2.5 Operation and Maintenance Plan

After completion of the construction works of the Project, the following entities would be in charge of operation: 1) Vaza Barris Multipurpose Dam; A project office under a water agency, 2) Domestic Water Supply in Urban and Large Rural Areas; DESO, 3) Irrigation Water Supply; COHIDRO (or the autarchy as proposed in the Master Plan).

(1) Vaza Barris Dam Facilities

The project has a characteristic of multi-purpose, and equitable operation and maintenance can not be fully expected by a single-purpose operators. Since the Vaza Barris river is of federal domain, the competent water agency is an agency for Vaza Barris basin under the National Water Agency (ANA). SEPLANTEC, however, can ask ANA to delegate the operation and maintenance of water facilities in the area of the State to the State Government. Current draft of the law establishing ANA shows high possibility of the delegation. SEPLANTEC should promote establishment of a water agency, allocating capable staff with similar experiences in cooperation with DESO and COHIDRO. SEPLANTEC can conclude an agreement for outsourcing to DESO or COHIDRO for day-to-day operation, as far as equitable management is assured, using their capability of operation of water facility.

Principles to be applied in operation and maintenance are a) safety, b) efficient water use and equitable water resources allocation, and c) environmental conservation. In order to realize these principles, 1) reporting and communication, 2) operation/inspection/ observation/ monitoring, and 3) accounting will be carried out.

The integrated intake management consists of a) to precisely analyze water resource potential in terms of quantity and quality at every sources at ordinary times and drought times and to calculate load factors of the current intake, b) to analyze social and economic losses in every types of water use caused by various level of droughts, and c) to control intake operation for overall efficiency of water use in cases of ordinary situations and droughts. Cooperation with DESO and COHIDRO is inevitable to formulate an operation plan.

(2) Domestic and Industrial Water Supply

As proposed in the Master Plan DESO should expand the operation and maintenance not by increasing its staff but by shifting its staff from its administrative sections as far as possible. Training for the shift should be conducted.

(3) Irrigation Water Supply

Brazilian irrigation management seems to be oriented to integrated management. However, this type of management requires excessive duties on government organs, and often causes financial burdens heavier than those levels of the government can afford. In proposed irrigation management, the role of the government operating entity will be limited to management of water facility. In order not to lose the merits of integrated management, a mechanism of close coordination with supporting entities in charge of agricultural extension, research, and crediting should be established.

For equitable, efficient and flexible water management, role of farmers themselves should

be enhanced, although role of government entity is very important at the construction stage and the initial stage of operation. Establishment of water users' association or irrigation association should be promoted with assistance through mobilization and education/ training activities. Farmers' participation in water management will often cause not only better efficiency of irrigation management but also better cost recovery, resulting less financial burdens on the government. However, farmers of the target area do not have any experience in irrigation and water management. Mobilization activities would be examined, referring successful cases in other parts of Brazil and other countries. The establishment of "Irrigation Districts" by CODEVASF, such as that in Petrolina perimeter would be a good example.

2.6 Project Cost Estimates

(1) Price Level

Cost estimation for the Study is based on the costs and prices in Brazilian "Real", R$, at the time of September 1999, namely 1 US$ = 1.92R$ and 1 US$ = 106.95 yen.

(2) Unit Price

Unit prices used for cost estimation of the Projects in the Feasibility Study are determined based on the data base for cost estimation of public works in the Sergipe State provided by CEHOP. Unit prices not covered by the CEHOP data base are obtained by quotations from manufacturers, suppliers or distributors of products required for the Projects or estimation from the prices of the similar projects in the past.

(3) Composition of Project Cost

Project cost is composed of the following cost items:

1)	Administration Cost	: 1% of 2), 3), 4) and 5)
2)	Consulting Services Cost	: 10% of 3) and 4)
3)	Construction Cost	: Direct and indirect construction cost
4)	Land Acquisition and Compensation Cost	
5)	Contingency	: 5% of 2), 3) and 4)

(4) Method of Estimation of the Project Cost

a) Cost Estimation based on the result of facility design
The cost estimation for the facilities related dam and water conveyance was made based on the quantities of equipment, materials, labor and other related items calculated from the design drawings of facilities:

b) Cost Estimation based on the Result in the Master Plan Study
The cost estimation of the Water treatment stations, treated water pump stations and distribution networks in Agreste and Piauitinga Integrated Water Supply Systems was made by adjusting the result of cost estimation in the Master Plan Study:

(5) Total Project Costs

Table-2.13 Summary of Project Cost

Unit: R$1000

Cost Item	Phase1	Phase2	Total
1. Administration Cost	2,065	563	2,628
2. Consulting Service Cost	17,877	4,876	22,753
3. Construction Cost	176,253	48,759	225,012
(1) Dam	67,280	0	67,280
(2) Urban water supply facility to Agreste	34,597	23,993	58,590
(3) Urban water supply facility to Piauitinga	36,716	24,766	61,482
(4) Reforestation	719	0	719
(5) Irrigation water supply facilities	36,941	0	36,941
4. Land Acquisition and Compensation Cost	2,536	0	2,536
5. Contingency	9,833	2,682	12,515
Total	208,564	56,880	265,444

2.7 Project Implementation of Phase-1

2.7.1 Implementation Schedule

The phase-1 project is composed of the following work items:

0) Project Preparation
1) Loan procedure for Foreign Soft Loan
2) Procurement for consulting services and construction work
3) Consulting services including project management, detailed design and construction supervision.
4) Construction work
5) Land acquisition and compensation

The overall implementation schedule is shown in Table-2.14.

2.7.2 Institution for Project Implementation

A Management Unit of the Project of Water Resources Development and Supply in Vaza Barris River (UGP-PROVABASE) was established by the State Decree No.18297 on 1st of September 1999. It is subordinated to SEPLANTEC. The Vaza Barris river belongs to federal domain, so the Vaza Barris Dam project is also placed under jurisdiction of the federal government. The project management unit (UGP-PROVABASE) has to implement the project through regulation formalities regarding water resources management under the "National Policy".

Regarding environmental assessment, the IBAMA is competent to issue licenses from the federal standpoint. Since the site of the proposed project is located in state territory, the ADEMA is also competent to issue licenses from the state standpoint.

In order to procure finances from international and local financial organizations, UGP-PROVABASE has to ask the State House to authorize a permission of finance. After that, the state government should get an approval from the competent agency of foreign loans in the federal government, i.e., External Financial Commission (COFIEX or Comissao de Financiamentos Externos) under Ministry of Planning, Budget and Management (MP or

Ministerio do Planejamento, Orcamento e Gestao). Besides, the permission from the Upper House is prerequisite for the project entity to procure international loans.

Just after the approval from COFIEX, the state government applies for construction license of Vaza Barris Dam through Secretariat of Water Resources (SRH or Secretaria de Recusos Hidricos) under Ministry of Environment, Water Resources and Legal Amazon (MMARHAL or Ministerio de Meio Ambiente, dos Recusos Hidricos e da Amazonia Legal). The state government (SEPLANTEC) also intends to take over the authorization of water right granting of Vaza Barris river by means of delegation from the federal government.

In the implementation stage, major tasks to be managed by UGP-PROVABASE are 1) land acquisition, 2) designing, 3) construction and its supervision. Although 1) should be carried with juridical support of the State Government such as legal advisors to SEPLANTEC and Office of the State General Prosecutor, it will be necessary for UGP-PROVABASE to get involved in investigations and negotiations for the land acquisition. As for 2) and 3), UGP-PROVABASE should hire consultants and conclude contracts with contractors. Tendering, tender evaluation, negotiations and contract awarding should proceed with the initiative of UGP-PROVABASE. Although the consultants and contractors will undertake most of the engineering works and construction works, check of the results of the works by consultants and contractors is to be done by UGP-PROVABASE. During the construction works, many administrative permissions may be required. Liaison to relevant authorities, such as police, will be necessary.

The following organization at implementation stage would be recommendable. The contents and volume of each section will vary according to the development of the project implementation.

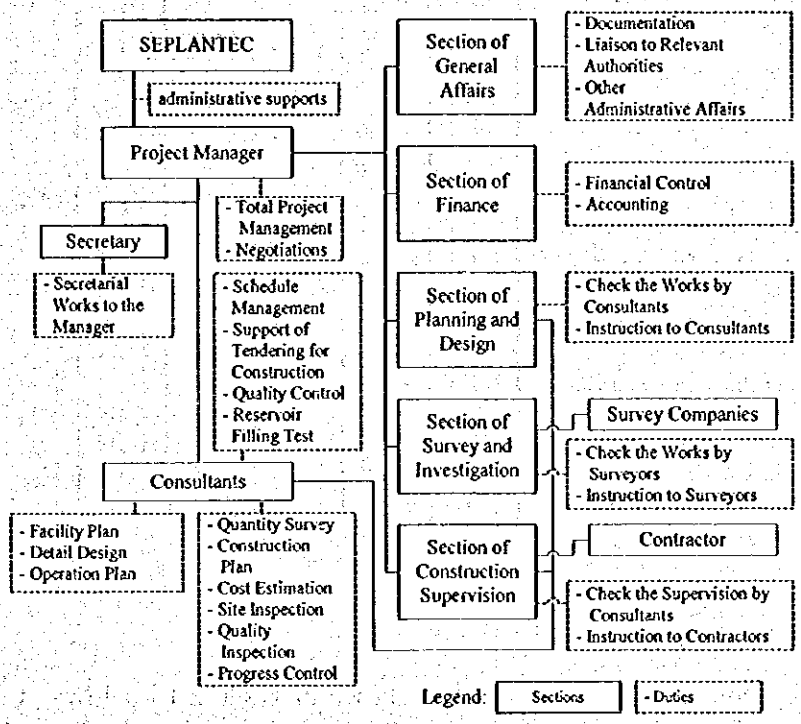
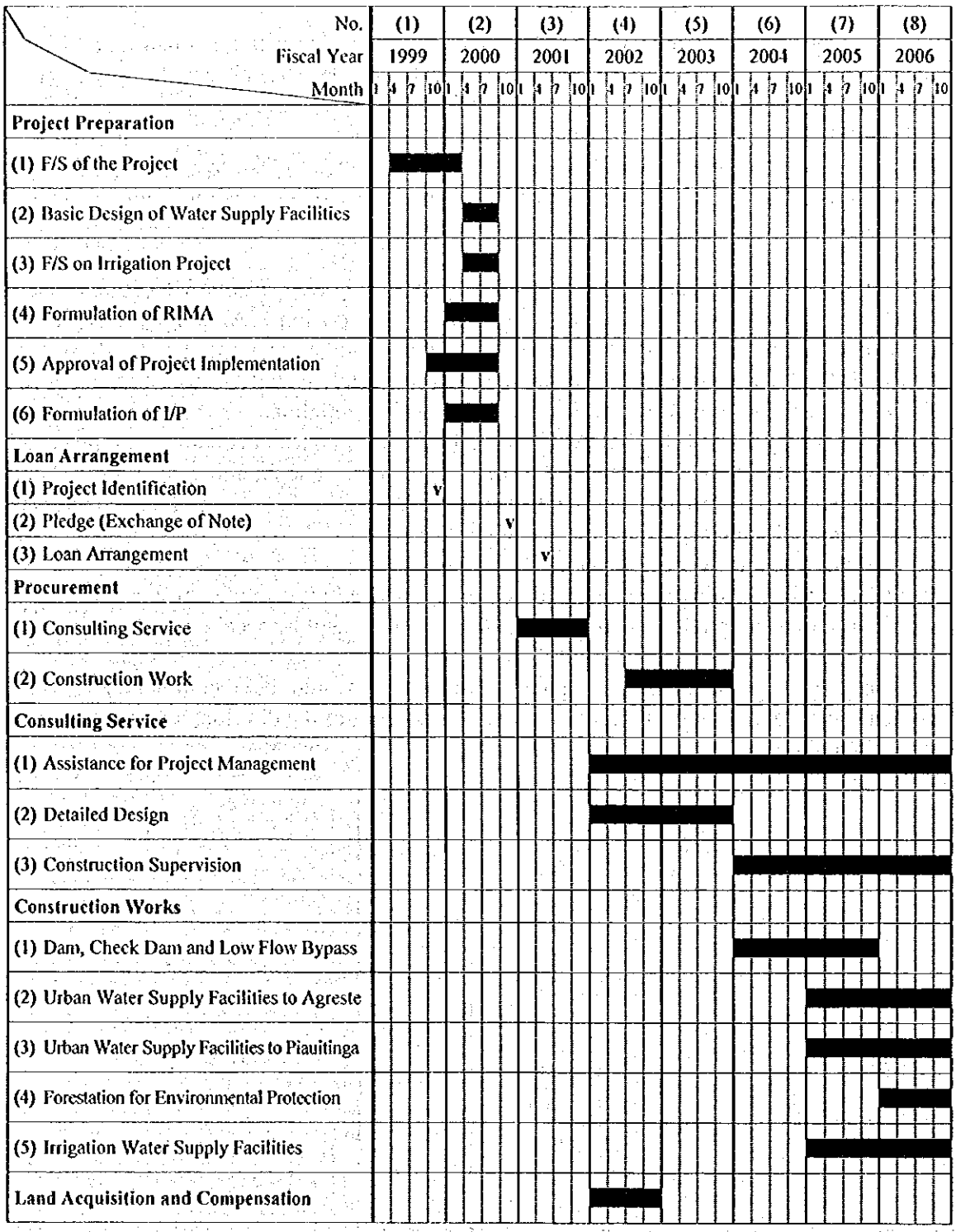


Figure-2.11 Proposed Organization of UGP-PROVABASE at Implementation Stage

Table-2.14 Implementation Schedule: Project of Water resources Development and Supply in Vaza Barris River- Sergipe



2.7.3 Project Components

The project components are summarized as shown in Table-2.15 below. Considering the type of work and site location of the components, the project is divided into five (5) construction packages as shown in following Table.

Table-2.15 Project Components

Project Components Construction Package	Specification
(1) Vaza Barris Multipurpose Dam	
Main Dam	Type: Gravity concrete dam, Height: 48.2m, Crest Length: 280.0m
Spillway	Type: Free overflow, Design discharge: 3,600m^3/s, Width: 150m, Height: 5.2m
Check Dam (or Intake Dam)	Type: Gravity concrete dam, Height: 20.0m, Crest Length: 127.0m Width of Overflow Section: 70.0m
Low Flow Bypass	Type: Concrete Box Culvert, Length: 27.7 km, Size: 1.05m x 1.05m Design discharge: 0.75m^3/s
(2) Domestic/Industrial Water Supply Facilities: <Itabaiana City Area>	
Water Conveyance Pipeline	Raw water pump station: 0.546 m^3/s, Ductile cast iron pipe: Diameter ϕ 500-700mm, Total length:25.4km
Treatment and distribution facilities	Municipalities: Itabaiana, Areia Branca, Campo do Brito, Macambira, Sao Domingos
(3) Domestic/Industrial Water Supply Facilities: <Lagarto City Area>	
Water Conveyance Pipeline	Raw water pump station: 0.52 m^3/s, Ductile cast iron pipe: Diameter ϕ 500-700mm, Total length:24.0km
Treatment and distribution facilities	Municipalities: Lagarto, Poço Verde, Simao Dias, Riachao do Dantes
(4) Forestation for Environmental Protection	
Forestation	Total 300 ha (main dam site: 150 ha, check dam site: 50 ha reservoir: 100 ha)
(5) Irrigation Water Supply Facilities	
Water Conveyance Pipeline	Raw water pump station: 2.912 m^3/s, Cast iron pipes from the dam reservoir to the irrigation area.
Irrigation Facilities	Irrigation area: 4,553 ha, Beneficial municipalities: Lagarto, Itaporanga de Ajuda, Salgado

2.7.4 Procurement Method

(1) Consulting Services

The procurement of consulting services is to be made between January 2001 and December 2001. The recommended method for the selection of a competent consultant is the Short List method in accordance with the Guidelines for the Employment of Consultants by borrowers of a foreign soft loan. However, the direct appointment of a specific consulting company should be considered, as the JICA Study Team has already studied the project in some detail. Similarly, the contract with the consultant should be made in one package for both the design stage and construction stage, in order to assist in the coordination and smooth execution of the project.

(2) Construction Work

The procurement of contractors is to commence from July 2002 and to be completed by December 2003. In accordance with the Guidelines for Procurement under foreign soft loans, International Competitive Bidding (ICB) is proposed. The project involves the construction of a concrete dam, a check dam, a low flow bypass, water supply facilities, forestation works and irrigation facilities. ICB will be the best method for achieving the economic and efficient implementation of the project. In the interests of the broadest possible competition, contract packages have been made a reasonable size to attract bids on an international basis. Tenders will be limited to contractors who have pre-qualified and been accepted onto the short list.

2.7.5 Financial Disbursement Schedule

Finance for the project is requested from the Foreign Soft Loan with the exception of costs for land acquisition and compensation, government administration and government tax which will be borne by the federal or state budget. Although loan amount to be borrowed is limited to 60 % of the total project cost, 50 % of that is assumed to be loaned taking into account of the State financial conditions.

The financial disbursement schedule of the project is summarized in Table-2.16.

Table-2.16 Finance and Disbursement Schedule

Unit: R$1000

Item		Total	2002	2003	2004	2005	2006
Consulting Services							
Construction Works							
Land Acquisition & Compensation							
1. Construction Costs	Total	224,232	0	0	39,213	112,512	72,508
	Base Cost	176,253	0	0	32,229	88,920	55,103
	Price Esc.	47,980	0	0	6,982	23,591	17,405
(1) Dam	Total	83,597	0	0	38,337	45,260	0
	Base Cost	67,280	0	0	31,510	35,770	0
	Price Esc.	16,317	0	0	6,827	9,490	0
(2) Itabaiana Water Supply	Total	44,667	0	0	0	21,444	23,223
	Base Cost	34,597	0	0	0	16,948	17,649
	Price Esc.	10,070	0	0	0	4,496	5,574
(3) Lagarto Water Supply	Total	47,419	0	0	0	22,439	24,980
	Base Cost	36,716	0	0	0	17,733	18,983
	Price Esc.	10,703	0	0	0	4,706	5,997
(4) Reforestation	Total	875	0	0	875	0	0
	Base Cost	719	0	0	719	0	0
	Price Esc.	156	0	0	156	0	0
(5) Irrigation Water Supply	Total	47,675	0	0	0	23,370	24,305
	Base Cost	36,941	0	0	0	18,470	18,471
	Price Esc.	10,734	0	0	0	4,900	5,834
2. Land Acquisition & Compensation	Total	2,929	951	1,978	0	0	0
	Base Cost	2,536	845	1,691	0	0	0
	Price Esc.	393	106	287	0	0	0
3. Consulting Services	Total	21,906	3,644	3,789	3,940	5,163	5,370
	Base Cost	17,877	3,239	3,239	3,239	4,080	4,081
	Price Esc.	4,029	405	550	701	1,083	1,289
4. Administration	Total	2,516	465	483	502	523	543
	Base Cost	2,065	413	413	413	413	413
	Price Esc.	451	52	70	89	110	130
5. Contingency	Total	12,452	235	292	2,163	5,876	3,886
	Base Cost	9,833	208	251	1,777	4,644	2,953
	Price Esc.	2,619	27	41	385	1,233	933
Total Project Costs	Total	264,038	5,294	6,542	45,818	124,075	82,308
	Base Cost	208,564	4,705	5,593	37,658	98,057	62,548
	Price Esc.	55,474	589	949	8,160	26,018	19,759
Foreign Soft Loan		132,019	2,647	3,271	22,909	62,037	41,154
<in US$>							
Total Project Costs (US$1000)		137,520	2,757	3,407	23,864	64,622	42,868
Foreign Soft Loan (US$1000)		68,760	1,379	1,704	11,932	32,311	21,434

Note: - Exchange rate: US$ 1 = R$ 1.92 as of September 1999
- 4 % of annual price escalation is set since the year of 2000
- 50 % of the project cost is assumed to be raised with Foreign Soft Loan, taking into account of the state financial condition.

2.8 Project Evaluation

2.8.1 Technical Evaluation

The Project of Water Resources Development and Water Supply Project in Vaza Barris River- Sergipe (PROVABASE) was planned according to the following technical information, standards, judgments and proper implementation procedures, and is assessed to be technically feasible as a result.

1) The information necessary for planning was collected from the data and information that the Federal Government and the State Government own and applied to the Plan after precise examination and careful selection. Moreover, additional information concerning the topographical, geological and environmental conditions was given through the topographic survey at the dam site and reservoir, geological survey, water quality survey and ecological survey at the dam site conducted by the Study Team. The standards established by the Federal Government were applied for the planning and design, as standards required in the Plan. For example, the Hydropower Generation Design Standards of CEMIG were used as the dam design standards in the Plan. However, the international standards such as in Japan and USA were also used when necessary.
2) The following facilities were added in the proposed system to ensure the quality level for domestic water and irrigation due to the high-chlorine concentrated river water at the proposed dam site:
   a) Additional storage volume system for dilution
   b) Low-flow bypass for discharging particularly the low flow volume of high-chlorine concentrated river water to downstream of the dam before inflowing to the dam reservoir.

   The technical viewpoint of the system are as follows: 1) volume necessary for dilution, 2) chlorine concentration of river water, 3) design discharge for low flow bypass, 4) type of the low flow bypass, and 5) possibility of chlorine-density layer formation. As to 2), the formula related between flow volume and chlorine concentration was given from the study of the existing data and the survey data by the Study Team. 1) and 3) were decided after completing reservoir simulation based on the above formula and flow volume data during these 10 years. As to 4), the culvert type was selected from the technical, economic and environmental viewpoints after compared with other two types of open channel and pipeline. As to 5), intake pump facilities to abstract surface reservoir water were planned, avoiding the abstraction of high-chloride concentrated water in the bottom of the reservoir, because it is not yet confirmed that the chlorine-density layer could be formulated.
3) The information and opinions concerning the basic policy of the plan as well as alternative plans and designs were exchanged aggressively between the Study Team and organization related to the water sector of the State Government through 6 workshops in the feasibility study stage.

Although PROVABASE was assessed to be technically feasible, this technical assessment should be reviewed and re-confirmed in the study of a detail design stage according to the additional information and data such as river water quality, geological condition of the dam and detail topographical maps.

2.8.2 Social Evaluation

(1) Increase of Employment and Activation of Regional Economy

Construction works of dam, pipelines for urban water supply and irrigation water supply would offer a new labor opportunity to the people unemployed and underemployed of the region in construction sector itself and the related sectors. In general, unskilled worker living in or near the project area would be employed. According to the project cost of dam and domestic/industrial water supply system, the wages payable to unskilled workers will be an amount of R$18million during the construction period. The annual amount will be R$3.6million, which is equivalent to 0.7% of 1998 GRDP of the project area. The effect would be far greater if considering the skilled workers' wages and similar wages of irrigation water supply system construction. In addition, basic material for concrete such as cement and aggregate for dam construction could be procured at the project area, an amount of which is estimated at R$30million during the two years of construction. Annual amount of R$15million is worth 3% of 1998 GRDP of the project area. Thus this increased income of both workers and manufacturers of the construction material will induce a multiplied economic effect to the region, which activate the regional economy as a whole.

(2) Improvement of Safe Water Coverage and Public Hygiene

Upon completion of the project, in 2020, all incremental urban population and 85% of rural population will be provided with safe and sufficient potable water by the project. Thus the project will contribute the water supply rate that is actually only 35% in rural area though 100% in urban area. Moreover, the project is designed on the basis of 10-year return period that will make it possible to supply water safely even during the dry season. According to the water use survey conducted by the Study Team on August 1998, almost rural inhabitants without residential water supply systems in dwellings desired an implementation of the projects for private tap system in the area. The most remarkable reason was a hygienic reason. The expansion of potable water supply by the project could decrease water-borne diseases and mortality rate in the region.

(3) Mitigation of Economic Disparity and Alleviation of Centralization in the State Capital

The industrial water supply rate currently assumed at less than 1% of the demand in the project area. The municipality has established several incentives to attract manufacturing companies to set up the plants inside the municipality but has not accomplished good results so far. One of the reasons is a scarcity of industrial water. The project will lift it to 50% of the demand by the year of 2020. Itabaiana and Lagarto are expected as a core industrial region in the project area. The proposed site of the irrigation project is located in Lagarto Municipality with total irrigation area of 4,519ha. Irrigated agriculture project could produce many benefits as follows: 1) higher productivity, 2) extension of cultivating season and possible multi-cropping, and 3) safe cropping particularly during droughts. According to pre-feasibility study of the irrigation water conducted by SEPLANTEC, the benefits of the with-project will increase almost by six times of the without-project within 5 years since the start of irrigation. Thus the project will alleviate the impact of water scarcity in the project area of the state that will attract the manufacturers to build its plant in the region and also give agricultural producers an incentive to cultivate harder. That will stimulate intensively regional economic activities and bring the inhabitants more sufficient living conditions there. As a result, it could lead the mitigation of economic disparity compared with the nation level and the alleviation of economic and demographic centralization to metropolitan area like Aracaju.

2.8.3 Economic Evaluation

For economic evaluation, Economic Internal Rate of Return (EIRR) of the project is used to ascertain the economic viability. In addition, other economic indices such as Net Present Value (NPV) and Benefit-Cost Ratio (B/C) are also used to verify the economic viability.

The following conditions and assumptions are applied in estimating cost and benefit on the basis of economic value to get these indices:

- Price Level : September/1999
- Conversion Factor : Principally the Sector-specific Conversion Factor used by World Bank (Machinery and Equipment 0.80, Material 0.88, Skilled Labor 0.81 and Unskilled Labor 0.46), and Standard Conversion Factor of 0.96 for the others.
- Opportunity Cost : 10%
- Time Horrizen for Evaluation : 50 years
  (Replacement of machinery and equipment for every 15 years.
- Economic Benefit for Residential Water : 3% of the household income
- Economic Benefit for Commercial, Public and Industrial Water : actual data based on the respective water tariff and consumption volume.
- Construction Cost of Dam was distributed on the basis of "Separable Cost Remaining Benefit Method".
- Irrigation Project : Basically Pre-feasibility Study Data conducted by SEPLANTEC (Conversion Factor of 0.85 was used in this study).

The EIRR of PROVABASE project resulted in 14.9%, which exceeds opportunity cost of 10%. NPV was R$75million and B/C was 1.59. Accordingly, the project is assessed to be in economic efficiency.

Table-2.17 Summary of Economic Analysis

Project	EIRR (%)	NPV at 10% (R$ million)	B/C
PROVABASE	14.9	75.4	1.59
PROVABASE Phase-1	16.0	72.6	1.74
PROVABASE Phase-2	10.7	2.8	1.09
Domestic & Industrial Water Supply	10.8	8.1	1.10
Phase-1	10.9	5.3	1.11
Phase-2	10.7	2.8	1.09
Irrigation Water Supply	20.4	67.3	2.37

(1) Domestic and Industrial Water Supply project

The EIRR of 10.8% of the Project shows economic efficiency. However, it was a slight lower than 12.1% in the Master plan, mainly due to the construction cost hikes of the low flow bypass construction in dam site and of the pipeline system as a result of precise cost estimation study in Feasibility Study. The results of economic analysis on each Phase respectively showed economic viability.

(2) Irrigation Water Supply Project

The EIRR of 20.4% shows sufficiently economic viability. It was higher than 15.0% in the Master Plan. The reason was derived particularly from the great difference of incremental benefits under the with/without project between in pre-feasibility study and in Master Plan, in spite of project economic cost hike by 70% in the pre-feasibly study.

(3) Sensitivity Analysis

In this analysis, the sensitivity of the EIRR is ascertained by the price values considered as the major variables. The price change is set at 10% as follows: (1) construction cost increase, and (2) market prices of agriculture products decrease. Table-2.18 shows the results of sensitivity analysis performed under the above variations. Almost all are in economic efficiency in both cases, though the EIRR of the PROVABASE Phase-2 in Case 1 results in 9.7%, slight lower than the opportunity cost of 10%.

Table-2.18 Sensitivity Analysis of the Projects

Project/Case	EIRR (%)		NPV at 10% (R$ million)	
	Case 1	Case 2	Case 1	Case 2
PROVABASE (Base Case)	13.8 (14.9)	13.6 (14.9)	63.5 (75.4)	55.1 (75.4)
PROVABASE Phase-1 (Base Case)	15.0 (16.0)	14.4 (16.0)	64.8 (72.6)	52.3 (72.6)
PROVABASE Phase-2 (Base Case)	9.7 (10.7)	10.7 (10.7)	-1.3 (2.8)	2.8 (2.8)
Dom. & Ind. Water (Base Case)	10.0 (10.8)	10.8 (10.8)	0.3 (8.1)	8.1 (8.1)
Phase-1 (Base Case)	10.3 (10.9)	10.9 (10.9)	1.6 (5.3)	5.3 (5.3)
Phase-2 (Base Case)	9.7 (10.7)	10.7 (10.7)	-1.3 (2.8)	2.8 (2.8)
Irrigation Water (Base Case)	19.1 (20.4)	17.6 (20.4)	63.2 (67.3)	47.0 (67.3)

2.8.4 Financial Evaluation

The following financial schemes is confirmed with the State Government and applied to financial analysis as basis.

- PROVABASE will be conducted by the State Government. Accordingly, the State Government shall be entirely responsible for raising funds for the projects.
- The source of funds will be composed with transfer from the Federal Government and Foreign Soft Loan
- After constructed by the State Government, all facilities will be transferred to the Public Companies concerned as a paid-in capital of the companies.

(1) State Government

< Financial Condition >

The debt services of the State are R$77million in 1999 and will decrease sharply to R$30million in 2015. The Debt Service Coverage Ratio was kept at 8.7% in 1999. The state government financial condition is healthy in terms of the ratio. But outstanding debt amount of the State exceeds the real net revenue. So further credit operations are not allowed for the Government at the moment. However, the external loans subject to projects are exceptional cases, though the state's indebtedness capacity is limited by Brazilian legislation as follows 1) capacity to assume an additional credit of up to R$140million, and 2) annual debt-service capacity of up to R$100million.

Total investment amount of the project are R$370.5million, of which R$174.6 (R$ 132.0million in Phase-1 and R$42.6 in Phase-2) will be disbursed by the Federal

Government as a transfer of the General Budget and R$195.9million (R$132.0million in Phase-1and R$63.9million in Phase-2) from the Soft Loan. The Soft Loan amount is respectively below the above limit and could be legally applied. The terms and condition of the Soft Loan are based on the guideline of the Japan Bank for International Cooperation (JBIC). In spite of debt service increases with the Soft Loan, the total debt services will not exceed the above limit. The debt service coverage ratio is estimated at a peak of 10.4% in 2002. It means that the State Government could afford the overall debt services.

Table-2.19 Debt Service Ratio of the State Government

Unit: R$ million

Items/Year	1999	2002	2005	2010	2015	2020	2030	2037
Current Debt Services	77.0	91.5	84.8	70.5	30.4	26.2	0.0	0.0
Debt Services Increases with Soft Loan	-	0.0	1.5	10.5	10.3	13.8	4.3	3.6
Total Debt Services	77.0	91.5	86.3	81.0	40.7	40.0	4.3	3.6
Debt Service Coverage Ratio (%)	8.7	10.4	9.8	9.2	4.6	4.5	0.5	0.4

Source of current debt services data: the Secretariat of Finance of Sergipe State
Note: Net Current Revenue of the State Budget Balance of 1998 (R$881.6million) was applied as a base revenue.

< Project Cash Flow >

Project cash flow of the State Government during from 2002 till loan termination of 2037 is shown in Table-2.19. The prices of September/1999 are used for this cash flow analysis. The aggregate net cash flow during 2002/2019 will be negative of R$76.1million, which should be made up by the State Government. However, the yearly net cash flow will turn positive in 2020 due to estimated dividends paid by the Water Supply Company from 2017. The accumulated cash surplus during 2020/2037 will be of R$291.6million. Accordingly, the Project generates accumulated cash surplus of R$215.5million till 2037 when the Loan terminates. Total project cost of R$265.5million could be entirely recovered by 2040. However, the cash surplus should be retained especially for re-construction cost.

Table-2.20 Project Cash Flow of the State Government

Unit: R$ million

Items/Year	2002 to 2019	2020 to 2037	Total
Cash Flow from Investing Activities	-265.4	0.0	-265.4
Cash Flow from Financial Activities	189.3	291.6	480.9
Transfer from Federal Gov.	127.0	0.0	127.0
The Foreign Soft Loan	138.4	0.0	138.4
Repayment of Loan	-63.7	-74.7	-138.4
Interest Payment	-33.4	-11.9	-45.3
Dividends Received	21.0	378.2	399.2
Cash increase/decrease	-76.1	291.6	215.5

Note: The Soft Loan – R$104.3million in Phase-1 and R$34.1 in Phase-2

(2) Public Companies Concerned

Financial evaluation is conducted independently on 2 companies to distinct each financial condition. The prices of Septemer/1999 are also used in the analysis. The O&M costs should be covered by beneficiaries. Water Supply Company could cover their O&M costs entirely with the collected water charges and gain profits from the operation. So the

Company could pay dividends to shareholder, the State Government, from 2017. Irrigation Water Supply company collects only an amount of O&M costs as irrigation water charges from beneficiaries. So the Company could not afford to pay dividends. The O&M costs of Dam will be covered by the above 2 public companies. Thus the project costs of R$265.4million could be covered entirely with dividends paid to the State Government by the Water Supply Company.

< Water Supply Company >

Water charges per m^3 of domestic water are set up at R$1.15 in urban and R$1.05 in rural on the basis of the actual water tariff and projected unit consumption rates. And the charges of industrial water are set up at R$2.70 based on the actual consumption.
The Company will start its operation in 2007. However, net income will continue negative till 2011. So the short-term bank loan should be raised during the period to run the company. The net income will turn positive from 2012. And retained earnings (accumulated net income) will turn to surplus from 2014. As a result, the Company could continue to pay dividends to the shareholders from 2017, judging from the Profit/Loss Statement and the Cash Flow Table. Thus the accumulated dividends paid till 2037 are estimated at R$399.2million. The State Government is a big shareholder and will receive almost all the dividends paid. Replacement costs of the water supply system and recurrent costs of the Company incurred during the period could be recovered entirely with water charges. And the cash surplus in 2037 is estimated at R$169.0million, which should be retained as a reserve for forthcoming replacement of the pipelines and re-construction of the system.

Table-2.21 Profit and Loss Statement and Cash Flow in Summary

Unit: R$ million

Financial Statement	Items	2002/11	2012/16	2017/37
Profit and Loss	Operating Revenue	15.0	78.1	840.7
	Net Income	-14.2	31.0	425.0
	Dividends	0.0	0.0	399.2
Cash Flow	Cash at end	3.9	55.5	169.0

<Irrigation Water Supply Company>

The O&M costs should be recovered by beneficiaries. The annual O&M expenses of the Company are R$3.5million. The projected irrigation water supply volume is set at 1.507m^3/se on average. As result, the irrigation water tariff should be set at R$0.074/$m^3$. The project costs could be covered indirectly with the dividends paid to the State Government by the Water Supply Company.

2.8.5 Environmental Impact Assessment

(1) Environment of the Study Area

Vaza Barris dam site, check dam site and two pipeline construction sites are located in the three municipalities of Itabaiana, Sao Domingos and Lagarto. These project sites are located in plain or hilly areas where agriculture is the only economic activity. Small cultivated-pasturelands and farmlands are dispersed in the area. The steep slopes of the riverside are mainly covered by shrub. State road (SE-110) crosses Vaza Barris River at about 20 km above Vaza Barris dam site. Electric wires exist near check dam site.

There are no towns and cultural properties in the inundated area. The nearest residence from Vaza Barris dam site is located 4 km upstream. In the estuary, fishery has been flourishing. In Sao Cristovao, registered fisher persons were 1,401 in 1998. The total including unregistered reaches approximately 6,000 people in a season. In recent years, the catch has been decreasing. However, annual catch for 1987-88 in Sao Cristovao was more than 400 ton, but the catch in 1998 has dropped by 13 ton.

Most of the project area is extensive pastureland or grassland, where the vegetation is monotonous biologically. Small forest areas are scattered along the riverside. These riverside forests provide habitats of wildlife such as birds, small mammals and insects. The riverside forests consist of several fauna species and have no precise dominant species. Sizable undisturbed forests and wildlife habitats do not exist in and around the inundated area. Rare or endangered wildlife species have not been identified around the reservoir area. Migratory fishes that swim up the river from sea to spawn have not been identified in Vaza Barris River. The estuary is a developed mangrove forest zone of 60.56 km^2. The saltwater intrusion reaches approximately 20 km up at the spring tide. Oceanic fish species dominate up to the confluence with Paramopama River. In the more upper area, demersal species dominate. There is a state protected-area in the estuary. This protected-area consists of Paraiso Island located at the river mouth and Paz Island located in front of Mosqueiro Village. However, Paraiso Island is a momentary island and has no biological importance. Paz Island is covered with old growth mangroves.

(2) Natural Environment Mitigation Plan

[Forest]

Buffer areas around the reservoir and two dam sites should be created, where reforestation programs should be implemented to replace the lost vegetation cover such as riverside forests. Total 300 hectares, as about three times of the inundated forest area (approximately 90 ha), or 30,000 trees will be reforested in this project.

[Reservoir Water Quality]

Because the nutrient level in the reservoir will be influenced by the decay of the vegetation left at the time of first filling for the first few years, vegetation in inundated area should be cut and removed in advance. To protect the water quality of the reservoir, settlements around the reservoir should be limited except for the families relocated by this project. The water quality monitoring should be conducted periodically.

[Division of Local Community]

Landowners of pastureland divided by the reservoir should be especially considered. Because the corridor from the end of the reservoir to the check dam, about 9km long, will dry up during dry season, bathing points for the livestock will be lost in the corridor. Constructions of wells or small pools for the livestock should be considered depend on claims from the farmers.

[Fishery in the Estuary]

To obtain the agreement of fisher persons in the estuary, information disclosure should be conducted at an early stage. Annual monitoring on fishery activities should be conducted to recognize the impacts of the projects on the fishing industry. The monitoring data

should be open to the public and utilized by scientists, consultants, teachers and fisher persons. In generally, it is impossible to estimate the exact impacts of a dam project on the ecosystem of a downstream area at the present time. If the serious impacts on the fishery are identified in the future, some compensation will be needed for the fisher persons. Not only economical compensation but also introduction of new fishery technique such as artificial incubation and farming should be considered as part of the compensation.

(3) Results

Vaza Barris Dam project has potentially adverse impacts on many environmental items. These environmental impacts will occur at operation stage as well as construction stage. However, some adverse effects can be avoided by suitable mitigation plans. Considering no other useful water resources, the conclusion of this Environmental Impact Assessment is that the Vaza Barris Dam project is environmentally feasible.

Table-2.22 Result of Environmental Impact Assessment

Environmental division	Environmental Item	Assessment
Social Environment	Resettlement	Actual resettlement requirements, including three families identified by field survey, will be less than ten families.
	Economic activity	Due to the reservoir's barrier effect, pastureland disruptions will occur. Because the corridor from end of the reservoir to check dam, about 9 km long, will dry up during dry season, bathing points for the livestock will be lost in this area.
	Infrastructure facilities and Cultural property	State road (SE-110) crosses Vaza Barris River at about 20km above the Vaza Barris dam site. The reservoir will reach the point at normal water level, but the bridge spans far over the water level. There are no other infrastructure facilities or cultural properties in the inundated area.
	Public health condition	The reservoir will lead to an increase in the potential of water borne disease and provide breeding areas for mosquitoes that tend to breed in stagnant water body and field edges. The local governments have conducted the campaign and eradication program for dengue fever. There are no villages around the reservoir. Therefore, schistosomiasis or dengue fever will hardly break out.
Natural Environment	Hazard and Soil erosion	According to the result of geological and topographical survey, large-scale landslide will not occur around the reservoir.
	Water quality	There are no significant pollution sources in the upper catchment area. Land clearing in the inundated area will improve water quality of the reservoir to some extend. The water quality of the reservoir will be essentially the same as that of the river under present condition except for the sediment load, and suitable for domestic use and irrigation.
	Hydrological situation and Estuary	The environmental discharge is adopted the 10-year return period 7-day discharge as 0.44m^3/s in this project. Because there are no domestic water use and irrigation systems in the downstream area, this value is considered to be suitable. About 70 percent of the mangrove forests in the estuary are formed on the coastal sand. Because the river sediments concentrate mainly the upper area of the estuary, the large-scale topographical transition will not occur. The impacts on mangrove forests will be limited within the upper area of the estuary and is considered not to be large scale. However, more detailed survey on the estuary and the long-term monitoring program should be conducted.
	Flora and Fauna	There are no extensive areas of undisturbed forest and wildlife habitat in the inundated area. Because rare or endangered species have not been identified in the project area, serious impacts on biodiversity would not occur. However, the riverside forests of about 90 hectares will be inundated. The biological resources lost by the project can be restored by reforestation program to some extend.
Environmental pollution		Impacts of dust, noise and vibration on local people are negligible because the work sites are remote from the residential area.

2.9 Recommendations

(1) Implementation of the Project of Water Resources Development and Supply in Vaza Barris River- Sergipe (PROVABASE)

The project of water resources development and supply for domestic and industrial water in Itabaiana and Lagarto areas and for irrigation water in the right side of Vaza Barris River was proposed. The project consists of:

- Vaza Barris Multi-purpose Dam
- Domestic and Industrial Water Supply Facilities for Itabaiana Water Supply Area
- Domestic and Industrial Water Supply Facilities for Lagarto Water Supply Area
- Irrigation Water Supply Facilities

The Low flow bypass system was introduced in the dam reservoir operation, while river water that could not be utilized before becomes clean and comes to be used as potable and irrigation water.
The population of these areas is 259,000 inhabitants in 1996 and is estimated to be 540,000 in 2020, which represents almost two thirds of population in Aracaju Capital Area at the same year (875,000 inhabitants). The lack of adequate water supply is a serious obstacle to the development of the so mentioned regions and creates a migratory pressure towards the State capital, worsening even more problems in Aracaju. Therefore, it's mandatory to try to stabilize the water supply for high-concentrated population, and is indispensable to boost its social-economical development and to improve the quality of life. The beneficial municipalities strongly requested the project and issued "Lagarto Declaration" to the Federal Government. Moreover, Sergipe Government has already proposed the consultation letter (Carta Consurta) to the Federal Government in order to progressively promote this project.

Although the expansion projects was proposed as PROAGUA in the same area, necessity of PROVABASE is still very high, because: 1) PROAGUA project cannot meet the future water demand in this area, 2) PROAGUA Project in Lagarto area will use the water of Piaui Dam, of which water is in high chlorine characteristics and is reserved by irrigation use.

(2) Financing of the Project Cost

The investment cost of the Phase-1 amounts to R$ 264 million with a price escalation of 4% per annum. The average share of water resources development investment to the tax revenue in the State budget was 3.1% during 5 years from 1994 to 1998. The funds of the State budget for the investment with a same increase rate of 5% per annum as projected GRDP growth rate of the State were estimated at R$ 390 million during ten (10) years. However, annual amount would be only R$ 39 million, which is far from the Phase-1 project cost.

Nevertheless, the indebtedness capacity of the State Government is limited by the federal legislation and is estimated as follows: 1) R$ 140 million of overall debt capacity and 2) R$ 100 million of debt service capacity. When considering current debt services of the State Government, the soft loan is required as a principal source of funds for the implementation of the project. Accordingly, the overall sources of funds are raised as follows:

- Soft Loan: 50% of the project cost in Phase-1
- Transfer from the Federal Government: 50% of the project cost in Phase-1

As for the phase-1 project, 50 % (R$ 132 million or US$ 69 million) of the project cost is recommended to be raised from the Foreign Soft Loan considering the debt limited by federal legislation and the other project progress. Accordingly, the State Government should raise R$ 132 million by itself.

(3) Necessity of Additional Study

Prior to the loan procedure and implementation of the project, the following additional studies are necessary and should be implemented by the State:

- Basic Design of Water Supply Facility in Itabaiana and Lagarto Areas
- Feasibility Study on Vaza Barris Irrigation Project
- Formulation and Approval of EIA Report (RIMA)
- Formulation of Implementation Program Integrated with this Study Results

(4) Necessity of Water Quality Monitoring

In the viewpoint of water quality in Vaza Barris River, Chlorine (Cl) concentration is high and critical for potable water, as well as Electric Conductivity (EC), Sodium (Na), Magnesium (Mg), Calcium (Ca), Carbonic Acid (HCO_3) and pH Value (pH) are important for irrigation planning. Water quality observation has been conducted during the Study.

However, it is noted that water quality data in Vaza Barris River is not yet enough to understand the water quality behavior. It is needed to continue observation of water quality such as the said parameters at least, not only at the existing observation stations but also at the proposed dam site and the check dam site.

(5) Arrangement between Sergipe and Bahia

Vaza Barris River is the federal river located in Bahia State upstream and Sergipe State downstream. Vaza Barris Dam is located in almost most downstream of the main stream of Vaza Barris River. Water resources development and management in the upstream, such as a dam construction, irrigation development and forestation, directly affects to the downstream river and to this project in Sergipe State. Therefore, the arrangement on basin development and management should be mutually discussed between Sergipe State and Bahia State. Responsible organization should be SRH/SE and SRH/BA.

附录