

Federative Republic of Brazil

Ex-post Evaluation of Japanese Technical Cooperation Project
The Project for Capacity Development on Non-Revenue Water Control

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0. Summary

The project was conducted with the aim of developing human resources and creating the systems needed to reduce non-revenue water at the Sanitation Company of the State of Sao Paulo (hereinafter “SABESP”), in order to achieve the stable supply of water in the State of Sao Paulo.

Non-revenue water control has been one of the highest priority issues in the state which has a large population and scarce water resources. The project is also in line with the Brazilian development plan which aims at the effective utilization of water resources. Therefore, the project’s relevance is high. There were some problems regarding the project implementation systems such as the insufficient number of local coordinators deployed. Nonetheless, technology transfer through on-the-job training (hereinafter “OJT”) promoted communication between engineers and administrators, and led to non-revenue water control at the pilot areas. However, there were only limited activities to disseminate the output obtained at the pilot areas to the rest of SABESP’s service area, and this negatively affected the Project Purpose achievement level. On the other hand, SABESP strengthened its non-revenue water control based on the output obtained at the pilot areas. As a result, the Overall Goal is expected to be achieved. Therefore, the effectiveness/impact of the project is fair. Although the project period and the elements of inputs were mostly within the plan, the project cost slightly exceeded the plan. Therefore, the efficiency of the project is fair. SABESP is the largest business entity in Latin America with the fully equipped business implementation system and a high level of technology. It has good financial standing and is expected to allocate a budget for non-revenue water control into the future. Therefore, the sustainability of the project effects is high.

In light of the above, this project is evaluated to be satisfactory.

1. Project Description



Project Locations



Pipe locating activity at a pilot area

1.1 Background

The State of Sao Paulo has the largest urban area in South America. It has a population of 40 million, which accounts for 21.5% of the total population of Brazil (2005). However, it has only 1.6% of the total water resources in Brazil (1999), and the efficient utilization and conservation of limited water resources is the highest priority issue. SABESP, which is the implementing agency of the project, is one of the largest public water supply and sewerage companies in the world. It supplies drinking water to 368 municipalities in the state¹. Since it created the leakage control program for the State of Sao Paulo in 1981, it has been working on the streamlining of water supply system operations, particularly the minimization of leakages from water supply networks. Since 2000², the Japan International Cooperation Agency (hereinafter “JICA”) has been dispatching Short-Term Experts to SABESP and giving advice on the formulation and implementation of the non-revenue water reduction plans. As a result, it was confirmed that company-wide measures are needed in order for SABESP to strengthen non-revenue water control including leakage control measures and to achieve a reduction in the Non-Revenue Water Rate. In response, in July 2005, the Brazilian government requested technical cooperation from the Japanese government (which has a high level of non-revenue water control technology) with the aim of improving SABESP’s non-revenue water control abilities. After the dispatch of the preliminary study mission in October 2006, the three-year Project for Capacity Development on Non-Revenue Water Control was launched in July 2007³.

1.2 Project Outline

| | | |
|-------------------|----------|--|
| Overall Goal | | Water supply will be stabilized by reduction of Non-Revenue Water (NRW) in service areas of SABESP. |
| Project Objective | | The capacity of SABESP’s staff to control NRW is strengthened. |
| Outputs | Output 1 | The SABESP staff who are involved in the Project understand the significance of NRW control, and the system for the human resources development is strengthened. |
| | Output 2 | Fundamental measures for NRW control ⁴ are strengthened through practice in the pilot areas. |
| | Output 3 | Corrective measures for NRW control ⁵ are strengthened through practice in the pilot areas. |
| | Output 4 | Preventive measures for NRW control ⁶ are strengthened through practice in the pilot areas. |

¹ This accounts for about 15% of the population supplied with water in Brazil.

² 2000, 2001 and 2003.

³ The Record of Discussion (R/D) was signed in March 2007.

⁴ They refer to advance preparations for non-revenue water control, including the identification of the components of non-revenue water in the water supply service area and formulating control measures.

⁵ They refer to measures to tackle currently occurring problems which cause the occurrence of non-revenue water, e.g., the identification of leaking spots and measures to stop leakages from identified spots.

⁶ They refer to measures to prevent the occurrence of non-revenue water, such as leakages from old water mains and service pipes, leakages caused by unnecessarily high water pressure during the night, and leakages caused by inappropriate construction work.

| | |
|-------------------------------|---|
| Inputs | <p>Japanese Side:</p> <ol style="list-style-type: none"> 1. 10 Experts One for Long-Term, nine for Short-Term 2. 50 counterpart trainees received in Japan 3. Zero trainees for third-country training programs (total) 4. Equipment: 35.4 million yen 5. Cost of the operation in Brazil: 24.4 million yen <p>Brazilian Side:</p> <ol style="list-style-type: none"> 1. Deployment of counterparts 2. Purchase of office equipment 3. Transport costs, per diems and accommodation costs 4. Land and facilities, project office, utilities 5. Budget allocation for NRW control works in the pilot areas, counterpart salary, seminars |
| Total cost | 362 million yen |
| Period of Cooperation | July 19, 2007 - July 18, 2010 |
| Implementing Agency | Sanitation Company of the State of Sao Paulo (SABESP) |
| Cooperation Agencies in Japan | The Ministry of Health, Labour and Welfare, the Saitama City Waterworks Bureau, and the Kawasaki City Waterworks Bureau |
| Related Projects | <ul style="list-style-type: none"> • Non Revenue Water Control Project in Sao Paulo State (Loan) (Loan Agreement (L/A): 2012) • Sanitation Improvement Project for Baixada Santista Metropolitan Region (Loan) (L/A: 2004) • Water Sector Project in the State of Sao Paulo (World Bank) (1989-1993) • Guarapiranga River Basin Environmental Sanitation Project (World Bank) (1993–2000) • Project of the Tietê River Decontamination (Inter-America Development Bank) (1992–2008) • Water Sector Project in the State of Sao Paulo (Inter-America Development Bank) (1996 onwards) |

[The Non-Revenue Water Volume (Rate)]

As shown in Figure 1 below, the International Water Association (hereinafter the “IWA”) defines the Non-Revenue Water Rate as: the percentage of the System Input Volume (i) which could not be

charged for (calculated by subtracting the Revenue Water Volume⁷ (ii) from the System Input Volume (i)). This Non-Revenue Water Rate is hereinafter referred to as the NRW. Therefore, in the IWA’s definition, the Non-Revenue Water Volume includes water consumption for public purposes⁸ such as water used at public facilities and water used for the maintenance of water supply facilities.

| | Category | IWA’s definition (NRW) | SABESP’s definition (IPF) |
|---------------------------|--|--------------------------|--|
| System Input Volume | Billed Authorized Consumption | Revenue Water Volume | Revenue Water Volume* |
| | Unbilled Authorized Consumption (water consumption for public purposes) | Non-Revenue Water Volume | Water consumption for public purposes ** |
| | Apparent Losses | | Non-Revenue Water Volume |
| | Real Losses (leakage) | | |

Source: Created by the Evaluators through interviews with SABESP.
 Note: * The Billed Authorized Consumption and the actual consumption do not match. The actual consumption is lower than the Billed Authorized Consumption.
 ** The water consumption for public purposes includes the water supplied to Slums (explained below) in addition to water used at public facilities and water used to maintain water supply facilities.

Figure 1: Different Definitions of the Non-Revenue Water Volume

As indicators for non-revenue water control, SABESP uses two Non-Revenue Water Rates that are different from the IWA definition. The first Non-Revenue Water Rate used by SABESP (hereinafter the “IPF”) is calculated as follows. Firstly, the following three volumes are subtracted from the System Input Volume (i): the actual water consumption by each household shown on the water meter (iii) for months where the water consumption of the household exceeded 10 m³/month; 10 m³/month for each household (iii) for months where the water consumption of the household did not exceed 10 m³/month⁹; and water consumption for public purposes (iv). The percentage of the resulting volume out of the total System Input Volume (i) is then calculated. Therefore, the IPF is the same as IWA’s Non-Revenue Water Rate (NRW) because it is calculated based on the volume of water charged for, but the IPF is different from the NRW in the following two ways: the volume of water charged for and the actual water consumption is different for months where the consumption did not exceed 10 m³; and it does not include water consumption for public purposes. The second Non-Revenue Water Rate used by SABESP (hereinafter the “IPM”) is calculated as follows. Firstly, the following two volumes are

⁷ The volume of water subject to the collection of water charges.
⁸ Water consumption for public purposes includes water used to maintain water purification plants, water used at public facilities and water used by the fire department, etc. for firefighting. While the IWA includes it in the Non-Revenue Water Volume, it is not included in Brazil.
⁹ In Brazil, each household is charged a fixed amount when water consumption does not exceed 10 m³/month. The fixed amount is 16.82 reals as of December 2013, which is about 748 yen with the exchange rate of 1 real to 44.47 yen.

subtracted from the System Input Volume (i): the actual water consumption by each household shown on the water meter (iii); and water consumption for public purposes (iv). The percentage of the resulting volume out of the total System Input Volume (i) is then calculated. The IPM is different from the NRW in the following two ways: it is based on actual water consumption rather than the volume of water charged for; and it does not include water consumption for public purposes.

Another important thing to note is the water supplied to Slums. The water supplied to Slums¹⁰ is normally included in the water consumption for public purposes (iv) and therefore it is not included in the Non-Revenue Water Rates used by SABESP (the IPF and the IPM)¹¹. Therefore, one should avoid drawing conclusions from simply looking at these numbers because the Non-Revenue Water Rates used by SABESP are different from one used by the IWA. The IPM was used as an indicator for the Project for Capacity Development on Non-Revenue Water Control (subject to this External Evaluation) and the IPF was used as an indicator for SABESP’s integrated non-revenue water reduction program (hereinafter the “Programa”) and the Non Revenue Water Control Project in Sao Paulo State (a yen-loan project). In this evaluation report, the IPF and the IPM will be specified where necessary to avoid confusion.

1.3 Outline of the Terminal Evaluation

The project was rated high in general as it was found to have contributed to improving the abilities of counterparts from SABESP which are needed to reduce non-revenue water, through visits to the pilot areas and interviews with relevant personnel.

1.3.1 Achievement of Project Objective at the time of the Terminal Evaluation

The achievement levels for the indicators were as shown below, and the Project Objective was expected to be achieved.

| Indicator | The achievement level at the time of the Terminal Evaluation |
|---|--|
| All 15 Business Units in charge of the distribution of water will launch the non-revenue water reduction plans using technologies obtained through the project. | Based on the non-revenue water reduction plans compiled by the 15 Business Units, SABESP formulated the 11-year Corporate Water Loss Reduction and Energy Efficiency Program ¹² in 2009 and was implementing the program. |
| The Non-Revenue Water Rate (IPM) will be reduced to 30% or less at each pilot area by 2010. | Although the target IPM of 30% had not been achieved at the pilot areas, the target IPM was expected to be achieved by the end of the project as a result of technology transfer. |

1.3.2 Achievement of Overall Goal at the time of the Terminal Evaluation

It was likely that the Overall Goal “The Non-Revenue Water Rate (IPM) will be reduced to 30% or

¹⁰ It is estimated that about 11% of the total population of the Sao Paulo Metropolitan area live in Slums (2011). <http://exame.abril.com.br/brasil/noticias/sao-paulo-e-metropole-com-mais-moradores-de-favelas-do-brasil-segundo-o-ibge>

¹¹ The IWA includes stolen water in Apparent Losses (i.e. they consider it as part of lost water), but in Brazil, the water supplied to Slums is normally included in the water consumption for public purposes.

¹² SABESP created a draft in 2007. It then completed the final version as the integrated non-revenue water reduction program (the “Programa”) in September 2010.

less in SABESP’s water supply service area” would be achieved, through the transfer of non-revenue water control technologies and methods to the counterparts via the project, in combination with the implementation of the non-revenue water control plans for all Business Units. Therefore, it was determined that the stable supply of water was likely to be achieved. It was also expected that the project output would be disseminated to other Latin American countries after the project is completed, through international seminars on non-revenue water control¹³.

1.3.3 Recommendations at the time of the Terminal Evaluation

The following shows the recommendations at the time of the Terminal Evaluation and the action taken in response to the recommendations at the time of the Ex-Post Evaluation.

| Recommendation at the time of the Terminal Evaluation | Action taken (at the time of the Ex-Post Evaluation) |
|--|---|
| For the remaining four months before the completion of the project, sufficient budget and personnel should be allocated to the activities for non-revenue water control measures specified in the Project Design Matrix (PDM), and the Project Objective’s indicator target (the Non-Revenue Water Rate of 30% or less) and the Output 3’s indicator target (reducing the rate of leakage by 75%) should be achieved. | As a preventive measure for non-revenue water control, the replacement of water mains and service pipes was conducted at two out of three pilot areas. The effects of preventive measures on reducing the Non-Revenue Water Rate and the rate of leakage would not show up immediately after the measures have been taken. The numerical targets on the Non-Revenue Water Rate and the rate of leakage could not be achieved except for the Non-Revenue Water Rate at one site. |
| To implement non-revenue water control measures effectively, the construction management abilities of private businesses and SABESP’s staff members need to be improved. | At the time of the Ex-Post Evaluation, there was a plan that the Brazilian Association of Sanitary and Environmental Engineering (hereinafter the “ABES”) would give training to private businesses. |
| The replacement of water mains and service pipes contributes to the reduction of leakage and the detection of illegal connections to the pipes. Therefore, it is desirable to take measures such as the establishment of training and qualification systems for construction supervisors and plumbers and the introduction of the criterion that private businesses must employ a specific number of qualified personnel before being able to place a bid. | After the project ended, the said training course was established at the ABES through SABESP’s independent efforts. It is expected that the ABES will provide training to private businesses and a system will be established to outsource piping operations to private businesses which have qualified workers. |
| One cannot ignore Slums when controlling non-revenue water. Although it is an extremely difficult problem to tackle, it is necessary to obtain the accurate volume of water supplied to Slums by installing flow meters at the points where water flows into Slums. | It was difficult for the project to work on non-revenue water control in Slums and the project took virtually no relevant measures. A yen-loan project for non-revenue water control is attempting to understand the volume of water supplied to Slums by installing flow meters at the points where water flows into Slums. |

2. Outline of the Evaluation Study

2.1 External Evaluators

- Yuko Kishino, IC Net Limited
- Noriaki Suzuki, IC Net Limited

¹³ International seminars on non-revenue water control were held in December 2008 and December 2009, with the participation of Brazil and other Latin American countries.

2.2 Duration of Evaluation Study

Duration of the Study: September 2013 - January 2015

Duration of the Field Study: November 25, 2013 - December 5, 2013;

February 13, 2014 - February 23, 2014; and May 12, 2014 - May 16, 2014

3. Results of the Evaluation (Overall Rating: B¹⁴)

3.1 Relevance (Rating: ③¹⁵)

3.1.1 Relevance to the Development Plan of Brazil

The Pluriannual Plan (PPA) 2004–2007, which was the Brazilian government’s national development plan being implemented at the time of the launch of the project, stated that the effective utilization of limited resources is essential for sustainable development and included an efficient water supply in its priority policies. The PPAs 2008–2011 of the Brazilian government and the State of Sao Paulo, which were implemented at the time of the completion of the project, stipulated that they would promote appropriate water management which is important for water resource conservation and the improvement of public health. Therefore, it was confirmed that the PPAs 2008–2011 continued the policies stipulated in the PPA 2004–2007. These policies are in line with the objective of the project, which is the efficient utilization of water. Therefore, the project’s relevance to the development policies of Brazil is high.

After creating the first draft of the Corporate Water Loss Reduction and Energy Efficiency Program in December 2007, SABESP set an IPF reduction target for each Business Unit in March 2008. This SABESP policy was in line with the national and state policy as well as the objective of the project, which were to aim at the efficient utilization of water. The *Programa*, which was formulated in September 2010 just after the completion of the project, included activities to promote non-revenue water control including the technologies transferred through the project¹⁶. The *Programa* is one of SABESP’s most important policies for sustaining and strengthening the output of the project.

3.1.2 Relevance to the Development Needs of Brazil

As shown in Table 1, the volume of water supplied per capita per day in the State of Sao Paulo in 2007 and 2010 are 175 liters (L) and 185 L, respectively, which are larger than the national average of 150 L and 159 L, respectively. Therefore, non-revenue water control is the largest issue for SABESP, due to the State of Sao Paulo having the largest demand for water in Brazil, the scarcity of water resources and the water shortages of recent years which have added to the seriousness of the problem¹⁷.

¹⁴ A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

¹⁵ ③: High; ② Fair; ① Low

¹⁶ To implement the activities, a request for a yen loan was submitted. The loan was approved in 2012 and the yen-loan project started in 2013.

¹⁷ In an average year, the monthly precipitation is 200–300 mm from December to February. However, the precipitation in 2013 and 2014 was much lower than in average years (62 mm in December 2013, 87.7 mm in January 2014 and 22.7 mm in February 2014). At the Cantareira reservoir, which provides water to half of the water supply area in Greater Sao Paulo, the water fell below 18% of capacity as of February 2014, which is less than one third of the water available in

Table 1: Volume of Water Supplied per Capita per Day in Major States (Unit: liters)

| State | 2007 | 2008 | 2009 | 2010 |
|---------------------------|-------|-------|-------|-------|
| Bahia | 122.1 | 121.7 | 120.0 | 120.3 |
| Rio de Janeiro | 205.8 | 236.3 | 189.1 | 236.3 |
| Minas Gerais | 142.5 | 138.3 | 137.4 | 147.0 |
| Sao Paulo | 175.0 | 176.0 | 177.8 | 184.7 |
| Parana | 127.0 | 127.5 | 128.7 | 136.5 |
| Brazil's national average | 149.6 | 151.2 | 148.5 | 159.0 |

Source: Calculated from the data of the SNIS (the National Information System on Sanitation).

Note: The volume of water supplied per capita per day is calculated by dividing the water supplied per day by the population in the water supply area.

Both at the time of the launch of the project and at the time of the completion of the project, there was a pressing need to increase water use efficiency and there was a strong need for non-revenue water control. The population living in SABESP's water supply area in the State of Sao Paulo is about 24.11 million (2010)¹⁸ which accounts for about 15% of the total population of Brazil, and therefore the implementation of a project which helped SABESP to control non-revenue water greatly benefited Brazil. Therefore, the project's relevance is extremely high.

3.1.3 Relevance to Japan's ODA Policy

Japan's country-specific ODA policy for Brazil (2006) included the environment in the six priority fields. JICA's country-specific project implementation plan (2007) stipulated assistance for solving urban problems and environmental problems such as waste treatment and air pollution, as part of the assistance for environmental conservation measures. The project was a technical cooperation project with SABESP which is in charge of water supply and sewerage projects in the State of Sao Paulo, and it was in line with Japan's ODA policy at the time of the launch of the project. The response to urban problems remained one of the priority fields in Japan's ODA policy for Brazil at the time of the completion of the project.

3.1.4 Appropriateness of the Plan and Approach

The project took two main approaches: the development of a training program for SABESP staff capacity building and the development of a training system; the planning and the implementation of non-revenue water control at the pilot areas. The project aimed to reduce the Non-Revenue Water Rate at the pilot areas using technologies transferred by Japanese experts as well as improving company-wide abilities to control non-revenue water by launching the non-revenue water reduction plans in all 15 Business Unit areas covered by SABESP. In the long term, the project also aimed to create systems to develop the human resources needed for non-revenue water control. In short, the focus of the above-mentioned approaches was to successfully disseminate the practices used at the pilot areas to other SABESP personnel and to establish a successful dissemination system. Although

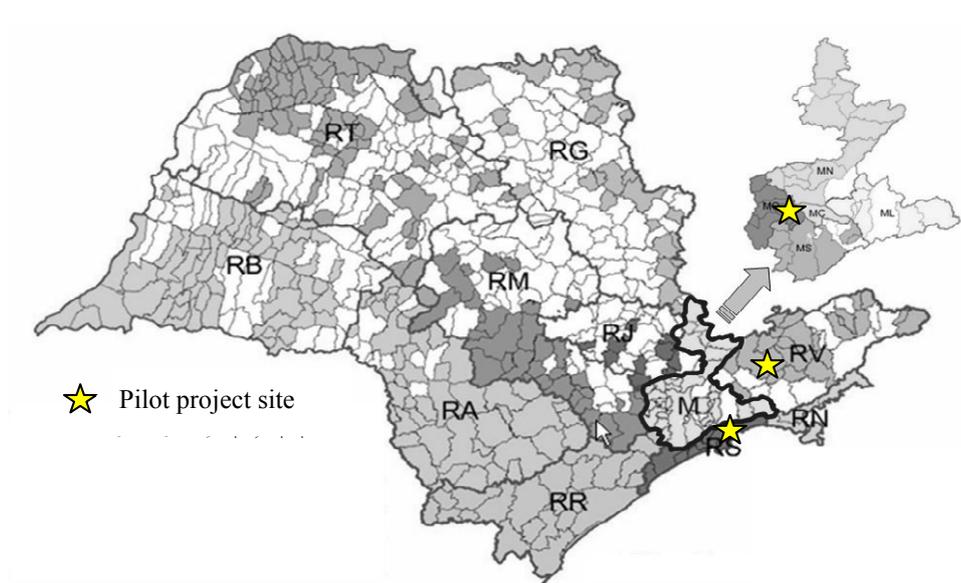
average years.

¹⁸ Calculated using SNIS (the National Information System on Sanitation) data. This is 1.88 times the population covered by the Bureau of Waterworks, Tokyo Metropolitan Government (12.84 million, as of April 2010).

there was no problem in the selection of pilot areas or the activities at the pilot areas, there was some room for improvement in the approaches taken and the indicators set in the PDM₁ which was created as a result of a revision made after a mid-term review of 2008, as explained below.

(1) The Selection of Pilot areas

Out of the 15 Business Unit areas, the following three areas were selected: the Metropolitan Region West Business Unit area (hereinafter “MO”); the Regional Baixada Santista Business Unit area (hereinafter “RS”); and the Regional Vale do Paraíba Business Unit area (hereinafter “RV”). One pilot area was then selected from each of the three selected Business Unit areas. Table 2 shows the names of the pilot areas.



Source: Project Completion Report for the Non-revenue Water Control project

Figure 2: SABESP Business Unit and Pilot areas

Table 2: The Average IPM at Each Pilot Area in 2007

| Pilot area name | IPM (%) | IPM in the relevant Business Unit area (%) |
|--------------------|--------------------|--|
| Jaguapé | 36.9* ¹ | MO: 34.8 |
| Vila Baiana | 51.7* ¹ | RS: 42.5 |
| Jardim das Colinas | 68.2* ² | RV: 41.0 |

Source: Calculated using non-revenue water control information system data owned by SABESP.

*1: The IPM for the whole sector which includes the relevant site is shown, as data on the IPM for each site is not available.

*2: The IPM for the relevant site is shown, as the relevant site is the whole sector.

As shown above, the average IPM at each pilot area in 2007 is higher than the average IPM in the water supply service area of the relevant Business Unit, i.e., priority sites which require non-revenue water control more than other sites were selected as pilot project sites. MO, where one of the pilot areas is located, is a metropolitan area where mainly middle class people reside. It has a high rate of leakage and there is a strong need for the replacement of water service pipes, because the area was developed many years ago. This means that the area requires both the corrective measures and the preventive measures which are included in the project's non-revenue water control measures. RS contains Slums and tourist sites. In this area, non-revenue water includes various components, and the consumption of water fluctuates depending on the season and the time of the day. Therefore, for this area, the project's fundamental measures for non-revenue water control as well as water pressure adjustment as a preventive measure are important. RV is a detached condominium where wealthy people reside. There is a strong need for the replacement of water mains because the construction of the mains was not appropriate when the developer constructed the water supply and sewage systems in the 1970s.

It was appropriate for the project to select pilot areas from the three areas which have different characteristics and have a strong need for non-revenue water control, in order to achieve the Overall Goal of disseminating the non-revenue water control methods proposed by the project to the rest of the SABESP water supply area.

(2) Project Approaches

Four "Outputs" set by the project laid out the means for achieving the Project Purpose "SABESP will increase its non-revenue water control abilities." However, only Output 1 was relevant to the whole of SABESP because Output 2, Output 3 and Output 4 laid out the means for strengthening non-revenue water control for the pilot areas. The counterparts subject to technology transfer at pilot areas accounted for less than 2% of the engineers and operational and maintenance personnel working at all the Business Units. There was no plan to conduct activities to train leaders at the Business Units where no pilot projects were conducted. The connection was weak between the achievement of the Outputs and the achievement of the Project Purpose because there were only a few activities to disseminate the results of the activities at the pilot areas to the whole company.

(3) Indicators

As shown below, the indicators set in the PDM₁ seemed to have room for improvement.

- ✓ One of the indicators for the Project Purpose was, “The NRW control plans are carried out in all the 15 business units.” This could have been used as an indicator for assessing the capacity development levels achieved by SABESP through the dissemination activities and training.
- ✓ Indicators for Output 1 included, “10 training courses (curricula) are created and carried out.” and “The 10 training courses target all the 15 business units, and both managerial and technical staff of SABESP participate in the training courses.” These indicators only state the progress of the activities. Therefore, it was necessary to set indicators which assess the extent to which the project was able to strengthen the training implementation systems for the other Business Units and develop the abilities of the staff members at the other Business Units.
- ✓ As an indicator for Output 2, a numerical target could have been set to assess the extent to which the engineers at the pilot areas deepened their understanding of non-revenue water.
- ✓ The indicator for Output 3 was, “The water leakage rate is reduced by 75% in the pilot areas, compared with the rate measured at the beginning of the activities in the pilot areas.” This could have been used as an indicator for assessing the achievement level for the technology transfer regarding corrective measures.

As explained above, the path set in the plan for achieving the project purpose was insufficient and there was some room for improvement in setting indicators. However, in light of the policy objectives of the efficient utilization of water resources and the streamlining of water supply, the project purpose was appropriate. In addition, the project has been highly relevant to the country’s development plan, development needs, as well as Japan’s ODA policy. Therefore, the project’s relevance is high.

3.2 Effectiveness and Impact¹⁹ (Rating: ②)

3.2.1 Effectiveness

The Ex-Post Evaluation Study confirmed that there were differences between the achievement levels for the different Outputs and the Project Purpose, at the completion of the project. The main reasons why some Outputs could not be achieved were the lack of budget and personnel for the replacement of water service pipes and mains²⁰. The following explains the achievement levels at the completion of the project and the achievement levels when the Ex-Post Evaluation was carried out, based on the PDM₁.

3.2.1.1 Project Output

1) **Output 1** “The SABESP staff who are involved in the Project understand the significance of NRW control, and the system for the human resources development is strengthened.”: Partially achieved.

¹⁹ The rating must be determined by taking into account the assessment results for both the Effectiveness and the Impact.

²⁰ These factors were mentioned in the PDM₁ as “external factors.”

Although training courses for non-revenue water control measures were sufficient qualitatively and quantitatively, the project could not implement training sufficiently for all the Business Units before the project was completed. At the time of the Ex-Post Evaluation, it was confirmed that non-revenue water control measures started to be disseminated to the other Business Units, thanks to the efforts of SABESP.

Indicator (1) “10 training courses (curricula) are created and carried out”:

Fully achieved. The project developed a training program where 13 courses were created under four themes. After the project ended, SABESP made alterations to the teaching materials for the “Introduction of Model for Water Distribution Network Analysis” which is part of the training program. In 2013, the ABES took over these courses and added them to its training programs. From 2014 onwards, the ABES will conduct training for strengthening non-revenue water control. The training courses developed by the project were determined to be sufficient both qualitatively and quantitatively.

Indicator (2) “The 10 training courses target all the 15 business units, and both managerial and technical staff of SABESP participate in the training courses”:

Not achieved. The 13 training courses were held once. Although participants included staff from all Business Units, all of them were administrators and there were no technical staff. It was expected that the participants would become training instructors after taking the training courses and disseminate the technologies by giving training at their Business Units. However, training of trainers (TOT) was not included in the Plan of Operations during the project period, and at the time of the Ex-Post Evaluation, we could not confirm that the participants held TOT.

Indicator (3) “Engineers and workers of private construction firms participate in the training course(s)”:

Not achieved. There were no participants from private businesses. However, as mentioned above, it was decided that the teaching materials for the training developed by the project would be used as official teaching materials for the training provided by the ABES after they had been revised by SABESP. This made it possible for private businesses to apply for the training and receive the training from the ABES rather than receiving the training from SABESP. Those who have completed the training are given a certificate of completion. If they pass the examination conducted by the Brazilian Association for Non-Destructive Inspection which is a national technical accreditation agency, they will be given a qualification for technologies concerning non-revenue water. This qualification will become one of the criteria that private businesses must meet when placing a bid for construction work related to non-revenue water control in the SABESP water supply area. There is no doubt that the results of the project’s activities will be utilized to train private sector engineers who will be engaged in non-revenue water control.

2) **Output 2** “Fundamental measures for NRW control are strengthened through practice in the pilot areas”: Fully achieved.

Indicator (1) “The technical staff of the pilot areas will be able to identify the components of NRW and the rate of each component.”

Fully achieved. Electromagnetic Type Flow Meters were installed and the measurement of the System Input Volume was launched at all the pilot areas before the project ended. They identified the components of non-revenue water through a series of activities including measuring the volume of leakage and identifying sources of the stolen water. In RS, they succeeded in measuring the volume of water used in Slums using Ultrasonic Type Flow Meters. From the results of interviews and beneficiary surveys in the Ex-Post Evaluation Study, it was confirmed that the identification of factors causing non-revenue water²¹ (which is the most important fundamental measure) was fully implemented at the pilot areas, and that many technology transfer activities are taking place within each Business Unit area. In particular, in MO, they conducted zoning for the service area and installed automatic water flow and pressure sensors in each zone, which constantly check and adjust the volume of water and the water pressure automatically.

Indicator (2) “The technical staff of the pilot areas will be able to utilize GIS (information about maps, pipes, leakage, customers, etc.) in NRW control.”²²:

Partially achieved. A Japanese expert recommended that they should build a system which enables the centralized management of all the data on fundamental measures related to non-revenue water control using SABESP’s databank, before the project ends. At the time of the completion of the project, the data collected through direct measurement was being accumulated and the quality of the data was improving. At the time of the Ex-Post Evaluation, administrators at each Business Unit were developing and managing GIS data²³. The databank contains various types of data along with map information, including the locations where leakages were detected, piping diagrams, the progress in the replacement of water mains and service pipes, the service pipe diagram for each household, and the service provided to each household. The system enables the extraction and management of data on non-revenue water control from the databank.

3) **Output 3** “Corrective measures for NRW control are strengthened through practice in the pilot areas”: Partially achieved.

Although the numerical target set at the time of the mid-term evaluation could not be achieved, corrective measures for non-revenue water control were taken including the detection and repair of

²¹ They include identifying non-revenue water components through the inspection of the volume of leakages, the measurement of the lowest flow during the night, leakage repair and the replacement of water service pipes.

²² This means that “The engineers will be trained to be able to utilize existing databases including GIS for non-revenue water control measures.” Source: Materials provided by JICA.

²³ The progress in the development and management of GIS data varied depending on the Business Unit. GIS data for MO was already in use and GIS data for RS and RV were still being developed.

leakages.

Indicator (1) “The water leakage rate is reduced by 75% in the pilot areas, compared with the rate measured at the beginning of the activities in the pilot areas”:

Not achieved. As shown in Table 3, the rate of leakage at the pilot areas was reduced by 63% in MO, 52% in RV and 10% in RS by the time of the completion of the project, when compared to the levels at the time of the launch of the project. Therefore, the target of a 75% reduction was not achieved. However, an interview with SABESP found that the rate of leakage as of May 2010 was 28% in RS and 30% in RV, which are the same or lower than the guideline level set by SABESP (30%). Therefore, the project was effective to a certain extent. Because the rate of leakage at the pilot areas was reduced to the guideline level, SABESP decided to prioritize areas which have a higher rate of leakage for the implementation of corrective measures. When considering SABESP’s policy, it was not appropriate to set the target of reducing the rate of leakage by 75%²⁴ for all the pilot areas, although some Business Units already had a rate of leakage close to the guideline level of 30% around the time of the launch of the project (e.g. 31% in RS²⁵).

Table 3: The Rate of Leakage at the Pilot Areas

| | MO (%) | RS (%) | RV (%) |
|--|--------|--------|--------|
| The baseline rate of leakage (2007) (%): a | 59 | 31 | 62 |
| The target rate of leakage (%): a/4 = b | 15 | 8 | 16 |
| The rate of leakage in May 2010 (%): c | 22 | 28 | 30 |
| The reduction rate (a-c)/c | 63% | 10% | 52% |

Source: Materials provided by JICA.

Note: After the project ended, they stopped using the method for checking the rate of leakage that was used at the time of the project.

In the Ex-Post Evaluation Study, it was confirmed that corrective measures (such as the detection of leakages from water mains, the water-tightness inspection for water service pipes and the repair of water mains and service pipes) were being conducted in many other parts of MO, RS and RV, using the knowledge and experience obtained through the project.

4) **Output 4** “Preventive measures for NRW control are strengthened through practice in the pilot areas”: Partially achieved.

Although the implementation of preventive measures lagged behind because of SABESP’s budget shortages, targets for the replacement of water service pipes and mains were mostly achieved. The detection of leakages and the adjustment of water pressures to appropriate levels have been adopted in many areas as very inexpensive and effective measures. However, the target for patrols could not be achieved because of personnel shortages at SABESP.

²⁴ The reason for setting the target of reducing the rate of leakage by 75% was not explained in any materials, nor could it be given in interviews with relevant personnel.

²⁵ The pilot area in RS had a much lower baseline rate of leakage than the other sites because it is a tourist site except for the Slums and the water mains and service pipes were relatively new.

Indicator (1) “Aged and deteriorated pipes are replaced in the pilot areas”:

Mostly achieved (the replacement of water service pipes: 1,387 out of 1,467 places, 95% achieved; the replacement of water mains: 7,821 out of 7,821 meters, 100% achieved). In RV, the replacement of water service pipes and mains was conducted as planned. In MO, all the service pipes and mains which required replacement in 2008 and 2009 were replaced. The replacement of service pipes for 200 places was planned for 2010, but SABESP determined after the Terminal Evaluation that replacements for 73 places should be sufficient, and the replacements for all 73 places was completed. In RS, the replacement of water service pipes was planned for 80 places and the plan was to complete the replacement for all 80 places before the end of the project, but the plan was not implemented. This was because the RS Business Unit decided not to implement the plan during the project period, as the replacement of water service pipes had been planned for in the Non Revenue Water Control Project in Sao Paulo State.

Table 4: Preventive Measures for Non-Revenue Water Control Taken in the Pilot Areas

| Pilot area | | Water service pipes replaced (unit: places) | | Water mains replaced (unit: meters) | |
|------------|------|---|---------------------------|-------------------------------------|---------------------------|
| | | At the Terminal Evaluation | At the Ex-Post Evaluation | At the Terminal Evaluation | At the Ex-Post Evaluation |
| MO | 2008 | 36 | 36 (100% achieved) | No plan | No plan |
| | 2009 | 492 | 493 (100% achieved) | No plan | No plan |
| | 2010 | 200 (initial plan) | 73 (100% achieved) | No plan | No plan |
| RV | 2007 | 349 | 349 (100% achieved) | 7,821 | 7,821 |
| | 2010 | 445 (initial plan) | 436 (100% achieved) | No plan | No plan |
| RS | 2010 | 80 | 0 (0% achieved) | No plan | No plan |

Source: Created by the Evaluators based on the results of interviews with SABESP at the time of the Ex-Post Evaluation.

Indicator (2) “Water pressure is adjusted to the appropriate level in the pilot areas”:

Partially achieved. The water pressure adjustment was conducted in RS and RV before the project ended, but it was not conducted in MO. This is because the need for the water pressure adjustment proposed by the project diminished as the remote automatic adjustment of the water volume and pressure was enabled²⁶ in MO after the project ended. In RV and RS where the installation of automatic detection and adjustment equipment has not progressed, the low-cost and sustainable water adjustment method proposed by the project is useful, and it was still being used at the time of the Ex-Post Evaluation. Water pressure adjustment is a proven technology in Japan. The technology was transferred not only to administrators but also to engineers who work on the ground, and administrators participated in OJT. These activities facilitated communication between administrators and engineers, which contributed to reducing the differences in awareness about the problems faced on

²⁶ The automatic adjustment using the measurement management zones (DMC), micro gauges and the General Packet Radio Service (GPRS).

the ground. The establishment of the technology within SABESP was enabled by the fact that SABESP had the human resources, financial strength and organization needed to utilize the technology continuously.

Indicator (3) “Patrol on the pipelines is conducted on the regular basis in the pilot areas in accordance with a manual on preventive measures”:

Not achieved. Patrol activities were hardly conducted because of personnel shortages. However, the method proposed by the project (taking photographs of the progress in construction work and improving work efficiency) was being used at the time of the Ex-Post Evaluation, and was contributing to strengthening preventive measures.

3.2.1.2 Achievement of Project Purpose

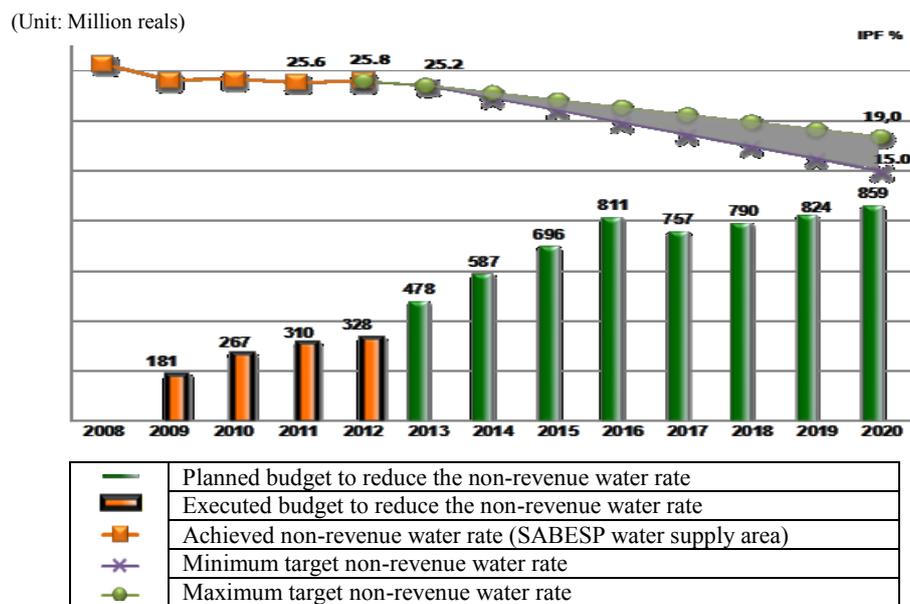
Indicator 1 “The NRW control plans are carried out in all the 15 business units”:

Not achieved. At the time of the mid-term review, it was confirmed that non-revenue water reduction plans had already been formulated by all 15 Business Units, and it was proposed that the plans should be launched by each Business Unit before the end of the project. The completion report stated that the Corporate Water Loss Reduction and Energy Efficiency Program was formulated and being implemented during the project period. However, in reality, the Corporate Water Loss Reduction and Energy Efficiency Program had only set the reduction target for the Non-Revenue Water Rate by the time the project had been completed. It was only in March 2010, four months before the completion of the project, that they started the actual formulation of the non-revenue water reduction plans. In September 2010, after the project ended, the plan for the Integrated Non-Revenue Water Reduction Program (*the Programa*, Table 5) was completed and launched.

Table 5: An Outline of the Integrated Non-Revenue Water Reduction Program
(the *Programa*)

| | |
|------------------|--|
| Program period | 2009–2019 |
| Objective | The long-term reduction in the Non-Revenue Water Rate (IPF) will be achieved. |
| Expected outcome | <ul style="list-style-type: none"> - The plans for non-revenue water reduction will be integrated into one plan. - Financial support for achieving the long-term reduction of the Non-Revenue Water Rate will be strengthened. |
| Main activities | <ul style="list-style-type: none"> - The replacement of water service pipes and mains - Zoning and the improvement of the water supply service area - The water-tightness surveys for service pipes within household properties and the detection of leakages - The installation of water pressure regulators and automatic water flow and water pressure measuring instruments - The control of illegal water supply (except for Slums) - The replacement of water meters |

Source: SABESP



Source: JICA presentation document for the Programa Investment Plans, elaborated by the SABESP (Dec. 2013)

Figure 3: *Programa* Investment Plans and Targets (IPF)

Indicator 2 “The NRW rate in each pilot area is reduced to less than 30%”:

Changes in the IPM at each pilot area are shown in Table 6.

Table 6: Changes in the IPM at Each Pilot Area (Unit: %)

| Pilot area name | 2007 (7-12) | 2008 (1-6) | 2008 (7-12) | 2009 (1-6) | 2009 (7-12) | 2010 (1-5) |
|-------------------------|----------------|---------------|-------------------|---------------|----------------|---------------|
| Jaguaré (MO) | 46.3 | 44.6 | Not calculated | 42.6 | 39.0 | 30.9 |
| Vila Baiana (RS) | 58.5 | 62.6 | 60.2 | 51.2 | 44.2 | 27.9 |
| Jardim das Colinas (RV) | 61.2 | 36.1 | 32.3 | 35.4 | 40.5 | 37.4 |

Source: The figures shown in bold were obtained from the mid-term review report. The other figures were calculated by the Evaluators based on the monthly Non-Revenue Water Volume table included in the completion report.

Note: The above table shows the IPM which is used in the project purpose.

In RS, the IPM was reduced from 58.5% in the year when the project started to 27.9% in the 2010 January-May term. This was because the analysis of the System Input Volume progressed and water consumption was measured accurately through the implementation of the project, which enabled specific non-revenue water control measures²⁷. In MO and RV, considerable effects were observed: the IPM was reduced from 46.3% and 61.2% in the 2007 July-December term to 30.9% and 37.4%, respectively. The IPM in RV was further reduced and the average IPM in the 2010 July-December term fell to 34.4%²⁸. However, the IPM did not fall below 30% because of issues including the delay in the replacement of water service pipes and mains.

²⁷ The first measure is to improve the accuracy of the System Input Volume analysis by measuring the water flow into Slums and identifying water taps that are not in use. The second measure is to reduce the water pressure from 30 kPa to 20 kPa which does not affect water supply and to adjust the water pressure during the night where necessary, in order to reduce leakages.

²⁸ The IPM (c) for June and July 2010 was not calculated for the pilot areas in MO and RS. Data was not available because the IPM was not monitored at the pilot areas after the project ended.

As explained above, some parts of the indicators have not achieved the intended results in the project purpose objectives. However, the Non-Revenue Water Rates in the pilot areas have improved substantially, and for the whole the SABESP, the project counterparts have been playing its central role toward the non-revenue water reduction. Therefore, it can be judged that the project has had a certain degree of positive outcomes.

3.2.1.3 External Factors Which Contributed to or Interfered with the Project’s Effectiveness

During the project period, SABESP employed a local consultant and implemented the Methods of Analysis and Solution for Water Losses and Non-Revenue Water Problems (MASPP). This program aimed to hold workshops which are designed to make all the SABESP staff members recognize their roles once again and raise their awareness. The program consequently created the conditions needed for the dissemination of non-revenue water control technologies resulting from the project to other Business Units.

Regarding the preventive measures for non-revenue water control stipulated in Output 4, the following factors interfered with the project’s progress, among others: the budget allocated by SABESP for the replacement of water service pipes and mains was insufficient; the procedures for contracting construction work were delayed; and the construction abilities of outsourced companies were insufficient. As a result, the launch of construction in RV was postponed to February 2010 which was five months before the completion of the project. They contributed to the failure to achieve a portion of the Project Purpose as a consequence.

3.2.2 Impact

3.2.2.1 Achievement of Overall Goal

Indicator “The NRW rate in the SABESP’s service area will be reduced to less than 30% by the year 2015”:

Changes in the IPM in SABESP’s water supply service area are shown in Table 7.

Table 7: Changes in the IPM

| The Non-Revenue Water Rate (IPM) (%): c | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|--|------|------|------|------|------|------|------|
| Results | The whole of SABESP | 35.8 | 34.1 | 32.4 | 32.3 | 32.0 | 32.1 | 31.2 |
| | The Sao Paulo Metropolitan Region Executive Office | 34.6 | 32.7 | 31.4 | 31.9 | 31.3 | 31.8 | 30.8 |
| | The Regional Systems Executive Office | 39.1 | 37.9 | 35.3 | 33.3 | 33.9 | 32.9 | 32.3 |

Source: The information was provided by the administrative division for the integrated non-revenue water reduction program at SABESP’s Technology, Enterprises and Environment Executive Office.

Note: The above table was created with the premise that the Non-Revenue Water Rate stated in the reduction target set as the project’s Overall Goal refers to an IPM.

The IPM for the whole of SABESP was observed between 30% and 33% at the time of the Ex-Post

Evaluation (2013). In 2013, the Non Revenue Water Control Project in Sao Paulo State was launched based on the *Programa*, and the Non-Revenue Water Rate which had stopped dropping was reduced by 0.9% from the previous year’s level. It is likely that the Overall Goal will be achieved by 2015 which is the target year for the Overall Goal, through the implementation of the Non Revenue Water Control Project in Sao Paulo State.

3.2.2.2 Contribution of Project to Overall Goal

A beneficiary survey²⁹ was conducted to confirm the degree to which the project has contributed to the Overall Goal. Three points were confirmed: (1) To what extent has the transferred non-revenue water control technology been understood? (2) Thirteen training courses on non-revenue water control were developed as part of the project. To what extent have these training courses been utilized? (3) How much awareness is there for the importance of reducing the Non-Revenue Water Rate?

(1) Grasp of non-revenue water control technology

Personnel at the Business Units in the pilot areas had a good grasp of the transferred technology, and were still utilizing it after the completion of the project. This is also evident from the results of the beneficiary survey shown in Table 8. The decrease in IPM at the Business Units in the pilot areas is largely attributable to the staff to whom the technology was transferred. Despite more than half of the staff members being reassigned after the completion of the project, the technology was transferred from the reassigned staff members to the new ones, who were actively working on measures to reduce non-revenue water.

Table 8: Understanding of Transferred Technology by the Business Units in the Pilot Areas

| Key transferred technology | MO | RS | RV |
|--|---|---|---|
| Division of water service areas, and understanding of the volume of water flowing in each area | In practice throughout entire area By individual DMCs | Partially maintained (25%) Sector by sector | Maintained throughout entire area Sector by sector |
| Appropriate adjustment of water pressure during the day and night | Automatically controlled throughout entire area | Adjusted throughout entire area as circumstances demand | Adjusted throughout entire area as circumstances demand |
| Testing for water-tightness following installation of service pipes | Performed throughout entire area | Performed in 80% of area | Performed throughout entire area |
| Testing for water-tightness prior to laying of service pipes | Performed throughout entire area | Performed in half of area | Performed at all new installations |
| Using photos, understanding the progress for each phase of implementation | Performed throughout entire area for all phases | Performed throughout entire area for all phases | Performed throughout entire area for all phases |
| Total evaluation of the grasp of transferred technology | 100% Has adopted advanced technologies, such as the automatic adjustment of water pressure | 70% Good grasp of the transferred technology | 100% Full use of the transferred technology |

Source: Compiled by the evaluator based on the results of the beneficiary survey of 90 SABESP staff members.

²⁹ The format for the beneficiary survey was a focus group discussion. At each of the nine business units, ten people were divided into two groups of five.

Ever since the project period, MO has been utilizing advanced technologies, such as the automatic adjustment of water pressure, as well as technologies for digitalizing the implementation progress and sharing it with those concerned. RV has utilized the transferred technology throughout its entire area. Overall, RS utilizes the transferred technology in 70% of its area. Although this is lower than the other pilot areas, all of the RS participants in the beneficiary survey had a grasp of the technology.

On the other hand, Table 9 shows the results of the beneficiary survey for the Business Units outside the pilot areas. As can be seen, the final evaluation of Business Units in metropolitan areas—MC,³⁰ MN,³¹ and MS³²—was about 70%, whereas, it was about 50% for Business Units in regional areas—RA,³³ RJ³⁴ and RN.³⁵ MN was selected by SABESP as a type of pilot area called a “mirror area,” and under the guidance of experts from the project, several OJT sessions were held here. This is thought to have had an impact on the particularly high evaluation of MN. MO played a central role in providing guidance on measures to reduce non-revenue water, and this had a positive bearing in MC and MN. This kind of dissemination of technology was inadequate at the Regional Systems Executive Office Business Units, and it is presumed that this is why the results were somewhat low.

Table 9: Understanding of Transferred Technology by the Six Business Units outside the Pilot Areas

| Key transferred technology | MC | MN | MS | RA | RJ | RN |
|--|------|------|------|-----|-----|-----|
| Division of water service areas, and understanding of the volume of water flowing in each area | 50% | 100% | 50% | 50% | 50% | 50% |
| Appropriate adjustment of water pressure during the day and night | 50% | 100% | 100% | 50% | 50% | 50% |
| Testing for water-tightness following installation of service pipes | 100% | 60% | 50% | 50% | 50% | 50% |
| Testing for water-tightness prior to laying of service pipes | 50% | 20% | 50% | 0% | 50% | 50% |
| Using photos, understanding the progress for each phase of implementation | 50% | 75% | 80% | 50% | 60% | 75% |
| Total evaluation of the grasp of transferred technology | 60% | 71% | 66% | 40% | 52% | 55% |

Source: Compiled by the evaluator based on the results of the beneficiary survey of 90 SABESP staff members.

(2) Utilization of the 13 training courses on non-revenue water control

Thirteen training courses on non-revenue water control were developed in the project. As shown in Table 10, at the time of the Ex-Post Evaluation, the rate at which the courses were being utilized was low, with 50% of staff members utilizing the courses at MO, and no more than 30% at other business units. This is because they were at a stage where verification of the training program had only just been completed in 2013. The Technology Development and Maintenance Department of the Planning

³⁰ Sao Paulo Metropolitan Center Business Unit.

³¹ Sao Paulo Metropolitan North Business Unit.

³² Sao Paulo Metropolitan South Business Unit.

³³ Sao Paulo State Alto Paranapanema Regional Business Unit.

³⁴ Sao Paulo State Capivari / Jundiaí Regional Business Unit.

³⁵ Sao Paulo State Litoral Norte Regional Business Unit.

Office (TOE), which is also a recipient of the technology transfer and is in charge of monitoring, played a central role in improving the training courses, and the private-sector enterprises involved in the Non Revenue Water Control Project in Sao Paulo State were obliged to undertake ABES certification training. A decision has been made to carry out full-scale training in 2014. Through this, it is expected that further reductions in IPM will be achieved.

Table 10: Utilization of the 13 Training Courses after Completion of the Project

| | MO | MC | MN | MS | RS | RV | RA | RJ | RN |
|------------------------------------|-----|-----|-----|-----|----|-----|-----|-----|-----|
| Number of respondents | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number of people utilizing courses | 5 | 3 | 3 | 1 | 0 | 1 | 2 | 1 | 0 |
| Rate of utilization | 50% | 30% | 30% | 10% | 0% | 10% | 20% | 10% | 10% |

Source: Compiled by the evaluator based on the results of the beneficiary survey of 90 SABESP staff members.

(3) Recognition of the importance of reducing the Non-Revenue Water Rate

As shown in Table 11, the percentage of those who recognize the importance of reducing the Non-Revenue Water Rate is extremely high, between 80% and 100%. Interviews have also confirmed that TOE took the lead in providing support to business units for activities related to non-revenue water. It appears that a consequence of strengthening technology in the pilot areas was that awareness for reducing non-revenue water spread, with TOE appealing to all business units. On the whole, the degree of recognition was higher in metropolitan areas than in regional areas, and this is as a result of the TOE having had a greater involvement in the geographically closer metropolitan areas.

Table 11: Recognition of the Importance of Reducing the Non-Revenue Water Rate

| | MO | MC | MN | MS | RS | RV | RA | RJ | RN |
|--|------|------|-----|------|-----|-----|-----|-----|-----|
| Number of respondents | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| Number of respondents recognizing importance | 10 | 10 | 8 | 10 | 9 | 9 | 9 | 9 | 9 |
| Rate of recognition | 100% | 100% | 80% | 100% | 90% | 90% | 90% | 90% | 90% |

Source: Compiled by the evaluator based on the results of the beneficiary survey of 90 SABESP staff members.

3.2.2.3 Other Impacts

During the project period, an international seminar was held on measures for controlling non-revenue water. This enabled the achievements of the project in the pilot areas to also be disseminated to participants not only from Brazil but also from other Latin American countries. Taking advantage of this opportunity, a third-country training program (TCTP) was planned by taking advantage of a JICA scheme, with an aim of making SABESP the focus of training for measures to reduce non-revenue water in Latin America. Since the completion of the project, a total of three third-country training programs have already been implemented.

A certain degree of positive outcomes was observed in the project, and therefore, the

effectiveness/impact of the project is fair. At Business Units in the pilot areas, the penetration rate of transferred technology was high, the level of accumulated technology was high, and the awareness of staff members was high. In addition, the control of non-revenue water had been put into practice, and as a result, this led to a considerable improvement in the Non-Revenue Water Rate. Even at Business Units outside the pilot areas, it was confirmed that the percentage of those recognizing the importance of reducing the Non-Revenue Water Rate was high, between 80% and 100%, and the total evaluation of the grasp of transferred technology had also advanced to between 40% and 70%. The project produced a change in the activities of the direct counterpart, namely TOE, and resulted in the creation of solid foundations for the control of non-revenue water. For instance, the influence of TOE led to a sufficient budget being allocated. With the start of full-scale training courses developed in the project for non-revenue water control technology, coupled with the effects of the Non Revenue Water Control Project in Sao Paulo State, the Overall Goal is expected to be achieved by 2015.

3.3 Efficiency (Rating: ②)

3.3.1 Inputs

The planned inputs and actual inputs are as follows.

| Inputs | Plan | Actual (at completion) |
|-------------------------------------|---|--|
| (1) Experts dispatched | <ul style="list-style-type: none"> ● Long-term: 1 (total: 36 months) ● Short-term: 4 (total: 41 months) Total: 77 person-months | <ul style="list-style-type: none"> ● Long-term: 1 (36 months) ● Short-term: 9 (46.5 months) Total: 82.5 person-months |
| (2) Trainees received | <ul style="list-style-type: none"> ● Number of trainees: about 15 every year ● Main fields of training: General measures to reduce non-revenue water Improvement of water supply equipment | <ul style="list-style-type: none"> ● Total number of trainees: 50 ● Main fields of training Measures for the comprehensive management of non-revenue water Sharing of expertise in Japan on achieving and maintaining low Non-Revenue Water Rate |
| (3) Third-country training programs | - | - |
| (4) Equipment | <ul style="list-style-type: none"> ● Provision of equipment: 45 million yen over 3 years ● Main input equipment Electromagnetic type flow meters, micro flow sensors for night minimum flow, etc. | <ul style="list-style-type: none"> ● Provision of equipment: 35.4 million yen ● Expenses borne by Japanese side: 24.4 million yen ● Main input equipment Portable electromagnetic / ultrasonic type flow meters, sonic pipe locators, correlative water leak detectors, endoscope pipe inspection cameras |
| Total project cost | Total: 290 million yen | Total: 362 million yen |
| Input from the recipient government | <ul style="list-style-type: none"> ● Assignment of counterparts (total of 49 staff members in 11 departments) ● Office space for experts and project staff ● Training costs (personnel expenses, transportation expenses, daily allowance/accommodation allowance, instructor remuneration) ● Improvement of training centers ● Costs involved in project for reducing non-revenue water in pilot areas Total (no planned value) | <ul style="list-style-type: none"> ● Assignment of counterparts (total of 82 staff members in 14 departments) ● Office space for experts and project staff ● Training costs (personnel expenses, transportation expenses, daily allowance/accommodation allowance, instructor remuneration) ● Improvement of training centers ● Costs involved in project for reducing non-revenue water in pilot areas Total: 19.2 million yen |

3.3.1.1 Elements of Inputs

Overall, the input from the Japanese side was slightly greater than planned. At the time of planning, short-term experts had been envisaged for the four areas of non-revenue water management and construction supervision, water distribution management, technologies for detecting leaks, and training programs. In addition to these areas, however, experts were also dispatched to the areas of water works and water service planning. The fact that experts for training programs and planning were dispatched for shorter periods of time meant that the inputs for disseminating the outputs from the pilot areas throughout all of SABESP were restricted, and was also a factor in limiting the dissemination of project outputs. As for the inputs from the Brazilian side, although the assignment of counterparts was greater than planned, the inputs apart from the costs in the pilot areas were as planned.

Of the outputs for the pilot areas, Output 4 did not proceed as planned because of a budget shortfall on the part of SABESP. For instance, in MO and RV, the replacement of pipes was delayed, and in RS, service pipes could not be replaced. The provided equipment has continued to be used.

Although the utilization of in-pipe cameras is low, this did not have a significant effect on outputs because the cost of providing the cameras is no more than about 6% of the total.

3.3.1.2 Project Cost

The project cost was 24% higher than planned. Whereas the planned cost was 290 million yen, the actual cost was 362 million yen. The increase was due to an increase in the number of experts dispatched and the number of trainees accepted.

3.3.1.3 Period of Cooperation

The period of cooperation was 100% as planned, namely 36 months.

3.3.2 Project Implementation Structure

Originally, the project established two pilot areas: MO from among metropolitan areas, and RS from among coastal regional areas. Later, RV was added as an inland regional area. In other words, in addition to SABESP headquarters, there were three project sites. RV and RS were more than 400 km apart, and both were more than 250 km away from headquarters. Thus, the project extended across a wide area, and although there were several project offices, a local coordinator was not assigned immediately after the start of the project. This did not pose any particular problems in terms of transferring technology through OJT, but in terms of infrastructure development in the pilot areas, such as the replacement of service pipes and distribution pipes, differences in language resulted in less than perfect communication and operational inefficiencies with the Brazilian government agencies. These resulted in an inordinate amount of time being spent on licensing procedures, and the start of construction being delayed. A local coordinator was assigned six months later, and these problems disappeared. If a local coordinator had been assigned immediately after the start of the project, the preceding activities at MO might have been implemented sooner, the knowledge and experience obtained from these activities might have been gleaned earlier, and the biggest challenge in this project—namely, dissemination to other Business Units—might have been promoted.

RV had been added afterward, and with no coordinator being assigned, the coordinator at RS was dealing with both sites single-handedly. The RS coordinator frequently worked at SABESP headquarters, and so the local sites were seldom inspected. There were delays in assessing the actual conditions and confirming the progress at RV and RS, and eventually, the activities here were more limited than those at MO. It would have been preferable to have an SABESP coordinator assigned to the business units responsible for each of the pilot areas.

In contrast, the transfer of technology through OJT was promoted while sharing with management any on-site issues and lessons learned, and while following the PDCA (Plan-Do-Check-Act) cycle according to circumstances. SABESP had lacked such a technique previously, and the counterparts evaluated it very highly as an effective and efficient practice.

In light of the above, despite the period of cooperation being kept to plan, project costs were higher than planned. In addition, although the implementation structure had room for improvement,

on-site technical instruction was provided in an effective and efficient manner. Therefore, the efficiency of the project is fair.

3.4 Sustainability (Rating: ③)

3.4.1 Related Policy towards the Project

As shown in Table 12, investments in the Programa as a percentage of investments in water supply projects are increasing year by year. Following completion of the project, activities for reducing the Non-Revenue Water Rate are being actively carried out at each business unit based on the Program. With an aim of reducing the Non-Revenue Water Rate in SABESP water service areas—which is the Overall Goal of the project—the sustainability of policy is evaluated as having been enhanced.

Table 12: Percentage of SABESP’s Investment Plan Accounted for by Investments in the Programa (Unit: Million real)

| | 2009 | 2010 | 2011 | 2012 | 2013 |
|--|------------|------------|------------|------------|------------|
| Water supply projects | 577 | 590 | 664 | 653 | 668 |
| Sewerage projects | 860 | 948 | 835 | 867 | 827 |
| Other | 214 | 213 | 254 | 228 | 231 |
| Total | 1,651 | 1,751 | 1,753 | 1,748 | 1,726 |
| The Program¹ | 181 | 267 | 310 | 328 | 478 |
| The Program / Water supply projects | 31% | 45% | 47% | 50% | 72% |

Sources: SABESP Financial Statement (2008), Corporate Program for Water Loss Reduction (updated version, December 2013).

Note 1: 2009–2012: actual, 2013: planned.

3.4.2 Institutional Aspects of the Implementing Agency

Although there were no changes to the agency’s organizational structure, the number of staff members decreased from 16,850 in 2007 to 15,049 in 2013. The reason for this decrease is that many staff members resigned once payment of pension benefits to active employees was disallowed.³⁶ The number of staff members fell to 15,103 in 2009, and has since been stable.³⁷ The number is unlikely to fall dramatically again. The employee retention rate is high, with many staff members being employed for 15 years or longer. Attempts have been made to raise the motivation of staff members, and this seems to be connected to the high retention rate. For instance, a department for managing non-revenue water was established, and staff members are paid a special bonus if the set target values for reducing non-revenue water are met.

One of the problems raised in the Project Completion Report was that functions were continuing to be outsourced without adequately developing the private-sector operators who take on the operations previously performed by SABESP. In response to the opinion that, from a long-term perspective,

³⁶ Previously, members of staff who continued to be employed even beyond the retirement age of 60 could receive both a salary and the pension. Following criticism of this, salaried workers were no longer able to receive the pension benefits.

³⁷ 15,330 (2010), 14,896 (2011), 15,019 (2012).

further efforts would be needed for building the technical capacity of private-sector operators, it was decided that certification testing based on the developed training program would be conducted by an external organization, ABES. In this way, the system for managing non-revenue water was further strengthened, and the creation of systems for developing private-sector operators was improved. Therefore, the institutional sustainability is high.

3.4.3 Technical Aspects of the Implementing Agency

According to the results of the interview and of the beneficiary survey of staff at Business Units in the pilot areas, it was confirmed that, in MO, more than half of the counterparts were still employed, and the transferred technologies had continued to be used for detecting leaks, testing water pressure and replacing distribution pipes and service pipes. In RS, only a few of the counterparts remained. Advances had been made in the control of non-revenue water for the Slums that had not been addressed during the project period, mainly by the department managing non-revenue water. In RV too, only a few of the counterparts continued to be employed, but after the completion of the project, technologies had been transferred to the younger staff members reassigned from other Business Units, and activities for controlling non-revenue water had been strengthened.

Table 13 shows the five challenges for improving technologies for reducing non-revenue water. Four of these five issues were dealt with in the project. The Japanese yen-loan project also covers four of the issues, and includes the following components. The technologies transferred in this project deal with technical issues for the SABESP measures to reduce non-revenue water, and they are also indispensable for the components of the Non Revenue Water Control Project in Sao Paulo State.

Table 13: Response to Technical Issues, and Components of the Non Revenue Water Control Project in Sao Paulo State

| Technical issue | Project response | Corresponding components of the Non Revenue Water Control Project in Sao Paulo State |
|--|----------------------|---|
| Using water meters to ascertain real losses and apparent losses | Addressed in project | Replacement of service pipes at each household |
| Laying of service pipes and distribution pipes for expanding water supply, and improved quality of maintenance | Addressed in project | Dealing with unauthorized use Replacement of distribution pipes |
| Shortage of experts to design and analyze pipe network | Addressed in project | Division of cities into sectors (DMCs) |
| Improvement of environment for investigating volume of loss (→ need recognized in this project) | Addressed in project | Detection of leaks using nondestructive testing, and repairs Installation of pressure-reducing valves ³⁸ Installation of macrogauges Setting of upper water pressure limit for small-capacity piping Setting of lower water pressure limit for large-capacity piping |
| Understanding of the economic benefits of measures to reduce non-revenue water | Not yet addressed | Not included |

Source: Compiled by the evaluator based on the results of the interview from the TOR Department and of the beneficiary survey conducted during this Ex-Post Evaluation.

³⁸ A device for lowering the pressure of supplied water in the water-supply pipelines so that households can use water at an appropriate pressure.

Some of the transferred technology and provided equipment has diminished in usefulness. In situations where macrogauges (meaning devices for measuring the volume of water in a wide area supplied from water treatment plants) had not been installed, the portable electromagnetic flow meters³⁹ provided in fiscal 2007 and fiscal 2009 were regarded as a useful means of measuring the pressure and volume of water. However, at the time of the Ex-Post Evaluation, progress had been made in installing macrogauges in Service Area M in the Greater Sao Paulo region, and the need for the above flow meters here has lessened. It is expected that their use will be limited to Service Area R in the suburbs of the Greater Sao Paulo region where macrogauges have not yet been installed, and in regions where both flow rate and water pressure are low and so leaks cannot be detected using macrogauges. Thus, while the usefulness of the transferred technology and equipment has diminished in some areas as advances have been made in technology, they have responded by independently developing alternative technologies, and therefore the technical sustainability can be judged as having been strengthened.

3.4.4 Financial Aspects of the Implementing Agency

As shown in Table 14, SABESP's financial situation is good. Its operating profit margin in 2012 was greater than 26%, and its net income amounted to 1,911.9 million real. In conjunction with a growing awareness regarding the need for measures to reduce non-revenue water, it is expected that SABESP will continue to secure its required budget, and therefore, there are no problems with respect to financial sustainability.

Table 14: Summary of SABESP Financial Data, 2010–2012 (Unit: Million real)

| Summary of SABESP financial data | 2010 | 2011 | 2012 |
|---|-----------|-----------|-----------|
| Net operating income | 9,231.0 | 9,941.6 | 10,754.4 |
| Cost of operation and management, facilities, and maintenance | (5,194.5) | (6,031.1) | (6,465.4) |
| Gross profit | 4,036.5 | 3,910.5 | 4,289.0 |
| Selling expenses | (712.9) | (619.5) | (697.8) |
| Administrative expenses | (653.2) | (846.6) | (726.1) |
| Operating profit | 2,672.2 | 2,354.3 | 2,845.3 |
| Operating profit margin | 28.9% | 23.7% | 26.5% |
| Financial income (expenses), net | (379.4) | (633.6) | (301.4) |
| Net income | 1,630.5 | 1,223.4 | 1,911.9 |

Source: SABESP Annual Report (Form 20-F) (2012).

In light of the above, no problems have been observed in the policy background and the institutional, technical and financial aspects of the counterpart agency. Therefore, the sustainability of the project effects is high.

³⁹ A device for measuring the flow of conductive liquids (water), which is able to be moved or transported. In this project, the meters were loaded onto SABESP vehicles and moved to wherever necessary to measure flow.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project was conducted with the aim of developing human resources and creating the systems needed to reduce non-revenue water at SABESP, in order to achieve the stable supply of water in the State of Sao Paulo.

Non-revenue water control has been one of the highest priority issues in the state which has a large population and scarce water resources. The project is also in line with the Brazilian development plan which aims at the effective utilization of water resources. Therefore, the project's relevance is high. There were some problems regarding the project implementation systems such as the insufficient number of local coordinators deployed. Nonetheless, technology transfer through OJT promoted communication between engineers and administrators, and led to non-revenue water control at the pilot areas. However, there were only limited activities to disseminate the output obtained at the pilot areas to the rest of SABESP's service area, and this negatively affected the Project Purpose achievement level. In contrast, SABESP strengthened its non-revenue water control based on the output obtained at the pilot areas. As a result, the Overall Goal is expected to be achieved. Therefore, the effectiveness/impact of the project is fair. Although the project period and the elements of inputs were mostly within the plan, the project cost slightly exceeded the plan. Therefore, the efficiency of the project is fair. SABESP is the largest business entity in Latin America with the fully equipped business implementation system and a high level of technology. It has good financial standing and is expected to allocate a budget for non-revenue water control into the future. Therefore, the sustainability of the project effects is high.

In light of the above, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

In implementing measures to reduce non-revenue water, the following two recommendations are offered.

The first recommendation is to establish clear standards regarding the definition and calculation of the volume of water for social purposes, and to promulgate this to all Business Units. At the time of the Ex-Post Evaluation, business operations were being conducted while these remained ambiguous. For the purpose of controlling non-revenue water, monitoring must be conducted based on a uniform definition and method of calculation, and then countermeasures must be examined based on the results of this monitoring.

The second recommendation concerns the promotion of measures to reduce non-revenue water in Slums. In this project, given that assistance in Slums is affected immensely by external factors, apart from some studies, they were excluded from the cooperation. Because the measures will require the involvement of the municipality, the police and other organizations, a strategy needs to be formulated based on a medium to long-term perspective, and an integrated action plan needs to be implemented.

4.2.2 Recommendations to JICA

After completion of the project, in an attempt to raise the bar for strengthening measures to reduce non-revenue water, SABESP took the training courses which had been demonstrated in the pilot areas and developed based on the many experiences and lessons learned, and introduced them into the national accreditation organization. In view of the need for measures to reduce non-revenue water in Brazil, it is recommended that JICA provide assistance for supporting dissemination of the knowledge and experiences accumulated in SABESP with regard to non-revenue water control, and for supporting the adoption by other states of the certification system introduced for strengthening non-revenue water control.

4.3 Lessons Learned

(1) Consideration of measures for facilitating communication prior to the start of local operations

At the start of the project, there were miscommunications between the Japanese side and the Brazilian side because of differences in language and culture, and these hindered various procedures at the preparatory stage. If the activities at MO could have been implemented sooner, it is possible that the knowledge and experience obtained from these activities would have been gleaned earlier, and even more transferred technology could have been applied to other pilot areas. In addition, the biggest challenge in this project—namely, dissemination of knowledge and experiences to other Business Units—could have been done more smoothly. Although this largely depends upon the communication skills of the counterparts and experts, in cases where such issues are envisaged, it is preferable that communication problems be prevented by assigning a person working as both interpreter and local coordinator, at Japan's expense, from the start of the project.

(2) Formulation of plans attuned to the Project Purpose, and active use of local resources

The aim of this project was to improve SABESP's overall non-revenue water control technology based on activities in the pilot areas. However, much of the limited resources were allocated to technical support in pilot areas, and inputs for dissemination were restricted. Ultimately, this negatively affected the achievement level of the Project Purpose. A major premise when forming a technical cooperation project is that consideration will be given to necessary and appropriate inputs in view of the objective, and that a reasonable plan will be formulated. Consideration should also be given to actively utilizing local resources and to taking consistency with the plan into account, for example, assigning experts who not only have technical competence but who are also proficient in dissemination activities. The appropriate assignment of counterparts is also an example of this. In cases where ambitious objectives are set with respect to the dissemination of technology, a mechanism for achieving this also needs to be incorporated into the project. During the project period, SABESP independently employed a local consultant, implemented a program called the Methods of Analysis and Solution for Water Losses and Non-revenue Water Problems (MASPP), and in the end, fostered an awareness for non-revenue water control among all Business Units. Although, in practice, these two

schemes were implemented separately, if the technical assistance provided through this project could have been incorporated into the MASPP, the capacity for non-revenue water control could have possibly been better enhanced across all Business Units.

(3) Development of the best implementation structure for executing business operations

SABESP's water service area is extremely vast, equivalent to the size of Honshu in Japan. The pilot areas are also several hundred kilometers apart. Despite the project covering such an extensive district, only one coordinator was assigned. Moreover, the coordinator was posted to the SABESP headquarters, and it was difficult for SABESP to grasp the situation in each district. This meant that there were often delays in confirming the progress of activities. In cases where the project target area is vast or where project sites are scattered, in order to conduct project operations smoothly, and in order to strengthen the transfer of technology in local areas, the most appropriate implementation structure should be developed, such as assigning coordinators from among staff members of the implementing agency who are working in each respective area.

(4) Promotion of coordination between technical cooperation projects and yen loan projects, and the selection and concentration of assistance

In non-revenue water control, both fundamental measures and preventive measures are important. During the project, it was suggested that, in addition to the technical cooperation project, ongoing support from Japan be sought to back up these preventive measures, and based on this suggestion, SABESP made a request for a yen-loan project. A project making use of a yen loan is able to immediately promote effective measures not possible in technical cooperation projects because of budgetary constraints, such as the large-scale replacement of distribution pipes and service pipes. This also served as an incentive to SABESP for non-revenue water control, and utilizing the human resources developed in the technical cooperation project, formulation of the Corporate Program for Water Loss Reduction was realized, and a training system that also included the private sector was built. Thus, combining support for "soft" components through technical cooperation projects together with support for "hard" components through yen loans is an effective means that also fits JICA's aid policy of selection and concentration.

(5) Clearer definitions of indicators used in projects relating to measures to reduce non-revenue water

According to the International Water Association (IWA) and the policy for supporting the international expansion of Japan's water supply industry,⁴⁰ non-revenue water is defined as the system input volume less the billed authorized consumption which has actually been charged. That corresponds to the Non Revenue Water Rate (NRW). In contrast, even while recognizing similar indicators to the IWA, SABESP uses non-revenue water rate (IPF) calculated by subtracting the

⁴⁰ Source: Ministry of Health, Labor and Welfare, "FY2009 Survey Report on International Contributions to Water Supply Services" (2009).

volume of water on a billed basis and the volume of water for social purposes from system input volume, as well as micro-measured water rate (IPM) calculated by subtracting the volume of water on an actual use basis and the volume of water for social purposes from system input volume. Water theft, such as water stolen in Slums, is recognized in the volume of water for social purposes, not in the volume of apparent losses.

In this project, taking into account Brazil's specific circumstances, micro-measured water rate (IPM) was used as the evaluation index, and the volume of apparent losses in Slums was included in the volume of water for social purposes. However, in the Ex-Ante Evaluation Report and the Project Completion Report, the definition of non-revenue water has been used ambiguously in statements, NRW and IPM have been mixed together, and the definition of the volume of water for social purposes has not been clearly stated. To get an accurate understanding of the project effects, it is imperative that target values be monitored and reports prepared with an awareness of how these indicators are defined and distinguished.

End.