

1.7.2 Social Environment

There are no specific areas with original culture or tradition, such as the Indio Park, in Sergipe State. Potsherds and rock wall paintings of indigenous people have been excavated at the suburbs of Itabaiana City and the upper valley of Xingo Dam respectively. There is an excavation site of fossils in Canhoba. Sao Cristovao City, Laranjeiras City and Salgado City are designated as historic or cultural area by the state decree.

There are schistosomiasis and dengue fever as an endemic disease in the whole area of Sergipe State. However, because local governments have conducted the campaign, education program and sprinkling of pesticides, the patients, especially dengue fever's, have been decreasing considerably.

Main fishery activities in Sergipe State are divided into two distinct categories, namely estuary fisheries and marine fisheries. In inland rivers, economic fishery activities are hardly practiced. The estuary fisheries use canoes with oar or sail, and are almost a day trip in accordance with the tides. Shrimps account for about 60 % of the total production.

1.7.3 Natural Environment

The natural vegetation can be divided into following five types:

- 1) Mangrove and coastal forest zone called Mata Atlantica
- 2) Evergreen or deciduous forest zone
- 3) Deciduous forest and Cerrado zone
- 4) Caatinga zone I (drought resistant)
- 5) Caatinga zone II (high drought resistant)

Caatinga is found in more arid zone than Cerrado as follows:

Cerrado : Woods composed of stunted and twisted trees (3-6 m in height), growing on cattle-grazing land.

Caatinga: Stunted sparse forest found in the drought areas; dominated by trumpet bush, *Bignoniaceous* *Caesalpiniaceous* and *Cereus*. The typical dominant species are *Mimosa bostilis* and *Caesalpinia pyramydalis*.

Mangrove forests in the coastal areas have thrived well. The dominant mangrove species are *Rhizophora mangle*, *Avicennia spp.*, *Laguncularia racemosa* and *Conocarpus erectus*. The natural inland vegetation remains only in limited areas such as mountainous district, hill area and riverside because of grazing and/or agricultural activity.

Most of the endemic fauna species have disappeared because of reforestation. However, amphibian and aquatic animals have thrived relatively well, caimans have been identified in the residual forests of Cerrado and Mata Atlantica zone. Large-sized carnivorous mammals such as jaguar have not been identified in the State. Rock cavy (*Kerodon rupestris*) is a well-known endemic species in the Cerrado zone.

Although surveys on the habitats of the endangered fauna and flora have not been conducted in the whole state yet, these species inhabit only limited areas such as sizable mangrove forests or undisturbed forests scattered in southern part of Sergipe State. The small amount of remaining riverside forest provides some habitat for wildlife too.

Aquatic life of rivers in Sergipe State can be divided two types roughly depend on the salinity level of the river water. Because of low salinity level of river water, aquatic life in Sao Francisco River and Japarutuba River is similar. Curimbata (*Prochilodus argenteus*) that swims up river from the sea to spawn have been identified in these two rivers. In the other four rivers, aquatic life with salinity tolerance is dominant.

There are seven protected areas in Sergipe State. They are shown in Table-1.30. These locations and the other environmental information are shown in Figure-1.20.

Table-1.30 Protected Areas in the State

Name	Category	Location	Remark
Santa Isabel Biological Reserve	Federal	Pirambu Pacatuba	Protection of turtle coast and ecosystem
Itabaiana Ecological Habitat	Federal	Itabaiana Areia Branca	Protection of ecosystem in Itabaiana mountain
Vaza-Barris River Estuary Environmental Protection Area	State	Itaporanga, Aracaju Sao Cristovao	Protection of permanent natural character
Southern Coast Environmental Protection Area	State	Itaporanga, Estancia Sta. Luzia, Itanhy	Protection of permanent natural character
Morro do Urubu Environmental Protection Area	State	Aracaju	Protection of residual Atlantic forest
Sergipe River Environmental Protection Area	State	Aracaju Barra dos Coqueiros	Protection of natural landscape and environment
Taramanday Municipal Ecological Park	Municipal	Aracaju	Protection of mangrove forest

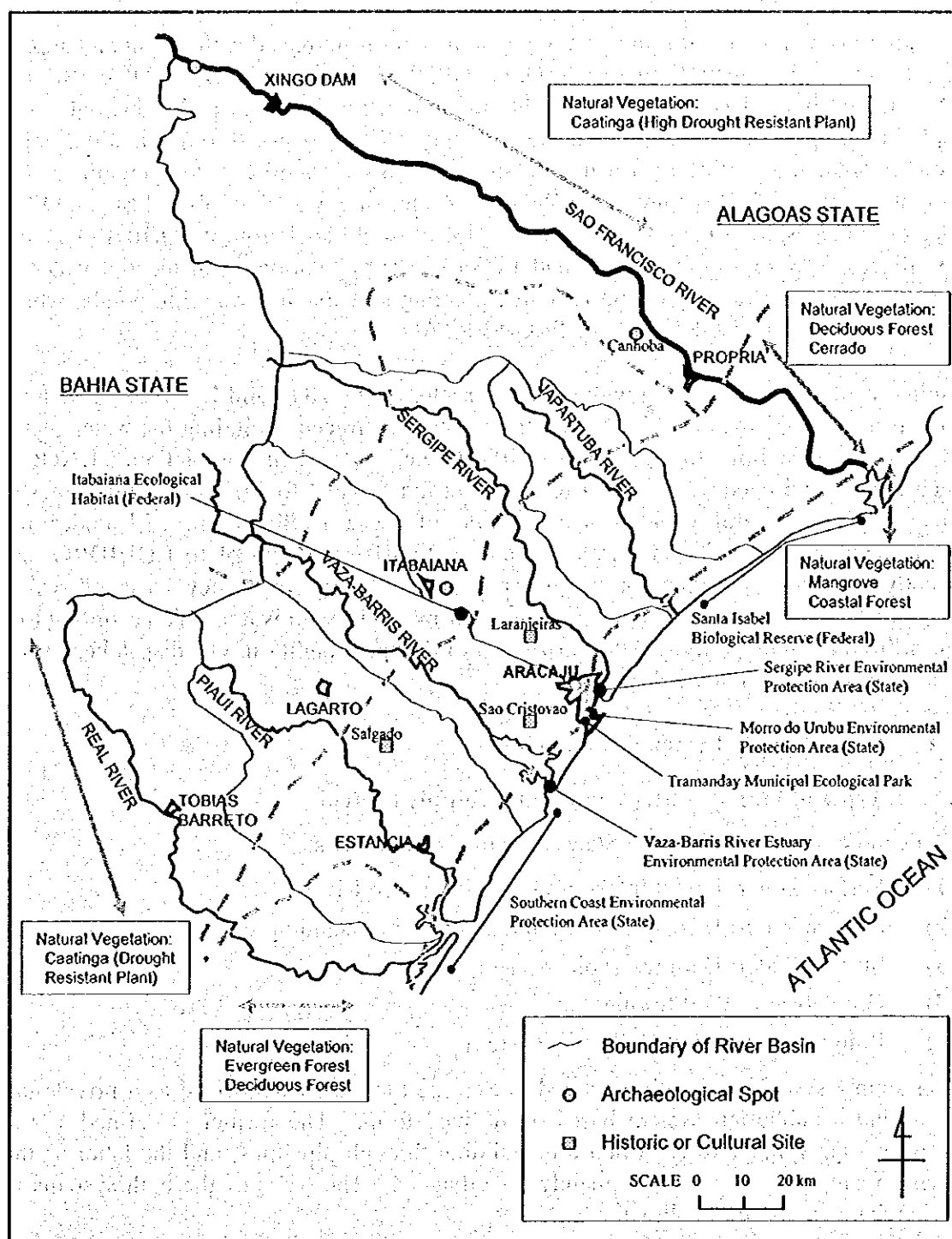


Figure-1.20 Environmental Characteristics in Sergipe State

1.8 Domestic and Industrial Water Supply

1.8.1 Water Supply Institutions and Services

In Sergipe State, main institutions that implement water resources development and supply projects are the five institutions of DESO, COHIDRO, PRO-SERTAO, CODEVASF and FNS. DESO is the largest and responsible institution for domestic and industrial water supply in Sergipe State. As for urban water supply, DESO covers 70 municipalities, 93% of supply amount and 92% of urban population. FNS covers other 5 municipalities, 7% of supply amount and 8% of urban population. As for rural water supply, DESO and FNS cover 225 villages, 8% of supply amount and 21% of rural population. COHIDRO covers 700 villages, 23% of supply amount and 14% of rural population. Residential water in the other rural villages depends on rainfall collecting systems and watering ponds, which mainly constructed by COHIDRO and PRO-SERTAO.

Another institutions concerning with the water sector are CEHOP and DNOCS. CEHOP, which is a state agency, designs and constructs various projects including the water sector and hands over facilities to DESO or COHIDRO etc. after their completion. DNOCS, which is a federal agency, was used to construct many dams for irrigation and domestic water supply a several decades ago. Some of these facilities are still under the management by DNOCS. However it plans to transfer the control to COHIDRO and currently has little activities for the water sector. On an emergency basis of severe drought, DC (Defesa Civil) delivers potable water by trucks with water tank, according to a request from a municipality. After inspection of drought condition, DC dispatches hiring trucks in order to calm down drought.

1.8.2 Water Supply Systems and Facilities

(1) Types of Water Sources and Water Supply System

Water sources utilized in Sergipe State are itemized as follows:

- 1) Surface Water: Direct Intake from Sao Francisco River
- 2) Surface Water: Direct Intake from Other Rivers (including weirs)
- 3) Surface Water: Dam reservoir
- 4) Groundwater: Well/Spring
- 5) Rain Water: Rainfall Collecting Cistern

Water supply systems currently operated in Sergipe State are categorized as a private-tap system and a public-tap system based on utilized form. The former is defined as the system to supply water to each house or building through pipelines, and the latter as the system to supply water in public mainly for villagers. The types of the both systems in Sergipe State are listed as follows:

< Private-tap System: Urban and Large Rural Water Supply >

- 1) Integrated Pipeline System by Sao Francisco River Intake
- 2) Integrated Pipeline System by Dams, Weirs and Wells/Springs
- 3) Independent Pipeline System by Weirs and Wells/Springs in Small Scale

< Public-tap System: Small Rural Water Supply >

- 4) Single Well System
- 5) Rainfall Collecting System

(2) Private-tap System (Urban and Large Rural Water Supply)

< Integrated and Independent Water Supply Systems >

Private-tap systems in Sergipe State could be divided into Integrated and Independent water supply systems, which are defined as follows:

- Integrated Water Supply System: the system supplying water to some municipalities including urban and rural areas
- Independent Water Supply System: the system supplying water, in general, to only one municipality including urban and rural areas

There are 86 water supply systems in Sergipe State, being operated by DESO and FNS. Of these systems, seven (7) systems, namely Aracaju, Itabaianinha, Piauitinga, Itabaiana, Propria, Sertaneja and Alto Sertao, are integrated water supply system and 79 systems are independent systems. The location of these systems is illustrated in Figure-1.21.

< Water Supply Facilities and Water Sources >

A private-tap system consists of intake pump (station), booster pump (station), purification plant, reservoir and pipeline. Water supply facilities and their water sources of private-tap system in Sergipe State are characterized as follows:

- Intake capacity of water is 437,580 m³/day (5.1 m³/s) in Sergipe State. The 82% (360,776 m³/day) of this water is purified and supplied. Total reservoir volume (136,475 m³) covers 31% of daily intake amount of water.
- Integrated water supply systems cover 73% of water resources, and independent systems cover 23%. It is noted that rural water supplied by private-tap systems account only for 0.5%.
- As for independent water supply systems, water sources depend mainly on weirs and deep wells accounting for 84%. However, water sources of integrated water supply systems depend on direct intakes of Sao Francisco River and weirs (intake from the other rivers) accounting for 55% and 28% respectively.
- In Sergipe State as a whole, Sao Francisco River occupies important water sources with 43% share. The second is weirs (intake from the other rivers) with 33%. Adding 1% of water sources from a large dam, surface water covers 77% of water sources in Sergipe State. The rest of water sources is groundwater accounting for 23%.

(3) Public-tap System (Small Rural Water Supply)

"Single Well System", constructed mainly by COHIDRO, supplies residential water only to small rural areas by means of public-tap system. In this report, the single well system is called as public-tap system against private-tap system in urban and large rural areas. Number of localities supplied by this system reach 700 localities, account for 23% of total rural localities (2,979 localities as of 1996) in Sergipe State.

(4) Other Systems

The population that is not covered by private-tap and public-tap systems depends mainly on rainfall collecting systems (Cisternas) for residential water. As rainwater is not a reliable water source, delivery truck water complements this system in severe drought conditions on emergency basis, especially in Semi-arid region. Watering pond (Aguadas) sometimes supplies water for human use but mainly for livestock.

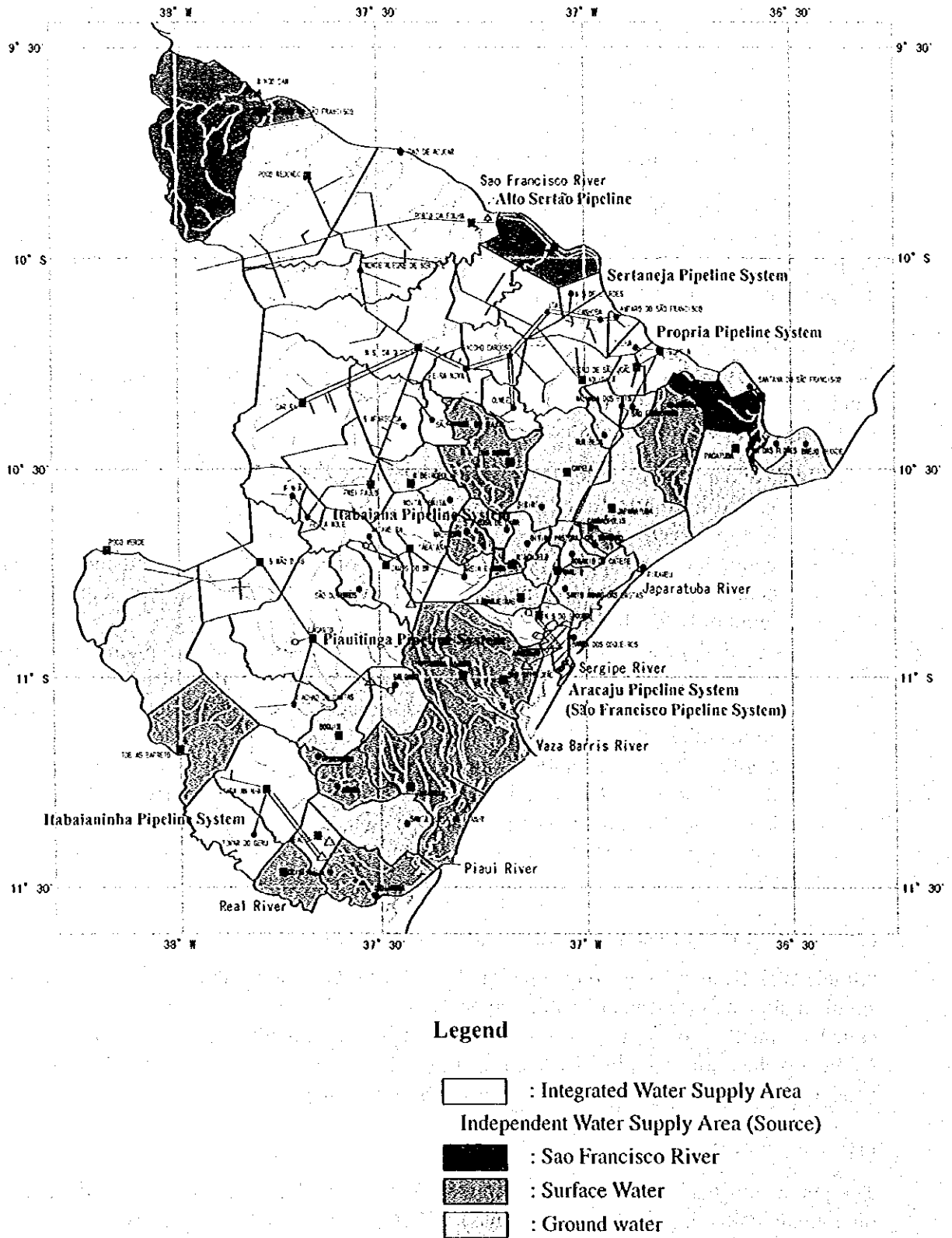


Figure-1.21 Integrated and Independent Water Supply System (Private-tap Tap System)

1.8.3 Present Condition of Water Supply

(1) Water Supply Population and Rate

Based on the data of DESO, FNS and COIHIDRO, number of localities supplied as well as population and rate of water supply by private-tap and public-tap are tabulated in Table-1.31 and Table-1.32. The average water supply rates in 1997 in Sergipe State are described as follows:

- Urban: 100% (Private tap system)
- Rural: 35% (21% by private tap system, 14% by public tap system)

Note that other systems such as rainfall collecting system and watering pond also supply water to 65% of rural population. However, water supply by the other systems is not counted due to its uncertainty.

Table-1.31 Population and Rate of Water Supply by Private-tap System as of 1997

River Basin	Total Population			Population and Rate of Water Supply		
	Urban	Rural	Total	Urban	Rural	Total
Sergipe State	1,170,784	483,022	1,653,806	1,170,784	102,273	1,273,057
	100%	100%	100%	100	21	77
Sao Francisco River	114,768	111,050	225,817	114,768	42,118	156,886
	100%	100%	100%	100	38	69
Japarutuba River	56,279	35,922	92,201	56,279	12,619	68,897
	100%	100%	100%	100	35	75
Sergipe River	697,487	81,062	778,549	697,487	6,456	703,943
	100%	100%	100%	100	8	90
Vaza Barris River	96,907	63,124	160,030	96,907	7,505	104,411
	100%	100%	100%	100	12	65
Piaui River	149,958	134,232	284,189	149,958	27,678	177,636
	100%	100%	100%	100	21	63
Real River	55,387	57,632	113,019	55,387	5,897	61,284
	100%	100%	100%	100	10	54

Table-1.32 Population and Rate of Water Supply by Public-tap and Other Systems as of 1997

River Basin	Total Rural Population	Public Tap System		Other System	
		Rural Population Supplied	Supply Rate (%)	Rural Population Supplied	Supply Rate (%)
Sergipe State	483,022	70,000	14	310,749	65
Sao Francisco River	111,050	11,081	10	57,851	52
Japarutuba River	35,922	5,310	15	17,993	50
Sergipe River	81,062	13,428	17	61,178	75
Vaza Barris River	63,124	12,498	20	43,121	68
Piaui River	134,232	18,785	14	87,769	65
Real River	57,632	8,897	15	42,837	74

Note. Rural population supplied by COIHIDRO public tap system was estimated, assuming that one deep well could supply water to 100 peoples.

(2) Water Loss Rate

< Private-tap System >

Water loss rate as of 1997 varied from 35% to 60% by water supply systems and municipalities. The water loss rate on the average of the whole state accounts for 48%, based on the water supply and consumption data from DESO and FNS. On the other hand, according to the material by DESO and Caixa Economica Federal, Water loss rate in the past and the future program is shown in Table-1.33.

Table-1.33 Water Loss Rate of Actual Condition and Future Program

Actual/Program	Actual						Program				
Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Water Loss Rate	44%	45%	45%	48%	48%	42%	38.25%	37.60%	36.64%	36.64%	36.64%

Note. This actual water loss rate includes measurement error.

This water loss includes 1) physical loss, 2) water consumption by unauthorized users, 3) consumption and operational loss, and 4) inaccuracy of measurement of water production. According to Table-1.33, water loss rate was improved to 42 % in 1998 from 48% in 1997 after the improvement project of measurement equipment in Aracaju. It means that measured water production is too large. As a result, actual water loss rate except measurement error is estimated to be less than 48% presently. Therefore, water loss rate in 1997 could be set at 42% in this Master Plan.

< Public-tap System >

There is no information about water loss rate of public-tap system. In general, the figure of 10% is employed as water loss rate, which includes pipe loss, consumption loss and operation loss.

(3) Present Water Supply Capacity

Based on the present water consumption and assumed water loss rate (42% in the whole state), present water supply capacity of private-tap system by municipalities is estimated as following equation:

$$[\text{Present Water Supply Capacity}] = [\text{Water Consumption}] \times (1 - [\text{Water Loss Rate}])$$

According to COHIDRO, present water supply capacity of public tap system is assumed to be 30 liter/capita/day. Assuming that 100 persons utilize a well, present water supply capacity per well was estimated as following equation:

$$\text{Water supply capacity per well} = 30 \text{ liter/capita/day} \times 100 \text{ person} = 3 \text{ m}^3/\text{day per well}$$

Table-1.34 Present Water Supply Capacity

River Basin	Private Tap System			Public Tap System		
	Water Consumption (m ³ /day)	Water Loss Rate (%)	Water Supply Capacity (m ³ /day)	Water Consumption (m ³ /day)	Water Loss Rate (%)	Water Supply Capacity (m ³ /day)
Sergipe State	163,234	42	281,438	2,100	10	2,333
Sao Francisco River	16,514	42	28,472	332	10	369
Japaratuba River	8,301	42	14,312	159	10	177
Sergipe River	104,556	42	180,270	403	10	448
Vaza Barris River	13,772	42	23,744	375	10	417
Piaui River	14,356	42	24,752	564	10	625
Real River	5,735	42	9,888	267	10	297

(4) Drought and Water Supply Restriction

In dry season, rural areas in Semi-arid region suffer from water shortage. The years of 1983 and 1984 were in the severest drought and about 6,700 trucks in 6 drought months were dispatched to the municipalities, of which water supply mainly depends on rainfall collecting systems. Even in municipality capitals, water supply is not stable and water supply is often restricted in dry season. In 1998, Aracaju has been suffering from severe water shortage, as well as livestock and rain fed agriculture in Sergipe State were damaged by this drought.

1.8.4 Future Programs of Water Resources Development and Supply

The main future programs concerning with water resources development and supply were as follows:

- 1) PROAGUA Project Proposed by Sergipe State
 - Expansion Project of Agreste Integrated System
 - Expansion Project of Piauitinga Pipeline System
 - Small Rural Water Supply Project in Semi-arid and Agreste Region
- 2) Expansion Project of Sao Francisco Pipeline System
- 3) Semi-arid Project Concerning with Sergipe State

As of December 1999, Expansion Projects of Agreste and Piauitinga Pipeline Systems were approved by PROAGUA. The project for Agreste is expected to complete until December 2001 and the project for Piauitinga is expected to complete until September 2001. The both project outline are described in Table-1.35.

Table-1.35 PROAGUA Projects Proposed by Sergipe State

Project	Item	Description
Expansion Project of Itabaiana Pipeline System	Outline	The aim of this project is to expand the water supply capacity of Agreste Integrated Water Supply System (Itabaiana Pipeline System) to meet the increased water demand in its coverage area until the year 2016. The Integrated System covers the communities of Areia Branca, Itabaiana, Campo do Brito, Macambira, Ribeira, Cajaiba and Mangueiras. New water sources from Jacarecica II Dam is added to the existing water source to meet the increased water demand.
	Project Cost	R\$ 5,028,357
Expansion Project of Piauitinga Pipeline System	Outline	The aim of this Project is to expand the water supply capacity of Piauitinga Integrated Water Supply System (Piauitinga Pipeline System) to meet the increased water demand in its coverage area until the year 2016. The Integrated System covers the communities of Lagarto, Simao Dias, Riachao do Dantas and Colonia XIII, Tanque Novo and the villages on the way from Simao Dias to São Jose. New water source from Gov. Dionizio Machado Dam is added to the existing water source to meet the increased water demand.
	Water Sources	The water from Gov. Dionizio Machado Dam and the water from other water sources shall be mixed because of the salinity of water from the dam in the proportion of 20% to 30% of water from the dam and 80% to 70% of water from other sources.
	Implementation Schedule	<ul style="list-style-type: none"> - The immediate stage shall be finished until the year 2001. - The 1st stage shall be implemented at the year 2000. - The 2nd stage shall be implemented at the year 2005.
	Project Cost	R\$ 9,962,382

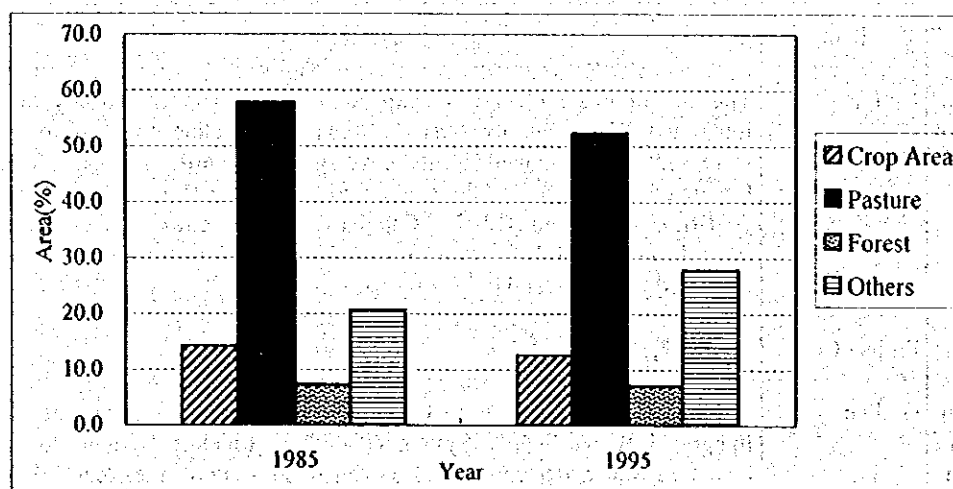
1.9 Agriculture and Irrigation

Agriculture in Sergipe was examined to assess whether the further water resources development is necessary for agriculture sector. Inland fish culture has been recently promoted by CODEVASF; however, its extension is still negligibly small compared to other agriculture practices. Besides, its water consumption is expected to be not significant because it will be practiced in reservoirs and ponds for other purposes, such as hydropower and irrigation. Therefore, inland fish culture was excluded from the study.

1.9.1 General Characteristics of Agriculture

(1) State Agricultural Area

As shown in Figure-1.22, approximately 14 % and 58 % of state land (2,205,030 ha) was cropland and pasture respectively in 1985, while both decreased to 13 % and 52 % in 1995. The reduction of agricultural areas is probably due to limited market and unfavorable prices. Urbanization also stipulates conversion of agricultural areas to other usage, such as residential areas and industrial areas.



Source: IBGE ("Census of Agriculture 1995-1996", 1996)

Figure-1.22 Agricultural Area

(2) Crop Cultivation

Primary crops in Sergipe are corn, beans, cassava, sugarcane, cotton, coconut and orange. Variation of yields and harvested areas of those crops in the last 20 years are shown in Table-1.36. Significant change is decrease in cultivation of traditional field crops, such as cotton and sugarcane, and increase in fruit cultivation. The harvested area of cotton dropped from 33,800 ha in 1985 to 1,900 ha in 1996. Harvested area of sugarcane reached to the maximum in 1990 (38,100 ha) but it decreased to 22,400 ha in 1996. Cultivation of other field crops has fluctuated depending on market. Beans have the similar tendency of corn because they are normally secondary crops of corn in Sergipe.

In the contrast to the field crops, fruit culture has increased steadily. Harvested areas of coconut and orange have increased at the rate of 1.6 % and 4.0 %, respectively. As a result, production of orange is classified second in Brazil after Sao Paulo state.

Since beans and cassava are staple food in Brazil, those crops are cultivated in approximately 35 % of the state cropland. Considering the self-sufficiency of farmers, areas of those crops will not decrease like cotton and sugarcane. At least, some areas for self-sufficiency will be maintained.

Table-1.36 Change in Harvested Areas of Primary Crops

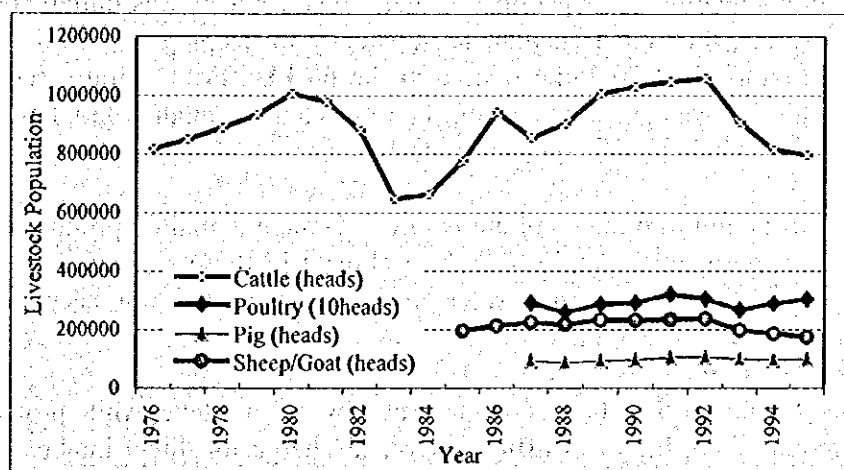
Crop	Yield (ton/ha)				Harvested Area (1,000 ha)			
	1981	1985	1990	1996	1981	1985	1990	1996
Corn	0.3	1.0	0.6	1.4	54.9	98.5	29.8	81.6
Beans	0.2	0.2	0.4	0.5	47.6	50.1	36.9	67.0
Cassava	13.1	13.1	14.9	15.0	28.8	35.2	34.2	39.8
Sugarcane	57.5	60.6	57.3	59.9	22.7	26.5	38.1	22.4
Cotton	0.1	0.4	0.3	0.4	19.7	33.8	2.7	1.9
Coconut ¹⁾	1.9	1.9	2.0	1.9	39.3	42.6	43.1	50.2
Orange ¹⁾	106.1	103.2	106.9	100.8	22.8	28.3	34.4	41.4

1): number of 1,000 fruits per hectare

Source: "Municipal Agricultural Production, 1981 - 1995" (IBGE) and EMDAGRO for Modification

(3) Livestock

Figure-1.23 shows state population of main livestock from 1976 to 1995. Main factors to fluctuate livestock population are price, climate and disease. According to "Brazil in Figures (IBGE, 1997)", sharp decline of cattle population in middle of 1980s is due to anti-inflationary price-control policies, while the local information explains that it is due to the severe drought. Since cattle raising in Sergipe mainly rely on pasture without irrigation system, unfavorable climate to pasture directly affects on cattle population. Recent decline of cattle population is probably explained by low precipitation.



Source: Municipality Livestock Population, 1976 ~ 1995 (IBGE), Modified by EMDAGRO

Figure-1.23 Livestock Population (1976 ~ 1995)

Populations of pigs and poultry maintain almost constant at 0.1 million and 3 million heads, respectively. Total population of sheep and goats has slightly decreased since 1992.

Since irrigation has not been applied to pasture, water required for livestock is mainly consumption by animals, and water supply relies on local water resources, such as spring, small stream, well water and so on. Unlike irrigation, water resources development in large scale has not been applied.

1.9.2 Irrigation

Main execution agencies to study and implement irrigation projects in Sergipe are CODEVASF and COHIDRO. CODEVASF promotes irrigation in Sao Francisco River Basin only, while COHIDRO promotes it in all state area.

Based on data and information collected from relative government agencies, technical specifications of existing irrigation projects in Sergipe were studied and summarized in Table-1.37. Since Jacare-Curituba and Jacareica II projects are still under the construction, those projects are included in the future projects discussed in Chapter 2.

Total irrigation area of 9 existing projects is approximately 17,000 ha; however, this area is not fully irrigated because settlement of farmers has not been completed in some projects. Problems associated with the settlement are mainly, 1) inadequate selection of crops due to fluctuation of market price, and 2) fail in formulating farmers' association for water management and market.

Existing irrigation projects are mostly located near Xingo dam, Propria and Neopolis where water intake from Sao Francisco River is available. 8 % and 79 % of the total irrigation area is located near Xingo dam and river mouth of Sao Francisco River (Propria and Neopolis), respectively. This is mainly due to surface water quality (see section 1.6). The surface water quality along the coast (tropical humid climate) is generally suitable for irrigation; however, quality of inland rivers in Sergipe, except Sao Francisco River, is mostly classified from slight to severe salinity.

Irrigation in Sergipe has been applied to cash crops because prices of staple food are not high enough for application of irrigation. CODEVASF projects was initially designed for paddy rice; however, they have encountered difficulty in keeping rice cultivation due to low price (approximately R\$0.25/kg of rice in the husk). Fruit culture, such as citrus, pineapple, mango, papaya etc., and vegetable culture, such as tomato, okra, lettuce, etc., are commonly cultivated in irrigation projects as cash crops.

Application of irrigation to orange culture is rare. Orange is mainly produced in Boquim and Agreste de Lagarto micro-regions. Since climate in these regions does not require irrigation and orange requires some water stress, irrigation has not been practiced for orange culture.

Projects in Sao Francisco river basin conduct water by direct intake, while projects in other river basins require dam due to insufficient river discharge for direct intake. Since high cost of dam construction is one of factors to limit application of irrigation, project scales in those basins are relatively small compared to projects along Sao Francisco River.

According to EMDAGRO ("Irrigated Agriculture in Sergipe State, Material for JICA Workshop", Jodemir, 1998), there are approximately 6,000 ha of private irrigation projects conducted by farmers themselves using mainly groundwater. These projects are small scale and located mostly in Itabaiana and Lagarto micro-regions. Since their exact locations and project specifications are unknown, they are excluded from Table-1.37.

Table-1.37 Existing Irrigation Projects

No.	1	2	3	4	5	6	7	8	9
Project Name	California	Propria	Cotinguiba	Neopolis	Betume	Jacareica	Pocao da Ribeira	Piaui	Jabiberi
Execution Agency	COHIDRO	CODEVASF	CODEVASF	COHIDRO	CODEVASF	COHIDRO	COHIDRO	COHIDRO	COHIDRO
Completed Year of Construction	1987	1975	1980	1994	1977	1987	1987	1987	1987
Area of Irrigation (ha)	1,360	1,177	2,215	7,230	2,861	252	1,100	703	225
Watershed	Sao Francisco River	Sao Francisco River	Sao Francisco River	Sao Francisco River	Sao Francisco River	Sergipe	Vaza Barris	Piaui	Real
Water Resources	Sao Francisco River	Sao Francisco River	Sao Francisco River	Sao Francisco River	Sao Francisco River	Jacareica River	Trairas River	Piaui River	Jabiberi
Intake	none	none	none	none	none	Concrete	Earth	Rock Fill	Concrete
Dam									
Type									
Height (m)						20	26	20	21.5
Crest Length (m)						420	500	465	290
Storage Volume (million m ³)									
Total Capacity (m ³ /s)	1.50	5.76	7.80	3.74	8.80	4.71	16.50	15.00	4.30
Pump Head (m)	170	NA	NA	123	NA	84	60	75	none
Distribution	Pipelines & Open Channels	Open Channels	Pipelines & Open Channels	Pipelines & Open Channels	Open Channels	Pipelines	Pipelines	Pipelines	Open Channels
Irrigation Method	Sprinkle	Surface & Sprinkle	Surface & Sprinkle	Sprinkle & Trickle	Surface	Sprinkle	Sprinkle	Sprinkle	Surface
Overall Irrigation Efficiency for Design	0.70	0.63	0.62	NA	0.60	0.70	0.70	0.70	0.60
Designed Crops	Fruits, Field & Vegetable Crops	Paddy Rice & Field Crops	Paddy Rice, Fruits & Field Crops	Fruits	Paddy Rice & Field Crops	Vegetable Crops	Vegetable Crops	Vegetable Crops	Fruits & Vegetable Crops
Soil Class	NC	Ae	Ae	PV	PV	PLc	LVd, PV	PV	Ae
Protect Water Requirement (m ³ /ha/month)									
January	1,150	2,624	1,810	990	2,350	3,210	690	720	2,800
February	970	2,368	1,640	850	1,300	2,590	810	760	2,540
March	1,400		240	570	550	2,520	1,420	1,220	3,390
April	1,460	1,568	810	120	950	1,580	870	720	2,770
May	1,100	880	450		1,700	90	180	190	810
June	710	1,008	500		1,500				400
July	590	1,104	550	100	1,000				310
August	700	1,696	940	340	750		80	120	650
September	1,070		220	330	550	530	310	1,200	1,970
October	1,680	2,448	1,440	790	1,000	1,680	1,650	2,460	4,310
November	1,800	2,448	1,470	910	2,550	2,650	2,950	2,090	5,530
December	1,670	2,592	1,640	1,000	2,900	3,160	2,020	1,620	4,970
Total Requirement (million m ³ /year)	19.4	22.1	25.9	43.4	48.9	4.5	12.1	7.8	6.9
Maximum Requirement (million m ³ /month)	2.4	3.1	4.0	7.2	8.5	0.8	3.3	1.7	1.2

NC: Non Calic Brown Soil, Ae: Eutrophic Alluvial Soil, PV: Red Yellow Podzolic Soil, PLc: Planosol, LVd: Red Yellow Latosol

Source: COHIDRO & CODEVASF (report of each project)

Project water requirements were adopted from the reports, except Cotinguiba whose requirement was calculated by Propria and Cotinguiba meteorological data.

1.10 Water Resources Management

1.10.1 Current Legislation on Water Resources Management

(1) Federal Constitution 1988

According to the stipulation of the Constitution, promulgated in 5th of October 1988, the ownership of river water and groundwater exclusively situated in the State except hydraulic energy potential, vast in the State. The water of the tributaries of federal rivers is also the property of the State in case that the tributaries wash only the State. Administrative classification of the river basins is shown in Table-1.38.

Table-1.38 Administrative Classification of River Basins in State of Sergipe

No.	River Basin	Administrative Classification (States where the main stream flows through)
1	Sao Francisco	Federal (States of Alagoas, Pernambuco, Bahia, Minas Gerais, and Federal District)
2	Japarutuba	State
3	Sergipe	State (a little upstream portion in State of Bahia, which has almost no interests)
4	Vaza-Barris	Federal (State of Bahia)
5	Piaui	State (a little upstream portion in State of Bahia, which has almost no interests)
6	Real	Federal (State of Bahia)

(2) Policies of Water Resources Management

The National Policy of Water Resources, Federal Law No.9443 promulgated on 18th of January 1997, gives a framework on the management policy of water resources in the federal domain. Succeeding to the national policy, the State Government of Sergipe enacted the State Policy of Water Resources, State Law No.3870 promulgated on 25th of September 1997. It stipulates the management policy of water resources in the state domain, which has almost the same contents as the National Policy, except raising State Fund of Water Resources as one of the management instruments.

(3) Laws and Regulations on Water Resources Conservation

The Constitution of the Federal Republic provides a legal base for the government administration on environmental protection and conservation. Major environmental enactment related to water resources conservation is shown in Table 1.38. As for the rivers of the state domain, the classification of the waters by predominant use has not been designated yet.

Table-1.39 Laws and Regulations Related to Water Resources Conservation

Laws and Regulation	Subject
Federal Law No.6938, 1981 and Federal Decree No.99274, 1990	National Environmental Policy
Federal Decree No.1413, 1975, Federal Decree No.76389, 1975	Industrial Pollution Control
Federal Law No.7802, 1989	Control of Agro toxics
Resolution of CONAMA No.001, 1986	Environmental Impact Assessment
Resolution of CONAMA No.20, 1986	Classification of Water Quality and Effluent Standards

1.10.2 Current Conditions of Organizations Related to Water Resources Management

Current conditions of state organs related to water resources management are summarized below for the following sub-sectors of water resources management.

- 1) Water Resources Allocation
- 2) Water Resources Development
- 3) Water Resources Conservation

(1) Water Resources Allocation

Activities required for water resources allocation are comprised of the following items, of which current conditions are described as follows:

- **Hydrological Measurement and Potential Analysis:** National Agency of Electric Energy (ANEEL), former DNAEE, is carrying out regular collection of river flow data in the State of Sergipe, operating 12 gauging stations. As state organs, COHIDRO and DESO are engaged in hydrological measurement on an intermittent basis on smaller basins. Currently, DESO collects river flow data at 89 points for their specific purposes or projects irregularly, while COHIDRO has suspended a program of flow measurement at 44 points due to lack of funds.
- **Analysis on Water Use and Demand Forecast:** Although DESO and COHIDRO have made demand projection for planning individual projects in their relevant field, such as public water supply or irrigation, none of state organs collaborate overall demand forecast for water resources. Overall water demands and their regional distribution in the state can be projected with long-term socio-economic development plan and regional/sectoral plans/strategies. There seem to be no such long-term plans in the state.
- **Granting Water Rights:** There seems to be only a few or several water rights registered in the state. There are no regulations or guidelines in force for application and granting water rights in the state.

(2) Water Resources Development

Water resources development has been carried out mainly by COHIDRO and CEHOP (State Company of Housing and Public Works). Although DESO has involved in water facility development in large scale for its water supply, its activities related to water resources development are limited to weir construction for direct intake or to pipeline construction for water conveyance. CEHOP is involved in construction projects for public works, including those for water resources development at tendering, contracting and supervision stages. Relevant organs, such as COHIDRO, are charged with up to feasibility studies or to basic design. Upon completion of construction, the works are handed over to the operating entities.

(3) Water Resources Conservation

SEMA and ADEMA are competent organs for environmental conservation of the state. SEMA was created recently and staffed with only 7 persons, while ADEMA was established before SEMA and has staff of 37 persons. As described above, classification of waters of the state domain according to the CONAMA resolution is still to be done. Regular monitoring at designated points with a certain interval has yet to be performed.

1.10.3 National Policy of Water Resources Management

The authority competent in the "National Policy of Water Resources (Law No.9433, 8th of January 1997)" is Ministry of Environment, Water Resources and Legal Amazon (MMARHAL). The Secretariat of Water Resources (SRH) under the ministry is in charge of water resources management. The SRH administers all issues of water resources within the federal domain. It is also the leading authority of PROAGUA.

The federal government is preparing drafts of decrees to promote the "National Policy of Water Resources" as soon as possible. Among the drafts, Nation Council of Water Resources (CONARH) was established under the Decree No.2612 on 3rd of June 1998. The CONARH composes 29 members as stipulated in the law. In addition, the federal government prepares to set up the "National Water Agency" (ANA or Agencia Nacional de Aguas). It is only one water agency on the national level. It covers the water resources of the whole federal surface waters such as rivers and lakes in the federal domain. The ANA plays a role of managing agency for the river basin committees in the federal domain.

The "National Policy of Water Resources" declares to adopt methodologies for integrated management of water resources in the whole country. The special features of the policy are summarized as follows:

- 1) The water resources are under the following two domains (Art. 1):
 - (a) The federal domain, covering surface waters such as rivers, lagoons and lakes that extend over more than one state unit, or between Brazil's territory and neighboring countries; and
 - (b) The state domain, covering surface and underground waters in one state.
- 2) The laws push forward to decentralization against power concentration (Art. 1).
- 3) The following basic principles are practiced for improvement of water resources management (Art. 1):
 - (a) The river basin is adopted as a planning unit.
 - (b) The multiple usage of water is promoted, and all sectors have equal access to water resources.
 - (c) The water resources are an ending and vulnerable natural resource.
 - (d) The water resources are an economic good and have economic value.
 - (e) The water resources are managed by the decentralized entities allowing the participation of water users.
- 4) The five essential instruments are employed for water resources management (Art. 5):
- 5) (a) Water resources plan; (b) Classification of waters; (c) Granting of water rights; (d) Charging to water resources user; and (e) Information system of water resources.
- 6) The new organizations are established for water resources management:
- 7) (a) National council of water resources (Art. 34); (b) River basin committee (Art. 37); (c) Water agency (Art. 41); and (d) Civil organizations of water resources (Art. 47).
- 8) The secretariat of MMARHAL/SRH in the nation (Art. 45) is obliged:
 - (a) To support the national council of water resources
 - (b) To make the national plan of water resources
 - (c) To coordinate the information system of water resources
 - (d) To make work programs and annual budget proposal, and to submit them to the national council of water resources

1.10.4 State System of Water Resources Management

The SEPLANTEC is the leading organ of water resources management in the state. In SEPLANTEC, the authority competent for the "State Policy of Water Resources" is the Superintendency of Water Resources (SRH). The SRH under the Secretary is in charge of water resources management in Sergipe. The SRH administers all issues of water resources within the state domain. The present SRH is still tentative, and will completely be established after enactment of the drafts of decrees by the governor. It is expected to fulfill the following functions:

- 1) To promote rational use and sustainable development of water
- 2) To formulate policies and instructions for the state's water resources management
- 3) To coordinate, to supervise and to plan activities concerning to water resources
- 4) To function as an executive secretariat of the state council of water resources, and to give necessary administrative and technical support
- 5) To promote engineering and economic studies of water resources
- 6) To develop and to maintain a state information system of water resources
- 7) To make the state plan of water resources and to submit it for appraisal by the state council of water resources
- 8) To coordinate the state plan of water resources and to submit an appraisal report to the national council of water resources
- 9) To do office works derived from the state council of water resources and the river basin committee
- 10) To analyze applications and to grant water use rights on the basis of regulation of the law
- 11) To analyze projects and to permit technical licenses for water facilities in case of no environment problems
- 12) To maintain communication and integration with agencies of operation and monitoring in terms of hydrometric net and hydro-meteologic data
- 13) To make an annual report regarding conditions of water resources
- 14) To make research aiming to settle criteria and standards for granting water usage right, charging system to users and arranging rational use of water resources, and to collect water tariff
- 15) To encourage water users to organize associations under the river basin committee

The main components of the State Policy of Water Resources are itemized in the following sections.

(1) State Council of Water Resources

The state council of water resources (CONERH/SE) was set up in the first place among organizations proposed in the state policy. It is the top deliberative organization in the field of water resources. It coordinates, inspect and deliberate issues of water resources in the state's domain. On 26th of May 1999, the CONDRH/SE was established on the basis of State Decree No.18099.

(2) River Basin Committee

A river basin committee is a deliberative organization covering whole water issues within the area closed in the watershed of the river. The committee is a forum for debating problems, planning multiple water usage and making decisions on issues of water resources,

with the aim at sustainable development in the basin. There are three river basins of the state domain: Sergipe, Japarutuba and Piaui Rivers. The each committee is composed of around twenty members. The number of members differs from one basin to another, which depends on the situation of the basin. However, the composition of the committee is made up of half members from the public power such as state and municipalities and half members from water users and civil societies.

(3) Water Agency

A Water Agency in Sergipe is placed as an executive secretariat under the river basin committees. The agency is established as an administrative and management body based on the state policy. Then, the agency has a character of autonomy and public company, and is indirectly a part of administrative structure of the state. In the state, it seems to be reasonable due to its territorial characteristics that only one agency assists its three river basin committees of Sergipe, Japarutuba and Piaui Rivers.

(4) Granting Rights to Use of Water Resources

The water resources are public domain, so the grant of rights to use of water resources is an administrative act in the nation and also in the states. The granted users are allowed to use water resources in a specified period on the basis of terms and conditions in the formal act. The water rights are given not to small end users but to bulk users of water resources. The purposes of the water rights are (a) to control quality and quantity of water resources and (b) to distribute water access rights effectively.

(5) Charging to Use of Water Resources

The charging to the users of water resources is considered as an administrative instrument as well as the granting. The charging system could ensure water availability not only under present conditions but also for future generation. It will urge water users to consume water rationally for sustainable economic growth. The fund from the charging covers the administrative costs of the agencies concerned and the costs of researches, studies and planning of works for water resources.

The charging system is under the jurisdiction of the water agency. The collected charges are revenue for water resources management, practically for the water agency and deposited in the water resources state fund (described later). Although the fund will basically be used to the competent basin, less than 50% of the total could be applied to the other areas under the committee's approval.

(6) State Fund of Water Resources

The state fund of water resources (FUNERH) is an independent accounting organization under the control of SEPLANTEC, with support of BANESE and under supervision of both the CONERH/SE and the Secretary of Finance. It will be established to play a financial role in the field of water resources management in the state. It aims to reduce regional distortions and economic disparities among sub-regions in the state. It is also expected to work for resolving or mitigating water problems in the river basins.

The fund comes from the charges to water resources use, basically. The fund should be utilized for improvement of water resources conditions in the state. However, a fund is

generally absorbed into the state general fund, unless there are any blocking legal actions for the absorption. This is another justification for existence of the FUNERII.

The fund is basically utilized for the water resources management. Up to 50% of the fund from the charges to water resources use in a river basin is applied to solve some problems in the said river basin. The fund of FUNERII is basically applied to borrowers through the type of loan.

(7) Master Plan of Water Resources

The master plan of water resources (PERII/SE) shows development targets, guidelines and procedures to goals of water resources in the state. The plan aims to guarantee preservation and sustainable development of water resources and to promote decentralization and civil participation. The plan is formulated on the basis of river basin. The river basin formed by watershed is another sub-division of the state in addition to administrative division and a planning unit of water resources management.

(8) SEPLANTEC

The draft of "SEPLANTEC" describes the function and organizations proposed for water resources management onto the current organization of SEPLANTEC at the beginning of 1999. It is composed of (1) Superintendency of Economic Planning and Budget (SPEO), (2) Superintendency of Studies and Researches (SUPES), and (3) Superintendency of Water Resources (SRH). The SRH is responsible for water resources management. The Secretary of SEPLANTEC presides the State Council of Water Resources and to represent the State Council of Environment.

1.10.5 Implementation Progress of Water Resources Management System

The new organizations for water resources management will be formulated on the basis of the policies above. They are illustrated in a diagram form in Figure-1.24. In the state level, the CONERH/SE is located onto the top position, which functions as a deliberative organ in the state. It coordinates, inspects and deliberates issues of water resources and establishes the state system of water resources. Under the state council, the river basin committees will be organized to coordinate and to deliberate issues of water resources in the respective basins. To support these committees in operational function, a water agency will be created for the respective basins. In the State of Sergipe, these river basins are the following three rivers only: Japarutuba, Sergipe and Piauí Rivers. As mentioned in the drafts of the decrees, the water agencies might be unified into one agency because of geographical characteristics in the state.

The rivers of Sao Francisco, Vaza Barris and Real are under the federal domain. Then, the council, committees and water agencies will be organized under the federal government. However, the latter two rivers extend between Sergipe and Bahia States only, so the special committees might be organized between the two state governments. Moreover, the SRH is considering getting the delegation to manage the state portions of these three federal rivers after the management system is established in the future.

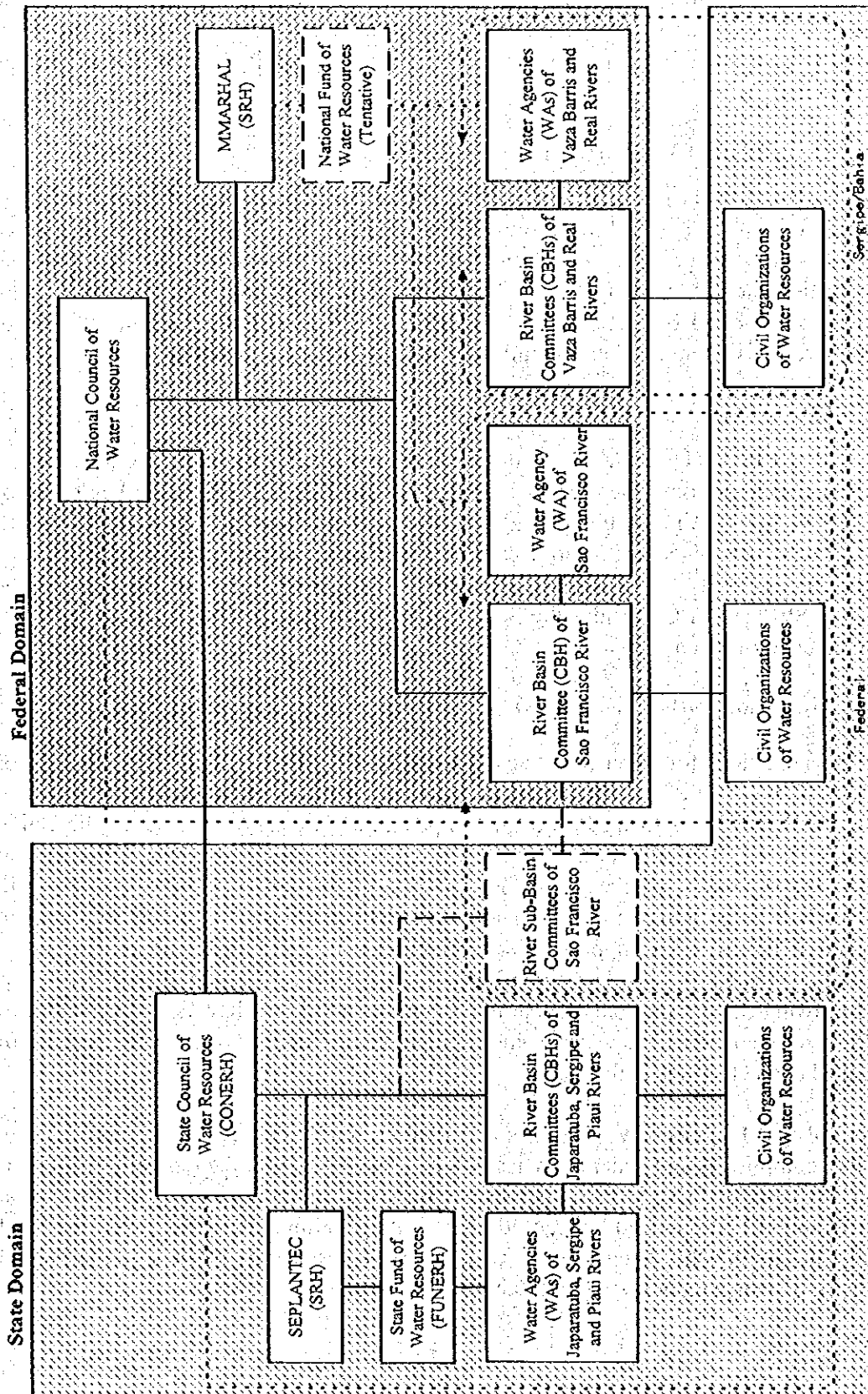


Figure-1.24 Organization Framework in the State Policy of Water Resources

1.11 Operation and Maintenance for Water Supply

1.11.1 Entities in Charge

(1) Domestic Water Supply in Urban and Large Rural Areas

Currently in the State of Sergipe, the water supply for domestic use is mainly implemented by DESO in urban and large rural areas. Four (4) Municipal Governments out of 75 ones operate water supply schemes by themselves with assistance of FNS. However, the involvement of FNS is decreasing. As for industrial water supply, many of industries supply by themselves, while some of industries, especially small industries, use water supplied by DESO.

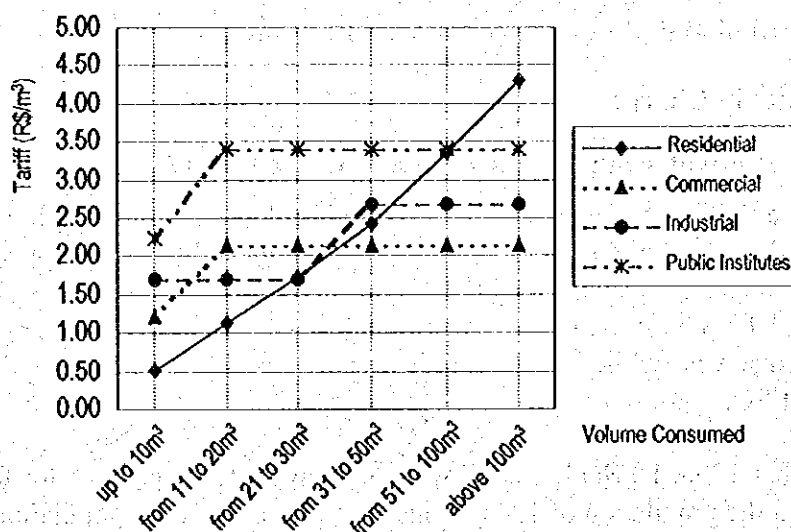
As of September 1998, DESO has employed as many as 1,066 persons for the services of water supply to the population of 1,320 thousand (82% of the total population of the State) and sewerage services for the population of 176 thousand (29% of the total). DESO is a state-owned company (so called mixed-economy society), almost 100% of whose share is held by the State Government.

Table-1.40 Outline of the Services by DESO

Items			1996 Nov.	1998 Oct.
1. Water Supply	1.1	Covered Locations	252	292
		Municipal Capital	70	70
		Villages	182	222
	1.2	Population Covered	1,214,913	1,319,988
		(%) to the Total Population	78 %	82 %
	1.3	Connection	265,449	296,850
		Connected	250,611	276,033
		Disconnected	17,310	23,907
	1.4	Volume of Billed Water	4,922,339 m ³	5,114,544 m ³
1.5	Volume of Consumed Water	4,643,703 m ³	4,757,005 m ³	
1.6	Volume of Produced Water	8,505,429 m ³	8,549,901 m ³	
1.7	Pipe Extension	3,931 km	4,183 km	
2. Sewerage	2.1	Covered Locations	3	3
		Population Covered	158,784	176,264
		(%) to the Total Population	27 %	29 %

Headquarters of DESO, being comprised of Directorates of Administration, Finance and Technique, and advisory offices to the Presidents, employs 360 persons that account for 34% of the total personnel. The rest of 706 persons, or 66% of the staff, are engaged in operation and maintenance, including some commercial activities, or seconded to the State Government or other companies. Out of the staff for operation and maintenance 365 persons, or 52% of the staff, are engaged in the operation and maintenance in the Capital region (Aracaju), while the rest of 337 persons work in the other regions over the state.

Current structure of water tariff by DESO is given in Figure-1.25. DESO takes fixed charge plus progressive block tariff: where succeeding blocks of units of water are sold at higher and higher prices. From small to medium scale user, tariff of residential water is lower than that for commercial or industrial user, while large commercial or industrial users enjoy slightly lower tariff than that for large residential users. The tariff up to 100 m³ for public institutes is comparatively high.



Source: DESO

Figure-1.25 Water Tariff by DESO (June 1998)

According to the financial data provided by DESO, the net loss of the recent three years amount to 7% to 9% of total operating expense. The personnel costs still share as high as 46% of the total operating expense in 1997. Administration costs accounted for nearly 36% in 1997 whose portion to the total operating expense increased by 2% annually in recent three years, while costs for operation, maintenance and commercial activities shared around 60% in 1997 whose portion in the total operating expense has been decreasing by 2% to 4% annually, on the contrary.

Table-1.41 Profit/Loss Statements of DESO

Item	1997		1996		1995	
	amount	% to OE	amount	% to OE	amount	% to OE
Operating Revenue	63,611	93%	52,953	94%	42,287	95%
Water Supply	57,062	84%	47,071	83%	37,424	84%
Sewerage Service	6,549	10%	5,881	10%	4,863	11%
Operating Expense	68,114	100%	56,568	100%	44,563	100%
Operation and Maintenance Cost	39,992	59%	34,773	61%	29,003	65%
Commercial Cost	858	1%	671	1%	586	1%
Administration Cost	24,246	36%	19,279	34%	14,362	32%
Tax and Duty	3,017	4%	1,844	3%	612	1%
Operating Loss	Δ4,503	-7%	Δ3,615	-6%	Δ2,275	-5%
Non-operating Revenue	1,499	2%	459	1%	442	1%
Non-operating Expense	1,842	3%	1,808	3%	1,469	3%
Net Loss	Δ4,847	-7%	Δ4,964	-9%	Δ3,303	-7%
(Personnel Cost)	31,620	46%	28,576	51%	-	-
(Outsourcing Cost)	18,730	27%	13,697	24%	-	-

Source: DESO

(2) Domestic and Agricultural Water in Rural Areas

COHIDRO takes a major role in domestic water supply in small rural areas through provision of public-tap systems. COHIDRO is also in charge of irrigation water supply. As of October 1998, COHIDRO employs 488 persons not only for the services mentioned above but also for actions on agricultural land and on mechanization of agriculture. The organization structure of COHIDRO is illustrated in the figure below.

Currently users of domestic water supplied by COHIDRO do not pay for the services even for the cost of operation and maintenance, such as electricity for pumps, while some part of the costs for irrigation are charged on users, whose tariff is shown in the table below. In some perimeters, the tariff for irrigation service is charged by water volume used, while in other perimeters the tariff is set by area of land cultivated. The level of the tariff varies widely in cases that the tariff is charged by land area, while the rate charged by volume is unified in all three perimeters.

Table-1.42 Tariff for Irrigation Water

Perimeter	Tariff	Unit
1. California	R\$ 66.66	/ha./4 month
2. Jacare-Curituba	not yet determined	
3. Neopolis	R\$ 4.50	/ha./month
4. Jacarecica	R\$ 0.025	/m ³
5. Poca da Ribeira	R\$ 0.025	/m ³
6. Piaui	R\$ 0.025	/m ³
7. Jabiberi	R\$ 30.00	/ha./4 month

Source: COHIDRO

Amount of tariff collected and O&M expenses in irrigation perimeters in 1998 are given below. The cost recovery by tariff collection remains quite low. The rate of tariff collections seems very low.

Table-1.43 Tariff Revenue and O&M Expenses in Irrigation Perimeters

Perimeter	Tariff Revenue	Energy Cost	Other O&M Costs	Total O&M Cost	Unit: R\$
					Deficit
Jacarecica	36,824	57,431	140,693	198,124	161,300
(% to Total O&M Cost)	(19%)	(29%)	(71%)	(100%)	(81%)
Poca da Ribeira	92,955	286,497	254,450	540,947	447,992
(% to Total O&M Cost)	(17%)	(53%)	(47%)	(100%)	(83%)
Piaui	24,855	77,293	177,060	254,353	229,498
(% to Total O&M Cost)	(10%)	(30%)	(70%)	(100%)	(90%)
California	144,609	1,408,703	638,212	2,046,915	1,902,306
(% to Total O&M Cost)	(7%)	(69%)	(31%)	(100%)	(93%)
Jabiberi	11,435	0	41,250	41,250	29,815
(% to Total O&M Cost)	(28%)	(0%)	(100%)	(100%)	(72%)
Total	310,679	1,829,926	1,251,667	3,081,593	2,770,914
(% to Total O&M Cost)	(10%)	(59%)	(41%)	(100%)	(90%)

Source: COHIDRO

Profit/loss statements of COHIDRO in recent four years are given in the table below. Most of the figures in the statement develop irregularly. Large losses occurred especially in recent two years.

Table-1.44 Profit/Loss Statement of COHIDRO

amount: R\$ 1,000

Item	1997		1996		1995		1994	
	amount	% to OE	amount	% to OE	amount	% to OE	amount	% to OE
Operating Revenue	1,861	15%	2,545	23%	11,662	80%	6,362	93%
Revenue from Services	1,958	16%	1,832	17%	11,205	77%	6,210	91%
Other Revenue	0	0%	713	7%	458	3%	152	2%
Revenue Deducted	△96	-1%	0	0%	0	0%	0	0%
Operating Expense	12,572	100%	10,915	100%	14,617	100%	6,861	100%
Operation Cost for Services	7,570	60%	1,043	10%	4,286	29%	237	3%
Administration Cost	4,786	38%	8,992	82%	9,494	65%	6,148	90%
Depreciation	216	2%	880	8%	837	6%	476	7%
Operating Loss	△10,711	-85%	△8,370	-77%	△2,954	-20%	△499	-7%
Non-operating Revenue	211	2%	462	4%	254	2%	332	5%
Non-operating Expense	1,335	11%	8	0%	84	1%	533	8%
Tax and Duty	0	0%	186	2%	301	2%	233	3%
Net Loss	△11,835	-94%	△8,103	-74%	△3,085	-21%	△932	-14%

Source: COHIDRO

1.11.2 Current Status of State-owned Companies

For the administration of the state, state-owned companies take important roles, taking major functions as a part of indirect administration. In the State Government, indirect administration, being composed of autarchies (autonomous organs), foundations, public enterprises and companies of mixed economy (sociedades de economia mista), is mainly in charge of provision of public services as a statutory entities except in the fields of education, public safety and public health. Most of the state-owned companies have been suffered from large amount of accumulated deficits.

COHIDRO has the largest accumulated deficits, followed by SERGIPTOS and EMDAGRO. Public services in rural areas seem to have low cost recovery, supported by the provision in the article 178 of the State Constitution, which establishes obligation of the State to provide free extension services in rural and agricultural areas.

EMDAGRO is competent for technical assistance to farmers, agricultural credit, rural extension (education) services, agricultural research, animal and vegetable sanitation, and encouragement and stimulation of agriculture, including livestock breeding, organizing agricultural and rural communities and services on commercialization and supply (mainly food supply in emergency). Services on commercialization and supply, however, have been shifted to the private sector. Reorganizing and restructuring of COHIDRO and EMDAGRO is intensively discussed, examining a merger of the two entities.

Concession to the private sector of water supply services in Aracaju currently carried out by DESO is also discussed by Agency for Concession of Public Services (ASES) affiliated to SEPLANTEC.

CHAPTER 2 FUTURE WATER DEMAND

2.1 Future Socio-economic Framework

2.1.1 Population Projection

The long-term projection of population is indispensable for formulating the future framework of socio-economic structure in the project areas. The population of Brazil was estimated up to the year 2020 by IBGE in the Annually Statistic Book in 1996 as shown in Table-2.1. Its annual growth rate was 1.0% between 1996 and 2020. As to the population of Sergipe State, the SUPES provides population projections for the state with a breakdown of its municipality level during the period from 1990 to 2010. These projections were based on the results of the 1991 census.

In this study, the future population is projected on the basis of the 1996 census results, applying the method of the SUPES projection. Table-2.1 shows the population projected up to the year 2020 at 10-year intervals. The state population in 2020 was projected at 2,778 thousand, of which growth rate is 2.3% on average between 1996 and 2020.

Table-2.1 Projected Population in Sergipe: 1997 – 2020

Item	Census 1996	Projected Population					Annual Growth Rate (%)
		1997	1998	2000	2010	2020	
Brazil	157,079	159,060	161,247	165,715	184,157	200,306	1.0
Sergipe	1,624	1,654	1,685	1,750	2,163	2,778	2.3
Urban	1,141	1,171	1,202	1,267	1,668	2,237	2.8
Rural	483	483	483	483	495	541	0.5
By Micro-region							
Sergip.de SF	116	117	117	119	131	54	1.2
Carira	57	58	59	60	70	85	1.7
N.S. das Dores	54	54	55	56	63	73	1.3
A. de Itabaiana	136	139	143	150	203	297	3.3
Tobias Barreto	92	93	94	97	111	132	1.5
A. de Lagarto	93	94	95	97	106	118	1.0
Propria	82	83	84	86	108	152	2.6
Cotinguiba	39	39	39	40	43	47	0.8
Japarutuba	44	44	44	45	51	59	1.3
B. Cotinguiba	70	71	72	75	91	115	2.1
Aracaju	608	625	643	680	903	1,212	2.9
Boquim	134	136	138	142	168	204	1.8
Estancia	100	101	102	103	115	130	1.1
By River Basin							
Sao Francisco	225	226	228	232	266	332	1.6
Japarutuba	91	95	95	97	116	147	1.4
Sergipe	759	776	798	841	1,016	1,494	2.9
Vaza Barris	165	160	163	168	203	253	1.8
Piaui	273	284	287	294	331	380	1.8
Real	111	113	114	118	141	172	2.0

Source: Anuario Estatístico do Brazil 1996

IBGE, Contagem da Populacao 1996, IBGE

Anuario Estatístico de Sergipe 1996, SEPLANTEC/SUPES

2.1.2 GRDP Projection

The long-term projection of GRDP is also indispensable for formulating the future framework of the socio-economic structure in the project areas. Official GRDP projection is not available, even though the report of "Plano Plurianual 1996-1999, Governo de Sergipe" tried to give the projection. Only the national development plan named "Perennial-Year Plan 1996-1999, Message from National Congress" proposed the target growth of 4.6% per annum on average during the planning period. The plan, however, presents the projections only until the year 1999. After that, no projection scenarios were suggested in any of the development plans, at present. Therefore, GDP and GRDP in the future are estimated on the following assumptions.

< GDP Projection Assumption >

- Until the year 1999, GDP will increase at the growth rates predicted in the national plan, and continue to grow at the same rate of 5.0 % as proposed in the plan to the year 2000.
- Beyond the year 2000, the growth rates were assumed to slow down to the followings: three-quarters (3.75%) of the growth (5.0%) at 2000 for the first decade and half (2.5%) for the second decade.

< GRDP Projection Assumption >

- Until the year 2000, GRDP of the state will increase at the same growth rates (5.0%) as GDP's growth after 1997.
- Beyond the year 2000, GRDP is assumed to keep the same rate of 5.0%, in order to alleviate the economic disparity between the national average and state level.
- Agriculture Sector will be assumed to grow at the rate of 1 % per annum after 1997. The growth rate of Industrial Sector and Services Sector after 1997 was estimated as shown in Table-2.2.

Table-2.2 GDP and GRDP Projection at 1998 Constant Prices

Item	1995	1997	1998	2000	2010	2020
GDP and GRDP (R\$ billion at 1998 Constant Prices) by Data and References						
1) Brazil	799.39	868.78	912.21	1,005.71	1,453.30	1,860.35
2) Sergipe	4.43	4.89	5.13	5.66	9.22	15.02
Agriculture	0.55	0.57	0.57	0.58	0.64	0.71
Industry	1.34	1.49	1.57	1.75	2.95	4.93
Services	2.54	2.83	2.99	3.33	5.63	9.38
Average Annual Growth Rate (%)						
1) Brazil	1.80*	4.50	5.00	5.00	3.75	2.50
2) Sergipe	1.33*	5.00	5.00	5.00	5.00	5.00
Agriculture	4.88*	1.00	1.00	1.00	1.00	1.00
Industry	1.94*	5.57	5.55	5.55	5.38	5.25
Services	3.90*	5.57	5.55	5.55	5.38	5.25

Source: Plano Plurianual 1996-1999, Mensagem ao Congresso Nacional, GOB, MPO
Anuario Estatístico do Brazil 1996, IBGE

* Annual growth rate between 1990 and 1995

By the year of 2020, GRDP of the state will reach to R\$15.02 billion at 1998 constant prices. It was 3.4 times of that (R\$4.43 billion) in 1995. Thus, it accounted for 0.80% in Brazil, which become larger than the percentage (0.55%) in 1995.

GRDP per capita in 2020 was calculated at R\$5,400 at 1998 constant prices, as shown in Table-2.3. It was 1.95 times of that (R\$2,770) in 1995. It was 58% of the national average, which became larger than that (54%) in 1995. Thus, the regional disparity could shrink and the people's lives would get closer to the national level for this period.

Table-2.3 Projection of GRDP per Capita

Item	1995	1997	1998	2000	2010	2020
Population Projection (million)						
1) Brazil	154.97	159.06	161.07	165.72	184.16	200.31
2) Sergipe	1.60	1.65	1.68	1.75	2.16	2.78
Per Capita GDP and GRDP(R\$)						
1) Brazil	5,160	5,460	5,660	6,070	7,890	9,290
2) Sergipe	2,770	2,960	3,050	3,230	4,270	5,400
Indices of Per Capita G(R)DP to 1997 Value						
1) Brazil	-	1.00	1.04	1.11	1.44	1.70
2) Sergipe	-	1.00	1.03	1.10	1.44	1.83

Source: Plano Pluriannual 1996-1999, Mensagem ao Congresso Nacional, GOB, MPO
Anuário Estatístico do Brasil, 1996, IBGE

2.1.3 Regional Socio-economic Framework

(1) Present Regional Socio-economic Framework

75 municipalities in Sergipe are divided into 13 Homogeneous Micro-Regions (Microrregiões Homogêneas-MRH). These Micro-regions are used as regional unit because these units are used for statistical works by federal level and state level. Estimated present regional socio-economic framework is summarized as follows according to this unit:

- Concentration of the State population and 2nd & 3rd economic sector's GRDP to central regions, which are composed of Micro-regions of Aracaju and Baixo Cotinguiba, reaches respectively 42% and 75% of the State population.
- Difference of the GRDP per capita among Micro-regions is very large. The GRDPs per capita of four Micro-regions, namely Sergipana do Sertao do Sao Francisco, Itabaiana, Lagarto and Estancia, correspond to a level ranging from 20% to 40% of GRDP per capita of the central region. Other Micro-regions' GRDP per capita is estimated at a level of less than 20% of the central region's one.

(2) Proposed Scenarios for Regional Development Planning

The two scenarios for regional distribution planning of the state population and GRDP are drawn in order to formulate the regional development plan, which displays the regional socio-economic framework at the target year of 2020.

(a) Trend Scenario

The trend scenario, which was drawn under the assumption that the present socio-economic framework will continue up to the target year without any change, is imaged as follows:

- The concentration ratio of population on central region rises from 42% to 48% and GRDP per capita of central region also rises from 75% to 80%.
- These too much concentration may break out social/natural environmental problems as: devastation of coast area and urban environmental problems such as shortage of infrastructure in the water resources development works.
- The rise of GRDP per capita in central region is estimated to be R\$3,700 but the rises of GRDP per capita in other Micro-regions might range from R\$1,000 to R\$2,700. It means that socio-economic disparity among Micro-regions would become larger.

(b) Strategic Scenario

Under the basic policy of decentralization to alleviate the foreseeable problems, such as over-concentrated situation of population and economic activity in the central region, and to alleviate the large socio-economic disparity among these Micro-regions, the trend scenario was proposed under the following method of decentralization of population and economic activity:

- Primary Sector: Increment of GRDP is distributed to seven (7) Micro-regions as shown in Table-2.4.
- Secondary and Tertiary Sector: A part (15%) of the 2nd and 3rd sector's GRDP increment of Aracaju Micro-region is distributed to seven (7) Micro-regions.
- Population: A part of urban population is distributed to the same seven (7) Micro-regions as GRDP's distribution.

Table-2.4 Distribution of Increment of GRDP and Population in Strategic Scenario in 2020

Micro-region	1st Sector		2nd & 3rd Sector		Urban Population	
	Irrigation Area (ha)	GRDP (Million R\$)	GRDP (Million R\$)	Distribution Rate (%)	(Persons)	(%)
01.Sergipana do Sertao do S.F.	24,709	76.4	284.20	20.0	43,860	20.0
02.Carira	0	0.0	0	0	0	0
03.Nossa Senhora das Dores	0	0.0	0	0	0	0
04.Agreste de Itabaiana	2,452	7.6	284.20	20.0	43,860	20.0
05.Tobias Barreto	225	0.7	0	0	0	0
06.Agreste de Lagarto	3,203	9.9	284.20	20.0	43,860	20.0
07.Propriá	13,483	41.6	142.10	10.0	21,930	10.0
08.Cotinguiba	0	0.0	71.05	5.0	10,963	5.0
09.Japaratuba	890	2.7	71.05	5.0	10,963	5.0
10. Baixo Cotinguiba	0	0.0	0	0	0	0
11.Aracaju	0	0.0	-1,421.00	-100.0	-219,294	-100.0
12.Boquim	0	0.0	0	0	0	0
13.Estancia	370	1.1	284.20	20.0	43,858	20.0
Total	46,332	140.00	0	0	0	0

Note-1: The distribution of urban population is based on the GRDP distribution, using the following unit: 190 person/million R\$ GRDP = Total urban population in 2020 / Total GRDP of 2nd & 3rd Sector in 2020

Note-2: Increase of GRDP of 1st Sector in 2020 (140 million R\$) was distributed according to the existing and proposed irrigation areas (46,322 ha) of each Micro-regions.

The projected population and GRDP by Strategic Scenario are tabulated in Table-2.5 and 2.6.

(3) Scenario to be applied for the Study

The Strategic Scenario is applied to the formulation of the Master Plan of Water Resources Development for the reasons as follows:

- Prospective high level of concentration of population and economic activity in the central region estimated in Trend Scenario has quite a possibility which breaks out the new problems regarding social and environmental fields. And it needs a large amount of investment to solve these problems. For this reason, the regional planning led from decentralized scenario should be selected.
- A harmonized development planning of the state is expected with a full use of water resources, other natural resources and human resources. From these viewpoints, the decentralized progress is considered desirable.

Table-2.5 Projected Population of Sergipe in 2020 (Strategic Scenario)

Micro-region and River Basin	Urban population		Rural Population		Total Population		Urban/Total (%)
	persons	%	persons	%	persons	%	
01.Sergipana do Sertao do S.F.	151,122	6.7	46,819	8.7	197,942	7.1	76.4
02.Carira	61,605	2.8	23,466	4.3	85,071	3.1	72.4
03.Nossa Senhora das Dores	51,109	2.3	22,118	4.1	73,227	2.6	69.8
04.Agreste de Itabaiana	266,777	11.9	74,400	13.8	341,177	12.3	78.2
05.Tobias Barreto	95,376	4.3	36,275	6.7	131,651	4.7	72.5
06.Agreste de Lagarto	106,522	4.8	55,716	10.3	162,238	5.8	65.7
07.Propria	149,611	6.7	23,912	4.4	173,523	6.3	86.2
08.Cotinguiba	41,307	1.8	16,974	3.1	58,281	2.1	70.9
09.Japaratuba	44,695	2.0	25,598	4.7	70,293	2.5	63.6
10.Baixo Cotinguiba	106,042	4.7	9,116	1.7	115,157	4.1	92.1
11.Aracaju	928,376	41.5	64,075	11.9	992,451	35.8	93.5
12.Boquim	111,393	5.0	92,210	17.0	203,602	7.3	54.7
13.Estancia	123,373	5.5	50,359	9.3	173,732	6.3	71.0
Total or Average	2,237,309	100.0	541,037	100.0	2,778,346	100.0	80.5
River Basin							
Sao Francisco	303,164	13.8	92,410	17.1	395,574	14.2	76.6
Japaratuba	121,865	5.2	41,594	7.7	163,459	5.9	74.6
Sergipe	1,202,811	41.9	123,821	22.9	1,326,632	47.8	90.7
Vaza Barris	202,669	21.4	64,787	12.0	267,456	9.6	75.8
Piaui	307,152	13.3	146,162	27.0	453,314	16.3	67.8
Real	99,648	4.4	72,263	13.3	171,911	6.2	58.00

Table-2.6 Projected GRDP & GRDP per Capita in 2020 at 1998 Constant Prices (Strategic Scenario)

Unit : R\$ million for GRDP

Micro-region and River Basin	1st Sector		2nd & 3rd Sector		Total of GRDP		GRDP per Capita
	GRDP	(%)	GRDP	(%)	GRDP	(%)	
01.Sergipana do Sertao do S.F.	162	22.9	804	5.6	966	6.5	4,910
02.Carira	39	5.5	30	0.2	69	0.5	800
03.Nossa Senhora das Dores	24	3.4	26	0.2	50	0.3	670
04.Agreste de Itabaiana	76	10.7	592	4.1	668	4.5	1,960
05.Tobias Barreto	34	4.7	150	1.1	184	1.2	1,390
06.Agreste de Lagarto	54	7.5	700	4.9	754	5.0	4,650
07.Propria	62	8.7	287	2.0	349	2.3	2,020
08.Cotinguiba	20	2.9	104	0.7	124	0.8	2,130
09.Japaratuba	27	3.8	163	1.1	190	1.3	2,680
10. Baixo Cotinguiba	46	6.5	2,447	17.1	2,493	16.6	21,640
11.Aracaju	30	4.2	8,052	56.3	8,082	53.8	8,140
12.Boquim	82	11.6	102	0.7	184	1.2	900
13.Estancia	54	7.6	853	6.0	907	6.0	5,220
Total or Average	710	100.0	14,310	100.0	15,020	100.0	5,400
River Basin							
Sao Francisco	238	33.6	1,024	7.2	1,262	8.4	3,190
Japaratuba	47	6.6	1,033	7.2	1,080	7.2	6,610
Sergipe	129	18.1	9,552	66.7	9,681	64.5	7,300
Vaza Barris	93	13.1	1,101	7.7	1,194	7.9	4,460
Piaui	135	19.1	1,403	9.8	1,538	10.2	3,390
Real	68	9.5	197	1.4	265	1.8	1,540

2.2 Domestic Water Demand Projection

2.2.1 Unit Consumption Rates

A planning standard of water supply system is not available in the state. In a water supply plan of DESO, water demand of various consumers is set up on the basis of the past supply records. The records of DESO's water supply services in 1997 on monthly average and unit consumption for the respective categorized consumers were shown in Table-2.7.

Table-2.7 Water Supply Records by Consumer in 1997

Category	Residential	Commercial	Public	Industrial	Total
Monthly Average Consumption (1000m ³ /month)					
Urban	4,031 (79%)	389 (8%)	334 (7%)	308 (6%)	5,062 (100%)
Rural	190 (84%)	13 (6%)	21 (9%)	2 (1%)	226 (100%)
Unit Consumption by DESO's Record (litter/day/capita)					
Aracaju	122	15	12	-	149
Urban	109	11	10	-	130
Rural	80	6	9	-	95

Source: Supply records of DESO, 1997

According to a DESO's expert, the supply capacity of DESO is not enough to cover the peak demand during the peak period. It is said that the capacity of supply system would be necessary 25% more than the present one. Taking this advice into consideration, the unit consumption rates are set up as shown in Table-2.8. In small rural area where the people are not covered with piped system, the unit rate was set up as 70 liter/day per capita in this study.

Table-2.8 Unit Consumption Rates Proposed

Unit: litter/day per capita

Category	Residential	Commercial	Public	Total
Aracaju	155	20	15	190
Urban	135	13	12	160
Large Rural	100	8	12	120
Small Rural	70	-	-	70

Remark: The unit consumption rates in the report of "Manual Operativo Vol. 2 do PROAGUA" are set up; 150 (litter/day) in the region with population of between 4,000 and 50,000, and 120 with that of less than 4,000.

Urban area is completely supplied with private tap system at present. As to the rural area, according to the study, rural area was divided into two types by the size of population as follows: 1) large rural area; villages with more than 101 inhabitants, and 2) small rural area; villages with less than 100 inhabitants. Consequently, large rural inhabitants (assuming 70% of the rural population) were estimated to be supplied with private tap system and small rural inhabitants (assuming 30% of the rural population) were estimated to be served with public tap system.

2.2.2 Projected Domestic Water Demand

The future water demand composed of residential, commercial and public uses is projected by municipality on the basis of the strategic scenario. The results are summarized in Table-2.9. The state demand in 2020 is estimated at 433,000 m³/day, also showing 1.7 times of the demand in 1997.

Table-2.9 Projection of Domestic Water Demand

Unit: m³/day

Micro-region and River Basin	1997	1998	2000	2005	2010	2015	2020
Sergipe	251,227	256,717	267,699	297,768	334,278	378,618	432,838
Urban	200,510	206,018	217,036	246,738	282,221	324,718	376,029
Rural	50,717	50,699	50,662	51,031	52,057	53,900	56,809
By Micro-region							
Sergipana do Sertao do S.F.	15,201	15,362	15,684	18,443	21,475	24,963	29,095
Carira	7,738	7,865	8,118	8,892	9,821	10,947	12,321
Nossa Senhora das Dores	7,305	7,404	7,602	8,094	8,725	9,515	10,500
Agreste de Itabaiana	18,848	19,428	20,587	27,179	34,093	41,734	50,496
Tobias Barreto	12,558	12,757	13,156	14,211	15,511	17,106	19,069
Agreste de Lagarto	12,080	12,216	12,487	14,721	17,113	19,793	22,894
Propria	11,681	11,900	12,339	15,287	18,505	22,165	26,448
Cotinguiba	5,308	5,355	5,450	6,008	6,666	7,449	8,392
Japaratuba	5,631	5,699	5,834	6,658	7,568	8,611	9,839
Baixo Cotinguiba	10,722	10,918	11,309	12,469	13,924	15,718	17,924
Aracaju	112,534	115,749	122,179	129,131	139,815	154,341	173,328
Boquim	17,704	18,013	18,630	20,240	22,209	24,599	27,505
Estancia	13,916	14,051	14,323	16,436	18,854	21,676	25,028
By River Basin							
San Francisco	30,023	30,411	31,188	36,736	42,859	49,897	58,209
Japaratuba	12,776	13,017	13,498	15,521	17,838	20,569	23,866
Sergipe	133,294	136,964	144,304	157,377	174,534	196,255	223,511
Vaza Barris	22,133	22,570	23,444	26,547	30,103	34,267	39,230
Piaui	38,088	38,572	39,542	44,464	50,095	56,673	64,491
Real	14,913	15,183	15,723	17,122	18,849	20,957	23,531
(Urban Area)							
San Francisco	18,363	18,879	19,913	26,002	32,558	39,936	48,506
Japaratuba	9,005	9,240	9,712	11,683	13,900	16,465	19,498
Sergipe	124,782	128,416	135,683	148,349	164,742	185,208	210,510
Vaza Barris	15,505	15,943	16,818	19,910	23,434	27,544	32,427
Piaui	23,993	24,447	25,353	30,076	35,451	41,711	49,144
Real	8,862	9,094	9,557	10,718	12,135	13,854	15,944
(Rural Area)							
San Francisco	11,660	11,532	11,275	10,734	10,301	9,961	9,703
Japaratuba	3,772	3,777	3,786	3,839	3,938	4,104	4,367
Sergipe	8,512	8,548	8,621	9,028	9,792	11,047	13,001
Vaza Barris	6,628	6,627	6,626	6,637	6,669	6,723	6,803
Piaui	14,094	14,126	14,189	14,388	14,644	14,961	15,347
Real	6,051	6,089	6,166	6,405	6,714	7,103	7,588

2.3 Industrial Water Demand Projection

There is only one inventory booklet of industrial establishments in the state. Based on the inventory booklet of "Official Registration of Industries in Sergipe 1991/92 (Cadastro Industrial Sergipe 1991/92), CODISE", the Study Team estimated a distribution of workers who were employed by the industrial establishments registered officially in 1991/92 in Sergipe State by municipality. The number of workers is a kind of indices showing industrial scale. These figures are only one index at the moment, which shows a production scale of the respective establishments. In this study, this index is used as basic data to estimate water demand of industrial sector.

As there is no statistical information regarding industries in Sergipe State, the Japanese standard are applied for this study, namely "Research Report of Unit Rates for Industrial Location in Japan, March 1993, Japan Industrial Location Center". The unit consumption rates for the respective industrial types are usually set as per production value ($\text{m}^3/\text{R\$ million of production}$), per factory site (m^3/m^2 of site), value added ($\text{m}^3/\text{R\$ million of VA}$), etc, of which information is not available though. Then the number of employees for the respective factories is applied to estimate the demand of industrial water.

The water demand of industrial use by municipality in 1991/1992 is estimated according to the strategic scenario. Since 1991/92 up to now, industrial circumstances in each municipality are supposed to be changed in numbers of industries, production scale, type of products etc. Then, the collected industrial ICMS (a kind of value added tax) amount of 1997, which are estimated to express current real industrial activities, was used in estimation of industrial water demand by municipality in 1997. The result is summarized in Table-2.10.

The industrial water demand of the both Micro-regions of Aracaju and Baixo Cotinguiba, is estimated totally at 437,000 m^3/day in 2020, which shows 2.9 times of 1997 demand. The demand of the Micro-regions in 2020, such as Sertao Sergipano do Sao Francisco, Agreste de Itabaiana, Agreste de Lagarto and Estancia is estimated respectively 12.9 times, 8.1 times, 4.4 times and 3.9 times of 1997 demand.

Table-2.10 Projection of Industrial Water Demand

Unit: m^3/day

Micro-region and River Basin	1997	1998	2000	2005	2010	2015	2020
Sergipe	201,869	213,706	237,380	309,090	400,763	518,259	668,514
By Micro-region							
Sergipana do Sertao do S.F.	1,415	1,498	1,664	3,895	7,112	11,655	17,957
Carira	240	254	282	368	477	617	795
Nossa Senhora das Dores	353	374	415	541	701	907	1,170
Agreste de Itabaiana	2,818	2,983	3,314	6,043	9,897	15,257	22,603
Tobias Barreto	1,338	1,417	1,574	2,049	2,657	3,436	4,432
Agreste de Lagarto	12,130	12,841	14,264	20,300	28,383	39,162	53,440
Propria	4,007	4,242	4,712	6,999	10,106	14,298	19,905
Cotinguiba	1,506	1,594	1,771	2,738	4,065	5,871	8,305
Japaratuba	1,700	1,799	1,999	3,034	4,450	6,369	8,946
Baixo Cotinguiba	79,083	83,720	92,994	121,082	156,994	203,019	261,881
Aracaju	73,057	77,341	85,908	103,229	123,534	147,461	175,604
Boquim	1,371	1,451	1,612	2,097	2,721	3,524	4,532
Estancia	22,851	24,191	26,871	36,715	49,666	66,685	88,943
By River Basin							
San Francisco	6,988	7,397	8,217	13,219	20,146	29,637	42,493
Jabaratuba	15,794	16,720	18,572	24,830	32,967	43,554	57,278
Sergipe	139,932	148,137	164,547	207,636	261,313	328,499	412,543
Vassa Barris	17,607	18,639	20,704	27,533	36,387	47,873	62,728
Piaui	20,850	22,072	24,517	34,801	48,561	66,900	91,155
Real	699	740	823	1,071	1,389	1,796	2,316