<b>(1) La Esperanza Dam</b>														
- Carrizal-Chone	15,000	8,316	2,388	10,204	18,692	27,048	19,220	23,694	28,529	36,603	34,133	26,874	17,526	253,227
- Amarillos	1,000	627	449	1,475	1,260	1,830	1,261	1,582	2,089	2,616	2,334	1,983	1,276	18,782
- Guarango	1,500	1,784	1,906	3,526	3,192	3,456	2,380	2,705	3,325	4,258	4,039	3,185	2,165	35,921
Sub-total	17,500	10,727	4,743	15,205	23,144	32,334	22,861	27,981	33,943	43,477	40,506	32,042	20,967	307,930
<b>(2) Río Chico</b>														
- Río Chico	1,700	1,032	596	1,661	2,226	3,406	1,991	2,885	3,542	4,542	4,197	3,292	1,970	31,340
- Pechiche-Pasaje	850	997	648	1,726	1,749	1,925	1,357	1,547	1,896	2,417	2,288	1,808	1,195	19,553
- Ceibal-Guayaba	4,650	5,550	5,921	10,938	9,893	10,727	7,396	8,415	9,773	13,209	12,520	9,878	6,725	110,945
Sub-total	7,200	7,579	7,165	14,325	13,868	16,058	10,744	12,847	15,211	20,168	19,005	14,978	9,890	161,838
<b>(3) Poza Honda Dam</b>														
- Santa Ana	3,300	3,810	3,589	6,364	7,230	7,172	4,582	5,468	7,018	9,001	8,289	6,522	4,492	73,537
- Mejía	1,250	1,438	1,357	2,402	2,719	2,696	1,722	2,066	2,656	3,413	3,142	2,419	1,695	27,725
Sub-total	4,550	5,248	4,946	8,766	9,949	9,868	6,304	7,534	9,674	12,414	11,431	8,941	6,187	101,262
<b>Total</b>	<b>29,250</b>	<b>23,554</b>	<b>16,854</b>	<b>38,296</b>	<b>46,961</b>	<b>58,260</b>	<b>39,909</b>	<b>48,362</b>	<b>58,828</b>	<b>76,059</b>	<b>70,942</b>	<b>55,961</b>	<b>37,044</b>	<b>571,030</b>

Note: Based on 5-year return period

(Alternative-4) (Unit : 1,000 m3)

Scheme	Area (ha)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
<b>(1) La Esperanza Dam</b>														
- Carrizal-Chone	15,000	8,316	2,388	10,204	18,692	27,048	19,220	23,694	28,529	36,603	34,133	26,874	17,526	253,227
- Amarillos	1,000	627	449	1,475	1,260	1,830	1,261	1,582	2,089	2,616	2,334	1,983	1,276	18,782
- Guarango	1,500	1,784	1,906	3,526	3,192	3,456	2,380	2,705	3,325	4,258	4,039	3,185	2,165	35,921
- Mejía	1,250	1,438	1,357	2,402	2,719	2,696	1,722	2,066	2,656	3,413	3,142	2,419	1,695	27,725
- Pechiche-Pasaje	850	997	648	1,726	1,749	1,925	1,357	1,547	1,896	2,417	2,288	1,808	1,195	19,553
- Ceibal-Guayaba	4,650	5,550	5,921	10,938	9,893	10,727	7,396	8,415	9,773	13,209	12,520	9,878	6,725	110,945
Sub-total	24,250	18,712	12,669	30,271	37,505	47,682	33,336	40,009	48,268	62,516	58,456	46,147	30,582	466,153
<b>(2) Río Chico</b>														
- Río Chico	1,700	1,032	596	1,661	2,226	3,406	1,991	2,885	3,542	4,542	4,197	3,292	1,970	31,340
<b>(3) Poza Honda Dam</b>														
- Santa Ana	3,300	3,810	3,589	6,364	7,230	7,172	4,582	5,468	7,018	9,001	8,289	6,522	4,492	73,537
<b>Total</b>	<b>29,250</b>	<b>23,554</b>	<b>16,854</b>	<b>38,296</b>	<b>46,961</b>	<b>58,260</b>	<b>39,909</b>	<b>48,362</b>	<b>58,828</b>	<b>76,059</b>	<b>70,942</b>	<b>55,961</b>	<b>37,044</b>	<b>571,030</b>

Note: Based on 5-year return period

Table D.5.2 Principal Features of Irrigation Development Schemes (1/2)

( Alternative-1, 2, 5 & 6 )											
Name of Scheme	Irrigable Area (ha)	Diversion Weir (m)	Regulation Pond (m3)	Main Canal					Secondary Canal (ha)	Farm Road (ha)	Drainage Canal (ha)
				No.	Discharge (m3/s)	Open Canal (km)	Tunnel (km)	Siphon (km)			
Carrizal - Chone	15,000	-	586,000	1	16.8	9.8	0.3	-	15,000	15,000	15,000
				2	8 - 10	9.0	0.4	1.2			
				3	6 - 8	17.2	-	-			
				4	4 - 6	5.3	0.5	2.4			
				5	2 - 4	18.8	-	2.6			
				6	0 - 2	10.0	-	0.5			
				70.1		1.2	6.7				
Los Amarillos	1,000	-	42,000	7	2.7	4.8	-	0.8	1,000	1,000	1,000
Guarango	1,500	-	69,000	8	1.7	9.7	6.6 *	1.4	1,500	1,500	1,500
Rio Chico	1,700	Ex.	-	9	0.4	12.5	-	0.4	1,700	1,700	1,700
				10	0.4	10.5 Reh.	-	0.4			
Santa Ana	3,300	Ex.	61,000	11	1.5	13.8 Ex.	-	-	1,000	1,000	3,300
				12	10.1	20.5 Ex.	-	-			
				13	10.1	4.4 Reh.	-	-			
				14	4.2	4.7 Ex.	-	3.0 Reh.			
Pechiche - Pasaje	850	-	-	15	0.7	-	-	2.5 Reh.	850	850	850
Mejia	1,250	-	-	16	1.7	4.5 Reh.	-	-	1,250	1,250	1,250
				17	3.8	9.2 Reh.	-	-			
Ceibal - Guayaba	4,650	Ex.	-	18	7.2	18.0 Reh.	-	-	4,650	4,650	4,650
				19	2.2	9.0 Reh.	-	-			
<b>Total</b>	<b>29,250</b>		<b>758,000</b>			<b>191.7</b>	<b>7.8</b>	<b>15.2</b>	<b>26,950</b>	<b>26,950</b>	<b>29,250</b>

Note: (\*) Including in transbasin cost, (Ex.) Existing, (Reh.) Rehabilitation

( Alternative-3 )											
Name of Scheme	Irrigable Area (ha)	Diversion Weir (m)	Regulation Pond (m3)	Main Canal					Secondary Canal (ha)	Farm Road (ha)	Drainage Canal (ha)
				No.	Discharge (m3/s)	Open Canal (km)	Tunnel (km)	Siphon (km)			
Carrizal - Chone	15,000	-	586,000	1	16.8	9.8	0.3	-	15,000	15,000	15,000
				2	8 - 10	9.0	0.4	1.2			
				3	6 - 8	17.2	-	-			
				4	4 - 6	5.3	0.5	2.4			
				5	2 - 4	18.8	-	2.6			
				6	0 - 2	10.0	-	0.5			
				70.1		1.2	6.7				
Los Amarillos	1,000	-	42,000	7	2.7	4.8	-	0.8	1,000	1,000	1,000
Guarango	1,500	-	69,000	8	1.7	9.7	6.6 *	1.4	1,500	1,500	1,500
Rio Chico	1,700	Ex.	-	9	0.4	12.5	-	0.4	1,700	1,700	1,700
				10	0.4	10.5 Reh.	-	0.4			
Pechiche - Pasaje	850	Ex.	-	11	0.7	3.5 Reh.	-	-	850	850	850
				12	1.0	4.0 Reh.	-	-			
Mejia	1,250	-	-	13	0.9	4.5 Reh.	-	-	1,250	1,250	1,250
				14	1.6	9.2 Reh.	-	-			
Santa Ana	3,300	Ex.	61,000	15	1.5	13.8 Ex.	-	-	1,000	1,000	3,300
				16	6.1	20.5 Ex.	-	-			
				17	2.8	4.4 Reh.	-	-			
				18	1.9	4.7 Ex.	-	3.0 Reh.			
Ceibal - Guayaba	4,650	Ex.	-	19	7.2	18.0 Reh.	-	-	4,650	4,650	4,650
				20	2.2	10.0 Reh.	-	-			
<b>Total</b>	<b>29,250</b>		<b>758,000</b>			<b>200.2</b>	<b>7.8</b>	<b>12.7</b>	<b>26,950</b>	<b>26,950</b>	<b>29,250</b>

Note: (\*) Including in transbasin cost, (Ex.) Existing, (Reh.) Rehabilitation



Table D.5.2 Principal Features of Irrigation Development Schemes (2/2)

(Alternative-4)											
Name of Scheme	Irrigable Area (ha)	Diversion Weir (m)	Regulation Pond (m3)	Main Canal					Secondary Canal (ha)	Farm Road (ha)	Drainage Canal (ha)
				No.	Discharge (m3/s)	Open Canal (km)	Tunnel (km)	Siphon (km)			
Carrizal - Chone	15,000	-	586,000	1	24.1	9.8	0.3	-	15,000	15,000	15,000
				2	14 - 16	16.7	0.4	1.2			
				3	8 - 10	-	-	-			
				4	6 - 8	9.5	-	-			
				5	4 - 6	5.3	0.5	2.4			
				6	2 - 4	18.8	-	2.6			
				7	0 - 2	10.0	-	0.5			
				70.1		1.2	6.7				
Los Amarillos	1,000	-	42,000	8	10.0	4.8	-	0.8	1,000	1,000	1,000
Guarango	1,500	-	69,000	9	9.0	9.7	6.6 *	1.4	1,500	1,500	1,500
Ceibal - Guayaba	4,650	-	213,000	10	3.9	12.5 Reh.	-	-	4,650	4,650	4,650
				11	3.5	-	-	2.0			
				12	1.2	10.0 Reh.	-	-			
				13	1.2	4.5	-	0.2			
Pechiche - Pasaje	850	-	39,000	14	2.3	7.0	-	-	850	850	850
				15	1.9	3.0	-	1.5			
Mejia	1,250	-	55,000	16	1.3	6.0	-	-	1,250	1,250	1,250
				17	0.8	-	-	0.2			
Rio Chico	1,700	Ex.	-	18	0.4	12.5	-	0.4	1,700	1,700	1,700
				19	0.4	10.5 Reh.	-	0.4			
Santa Ana	3,300	Ex.	61,000	20	1.5	13.8 Ex.	-	-	1,000	1,000	3,300
				21	3.7	20.5 Ex.	-	-			
				22	0.4	4.4 Reh.	-	-			
				23	0.4	4.7 Ex.	-	3.0 Reh.			
<b>Total</b>	<b>29,250</b>		<b>1,065,000</b>			<b>194.0</b>	<b>7.8</b>	<b>16.6</b>	<b>26,950</b>	<b>26,950</b>	<b>29,250</b>

Note: (\*) Including in transbasin cost, (Ex.) Existing, (Reh.) Rehabilitation

Table D.6.1 Unit Costs

1. Main canal and siphon

Discharge (m <sup>3</sup> /sec)	Main canal (US\$/m)	Siphon (US\$/m)
0.5	100	-
1	125	360
2	150	420
3	170	480
4	200	540
5	220	600
6	220	650
7	250	710
8	250	770
9	250	830
10	280	890
12	310	1,010
14	340	1,120
16	340	1,240
18	370	1,360
20	370	1,480
22	410	1,590
24	410	1,710
26	440	1,830

Main canal: Trapezoidal concrete lined canal with operation road

- 2. Regulation pond                 0.2 US\$ per 1 m<sup>3</sup> of storage capacity
- 3. Secondary canal                 610 US\$ / ha  
  ( Trapezoidal concrete lined canal )
- 4. Farm road                         230 US\$ / ha  
  ( 4 m width road without gravel paveme
- 5. Drainage canal                    210 US\$ / ha

Table D.6.2 Estimation of Construction Cost for Irrigation Development (1/2)  
(Alternative-1, 2, 5 & 6)

Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)	Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)
<b>CARRIZAL - CHONE SCHEME</b>					<b>GUARANGO SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	586,000	0.2	117	(2) Regulation Pond	m3	69,000	0.2	14
(3) Main Canal					(3) Main Canal				
- No.1 Canal	m	9,800	340	3,332	- No.8 Canal	m	9,700	150	1,455
- No.2 Canal	m	9,000	250	2,250	(4) Tunnel				
- No.3 Canal	m	17,200	250	4,300	- No.8 Canal *	m	6,600	0	0
- No.4 Canal	m	5,300	220	1,166	(5) Siphon				
- No.5 Canal	m	18,800	170	3,196	- No.8 Canal	m	1,400	420	588
- No.6 Canal	m	10,000	125	1,250	(6) Secondary Canal	ha	1,500	610	915
(4) Tunnel					(7) Farm Road	ha	1,500	230	345
- No.1 Canal	m	300	1,833	550	(8) Drainage Canal	ha	1,500	210	315
- No.2 Canal	m	400	1,690	676	(9) Related Structure	LS			680
- No.4 Canal	m	500	1,298	649					
(5) Siphon					<b>Total of A</b>				<b>4,312</b>
- No.2 Canal	m	1,200	830	996					
- No.4 Canal	m	2,400	600	1,440	<b>B. Administration Cost</b>				<b>216</b>
- No.5 Canal	m	2,600	480	1,248	(5% of A)				
- No.6 Canal	m	500	360	180	<b>C. Engineering Cost</b>				<b>431</b>
(6) Secondary Canal	ha	15,000	610	9,150	(10% of A)				
(7) Farm Road	ha	15,000	230	3,450					
(8) Drainage Canal	ha	15,000	210	3,150	<b>Total of Guarango scheme</b>				<b>4,959</b>
(9) Related Structure	LS			8,439	1,500 ha		(US\$/ha)		<b>3,306</b>
<b>Total of A</b>				<b>45,539</b>					
<b>B. Administration Cost</b>				<b>2,277</b>					
(5% of A)									
<b>C. Engineering Cost</b>				<b>4,554</b>					
(10% of A)									
<b>Total of Carrizal-chone scheme</b>				<b>52,370</b>					
15,000 ha			(US\$/ha)	<b>3,491</b>					
<b>LOS AMARILLOS SCHEME</b>					<b>RIO CHICO SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	42,000	0.2	8	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
- No.7 Canal	m	4,800	170	816	- No.9 Canal	m	12,500	100	1,250
(4) Tunnel	m	0	0	0	- No.10 Canal	m	10,500	70	735
(5) Siphon					(4) Tunnel	m	0	0	0
- No.7 Canal	m	800	480	384	(5) Siphon				
(6) Secondary Canal	ha	1,000	610	610	- No.9 Canal	m	400	360	144
(7) Farm Road	ha	1,000	230	230	- No.10 Canal	m	400	360	144
(8) Drainage Canal	ha	1,000	210	210	(6) Secondary Canal	ha	1,700	500	850
(9) Related Structure	LS			446	(7) Farm Road	ha	1,700	230	391
					(8) Drainage Canal	ha	1,700	210	357
					(9) Related Structure	LS			825
<b>Total of A</b>				<b>2,704</b>	<b>Total of A</b>				<b>4,696</b>
<b>B. Administration Cost</b>				<b>135</b>					
(5% of A)					<b>B. Administration Cost</b>				<b>235</b>
<b>C. Engineering Cost</b>				<b>270</b>	(5% of A)				
(10% of A)					<b>C. Engineering Cost</b>				<b>470</b>
					(10% of A)				
<b>Total of Los Amarillos scheme</b>				<b>3,110</b>	<b>Total of Rio Chico scheme</b>				<b>5,400</b>
1,000 ha			(US\$/ha)	<b>3,110</b>	1,700 ha		(US\$/ha)		<b>3,177</b>

Note: (\*) Including in transbasin cost

Table D.6.2 Estimation of Construction Cost for Irrigation Development (2/2)  
(Alternative-1, 2, 5 & 6)

Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)	Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)
<b>SANTA ANA SCHEME</b>					<b>MEJIA SCHEME</b>				
A. Direct Cost					A. Direct Cost				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	61,000	0.2	12	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
- No.11 Canal (Ex.)	m	13,800	0	0	- No.16 Canal (Rech.)	m	4,500	75	338
- No.12 Canal (Ex.)	m	20,500	0	0	- No.17 Canal (Rech.)	m	9,200	100	920
- No.13 Canal (Rech.)	m	4,400	140	616	(4) Tunnel	m	0	0	0
- No.14 Canal (Ex.)	m	4,700	0	0	(5) Siphon	m	0	0	0
(4) Tunnel	m	0	0	0	(6) Secondary Canal	ha	1,250	610	763
(5) Siphon					(7) Farm Road	ha	1,250	230	288
- No.14 Canal (Rech.)	m	3,000	270	810	(8) Drainage Canal	ha	1,250	210	263
(6) Secondary Canal	ha	1,000	610	610	(9) Related Structure	LS			602
(7) Farm Road	ha	1,000	230	230					
(8) Drainage Canal	ha	3,300	210	693	Total of A				3,172
(9) Related Structure	LS			836					
Total of A				3,807	B. Administration Cost (5% of A)				159
B. Administration Cost (5% of A)				190	C. Engineering Cost (10% of A)				317
C. Engineering Cost (10% of A)				381	Total of Mejia scheme				3,648
Total of Santa Ana scheme				4,378	1,250 ha		(US\$/ha)		2,919
3,300 ha		(US\$/ha)		1,327					
<b>PECHICHE-PASAJE SCHEME</b>					<b>CEIBAL-GUAYABA SCHEME</b>				
A. Direct Cost					A. Direct Cost				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	0	0.2	0	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
(4) Tunnel	m	0	0	0	- No.18 Canal (Rech.)	m	18,000	125	2,250
(5) Siphon					- No.19 Canal (Rech.)	m	9,000	75	675
- No.15 Canal (Rech.)	m	2,500	180	450	(4) Tunnel	m	0	0	0
(6) Secondary Canal	ha	850	610	519	(5) Siphon	m	0	0	0
(7) Farm Road	ha	850	230	196	(6) Secondary Canal	ha	4,650	610	2,837
(8) Drainage Canal	ha	850	210	179	(7) Farm Road	ha	4,650	230	1,070
(9) Related Structure	LS			298	(8) Drainage Canal	ha	4,650	210	977
Total of A				1,640	(9) Related Structure	LS			2,132
B. Administration Cost (5% of A)				82	Total of A				9,939
C. Engineering Cost (10% of A)				164	B. Administration Cost (5% of A)				497
Total of Pechiche-Pasaje scheme				1,886	C. Engineering Cost (10% of A)				994
850 ha		(US\$/ha)		2,219	Total of Ceibal-Guayaba scheme				11,430
					4,650 ha		(US\$/ha)		2,458
					<b>GRAND TOTAL</b>				<b>87,181</b>
					29,250 ha		(US\$/ha)		2,981

Table D.6.3 Estimation of Construction Cost for Irrigation Development (1/2)  
(Alternative-3)

Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)	Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)
<b>CARRIZAL - CHONE SCHEME</b>					<b>GUARANGO SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	586,000	0.2	117	(2) Regulation Pond	m3	69,000	0.2	14
(3) Main Canal					(3) Main Canal				
- No.1 Canal	m	9,800	340	3,332	- No.8 Canal	m	9,700	150	1,455
- No.2 Canal	m	9,000	250	2,250	(4) Tunnel				
- No.3 Canal	m	17,200	250	4,300	- No.8 Canal *	m	6,600	0	0
- No.4 Canal	m	5,300	220	1,166	(5) Siphon				
- No.5 Canal	m	18,800	170	3,196	- No.8 Canal	m	1,400	420	588
- No.6 Canal	m	10,000	125	1,250	(6) Secondary Canal	ha	1,500	610	915
(4) Tunnel					(7) Farm Road	ha	1,500	230	345
- No.1 Canal	m	300	1,833	550	(8) Drainage Canal	ha	1,500	210	315
- No.2 Canal	m	400	1,690	676	(9) Related Structure	LS			680
- No.4 Canal	m	500	1,298	649					
(5) Siphon					<b>Total of A</b>				<b>4,312</b>
- No.2 Canal	m	1,200	830	996					
- No.4 Canal	m	2,400	600	1,440	<b>B. Administration Cost</b>				<b>216</b>
- No.5 Canal	m	2,600	480	1,248	(5% of A)				
- No.6 Canal	m	500	360	180	<b>C. Engineering Cost</b>				<b>431</b>
(6) Secondary Canal	ha	15,000	610	9,150	(10% of A)				
(7) Farm Road	ha	15,000	230	3,450					
(8) Drainage Canal	ha	15,000	210	3,150	<b>Total of Guarango scheme</b>				<b>4,959</b>
(9) Related Structure	LS			8,439	1,500 ha			(US\$/ha)	<b>3,306</b>
<b>Total of A</b>				<b>45,539</b>					
<b>B. Administration Cost</b>				<b>2,277</b>					
(5% of A)									
<b>C. Engineering Cost</b>				<b>4,554</b>					
(10% of A)									
<b>Total of Carrizal-chone scheme</b>				<b>52,370</b>					
15,000 ha			(US\$/ha)	<b>3,491</b>					
<b>LOS AMARILLOS SCHEME</b>					<b>RIO CHICO SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	42,000	0.2	8	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
- No.7 Canal	m	4,800	170	816	- No.9 Canal	m	12,500	100	1,250
(4) Tunnel	m	0	0	0	- No.10 Canal	m	10,500	70	735
(5) Siphon					(4) Tunnel	m	0	0	0
- No.7 Canal	m	800	480	384	(5) Siphon				
(6) Secondary Canal	ha	1,000	610	610	- No.9 Canal	m	400	360	144
(7) Farm Road	ha	1,000	230	230	- No.10 Canal	m	400	360	144
(8) Drainage Canal	ha	1,000	210	210	(6) Secondary Canal	ha	1,700	500	850
(9) Related Structure	LS			446	(7) Farm Road	ha	1,700	230	391
					(8) Drainage Canal	ha	1,700	210	357
					(9) Related Structure	LS			825
<b>Total of A</b>				<b>2,704</b>	<b>Total of A</b>				<b>4,696</b>
<b>B. Administration Cost</b>				<b>135</b>					
(5% of A)					<b>B. Administration Cost</b>				<b>235</b>
<b>C. Engineering Cost</b>				<b>270</b>	(5% of A)				
(10% of A)					<b>C. Engineering Cost</b>				<b>470</b>
					(10% of A)				
<b>Total of Los Amarillos scheme</b>				<b>3,110</b>	<b>Total of Rio Chico scheme</b>				<b>5,400</b>
1,000 ha			(US\$/ha)	<b>3,110</b>	1,700 ha			(US\$/ha)	<b>3,177</b>

Note: (\*) Including in transbasin cost

Table D.6.3 Estimation of Construction Cost for Irrigation Development (2/2)  
(Alternative-3)

Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)	Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)
<b>SANTA ANA SCHEME</b>					<b>MEJIA SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	61,000	0.2	12	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
- No.15 Canal (Ex.)	m	13,800	0	0	- No.13 Canal	m	4,500	65	293
- No.16 Canal (Ex.)	m	20,500	0	0	- No.14 Canal	m	9,200	75	690
- No.17 Canal (Reh.)	m	4,400	140	616	(4) Tunnel	m	0	0	0
- No.18 Canal (Ex.)	m	4,700	0	0	(5) Siphon	m	0	0	0
(4) Tunnel	m	0	0	0	(6) Secondary Canal	ha	1,250	610	763
(5) Siphon					(7) Farm Road	ha	1,250	230	288
- No.18 Canal (Reh.)	m	3,000	270	810	(8) Drainage Canal	ha	1,250	210	263
(6) Secondary Canal	ha	1,000	610	610	(9) Related Structure	LS			547
(7) Farm Road	ha	1,000	230	230					
(8) Drainage Canal	ha	3,300	210	693	Total of A				2,842
(9) Related Structure	LS			836					
Total of A				3,807	B. Administration Cost (5% of A)				142
B. Administration Cost (5% of A)				190	C. Engineering Cost (10% of A)				284
C. Engineering Cost (10% of A)				381	Total of Mejia scheme				3,268
Total of Santa Ana scheme				4,378	1,250 ha			(US\$/ha)	2,615
3,300 ha				1,327					
<b>PECHICHE-PASAJE SCHEME</b>					<b>CEIBAL-GUAYABA SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	0	0.2	0	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
- No.11 Canal	m	3,500	65	228	- No.19 Canal (Reh.)	m	18,000	125	2,250
- No.12 Canal	m	4,000	65	260	- No.20 Canal (Reh.)	m	10,000	75	750
(4) Tunnel	m	0	0	0	(4) Tunnel	m	0	0	0
(5) Siphon	m	0	0	0	(5) Siphon	m	0	0	0
(6) Secondary Canal	ha	850	500	425	(6) Secondary Canal	ha	4,650	610	2,837
(7) Farm Road	ha	850	230	196	(7) Farm Road	ha	4,650	230	1,070
(8) Drainage Canal	ha	850	210	179	(8) Drainage Canal	ha	4,650	210	977
(9) Related Structure	LS			373	(9) Related Structure	LS			2,140
Total of A				1,659	Total of A				10,022
B. Administration Cost (5% of A)				83	B. Administration Cost (5% of A)				501
C. Engineering Cost (10% of A)				166	C. Engineering Cost (10% of A)				1,002
Total of Pechiche-Pasaje scheme				1,908	Total of Ceibal-Guayaba scheme				11,525
850 ha				2,245	4,650 ha			(US\$/ha)	2,479
					<b>GRAND TOTAL</b>				
					29,250 ha				
					(US\$/ha)				
					86,919				
					2,972				

Table D.6.4 Estimation of Construction Cost for Irrigation Development (1/2)  
(Alternative-4)

Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)	Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)
<b>CARRIZAL - CHONE SCHEME</b>					<b>GUARANGO SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	586,000	0.2	117	(2) Regulation Pond	m3	69,000	0.2	14
(3) Main Canal					(3) Main Canal				
- No.1 Canal	m	9,800	410	4,018	- No.9 Canal	m	9,700	250	2,425
- No.2 Canal	m	16,700	340	5,678	(4) Tunnel				
- No.4 Canal	m	9,500	250	2,375	- No.9 Canal *	m	6,600	0	0
- No.5 Canal	m	5,300	220	1,166	(5) Siphon				
- No.6 Canal	m	18,800	170	3,196	- No.9 Canal	m	1,400	830	1,162
- No.7 Canal	m	10,000	125	1,250	(6) Secondary Canal	ha	1,500	610	915
(4) Tunnel					(7) Farm Road	ha	1,500	230	345
- No.1 Canal	m	300	2,036	611	(8) Drainage Canal	ha	1,500	210	315
- No.2 Canal	m	400	1,874	750	(9) Related Structure	LS			1,107
- No.5 Canal	m	500	1,298	649					
(5) Siphon					<b>Total of A</b>				<b>6,283</b>
- No.2 Canal	m	1,200	1,240	1,488					
- No.5 Canal	m	2,400	600	1,440	<b>B. Administration Cost</b>				<b>314</b>
- No.6 Canal	m	2,600	480	1,248	(5% of A)				
- No.7 Canal	m	500	360	180	<b>C. Engineering Cost</b>				<b>628</b>
(6) Secondary Canal	ha	15,000	610	9,150	(10% of A)				
(7) Farm Road	ha	15,000	230	3,450					
(8) Drainage Canal	ha	15,000	210	3,150	<b>Total of Guarango scheme</b>				<b>7,225</b>
(9) Related Structure	LS			9,588	1,500 ha			(US\$/ha)	<b>4,817</b>
<b>Total of A</b>				<b>49,504</b>					
<b>B. Administration Cost</b>				<b>2,475</b>					
(5% of A)									
<b>C. Engineering Cost</b>				<b>4,950</b>					
(10% of A)									
<b>Total of Carrizal-chone scheme</b>				<b>56,929</b>					
15,000 ha			(US\$/ha)	<b>3,795</b>					
<b>LOS AMARILLOS SCHEME</b>					<b>RIO CHICO SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	42,000	0.2	8	(2) Regulation Pond	m3	0	0.2	0
(3) Main Canal					(3) Main Canal				
- No.8 Canal	m	4,800	280	1,344	- No.18 Canal	m	12,500	100	1,250
(4) Tunnel	m	0	0	0	- No.19 Canal	m	10,500	70	735
(5) Siphon					(4) Tunnel	m	0	0	0
- No.8 Canal	m	800	890	712	(5) Siphon				
(6) Secondary Canal	ha	1,000	610	610	- No.18 Canal	m	400	360	144
(7) Farm Road	ha	1,000	230	230	- No.19 Canal	m	400	360	144
(8) Drainage Canal	ha	1,000	210	210	(6) Secondary Canal	ha	1,700	500	850
(9) Related Structure	LS			657	(7) Farm Road	ha	1,700	230	391
					(8) Drainage Canal	ha	1,700	210	357
					(9) Related Structure	LS			825
<b>Total of A</b>				<b>3,772</b>	<b>Total of A</b>				<b>4,696</b>
<b>B. Administration Cost</b>				<b>189</b>					
(5% of A)					<b>B. Administration Cost</b>				<b>235</b>
<b>C. Engineering Cost</b>				<b>377</b>	(5% of A)				
(10% of A)					<b>C. Engineering Cost</b>				<b>470</b>
					(10% of A)				
<b>Total of Los Amarillos scheme</b>				<b>4,337</b>	<b>Total of Rio Chico scheme</b>				<b>5,400</b>
1,000 ha			(US\$/ha)	<b>4,337</b>	1,700 ha			(US\$/ha)	<b>3,177</b>

Note: (\*) Including in transbasin cost

Table D.6.4 Estimation of Construction Cost for Irrigation Development (2/2)  
(Alternative-4)

Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)	Work Item	Unit	Quantity	Unit Price (US\$)	Amount (1,000 US\$)
<b>SANTA ANA SCHEME</b>					<b>MEJIA SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	61,000	0.2	12	(2) Regulation Pond	m3	55,000	0.2	11
(3) Main Canal					(3) Main Canal				
- No.20 Canal (Ex.)	m	13,800	0	0	- No.16 Canal	m	6,000	150	900
- No.21 Canal (Ex.)	m	20,500	0	0	(4) Tunnel	m	0	0	0
- No.22 Canal (Reh.)	m	4,400	140	616	(5) Siphon				
- No.23 Canal (Ex.)	m	4,700	0	0	- No.17 Canal	m	200	360	72
(4) Tunnel	m	0	0	0	(6) Secondary Canal	ha	1,250	610	763
(5) Siphon					(7) Farm Road	ha	1,250	230	288
- No.23 Canal (Reh.)	m	3,000	270	810	(8) Drainage Canal	ha	1,250	210	263
(6) Secondary Canal	ha	1,000	610	610	(9) Related Structure	LS			510
(7) Farm Road	ha	1,000	230	230					
(8) Drainage Canal	ha	3,300	210	693	<b>Total of A</b>				<b>2,805</b>
(9) Related Structure	LS			836					
<b>Total of A</b>				<b>3,807</b>	<b>B. Administration Cost</b>				<b>140</b>
<b>B. Administration Cost</b>				<b>190</b>	(5% of A)				
(5% of A)					<b>C. Engineering Cost</b>				<b>281</b>
<b>C. Engineering Cost</b>				<b>381</b>	(10% of A)				
<b>Total of Santa Ana scheme</b>				<b>4,378</b>	<b>Total of Mejia scheme</b>				<b>3,226</b>
3,300 ha			(US\$/ha)	1,327	1,250 ha			(US\$/ha)	2,581
<b>PECHICHE-PASAJE SCHEME</b>					<b>CEIBAL-GUAYABA SCHEME</b>				
<b>A. Direct Cost</b>					<b>A. Direct Cost</b>				
(1) Diversion Weirs	LS			0	(1) Diversion Weirs	LS			0
(2) Regulation Pond	m3	39,000	0.2	8	(2) Regulation Pond	m3	213,000	0.2	43
(3) Main Canal					(3) Main Canal				
- No.14 Canal	m	7,000	170	1,190	- No.10 Canal (Reh.)	m	12,500	100	1,250
- No.15 Canal	m	3,000	150	450	- No.12 Canal (Reh.)	m	10,000	70	700
(4) Tunnel	m	0	0	0	- No.13 Canal	m	4,500	125	563
(5) Siphon					(4) Tunnel	m	0	0	0
- No.15 Canal	m	1,500	420	630	(5) Siphon				
(6) Secondary Canal	ha	850	610	519	- No.11 Canal	m	2,000	540	1,080
(7) Farm Road	ha	850	230	196	- No.13 Canal	m	200	360	72
(8) Drainage Canal	ha	850	210	179	(6) Secondary Canal	ha	4,650	610	2,837
(9) Related Structure	LS			486	(7) Farm Road	ha	4,650	230	1,070
					(8) Drainage Canal	ha	4,650	210	977
<b>Total of A</b>				<b>3,656</b>	(9) Related Structure	LS			1,917
<b>B. Administration Cost</b>				<b>183</b>	<b>Total of A</b>				<b>10,506</b>
(5% of A)					<b>B. Administration Cost</b>				<b>525</b>
<b>C. Engineering Cost</b>				<b>366</b>	(5% of A)				
(10% of A)					<b>C. Engineering Cost</b>				<b>1,051</b>
<b>Total of Pechiche-Pasaje scheme</b>				<b>4,204</b>	(10% of A)				
850 ha			(US\$/ha)	4,946	<b>Total of Ceibal-Guayaba scheme</b>				<b>12,082</b>
					4,650 ha			(US\$/ha)	2,598
					<b>GRAND TOTAL</b>				<b>97,782</b>
					29,250 ha			(US\$/ha)	3,343



Table D.7.1 Economic Farmgate Prices of Agricultural Products (1/2)

		Rice (IP)*1	Maize (IP)	Soybean (IP)	Peanut Oil (IP)	Beef (IP)
1) World market price (Projected 2000) *2						
- 1985 constant	(US\$/t)	190	80	150	380	1,890
- 1991 constant *3	(US\$/t)	292	123	230	583	2,900
2) Freight and insurance	(US\$/t)	+ 40	+ 20	- *9	- *9	184
3) FOB/CIF Manta	(US\$/t)	332	143	230	583	3,084
	(S/t)*4	381,800	164,500	264,500	670,500	3,546,600
4) Port handling charge	(S/t)	+ 3,000	+ 3,000	3,000	3,000	3,000
5) Transportation cost						
Manta - Portoviejo	(S/t)	+ 12,500	+ 12,500	12,500	12,500	12,500
6) Marketing cost *5	(S/t)	+ 38,200	+ 16,500	26,500	67,100	354,700
7) Ex-mill gate / market prices						
at Portoviejo	(S/t)	435,500	196,500	306,500	753,100	3,916,800
- Processing rate	(%)	65 *6	-	-	35	35
- Processing cost	(S/t)	- 10,300 *7	-	-	14,100	64,000
- By-products	(S/t)	+ 4,500	-	-	85,400 *8	-
8) Mill gate price	(S/t)	277,300	-	-	334,900 *10	1,287,300 *11
9) Local transportation cost	(S/t)	- 4,000	- 4,000	4,000	4,000	4,000
10) Economic farmgate prices	(S/t)	273,300	192,500	302,500	330,900	1,283,300
	(US\$/t)	238	167	263	288	1,116

\*1 IP: Import parity prices.

\*2 Source: The World Bank commodity price forecasts dated August 1991.

Pricing bases:

- Rice (Thai) : White, milled 5% broken, FOB Bangkok, Thai

- Maize (US) : No.2 yellow, FOB Gulf ports, US

- Soybeans (US) : CIF Rotterdam

- Peanut (West African) : Any origin, CIF Rotterdam

- Beef (US) : US imported frozen boneless, FOB port of entry

\*3 Conversion factor from 1985 to 1991: 1.5345

\*4 US\$ 1.00 = S/.1150

\*5 Assumed at 10% of FOB/CIF prices.

\*6 Although present milling rate is 62.5%, it is forecasted that milling rate will be improved to 65% in future.

\*7 In general, the farmers pay about 20% of output to millers as a milling charge. Assuming that actual milling cost is 50% of its milling charge, economic milling cost was estimated below.

$$1,000\text{kg} \times 65\% \times 20\% \times S/.158/\text{kg} \times 50\% = S/.10,300/\text{kg}$$

\*8 Production of peanut meal: 50% of peanut Price of peanut meal: 23% of peanut oil

$$0.5\text{t} \times (S/.742,600/\text{t} \times 23\%) = S/.85,400$$

\*9 Assuming that soybean and peanuts can be imported at the same prices with CIF Rotterdam Prices, freight and insurance is excluded.

\*10 Grain

\*11 Economic farmgate price of liveweight per ton.

Table D.7.1 Economic Farmgate Prices of Agricultural Products (2/2)

	Cotton (EP)*1		Coffee (EP)	Cacao (EP)	Coconut oil (IP)*2
	Lint	Seed			
1) World market price (Projected 2000) *3					
- 1985 constant (US\$/A)	1,170		2,070	1,090	387
- 1991 constant *4 (US\$/A)	1,795		3,176	1,672	593
2) Freight and insurance (US\$/A)	95		95	95	- *10
3) FOB/CIF Manta (US\$/A)	1,700		3,081	1,577	593
(S/A)*5	1,955,000	78,200	3,543,200	1,813,600	682,000
4) Port handling charge (S/A)	3,000	3,000	5,500	5,500	+ 3,000
5) Transportation cost					
Manta - Portoviejo (S/A)	12,500	12,500	12,500	12,500	+ 12,500
6) Marketing cost *6 (S/A)	195,500	7,800	22,000	22,000	+ 68,200
7) Ex-mill gate / market prices at Portoviejo					
(S/A)	1,744,000	54,900	3,503,200	1,773,600	765,700
- Processing rate (%)	35	63	20 *8	21	14
- Processing cost (S/A)	27,200		61,500	17,500	4,500
- By-products (S/A)					
8) Mill gate price (S/A)	617,800 *7		625,100	355,000	100,400 *12
9) Local transportation cost (S/A)	4,000		3,300	3,300	4,000
10) Economic farmgate prices (US\$/A)	613,800 *11		621,800 *9	351,700	96,400 *12
	534		541	306	84

\*1 EP: Export parity prices

\*2 IP: Import parity prices.

\*3 Source: The World Bank commodity price forecasts dated August 1991.

Pricing bases:

- Cotton : Mexican middling (1-3/32"), CIF Europe

- Coffee (ICO) : Indicator price, other mild Arabicas, average New York and Hambrug markets, ex-dock for prompt shipment

- Cacao (ICCO) : Daily average price, New York and London, nearest three future trading months

- Coconut oil (Philippines/Indonesian) : Bulk, CIF Rotterdam

\*4 Conversion factor from 1985 to 1991: 1.5345

\*5 US\$ 1.00 = S/1.150

\*6 Marketing cost was assumed at 10% of FOB/CIF prices, except for coffee.

\*7 (Ex-mill gate price of lint x Processing rate) + (Ex-mill gate price of seed x Processing rate) - Processing cost

\*8 Processing rate: 46.2% x 50% x (100% - 15%) = 19.6%

Fresh cherries - Dry cherries 46.2%

Dry cherries - Clean coffee 50.0%

Grading losses 15.0%

\*9 Economic farmgate price of fresh cherries

\*10 Assuming that coconut oil can be imported at the same prices with CIF Rotterdam prices, freight and insurance is excluded.

\*11 Seed cotton

\*12 Coconut

Table D.7.2 Economic Farmgate Prices of Farm Inputs

		Urea (IP)*1	TSP (IP)	KCL (IP)
1) World market price (Projected 2000) *2				
- 1985 constant	(US\$/t)	120	114	72
- 1991 constant *3	(US\$/t)	184	175	110
2) Freight and insurance	(US\$/t)	+ 20	+ 20	+ 20
3) FOB/CIF Manta	(US\$/t)	204	195	130
	(S./t)*4	234,600	224,300	149,500
4) Port handling charge	(S./t)	+ 3,000	+ 3,000	+ 3,000
5) Transportation cost				
Manta - Portoviejo	(S./t)	+ 2,000	+ 2,000	+ 2,000
6) Marketing cost *5	(S./t)	+ 23,000	+ 22,000	+ 15,000
7) Market prices at Portoviejo	(S./t)	262,600	251,300	169,500
8) Local transportation cost and handling cost	(S./t)	+ 4,000	+ 4,000	+ 4,000
9) Economic farmgate prices	(S./t)	266,600	255,300	173,500
10) Price/ton of nutrient content	(S./t)	579,600	555,000	289,200
		N	P205	KCl
		46 %	46 %	60 %
<b>11) Economic farmgate price of fertilizers</b>				
- Urea (46%)	(S./t)	266,600	266,600	
- Abono completo (10:30:10)	(S./t)	253,400	58,000	166,500
- Sulfato amonio (21%)	(S./t)	121,700	121,700	28,900
- Triple superphosphate (TSP)(46%)	(S./t)	255,300	255,300	
- Muriate of potash (60%)	(S./t)	173,500		173,500

\*1 IP: Import parity prices.

\*2 Source: The World Bank commodity price forecasts dated August 1991.

Pricing bases:

- Urea : Bagged, FOB N.W Europe

- TSP : Bulk, FOB US Gulf

- KCL : Bulk, FOB Vancouver

\*3 Conversion factor from 1985 to 1991: 1.5345

\*4 US\$ 1.00 = S/.1150

\*5 Assumed at 10% of FOB/CIF prices.

Table D.7.3 Financial and Economic Prices of Farm Inputs and Outputs (1/2)

Item	Unit	Financial Price	Economic Price	Item	Unit	Financial Price	Economic Price
<b>AGRICULTURAL PRODUCTS *1</b>							
- Arroz	(S./kg)	184	273	- Papaya	(S./kg)	101	101
- Frejol	(S./kg)	300	300	- Pina	(S./kg)	380	380
- Haba	(S./kg)	512	512	- Platano	(S./kg)	59	59
- Maiz	(S./kg)	132	193	- Coco	(S./kg)	95	96
- Camote	(S./kg)	35	35	- Higuera	(S./kg)	205	205
- Yuca	(S./kg)	18	18	- Mani	(S./kg)	396	331
- Melon	(S./kg)	100	100	- Soya	(S./kg)	264	303
- Pepino	(S./kg)	55	55	- Algodon	(S./kg)	616	614
- Pimiento	(S./kg)	205	205	- Cacao en grano	(S./kg)	1,140	1,774
- Sandia	(S./kg)	125	125	- Cofe Cereza	(S./kg)	293	293
- Tomate	(S./kg)	99	99	- Cafe seco *3	(S./kg)	1,650	1,346
- Zapallo	(S./kg)	50	50	- Marigold	(S./kg)	-	-
- Cebolla	(S./kg)	120	120	- Carne *4	(S./kg)	1,766	1,283
- Citricos *2	(S./kg)	60	60	- Leche	(S./lt)	250	250
<b>SEED/SEEDLINGS *5</b>							
- Arroz	(S./kg)	490	490	- Zapallo	(S./kg)	6,000	6,000
- Frejol	(S./kg)	500	500	- Cebolla	(S./kg)	39,600	39,600
- Haba	(S./kg)	600	600	- Papaya	(S./Plantula)	180	180
- Maiz	(S./kg)	590	590	- Pina	(S./chupon)	25	25
- Camote	(S./kg)	-	-	- Platano	(S./Colino)	60	60
- Yuca	(S./Estaca)	10	10	- Coco	(S./Plantula)	1,200	1,200
- Melon	(S./kg)	17,600	17,600	- Higuera	(S./kg)	370	370
- Pepino	(S./kg)	20,900	20,900	- Mani	(S./kg)	1,200	1,200
- Pimiento	(S./kg)	37,400	37,400	- Soya	(S./kg)	830	830
- Sandia	(S./kg)	250,000	250,000	- Algodon	(S./kg)	1,400	1,400
- Tomate	(S./kg)	90,000	90,000	- Marigold	(S./kg)	-	-
<b>FERTILIZERS *6</b>							
- Urea	(S./kg)	310	277	- Sulfato de amonio	(S./kg)	180	127
- Abono completo	(S./kg)	350	264	- TSP	(S./kg)	370	266
- Sulfomag.	(S./kg)	310	277	- Muriato de potasio	(S./kg)	220	184
<b>HERBICIDES *5</b>							
- Propanil 36%	(S./kg)	7,000	7,000	- Gramoxone	(S./lt)	7,270	7,270
- Lazo	(S./lt)	6,900	6,900	- Dual	(S./lt)	17,500	17,500
- Afalon	(S./kg)	13,300	13,300	- Goal	(S./lt)	24,000	24,000
- Malexone	(S./lt)	8,600	8,600	- Gesagaro	(S./kg)	19,800	19,800

\*1 Economic prices of tradable products such as rice, maize, soybean, peanuts, cotton, coffee, cacao, coconut, banana and beef were estimated on the basis of these border prices (see Table D.7.1).

\*2 Price of Naranja

\*3 Conversion factor from fresh cherries to dry coffee: 0.462 (1,346 = 622/0.462)

\*4 Price of liveweight (cattle)

Financial price: S/.80,000/head / 100Lbs/head = S/.800/lbs = S/.1,766/kg

Economic price (see Table D.7.1)

\*5 Financial prices were applied to economic prices.

\*6 See Table D.7.2

Note: Financial prices: As of August 1991

Economic prices: Projected in 2000 at 1991 constant.

Table D.7.3 Financial and Economic Prices of Farm Inputs and Outputs (2/2)

Item	Unit	Financial Price	Economic Price	Item	Unit	Financial Price	Economic Price
<b>INSECTICIDES AND FUNGICIDES *1</b>							
- Monitor	(S./lt)	13,600	13,600	- Lorsban	(S./lt)	19,800	19,800
- Ambush	(S./lt)	87,300	87,300	- Vitavax	(S./kg)	20,500	20,500
- Curacron	(S./lt)	19,800	19,800	- Mavrik	(S./lt)	40,000	40,000
- Larvin	(S./lt)	31,400	31,400	- Azodrin	(S./lt)	19,000	19,000
- Pillaron	(S./lt)	13,600	13,600	- Bayfolan	(S./lt)	3,800	3,800
- Dimecron	(S./lt)	9,400	9,400	- Desis	(S./lt)	35,000	35,000
- Nuvacron	(S./lt)	13,100	13,100	- Fenon	(S./lt)	33,600	33,600
- Karate	(S./lt)	35,000	35,000	- Supracio	(S./lt)	29,000	29,000
- Nudrin	(S./lt)	8,600	8,600	- Agral 90	(S./lt)	5,800	5,800
- Mitac 20	(S./lt)	15,200	15,200	- Malathion 57	(S./lt)	5,200	5,200
- Oxiclor	(S./kg)	4,800	4,800	- Lonzin	(S./kg)	6,000	6,000
- Lannate	(S./kg)	52,000	52,000	- Furadan 5%	(S./kg)	3,000	3,000
- Cuprosan	(S./kg)	4,700	4,700	- Furadan 10%	(S./kg)	4,900	4,900
- Tricarbamix	(S./kg)	8,400	8,400	- Triciman	(S./kg)	6,600	6,600
- Terraclor	(S./kg)	19,000	19,000	- Maneb-50	(S./kg)	4,800	4,800
- Daconil	(S./kg)	21,500	21,500	- Maneb-80	(S./kg)	5,900	5,900
- Benlate	(S./kg)	56,000	56,000	- Incolante	(S./kg)	8,000	8,000
- Orthocide	(S./kg)	5,900	5,900	- Piola	(S./kg)	6,000	6,000
- Evicet	(S./kg)	54,000	54,000	- Temik	(S./kg)	12,300	12,300
- Morestan	(S./kg)	26,300	26,300	- Malathion	(S./kg)	3,800	3,800
- Topsin	(S./kg)	21,600	21,600	- Antracol	(S./kg)	9,200	9,200
- Mancozeb	(S./kg)	6,000	6,000	- Ridomil	(S./kg)	13,500	13,500
<b>SUPPORTS FOR VEGETABLES *1*2</b>							
- Fundas de polietileno	(S./Millar)	1,200	1,200	- Estaca 50%	S./Unidad	30	30
- Aceite agri.	(S./lt)	2,100	2,100	- Alambre 25%	(S./kg)	280	280
<b>FARM MACHINERY *3</b>							
- Preparacion de suelo	(S./ha)	40,000	40,000	- Trillada y limpieza	(S./t)	11,110	11,110
- Desgranada de maiz	(S./t)	13,200	13,200	de soya			
- Desgranada de mani	(S./t)	10,000	10,000	- Transporte (Algodon)	(S./t)	12,500	12,500
				- Transporte (Marigold)	(S./t)	-	-
<b>LABOR WAGE</b>							
- Skilled labor (Poda)	(S./day)	5,000	5,000	AGUA *1	(S./ha/time)	90	90
- Unskilled labor	(S./day)						
Ordinary works		2,000	1,400 *4				
Control fitosanitario		2,500	1,750 *4				

\*1 Financial prices are applied.

\*2 Assumed that all the agricultural support materials are local products.

\*3 For the economic prices of farm machinery, those financial prices were applied, because import taxes are negligible small.

\*4 From the standpoint of agricultural development, economically active population in Manabi was estimated at 306,000 persons in 1982, who consist of 70% for employment and for unemployment. Based on these figures, shadow wage rate of laborer for farm work was estimated at 70%.

	(A)	(B)	(%)
Population over 12 years old	537,000	537,000	
- Poblacion activa	207,000	273,000 *	100
Ocupado	191,000	191,000	70
Desocupado	16,000	82,000 **	30
- Poblacion inactiva y no declarado	330,000	264,000	

(A) Employment situation in Manabi (1982)

(B) Employment situation for agricultural development

\* Including employment opportunity on temporary farm work

\*\* Assuming that about 20% of inactive population have the employment opportunity on temporary farm work, unemployment population was estimated at 82,000 (330,000 x 0.2 + 16,000)

Note: (1) Conversion factors for local and metric units used in the estimate of unit prices

qq = 45.36 kg    gallon = 3.785 lt    lb = 0.454 kg    onze = 28.35 g (0.02835 kg)

(2) US\$ 1.00 = S/1150

Table D.7.4 Economic Net Return per Hectar Under Without Project (1/8)

		Pasto de Corte (SR)		Citricos (SR)		Platano (SR)		Cacao (SR)	
<b>I. PRODUCTION VALUE</b>									
1) Unit yield		(t/ha)	70	(t/ha)	13.8	(t/ha)	12	(t/ha)	0.3
2) Unit price		(S./t)	-	(S./t)	60,000	(S./t)	59,000	(S./t)	1,774,000
3) Production value		(S./)	-	(S./)	828,000	(S./)	708,000	(S./)	532,200
<b>II. TOTAL EXPENSE</b>									
	Unit	Unit cost (S./)	Quantity	Total (S./)	Quantity	Total (S./)	Quantity	Total (S./)	Quantity Total (S./)
<b>1. Production cost</b>									
1) Labor	(day's wage)								
- Control de maleza	-Quimico	1,750		0		0		0	
	-Manual	1,400	6	8,400	18	25,200		0	24 33,600
- Control de maleza mantenimiento de canales		1,400		0		0	10	14,000	0
- Limpieza y mantenimiento canales, surco y corona		1,400		0		0		0	0
- Fertilizacion		1,400	8	11,200	6	8,400	6	8,400	4 5,600
- Control fitosanitario		1,750		0	15	26,250	6	10,500	3 5,250
- Poda		5,000		0	6	30,000		0	6 30,000
- Poda y aplicacion de cicatrizante		1,400		0		0		0	0
- Deshierba y deshije		1,400		0		0	40	56,000	0
- Riego		1,400	8	11,200		0		0	0
- Corte y acarreo		1,400	50	70,000		0	36	50,400	0
- Cosecha, acarreo y cargada		1,400		0	69	96,600		0	0
- Cosecha, acarreo, fermentacion secada y cargada		1,400		0		0		0	23 32,200
2) Materials									
- Urea	(kg)	277	363	100,551		0		0	0
- Sulfato amonio	(kg)	127		0	227	28,829		0	0
- Abono completo	(kg)	264		0	340	89,760	181	47,784	272 71,808
- Furadan 5%	(kg)	3,000		0		0	15	45,000	0
- Supracio	(lt)	29,000		0	2	58,000		0	0
- Lorsban	(lt)	19,800		0	2	39,600		0	0
- Pillaron	(lt)	13,600		0	2	27,200		0	0
- Curacron	(lt)	19,800		0		0		0	1.5 29,700
- Oxiclor	(kg)	4,800		0	4.6	22,080		0	4.6 22,080
- Lonzin	(kg)	6,000		0	4.6	27,600		0	0
- Aceite agr.	(lt)	2,100		0	10.0	21,000		0	0
- Agral 90	(lt)	5,800		0	1.5	8,700		0	0
- Agua	(Riego)	90		0		0		0	0
3) Equipments (Prepar. suelo)(ha)				0		0		0	0
Total of 1),2) and 3)				201,351		509,219		232,084	230,238
2. Unexpected Expense *1				20,135		50,922		23,208	23,024
Total of 1 & 2				221,486		560,141		255,292	253,262
<b>III. NET RETURN</b>						267,859		452,708	278,938

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation

Table D.7.4 Economic Net Return per Hectar Under Without Project (2/8)

	Cocotero (SR)		Yuca (SR)		Arroz - Invierno (SR)		Arroz - Verano (SR)			
<b>I. PRODUCTION VALUE</b>										
1) Unit yield	(t/ha)	12.0	(t/ha)	11.0	(t/ha)	2.0	(t/ha)	3.2		
2) Unit price	(S./t)	96,000	(S./t)	18,000	(S./t)	273,000	(S./t)	273,000		
3) Production value	(S./)	1,152,000	(S./)	198,000	(S./)	546,000	(S./)	873,600		
<b>II. TOTAL EXPENSE</b>										
	Unit	Unit cost (S./)	Quantity	Total (S./)	Quantity	Total (S./)	Quantity	Total (S./)	Quantity	Total (S./)
<b>1. Production cost</b>										
1) Labor	(day's wage)									
- Preparacion de suelo		1,400		0		0	10	14,000	10	14,000
- Control de maleza	- Quimico	1,750		0	4	7,000	3	5,250	3	5,250
	- Manual	1,400	16	22,400	10	14,000		0		0
- Siembra		1,400		0	8	11,200	10	14,000	10	14,000
- Fertilizacion		1,400	4	5,600	4	5,600	6	8,400	6	8,400
- Control fitosanitario		1,750	44	77,000		0	12	21,000	12	21,000
- Poda		5,000	12	60,000		0		0		0
- Riego		1,400		0		0		0	10	14,000
- Corte y acarreo		1,400		0	23	32,200		0		0
- Cosecha corte y trillado		1,400		0		0	16	22,400	20	28,000
- Cosecha, acarreo y cargada		1,400	42	58,800		0		0		0
- Vigilancia de cosecha		1,400	36	50,400		0		0		0
2) Materials										
- Semilla (Arroz)	(kg)	490		0		0	100	49,000	100	49,000
- Estaca	(Estaca)	1.5		0	10,000	15,000		0		0
- Urea	(kg)	277		0	91	25,207	136	37,672	181	50,137
- Abono completo	(kg)	264	91	24,024		0		0	91	24,024
- Propanil 36%	(kg)	7,000		0		0	3.8	26,600	3.8	26,600
- Gramoxone	(lt)	7,270		0	1.8	13,086		0		0
- Monitor	(lt)	13,600		0		0	2	27,200	2	27,200
- Lannate	(kg)	52,000		0		0	0.4	20,800	0.4	20,800
- Nudrin	(lt)	8,600	8	68,800		0		0		0
- Malathion	(kg)	3,800	9	34,200		0		0		0
- Aceite agr.	(lt)	2,100	8	16,800		0		0		0
- Agua	(Riego)	90		0		0		0	5	450
3) Equipos (Prepar. suelo)(ha)		40,000		0	1	40,000	1	40,000	1	40,000
Total of 1),2) and 3)				418,024		163,293		286,322		342,861
<b>2. Unexpected Expense</b>										
1) Imprevistos y Gastos de Administracion *1				41,802		16,329		28,632		34,286
Total of 1 & 2				459,826		179,622		314,954		377,147
<b>III. NET RETURN</b>										
				692,174		18,378		231,046		496,453

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation

Table D.7.4 Economic Net Return per Hectar Under Without Project (3/8)

		Algodon (SR)		Maiz - Verano (CR)		Maiz - Invierno (SR)		Mani - Invierno (SR)		
<b>I. PRODUCTION VALUE</b>										
1) Unit yield		(t/ha)	1.4	(t/ha)	3.4	(t/ha)	1.5	(t/ha)	1.3	
2) Unit price		(S./t)	614,000	(S./t)	193,000	(S./t)	193,000	(S./t)	331,000	
3) Production value		(S./)	859,600	(S./)	656,200	(S./)	289,500	(S./)	430,300	
<b>II. TOTAL EXPENSE</b>										
	Unit	Unit	Quantity	Total	Quantity	Total	Quantity	Total	Quantity	Total
	(S./)	(S./)	(S./)	(S./)	(S./)	(S./)	(S./)	(S./)	(S./)	(S./)
<b>I. Production cost</b>										
1) Labor (day's wage)										
- Preparacion de suelo	1,400		10	14,000		0		0		0
- Arreglo de suelo	1,400			0	4	5,600		0		0
- Control de maleza - Quimico	1,750		2	3,500	2	3,500	2	3,500	2	3,500
- Manual	1,400		12	16,800	6	8,400	6	8,400	10	14,000
- Siembra	1,400		10	14,000	8	11,200	8	11,200	10	14,000
- Fertilizacion	1,400		10	14,000	4	5,600	4	5,600		0
- Control fitosanitario	1,750		16	28,000	4	7,000	4	7,000	8	14,000
- Riego	1,400			0	14	19,600	4	5,600		0
- Cosecha	1,400		30	42,000		0	7	9,800	26	36,400
- Corte y acarreo	1,400			0	15	21,000		0		0
- Desgranada	1,400			0	5	7,000	2	2,800		0
2) Materials										
- Semilla (Algodon)	(kg)	1,400	7	9,800		0		0		0
- Semilla (Mani)	(kg)	1,200		0		0		0	60	72,000
- Semilla (Maiz)	(kg)	590		0		0	15	8,850		0
- Certificada (Maiz)	(kg)	590		0	15	8,850		0		0
- Urea	(kg)	277	181	50,137	91	25,207	91	25,207		0
- Abono completo	(kg)	264	91	24,024		0		0		0
- Vitavax	(kg)	20,500		0		0		0	0.5	9,225
- Larvin	(lt)	31,400	0.2	6,280	0.2	6,280	0.2	6,280		0
- Lazo	(lt)	6,900	2	13,800	2	13,800	2	13,800	2	13,800
- Afalon	(kg)	13,300		0	0.7	9,310	0.7	9,310		0
- Gessagaro	(kg)	19,800	1	19,800		0		0	1	19,800
- Nuvacron	(lt)	13,100	1.5	19,650		0		0	1	13,100
- Karate	(lt)	35,000	1	35,000		0		0		0
- Lorsban	(lt)	19,800	1.5	29,700	1.2	23,760	2	39,600	1	19,800
- Monitor	(lt)	13,600		0		0		0	1	13,600
- Agua (Riego)		90		0	7	630	2	180		0
3) Equipments										
- Preparacion de suelo		40,000	1	40,000	1	40,000	1	40,000	1	40,000
- Desgranada (Maiz)		13,200		0	3.4	44,880	1.3	17,160		0
- Desgranada (Mani)		10,000		0		0		0	1.1	11,000
- Transporte (Algodon)		12,500	1.2	15,000		0		0		0
Total of 1),2) and 3)				395,491		261,617		214,287		294,225
<b>2. Unexpected Expense</b>										
1) Imprevistos y Gastos de Administracion *1										
				39,549		26,162		21,429		29,423
Total of 1 & 2				435,040		287,779		235,716		323,648
<b>III. NET RETURN</b>				424,560		368,421		53,784		106,653

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation



Table D.7.4 Economic Net Return per Hectar Under Without Project (4/8)

		Mani - Verano (CR)		Haba - Invierno (SR)		Haba - Verano (CR)		Frejor Caupi-Invierno (SR)		
<b>I. PRODUCTION VALUE</b>										
1) Unit yield		(t/ha)	1.8	(t/ha)	1.6	(t/ha)	1.6	(t/ha)	1.2	
2) Unit price		(\$/t)	331,000	(\$/t)	512,000	(\$/t)	512,000	(\$/t)	300,000	
3) Production value		(\$/)	595,800	(\$/)	819,200	(\$/)	819,200	(\$/)	360,000	
<b>II. TOTAL EXPENSE</b>										
	Unit	Unit cost (\$/)	Quantity	Total (\$/)	Quantity	Total (\$/)	Quantity	Total (\$/)	Quantity	Total (\$/)
<b>1. Production cost</b>										
<b>1) Labor (day's wage)</b>										
- Arreglo de surco		1,400	3	4,200		0	4	5,600		0
- Control de maleza -Quimico		1,750	2	3,500		0		0	2	3,500
- Control de maleza -Manual		1,400	10	14,000	35	49,000	30	42,000		0
- Siembra		1,400	10	14,000	5	7,000	5	7,000	4	5,600
- Raleo		1,400		0		0		0	2	2,800
- Deshierba manual		1,400		0		0		0	20	28,000
- Tutorco		1,400		0	10	14,000	10	14,000		0
- Amarre		1,400		0	4	5,600	4	5,600		0
- Control fitosanitario		1,750	8	14,000	20	35,000	20	35,000	14	24,500
- Riego		1,400	16	22,400		0	30	42,000		0
- Cosecha		1,400	38	53,200	35	49,000	50	70,000	18	25,200
<b>2) Materials</b>										
- Semilla (Mani)	(kg)	1,200	60	72,000		0		0		0
- Semilla (Haba)	(kg)	600		0	10	6,000	10	6,000		0
- Semilla (Frejor)	(kg)	500		0		0		0	7	3,500
- Vitavax	(kg)	20,500	0.45	9,225		0		0		0
- Larvin	(lt)	31,400		0	0.1	3,140	0.1	3,140		0
- Estaca	(Estaca)	30		0	400	12,000	400	12,000		0
- Alambre	(kg)	280		0	9.1	2,548	9.1	2,548		0
- Lazo	(lt)	6,900	2	13,800		0		0	2	13,800
- Afalon	(kg)	13,300		0		0		0	1	13,300
- Gramoxone	(lt)	7,270		0		0		0	1.5	10,905
- Gessagaro	(kg)	19,800	1	19,800		0		0		0
- Nuvacron	(lt)	13,100	1	13,100	1	13,100	2	26,200		0
- Lorsban	(lt)	19,800	1	19,800		0		0		0
- Mavrik	(lt)	40,000	0.4	16,000	1	40,000	2	80,000		0
- Morestan	(kg)	26,300		0		0	0.75	19,725		0
- Topsin	(kg)	21,600		0		0	0.5	10,800		0
- Mancozeb	(kg)	6,000		0	4.5	27,000	2.7	16,200		0
- Oxiclor	(kg)	4,800		0	4.5	21,600	2.7	12,960		0
- Lonzin	(kg)	6,000		0		0	4.5	27,000		0
- Furadan 10%	(kg)	4,900		0		0		0	0.09	441
- Monitor	(lt)	13,600		0	2	27,200	2	27,200	2	27,200
- Azodrin	(lt)	19,000		0		0		0	1	19,000
- Maneb-50	(kg)	4,800		0		0		0	1	4,800
- Agua	(Riego)	90	8	720		0	15	1,350		0
<b>3) Equipments</b>										
- Preparacion de surlo (ha)		40,000	1	40,000	1	40,000	1	40,000	1	40,000
- Desgranada (Mani)		10,000	1.8	18,000		0		0		0
Total of 1),2) and 3)				347,745		352,188		506,323		222,546
<b>2. Unexpected Expense *1</b>										
Total of 1 & 2				382,520		387,407		556,955		244,801
<b>III. NET RETURN</b>										
				213,281		431,793		262,245		115,199

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation

Table D.7.4 Economic Net Return per Hectar Under Without Project (5/8)

	Frejol Caupi-Verano (CR)		Camote (SR)		Soya - Invierno (SR)		Soya - Verano (SR)			
<b>I. PRODUCTION VALUE</b>										
1) Unit yield	(t/ha)	1.5	(t/ha)	10.6	(t/ha)	1.2	(t/ha)	1.8		
2) Unit price	(S./t)	300,000	(S./t)	35,000	(S./t)	303,000	(S./t)	303,000		
3) Production value	(S./)	450,000	(S./)	371,000	(S./)	363,600	(S./)	545,400		
<b>II. TOTAL EXPENSE</b>										
	Unit	Unit cost (S./)	Quantity	Total (S./)	Quantity	Total (S./)	Quantity	Total (S./)	Quantity	Total (S./)
<b>I. Production cost</b>										
1) Labor	(day's wage)									
- Arreglo de surco		1,400	4	5,600		0		0		0
- Limpia y quema		1,400		0	15	21,000		0		0
- Recoleccion de material		1,400		0	6	8,400		0		0
- Transplante		1,400		0	70	98,000		0		0
- Control de maleza -Quimico		1,750	2	3,500		0	2	3,500	2	3,500
-Manual		1,400	20	28,000		0	4	5,600	4	5,600
- Siembra		1,400	4	5,600		0		0		0
- Siembra y resiembra		1,400		0		0	22	30,800	22	30,800
- Raleo		1,400	2	2,800		0		0		0
- Fertilizacion		1,400		0	4	5,600		0		0
- Control fitosanitario		1,750	18	31,500	4	7,000	4	7,000	6	10,500
- Deshierba		1,400		0	18	25,200		0		0
- Riego		1,400	16	22,400	4	5,600		0	18	25,200
- Cosecha		1,400	20	28,000	30	42,000		0		0
- Corte, amontonada y acarreo		1,400		0		0	12	16,800	20	28,000
- Trillada y limpieza		1,400		0		0	1	1,400	2	2,800
2) Materials										
- Semilla (Frejol)	(kg)	500	7	3,500		0		0		0
- Semilla (Soya)	(kg)	830		0		0	45	37,350	45	37,350
- Urea	(kg)	277		0	91	25,207		0		0
- Incolante	(kg)	8,000		0		0	0.45	3,600	0.45	3,600
- Lazo	(lt)	6,900		0		0	2	13,800	2	13,800
- Dual	(lt)	17,500	2	26,250		0		0		0
- Gessagaro	(kg)	19,800		0		0	1	19,800	1	19,800
- Ambush	(lt)	87,300		0		0	0.2	17,460	0.3	26,190
- Nuvacron	(lt)	13,100		0		0	1	13,100	1	13,100
- Mavrik	(lt)	40,000	1	40,000		0		0		0
- Morestan	(kg)	26,300	0.5	13,150		0		0		0
- Topsin	(kg)	21,600	1	21,600		0		0		0
- Lannate	(kg)	52,000		0	0.2	10,400		0		0
- Mancozeb	(kg)	6,000	2.3	13,800		0		0		0
- Furadan 10%	(kg)	4,900	0.1	490		0		0		0
- Monitor	(lt)	13,600	1.5	20,400		0		0		0
- Maneb-80	(kg)	5,900	2.3	13,570		0		0		0
- Agua	(Riego)	90	8	720	2	180		0	8	720
3) Equipments										
- Preparacion de suelo (ha)		40,000	1	40,000		0	1	40,000	1	40,000
- Trillada y limpieza (t)		11,110		0		0	1.2	13,332	2.7	29,997
Total of 1),2) and 3)				320,880		248,587		223,542		290,957
2. Unexpected Expense *1				32,088		24,859		22,354		29,096
Total of 1 & 2				352,968		273,446		245,896		320,053
<b>III. NET RETURN</b>				<b>97,032</b>		<b>97,554</b>		<b>117,704</b>		<b>225,347</b>

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation

Table D.7.4 Economic Net Return per Hectar Under Without Project (6/8)

		Pimiento-Invierno (SR)		Pimiento - Verano (CR)		Pepino - Invierno (SR)	
<b>I. PRODUCTION VALUE</b>							
1) Unit yield		(t/ha)	5.6	(t/ha)	6.0	(U/ha)	40,000
2) Unit price		(\$/t)	205,000	(\$/t)	205,000	(\$/U)	12
3) Production value		(\$/.)	1,148,000	(\$/.)	1,230,000	(\$/.)	480,000
		Unit					
		cost					
		(\$/.)					
<b>II. TOTAL EXPENSE</b>							
<b>1. Production cost</b>							
1) Labor	(day's wage)						
- Arreglo de surco		1,400	4	5,600	4	5,600	4
- Const. y siembra sem.		1,400		0		0	
- Prep. desinf. y siem.		1,400	6	8,400	6	8,400	
- Transplante		1,400	30	42,000	30	42,000	
- Control de maleza	-Quimico	1,750		0		0	2
	-Manual	1,400	40	56,000	25	35,000	8
- Siembra		1,400		0		0	8
- Fertilizacion		1,400	8	11,200	8	11,200	6
- Aplic. pest. semillero		1,400	1	1,400	1	1,400	
- Aplic. pest. campo		1,400	20	28,000	20	28,000	
- Riego y control fito-sanitario (semillero)		1,400		0		0	
- Control fitosanitario		1,750		0		0	16
- Riego		1,400		0		0	
- Riego semillero		1,400	2	2,800	2	2,800	
- Riego campo		1,400		0	30	42,000	
- Cosecha		1,400		0		0	
- Cosecha y acarreo		1,400		0		0	20
- Cosecha, acarreo y empac.		1,400	120	168,000	120	168,000	
2) Materials							
- Semilla (Marigold)	(kg)	14,900		0		0	
- Semilla (Pimiento)	(kg)	37,400	0.91	34,034	0.91	34,034	
- Semilla (Pepino)	(kg)	20,900		0		0	0.91
- Urea	(kg)	277	181	50,137	181	50,137	91
- Abono completo	(kg)	264		0		0	136
- Dual	(lt)	17,500		0		0	2
- Malexone	(lt)	8,600		0		0	
- Pillaron	(lt)	13,600	1	13,600	1	13,600	
- Dimecron	(kg)	9,400	3	28,200	3	28,200	
- Cuprosan	(kg)	4,700	2.72	12,784	2.72	12,784	
- Tricarbamix	(kg)	8,400	3.63	30,492	3.63	30,492	
- Vitavax	(kg)	20,500	1.82	37,310	1.82	37,310	
- Terraclor	(kg)	19,000	1.82	34,580	1.82	34,580	
- Nuvacron	(lt)	13,100		0		0	2
- Mavrik	(lt)	40,000	1	40,000	1	40,000	0.5
- Topsin	(kg)	21,600		0		0	1
- Daconil	(kg)	21,500		0		0	2
- Lannate	(kg)	52,000		0		0	
- Monitor	(lt)	13,600	2	27,200	2	27,200	
- Benlate	(kg)	56,000		0		0	
- Bayfolan	(lt)	3,800		0		0	
- Agua	(Riego)	90		0	15	1,350	
3) Equipments							
- Preparacion de suelo (ha)		40,000	1	40,000	1	1	1
- Transporte (Carro)	(t)	12,500		0		0	
Total of 1),2) and 3)				671,737		654,088	361,830
2. Unexpected Expense *1				67,174		65,409	36,183
Total of 1 & 2				738,911		719,497	398,013
<b>III. NET RETURN</b>				409,089		510,503	81,987

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation

Table D.7.4 Economic Net Return per Hectar Under Without Project (7/8)

		Pepino - Verano (CR)		Tomate - Invierno (SR)		Tomate - Verano (CR)		Melon - Invierno (SR)		
<b>I. PRODUCTION VALUE</b>										
1) Unit yield		(U/ha)	60,000	(t/ha)	6.5	(t/ha)	25.0	(t/ha)	10	
2) Unit price		(S./U)	12	(S./t)	99,000	(S./t)	99,000	(S./t)	100,000	
3) Production value		(S./)	720,000	(S./)	643,500	(S./)	2,475,000	(S./)	1,000,000	
		Unit								
		cost	Quantity	Total	Quantity	Total	Quantity	Total	Quantity	
		(S./)		(S./)		(S./)		(S./)		
<b>II. TOTAL EXPENSE</b>										
1. Production cost										
1) Labor (day's wage)										
- Arreglo de surco		1,400	4	5,600	4	5,600	4	5,600	4	5,600
- Siembra semillero y riego		1,400		0	3	4,200	3	4,200		0
- Prep. desinf. y siem.		1,400		0	2	2,800	2	2,800		0
- Transplante		1,400		0	14	19,600	14	19,600		0
- Control de maleza	-Quimico	1,750	2	3,500		0		0		0
	-Manual	1,400	8	11,200		0		0	18	25,200
- Siembra		1,400	8	11,200		0		0	6	8,400
- Fertilizacion		1,400	6	8,400		0		0	8	11,200
- Fertilizacion y aporque		1,400		0	6	8,400	12	16,800		0
- Control fitosanitario		1,750	16	28,000	15	26,250	30	52,500	20	35,000
- Deshierba		1,400		0	20	28,000	30	42,000		0
- Riego		1,400	18	25,200		0	30	42,000		0
- Tutorio		1,400		0	6	8,400		0		0
- Amarre		1,400		0	79	110,600		0		0
- Cosecha		1,400		0	39	54,600	140	196,000		0
- Cosecha y acarreo		1,400	20	28,000		0		0	18	25,200
2) Materials										
- Semilla (Pepino)	(kg)	20,900	0.91	19,019		0		0		0
- Semilla (Tomate)	(kg)	90,000		0	0.14	12,600	0.14	12,600		0
- Semilla (Melon)	(kg)	17,600		0		0		0	0.45	7,920
- Urea	(kg)	277	91	25,207	68	18,836	136	37,672	136	37,672
- Abono completo	(kg)	264	136	35,904	68	17,952	136	35,904	136	35,904
- Orthocide	(kg)	5,900		0	0.23	1,357	0.45	2,655		0
- Dual	(lt)	17,500	2	35,000		0		0		0
- Evicet	(kg)	54,000		0	1	40,500	1.5	81,000		0
- Desis	(lt)	35,000		0	0.5	17,500	1	35,000		0
- Lorsban	(lt)	19,800		0	0.9	17,820	1.8	35,640		0
- Oxiclor	(kg)	4,800		0	3.4	16,320	6.8	32,640	5	25,920
- Triciman	(kg)	6,600		0	2.25	14,850	4.5	29,700		0
- Fenon	(lt)	33,600		0	0.75	25,200	1.5	50,400		0
- Tricarbamix	(kg)	8,400		0	2.25	18,900	4.5	37,800		0
- Nuvacron	(lt)	13,100	2	26,200	1	13,100	2	26,200	2	26,200
- Mavrik	(lt)	40,000	0.5	20,000		0		0	0.5	20,000
- Karate	(lt)	35,000		0		0		0	0.5	17,500
- Morestan	(kg)	26,300		0		0		0	1.5	39,450
- Topsin	(kg)	21,600	1	21,600		0		0	3	64,800
- Dacnil	(kg)	21,500	2	43,000		0		0		0
- Mancozeb	(kg)	6,000		0	3.4	20,400	5	27,000		0
- Furandán 5%	(kg)	3,000		0	0.5	1,500	1	3,000	15	45,000
- Piola	(kg)	6,000		0	2	12,000		0		0
- Alambre	(kg)	280		0	12.5	3,500		0		0
- Estaca	(Unidad)	30		0	625	18,750	1,250	37,500		0
- Agua	(Riego/ha)	90	9	810		0	15	1,350		0
3) Equipments										
- Preparacion de surlo (ha)		40,000	1	40,000	1	40,000	1	40,000	1	40,000
Total of 1),2) and 3)				387,840		579,535		907,561		470,966
2. Unexpected Expense *1										
Total of 1 & 2				426,624		637,489		998,317		518,063
<b>III. NET RETURN</b>										
				293,376		6,012		1,476,683		481,937

\*1 - 10% of production cost

Note: SR = Without irrigation, CR = With irrigation

Table D.7.4 Economic Net Return per Hectar Under Without Project (8/8)

		Melon - Verano (CR)		Sandia - Invierno (SR)		Sandia - Verano (CR)	
<b>I. PRODUCTION VALUE</b>							
1) Unit yield		(t/ha)	13.0	(t/ha)	14.0	(t/ha)	15.0
2) Unit price		(\$/t)	100,000	(\$/t)	125,000	(\$/t)	125,000
3) Production value		(\$/)	1,300,000	(\$/)	1,750,000	(\$/)	1,875,000
<b>II. TOTAL EXPENSE</b>							
	Unit cost (\$/)	Quantity	Total (\$/)	Quantity	Total (\$/)	Quantity	Total (\$/)
<b>1. Production cost</b>							
<b>1) Labor (day's wage)</b>							
- Arreglo de surco	1,400	4	5,600	2	2,800	2	2,800
- Prep. vivero y siemb.	1,400		0	4	5,600	4	5,600
- Transplante	1,400		0	8	11,200	8	11,200
- Control de maleza	-Quimicc -Manual	1,750	0	4	7,000	4	7,000
	1,400	15	21,000	14	19,600	14	19,600
- Siembra	1,400	6	8,400		0		0
- Fertilizacion	1,400	8	11,200	8	11,200	8	11,200
- Control fitosanitario	1,750	20	35,000	24	42,000	24	42,000
- Riego	1,400	20	28,000		0	26	36,400
- Cosecha y acarreo	1,400	25	35,000	60	84,000	60	84,000
<b>2) Materials</b>							
- Semilla (Melon)	(kg) 17,600	0.45	7,920		0		0
- Semilla (Sandia)	(kg) 250,000		0	0.45	112,500	0.45	112,500
- Fundas de polietileno	(millar) 1,200		0	5	6,000	5	6,000
- Urea	(kg) 277	136	37,672	91	25,207	91	25,207
- Abono completo	(kg) 264	136	35,904	136	35,904	136	35,904
- Sulfato de Amonio	(kg) 127		0	136	17,272	136	17,272
- Dual	(lt) 17,500		0	1	17,500	1	17,500
- Oxiclor	(kg) 4,800	3.6	17,280	3.6	17,280	3.6	17,280
- Nuvacron	(lt) 13,100	2	26,200	3	39,300	3	39,300
- Mavrik	(lt) 40,000	0.5	20,000	1.2	48,000	1.2	48,000
- Karate	(lt) 35,000	1	35,000	1	35,000	1	35,000
- Temik	(kg) 12,300	15	184,500		0	15	184,500
- Morestan	(kg) 26,300	1	26,300	1.5	39,450	1.5	39,450
- Topsin	(kg) 21,600	3	64,800	5	108,000	5	108,000
- Terraclor	(kg) 19,000		0	0.91	17,290	0.91	17,290
- Vitavax	(kg) 20,500		0	0.91	18,655	0.91	18,655
- Mancozeb	(kg) 6,000		0	5.4	32,400	5.4	32,400
- Furandán 5%	(kg) 3,000		0	15	45,000		0
- Agua	(Ricgo/ha) 90	10	900		0	13	1,170
<b>3) Equipos</b>							
- Preparacion de surlo	(ha) 40,000	1	40,000	1	40,000	1	1
Total of 1),2) and 3)			640,676		838,158		975,229
<b>2. Unexpected Expense *1</b>			64,068		83,816		97,523
Total of 1 & 2			704,744		921,974		1,072,752
<b>III. NET RETURN</b>			595,256		828,026		802,248

\*1 10% of production cost

Note: SR = Without irrigation, CR = With irrigation