

Brazil

Todos Os Santos Bay Environmental Sanitation Project

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Field Survey: August and November 2006

1. Project Profile and Japan's ODA Loan



Map of project area



Pumping station equipped with environment-conscious treatment function

1.1 Background

In Salvador¹, capital city of the state of Bahia in northeastern Brazil, rapid urbanization and industrialization in the first half of the 1990s caused deterioration of the environment. In particular, untreated household and industrial sewage discharged into Todos Os Santos Bay in front of Salvador not only damaged the living environment in Salvador but also adversely affected the historic center, which is listed as a UNESCO World Heritage site, as well as precious tourism resources such as the beach visited by many sea bathers from inside and outside of Bahia state.

With this background situation, the state government of Bahia realized the urgent need to improve the sanitary environment of Todos Os Santos Bay, which is an enclosed sea area², by constructing sewerage facilities, strengthening environmental pollution monitoring, providing extensive education on sanitation and the environment, and establishing a water quality control model.

1.2 Objective

¹ The population of Salvador as of 2006 was 2.78 million (the population of the entire Bahia state is 14.33 million), larger than that of Osaka city, 2.63 million. Salvador is a tourist city with its old center registered on the list of World Cultural Heritage sites.

² A bay with a few passages to the ocean which, if seriously polluted, requires much time to recover.

The project objective was to construct sewerage systems³ in Salvador, capital city of Bahia state in northeastern Brazil, where rapid urbanization and industrialization caused the deterioration of the environment, for the purpose of improving the sanitation of the urban environment of Salvador and reducing harm to the oceanic environment, and thereby contributing to the improvement of the living environment and health of residents of the city.

1.3 Borrower/Executing Agency

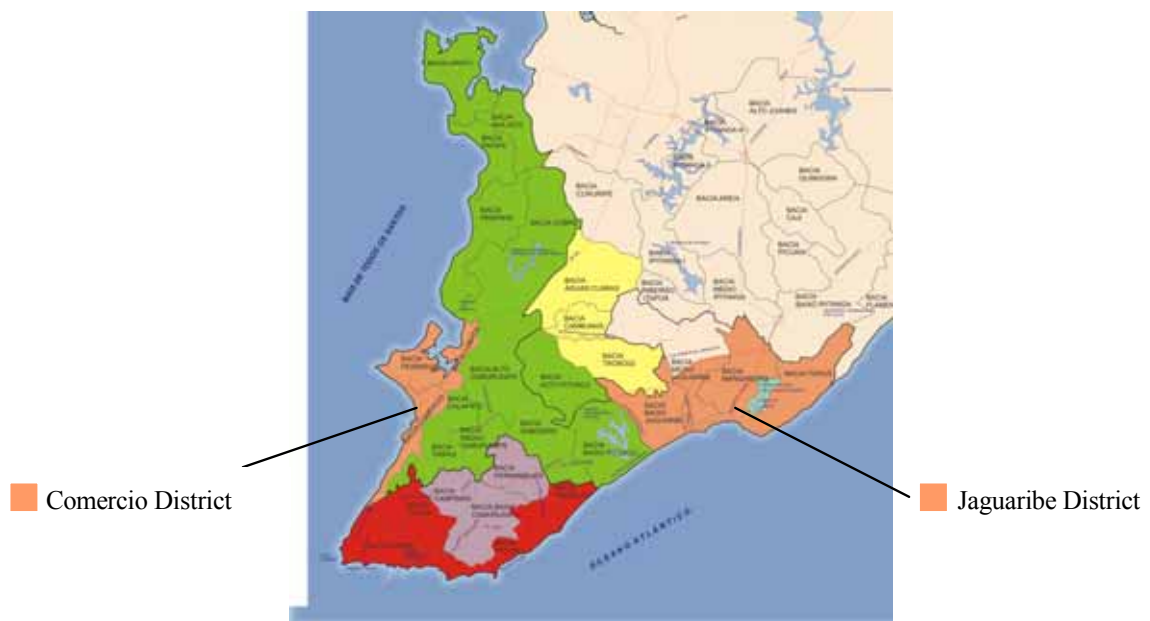
Borrower: the government of the state of Bahia, Brazil

Executing Agency: Secretaria de Recursos Hidricos, Saneamento e Habitacao (Srhsh) (at the time of appraisal)

Secretaria de Desenvolvimento Urbano (Sedur) (at the time of evaluation)

Empresa Baiana de Águas e Saneamento (Embasa) (the operation and maintenance unit of this project)

Figure 1: Two Districts Covered by the Project (Salvador)



Source: Sedur

³ This project was co-financed by JBIC and the Inter America Development Bank (IDB). JBIC's portion covered two districts where the living environment had substantially deteriorated as a result of rapid population increase.

1.4 Outline of Loan Agreement

Loan Amount / Loan Disbursed Amount	7,895 million yen / 7,751 million yen
Exchange of Notes / Loan Agreement	August 1996 / May 1997
Terms and Conditions	
-Interest Rate	4.0%
-Repayment Period (Grace Period)	25 years (7 years)
-Procurement	General untied
Final Disbursement Date	September 2003
Main Contractors	Queiroz Galvao / Passarelli construction consortium, Terrabrás construction (local company)
Consultant Services	Pacific Consultants International, Hidros, Geohidros Hidros (local company)
Feasibility Study (F/S), etc.	1995 Inter-America Development Bank (IDB)

2. Evaluation Result

2.1 Relevance

2.1.1 Relevance at the time of appraisal

Of the six priority investment items listed in the “Government 4-Year Plan” (1996–1999) of the state of Bahia, three items related to sewerage works: human resource development for the improvement of standards of living; environmental conservation for the consideration for water resources preservation, etc.; and organizational development for efficient public services.

Based on this plan, the state government of Bahia mapped out three projects: the Bahia Azul Program, the Provincial City Basic Sanitation Plan, and the Solid Wastes Collection Program. The Bahia Azul Program is a comprehensive sanitation sector improvement program designed to enhance the sewerage coverage rate, improve the water quality of rivers in the city and the coastal water, and protect the environment by installing water supply and sewerage systems, treating wastes, and strengthening related organizations in the Salvador Metropolitan Area, reflecting the commitment of the state government (in addition to JBIC, World Bank and Inter-America Development Bank also extended loans).

As of 1994, sewerage systems in Bahia state covered only 26% of the total population. This low coverage rate resulted in serious water pollution, particularly in Todos Os Santos Bay into which untreated household and industrial sewage was discharged. A comprehensive environmental improvement plan was urgently needed.

This project was to improve environmental sanitation in the Salvador Metropolitan Area by constructing sewerage facilities in the city and therefore was highly important.

2.1.2 Relevance at the time of evaluation

After the completion of the Bahia Azul Program in which intensive construction of sewerage systems was carried out in the Salvador Metropolitan Area, the state government, mainly Sedur, and the Empresa Baiana de Águas e Saneamento (Embasa) under Sedur have been making continuous efforts to improve sewerage services. At the same time, the state government drew up and is implementing an environmental sanitation project focused on the construction of sewerage systems in slum areas where many poor people live.

As a result of the increase in the sewerage coverage rate in all of Salvador, which rose from 26% in 1994 to 69% in 2006, improvement of the environment has been observed particularly in Todos Os Santos Bay. In order to promote further improvement of environmental sanitation, the state government of Bahia organized education activities such as the environmental sanitation education program for primary school students in addition to expanding sewerage facilities, thus implementing continuous and comprehensive measures to support the sewerage project.

Therefore, this project, which aims to improve environmental sanitation in the Salvador Metropolitan Area by constructing sewerage systems, remains highly important.

2.2 Efficiency

2.2.1 Outputs

Comparing the planned and actual output, the actual output generally increased from the output planned at the time of appraisal, as shown in the table below. Each output item increased because the project plan was revised for the following reasons:

- There was a change in the urban housing environment from the time of planning due to the disorderly migration of the population from rural to urban areas at a rate higher than estimated.
- The planned method for excavating roads and installing underground pipes were not permitted by the Salvador municipal government which has jurisdiction over the roads in the city and those methods had to be changed.
- As a result of the above change in the project plan, it became necessary to draw up a piping plan to avoid rough terrain and hard or soft soil.
- The urban development plan by the state government of Bahia was changed during the implementation of the project and as a result the piping plan was changed.

Table 1: Comparison Planned and Actual Output

Output	Plan	Actual
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1) Construction of trunk pipes and drains (water pipes with diameter of 400 mm or more)	32 km	46.4 km (14.4 km increase)
2) Construction of pumping stations	21 units	44 units (23 sites increase)
3) Construction of standard type branch pipes and drains (conduit pipes with diameter of less than 400 mm)	323 km	368.5 km (45.5 km increase)
4) Construction of standard type household connection pipes (water supply pipes)	39,600 units	42,000 units (2,400 increase)
5) Construction of condominium type branch pipes and drains (conduit pipes)	87 km	378.5 km (291.5 km increase)
6) Construction of condominium type household connection pipes (pipe diameter: 100 mm)	38 km	55.4 km (17.4 km increase)

Note: The condominium type household connection pipe line is an inexpensive way of constructing sewerage which is unique to Brazil. The pipe installation cost is one-third to one-fourth of the cost of the standard method.

Source: Sedur/Embasa



Figure 2: Water supply network in the residential area along the coast



Figure 3: Pumping station

2.2.2 Project period

The project period was from May 1997 to December 2003 (80 months), 36 months longer than the planned period from May 1997 to January 2001 (44 months).

The main causes of delay were as follows:

- There was a delay in the procedure to select consultants and contractors, which lead to the delay in the start of construction work.
- Due to the change in the output as described above, the project plan and the detailed design had to be reviewed and changed and, as a result, the construction period was increased.
- The conditions of construction work deteriorated (loosened ground, etc.) due to the abnormal weather that caused several great floods.

Table 2: Comparison of Planned and Actual Project Period

	Plan	Actual	Against the plan
Selection of consultants	May 1997 – December 1997 (7 months)	May 1997 – September 1998 (16 months)	9 months increase
Consultant services	January 1998 – January 2001 (36 months)	September 1998 – October 2003 (61 months)	25 months increase
Selection of contractors (selected in the order of blocks)	June 1997 – June 1999 (24 months)	May 1997 – February 2000 (33 months)	9 months increase
Construction work (Comercio District)	November 1997 – June 2000 (31 months)	December 1997 – July 2002 (55 months)	24 months increase
Construction work (Jaguaribe District)	May 1998 – January 2001 (32 months)	June 1998 – December 2003 (66 months)	34 months increase
Total project period	May 1997 – January 2001 (44 months)	May 1997 – December 2003 (80 months)	36 months increase

Source: Sedur/Embasa

2.2.3 Project cost

The project cost for the two districts covered by the JBIC portion (Comercio and Jaguaribe Districts), which was estimated at 8,879 million yen (ODA loan 7,895 million yen) at planning time, totaled 8,417 million yen (ODA loan 7,751 million yen). The total project cost was within the planned amount in spite of the increase in the outputs due to the following reasons:

- The project cost decreased from planning time due to the exchange depreciation.
- The reserve fund was unnecessary and appropriated to other expenses.
- In dense residential areas, an inexpensive method of sewerage installation unique to Brazil (condominium method) was adopted, which cost one-third to one-fourth the cost of the initially planned method. As a result, the amount saved was appropriated to other expenses.

Table 3: Comparison of Planned and Actual Project Cost

	Plan	Actual Cost	Against the plan
Total Project Cost	8,879 million yen	8,417 million yen	462 million yen decrease
1) Sewerage construction	3,093 million yen	3,754 million yen	661 million yen

in Comercio District			increase
2) Sewerage construction in Jaguaribe District	3,648 million yen	3,821 million yen	173 million yen increase
3) Consultant services	904 million yen	842 million yen	62 million yen decrease
4) Price escalation	135 million yen	135 million yen	0
5) Reserve fund	1,099 million yen	1,099 million yen	0

Source: Sedur/Embasa

The project cost of “Todos Os Santos Bay Environmental Sanitation Project”⁴ co-financed by IDB and JBIC accounted for approximately 73% of the total project of the Bahia Azul Program and the amount loaned by JBIC accounted for approximately 18% of the total cost.

Table 4: Project Cost of Bahia Azul Program (for information)

Project	Actual Cost
Total Project Cost	600 million US dollars
1) Todos Os Santos Bay Environmental Sanitation Project	440 million US dollars
2) Water Resources Modernization Project	140 million US dollars
3) Metropolitan Project	20 million US dollars

Source: Sedur/Embasa

⁴ As shown in Table 4, this ODA loan project is part of the “Todos Os Santos Bay Environmental Sanitation Project” of the Bahia Azul Program. The “Water Resources Modernization Project” is a water supply project and the “Metropolitan Project” is an environmental project in the capital area.

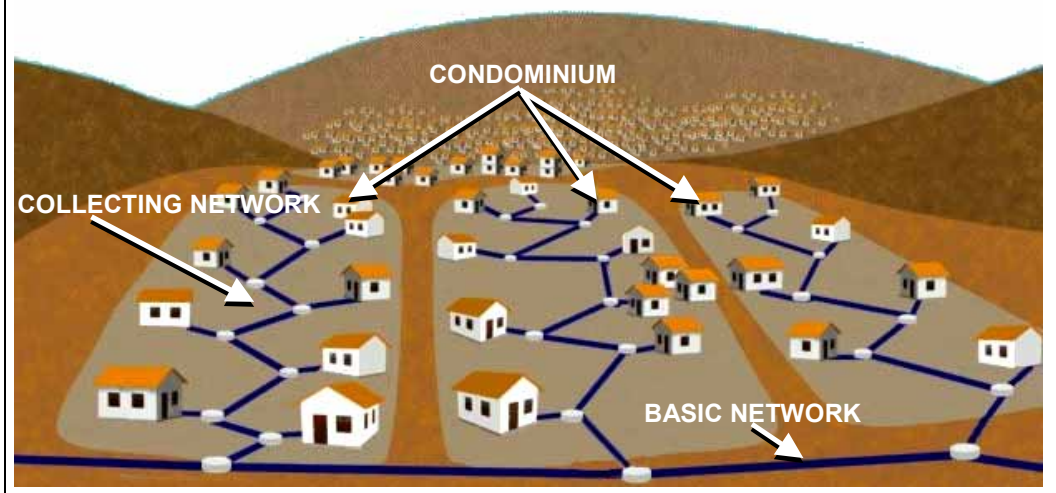
Condominium Method (for information)

The Condominium Method adopted for part of this project is a new method of installing branch pipes and drains (conduit pipes) developed at the end of the 1990s in Brazil. Since it is lower in cost than the conventional method and convenient for laying pipes in dense residential areas, Bahia state began to introduce this method at the beginning of 2000 mainly in low income areas.

This method is to lay pipes connected to the basic network via each house to form piping network units in the poor, disorderly areas. (In the existing method, pipes from each house are directly connected to the basic network). For each unit, a resident's organization is formed to take part in the operation and maintenance work together with the operation and maintenance service company (Embasa in the case of this project), thereby achieving low cost (in the existing method, residents are not involved in the operation and maintenance work).

The Condominium Method with above-described features is expected to be used in dense residential areas in Brazilian cities where population influx is rapidly increasing, particularly the areas where many poor people live.

Figure 4: Condominium Method



2.3 Effectiveness

2.3.1 Sewage treatment population

In the two districts covered by JBIC financing, where public sewage treatment services were not provided before the start of this project, 226,000 people received sewage treatment services in 2006 as shown in Table 5 below⁵. They account for 38% of the total population of these two districts. In Salvador, as a result of the Bahia Azul Program as a whole, the population receiving sewage treatment services increased from 28% in 1997 when this project started to 68% in 2006.

Judging from this data, this project is evaluated as having contributed to the

⁵ The number of direct beneficiaries of this project is estimated at about 340,000 (assuming that the facility utilization is 100%) and that of indirect beneficiaries is estimated at about 5.3 million (the total population of Salvador, 2.8 million, plus annual total number of tourists, 2.5 million).

improvement of the sanitary environment of Salvador by helping increase sewage treatment capacity. At present, the rate of sewage treatment population of the two districts covered by the JBIC portion is lower than that of Salvador. According to Sedur, these two districts are densely populated low income areas where population influx occurred particularly rapidly in Salvador. These two districts are considered to be in need of construction of sewage systems in the future.

Table 5: Sewage Treatment Population

	1997	2003	2006
Sewage treatment population (Salvador)	614,868	1,108,173	1,890,322
Total population of Salvador	2,211,539	2,651,627	2,789,140
(Sewage treatment population rate in Salvador)	(28%)	(42%)	(68%)
Sewage treatment population (two districts covered by the JBIC portion)	–	–	226,083
Total population of the two districts covered by the JBIC portion	441,764	544,245	598,187
(Sewage treatment population rate in the two districts covered by the JBIC portion)	–	–	(38%)

Source: Sedur/Embasa

2.3.2 Facility utilization

With the increase in the sewerage coverage rate as a result of the Bahia Azul Program⁶, the facility utilization rate of pumping stations in Salvador increased substantially from 16% in 1997 when the project started to 53% in 2003 and 86% in 2006.

In the two districts covered by the JBIC portion, there was no sewage treatment pumping station before this project was implemented. In this project, pumping stations were constructed and their facility utilization rate was 66% as of 2006. The facility utilization rate of pumping stations is expected to increase as the sewerage coverage rate in these two district increases.

Table 6: Facility Utilization Rate of Sewage Treatment Pumping Stations and Amount of Sewage Treated

	1997	2003	2006
Facility utilization rate of pumping stations (Salvador: %)	16	53	86
Amount of sewage treated (Salvador: m ³ /day)	–	382,675	402,499
Facility utilization rate of pumping stations (two	–	–	66

⁶ See 2.3.3.below.

districts covered by the JBIC portion: %)			
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Note: There is only one sewage treatment plant in Salvador and the amount of treated sewage from the districts covered by the JBIC portion is not known.

Source: Sedur/Embasa

2.3.3 Sewerage coverage rate

As an effect of the Bahia Azul Program including construction of sewerage systems under this project, the sewerage coverage rate in Salvador increased from 26% in 1997 before the project to 69% in 2006. According to Sedur, a contractor agreement for the works to achieve a sewerage coverage rate of 80%, the target of this project, has already been signed, and the construction work is to begin at any time. The sewerage coverage rate in Bahia state also increased from 28% in 1997 to 47% in 2006. Compared with the only slight increase in the sewerage coverage rate in Brazil from 54% in 1992 to 66% in 2004, the increase rate of sewerage coverage rate in Bahia state is remarkable.

As a result of this increase in the sewerage coverage rate, as evidenced by 2.3.4 and 2.4 below, the sanitation conditions of the urban environment in Salvador have been improved as was stated in the objective of the project, showing that the project contributed to the improvement of living environment and health of urban residents.

However, looking at the sewerage situation in Bahia state as a whole, in contrast to the increased sewerage coverage rate in urban areas, the sewerage coverage rate in rural areas remained as low as 9% (2004). Sedur expressed its opinion that its future task should be the construction and expansion of sewerage systems in rural areas.

2.3.4 Reduction of burden on marine environment

As a result of the comprehensive environmental measures taken under the Bahia Azul Program including this project, the burden on the environment has been reduced. As shown in the table below, the values of BOD (biochemical oxygen demand)⁷ and COD (chemical oxygen demand)⁸ decreased substantially, indicating that the burden on the marine environment has been reduced. Prior to the implementation of the project, all 333 drain outlets which discharged sewage into the Todos Os Santos Bay and the Atlantic Ocean were filled in and a substantial reduction of burden by sewage on sea water has been confirmed.

Table 7: Environmental Pollution in Todos Os Santos Bay

	1997	2003	2006
BOD (kg/day)	107,100	80,935	18,635

⁷ The amount of oxygen consumed when organic matter is decomposed by microorganisms in water.

⁸ The amount of oxygen consumed when oxidizable substances in water are oxidized.

COD (kg/day)	39,224	27,743	7,912
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Source: Sedur/Embasa



Figure 5: Sewage outlets that used to discharge sewage to the bathing beach before the project



Figure 6: The bay coast free from discharge of household sewage

2.3.5 Economic internal rate of return (EIRR)

Because of the limited data available, EIRR for the portion of this project was not able to be recalculated. EIRR for the whole “Todos Os Santos Bay Environmental Sanitation Project” co-financed by Inter-America Development Bank (IDB) and JBIC was recalculated to be 12.24%. Considering that EIRR for the two districts covered by the JBIC portion calculated at the time of appraisal was 16.12% (Comercio District) and 14.85% (Jaguaribe District), actual EIRR for the ODA loan portion is presumed to have slightly decreased from the appraisal time.

2.4 Impact

For the evaluation of this project, a beneficiary survey was conducted of 189 beneficiaries in the two districts covered by the JBIC portion⁹. According to the results of the beneficiary survey, about 70% of the beneficiaries were very satisfied or satisfied with the project. Generally, the project gained positive response and is highly evaluated.

Table 8: Beneficiary Satisfaction with the Project

Very satisfied	Satisfied	Somewhat satisfied	Dissatisfied	No change
21%	48%	23%	7%	1%

Source: Beneficiary Survey (189 people)

⁹ The survey was conducted in the form of an interview with beneficiaries based on a questionnaire.



Figure 7: Beneficiary survey in the district where sewerage system was constructed

2.4.1 Top 5 impact items

The impact of this project was highly evaluated at the household level, mainly in the field of health and sanitation. As sewerage was installed inside of the house, residents could do housework such as the dish washing and laundry, formerly done outdoors, in their houses, which lead to the reduction of the burden of housework. These facts show that the project brought about improvements in the living environment in various aspects at the household level.

Also at the community level¹⁰, the project’s effects in the field of health and sanitation were highly evaluated along with the environmental clean-up effect of sewage treatment in public places such as roads, parks and coast where household effluents were once discharged untreated. Thus, the project has wide-ranging impacts on the improvement of the community environment.

Table 9: Beneficiary Satisfaction with the Project

Household Level	Improvement of health and nutrition	Improvement of sanitary environment	Removal of foul smell	Extermination of insect pests	Reduction of housework burden
	50%	43%	32%	29%	22%
Community Level	Cleaned-up roads and parks	Removal of foul smell	Conservation of ocean	Extermination of insect pests	Improvement of health and nutrition
	58%	55%	50%	49%	40%

Note: multiple answers

Source: Beneficiary Survey (189 people)

2.4.2 Improvement of the living environment

¹⁰ The “community level” in this report means the local community as the daily living area of the beneficiaries.

2.4.2.1 Improvement of the household environment

Since in-house sewerage was installed, the number of households installing toilet, shower facilities, kitchen and washing place in their houses has been increasing particularly in the low income group. Housework such as dish washing, laundry and bathing was once done at the outside community well and excrement would be left at the roadside or on empty land so as not to discharge foul water in their houses. The living drainage discharged untreated in the community damaged the living environment of the community.

The results of the beneficiary survey in which cleaned-up roads and parks were considered the most evident impact of the project at the community level as shown in 2.4.1 above indicate that the improvement of the household environment in the target area, especially in the poor area, brought about by the project led to the improvement of the living environment of the community.

Table 10: Installation of In-house Facilities

Project	All Beneficiaries		Medio Jaguaribe District	
	Before Project	After Project	Before Project	After Project
In-house toilet installation rate	80%	91%	59%	90%
Shower facilities installation rate	87%	98%	68%	95%
In-house kitchen installation ratio	80%	96%	39%	90%
In-house laundry place installation ratio	61%	78%	20%	51%

Note: Medio Jaguaribe District is the poorest among the districts where the beneficiary survey was conducted and 96% of the surveyed represented poor households according to the social classification by ABEP.

Source: Beneficiary Survey (189 people), Brazilian Association for Population Studies (ABEP)

2.4.2.2 Improvement of the sanitary environment

It cannot be said that infant morbidity decreased only due to the improvement of the sanitary environment brought about by this project. Still, from the results of the beneficiary survey in which the improvement of health and nutrition comes first of the list of the positive impacts of the project at the household level as shown in 2.4.2.1 above, promotion of the Bahia Azul Program including this project is thought to have contributed to the improvement of child health in Salvador.

Table 11: Child Morbidity

	1999	2003
Decrease in infant mortality rate (per 1,000)	30.6	24.5
Decrease in incidence rate of watery diarrhea in children under 5 years (per 10,000)	2,132	1,198

Source: Bahia State Government

2.4.2.3 Enhancement of residents' consciousness

In the Bahia Azul Program including this project, an environmental education program for primary schools was provided, environmental education pamphlets and educational material concerning environmental conservation were prepared and distributed, and environmental advertisements were presented via mass media such as TV and radio. These activities to raise residents' environmental consciousness are now continued mainly by Sedur and Embasa. As a result of these continued activities to raise environmental consciousness, under the beneficiary survey item "Beneficiary Satisfaction with the Project" presented in Table 9 above, 16% of the beneficiaries said that "awareness of environmental issues" had enhanced and 19% said that "awareness of the treatment of waste and sewage" had enhanced. These results indicate that residents' environmental consciousness had begun to emerge.

Also, as evidenced by the results of the beneficiary survey in which cleaned-up roads and parks were considered the most tangible of impacts of the project at the community level as shown in 2.4.1 above, the sewage discharge to public places such as roads and empty land has been reduced after the completion of the project and the community is getting cleaner. These cleaner public places would lead to the securing of safe playing areas for children in the community and places of recreation and relaxation for neighbors. In the poor areas with densely built-up houses, the resident organizations which were formed within the communities when sewerage system was constructed engage in operation and maintenance of sewerage. Thus, as emphasized by the leader of the resident organization, the whole community grew more conscious of the need to maintain the clean environment of public places.

2.4.2.4 Creation of employment opportunities

The Bahia Azul Program including this project had an impact on the creation of employment opportunities as follows:

- Creation of temporary job opportunities in sewerage construction work
- Creation of job opportunities through the increase of sewerage operation and maintenance work

- Creation of employment opportunities due to the increase of tourists

The contribution to tourism was particularly emphasized in the interview to the state government of Bahia. As a result of the comprehensive environmental measures implemented under the Bahia Azul Program including this project, the number of bathing beaches that meet the environmental standards for the beach suitable for swimming among 23 beaches increased from 7 before the project started to 21 in 2006. This increase in the number of bathing beaches led to the increase of kiosks and restaurants that created job opportunities as well as the increase in sales of marine products by local fishermen to tourists, though no quantitative data is available. Thus, the project seems to be helping to revitalize the tourism industry.

Table 12: Number of Tourists to Salvador

	1997	2006
Domestic tourists	1,579,000	2,026,000
Foreign tourists	166,000	494,000

Source: Secretaria da Cultura e Turismo da Bahia (SCT)



Figure 8: Kiosk constructed on a bathing beach with the support from the administration



Figure 9: Toilet and wet area facilities installed after the construction of the sewerage system

2.4.3 Environmental impact

No adverse impact on the environment has been identified in the project target area.

2.4.4 Land acquisition/resident relocation

In the project target area, land acquisition and resident relocation were carried out smoothly without any adverse impact pointed out. Those of the Bahia Azul Program, as a whole, were also carried out without problem under the supervision of Inter-America Development Bank (IDB).

2.5 Sustainability

2.5.1 Executing agency

2.5.1.1 Technical capacity

Empresa Baiana de Águas e Saneamento (Embasa) has no problem with its technical organizational structure and technical capacity in performing the operation and maintenance of the project. In order to accommodate new technology, it is active in sending employees to outside institutions such as universities and material and equipment manufacturers to receive training.

The technical level of each private contractor that actually performs the operation and maintenance works is checked when entering into a contract. In addition, Embasa provides complementary technical training to private contractors using the training manual it developed to maintain the required technical level.



Figure 10: Construction of branch pipe and drain



Figure 11: Pumping station and operation/maintenance workers

2.5.1.2 Operation and maintenance system

Embasa is under the supervision of the Secretaria de Desenvolvimento Urbano (Sedur), which is the department of the state government in charge, and is fully financed by the state government.

The total number of employees is about 7,830. Among them, 25 operation and maintenance staff and 89 outside contract employees are working within the sewerage system division. The pumping station division has 9 operation and maintenance staff and 16 outside contract employees.

The day-to-day operation and maintenance works are contracted out to private contractors.

2.5.1.3 Financial status

The operating revenue and operating profit of Embasa have been steadily increasing since 2000. For FY2005, the operating revenue was 734 million reals and the operating

profit was 183 million reais. The net profit, which had been negative up to 2002 before the completion of project, turned positive after the completion of the Bahia Azul Program including this project due to the increase in the revenue from sewerage charges resulting from the increase in the sewerage coverage rate. For FY2005, a net profit of 77 million reais was posted.

Table 13: Financial Status of Embasa (million reais)

	2000	2001	2002	2003	2004	2005
Operating revenue	361	405	443	539	628	734
Operating expenses	379	346	347	421	484	551
Operating profit	-18	59	96	118	144	183
Net profit	-156	-128	-399	154	27	77

Source: Embasa

The revenue from sewerage service charges has been increasing year by year with the increase in the sewerage coverage rate. Especially from 2003 to 2005 after the completion of the Bahia Azul Program including this project, the revenue from sewerage charges increased sharply with the sharp increase in the sewerage coverage rate and these revenues were used for operation and maintenance expenses. Sewerage charges are collected together with water charges and the collection rate was maintained at around a 90% monthly average during 2005¹¹. According to Embasa, if a user fails to pay service charges for three months or more, water supply will be suspended. Therefore, although approximately 18% of residents are one to three months overdue with payment of service charges, there is almost no household that fails to pay service charges for more than three months.

Table 14: Revenue from Sewerage Charges (thousand reais)

	1998	2000	2003	2005
Revenue from sewerage charges	31,549	35,362	57,231	93,529

Source: Embasa

Based on the above facts, the financial status of Embasa is considered good and there is no problem with the sustainability of the effects of this project.

2.5.2 Operation and maintenance status

Embasa established a computerized operation and maintenance information system whereby it comprehensively manages operation and maintenance activity in the service

¹¹ Sewerage service charges are determined according to the amount used and the purpose of use. The minimum charge is 9.1 reais/month (approx. 500 yen) for general households and 5.2 reais/month (approx.

area. For example, if any trouble, such as an accident, happens at a sewage pumping station, the system automatically notifies the head office of Embasa.

The day-to-day operation and maintenance works are carried out by private contractors under the supervision of Embasa. The private contractors submit periodic reports to Embasa and the quality of their operation and maintenance works are maintained at a satisfactory level.

In the poor areas with densely built-up houses, the condominium method unique to Brazil is being tried in which resident organizations are formed in each district to engage in the operation and maintenance of the sewerage system, whereby residents themselves perform day-to-day operation and maintenance. Under this operation and maintenance system, the leader of the resident organization who has received education and training on the sewerage system and environmental sanitation from Embasa plays a central role in performing day-to-day operation and maintenance. In the event of trouble, the leader will notify Embasa.

While such an operation and maintenance system as described above has been established, the amount allocated to the operation and maintenance expenses has also increased in line with the sewerage coverage rate to perform proper operation and maintenance.

Table 15: Operation and Maintenance Expenses

	1998	2000	2003	2005
Total expenses (real)	9,129,916	10,743,077	26,216,595	35,455,544

Source: Embasa

Sedur won the “2006 UN Public Service Award” and Embasa won the “National Award for Sanitation Improvement”, showing that their operation and maintenance including the maintenance of facilities are appreciated both at home and abroad.



Figure 12: Model houses of the



Figure 13: Electrical system repair

300 yen) for poor households.

3. Feedback

3.1 Lessons Learned

In this project, the initial plan for the sewerage piping system was changed to adopt the condominium method for poor people developed in the other regions of Brazil after the start of the project. This method has the following characteristics: 1) the construction cost is 30% lower than the conventional system; 2) it is easy to apply in densely built-up areas where laying pipes is difficult with the conventional method, especially poor areas densely populated with small houses; and 3) unlike the conventional system that relies on the operation and maintenance company, it is operated and maintained by resident organizations.

The introduction of this method generated positive effects for the executing agency such as reduction in the project cost and in day-to-day operation and maintenance works. The effects on the resident side include the reduction of the financial burden of the initial investment, acquisition of knowledge on operation and maintenance through resident participation, and enhancement of awareness of environmental sanitation.

As a result, more sewerage systems were expanded and installed than planned and sewerage installation in poor areas, which is considered extremely difficult, was made possible.

As shown in this project, it is important to consider the objective and budget of the project, the operation and maintenance system at the executing agency, and the "introduction of a system suited to the local society (like the condominium method)" at the project planning phase without adhering to the conventional system.

3.2 Recommendations

N.A.

Comparison of Original and Actual Scope

Item	Plan	Actual
1. Outputs		
1) Construction of trunk pipes and drains (water pipes with diameter of 400 mm or more)	32km	46.4km
2) Construction of pumping stations	21 units	44 units
3) Construction of standard type branch pipes and drains (conduit pipes with diameter of less than 400 mm)	323km	368.5km
4) Construction of standard type household connection pipes (water supply pipes)	39,600 units	42,000 units
5) Construction of condominium type branch pipes and drains (conduit pipes)	87km	378.5km
6) Construction of condominium type household connection pipes (pipe diameter: 100 mm)	38km	55.4km
2. Project Period		
Selection of consultants	May 1997–Dec. 1997 (7 months)	May 1997–Sep. 1998 (16 months)
Consultant services	Jan. 1998–Jan. 2001 (36 months)	Sep. 1998–Oct. 2003 (61 months)
Selection of contractors (selected in order of blocks)	Jun. 1997–Jun. 1999 (24 months)	May 1997–Feb. 2000 (33 months)
Construction work (Comercio District)	Nov. 1997–Jun. 2000 (31 months)	Dec. 1997–Jul. 2002 (55 months)
Construction work (Jaguaribe District)	May 1998–Jan. 2001 (32 months)	Jun. 1998–Dec. 2003 (66 months)
Total	May 1997–Jan. 2001 (44 months)	May 1997–Dec. 2003 (80 months)
3. Project Cost		
Foreign currency	7,895 million yen	7,751 million yen
Local currency	984 million yen (8.75 million reals)	666 million yen (17.3 million reals)
Total	8,879 million yen	8,417 million yen
ODA loan portion	7,895 million yen	7,751 million yen
Exchange rate	1 real = 112.4 yen (as of 1997)	1 real = 38.4 yen (as of 2003)