SECTOR I

SOCIOECONOMIC CONDITION AND PROJECT EVALUATION

THE STUDY ON
THE ENVIRONMENTAL IMPROVEMENT PROGRAM OF
THE UPPER AND MIDDLE STREAM OF THE TUY RIVER BASIN

SECTOR I: SOCIOECONOMIC CONDITION AND PROJECT EVALUATION

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SECTOR I: SOCIOECONOMIC CONDITION AND PROJECT EVALUATION

1. PRESENT SOCIOECONOMIC CONDITION

Analysis and observations in this section were mainly based on the Population Census and the Statistical Yearbook of Venezuela published by OCEI (Oficina Central de Estatistica e Informatica). Useful data from the census were used to characterize the country's socioeconomic condition (Table 1.1-1, Tables 1.2-1 and 1.2-2, Tables 1.3-1 to 1.3-3).

1.1 Population

Table 1.1-1 shows the population in the study area in 1981 and 1990, which also provides the population in 1981 broken down into three age groups: 0 to 17, 18 to 64, and 65 and over.

In 1990, the population of Venezuela was 19,501,849 and that of the study area was 309,463, or 1.6% of the national population. The population of Caracas Metropolitan Area (CMA) is important for any relevant analysis of the study area because the citizens will benefit from the improved water supply resulting from the implementation of proposed projects. The population of Caracas in 1990 was 3,124,171, comprising 16.0% of that of the country.

The national population grew at the average annual rate of 2.6% in nine years from 15,484,656 in 1981, while the population of the study area grew at the average annual rate of 5.1% from 197,458 in 1981. Since the population of CMA was 2,577,127 in 1981, its average annual growth rate was 2.2% in the same nine years.

It should be noted that the annual growth rate of the population of CMA was 0.4% less than the national average, while that of the population of the study area was about double the national average. The fact to be concluded from this is that the immigration to Caracas has slowed down, whereas more people are moving to the surrounding towns.

The study area is composed of the upper and middle Tuy River basins. The population of the upper basin was 113,393 in 1990 accounting for 36.6% of total, while the population of the middle basin was 196,070 accounting for 63.4%. The population of the upper basin grew at the average annual rate of 3.2% in the nine years, 1981 to 1990, while the population of the middle basin grew at the average annual rate of 6.4% in the same period.

The study area consists of 44 towns. The boundary of the area divides several towns such as Carrizal and San Diego. For convenience, the population of these towns were entirely incorporated in that of the study area. Five of the towns have more than twenty thousand population as of 1990, namely Ocumare del Tuy with 61,043,

Charallave with 51,807, Cúa with 50,520, Carrizal with 30,423 and Las Tejerías with 20,246.

Age was classified into three groups, that is, younger than 17, between 18 and 64, and 65 and over. The age from 18 to 64 is the so-called workable age. The ratios of population falling under the three age groups were 47.8%, 48.9% and 3.3% in 1981 in the study area. Basin-wise, they were 47.6%, 49.1% and 3.3% in the upper basin and 48.0%, 48.8% and 3.2% in the middle basin. Thus, there is no significant difference in the age structure between the upper and middle basins. In CMA the population ratios were 35.2%, 61.2% and 3.6%, respectively. It is noticed that the percentage of the workable age population is greater in CMA than in the study area.

1.2 Economy

1.2.1 General

Table 1.2-1 contains the information on income level of the people in the Study Area.

The GDP of Venezuela was Bs.8,651,300 million in 1994, while the population was 21,377,426 in the same year. Therefore, the GDP per capita is calculated at Bs.404,693. When it is converted into the US dollars at the exchange rate of Bs.148.3 to US$ 1, it equals US$2,729.

The economy of the country grew during a decade from 1984 to 1994 at the average annual rate of 2.9%, while the population increased during the same period at the average annual rate of 2.5%. The sectoral composition of the 1994 economy was 4.4% for agricultural, 46.2% for industrial and 49.4% for service sectors. The GDP deflator grew during the above mentioned ten years 15.939 times at the average annual rate of 31.9%.

1.2.2 Income Level

Table 1.2-1 was based on the 1981 Population Census data by OCEI. The amount of income in an income group was updated taking inflation into consideration in order to be applied in 1996. It is assumed that Table 1.2-1 reflects the existing status of the income level. The table shows the number of households interviewed. It is assumed that the average monthly income of the less than Bs.200,000 income group is Bs.100,000, that of the Bs.200,000 to Bs.1,000,000 group is Bs.500,000 and that of the more than Bs.1,000,000 group is Bs.1,500,000. Then, the average monthly household income is calculated at Bs.235,911 in the study area. Basin-wise, it is Bs.232,247 and Bs.238,348 in the upper and middle basins respectively. In the same way the average monthly household income in CMA is calculated at Bs.233,161. It is to be noted that so far as the average household income is concerned, there is little difference between the two basins and also between the study area and CMA.

The composition of the three income groups is 84%:9%:7% in the study area. Basin-wise, it is 85%:8%:7% and 83%:10%:7% in the upper and middle basins respectively. Again, there is little difference between both basins in household income structure. In the CMA, however, the composition is 68%:31%:1%. That is to say, in the study area

most of the households belong to the lowest income group, but at the same time there is a certain proportion of the high income group, while in CMA there is a large portion of the middle income group and the majority of households fall under the lowest income group and those belonging to the high income group are proportionally few.

1.2.3 Employment Structure

Table 1.2-2 shows the employment structure in 1981.

It is assumed that the characteristics of the employment structure remain unchanged today. In terms of the number of employees the primary (agricultural and fishery), secondary (industrial) and tertiary (services) sectors were 6%, 46% and 48% respectively in the study area. In the upper basin of the area they were 9%, 45% and 46%, and in the middle basin they were 4%, 47% and 49%. Thus, a higher proportion of people were employed in the agricultural sector in the upper basin than in the middle basin.

In CMA the employment structure was 1% for the primary sector, 28% for the secondary sector and 71% for the tertiary sector. In comparison with the CMA, a higher proportion of workers are employed in the primary and secondary sectors in the study area.

1.3 Social Services

1.3.1 Utility Service

Table 1.3-1 shows the number of households with public utilities.

The data in the table are a mixture of OCEI data in 1981 and 1990. The total number of households in each town is the results of the 1990 Population Census, while the ratio of the number of households served with three types of utility in a town is based on the 1981 Population Census. The table practically conveys the characteristics of the situation in 1990.

The service ratio of piped water in the study area is calculated at 73%, while that of sewer is calculated at 42%. The gas service ratio is 72%. Basin-wise, the service ratios of piped water, sewer and gas are 67%, 28% and 72% respectively in the upper basin and they are 75%, 48% and 72% in the middle basin. Therefore, the service ratios of both water and sewer are considerably lower in the upper basin than in the middle basin, while in the CMA the ratio of households with water is 84%, while the ratio of households with sewer connections is 48%. Judging from the service ratios of water and sewer, it is observed that they are better provided in CMA than in the study area.

1.3.2 Education

Table 1.3-2 is based on the 1990 Population Census by OCEI.

Some 63,937 people or 21% of the total population were being educated in the study area. Basin-wise, 14,059 people or 12% of the population in the upper basin and 49,878 people or 25% of the population in the middle basin were in school. The ratio of the number of students to the population was more than twice as large in the middle basin than in the upper basin. In contrast, in the CMA the number of students was 441,403 or 14% of the population, which is considerably lower than in the study area.

1.3.3 Medical Service

Table 1.3-3 is based on the 1990 Population Census by OCEI.

The numbers of hospitals, urban and rural health centers were 7, 1 and 28 respectively in the study area. Basin-wise, they were 2, 1 and 8 in the upper basin and 5, 0 and 20 in the middle basin.

The population per medical center and health center was 44,209 and 10,671 respectively in the Study Area. Basin-wise, it was 56,697 and 12,599 in the upper basin and 39,214 and 9,804 in the middle basin. Judging from the population per medical center, it is observed that medical services were better in the middle basin than in the upper basin.

The population per hospital was 28,928 in CMA, which is about two thirds the study area figure.

1.4 Public Budget

1.4.1 National Budget

Ministries with major budget allocations in 1996 are shown in the table below:

No.	Name of Ministry	Amount (Million Bs.)
1.	Ministry of Finance	1,730,380
2.	Ministry of Internal Affairs	671,807
3.	Ministry of Education	631,813
4.	Ministry of Defense	240,576
5.	Ministry of Sanitation and Welfare	193,982
6.	Ministry of Urban Development	156,798
7.	Ministry of Environment and Renewable Natural Resources	97,873
8.	Ministry of Transport and Communications	97,574

The national budget of Venezuela in 1996 was Bs. 4,104,890 million. It can be converted to US$8,828 million at the exchange rate of Bs. 465 to a US dollar. The GDP of the country was estimated to reach US$59,024 million in the same year. It means that the national budget as the percentage of GDP was 15.0%.

The budget was allocated to 24 public organizations including 17 ministries, the average amount per organization being calculated at Bs. 171,037 million or US$368 million, each receiving, on average, 4.2%.

The three dominant beneficiaries of the national budget were the Finance Ministry receiving Bs. 1,730,380 million or US$3,721 million accounting for 42.2% of the total budget, the Ministry of Internal Affairs received Bs. 671,807 million or US$1,445 million (16.4%) and the Ministry of Education got Bs.631,813 million or US$1,359 million (15.4%). The combined amount of the three ministries reached Bs. 3,034,000 million or US$6,525 million, occupying 73.9% of the total budget.

The allocation for the Ministry of Sanitation and Welfare was Bs.193,982 million or US$417 million, accounting for 4.7%. The ministry was the fifth largest recipient among the 24 organizations. The allocation for the Ministry of Environment and Natural Resources (MARNR) was Bs. 97,873 million or US$210 million, accounting for 2.4%. The ministry was in the seventh position. The combined allocations for these ministries, which are considered influential to the study was Bs. 291,855 or US$627million, accounting for 7.1% of the entire budget.

1.4.2 Budget for Tuy River Basin Agency

The budget for Tuy River Basin Agency amounted to Bs. 326,720,000 or US$703,000 in 1996. Of this, 311,720,000 or 95.4% was transferred from MARNR. Of the balance of Bs. 15,000,000, Bs.10,000,000 was derived from its own resources and Bs. 5,000,000 was a transfer from the Federal District Government.

The transfer to Tuy River Basin Agency accounted for 0.3% of the MARNR budget. Of the total Tuy Agency budget of Bs. 326,720,000, Bs. 224,758,253 or 68.8% was earmarked for personnel expenses.

1.4.3 Budget of Miranda and Aragua States

The table below shows the sectors with major budget allocations in 1994 (Aragua State)

No.	Sector	Amount (Bs.)
1.	Urban Development, Households and Related Services	5,147,700,000
2.	Education	2,647,900,000
3.	Security and Defense	2,292,400,000
4.	Superior Directorate of the State	1,935,700,000
5.	Social Security	1,295,400,000
6.	Health	1,212,600,000
7.	Social Development and Participation	726,000,000
10.	Agriculture	15,000,000

The budget of the Aragua State was Bs. 19,765,100,000 or US$133,300,000 in 1994 at the exchange rate of Bs. 148.3 to a US dollar.

There are 15 sectors, and the three sectors of urban development, households and related service, health and agriculture are considered to be responsible for the

activities related to water, sewerage and environmental protection. The combined amount of allocations for the three sectors was Bs. 6,375,300,000 or US$43,000,000, accounting for 32.3% of the total budget.

The table below shows the sectors with major budget allocations in 1994 (Miranda State).

No.	Sector	Amount (Bs.)
1.	Education	4,503,900,000
2.	Urban Development, Households and Related Services	3,049,400,000
3.	Security and Defense	2,958,400,000
4.	Health	1,923,500,000
5.	Superior Directorate of the State	1,854,200,000
6.	Social Security	1,453,100,000
7.	Social Development and Participation	1,304,300,000
8.	Agriculture	431,800,000

The budget of the Miranda State was Bs. 21,287,900,000 or US$143,500,000 in 1994 at the exchange rate of Bs. 148.3 to a US dollar.

There are 15 sectors, and the three sectors of urban development, households and related service, health and agriculture are considered to be responsible for activities related to water, sewerage and environmental protection. The combined amount of allocations to the three sectors was Bs. 5,404,700,000 or US$36,400,000, accounting for 25.4% of the total budget. The expenditure allocated for water and sewerage works under the agriculture and health sectors was Bs. 299,600,000 or US$2,000,000, accounting for 1.4% of the total budget.

1.5 Existing Financial Status of Factories and Piggeries in the Study Area

The following table gives the results of the questionnaire survey conducted by the JICA Study Team in May, 1996.

1.5.1 Financial Status of Factories

Item	Food	Non-Food	Total
Number of Factories	21	82	103
Number of Employees	3,715	9,566	13,028
Shipment (Bs. million/annum)	82,666	191,377	274,043
Profit Rate (%)	12.62	16.40	15.26
Number of Employees / Factory	177	117	126
Shipment/Factory (Bs. million/annum)	3,936	2,334	2,661
Profit/Factory (Bs. million/annum)	497	383	406

Sources: JICA and OCEI

The total shipment of the 103 factories in the study area was estimated to reach Bs. 274,043 million or US$589 million in 1996 at the exchange rate of Bs. 465 to the US dollar. Food factories accounted for 30.2%, and the balance of 69.8% was accounted for by non-food factories.

The profit rate for this year was estimated to be on average 12.62% for the food industry, 16.40% for the non-food industry and 15.26% for the entire manufacturing sector.

In terms of the per factory performances, the annual shipment was estimated to be on average Bs. 3,936 million for the food industry, Bs. 2,334 million for the non-food industry and Bs. 2,661 million for the entire manufacturing sector. Also, the annual profit would be on average Bs. 497 million, Bs. 383 million and Bs. 406 million for the food, non-food and entire manufacturing industry respectively.

1.5.2 Financial Status of Piggeries

Item	Values
Number of Piggeries	33
Number of Employees	118
Sales (Bs. million/annum)	3,629
Profit Rate (%)	2.5
Number of Employees / Piggery	3.58
Sales/Piggery (Bs. million/annum)	110
Profit/Piggery (Bs. million/annum)	2.7

Sources: JICA and OCEI

The total sales for the 33 piggeries in the study area were estimated to be Bs. 3,629 million or US$7.8 million in 1996 at the exchange rate of Bs. 465 to a US dollar. The profit rate would be on average 2.5%. The annual sales and profit would be on average Bs. 110 million and Bs. 2.7 million, respectively. Piggeries are a small-scale industry.

1.6 Financial Status of Water Organization

1.6.1 Major Characteristics of Water Tariffs of Hidroven

Hidroven is the national organization for water supply and sewerage, consisting of 10 regional water supply organizations.

The same tariff rules are applied nationwide. Some of the salient features of the rules are listed below.

- The tariffs are structured so that water price per unit consumption volume varies in accordance with the monthly volume of water consumption per client and at the same time in accordance with the types of clients such as social residential, residential, commercial and industrial customers
- A tariff in a period will be adjusted considering the changes that have taken place since the preceding period in personnel, electricity, chemical and maintenance cost.
- The tariffs are determined to balance income with cost.
- The cost consists of the running cost and the installation cost of the water supply and sewerage systems.

1.6.2 Financial Performances of Hidrocapital and Hidrocentro

Hidrocapital covers the Federal District and Miranda State, while Aragua State is under Hidrocentro.

Financial performances in 1995 of the two water supply organizations are tabulated below.

Item		Hidrocapital	Hidrocentro
Income (Thousand Bs.)	(1)	12,685,352	3,500,000
Cost (Thousand Bs.)	(2)	28,612,099	3,545,062
Water Produced (thousand m^3)	(3)	824,468	447,988
Water Sold (thousand m^3)	(4)	318,810	133,793
Income Cost Ratio (%)	(1)/(2)	44.3	98.7
Unit Cost of Water Produced (Bs./m^3)	(2)/(3)	34.7	7.9
Unit Price of Water Produced (Bs./m^3)	(1)/(3)	15.4	7.8
Unit Price of Water Sold (Bs./m^3)	(1)/(4)	39.8	26.2
Ratio of Water Sold (%)	(4)/(3)	38.7	29.9

Source: *Memoria y Cuenta Ano 1995*, MARNR

Hidrocapital received as income from the sale of water Bs. 12,685 million or US$71.8 million in 1995 at the exchange rate of Bs. 176.6 to the US dollar. It incurred a total cost of Bs. 28,612 million or US$162.0 million in the same year. Thus, the income cost ratio is 44.3%.

The annual production of water was 824,468 thousand m^3, out of which 318,810 thousand m^3 (38.7%) was sold. The unit cost of water produced is calculated at Bs. 34.7 per m^3, while the unit price of water produced was Bs. 15.4 per m^3. The unit price of water sold was Bs. 39.8 per m^3.

Hidrocentro earned Bs. 3,500 million or US$19.8 million as income from the sale of water in 1995. The cost for the same year was Bs. 3,545 million or US$20.1 million. Thus, the income cost ratio is 98.7%.

Hidrocentro produced 447,988 thousand m^3 of water in the same year, of which 133,793 thousand m^3 or 29.9% was sold. The unit cost of water produced is calculated at Bs. 7.9 per m^3. The unit price of water produced was similar with Bs. 7.8 per m^3. The unit price of water sold was Bs. 26.2 per m^3.

1.7 External Assistance in Recent Years

1.7.1 Ongoing Loan Projects under MARNR

The table below is the list of the ongoing MARNR projects financially assisted by external agencies.

No.	Name of Project	Starting Year	Basic Objective; Investment Amount; External Financial Sources
1	Basin Management	1993	Rational management of natural resources in basins of Bocono, Tocuyo and Yaracuy rivers; US$53.5 million; IDB
2	Water Supply of Central Region	1989	Covering the shortage and meeting the demand of potable water for the central region up to the year 2010; US$383.5 million; IDB
3	Sanitation of Lake Valencia	1990	Sewage treatment systems in the Lake Valencia basin; US$125.0 million; IDB
4	Park Management	1995	Strengthening the institutional and operational structure of National Parks; US$90.0 million; WB
5	PSAT	1990	Institutional strengthening and preparation of pre-investment studies that will contribute to the promotion of economic and social development; US$9.8 million; WB/IDB
6	Water Supply of Guanare Region	1992	Expansion and improvement of the treatment, storage and distribution system of domestic water; US$23.1 million; Eximbank USA
7	Integral Exploiting of Water Resources of River Cojedes	1995	Exploitation of River Cojedes by Las Palmas Dam for inundation control and irrigation use; Suspended
8	Sanitation of East Litoral, Puerto La Cruz - Carupano	1992	Sanitation and treatment of wastewater and treatment of potable water; US$93.0 million; Germany/England/USA
9	Rehabilitation and Sanitation of West Litoral	1995	Recuperation and conservation of water supply, construction of wastewater collection and disposal systems, urban drainage and solid waste disposal; US$80.35 million; Eximbank USA / HERMES Germany
10	Yacambu - Quibor Hydraulic System	1990	Treatment of water for irrigation and supply of potable water; US$274.8 million; EDC Canada
11	Falconian System	1991	Supply of potable water; US$44.8 million; Eximbank USA
12	Continued Works and Operation for El Diluvio Weir	1990	Optimal utilization of weir water for the purpose of irrigation and exploitation for agro-industrial production; US$17.4 million EDC Canada
13	Integral Sanitation of Lake Maracaibo	1992	Sanitation and treatment of wastewater dumped in Lake Maracaibo and its re-utilization for irrigation; US$188.0 million; EDC Canada
14	Integral Sanitation of Trujillo Water Resources	1992	Agua Viva Dam exploitation system for inundation control, irrigation, agro-industrial use and supply of potable water; US$27.3 million; Eximbank USA / EDC Canada
15	Rehabilitation of Water System in Edo Nueva Esparta	1994	Sanitation and rehabilitation of potable water system, and sanitation and treatment of wastewater; US$41.35 million; EDC Canada

Source: UPPI - MARNR

In addition, two other projects are now underway: MARNR Strengthening Component of Venezuelan Environmental Management Project by World Bank with the estimated cost of US$60 million and Improvement of Water Supply Administration with the estimated cost of US$150 million.

The amount of investment for the above-listed projects totals US$1,662 million. The period covered is 7 years from 1989 to 1996. It means the annual average is US$237 million, which is greater than the 1996 MARNR budget, US$210 million. Supposing foreign components are fifty percent, external loans will be US$831 million, and the annual average will be US$119 million.

Major external financial agencies are the IDB (the Inter-American Development Bank), the World Bank, Eximbank USA and EDC Canada.

1.7.2 Ongoing Grant Projects under MARNR

Regarding the ongoing study projects with grant-aid from external agencies, there are the Cleaning of the Tuy River by GTZ (the German Agency for Technical Cooperation) as well as this one by JICA, Japan. Furthermore, various grant projects for the conservation of the natural environment of the Amazonas are being carried out. The major donor is the European Union (EU).

1.8 Existing Development Plans

The relationships between types of development plans and responsible organizations are tabulated below:

Type of Development Plan	Organizations in Charge
Urban Development Plan	Min. of Urban Development (MINDUR)
Land Use Plan	MINDUR, MARNR, Agricultural Ministry
Industrial Promotion Plan	Min. of Fomentation (MINFOMENTO)
Water Resources Development Plan	MARNR, CORDIPLAN
Tourism Development Plan	Tourism Corporation (CORPOTURISMO)

Some of the major development plans are summarized below.

1.8.1 National Plans

Name of Plan	Year	Short Description; Responsible Organizations; Target Year
Venezuelan Environmental Systems*	1982	The basic idea is to disperse the economic activities and population concentrated in the North-Central-Coastal Region to the inland areas bordering Brazil and Colombia, thereby attaining environmental protection and economic development.; MARNR; 2010
9th National Plan**	1995	Against the background that the persistent declining national oil revenues have resulted in less public investment, inflation, weakening local currency, etc., leading to economic and social crisis it proposes to find solutions in linking with the world-wide information industry, exploitation of foreign investment, development of internationally competent domestic industries, etc.; CORDIPLAN; 2000 to 2010

Note: * = Sistemas Ambientales Venezolanos, ** = Un Proyecto de Pais

1.8.2 Regional Plans

Name of Plan	Year	Short Description; Responsible Organizations; Target Year
Regional Plan for Land Management of Capital Region*	1992	This document works out a regional, state-wise and sectoral analysis with the resultant macro-economic variables (such as population, income, water supply, health, education, agriculture, land use and transport) considered fundamental to explain the dynamic behavior of the region in terms of natural, social and economic environment.; Federal District / Miranda State; 2010
Scenarios of Land Occupation in the Tuy River Basin**	1990	It comes up with three scenarios regarding the demographic and employment projection for the Tuy River Basin based on trend analysis (standard growth), the theory/policy of more concentration of population (high growth) and the proposition of the interspersing of population in outlying areas (low growth).; MARNR; 2010
Resume and General Rules of Urban and Rural Management Plan of Middle Tuy Valleys***	1976	It includes basic assumptions for Middle Tuy Valleys development based on de-concentration policy about economic activities pursued at the time by the government, making proposals on the development of agricultural, industrial, metropolitan services, urban residential, transport, public and infrastructural services and ecologico-environmental sectors.; Ministry of Public Works

Note: * = *Plan Regional de Ordenacion del Territorio de la Region Capital*; ** = *Escenarios de Ocupacion Territorial de la Cuenca del Rio Tuy*; *** = *Valles del Tuy Medio Plan de Ordenamiento Urbano y Rural Informe Resumen y Reglamentation General*

1.8.3 Sanitation/Water Supply Plans under MARNR

Name of Plan	Year	Short Description; Target Year
Sanitation and Recovery of the Tuy River Basin*	1987	It analyzed the existing extent of pollution in the Tuy River Basin by type of polluters and made future pollution projections based on two socio-economic scenarios.; 2010
Socio-Economic Diagnosis of the Tuy River Basin for the Purpose of Sanitation and Recovery**	1988	It takes note of the direct, positive relationships between oil revenues and demographic concentration in the North-Central region, and works out socio-economic projections for the Tuy River Basin under the future circumstances where oil revenues will increasingly decline.; 2010
Plan for the Management of the Critical Area with Treatment Priority in the Tuy River Basin ***	1993	It focuses on the increasing population and industrial concentration in the Tuy River Basin, giving rise to the requirements for road, development of mass-transport system, costly sanitation programs, large housing scheme, etc. Under such circumstances it proposes the strategies and orientations to improve the quality of life in future by locating population and industry in an adequate way, providing adequate physical infrastructure and obtaining an optimal distribution of social services through conservation and improvement of environment.

Name of Plan	Year	Short Description, Responsible Organization, Target Year
Technical and Financial Assistance Program for Minimization and Control of Industrial Contamination*4	1993	It aims at attaining the execution of Legal Standard applicable to environmental material on the part of small and medium industries located in the Tuy River Basin, executing Central Plants projects for the joint treatment of industrial effluents, and reducing industrial contamination through optimization and modification of production processes.
Adjustment Program of the Potable Water and Sanitation Sector, HIDROVEN*5	1994	It proposes to attain the efficiency and quality of service, maintenance of the principle of social equality and rationalization of cost by transferring responsibilities in the form of financial, organizational and managerial autonomy to municipalities and the private sector.; 2000
Provision of Metropolitan Aqueduct*6	1985	It analyzes the water supply systems of the Caracas Metropolitan and Middle Tuy Areas, the establishment of the balance between supply and demand of water and the required actions to guarantee the provision of potable water to the urban centers; 2000

Note: * = *Programa de Saneamiento y Recuperacion de la Cuenca del Rio Tuy*; ** = *Diagnostico Socio-Economico de la Cuenca del Rio Tuy a los Fines de Saneamiento y Recuperacion*;
*** = *Plan de Ordenamiento del Area Critica con Prioridad de Tratamiento, Cuenca del Rio Tuy*, *4 = *Programa de Asistencia Tecnica y Financiera para la Minimizacion y Control de la Contaminacion Industrial*, *5 = *Programa de Ajuste del Sector Agua Potable y Saneamiento*, *6 = *Abastecimiento al Acueducto Metropolitano*

There are many urban development plans at the state and population center levels by MINDUR.

2. FINANCIAL EVALUATION IN MASTER PLAN STUDY

2.1 Sources of Cost Recovery

Sources of Cost Recovery	Projects
Income of Households in CMA	Securement of Water Quantity, Construction of Sand Settling Pond for Intake
Revenues of Factories and Piggeries	Environmental Fund
Income of Households in a Town	Construction of Sewage Treatment Plant in the Town
Budget of MARNR, Miranda State and Aragua State	Construction of Sand Settling Pond at Tributaries, Reforestation, Institutional Measures (Exc. Environmental Fund)

It is proposed that the O&M cost, repayment cost and replacement cost of a particular project be met in accordance with the above table.

The financial sources of the initial cost will be entirely external except those for the construction of sewage treatment plants. Regarding the latter, they will be basically derived from the government (central and state) budget in consideration of repayment capability of the polluter, i.e., households. The ratio of the external loan for each project shown below is worked out after repeated simulations have been conducted regarding the affordability of the households concerned and the size of repayments.

Ratio of External Loan

Construction of sewage treatment plant in Ocumare del Tuy	35%
Construction of sewage treatment plant in Las Tejerías	20%
Construction of sewage treatment plant in San Francisco de Yare	25%
Construction of sewage treatment plant in El Consejo	7%

2.2 Financial Evaluation

In performing financial analysis, the following pre-conditions are established:

(1) Terms of external loan

Annual interest rate: 6%, grace period: 3 years, repayment period: 15 years

(2) Collection efficiency of sewerage charge from households and of repayments from factories & piggeries: 95%

(3) Durable life: electro-mechanical equipment: 15 years; civil engineering structures and other facilities: 40 years

(4) Implementation period:

Project	Short-Term Program	Medium-Term Program
Securement of Water Quantity - Ocumare-Tuy III Pumping Plan	1998-2000	-
Securement of Water Quantity - Guare Dam Plan	1998-2003	
Construction of Sand Settling Pond for Intake	2000-2003	-
Environmental Fund	2000-2003	2004-2010
Construction of Sewage Treatment Plant in Ocumare del Tuy	1998-2001	2004-2006
Construction of Sewage Treatment Plant in Las Tejerías	2000-2003	-
Construction of Sewage Treatment Plant in San Francisco de Yare	-	2004-2007
Construction of Sewage Treatment Plant in El Consejo	-	2007-2010
Construction of Sand Settling Pond at Tributaries	-	2004-2006
Reforestation	1998-2003	2004-2010
Institutional Measures (Exc. Environmental Fund)	1998-1999	-

(5) Period of financial analysis: 20 years from the start of project implementation

By financial analysis one means affordability analysis to see if the cost bearer is capable of shouldering the O & M, repayment and replacement costs.

2.2.1 Cost Required

Eleven projects are proposed under the master plan. Initial cost for them are estimated as presented below:

(Unit: US$ thousand)

Project	Short-Term Program	Medium-Term Program	Total
Securement of Water Quantity - Ocumarito-Tuy III Pumping Plan	9,880	-	9,880
Securement of Water Quantity - Guare Dam Plan	76,100		76,100
Construction of Sand Settling Pond for Intake	2,610	-	2,610
Environmental Fund	24,846	18,606	43,452
Construction of Sewage Treatment Plant in Ocumare del Tuy	28,020	4,914	32,934
Construction of Sewage Treatment Plant in Las Tejerías	12,700	-	12,700
Construction of Sewage Treatment Plant in San Francisco de Yare	-	14,100	14,100
Construction of Sewage Treatment Plant in El Consejo	-	13,100	13,100

Project	Short-Term Program	Medium-Term Program	Total
Construction of Sand Settling Pond at Tributaries	-	11,391	11,391
Reforestation	2,520	5,130	7,650
Institutional Measures (Exc. Environmental Fund)	1,702	-	1,702
Total	158,378	67,241	225,619

As the table shows, the total initial cost is estimated to come to US$226 million. Out of it, US$159 million or 70% belongs to the short-term program, and US$67 million or 30% to the medium-term program.

In terms of financial sources, foreign resources will be US$173 million or 77%, while local resources will be US$53 million or 23% as the table below shows:

(Unit: US$ thousand)

Foreign Resources	Local Resources	Total
172,768	52,851	225,619

Sensitivity Analysis

The above are the estimates on condition that population and industry in the study area follow the Pattern 1 (standard) projection. How will they change under the Pattern 2 (high) or Pattern 3 (low) projection?

In the Pattern 2 case the initial and O&M costs of a project will be greater than in the Pattern 1 case, while in the Pattern 3 case they will be less than in Pattern 1 case.

The table below shows the results of the estimation of initial cost in Pattern 1 and Pattern 2 cases.

(1) Pattern 2 Case

(Unit: US$ thousand)

Project	Short-Term Program	Medium-Term Program	Total
Securement of Water Quantity - Ocumarito-Tuy III Pumping Plan	9,880	-	9,880
Securement of Water Quantity - Guare Dam Plan	76,100		76,100
Construction of Sand Settling Pond for Intake	2,610	-	2,610
Environmental Fund	28,728	33,615	62,343
Construction of Sewage Treatment Plant in Ocumare del Tuy	29,406	5,219	34,625
Construction of Sewage Treatment Plant in Las Tejerías	14,545	-	14,545
Construction of Sewage Treatment Plant in San Francisco de Yare	-	15,413	15,413
Construction of Sewage Treatment Plant in El Consejo	-	16,692	16,692

Project	Short-Term Program	Medium-Term Program	Total
Construction of Sand Settling Pond at Tributaries	-	12,848	12,848
Reforestation	2,520	5,130	7,650
Institutional Measures (Exc. Environmental Fund)	1,702	-	1,702
Total	165,491	88,917	254,408

As the above table shows, the total initial cost is estimated at US$254 million, which is by US$29 million or 13% greater than the amount in the Pattern 1 case.

(2) Pattern 3 Case

(Unit: US$ thousand)

Project	Short-Term Program	Medium-Term Program	Total
Securement of Water Quantity - Ocumarito-Tuy III Pumping Plan	9,880	-	9,880
Securement of Water Quantity - Guare Dam Plan	76,100		76,100
Construction of Sand Settling Pond for Intake	2,610	-	2,610
Environmental Fund	20,686	7,596	28,282
Construction of Sewage Treatment Plant in Ocumare del Tuy	23,336	3,909	27,245
Construction of Sewage Treatment Plant in Las Tejerías	11,140	-	11,140
Construction of Sewage Treatment Plant in San Francisco de Yare	-	10,004	10,004
Construction of Sewage Treatment Plant in El Consejo	-	10,249	10,249
Construction of Sand Settling Pond at Tributaries	-	6,461	6,461
Reforestation	2,520	5,130	7,650
Institutional Measures (Exc. Environmental Fund)	1,702	-	1,702
Total	147,974	43,349	191,323

As the above table shows, the total initial cost is estimated at US$191 million, which is by US$34 million or 15% less than the amount in the Pattern 1 case.

The results of the sensitivity analysis show that the estimated cost in the Pattern 1 case is possible to fluctuate between the +13% to -15% range.

2.2.2 Affordability of CMA Clients

The annual outlays of the three projects , "securement of water quantity - Ocumarito - Tuy III pumping plan", "securement of water quantity - Guare dam plan" and "construction of sand settling pond for intake" and how they will be met for the period

of 20 years are shown in Tables 2.2.1 to 2.2.3. The table below summarizes the sources of incomes.

Project	Income/Month/ Household (US$)	Payment in Percentage	Payment/Month/ Household (US$)
Securement of Water Quantity - Ocumarito-Tuy III Pumping Plan	496	0.038%	0.188
Securement of Water Quantity - Guare Dam Plan	496	0.131%	0.650
Construction of Sand Settling Pond for Intake	496	0.005%	0.025
Total	-	0.174%	0.863

Clients in the CMA are represented by households. The monthly charge of a household will be 0.174% of its income, coming to US$0.863 or Bs. 406 on average in 1997. This is not a heavy load.

2.2.3 Affordability of Factories and Piggeries

The annual outlays of the Environmental Fund for the duration of 20 years and how they will be met for the short-term and medium-term programs are shown in Tables 2.2.4 and 2.2.5 respectively. The table below summarizes the sources of incomes.

Project	Revenues/Year/ Factory/Piggery (US$ thousand)	Payment in Percentage	Payment/Year/ Factory/Piggery (US$)
Environmental Fund (Short-Term)	5,662 (Factory), 234 (Piggery)	0.53%	30,009 (Factory) 1,240 (Piggery)
Environmental Fund (Mid-Term)	5,662 (Factory)	0.48%	27,178 (Factory)

Each factory will annually pay 0.48% to 0.53% of its revenues, or US$27,178 to US$30,009 on average to the Environmental Fund. Each piggery will annually pay 0.53% of its revenues or US$1,240 on average. This does not appear to be an excessive amount.

2.2.4 Affordability of Households

The annual outlays of each of the four sewage treatment plant construction projects for the duration of 20 years and how they will be met are shown in Tables 2.2.6 to 2.2.10. The table below summarizes the sources of incomes for those projects.

A household in the four towns will pay about 1% to 2% of its monthly income as the sewerage charge, amounting to US$5 to US$10 on average in 1997. This is considered a reasonable range. The World Bank recommends that the payment for sewerage service be within 2% of household income.

Project	Income/Month/ Household (US$)	Payment in Percentage	Payment/Month/ Household (US$)
Construction of Sewage Treatment Plant in Ocumare del Tuy (Short-Term + Medium-Term)	507	0.93%+0.21%	5.780
Construction of Sewage Treatment Plant in Las Tejerías	494	1.67%	8.250
Construction of Sewage Treatment Plant in San Francisco de Yare	507	1.96%	9.937
Construction of Sewage Treatment Plant in El Consejo	494	1.98%	9.781

2.2.5 Affordability of Government

The annual outlays of the three projects , "construction of sand settling pond at tributaries", "reforestation" and "institutional measures (exc. the Environmental Fund)" and how they will be met for the period of 20 years are shown in Tables 2.2.11, 2.2.13 and 2.2.14. The table below summarizes the sources of incomes.

Project	Annual Budget of MARNR, Miranda State and Aragua State (US$ thousand))	Payment in Percentage	Payment/Year (US$ thousand)
Construction of Sand Settling Pond at Tributaries	486,800	0.219%	1,066
Reforestation (Short-Term + Medium-Term)	486,800	0.041%+0.060 %	492
Institutional measures (Exc. Environmental Fund)	210,000*	0.155%	326
Total	-		1,884

* Annual budget of MARNR

The 1996 annual budgets of MARNR, Miranda State and Aragua State were US$210,000 thousand, US$133,300 thousand and US$143,500 thousand, respectively, totaling US$486,800 thousand.

Miranda State and Aragua State are annually going to set aside 0.320% of their budget, amounting to US$887 thousand in 1996 for repayments and other cost. Likewise, MARNR will set aside 0.475% of its budget amounting to US$997 thousand. This does not seem to be an extraordinary obligation.

2.2.6 Conclusions

1. The total initial cost of master plan projects is estimated to come to US$226 million. Depending on the circumstances surrounding economic and population growths, this amount will change between the +13% to -15% range.
2. Of US$226 million, US$173 million or 77% is proposed to be provided by external agencies such as the World Bank, IDB (Interamerican Development Bank) and OECF (Overseas Economic Cooperation Fund) of Japan, and the remaining US$53 million or 23% by the Venezuelan central government.

It has been usually the case that the financial sources of externally assisted loan projects are 50% external and 50% domestic. As regards the master plan projects, however, affordability analysis shows that the cost-bearers (that is, beneficiaries and polluters) can afford to pay back up to 77% of total initial cost. Therefore, it is recommended that the Venezuelan government and external financial agencies agree on the above-mentioned external versus domestic ratio.

3. The repayments of the external loan are proposed to be entirely shouldered by beneficiaries or polluters themselves.

4. Less than 0.2% of the income of the CMA households will be regularly collected as additional water charge by HIDROCAPITAL to meet the O&M, repayment and replacement cost of the securement of water quantity - Ocumarito - Tuy III pumping plan, the securement of water quantity - Guare dam plan and construction of sand settling pond for intake.

5. Around 0.5% of the revenues of factories and piggeries will be annually collected by the Environmental Fund to meet the O&M, repayment and replacement cost of the Fund.

6. Around 1% to 2% of the household income will be regularly collected as sewerage charge by the Tuy Agency to meet the O&M, repayment and replacement cost of the construction of sewage treatment plants in Ocumare del Tuy, Las Tejerías, San Francisco de Yare and El Consejo.

7. Around 0.3% of the budgets of Miranda State and Aragua State will be annually set aside to meet the O&M, repayment and replacement cost of the construction of sand settling pond for tributaries and reforestation. Also, around 0.5% of the MARNR budget will be annually set aside to meet the O&M, repayment and replacement cost of the construction of sand settling pond for intake, reforestation and institutional measures excluding the Environmental Fund.

8. Items 4 to 7 attest to the adequate capability for the beneficiaries and polluters to shoulder the cost of all the master plan projects.

3. ECONOMIC AND FINANCIAL EVALUATION IN FEASIBILITY STUDY

3.1 Methodology for Project Evaluation

Economic evaluation of environmental improvement projects is a relatively new field. Now various methodologies are being theorized, put to experiment, or actually used such as contingency valuation method (CVM), dose-response relationship (DRR) and travel cost method (TCM).

In performing economic analysis of F/S projects, such new technologies were utilized to the extent possible along with existing stochastic tools. All the methodologies employed below are the established or newly recognized ones.

The methodologies to be employed can be different from analyst to analyst. Therefore, it is advised that the wayof economic evaluation adopted here and its results be viewed as an example among possibly alternative ways of economic evaluation and their results.

3.1.1 Economic Evaluation

Estimation of Economic Cost

The initial cost and O & M cost is estimated in economic terms in the following way:

Item	Initial Cost	O&M Cost
Step 1	Estimation of initial cost by cost item	Estimation of O&M cost by cost item
Step 2	Conversion of initial cost to economic terms applying a conversion factor to each cost item	Conversion of O&M cost to economic terms applying a conversion factor to each cost item
Step 3	Annual distribution of initial cost	Annual distribution of O&M cost

Conversion factors by project and by cost item for the initial and O&M cost are shown in Table 3.1.2.

As the final form, the annual streams of the economic initial and O&M cost are prepared by project, encompassing the project implementation period and the project life period of 30 years (project life will be started after the project has been implemented).

Estimation of Economic Benefits

(1) Types of Benefits

Item	Indirect Benefits		Direct Benefits		
Types of Benefits	1) Appreciation of estate values; 2) Enhancement of tourism value of Tuy River basin; 3) Appreciation of "existence value" of Tuy River basin	4) Reduction of water-borne diseases	5) Reduction of turbidity	6) Reduction of water intake suspension due to color & odor	7) Reduction of chemicals for pre-treatment
Related Projects	a) Installation of treatment plants in factories; c) Construction of sewage treatment plants; d) Reforestation	a) Installation of treatment plants in factories; c) Construction of sewage treatment plants	b) Construction of sand settling pond; d) Reforestation	a) Installation of treatment plants in factories	a) Installation of treatment plants in factories; c) Construction of sewage treatment plans

Seven types of benefits are identified and quantitatively analyzed. They are shown above. Also, the above table shows which project(s) are related to the effectuation of a particular benefit.

Each of the benefits is briefly explained below:

Types of Benefits	Brief Explanation
1) Appreciation of estate values	An expected increase of the price of houses and land located near the Tuy River and its tributaries as a result of a reduction of pollution (BOD effluents, SS load and toxicants) in their water.
2) Enhancement of tourism value of Tuy River basin;	An expected increase of the number of people going to the Tuy River basin for tourism/recreational purposes (fishing, swimming, boating, strolling, horse-riding, etc.) as a result of a reduction of pollution (BOD effluents, SS load and toxicants) in the Tuy River and its tributaries.
3) Appreciation of "existence value" of Tuy River basin	An expected increase of the "existence value" (economic value of an object deriving from the fact that it just exists) of the Tuy River basin as an area where biodiversity is preserved and clean streams flow as a result of a reduction of pollution (BOD effluents, SS load and toxicants) in the Tuy River and its tributaries.
4) Reduction of water-borne diseases	An expected decrease of the incidence of water-borne diseases among people residing near the Tuy River and its tributaries as a result of a reduction of pollution (BOD effluents) in their water.
5) Reduction of turbidity	An expected reduction of water intake suspension due to turbidity, an expected reduction of chemicals for pre-treatment at intake point, Toma de Agua, an expected elimination of necessity for pre-treatment pond cleaning by heavy machine and an expected reduction of water intake suspension for sediment disposal, as a result of a reduction of turbidity in the Tuy River water.
6) Reduction of water intake suspension due to color & odor	An expected reduction of water intake suspension due to excessive color and odor at intake point, Toma de Agua, as a result of the installation of treatment plants in factories..
7) Reduction of chemicals for pre-treatment	An expected reduction of chemicals for pre-treatment at intake point, Toma de Agua, as a result of a reduction of BOD pollution in the Tuy River water.

(2) Methodology for Estimation of Benefits

Regarding the indirect benefits, the data and information collected through the sampling questionnaire survey were used for quantitative analysis. The survey was conducted in December 1996 involving 150 households residing around

the Tuy River. The number of samples is broken down as follows according to the distance from the river: <50 m : 60, 50 m =<<100 m: 30, 100 m =<<200 m: 30, =<200 m: 30

The methodology for estimation of the 7 benefits is summarized:

Types of Benefits	Methodology
1) Appreciation of estate values	Multi-correlation analysis was performed between 5 independent variables (distance from the Tuy River, distance from the commercial center, distance from the work place, quietness of the location and security of the location) and the price of estate (houses and land). As a result, it was revealed that there is a significant correlation between 3 independent variables (distance from the Tuy River, distance from the commercial center and security of the location) and the price of estate. In calculating the benefit it was assumed that in the with project case the price of the estate near the river would go up to that of the estate located 200 m or more away. Eventually, the incremental price of estate per household was multipled by the estimated number of households near the Tuy River and its tributaries.
2) Enhancement of tourism value of Tuy River basin;	The expected number of people going to the basin for tourism/recreational purpose in a year was compared between the without and with project cases. The resultant incremental number of people or households was multiplied by the time cost per capita, vehicle operating cost per household and commercial profit per capita.
3) Appreciation of "existence value" of Tuy River basin	The average amount of the annual environmental tax a household is willing to pay to preserve and protect the natural environment of the Tuy River basin was multipled by the total number of households in the project area.
4) Reduction of water-borne diseases	Multi-correlation analysis was performed between the independent variables (distance from the Tuy River, household income and the use of piped water and sewerage) and the incidence of water-borne diseases. As a result, it was found that only distance from the river was significantly correlated to water-borne diseases. In calculating the benefit it was assumed that in the with project case the incidence of water-borne diseases in the households residing near the Tuy River would go down to the incidence of the diseases in the households residing 200 m or more away.
5) Reduction of turbidity	The annual volume of water to be newly available through the reduction of water intake suspension due to turbidity was multiplied by the economic value of unit volume of water. The annually available water from the Tuy River was multiplied by the estimated reduction of the cost of alum per unit volume of water. The annual volume of sediments was multiplied by the cost of disposal by heavy machine per unit volume of sediments. The annual volume of water to be newly available through the reduction of water intake suspension for the purpose of sediment disposal was multiplied by the economic value of unit volume of water.
6) Reduction of water intake suspension due to color & odor	The annual volume of water to be newly available through the reduction of water intake suspension due to color and odor was multiplied by the economic value of unit volume of water.
7) Reduction of chemicals for pre-treatment	The annually available water from the Tuy river was multiplied by the estimated reduction of the cost of chlorine per unit volume of water.

The actual calculation steps and the resultant values are shown in Table 3.1.1. In obtaining the final values conversion factors shown in Table 3.1.2 were applied.

The indirect benefits will increase in parallel with the growth of population.

(3) Allocation of Benefits to Projects

Table 3.1.3 shows the details of how the 7 benefits were allocated to each of the 5 F/S projects.

As it shows, each project is allocated benefits according to the extent it will contribute to the generation/creation of a particular benefit.

As a final form benefits are distributed over the project life period of 30 years by project.

Economic Evaluation

Using the cost benefit streams prepared over the project implementation period and the project life period, economic criteria, i.e., NPV (net present value), B/C (cost benefit ratio) and EIRR (economic internal rate of return) are calculated for each project as well as for the 5 projects combined. In performing economic analysis OCC (opportunity cost of capital) in Venezuela is assumed as 12%.

Usually OCC is set at 10% in most countries. However, the OCC of 12% was chosen for Venezuela because the country is at a very active economic development stage and consequently there are strong demands for capital in the economy in general.

The resultant economic criteria are evaluated, assessed and/or commented on.

Sensitivity analysis is conducted for installation of treatment plants in factories, construction of sewage treatment plant in Ocumare del Tuy and construction of sewage treatment plant in Las Tejerias applying the alternatives of the high and low growth of population and industry to see how a change of premises will affect the EIRR.

3.1.2 Financial Evaluation

In performing financial analysis the following were assumed:

(1) Ratio of external loan in funding the initial cost

Installation of treatment plants in factories	100%
Construction of sand settling pond for intake	100%
Construction of sewage treatment plant in Ocumare del Tuy	35%
Construction of sewage treatment plant in Las Tejerias	20%
Reforestation in priority areas	100%

The financial resources for the construction of sewage treatment plant will not be 100% external due to the constraints in the affordability of households concerned in repaying the loan.

(2) Terms of external loan

Annual interest rate: 6%, grace period: 3 years, repayment period: 15 years

(3) Collection efficiency of sewerage charge from households and of repayments from factories & piggeries: 95%

(4) Durable life: electro-mechanical equipment: 15 years, civil engineering structures and other facilities: 40 years

(5) Period of financial analysis: 20 years from the start of project implementation

Two types of financial analysis are performed. One is affordability analysis to see if the cost bearer is capable of shouldering the O&M and repayment costs.

Another is the projection of financial statements to assure that the financial entity concerned will be profitable and solvent for years after the project has been implemented.

Affordability Analysis

(1) Estimation of Outlays

The O & M cost is estimated. Then, it is distributed over the years.

The repayments of interest and the principal is projected based on the initial cost and the lending terms.

The replacement cost of electro-mechanical equipment is projected.

Then, the above outlays are annually totaled over the period of 20 years.

As the final form, the annual streams of the above-mentioned cost are prepared, starting from the initial year of project implementation for the period of 20 years.

(2) Evaluation of Income Sources

Financial sources of the cost-bearer are projected. Then, the ratio and amount of their allocations to meet the above-mentioned outlays are calculated and evaluated.

Projection of Financial Statements

Financial statements of the financial entity, e.g., Environmental Fund, HIDROCAPITAL and the Tuy Agency are projected for the projects concerned starting from the initial year of project implementation for 20 years.

The items to be annually projected are revenues, O&M cost, depreciation, payment of interest, total cost, profits before tax, tax and profits after tax for the income statement.

In addition to depreciation and profits after tax, loans, governmental budget, total sources of funds, capital cost, payment of principal, working capital and total applications of funds are annually projected for the funds statement.

For the balance sheet current assets, fixed assets, total assets, liabilities and capital are annually projected.

The purpose of the above-mentioned projected financial statements is to show that the financial entity will remain financially sound and stable if the predetermined conditions regarding income sources, O&M cost, and loans and repayments are met.

3.2 Installation of Treatment Plants for Factories

3.2.1 Estimation of Economic Cost

(1) Initial Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Treatment Tanks	9,527	0.91	8,670
Incidental Facilities	5,954	0.87	5,180
Instruments	8,336	0.91	7,586
Total	23,817		21,436

The initial cost of the installation of treatment plants for the existing factories and piggeries and new factories totals US$23,817 thousand. It is broken down into three cost components, to each of which a conversion factor is applied. As a result, the economic initial cost works out to US$21,436 thousand.

The proposed implementation period is from the middle of the year 2000 to the end of 2003. The cost is distributed in proportion to the length of time.

(2) O&M Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	Economic Cost
Personnel	1,141	0.81	924
Electricity	381	0.61	232
Chemicals	381	0.96	366
Total	1,903		1,522

The O&M cost of treatment plants for the existing and new factories totals US$1,903 thousand. It is broken down into three cost components, to each of which a conversion factor is applied. As a result, the economic O&M cost works out to US$1,522 thousand.

The O&M cost is assumed to be incurred starting in 2004.

3.2.2 Estimation of Economic Benefits and Economic Analysis

(1) Estimation of Economic Benefits

Six kinds of benefits are expected to arise in the with project case: (a) appreciation of estate values, (b) reduction of water-borne diseases, (c) enhancement of the value of the Tuy River basin as a tourism resource, (d) appreciation of the "existence value" of the Tuy River basin, (e) reduction of water intake suspension at Toma de Agua due to color and odor and (f) reduction of chemicals for pre-treatment.

(Unit: US$ thousand)

Item	Total Amount	Ratio Attributed to the Project	Amount Attributed to the Project
1) Appreciation of Estate Values	55,596	49.35%	27,437
2) Enhancement of the Tourism Value of the Tuy River Basin	369	49.35%	182
3) Appreciation of "Existence Value" of Tuy River Basin	1,145	49.35%	565
4) Reduction of Water-Borne Diseases	314	53.00%	166
5) Reduction of Water Intake Suspension due to Color and Odor	328	100.00%	328
6) Reduction of Chemicals for Pre-treatment	242	53.00%	128
Total	57,994		28,806

How the total amount for the six items in the above table is estimated is shown in Table 3.1.1. How the ratio to be attributed to the project is arrived at is presented in Table 3.1.3.

As the above table shows, the total economic benefits are calculated at US$57,994 thousand. This is the amount to be expected supposing the project is completed in 1997. Out of them, those to be attributed to the project total US$28,806 thousand.

The benefits of item 1) to 4) are estimated to grow at the average annual rate of 4.7% in parallel with the growth of population in the project area.

The benefits will start to be realized in 2004.

(2) Economic Analysis

In performing economic analysis, it is assumed that the project life is 30 years after the project has been implemented, that the opportunity cost of capital is 12% and also that the durable life is 15 years for the electro-mechanical equipment and 40 years for civil engineering structures and other facilities.

Using the cost benefit streams shown in Table 3.2.1, the following economic criteria are worked out:

NPV (US$ thousand)	B/C	EIRR
18,161	1.80	35.2%

The above results hold true on condition that industrial growth in the project area will follow the Pattern 1 (standard) projection. How will the EIRR change if the industrial growth follows the Pattern 2 (high) or Pattern 3 (low) projection? The initial and O&M cost of the installation of treatment plants for

new factories in the Pattern 2 and Pattern 3 cases is estimated at 1.360 times and 0.614 times that in the Pattern 1 case respectively. This information was used for the sensitivity analysis. The benefits are assumed to be the same.

The results of the sensitivity analysis are as follows:

Industrial Growth	Pattern 1	Pattern 2	Pattern 3
EIRR	35.2%	29.5%	42.7%

It is evident from the above that the project will be economically highly viable under all circumstances.

3.3 Construction of Sand Settling Pond for Intake

In this section economic and financial analyses are performed. The values and conditions which are applied or relevant to both analyses are shown below.

(1) Initial Cost	US$6,245 thousand
(2) O & M Cost	US$17 thousand
(3) Implementation Period	2000 to 2002
(4) Durable Life	Electro-Mechanical Equipment: 15 years Civil Engineering Structures and Other Facilities: 40 years

3.3.1 Economic Analysis

Estimation of Economic Cost

(1) Initial Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Site Preparation	9	0.83	7
Excavation and Backfilling	375	0.83	311
Structure Construction	3,275	0.91	2,980
Bridges	182	0.89	162
Pipeline Installation	953	0.92	877
Gates and Screen			
Sluice Gate	92	0.91	84
Motorized Winch	100	0.87	87
Carbon Steel Screen	10	0.91	9
Sub-Total	4,996		4,517
Contingency (25%)	1,249		1,129
Total	6,245		5,646

The initial cost of the construction of sand settling pond for intake totals US$6,245 thousand. It is broken down into 8 cost components, to each of which a conversion factor is applied. As a result, the economic initial cost works out to US$5,646 thousand.

The cost is distributed over years according to the implementation schedule.

(2) O&M Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Personnel	14	0.81	11
Electricity	3	0.61	2
Total	17		13

The O&M cost of the sand settling pond for intake totals US$17 thousand. It is broken down into two cost components, to each of which a conversion factor is applied. As a result, the economic O&M cost works out to US$13 thousand.

The O&M cost is assumed to be incurred starting in 2003.

Estimation of Economic Benefits and Economic Analysis

(1) Estimation of Economic Benefits

The benefits pertain to the elimination of turbidity. Four kinds of benefits are expected to arise in the with project case, i.e. 1) reduction of water intake suspension due to turbidity, 2) reduction of the chemical (alum) for pre-treatment, 3) elimination of necessity for pre-treatment pond cleaning by heavy machine and 4) reduction of water intake suspension for disposal of sediments.

(Unit: US$ thousand)

Item	Financial Benefits	Conversion Factor	Economic Benefits
(1) Reduction of Water Intake Suspension due to Turbidity	485	0.87	422
(2) Reduction of Chemicals for Pre-treatment	238	0.96	228
(3) Elimination of Necessity for Pre-treatment Pond Cleaning by Heavy Machine	96	0.83	80
(4) Reduction of Water Intake Suspension for Sediment Disposal	127	0.87	110
Total	946		840

As the above table shows, the total economic benefit is calculated at US$840 thousand. This will be annually realized in the with-project case.

The benefits will start to be realized in 2003.

(2) Economic Analysis

In performing economic analysis, it is assumed that the project life is 30 years after the project is implemented and also that the opportunity cost of capital is 12%.

Using the cost benefit streams shown in Table 3.3.1, the following economic criteria are worked out:

NPV (US$ thousand)	B/C	EIRR
279	1.07	12.9%

As the above table shows, EIRR is 12.9%, or 0.9% higher than the opportunity cost of capital. Therefore, the project can be judged to be economically feasible.

3.3.2 Financial Analysis

Two types of financial analyses are performed. One is affordability analysis and the other, projection of financial statements. Values and conditions used in both of them are shown below.

Beneficiary

Ultimate Beneficiary	Direct Beneficiary
CMA Households	HIDROCAPITAL

The direct beneficiary of the project is HIDROCAPITAL. But, the ultimate beneficiaries are the CMA (Caracas Metropolitan Area) clients of HIDROCAPITAL. The clients will be represented by households.

Financial Source, Lending Terms and Bearer of Cost

External Source	Government Budget	Lending Terms	Bearer of Cost
100%	-	(Section 3.1)	Beneficiary

All of the initial cost is assumed to be provided by an external source on the terms described in Section 3.1. O&M cost and repayment cost will be borne by the beneficiaries.

Financial Capacity of Beneficiaries

Item	No. of CMA Households	Income/Household/ Month	Aggregate Household Income/Year
Estimated Value in 1997	843,371	US$496	US$5,019,744 thousand
Annual Growth Rate	1.81%	2%	3.85%

The financial capacity of CMA households works out to US$5,109,744 thousand in 1997. It is estimated to grow at the average annual rate of 3.85%.

Item	Income of HIDROCAPITAL
Estimated Value in 1997	US$ 4,701 thousand
Annual Growth Rate	2%

The financial capacity of HIDROCAPITAL is estimated at US$74,701 in 1997. It is assumed to grow at the average annual rate of 2%.

Affordability Analysis

This is an analysis to judge and determine if the beneficiaries are capable of bearing the cost of the project.

(1) Cost Bearer = CMA Households

Table 3.3.2 shows the annual projection of the O&M, replacement and repayment cost, and the percentage of income CMA households should set aside to meet the cost for the 20 years from 1999 to 2018 under the above-mentioned conditions.

It is revealed that over the 14 years from 2003 to 2016 CMA households will annually shoulder US$784 thousand on average.

Monthly Payment as Percentage of CMA Household Income	Corresponding Monthly Payment per CMA Household in 1997
0.010%	US$0.05 or Bs. 24

In terms of the percentage of household income, each household will monthly pay 0.010% of its income as an addition to water charge. This means US$0.05 or Bs. 24 on average in 1997.

At present they pay 1.1% of their income for water. The addition is considered not to unduly affect their budgets.

(2) Cost Bearer = HIDROCAPITAL

Table 3.3.3 shows the annual projection of the O&M, replacement and repayment cost. and the percentage of income HIDROCAPITAL will set aside to meet the cost for 20 years from 1999 to 2018 under the above-mentioned conditions.

It is revealed that during 14 years from 2003 to 2016 HIDROCAPITAL will annually shoulder US$784 thousand on average.

Annual Payment as Percentage of Income of HIDROCAPITAL	0.82%

In terms of the percentage of income, HIDROCAPITAL will annually pay 0.82% of its income to the external agency. This seems to be not a heavy obligation.

Projection of Financial Statements

Financial statements (income statement, funds statement and balance sheet) of the project were projected on condition that the financial entity be HIDROCAPITAL and it collects sufficient funds from CMA households to make the project financially feasible.

Table 3.3.4 shows the annual financial statements of the project for 20 years from 1999 to 2018.

Monthly Payment as Percentage of CMA Household Income	Corresponding Monthly Payment per CMA Household in 1997
0.0145%	US$0.072 or Bs.34

As yearly average from 2003 to 2016 a CMA household will monthly pay 0.0145% of its income. This corresponds to US$0.072 or Bs. 34 on average in 1997.

Ratio of Working Capital to Total Assets	Ratio of Revenues to Total Assets
10.2%	7.4%

Also, the ratio of working capital to the total assets and the ratio of revenues to the total assets are 10.2% and 7.4%, respectively.

3.4 Construction of Sewage Treatment Plant in Ocumare del Tuy

In this section economic and financial analyses are performed. The values and conditions which are applied or relevant to both analyses are shown below.

(1) Initial Cost	US$26,763 thousand
(2) O & M Cost	US$341 thousand
(3) Implementation Period	1998 to 2001 for sewage treatment plant 1998 to 2003 for sewers
(4) Durable Life	Electro-Mechanical Equipment: 15 years Civil Engineering Structures and Other Facilities: 40 years

3.4.1 Economic Analysis

Estimation of Economic Cost

(1) Initial Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	Economic Cost
Land Acquisition	1,500	0.90	1,350
Site Preparation Works	166	0.83	137
Earthworks	230	0.83	191
Roadworks	49	0.86	42
Structures	3,033	0.91	2,760
Yard Piping	791	0.92	727
Supply and Installation of Pumps	1,668	0.87	1,451
Filters	428	0.91	390
Process Equipment	2,285	0.93	2,125
Gas Storage	160	0.90	144
O & M Equipment	305	0.91	278
Pumping Station	248	0.91	226
Sewers	10,547	0.92	9,704
Sub-Total	21,410		19,525
Contingency (25%)	5,353		4,881
Total	26,763		24,406

The initial cost of the construction of the sewage treatment plant in Ocumare del Tuy totals US$26,763 thousand. It is broken down into 13 cost components, to each of which a conversion factor is applied. As a result, the economic initial cost works out to US$24,406 thousand.

The cost is distributed over years according to the implementation schedule.

(2) O&M Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Personnel	71	0.81	58
Electricity	145	0.61	88
General Operation Expenses			
Sludge Disposal	3	0.83	2
Equipment Maintenance	40	0.81	32
Testing	7	0.97	7
Miscellaneous	7	0.96	7
Sub-Total	273		194
Contingency (25%)	68		49
Total	341		243

The O&M cost of the sewage treatment plant in Ocumare del Tuy totals US$341 thousand. It is broken down into 6 cost components, to each of which a conversion factor is applied. As a result, the economic O&M cost works out to US$243 thousand.

The O&M cost will be incurred starting in 2004.

Estimation of Economic Benefits and Economic Analysis

(1) Estimation of Economic Benefits

Five kinds of benefits are expected to arise in the with project case, i.e.. (a) appreciation of estate values; (b) reduction of water-borne diseases; (c) enhancement of the value of the Tuy River basin as tourism resources; (d) appreciation of the "existence value" of the Tuy River basin; (e) reduction of chemicals for pre-treatment.

(Unit: US$ thousand)

Item	Total Amount	Ratio Attributed to the Project	Amount Attributed to the Project
(1) Appreciation of Estate Values	55,596	28.57%	15,884
(2) Enhancement of the Tourism Value of the Tuy River Basin	369	28.57%	105
(3) Appreciation of "Existence Value" of Tuy River Basin	1,145	28.57%	327
(4) Reduction of Waterborne Diseases	314	35.29%	111
(5) Reduction of Chemicals for Pre-treatment	242	35.29%	85
Total	57,666		16,512

How the total amount for the five items in the above table is estimated is shown in Table 3.1.1. How the ratio to be attributed to the project is arrived at is presented in Table 3.1.3.

As the above table shows, the total economic benefits are calculated at US$57,666 thousand. This is the amount to be expected supposing the project is completed in 1997. Out of them, those to be attributed to the project totals US$16,512 thousand.

The benefits of Item (1) to (4) are estimated to grow at the average annual rate of 4.7% in parallel with the growth of population in the project area.

The benefits will start to be realized in 2004.

(2) Economic Analysis

In performing economic analysis, it is assumed that the project life is 30 years after the project is implemented and also that the opportunity cost of capital is 12%.

Using the cost benefit streams shown in Table 3.4.1, the following economic criteria are worked out:

NPV (US$ thousand)	B/C	EIRR
1,863	1.09	13.2%

As the above table shows, EIRR is 13.2%, or 1.2% higher than the opportunity cost of capital. Therefore, the project can be judged to be economically feasible.

The above results hold true on condition that population growth of Ocumare del Tuy will follow the Pattern 1 (standard) projection. How will the EIRR change if the population growth follows the Pattern 2 (high) or Pattern 3 (low) projection? The ratios of population growth of the Pattern 2 and Pattern 3 projections to that of the Pattern 1 projection from now up to 2003 are 1.0495 and 0.8328, respectively. It is assumed that the initial and O&M cost of the construction of sewage treatment plant may go up or down within that range. The benefits are assumed to be the same.

The results of the sensitivity analysis are as follows:

Population Growth	Pattern 1	Pattern 2	Pattern 3
EIRR	13.2%	12.5%	16.0%

Therefore, the project can be judged to be economically feasible under all circumstances.

3.4.2 Financial Analysis

According to the general recommendation of the World Bank, water and sewerage charges as percentage of household income should be up to 4% and 2%, respectively. In the study area, however, sewerage charge is proposed to be up to 1% of household income on the assumption that the households' willingness to pay for sewerage charge is no more than the actual payment for water charge, which is currently on average 1% of household income. The percentage of initial cost to be externally financed and repaid by the cost-bearers was determined based on this premise.

Two types of financial analyses are performed. One is affordability analysis and the other, projection of financial statements. Values and conditions used in both of them are shown below.

Polluters

Polluters
Households and Factories/Piggeries in Ocumare del Tuy

The polluters concerned are households, factories and piggeries in Ocumare del Tuy.

Financial Source, Lending Terms and Bearer of Cost

External Source	Government Budget	Lending Terms	Bearer of Cost
35%	65%	(Section 3.1)	Polluters

Some 35% of the initial cost is assumed to be provided by an external source on the terms described in Section 3.1 and the balance of 65% by the government budget. O&M cost and repayment cost will be borne by the polluters.

Financial Capacity of Polluters

Item	No. of Targeted Households	Income/Household/ Month	Aggregate Household Income/Year
Estimated Value in 1997	18,100	US$507	US$110,120 thousand
Annual Growth Rate	4.58%	2%	6.67%

The financial capacity of households works out to US$110,120 thousand in 1997. It is estimated to grow at the average annual rate of 6.67%.

Item	No. of Targeted Factories/Piggeries	Sales/Factory/ Piggery/Year	Aggregate Sales/Year
Estimated Value in 1996	9 (F) 7 (P)	US$5,662T (F) US$234T (P)	US$50,958T. (F) US$1,638T. (P)
Annual Growth Rate	6.26% (F) 0% (P)	-	6.26% (F) 0% (P)

The financial capacity of factories works out to US$50,958 thousand in 1996 and it is estimated to grow at the average annual rate of 6.26%. The financial capacity of piggeries works out to US1,638 thousand in 1996.

It is assumed that 90% of the repayment cost and O&M cost will be borne by households and the remaining 10% by factories and piggeries in accordance with their respective contribution rates to the pollution of sewage.

Affordability Analysis

This is an analysis to judge and determine if the polluters are capable of bearing the cost of the project.

Table 3.4.2 shows the annual projection of the O&M, replacement and repayment cost, and the percentage of income households should set aside to meet the cost for the 20 years from 1998 to 2017 under the above-mentioned conditions.

It is revealed that over the 14 years from 2004 to 2017, the amount to be annually shouldered by all households will be US$1,523 thousand.

Monthly Payment as Percentage of Household Income	Corresponding Monthly Payment per Household in 1997
0.69%	US$3.498 or Bs. 1,644

In terms of the percentage of household income, each household will monthly pay 0.69% of its income as an addition to water charge. This means US$3.498 or Bs. 1,644 on average in 1997.

At present they pay 1% of their income for water. The addition is considered not to unduly affect household budgets.

Likewise, over the same period the amount to be annually shouldered by all factories and piggeries will be US$169 thousand.

Annual Payment as Percentage of Sales of a Factory/Piggery	Corresponding Annual Payment per Factory/Piggery
0.16%	US$9,059 (F) US$374 (P)

In terms of the percentage of sales, each factory/piggery will yearly pay 0.16% of its sales as sewerage charge. This means US$9,059 for a factory and US$374 for a piggery on average.

Projection of Financial Statements

Financial statements (income statement, funds statement and balance sheet) of the project were projected on condition that the financial entity be the Tuy River Basin Agency and it collects sufficient funds from households to make the project financially feasible.

Table 3.4.3 shows the annual financial statements of the project for 20 years from 1998 to 2017.

Monthly Payment as Percentage of Household Income	Corresponding Monthly Payment per Household in 1997
0.90%	US$4.563 or Bs.2,145

As the average from 2004 to 2017 a household will monthly pay 0.9% of its income. This corresponds to US$4.563, or Bs.2,145 on average in 1997.

Annual Payment as Percentage of Sales of a Factory/Piggery	Corresponding Monthly Payment per Factory/Piggery
0.17%	US$9,625 (F) US$398 (P)

As the average over the same period a factory and a piggery will yearly pay 0.17% of its sales. Thi corresponds to US$9,625 for a factory and US$398 for a piggery on average.

Ratio of Working Capital to Total Assets	Ratio of Revenues to Total Assets
11.1%	2.2%

Also, the ratio of working capital to the total assets and the ratio of revenues to the total assets are 11.1% and 2.2%, respectively.

Water and Sewerage Charges in Venezuela

(1) Comparison of Water Charge (1994)

Comparison of Water Charge by Region in the World

Region	Middle & South America	North America	Western Europe	Africa
Water Charge (US$/30m^3)	16.0	24.9	38.9	7.7
Region	Asia	Middle & Near East	Average	
Water Charge (US$/30m^3)	12.1	16.0	18.8	

Comparison of Water Charge by Country in Middle & South America

Country	Venezuela	Colombia	Ecuador	Peru	Chile
Water Charge (US$/30m^3)	1.8	15.6	11.5	8.0	9.1
Country	Brazil	Mexico	Panama	Guatemala	Costa Rica
Water Charge (US$/30m^3)	79.0	15.2	11.9	2.6	6.4

The water charge in Caracas, Venezuela is about one-ninth of the average water charge in Middle and South American countries. It is also about one-tenth of the average water charge in the whole world.

(2) Standard Levels of Water and Sewerage Charges

Water Charge/Household Income (%)	Sewerage Charge/Household Income (%)
up to 4%	up to 2%

The World Bank recommends that water charge and sewerage charge as percentage of household income be within 4% and 2%, respectively. In other words, it can be considered that the water charge up to 4% and sewerage charge up to 2% of household income are normal and reasonable.

(3) Sewerage Charge versus Water Charge

Usually the amount of sewerage charge is 30% to 50% of that of water charge.

(4) Desireable Levels of Water and Sewerage Charges in Venezuela

Against the above background the standard water charge and the sewerage charge in Venezuela are proposed to be 2% to 4% and 1% to 2% of household income, respectively.

(5) Water and Sewerage Charges in the Study Area

A household in the Miranda State, for instance, now pays about 1% of of its income for water on average. If water tariffs of HIDROCAPITAL were strictly observed, the household would have to pay 2.26% of its income for water on average. This percentage can be considered a standard one.

As sewerage charge is usually 30% to 50% of water charge, sewerage charge in Venezuela should preferably be 0.68% to 1.13% of household income. However, it can be raised up to 2% in accordance with the World Bank recommendation.

Alternatives on Cost Recovery

(1) Alternative I

Polluters, that is, households and factories/piggeries in Ocumare del Tuy bear the cost.

In this alternative 90% of the repayment and O&M cost is borne by households and the remaining 10% by factories/piggeries according to their respective contribution rates to the pollution of sewage.

Four (4) representative cases are considered regarding the percentage of cost to be borne by households and factories/piggeries and the corresponding sewerage charges.

(Unit: %)

Item	Case 1	Case 2	Case 3	Case 4
Sharing of the Initial Cost by Households and Factories/Piggeries	100	50	35	0
Sharing of the O&M Cost by Households and Factories/Piggeries	100	100	100	100
Sewerage Charge as Percentage of Household Income	2.07	1.13	0.90	0.54
Sewerage Charge as Percentage of Sales of Factories/Piggeries	0.65	0.27	0.17	0.03

As the above table shows, supposing both the initial cost and O&M cost is entirely recovered from households and factories/piggeries, households will set aside 2.07% of their income for sewerage charge, and factories/piggeries will allocate 0.65% of their sales for the same purpose.

On the other hand, supposing only the O & M cost is recovered from households and factories/piggeries, households will set aside 0.54% of their income for sewerage charge, and factories/piggeries will allocate 0.03% of their sales for the same purpose.

The bold lettered case (Case 3) is proposed by the JICA study team.

(2) Alternative II

Both polluters, that is, households and factories/piggeries in Ocumare del Tuy and beneficiaries, that is, households in CMA bear the cost.

In this alternative 90% of the repayment and O&M cost is borne by households in Ocumare del Tuy and CMA, and the remaining 10% by factories/piggeries in Ocumare del Tuy.

Four (4) representative cases are considered regarding the percentage of cost to be borne by households and factories/piggeries and the corresponding sewerage charges.

(Unit: %)

Item	Case 1	Case 2	Case 3	Case 4
Sharing of the Initial Cost by Households and Factories/Piggeries	100	50	35	0
Sharing of the O&M Cost by Households and Factories/Piggeries	100	100	100	100
Sewerage Charge as Percentage of Household Income	0.058	0.031	0.024	0.014
Sewerage Charge as Percentage of Sales of Factories/Piggeries	0.65	0.27	0.17	0.03

As the above table shows, supposing both the initial cost and O&M cost is entirely recovered from households and factories/piggeries, households will set aside 0.058% of their income for sewerage charge, and factories/piggeries will allocate 0.65% of their sales for the same purpose.

On the other hand, supposing only the O&M cost is recovered from households and factories/piggeries, households will set aside 0.014% of their income for sewerage charge, and factories/piggeries will allocate 0.03% of their sales for the same purpose.

Supposing 35% of the initial cost and 100% of the O&M cost is recovered from households and factories/piggeries, households will set aside 0.024% of their income for sewerage charge, and factories/piggeries will allocate 0.17% of their sales for the same purpose.

(3) Alternative III

Beneficiaries, that is, households in the Caracas Metropolitan Area bear the cost.

Four (4) representative cases are considered regarding the percentage of cost to be borne by the CMA households and the corresponding sewerage charge.

(Unit: %)

Item	Case 1	Case 2	Case 3	Case 4
Sharing of the Initial Cost by CMA Households	100	50	35	0
Sharing of the O&M Cost by CMA Households	100	100	100	100
Sewerage Charge as Percentage of Household Income	0.068	0.036	0.028	0.016

As the above table shows, supposing both the initial cost and O&M cost is entirely recovered from the CMA households, they will set aside 0.068% of their income for sewerage charge.

On the other hand, supposing only the O&M cost is recovered from the CMA households, they will set aside 0.016% of their income for sewerage charge.

Supposing 35% of the initial cost and 100% of the O&M cost is recovered from the CMA households, they will set aside 0.028% of their income for sewerage charge.

Billing and Collection of Sewerage Charge

The Tuy River Basin Agency is supposed to manage the sewerage services including billing and collection of sewerage charge. However, in view of the fact that the volume of the discharge of sewage corresponds to the consumption of water, and for the sake of efficiency, it is proposed that sewerage charge be added onto water charge as a fixed percentage, that the water bill now in use be used as the water and sewerage bill, and thus that sewerage charge be collected together with water charge by HIDROCAPITAL.

3.5 Construction of Sewage Treatment Plant in Las Tejerías

In this section economic and financial analyses are performed. The values and conditions which are applied or relevant to both analyses are shown below.

(1) Initial Cost	US$11,368 thousand
(2) O&M Cost	US$194 thousand
(3) Implementation Period	2000 to 2002 for sewage treatment plant 2000 to 2003 for sewers
(4) Durable Life	Electro-Mechanical Equipment: 15 years Civil Engineering Structures and Other Facilities: 40 years

3.5.1 Economic Analysis

Estimation of Economic Cost

(1) Initial Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Land Acquisition	1,064	0.90	958
Site Preparation Works	38	0.83	32
Earthworks	177	0.83	143
Roadworks	54	0.86	47
Structures	1,665	0.91	1,515
Yard Piping	316	0.92	290
Supply and Installation of Pumps	886	0.87	771
Filters	228	0.91	207
Process Equipment	1,378	0.93	1,282
Gas Storage	120	0.90	108
O & M Equipment	305	0.91	278
Sewers	2,863	0.92	2,635
Sub-Total	9,094		8,266
Contingency (25%)	2,274		2,067
Total	11,368		10,333

The initial cost of the construction of the sewage treatment plant in Las Tejerías totals US$11,368 thousand. It is broken down into 12 cost components, to each of which a conversion factor is applied. As a result, the economic initial cost works out to US$10,333 thousand.

The cost is distributed over years according to the implementation schedule.

(2) O&M Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Personnel	63	0.81	51
Electricity	55	0.61	34
General Operation Expenses			
Sludge Disposal	2	0.83	2
Equipment Maintenance	25	0.81	20
Testing	5	0.97	5
Miscellaneous	5	0.96	5
Sub-Total	155		117
Contingency (25%)	39		29
Total	194		146

The O&M cost of the sewage treatment plant in Las Tejerías totals US$194 thousand. It is broken down into 6 cost components, to each of which a conversion factor is applied. As a result, the economic O & M cost works out to US$146 thousand.

The O & M cost will be incurred starting in 2004.

Estimation of Economic Benefits and Economic Analysis

(1) Estimation of Economic Benefits

Five kinds of benefits are expected to arise in the with-project case, i.e., (a) appreciation of estate values; (b) reduction of waterborne diseases; (c) enhancement of the value of the Tuy River basin as tourism resources; (d) appreciation of the "existence value" of the Tuy River basin; and, (e) reduction of chemicals for pre-treatment.

(Unit: US$ thousand)

Item	Total Amount	Ratio Attributed to the Project	Amount Attributed to the Project
(1) Appreciation of Estate Values	55,596	9.48%	5,271
(2) Enhancement of the Tourism Value of the Tuy River Basin	369	9.48%	35
(3) Appreciation of "Existence Value" of Tuy River Basin	1,145	9.48%	109
(4) Reduction of Water-Borne Diseases	314	11.71%	37
(5) Reduction of Chemicals for Pre-treatment	242	11.71%	28
Total	57,666		5,480

How the total amount for the five items in the above table is estimated is shown in Table 3.1.1. How the ratio to be attributed to the project is arrived at is presented in Table 3.1.3.

As the above table shows, the total economic benefits are calculated at US$57,666 thousand. This is the amount to be expected supposing the project is completed in 1997. Out of them, those to be attributed to the project totals US$5,480 thousand.

The benefits of item 1) to 4) are estimated to grow at the average annual rate of 4.7% in parallel with the growth of population in the project area.

The benefits will start to be realized in 2004.

(2) Economic Analysis

In performing economic analysis, it is assumed that the project life is 30 years after the project is implemented and also that the opportunity cost of capital is 12%.

Using the cost benefit streams shown in Table 3.5.1, the following economic criteria are worked out:

NPV (US$ thousand)	B/C	EIRR
-469	0.94	11.1%

As the above table shows, EIRR is 11.1% or by 0.9% lower than the opportunity cost of capital. However, it is to be noted that EIRR is more than 10%.

Usually OCC is set at 10% in most countries. Under this condition the EIRR of the project exceeds the feasibility line.

The above results hold true on conditions that population growth of Las Tejerías will follow the Pattern 1 (standard) projection. How will the EIRR change if the population growth follows the Pattern 2 (high) or Pattern 3 (low) projection? The ratios of population growth of the Pattern 2 and Pattern 3 projections to that of the Pattern 1 projection from now up to 2003, are 1.1453 and 0.8772, respectively. It is assumed that the initial and O&M cost of the construction of sewage treatment plant may go up or down within that range. The benefits are assumed to be the same.

The results of the sensitivity analysis are as follows:

Population Growth	Pattern 1	Pattern 2	Pattern3
EIRR	11.1%	9.0%	13.3%

The above table shows that EIRR is above OCC or below 10% depending on circumstances.

3.5.2 Financial Analysis

According to the general recommendation of the World Bank, water and sewerage charges as percentage of household income should be up to 4% and 2%, respectively. In the study area, however, sewerage charge is proposed to be up to 1% of household income on the assumption that the households' willingness to pay for sewerage charge is no more than the actual payment for water charge, which is currently on average 1% of household income. The percentage of initial cost to be externally financed and repaid by the cost-bearers was determined based on this premise.

Two types of financial analyses are performed. One is affordability analysis and another projection of financial statements. Values and conditions used in both of them are shown below.

Polluters

Polluters
Households and Factories/Piggeries in Las Tejerías

The polluters concerned are households, factories and piggeries in Las Tejerías.

Financial Source, Lending Terms and Bearer of Cost

External Source	Government Budget	Lending Terms	Bearer of Cost
20%	80%	(Section 3.1)	Polluters

Some 20% of the initial cost is assumed to be provided by an external source on the terms described in Section 3 and the balance of 80% by the government budget. O&M cost and repayment cost will be borne by the polluters.

Financial Capacity of Polluters

Item	No. of Targeted Households	Income/Household/ Month	Aggregate Household Income/Year
Estimated Value in 1997	5,062	US$494	US$30,008 thousand
Annual Growth Rate	2.10%	2%	4.14%

The financial capacity of households works out to US$30,008 thousand in 1997. It is estimated to grow at the average annual rate of 4.14%.

Item	No. of Targeted Factories/Piggeries	Sales/Factory /Piggery/Year	Aggregate Sales /Year
Estimated Value in 1996	18 (F) 2 (P)	US$5,662T (F) US$234T (P)	US$101,916T (F) US$468T (P)
Annual Growth Rate	5.57% (F) 0% (P)	-	5.57% (F) 0% (P)

The financial capacity of factories works out to US$101,916 thousand in 1996 and it is estimated to grow at the average annual rate of 5.57%. The financial capacity of piggeries works out to US468 thousand in 1996.

It is assumed that 50% of the repayment cost and O&M cost will be borne by households and the remaining 50% by factories and piggeries in accordance with their respective contribution rates to the pollution of sewage.

Affordability Analysis

This is an analysis to judge and determine if the polluters are capable of bearing the cost of the project.

Table 3.5.2 shows the annual projection of the O&M, replacement and repayment cost, and the percentage of income households should set aside to meet the cost for the 20 years from 1998 to 2017 under the above-mentioned conditions.

It is revealed that over the 14 years from 2004 to 2017, the amount to be shouldered by all households will beUS$347 thousand.

Monthly Payment as Percentage of Household Income	Corresponding Monthly Payment per Household in 1997
0.75%	US$3,705 or Bs. 1,741

In terms of the percentage of household income, each household will monthly pay 0.75% of its income as an addition to water charge. This means US$3.705 or Bs. 1,741 on average in 1997.

At present they pay 1% of their income for water. The addition is considered not to unduly affect household budgets.

Likewise, over the same period the amount to be annually shouldered by all factories and piggeries will be US$347 thousand.

Annual Payment as Percentage of Sales of a Factory/Piggery	Corresponding Annual Payment per Factory/Piggery
0.18%	US$10,192 (F), US$421 (P)

In terms of the percentage of sales, each factory/piggery will yearly pay 0.18% of its sales as sewerage charge. This means US$10,192 for a factory and US$421 for a piggery on average.

Projection of Financial Statements

Financial statements (income statement, funds statement and balance sheet) of the project were projected on condition that the financial entity be theTuy River Basin Agency and it collects sufficient funds from households to make the project financially feasible.

Table 3.5.3 shows the annual financial statements of the project for 20 years from 2000 to 2019.

Monthly Payment as Percentage of Household Income	Corresponding Monthly Payment per Household in 1997
0.90%	US$4.446 or Bs.2,090

As the yearly average from 2004 to 2017 a household will monthly pay 0.90% of its income. This corresponds to US$4.446 or Bs. 2,090 on average in 1997.

Annual Payment as Percentage of Sales of a Factory/Piggery	Corresponding Monthly Payment per Factory/Piggery
0.22%	US$12,456 (F) US$515 (P)

As the average over the same period a factory and a piggery will yearly pay 0.22% of its sales. This corresponds to US$12,456 for a factory and US$515 for a piggery on average.

Ratio of Working Capital to Total Assets	Ratio of Revenues to Total Assets
11.2%	1.0%

Also, the ratio of working capital to the total assets and the ratio of revenues to the total assets are 11.2% and 1.0% respectively.

Alternatives on Cost Recovery

(1) Alternative I

Polluters, that is, households and factories/piggeries in Las Tejerías bear the cost.

In this alternative 50% of the repayment and O&M cost is borne by households and the remaining 50% by factories/piggeries according to their respective contribution rates to the pollution of sewage.

Four (4) representative cases are considered regarding the percentage of cost to be borne by households and factories/piggeries and the corresponding sewerage charges.

(Unit: %)

Item	Case 1	Case 2	Case 3	Case 4
Sharing of the Initial Cost by Households and Factories/Piggeries	100	50	**20**	0
Sharing of the O&M Cost by Households and Factories/Piggeries	100	100	**100**	100
Sewerage Charge as Percentage of Household Income	2.45	1.40	**0.90**	0.70
Sewerage Charge as Percentage of Sales of Factories/Piggeries	0.73	0.39	**0.22**	0.15

As the above table shows, supposing both the initial cost and O&M cost is entirely recovered from households and factories/piggeries, households will set aside 2.45% of their income for sewerage charge, and factories/piggeries will allocate 0.73% of their sales for the same purpose.

On the other hand, supposing only the O&M cost is recovered from households and factories/piggeries, households will set aside 0.70% of their income for sewerage charge, and factories/piggeries will allocate 0.15% of their sales for the same purpose.

The bold lettered case (Case 3) is proposed by the JICA study team.

(2) Alternative II

Both polluters, that is, households and factories/piggeries in Las Tejerías and beneficiaries, that is, households in CMA bear the cost.

In this alternative 50% of the repayment and O&M cost is borne by households in Las Tejerías and CMA, and the remaining 50% by factories/piggeries in Las Tejerías.

Four (4) representative cases are considered regarding the percentage of cost to be borne by households and factories/piggeries and the corresponding sewerage charges.

(Unit: %)

Item	Case 1	Case 2	Case 3	Case 4
Sharing of the Initial Cost by Households and Factories/Piggeries	100	50	20	0
Sharing of the O & M Cost by Households and Factories/Piggeries	100	100	100	100
Sewerage Charge as Percentage of Household Income	0.016	0.008	0.005	0.004
Sewerage Charge as Percentage of Sales of Factories/Piggeries	0.73	0.39	0.22	0.15

As the above table shows, supposing both the initial cost and O&M cost is entirely recovered from households and factories/piggeries, households will set aside 0.016% of their income for sewerage charge, and factories/piggeries will allocate 0.73% of their sales for the same purpose.

On the other hand, supposing only the O&M cost is recovered from households and factories/piggeries, households will set aside 0.004% of their income for sewerage charge, and factories/piggeries will allocate 0.15% of their sales for the same purpose.

Supposing 20% of the initial cost and 100% of the O&M cost is recovered from households and factories/piggeries, households will set aside 0.005% of their income for sewerage charge, and factories/piggeries will allocate 0.22% of their sales for the same purpose.

(3) Alternative III

Beneficiaries, that is, households in the Caracas Metropolitan Area bear the cost.

Four (4) representative cases are considered regarding the percentage of cost to be borne by the CMA households and the corresponding sewerage charge.

(Unit: %)

Item	Case 1	Case 2	Case 3	Case 4
Sharing of the Initial Cost by CMA Households	100	50	20	0
Sharing of the O&M Cost by CMA Households	100	100	100	100
Sewerage Charge as Percentage of Household Income	0.034	0.018	0.011	0.008

As the above table shows, supposing both the initial cost and O&M cost is entirely recovered from the CMA households, they will set aside 0.034% of their income for sewerage charge.

On the other hand, supposing only the O&M cost is recovered from the CMA households, they will set aside 0.008% of their income for sewerage charge.

Supposing 20% of the initial cost and 100% of the O&M cost is recovered from the CMA households, they will set aside 0.011% of their income for sewerage charge.

Billing and Collection of Sewerage Charge

The Tuy River Basin Agency is supposed to manage the sewerage services including billing and collection of sewerage charge. However, in view of the fact that the volume of the discharge of sewage corresponds to the consumption of water, and for the sake of efficiency it is proposed that sewerage charge be added onto water charge as a fixed percentage, the water bill now in use be used as the water and sewerage bill, and that sewerage charge be collected together with water charge by HIDROCAPITAL.

3.6 Reforestation in Priority Areas

In this section economic and financial analyses are performed. The values and conditions which are applied or relevant to both analyses are shown under:

(1) Initial Cost	US$3,347 thousand
(2) O&M Cost	Virtually not necessary
(3) Implementation Period	1998 for the nursery 1999 to 2003 for the reforestation operations
(4) Durable Life	Electro-Mechanical Equipment: 15 years Civil Engineering Structures and Other Facilities: 40 years

3.6.1 Economic Analysis

Estimation of Economic Cost

(1) Initial Cost

(Unit: US$ thousand)

Item	Financial Cost	Conversion Factor	EconomicCost
Nursery			
Site Preparation	9	0.83	8
Roadworks	14	0.89	12
Buildings	96	0.91	87
Irrigation System	11	0.93	10
Nursery Beds	23	0.83	19
Sub-Total	153		136
Contingency (25%)	38		34
Operation			
New Road	11	0.86	9
Others	3,145	0.81	2,547
Sub-Total	3,156		2,556
Total	3,347		2,726

The initial cost of reforestation in priority areas totals US$3,347 thousand. It is broken down into7 cost components, to each of which a conversion factor is applied. As a result, the economic initial cost works out to US$2,726 thousand.

The cost is distributed over years according to the implementation schedule.

(2) O&M Cost

Due to the nature of the O&M costs for the nursery and the reforestation works they have been included in the initial cost.

Estimation of Economic Benefits and Economic Analysis

(1) Estimation of Economic Benefits

Broadly speaking, two categories of benefits are expected to arise in the with-project case. One is related to the appreciation of the values of the Tuy River basin. Another pertains to the reduction of water intake suspension and chemical treatment cost.

Regarding the first category, three kinds of benefits are expected to arise in the with project case, i.e., (1) appreciation of estate values, (2) enhancement of the value of the Tuy River basin as tourism resources and (3) appreciation of the "existence value" of the Tuy River basin.

(Unit: US$ thousand)

Item	Total Amount	Ratio Attributed to the Project	Amount Attributed to the Project
(1) Appreciation of Estate Values	55,596	1.01%	562
(2) Enhancement of the Tourism Value of the Tuy River Basin	369	1.01%	4
(3) Appreciation of "Existence Value" of Tuy River Basin	1,145	1.01%	12
Total	57,110		578

How the total amount for the three items in the above table is estimated is shown in Table 3.1.1. How the ratio to be attributed to the project is arrived at is presented in Table 3.1.3.

As the above table shows, the total economic benefits are calculated at US$57,110 thousand. This is the amount to be expected supposing the project is completed in 1997. Out of them, those to be attributed to the project totals US$578 thousand.

The benefits are estimated to grow at the average annual rate of 4.7% in parallel with the growth of population in the project area.

(Unit: US$ thousand)

Item	Financial Benefits	Conversion Factor	Economic Benefits
(1) Reduction of Water Intake Suspension	53	0.87	46
(2) Reduction of Chemical for Pre-treatment	7	0.96	7
Total	760		53

As the above table shows, the total economic benefits are calculated at US$53 thousand. They will be realized annually.

The benefits will start to be realized in 2004.

(2) Economic Analysis

In performing economic analysis, it is assumed that the project life is 30 years after the project is implemented and also that the opportunity cost of capital is 12%.

Using the cost benefit streams shown in Table 3.6.1, the following economic criteria are worked out:

NPV (US$ thousand)	B/C	EIRR
-1,009	0.50	5.2%

As the above table shows, EIRR is low. It shows that it is difficult to quantitatively fully assess the positive effects of reforestation.

For instance, such benefits as the conservation of water holding capacity of soil thereby preventing flooding of the Tuy River basin and the protection of the fertility of soil were not quantitatively analysed.

The arguments that the positive effects of reforestation are too far-reaching and complex to be easily grasped in a short term might be true.

3.6.2 Financial Analysis

Affordability analysis is performed to judge and determine if the responsible organizations will be capable of bearing the cost of the project.

Responsible Organizations

Responsible Organizations
MARNR, Aragua State and Miranda State

The above-shown government organizations are responsible for the preservation of the natural environment and the reduction of turbidity of the Tuy River in the upper and middle basins. Reforestation is one of the most far-reaching and effective means to that end. Therefore, it is considered to be appropriate that they bear the repayment cost of the project.

Financial Source, Lending Terms and Bearer of Cost

External Source	Government Budget	Lending Terms	Bearer of Cost
100%	-	(Section 3.1)	Responsible Organizations

All of the initial cost is assumed to be provided by an external source on the terms described in Section 3.1. Repayment cost will be borne by the responsible organizations.

Financial Capacity of Responsible Organizations

Item	MARNR	Miranda State	Aragua State	Total
Annual Budget (US$ thousand) in 1996	210,000	133,300	143,500	486,800

The combined financial capacity of the responsible organizations works out to US$486,800 thousand in 1996. This is estimated to grow at the average annual rate of 4%.

Table 3.6.2 shows the annual projection of the replacement and repayment cost and the percentage of the annual budget the responsible organizations should set aside to meet the cost for 20 years from 1998 to 2017 under the above-mentioned conditions.

It is revealed that over the 14 years from 2004 to 2017, the organizations will annually shoulder US$383 thousand.

Percentage of Annual Budget to be Allocated by the Organizations	Corresponding Budget Allocations in 1996
0.048%	US$234 thousand

In terms of the percentage of annual budget to be allocated by the organizations, they will annually pay 0.048% of their budget. This corresponds to US$234 thousand in 1996. This appears to be not a heavy load.

3.7 Establishment of Environmental Fund

The values and conditions used for financial analyses are shown under:

(1) Initial Cost	US$24,017 thousand
(2) O&M Cost	US$177 thousand
(3) Implementation Period	1998 to middle of 2000 (establishment) middle of 2000 to 2003 (application)
(4) Durable Life	Electro-Mechanical Equipment: 15 years Civil Engineering Structures and Other Facilities: 40 years

Two types of financial analyses are performed. One is affordability analysis and the other, projection of financial statements. Values and conditions used in both of them are shown below.

Beneficiaries

Beneficiaries
Factories and Piggeries

The beneficiaries or clients of the Environmental Fund are factories and piggeries.

Financial Source, Lending Terms and Bearer of Cost

External Source	Government Budget	Lending Terms	Bearer of Cost
100%	-	(Section 3.1)	Beneficiaries

All of the initial cost is assumed to be provided by an external source on the terms described in Section 3.1. The external resources will be relent to factories and piggeries on the terms shown in Section 3.3 of Sector G. O&M cost of the Environmental Fund and repayment cost will be borne by the beneficiaries.

Financial Capacity of Beneficiaries

Item	Total Number up to 2003	Annual Sales per Factory or Piggery (US$ thousand)	Aggregate Annual Sales (US$ thousand)
Factories	103	5,662	583,186
Piggeries	27	234	6,318
Total	130	-	589,504

The financial capacity of factories and piggeries works out to US$589,504 thousand per annum.

3.7.1 Affordability Analysis

This is an analysis to judge and determine if the beneficiaries are capable of bearing the cost of the Enviroinmental Fund.

Table 3.7.1 shows the annual projection of the O&M and repayment cost and the percentage of sales factories and piggeries should set aside to meet the cost for the 20 years from 2000 to 2019 under the above-mentioned conditions.

It is revealed that over the14 years from 2004 to 2017 factories and piggeries will annually shoulder US$3,079 thousand.

Annual Payment as Percentage of Sales	Corresponding Annual Payment per Factory and Piggery (US$)
0.55%	31,141 (Factory) 1,287 (Piggery)

In terms of the percentage of sales, each factory or piggery will annually pay 0.55% of its sales. It means US$31,141 for a factory and US1,287 for a piggery. The amount appears to be not unduly burdensome.

3.7.2 Projection of Financial Statements

Financial statements (income statement, funds statement and balance sheet) of the project were projected on condition that the Environmental Fund collect sufficient funds from factories and piggeries to make this undertaking financially feasible.

Table 3.7.2 shows the annual financial statements of the project for 20 years from 2000 to 2019.

Annual Payment as Percentage of Sales	Corresponding Annual Payment per Factory and Piggery (US$)
0.59%	33,406 (Factory) 1,381 (Piggery)

As the yearly average from 2004 to 2017, each factory or piggery will annually repay 0.59% of its sales. This corresponds to US$33,406 for a factory and US1,381 for a piggery on average.

Ratio of Working Capital to Total Assets	Ratio of Revenues to Total Assets
6.8%	7.7%

Also, the ratio of working capital to the total assets and the ratio of revenues to the total assets are 6.8% and 7.7%, respectively.

3.8 Institutional Measures (Exc. Environmental Fund)

The values and conditions used for financial analysis are shown below.

(1) Initial Cost	US$658 thousand
(2) O&M Cost	US$116 thousand
(3) Implementation Period	1998 to 1999 (establishment of systems)
(4) Durable Life	Electro-Mechanical Equipment: 15 years Civil Engineering Structures and Other Facilities: 40 years

Affordability analysis is performed to judge and determine if the responsible organization will be capable of bearing the cost of institutional measures. In this section, by institutional measures one means the establishment of the monitoring system and the establishment of the public education system.

Responsible Organization

Responsible Organization
MARNR

The MARNR will be the ministry responsible for the institutional measures.

Financial Source, Lending Terms and Bearer of Cost

External Source	Government Budget	Lending Terms	Bearer of Cost
100%	-	(Section 3.1)	Responsible Organization

All of the initial cost is assumed to be provided by an external source on the terms described in Section 3.1. O&M and repayment cost will be borne by the responsible organization.

Financial Capacity of Responsible Organization

Item	MARNR
Annual Budget (US$ thousand) in 1996	210,000

The annual budget of MARNR is estimated to grow at the average annual rate of 4%.

Table 3.8.1 shows the annual projection of the O&M, replacement and repayment cost and the percentage of the annual budget the responsible organization should set aside

to meet the cost for 20 years from 1998 to 2017 under the above-mentioned conditions.

It is revealed that over the 14 years from 2000 to 2013, the organization will annually shoulder US$219 thousand.

Percentage of Annual Budget to be Allocated by the Organization	Corresponding Budget Allocations in 1996
0.070%	US$147 thousand

In terms of the percentage of annual budget to be allocated by the organization, they will annually pay 0.070% of their budget. This corresponds to US$147 thousand in 1996. This appears to be not a heavy obligation.

3.9 Overall Evaluation

3.9.1 Economic Evaluation

Project	NPV (US$ thousand)	B/C	EIRR (%)
Installation of Treatment Plants in Factories	18,161	1.80	35.2
Construction of Sand Settling Pond for Intake	279	1.07	12.9
Construction of Sewage Treatment Plant in Ocumare del Tuy	1,863	1.09	13.2
Construction of Sewage Treatment Plant in Las Tejerías	-469	0.94	11.1
Reforestation in Priority Areas	-1,009	0.50	5.2
Total	18,825	1.32	17.6

The above table shows that the three projects, "installation of treatment plants in factories", "construction of sand settling pond for intake" and "construction of sewage treatment plant in Ocumare del Tuy" have EIRR's greater than the OCC, that is 12%, while the two projects, "construction of sewage treatment plant in Las Tejerías" and "reforestation in priority areas" have EIRR's below the OCC.

Especially it is to be noticed that "installation of treatmemt plants in factories" has an exceptionally high EIRR on one hand and "reforestation in priority area" has a low EIRR on the other.

Speaking of the five F/S projects as one, one finds that they have an NPV of US$18.8 million, B/C of 1.32 and EIRR of 17.6% or 5.6 points higher than the OCC.

Table 3.9.1 shows the cost benefit streams of the five projects combined.

Project	EIRR (%)		
	Pattern 1 (Standard) Projection	Pattern 2 (High) Projection	Pattern 3 (Low) Projection
Installation of Treatment Plants in Factories	35.2	29.5	42.7
Construction of Sand Settling Pond for Intake	12.9	12.9	12.9
Construction of Sewage Treatment Plant in Ocumare del Tuy	13.2	12.5	16.0
Construction of Sewage Treatment Plant in Las Tejerías	11.1	9.0	13.3
Reforestation in Priority Areas	5.2	5.2	5.2
Total	17.6	15.8	21.0

The above table shows the results of the sensivity analysis. The Pattern 2 projection is an alternative based on a high industrial and population growth, whereas the Pattern 3 projection is an alternative premised on a low industrial and population growth.

The above reveals that the F/S projects have an EIRR well beyond the OCC even under conceivably adverse circumstances and also that they have an EIRR exceeding 20% under favourable conditions.

It follows from the above that this short-term program will be an economically robust undertaking.

The two projects for the securement of water quantity, the Ocumare-Tuy III pumping plan and the Guare Dam plan were excluded from economic evaluation due to the study stage (pre-F/S) of those projects.

3.9.2 Financial Evaluation

The total initial cost for the six F/S projects comes to US$72 million. Its breakdown by project and by financial source is presented below.

(Unit: US$ thousand)

Project	External Source	Government Budget	Total
Construction of Sand Settling Pond for Intake	6,245	-	6,245
Construction of Sewage Treatment Plant in Ocumare del Tuy	9,367	17,396	26,763
Construction of Sewage Treatment Plant in Las Tejerías	2,274	9,094	11,368
Reforestation in Priority Areas	3,347	-	3,347
Environmental Fund	24,017	-	24,017
Institutional Measures (Exc. Environmental Fund)	658	-	658
Total	45,908	26,490	72,398

As the above table shows, foreign resources are US$46 million accounting for 63.0% of the total initial cost and local resources are US$26 million accounting for 37%.

It has been usually the case that the financial sources of externally assisted loan projects are 50% external and 50% domestic. As regards the F/S projects, however, affordability analysis shows that the cost-bearers (that is, beneficiaries and polluters) can afford to pay back up to 63% of the total initial cost. Therefore, it is recommended that the Venezuelan government and external financial agencies agree on the above-mentioned external versus domestic ratio.

It is recommended that the Venezuelan government starts discussion with external agencies such as the World Bank, IDB and OECF for financing the foreign components.

Project	Cost-Bearer	Payment in Percentage	Payment (US$)
Construction of Sand Settling Pond for Intake	Households in CMA	0.0145% of income	0.072/month /household
Construction of Sewage Treatment Plant in Ocumare del Tuy	Households and Factories/ Piggeries in Ocumare del Tuy	0.90% of income (H) 0.17% of sales (F/P)	4.56/month /household, 9,625/year/factory 398/year/piggery
Construction of Sewage Treatment Plant in Las Tejerías	Households and Factories/ Piggeries in Las Tejerias	0.90% of income (H) 0.22% of sales (F/P)	4.45/month /household 12,456/year/factory 515/year/piggery
Reforestation in Priority Areas	MARNR, Miranda State, Aragua State	0.048% of budget	234,000 /year
Environmental Fund	Factories, piggeries	0.59% of sales	33,406/year/factory 1,381/year/piggery
Institutional Measures (Exc. Environmental Fund)	MARNR	0.070% of budget	147,000/year

The above table summarizes the affordability of cost-bearers for the six projects.

The repayment, O&M and replacement cost for "construction of sand settling pond for intake" will be met from the incomes of CMA households. Both the ratio to income and the amount of the charge per household will be very small.

The cost of "construction of sewage treatment plant in Ocumare del Tuy" will be borne by the households and factories/piggeries of that town. Both the ratio to income and the amount of the charge per household appear to be reasonable. Also, both the ratio to sales and the amount of the charge per factory/piggery appear to be reasonable.

The cost of "construction of sewage treatment plant in Las Tejerías" will be borne by the households and factories/piggeries of that town. Both the ratio to income and the amount of the charge per household appear to be reasonable. Also, both the ratio to sales and the amount of the charge per factory/piggery appear to be reasonable.

MARNR, Miranda State and Aragua State will combinedly shoulder the cost for "reforestation in priority areas". The ratio of the payment to budget will be 0.048%, the annual payment coming to US$234 thousand. This seems to be not a heavy obligation.

Each factory and piggery will outlay 0.59% of their sales as repayments to the Environmental Fund. It means that each factory and piggery will annually pay US$33,406 and US$1,381, respectively. This is not a heavy burden.

MARNR will shoulder the cost for "institutional measures other than the Environmental Fund". The ratio of the payment to budget will be 0.070%, the annual payment coming to US$147 thousand. This seems to be not a heavy obligation.

As a conclusion it can be said that all the six projects under study as the short-term program will be financially feasible.