Ex-Post Project Evaluation 2020：

Package Ⅳ-3 (Peru, Paraguay, India)

March 2022

JAPAN INTERNATIONAL COOPERATION AGENCY

GLOBAL GROUP 21 JAPAN, INC.
OPMAC C.

EV
JR
21-52

Disclaimer

This report compiles the result of the ex-post evaluations. These are conducted by external evaluators to ensure objectivity, and the views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of the English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this report is posted on JICA's website.

Comments by JICA and/or the Counterpart Agencies may be added at the end of the evaluation report when the views held by them differ from those of the external evaluator.

Republic of Peru

FY2020 External Ex-post Evaluation Report of Japanese ODA Loan

"Cajamarca Water Supply and Sewerage Improvement and Expansion Project"

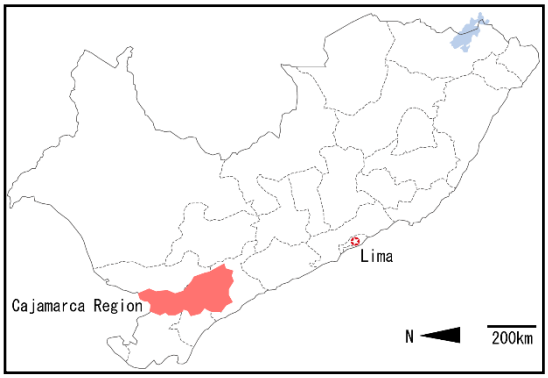
External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

0. Summary

"Cajamarca Water Supply and Sewerage Improvement and Expansion Project" (hereinafter referred to as "the Project") was implemented for the purpose of improving water supply and sewerage services in Cajamarca Region by rehabilitating and expanding the water supply and sewerage facilities in small and medium-sized cities in the Region, thereby contributing to the improvement of the living environment of the residents. The Project is highly relevant to the development policies, plans and development needs of the Republic of Peru (hereinafter referred to as "Peru") and Cajamarca Region both at the time of planning and ex-post evaluation. The Project is also highly consistent with Japan's aid policy at the time of planning, and therefore, the relevance of the Project is high. Both the project cost and project period are much larger than planned, and, as of June 2021, the Project is not completed having some sewage treatment plants (hereinafter referred to as "STP") not being constructed. Therefore, the efficiency of the Project is low. The achievement level of the Project on the coverage of water supply and sewerage services is high, but the achievements related to water supply time and sewage treatment are moderate. While the residents are not much satisfied with the improvement of water supply service in the already-connected water supply areas but are highly satisfied in the areas where water supply services were newly expanded. While, the residents are highly satisfied with the improved sewer service in general. It was also confirmed that the Project contributed to the improvement of water-related convenience and the improvement of the residents' sanitary environment. Based on the above, the effectiveness and impact of the Project are fair. The transfer of ownership of the completed facilities to the cities and the transfer of operation rights of the water supply and sewerage facilities from the cities to the Water Supply and Sewerage Public Corporation (hereinafter referred to as "EPS") have not yet been completed, so the institutional / organizational setup of operation and maintenance of this Project remains uncertain. In addition, the cities, which may operate and maintain some of the facilities in the future, face technical and financial challenges. Therefore, the sustainability of the Project is fair.

In light of the above, the Project is evaluated to be unsatisfactory.

1. Project Description



Project Location

Water Treatment Plant in Jaén

1.1 Background

In Cajamarca Region (regional population 1.34 million in 2017, including 200,000 in the regional capital: Cajamarca City), located in the mountainous area of northern Peru, water supply and sewerage facilities were established in the 1960s - 1970s, but since then there has been no significant investment in new construction or renewal of the facilities. As a result, by the latter half of the 2000s, the facilities were aging, and insufficient services were being provided in terms of quality and quantity to meet the growing demand caused by population growth. In addition, many cities outside the regional capital did not have STPs, and untreated sewage was discharged into rivers, raising concerns about the impact on the living environment of local residents and agriculture. The Garcia administration of Peru, which took office in 2006, had launched the “Water for All” program to strengthen state investment in the water and sewerage sectors. The Regional Government of Cajamarca, which took office in 2007, positioned the water and sewerage sector as a regional issue and proposed a policy that the regional government would improve its water and sewage systems through external loans, using mining royalty revenues as the source of repayment. Against this background, the Peruvian government requested an ODA loan project from Japan in 2007 to improve the water supply and sewerage systems in the local cities of Cajamarca Region, and a loan agreement for the Project was signed in 2009.

1.2 Project Outline

To improve water supply and sewerage services in Cajamarca Region by rehabilitating and expanding the water supply and sewerage facilities in small and medium-sized cities in the Region, thereby contributing to the improvement of the living environment of the residents.

Loan Approved Amount / Disbursed Amount	4,995 million yen / 4,717 million yen
Exchange of Notes Date / Loan Agreement Signing Date	November 2008 / March 2009
Terms and Conditions	Interest Rate: Water: 0.8%, Sewerage: 0.4% Consulting services 0.01% Repayment Period: 15 years (Grace Period: 5 years) Conditions for Procurement: General Untied
Borrower / Executing Agencies	Republic of Peru / Cajamarca Region Program Implementation Unit (PROREGION)
Project Completion	Not yet completed as of October 2021
Target Area	11 local cities in Cajamarca Region[1]
Main Contractors	BM3 Obras y Servicios S.A. (Spain), Cobra Instalaciones y Servicios S.A. (Spain), HV Contratistas S.A. (Peru) / Obras de ingeniería S.A. (OBRAINSA) (Peru)
Main Consultant	NJS Co., Ltd. (Japan)
Related Studies	Feasibility Study by Cajamarca Region (2008)
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study: December 2020 - March 2022

Duration of the Field Survey: May and September 2021 (by local consultants)

2.3 Constraints During the Evaluation Study

Due to the pandemic of COVID-19, the external evaluator did not travel to Peru, but conducted interviews with the executing agencies, the field inspection of the water supply and sewerage facilities constructed by the Project, and interviews with water users and others through the local assistants. The collected information and data were carefully examined, and evaluation analysis and judgment were conducted by the evaluator.

[1] Celendín, Cajabamba, San Marcos, San Pablo, San Miguel, Hualgayoc, Contumaza, Chota, Bambamarca, Cutervo, and Jaén.

3. Results of the Evaluation (Overall Rating: D[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Consistency with the Development Plans of Peru

As mentioned in "1.1 Background," at the time of planning of the Project, the Garcia administration, which was inaugurated in 2006, was emphasizing the water supply and sewerage sectors, and the Regional Government of Cajamarca, which was inaugurated in 2007, was proposing a new scheme in which the Region would be responsible for infrastructure improvement of water supply and sewerage sectors.

At the time of the ex-post evaluation, Peru's "National Sanitation Policy" (2017-2021) was based on such policy axes as increasing water supply and sewerage coverage, financial sustainability, strengthening the capacity of service providers, applying optimal technologies, coordination with relevant organizations, and educating and enlightening the public about water and sanitation. The "National Sanitation Plan" (2017-2021) prepared in line with the policy has the main objective of "universal and sustainable access to quality water supply and sewerage services" and aims at achieving 100% urban water supply coverage, 22 hours/day of water supply, 100% sewerage coverage, and 100% sewage treatment by 2021.

Based on the above, the Project is highly consistent with the development plans of Peru both at the time of planning and ex-post evaluation.

3.1.2 Consistency with the Development Needs of Peru

As described in "1.1 Background," the water and sewerage facilities in Cajamarca Region were not able to provide sufficient services in terms of quality and quantity. In addition, in many cities outside of Cajamarca City, there were concerns about environmental impacts due to the untreated direct discharge of sewage around residences or into rivers.

At the time of ex-post evaluation, the facilities constructed under the Project have been utilized and have resulted in the increase of water supply and sewerage service coverage, improvement of water supply service quality and increase of sewage treatment in the 11 target cities (see "3.3.1 Effectiveness"). However, the indicators such as water supply and sewerage service coverage rate, water supply time, and sewage treatment rate have not reached the above policy targets, and the need for water supply and sewerage service improvement is still high at the time of ex-post evaluation.

Based on the above, it is concluded that the Project is relevant with the development needs of the Cajamarca Region at the time of planning and that the need for the Project

[2] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[3] ③: High, ②: Fair, ①: Low

is maintained at the time of the ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

At the time of planning, JICA had positioned the reduction of poverty and disparity as one of the priority areas in its assistance to Peru and was working on water supply and sewerage system development as one of the priority issues. As the implementation of the Project was in line with this policy, the Project was found to be consistent with Japan's ODA policy at the time of planning.

3.1.4 Appropriateness of the Project Plan and Approach

At the time of planning, water supply and sewerage services in three of the 11 cities were operated by the two EPSs of Cajamarca Region[4]. In the other 8 cities, they were directly operated by the relevant departments / units of each city[5]. It was planned that, after the completion of the Project, the operation rights of water supply and sewerage facilities, including the facilities to be constructed by the Project, would be transferred to one EPS which was considered to have higher operational capacity, and EPS and the mayors of each city had agreed to this in writing through the letters addressed to the regional government. For the transfer to be realized, each city needed to sign a transfer agreement with EPS after obtaining approval of the respective city council, but this was not done.

After the start of the Project, the mayors of all cities were changed in the elections. Many of the mayors at the time of the ex-post evaluation were negative toward the operation by EPS in consideration of the opposing opinions of the residents who feared the fee increase after the transfer, and it is unclear when the transfer to EPS would be realized[6]. Training was provided by the Project to the city staff in charge of operation and maintenance management, and once the transfer of the facilities constructed by the Project to EPS was realized, the staff who had received the training were scheduled to continue to be employed by EPS. However, while the transfer was not realized, most of the staff in charge were replaced, and the results of the training were lost. Therefore, the technical capability of the cities for the operation and maintenance of the facilities remains an issue. In this way, although it was planned that the operation rights of the water supply and sewerage services in the eight cities of the Project would be transferred

[4] EPS SEDACAJ operated the water supply and sewerage services in San Miguel and Contumaza, and EPS MARAÑON operated the water supply and sewerage services in Jaen.
[5] Celendín, Cajabamba, San Marcos, San Pablo, Hualgayoc, Chota, Bambamarca, and Cutervo.
[6] Prior to the transfer from the cities to EPS, the ownership of the Project's facilities must be transferred from PROREGION to the cities. However, at the time of the ex-post evaluation, this process had not yet been completed. It should be noted that Peruvian law allows cities to operate water and sewage services under certain conditions. (For details, please refer to "3.4 Sustainability")

to EPS, the Project proceeded without concrete transfer agreements being finalized, and this has left issues of sustainability. In view of the above, it can be considered that there were insufficient aspects in the planning and preparation of the operation and maintenance arrangement of the Project, but it cannot be said that this has undermined the Project's relevance.

Based on the above, the Project has been highly relevant to the Peru's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

Figure 1 Location of the Cities Targeted by the Project

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

In the Project, water supply and sewerage facilities in 11 target cities were constructed or rehabilitated. The planed and actual outputs are shown in Table 1. There were various changes in the scope of the Project due to (i) the differences from the natural conditions (geology, topography, amount of spring water production, etc.) assumed at the time of planning, (ii) the differences from assumptions about the conditions of existing facilities, (iii) the intentions of landowners and surrounding residents, and (iv) the results of technical re-examination (see Table 1).

Table 1 Planned and Actual Outputs of the Project (as of June 2021)

	Planned outputs	Actual outputs	Differences and remarks
Water Supply			
Water intake	Rehabilitation: 13 facilities (211 l/s) Construction: 1 facility (11.0 l/s)	Rehabilitation: 13 facilities (225 l/s) Construction: 3 facilities (38 l/s)	Total intake capacity of rehabilitated / constructed facilities is 118% of the plan. Some locations were changed due to inability to obtain land.
	9 cities	11 cities	
Conduit	Rehabilitation: 57.0 km Construction: 19.1 km	Rehabilitation: 43.0 km Construction: 24.4 km	Total length of the conduit rehabilitated and constructed was 89% of the plan. Locations and extension of the conduit were adjusted to match with the current condition of the facilities.
	10 cities	10 cities	
WTP	Rehabilitation: 2 facilities (35 l/s) Construction: 2 facilities (305 l/s)	Rehabilitation: 2 facilities (35 l/s) Construction: 2 facilities (305 l/s)	As planned
	4 cities	4 cities	
Distribution reservoir	Rehabilitation : 11 facilities (3,934 m^3) Construction: 7 facilities (7,440 m^3)	Rehabilitation: 9 facilities (3,884 m^3) Construction: 7 facilities (7,440 m^3)	Construction was as planned. Rehabilitation was 81% of the plan.
	8 cities	8 cities	
Water main / distribution pipes	Rehabilitation: 65.4 km Construction: 191.0 km	Rehabilitation and Construction: 286.3 km	Total length of rehabilitated and constructed pipes was 112% of the plan.
	11 cities	11 cities	
House connection	Rehabilitation: 21,033 Construction: 9,332	Rehabilitation and construction: 33,741	Number of rehabilitated and constructed connections was 111% of the plan.
	11 cities	11 cities	
Sewerage			
House connection	Rehabilitation: 18,383 Construction: 12,168	Rehabilitation and construction: 30,896	Number of rehabilitated and constructed connections was 101% of the plan.
	11 cities	11 cities	
Sewer pipes	Rehabilitation: 191.9 km Construction: 81.1 km	Rehabilitation and Construction: 285.0 km	Length of rehabilitated and constructed pipes was 104% of the plan.
	11 cities	11 cities	
Pumping station	Construction 3 facilities	Construction 1 facility	Partially cancelled because relevant STP was not built.
	2 cities	1 city	
STP	Construction: 8 facilities (18,517 m^3/day)	Construction: 5 facilities (14,809 m^3/day)	Not completed in three cities due to opposition from residents (see note). In one city where it was constructed, treatment capacity was expanded to meet the demand. Total treatment capacity was 80% of the plan.
	8 cities	5 cities	

(Source) Prepared by the evaluator based on materials provided by JICA and PROREGION.
(Note) Five STPs were constructed in Celendín, Cajabamba, Hualgayoc, Cutervo, and Jaén, and three STPs were planned but not constructed in San Pablo, Chota, and Bambamarca.

In particular, the construction of STPs of the oxidizing pond type (anaerobic oxidizing pond + aerated pond), which requires a large area of land, was suspended or cancelled in three of the four cities where this type of STP was planned, as it was difficult to secure land for such plants and / or it was difficult to obtain the consent of

the surrounding residents from the standpoint of odor and aesthetics[7].

The background, current status, and future outlook for the planned and actual results are as follows.

- In the Project, the 11 target cities are divided into 3 groups (6 southern cities: Celendín, San Marcos, Cajabamba, San Miguel, San Pablo, and Contumaza; 4 central cities: Bambamarca, Cutervo, Chota, and Hualgayoc; and 1 northern city: Jaen), and the construction contracts for each group were signed in June 2010.

- The construction period for the six cities in the southern area was planned to be 360 days. However, disputes arose between the construction contractor (a Peruvian company) and the residents who wanted more favorable compensation conditions and the residents who did not want privatization by EPS after the Project. The construction works were significantly delayed due to the time required for mediation and site compensation talks, interruptions due to rainfall, and design changes in response to the actual geology. The contract was terminated by 2015 with a progress rate of about 85%. According to PROREGION, a dispute arose with the construction contractor over the power supply required for the construction, and after PROREGION won the case, the construction contractor withdrew. The contractor started with the construction in those areas that did not require consultation with the residents, leaving only the works in the areas that required consultation with the residents. Regarding the completed works, there was no adequate response to the defects, nor testing and commissioning.

- The construction period for the four cities in the central area was planned to be 360 days, but construction was significantly delayed due to difficulties in negotiating the land acquisition with residents who seek additional compensation in all cities, interruptions due to rainfall, and design changes based on actual geology and changes in construction sites. The contract was terminated by 2015 with a progress rate of about 76%. According to PROREGION, the contract was terminated as the construction contractor (a Spanish company) applied for termination of the contract due to its financial problems. Some part of the work was abandoned in the middle of execution, and even for the completed works, there was no adequate response to the defects, nor testing and commissioning.

[7] As for the unconstructed STPs, based on the discussion with JICA, PROREGION is considering removing them from the scope of the Project and implementing it as new projects, because it is necessary to find a new site and start from the planning study again.

- The construction period for one city in the northern area was planned to be 360 days. Due to the time required to acquire the land for the STP, design changes in accordance with the actual geology, changes in the site for the STP, and additional works required by technical examinations, the construction work was significantly delayed and was completed in November 2013. The construction contractor was a Spanish company.

- Since the initial contracts were terminated without completion in the southern and central areas, PROREGION has been addressing remaining works and defects since 2015 through 22 contracts in the southern area, 10 contracts in the central area, and the works by direct management. The reason for the large number of contracts is that PROREGION has been implementing the works sequentially, starting from the works for which coordination with the residents has been completed in each city. As of September 2021, the works have been completed in eight out of 11 cities, while the detailed design for the construction of the unfinished STPs in two cities (Chota and Bambamarca) had started at new candidate sites. However, these activities have been suspended in both cities due to opposition from residents. In addition, the construction of the STP in San Pablo has been suspended since 2017 due to the opposition of the residents and there is no prospect for its completion, therefore, based on the discussion with JICA, PROREGION decided not to complete it under the scope of the Project.

- PROREGION is progressively transferring the completed facilities to the cities (see "3.4 Sustainability"), but new defects may be found out in the process, and additional repair works might be required.

- As for the STPs in eight cities, the feasibility study of the Project (2008) identified the specific construction site and the basic design of each facility. According to PROREGION, at that time, the landowners of the planned site for the STPs and the access roads, as well as the residents in the vicinity, were briefed on the Project, and there were no particular oppositions from the residents. In most of the cases where opposition arose afterwards in the implementation stage, the residents demanded higher compensation for the land[8]. In addition, the existing STP had been experiencing problems such as bad odors, which led to distrust of the STP itself, which made it difficult to discuss with the residents.

[8] According to PROREGION, some of the residents demanded compensation several times the amount stipulated by law. This is no longer a social issue, but a legal one, but the prosecuting authorities have not intervened and the matter has been resolved through discussion.

- In three of the 11 cities covered by the Project, the two EPSs of the Cajamarca Region (EPS SEDACAJ and EPS MARAÑON) operated the water supply and sewerage services, while in the remaining eight cities, the municipal governments operated the services. It was assumed that, after the completion of construction of the water supply and sewerage facilities through the Project in these eight cities, the right to operate the facilities would be transferred to EPS SEDACAJ. In order for EPS to receive the facilities, it is necessary that the facilities have specifications and construction quality that are acceptable to EPS. Therefore, in the Project, EPS dispatched engineers to PROREGION and the consultant to support the detailed design and implementation. However, according to PROREGION and EPS, this support was mainly provided in regard with the three cities where EPS were already in charge of the operation of the water and sewerage facilities, while limited support was provided to the other eight cities where the water supply and sewerage service transfer contracts had not yet been concluded.

STPs constructed and in operation under the Project
Left: Celendín (oxidation pond method) Right: Cajabamba (tricking filter method)

- In the interviews conducted with each city at the time of the ex-post evaluation[9], several cities pointed out problems with the water supply facilities and raised questions about the construction capacity of the contractors and the management capacity of the consultant (a Japanese company). However, it appears that some of the problems pointed out are operation and maintenance issues (see “1.4.4 Technical Aspects of Operation and Maintenance”), and not all of them are

[9] In the ex-post evaluation, interviews were conducted with all 11 cities, and the water and sewage facilities of each city constructed by this project were inspected through the local consultants.

necessarily considered as weaknesses in design and construction. On the other hand, the consultant of the Project received a warning by JICA because inadequate procedures related to documents and drawings were pointed out by the Government of Peru. In addition, PROREGION expressed doubts about the consultant's performance in design, construction supervision, payment management, etc., and terminated the contract in November 2017 due to the consultant's failure to fulfill some of contractual obligations. It was also found out that there was a period when PROREGION did not report to JICA the fact that various problems occurred in the Project and many contract changes were made, and JICA, after it became aware of the problems, repeatedly sent to the field its staff and independently hired local engineers to support the implementation of the Project.

3.2.2 Project Inputs

3.2.2.1 Project Cost

The total cost of the Project was planned to be 11,133 million yen (yen loan: 4,995 million yen); as of June 2021, the actual project cost was 19,871 million yen (178% of the plan). The outputs at this moment do not include the uncompleted STPs, and the project cost is expected to increase further when their cost is considered. Therefore, it is judged that the efficiency of the cost of the Project is low.

Table 2 Planned and Actual Project Costs (as of June 2021)

(Unit: Millions of yen)

	Planned cost			Actual cost		
	Total	ODA loan	Peruvian Funds	Total	ODA loan	Peruvian Funds
Civil works	7,740	3,877	3,863	13,714	3,862	9852
Consulting services	876	876	0	1,714	855	859
Price escalation	4	4	0	-	-	-
Contingency	431	238	193	-	-	-
Land acquisition	14	0	14	33	0	33
Administration cost	272	0	272	1,388	0	1,388
Tax	1,720	0	1,720	2,938	0	2,938
Others	76	0	76	84	0	84
Total	**11,133**	**4,995**	**6,138**	**19,871**	**4,717**	**15,154**

(Source) Prepared by the evaluator based on materials provided by PROREGION and JICA.
(Notes) Exchange rate: planned 1 sol = 35.13 yen, actual 1 sol = 33.64 yen (average rate for 2011-2020)
The tax amount is estimated from the cost of civil works and consulting services.

Total contract value of the first three civil works contracts in the northern, central and southern areas subject to the ODA Loan had increased by 12% up to October 2013 due to contractual modifications. The main reasons for this increase included additional costs due to geological and other conditions in the target areas different from those assumed in the design stage, additional facilities which were not considered in the detail design, design changes based on technical examinations [10]. In the south and central areas, the initial construction contractors terminated the contract without completing the works, and PROREGION has carried out the remaining works and repairs of defects under a number of contracts and direct management since 2016. According to the management system of public investment projects of the Peruvian Ministry of Economy and Finance, by June 2021, the total cost of civil works had increased by 33% from the value of the first contracts. According to PROREGION, the increase in costs was due to the inefficient implementation of the remaining works due to the large number of small contracts in each city, the repair of numerous defects left by the first contractors, and repairs that became apparent after the start of construction.

3.2.2.2 Project Period

The Project was planned to be implemented in 31 months from the signing of the loan agreement in March 2009 to the start of operation of all facilities in September 2011. In fact, the loan agreement was signed in March 2009 as planned, but as of June 2021, the Project is not yet completed because some STPs are not yet in operation or unconstructed. By June 2021, the project period reached 11 years and 4 months (136 months, 439% of the planned period), and the efficiency of the project period is judged to be low.

Of the 11 target cities, the earliest construction completion was in Jaen of the northern area, which was completed in November 2013. After that, the remaining works in six cities in the southern and central areas were completed successively between 2018 and 2021, but three cities (San Pablo, Chota, and Bambamarca) that have not yet constructed STPs are still incomplete. In each city, excluding some STPs, the completed facilities have been operated successively by PROREGION, the respective cities and EPS, but the process of transferring the facilities to a permanent operation and maintenance entity (EPS or city) has not been completed in any of the cities (see “3.4 Sustainability”).

The main reasons for the delay in the project implementation were, as mentioned above, the time required for land acquisition and consultation with local residents in the

[10] According to PROREGION, the detailed design of the Project was carried out in a short period of time with little involvement of the city, which left numerous technical weaknesses. In addition, the geological survey was not sufficiently carried out.

first contracts, the time required for technical examinations and design changes according to the geology and local conditions, and the interruption of construction due to rainfall and other factors [11]. After that, a number of contracts were made with different contractors for the remaining work by PROREGION.

3.2.3 Results of Calculations for Internal Rates of Return (Reference only)

At the time of planning, the financial internal rate of return (FIRR) and economic internal rate of return (EIRR) for the Project were calculated to be 6.5% and 11.9%, respectively, based on the following assumptions.

Costs	FIRR:	Initial investment and operation and maintenance costs
	EIRR:	Initial investment and operation and maintenance costs (economic costs)
Benefits	FIRR:	Fee revenue
	EIRR:	Decrease in health care costs due to improved sanitation
Project life:	20 years from the start of operation	

In this ex-post evaluation, no recalculation was carried out because the Project is not yet completed, the details of the calculation process at the time of planning were unknown, and the data necessary for recalculation were not available.

Based on the above, both the project cost and project period significantly exceeded the plan. Therefore, efficiency of the Project is low.

3.3 Effectiveness and Impacts [12] (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

The purpose of the Project is to improve the water supply and sewerage services in the 11 target cities, and the indicators listed in Table 3 had been set for the 11 target cities as a whole. Below, the project effects are analyzed from the perspective of water supply service coverage, water supply time, sewerage service coverage and sewage treatment.

[11] According to PROREGION, the most significant factor contributing to the increased project period was the time required for land acquisition and consultation with residents.
[12] The impact is also taken into account in determining the effectiveness of the rating.

(1) Coverage of water supply services (level of achievement: high)

The number of water supply connections in the 11 cities increased from 32,754 in 2007 to 53,768 in April 2021. This is 164% of the number of connections in 2007 and 103% of the target of 52,197 for 2020. The increase from 2007 to April 2021 was 21,014. The Project has contributed to this increase by constructing about 200 km of water distribution network and about 10,000 connections [13]. The water supply coverage rate in the 11 cities increased from 67.5% in 2007 to 87.9% in 2020. This is 92% of the target of 95.4% for 2020. Based on the above, it is judged that the achievement of the target for the coverage of water supply services is high.

Table 3 Plan and Achievements of Operation and Effectiveness Indicators

Indicator	Baseline value (2007)	Target value*** (2020)	Actual value (2020)	Rate of achievement (2020)
Water supply:				
Population served (11-city total)	113,912	190,065	194,064**	102%
Water supply time (11-city average)	13.7 hr/day	24 hr/day	17.5 hr/day	73%
Coverage rate (11-city average)	67.5%	95.4%	87.9%	92%
No. of connections (11-city total)	32,754	52,197	53,768*	103%
Sewerage:				
Population served (11-city total)	106,940	188,186	181,583**	96%
Sewage treated (11-city total)	7,599 m^3/day	Unknown	Unknown	-
Coverage rate (11-city average)	63.3%	94.4%	82.2%	87%
No. of connections (11-city total)	29,918	52,069	50,310**	97%
BOD concentration (after treatment)	-	-	(See text.)	(See text.)

(Source) Based on data provided by JICA for baseline and target values, data provided by PROREGION and interviews with each city for the actual results in 2020.

(Note) * Number of service contracts as of the end of April 2021.

** Estimates based on each city's water and sewage connection rates, total population, and average household size (persons/household).

*** At the time of ex-post evaluation, the target year (in this case, 2013, two years after the planned completion of the Project) and target values set at the time of planning are usually used, but since this Project is not yet completed, the 2020 target values in the feasibility study report of each city were used.

[13] A breakdown of the actual construction and actual rehabilitation was not available. Therefore, estimation was made based on the planned breakdown figures and the actual total figure. It should be also noted that, regarding the number of water supply connections, most of the increase of some 11,000 over the Project's direct contribution of some 10,000 was added by each city after the construction of connections by the Project.

(2) Water supply time (achievement level: moderate)

The water supply time increased from 13.7 hours/day in 2007 to 17.5 hours/day in 2020 (13.8 hours/day during dry period from May to September and 20.1 hours/day during other periods). The plan was to achieve 24-hour water supply in all cities in 2013, but only two cities, Bambamarca and Jaén, actually achieved 24-hour water supply throughout the year. Five cities, namely Cajabamba, San Miguel, Hualgayoc, Contumaza and Cutervo, achieved 24-hour water supply except during dry periods, while the other four cities did not achieve 24-hour water supply throughout the year. The achievement rate of water supply time is 73% (17.5 hours ÷ 24 hours), and the achievement of the target is judged to be moderate.

Each ESP and each city, which operates waterworks, controls water supply hours according to water demand and supply conditions. It was pointed out in several cities that the reason for the limited water supply hours is that some residents waste a lot of water by leaving the faucets open or using the water supply for irrigating crops. One of the reasons why residents do not make efforts to conserve water is that water rates are generally kept low, many residents have fixed rate contracts that do not depend on the amount of water used, and some residents still do not agree to pay [14]. This is the result of the city's political decision to operate the water and sewage systems in accordance with the residents' requests. In the Project, water meters were installed in conjunction with the rehabilitation and construction of the connections, and the plan was to have 100% meter coverage. However, some residents refused to do so, and some cities were hardly able to install meters.

Another factor limiting the water supply time is that there are many leaks due to defects in the pressure reducing valves [15]. In the demand forecast at the time of planning, non-revenue water ratio was expected to improve to an average of 27% by 2020, but the same ratio reported by the seven cities at the time of the ex-post evaluation was in the range of 25% to 45% [16].

From the above, it is considered that the non-revenue water ratio is higher than planned due to water wastage and leakage, which is leading to the reduced water supply time [17].In this ex-post evaluation, detailed data on the water quality of each

[14] Water rates in the target cities ranged from 150 - 350 yen (1.3 - 3.0 USD equivalent) per month. Two of the 11 cities had a fee collection rate of less than 5%.
[15] Although the Project is believed to have reduced leakages by replacing many of the aging pipelines and house connections, interviews with the target cities indicated that the pressure-reducing valves used to adjust water pressure were not functioning due to lack of maintenance, and water was distributed with high water pressure, leading to pipeline damage and leakage.
[16] No information was available for the other four cities.
[17] While it was pointed out that the water supply population exceeded projections due to the influx of people from rural areas to cities, the estimated water supply population was only 2% higher than planned. Therefore, this is unlikely to be a major factor in limiting water supply hours.

city's water supply system was not obtained. In each city, disinfection with chlorine is carried out at WTPs or distribution reservoirs. In the Project, WTPs were constructed in two of the 11 cities, and existing WTPs were expanded and improved in two cities. According to EPS MARAÑON, which operates the water supply and sewage system in Jaén, there has been a significant improvement in water quality in the city where a new WTP was constructed under the Project.

(3) Coverage of sewerage services (level of achievement: high)

The number of sewer connections in the 11 cities increased from 29,918 in 2007 to 50,310 in 2020. This is 168% of the number of connections in 2007 and 97% of the target of 52,069 in 2020, and the increase since 2007 until April 2021 is 20,392. The Project has contributed to this increase by constructing about 285 km of sewer pipes and about 12,000 new connections[18]. The sewerage coverage rate of the 11 cities increased from 63.3% in 2007 to 82.2% in 2020. This is 87% of the target of 94.4% for 2020. From the above, it can be concluded that the achievement of the target for the coverage of sewerage services is high.

(4) Sewage treatment (achievement level: moderate)

The Project had planned to construct STPs with a total treatment capacity of 18,517 m^3/day in eight cities, and to increase the volume of sewage treated in 11 cities from 7,599 m^3/day in 2007 to 17,807 m^3/day in 2013. In reality, so far, STPs have not been completed in three cities, and STPs with a total treatment capacity of 15,085 m^3/day have been constructed in five cities. Of these, as of May 2021, the STP in Hualgayoc (with a treatment capacity of 147 m^3/day) was not in operation as it was immediately after completion, and the STP in Cutervo (with a treatment capacity of 3,430 m^3/day) was not in operation due to opposition from residents who dislike the foul odor. Therefore, the total treatment capacity of the STPs constructed under the Project and in operation at the time of the ex-post evaluation is only 11,232 m^3/day in the three cities (Celendín: 3,940 m^3/day, Cajabamba: 2,972 m^3/day, and Jaén: 4,320 m^3/day). This is equivalent to 61% of the planned capacity of 18,517 m^3/day.

In Jaén, it was reported that the existing STP (treatment capacity: 4,320 m^3/day) and the new STP constructed by the Project (treatment capacity: 4,320 m^3/day) are already receiving sewage more than their capacity, but the actual treatment volume data for each STP could not be obtained. On the other hand, the total number of sewer

[18] A breakdown of the actual construction and actual rehabilitation was not available. Therefore, estimation was made based on the planned breakdown figures and the actual total outputs. It should be noted that, regarding the number of sewer connections, most of the increase of some 8,400 over the Project's direct contribution of some 12,000 was added by each city after the construction of connections by the Project.

connections in the three cities where sewage is treated is estimated to be about 30,000, and based on this, the sewage treatment rate for all 11 cities is estimated to be about 60%. At the time of planning, the target was to achieve a 100% treatment rate, so the degree of achievement of the sewage treatment rate is judged to be moderate.

Information on BOD concentrations of untreated sewage and effluent of the STPs in operation in the three cities was not obtained from PROREGION, while the information in Table 4, which is sourced from dissertations, is available for reference. The STP at Celendín is generally operating without problems, but there are no chlorine disinfection facilities, and the bacteria removal efficiency is low. Coliform counts exceed environmental standards for effluent. The STP at Cajabamba and the existing STP at Jaén have low treatment efficiency and BOD concentrations exceed environmental standards. The existing STP at Jaén is an oxidation pond system, but the treatment efficiency is considered to have decreased due to the accumulation of sludge in the treatment ponds, which reduced the effective capacity. No information was available on the treatment efficiency of the STP constructed by the Project in Jaén. In addition to the waterworks operated by EPS MARAÑON, there are a number of unofficial private waterworks in Jaén, which discharge sewage into the sewerage system of EPS MARAÑON. Therefore, it is believed that the STPs are already receiving more sewage than they can accept. The STP of Cajabamba is a combination of an Imhoff tank (two-story initial settling basin) and a tricking filter, and although the filter material seems to be too small, the cause of the low treatment efficiency needs further investigation. The chlorination facility at the STP in Cajabamba is not in operation.

Table 4 Treatment Efficiency of STPs

	Treatment capacity	BOD: untreated sewage	BOD: effluent (Standard: 100 mg/l or less)	Treatment efficiency
Celendín	3,940 m^3/day	324.5 mg/l	87.7 mg/l	83%
Cajabamba	2,972 m^3/day	256.1 mg/l	196.7 mg/l	33%
Jaén (the existing STP) Dry season Rainy season	4,320 m^3/day	 1,840 mg/l 216 mg/l	 1,200 mg/l 190 mg/l	 35% 12%

(Source) Dissertations on the treatment efficiency of sewage treatment plants in Cajamarca Region: Franklin Quispe Cotrina (2019), Dr. Mariela Nuñez Figueroa (2019), Luis Alberto Cabrera Garcia and Lixon Alfredo Zevallos Julca (2019)

In summary, the treatment capacity of the STPs constructed under the Project and in operation is 61% of the planned capacity, and the sewage treatment rate is 60% of the

plan. In addition, since there are still some cities with incomplete or inoperative STPs, and that the treatment may not be adequate at the STPs in Cajabamba and Jaén, the degree of achievement of sewage treatment in the Project is judged to be moderate.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The Project was expected to contribute to the improvement of the residents' living environment through the improvement of water and sewage services. As a qualitative survey, 52 residents of 5 cities were interviewed by the local assistants [19]. The following is an analysis of the impact based on the results of the qualitative survey.

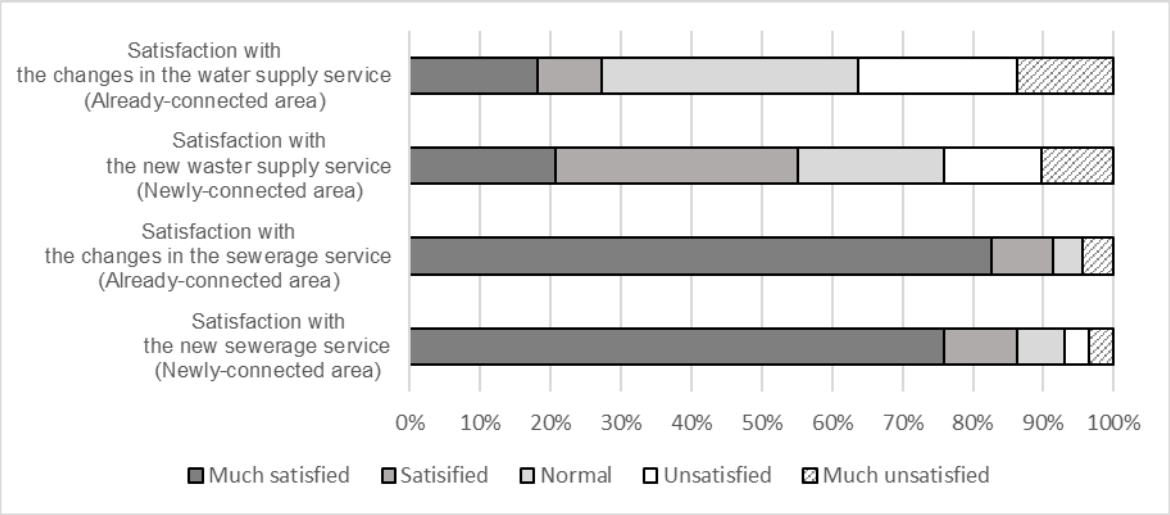
(1) Improvement in water supply services

According to the residents who already had connection to water supply before the Project, the improvement of water supply service was limited, and they are not much satisfied with the Project. They pointed out that, even after the Project, the water supply time is short, the water becomes muddy, and the water pressure is too high. On the other hand, newly connected residents are highly satisfied with the Project (Figure 2). Before the Project, the residents in the newly connected area were using public water taps operated by the water associations (untreated spring water) or receiving water from neighbors who had piped water.

(2) Improvement of sewerage services

Satisfaction with improved sewerage services is high in both already-connected and newly-connected areas (Figure 2). They reported that sewage no longer overflows in houses and on streets during rainfall which cause bad odors, and that they no longer use outdoor toilets and cesspits which cause bad odors, flies, pollution and the danger of going outside in the dark.

[19] The target cities are Cajabamba, Celendín, Cutervo, Chota, and Jaén which have large population and the Project's outputs among the 11 cities. The interviewees were 52 residents who were purposively selected from the already-connected and newly-connected areas (23 from the already-connected area and 29 from the newly-connected area: 21 males and 31 females).



(Source) Interviews conducted with 52 residents of five cities (qualitative survey)

Figure 2 Level of Satisfaction with Water and Sewage Services

(3) Improvement of living environment

Nearly half of the residents reported positive changes in water use and two-thirds of the residents reported positive changes in water-based hygiene behaviors. In newly connected areas, easy access to water and the ability to bathe and do household chores whenever they want is welcomed. Many residents reported being able to use water to clean thoroughly and to wash clothes, bathe, wash hands more often. Some reported an increase in the frequency of hand washing due to the pandemic of COVID-19 since last year. Many residents also reported a decrease in clogged or overflowing sewage, bad odors, and flies and mosquitoes. Two-thirds of the residents think that diarrhea had decreased after the Project, but no concrete information was available to support this. Many residents were careful to save water, for example by using water used for washing food to use the toilet, while others said the piped water is useful for watering their gardens and vegetables.

In the interviews conducted with 12 restaurant / hotel owners apart from the residents, positive comments were heard such as water now reaches the upper floors of the hotels / restaurants, the frequency of cleaning with water has increased, and the frequency of hand washing has increased.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on Natural Environment

At the time of planning, the Project was judged to have no significant undesirable impact on the natural environment and to fall under Category B in accordance with the “JBIC Guidelines for Confirmation of Environmental and Social Considerations”

(April 2002). The environmental impact assessment of each city for the Project was approved by the Environmental Bureau of the Ministry of Housing, Construction and Sanitation in August 2010, and the environmental permit was granted. The environmental impact assessment included air, noise, water, and soil monitoring and an environmental management plan to prevent pollution. According to PROREGION and the consultant, it is believed that the removed asbestos cement water pipes were properly disposed of in accordance with the hazardous waste handling procedures in the plan. The sludge from the STPs in operation in the three cities has all been properly disposed of in accordance with Peruvian laws and regulations. In Celendín and Cajabamba, organic fertilizer is produced from the sludge and distributed to farmers free of charge. In Jaén, sludge is landfilled at the final disposal site, but sanitary landfill with soil cover is not made. No particular environmental problems have been reported in relation to the implementation of the Project.

One of the impacts on the natural environment that was not examined in the environmental impact assessment of the Project is the possibility that the amount of untreated sewage discharged increased. The Project was expected to reduce environmental pollution caused by the discharge of untreated sewage by promoting sewage treatment. In fact, at the time of the ex-post evaluation, STPs had been realized and were in operation only in three of the planned eight cities, and untreated sewage were still discharged into rivers in five cities. In these five cities, the amount of sewage generated is thought to have increased in response to the increased number of water users, and there is concern that the amount of untreated sewage discharged into rivers has increased. PROREGION is aware of this problem and is continuing its efforts to bring the inoperable STPs into operation and to complete the incomplete STPs.

(2) Social Impacts

According to PROREGION, the Project involved the acquisition of land for water intake facilities, reservoirs, and STPs in the cities of San Miguel, San Marcos, Chota, and Cutervo. No resettlement occurred. As the construction and operation of the STPs was opposed by residents who were concerned about odors and who wanted more compensation, PROREGION and the city explained the environmental standards for the STP, odor control measures, and legal standards for compensation, and the discussions were repeated. According to PROREGION, the amount of compensation paid to the residents was much higher than the original plan.

To summarize the effectiveness and impact of the Project, the degree of achievement

on the coverage of water supply and sewerage services through the Project is high, but the degree of achievement on water supply time and sewage treatment is moderate. While the residents are not much satisfied with the improvement of water supply service in the already-connected areas but are highly satisfied in the areas where water supply services were newly expanded. The residents are highly satisfied with the improved sewer service in general. It was also confirmed that the Project contributes to the improvement of water-related convenience and the improvement of the residents' sanitary environment. Based on the above, the effectiveness and impact of the Project are fair.

3.4 Sustainability (Rating: ②)

3.4.1 Institutional / Organizational Aspects of Operation and Maintenance

In Peru, the 2016 "Basic Law on Provision and Management of Sanitation Service" established that urban water and sewerage systems are basically to be operated by EPSs. However, in smaller cities with a population of 15,000 or less, it is allowed to be operated by a "Municipal Administration Unit" established by the city or a "Specialized Operator" contracted by the city as an exception and as a temporary measure under the approval of National Superintendency of Sanitation Services (hereinafter referred to as "SUNASS").

As of September 2021, the water supply and sewerage systems of eight cities other than the three cities (San Miguel, Contumaza, and Jaén) that were operated by EPSs prior to the Project are operated by their respective cities[20]. The facilities completed and in operation under the Project, although before the transfer, are operated and maintained by EPS in the three cities where EPSs operate, and by the municipal department / unit relevant on water supply and sewerage in the other eight cities. In addition, PROREGION is operating and maintaining the STPs constructed by the Project in Celendín and Cutervo, and the facilities other than the water supply and sewage network (secondary pipeline network) in Cajabamba on a temporary basis[21].

In order to transfer the facilities of the Project to EPS, the ownership of the facilities must first be transferred from PROREGION to the city, and then the city must transfer the right to operate the entire water and sewerage facilities, including the facilities of the Project, to EPS. As of September 2021, three cities (Jaén, San Miguel, and Contumaza) and two other cities (San Pablo and San Marcos) that have been operated by EPS have begun the process of transferring their water and sewerage facilities to the

[20] According to PROREGION, the city tends to be reluctant to spend money on pre-transfer facilities, i.e. facilities that are not officially owned by the city, and only minimal repairs are done.
[21] The water and sewer department / unit in each city is not a SUNASS-approved municipal administration unit.

city. In the other six cities, PROREGION and the cities are coordinating to start the transfer process [22].

On the other hand, according to the interviews with each city by the local assistants, seven of the eight cities that were supposed to transfer their water and sewerage operation rights to EPS, except for San Pablo, do not want to do so. Many residents are opposed to the operation by EPS because they fear that the privatization will result in a large increase in fees, and it is thought that the cities are making political decisions based on the wishes of these residents. Of these seven cities, five cities with populations of 15,000 or more are originally required to transfer their operation rights to EPS based on the Basic Law. However, since the Basic Law does not set a deadline for the transition to the stipulated operation system, it is effectively left to the discretion of each city to realize it. PROREGION is continuing its efforts to promote understanding of the purpose and details of the Basic Law among the cities to realize the transfer to EPS as planned at the time of planning.

In view of the above, the operation and maintenance system of the Project at the time of ex-post evaluation is still provisional, and there is no clear prospect for the establishment of the operation system in accordance with laws and regulations, remaining some issues.

3.4.2 Technical Aspects of Operation and Maintenance

SUNASS has established a multifaceted index to evaluate the performance of each EPS, which is based on annual results and an overall assessment of provision of water supply and sewerage services and their management of each EPS. In the ranking based on 2019 results, EPS SEDACAJ was ranked sixth out of 14 EPSs of similar size, and EPS MARAÑON was ranked 6th out of 16 EPSs of the same size group. Therefore, it can be considered that both EPSs have maintained relatively good performance in Peru [23].

EPS SEDACAJ in 2018 and EPS MARAÑON in 2020, receiving support by the Technical Authority for Sanitation Services Administration (hereinafter referred to as

[22] In order to start the transfer procedure, it will take time to complete the liquidation procedures with the construction contractors, organize the technical and accounting information of the facilities built by several contractors, and prepare the official documents with signatures. The impact of the spread of the new coronavirus infection has also been significant, as activities have been constrained. In addition, many cities have opinions about the design of the facility, defects and problems that have arisen since it became operational, and PROREGION has been forced to respond to them with its limited staff.

[23] The water utilities are divided into four sizes, with EPS SEDACAJ being the second from the largest and EPS MARAÑON the third. Indicators include water supply and sewerage service coverage, water supply hours, water pressure, number of complaints, number of leaks, non-revenue water rate, meter coverage, number of sewage clogs, compliance with environmental standards, energy efficiency, financial indicators (e.g. operating margin), and corporate governance indicators in accordance with Peruvian legislation.

"OTASS") which provides technical and operational support to EPSs across the country, procured various equipment for operation and maintenance (equipment for leak detection, pipeline repair, water quality testing, PC, etc.) and provided related technical training to their staff. In the interviews with the two EPS, no particular constraints or problems related to the technical aspects of operation and maintenance were reported. Based on the above, it is considered that there are no problems in the technical aspects of operation and maintenance by the two EPSs.

In all the eight cities where the city operates water and sewerage systems rather than EPS, personnel are assigned to the water and sewerage departments / units to operate and maintain the facilities and collect fees. Depending on the size of the city, about 20 to 40 people are assigned to this department / unit. According to the interviews with each city during the field visit, the technical capabilities of the staff in charge are found not necessarily high. In addition, after every five-year election, there is a significant turnover of personnel, making it difficult for them to accumulate experience. In fact, according to the field inspection, there are cities where existing WTPs and sewage treatment plants are not properly operated and maintained[24]. Based on the above, the technical level of the cities in general is judged not high. It should be also noted that the Project provided training for city staff on operation and maintenance, but the results were not sustained due to frequent staff turnover.

In 2018, PROREGION prepared a plan to ensure the sustainability of infrastructure projects, including the Project, by transferring facilities to the responsible agencies, while strengthening capacity for operation and maintenance through communication between relevant organizations. For the Project, a series of workshops on the Basic Law of 2016, technical training for eight cities (eight cities not operated by EPSs were targeted, but only five were implemented), and a sanitation education workshop for 11 cities were conducted[25]. PROREGION reported that the technical level of the staff in charge in each city was low, and that hygiene education was a new topic that they were not familiar with.

From the above, it is considered that there are some issues regarding the technical aspects of operation and maintenance by the cities.

3.4.3 Financial Aspects of Operation and Maintenance

In 2018 and 2019, both EPS SEDACAJ and EPS MARAÑON generated operating profits (surpluses) (Table 5). EPS MARAÑON, while supported by OTASS in 2019, has

[24] The existing WTPs in the cities of San Pablo and Hualgayoc, and the existing STPs in the cities of San Marcos and San Miguel are not operational. These facilities were not included in the scope of the Project.
[25] Apart from this, according to PROREGION, sanitation education has been added to the scope of the consulting service for the Project, following the "National Sanitation Policy" (2017-2021).

taken measures such as optimization of contracts with water users (updating contract categories when commercial use begins), strict implementation of measures against delinquency by suspending water supply, and detection and legalization of illegal connections, which led to an increase in revenues. In the 2020 assessment by OTASS, EPS MARAÑON did not report any major technical or financial challenges. EPS SEDACAJ's Annual Report for 2019 shows that in 2019 operating margin, current ratio, and debt ratio were all at adequate levels and the financial health of EPS was moderate. No specific financial constraints were reported in the interviews with both EPS during the field visit. Based on the above, no financial issues were found in the operation and maintenance of the Project by the two EPS.

Table 5 Financial Status of EPS

(Unit: thousand soles)

	EPS SEDACAJ		EPS MARAÑON	
	2018	2019	2018	2019
Operating revenue	23,642	25,576	6,602	7,823
Operating expenses	23,143	25,004	5,385	7,293
Operating profit	499	572	1,217	530

(Source) Annual reports of each EPS

No specific financial information was available for the eight cities where EPS is not involved in the operation. The following situations related to financial aspects were reported through the interviews.

- Many residents object to pay-for-use charges based on water meters and pay a fixed amount. This leads to a lot of water wastage. Many residents do not pay the fee, for example, in Hualgayoc, no one pays, and in San Pablo, only 5% of residents pay.

- The city of Hualgayoc wants to entrust the operation of the water and sewerage system to EPS considering its financial difficulties, but the residents need to be convinced.

These cities are operating water and sewage systems while supplementing them with municipal financial resources in response to residents' requests due to political decisions. Since this is not the operation in accordance with the laws and regulations at the time of the ex-post evaluation, it is necessary to improve the financial sustainability while working to realize the planned transfer to EPS, creation of municipal administration units or outsourcing to specialized operators.

Based on the above, the eight cities have financial challenges in the operation and maintenance of the Project.

3.4.4 Status of Operation and Maintenance

Regarding the operation and maintenance of the facilities constructed under the Project, following issues were reported by PROREGION, EPSs, and the cities.

- The water dissemination network has many problems with pressure reducing valves in many cities, and where water pressure is too high, leaks frequently occur in distribution pipelines. According to the visual inspection during the site visit and the interview with the city staff in charge, it is considered that, in many cases, pressure reducing valves are not properly inspected and maintained. In addition, valve failures were also frequently observed in some cities.

- In many cities, the sewage network is often clogged with garbage. This is because the residents dump household waste into the sewers, and PROREGION and the cities believe that residents need to be educated.

- Rainwater flows into the sewer during the rainy season and overflows the manholes and damages the manholes due to excessive flow in many cities[26]. Many of the manholes in Hualgayoc need repair, but this is likely due to the vibrations from blasting at a nearby mine.

- In general, including the facilities other than those constructed in the Project, the pumps in the WTPs and the sludge pumps in the STPs often break down, and some of them are not in operation. According to the visual inspection during the site visit and the interview with the city staff, the reason behind is believed that the inspection and maintenance of the pumps are not properly carried out.

- Among the STPs constructed under the Project and in operation, the STP in Celendín is properly operated and has high treatment efficiency, but the STP in Cajabamba has very low treatment efficiency. Some of the sludge pumps, chlorine disinfection facilities, and rotary sprayers in the sprinkling filter beds are out of order.

To summarize on sustainability of the Project from the above, since the completed

[26] Although the sewerage facilities of the Project are not supposed to accept rainwater. Although using the sewerage system for stormwater drainage is prohibited by the city, according to PROREGION, residents habitually use the sewerage system to drain rainwater since the drainage facilities are inadequate.

facilities have not yet been transferred to the city and EPS, there are still uncertainties in the operation and maintenance system of the Project. The city government, which may operate and maintain some of the facilities, is considered to have technical and financial challenges. Therefore, sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented for the purpose of improving water supply and sewerage services in Cajamarca Region by rehabilitating and expanding the water supply and sewerage facilities in small and medium-sized cities in the Region, thereby contributing to the improvement of the living environment of the residents. The Project is highly relevant to the development policies, plans and development needs of the Republic of Peru (hereinafter referred to as "Peru") and Cajamarca Region both at the time of planning and ex-post evaluation. The Project is also highly consistent with Japan's aid policy at the time of planning, and therefore, the relevance of the Project is high. Both the project cost and project period are much larger than planned, and, as of June 2021, the Project is not completed having some sewage treatment plants (hereinafter referred to as "STP") not being constructed. Therefore, the efficiency of the Project is low. The achievement level of the Project on the coverage of water supply and sewerage services is high, but the achievements related to water supply time and sewage treatment are moderate. While the residents are not much satisfied with the improvement of water supply service in the already-connected water supply areas but are highly satisfied in the areas where water supply services were newly expanded. While, the residents are highly satisfied with the improved sewer service in general. It was also confirmed that the Project contributed to the improvement of water-related convenience and the improvement of the residents' sanitary environment. Based on the above, the effectiveness and impact of the Project are fair. The transfer of ownership of the completed facilities to the cities and the transfer of operation rights of the water supply and sewerage facilities from the cities to EPS have not yet been completed, so the institutional / organizational setup of operation and maintenance of this Project remains uncertain. In addition, the cities, which may operate and maintain some of the facilities in the future, face technical and financial challenges. Therefore, the sustainability of the Project is fair.

In light of the above, the Project is evaluated to be unsatisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency and the Operation and

Maintenance Agencies

- PROREGION needs to complete the entire Project as soon as possible while ensuring proper operation and finish the transfer of the facilities to the cities. Even if the unconstructed STPs are excluded from the scope of the Project, they should be constructed through separate projects as soon as possible.

- PROREGION, with the cooperation of the Ministry of Housing, Construction and Sanitation, EPS SEDACAJ, EPS MARAÑON, SUNASS and OTASS, will consult with the eight cities that have not signed an operation transfer agreement with EPS, and will examine the most appropriate operation and maintenance system for each city while aiming at transferring operation right to EPS as originally planned, and will promote the realization of such operation and maintenance system. It is necessary to provide training to the cities on the relevant laws and regulations and the procedures for transferring operation right to EPS based on them, the actual situation of operation by EPS (including the method of calculating water and sewage rates), and the merits and demerits of the transfer. At the same time, it is desirable to disseminate information to residents and provide education on water conservation and sanitation.

- PROREGION will investigate the causes of low treatment efficiency at the STP in Cajabamba and make necessary improvements.

- EPS MARAÑON needs to improve the quality of treated water by properly maintaining the STP in Jaén, i.e. restoring its functionality by removing sludge.

4.2.2 Recommendations to JICA

JICA will encourage the implementation of the above recommendations by the Peruvian side and will monitor their implementation status.

4.3 Lessons Learned

<u>Ensuring the preparation of a new operation and maintenance system</u>

In the Project, it was assumed that the operation and maintenance by EPS would be carried out on the premise that the Project would be transferred to EPS for the eight cities where the city was operating the water and sewerage facilities at the time of planning. The mayors of each city at the time of the planning agreed in writing that the operation would be transferred. In order for this to happen, each city needed to sign an operation transfer agreement with EPS after getting approval from the city council, but

no such agreement was signed by any of the cities before the Project began. Subsequently, all mayors were replaced by elections. On the other hand, the new law stipulated an operational structure basically by EPS. However, at the time of the ex-post evaluation, the mayors of seven of the eight cities did not want to transfer the operation right to EPS due to political decisions based on the wishes of the residents, and the operation and maintenance system is unclear.

In view of the above, when assuming an operation and maintenance system that differs from that at the time of planning, it is important to confirm the conditions necessary to realize the planned structure based on a close examination of the relevant legal system, analyze the procedures and risks involved in setting it up, and then evaluate the feasibility of the structure and take measures to realize it.

Comparison of the Original And Actual Scope of the Project (as of June 2021)

Item	Plan	Actual
① Output		
Water supply		
Water intake	Rehabilitation: 13 facilities (211 l/s) Construction: 1 facility (11.0 l/s) 9 cities	Rehabilitation: 13 facilities (225 l/s) Construction: 3 facilities (38 l/s) 11 cities
Conduit	Rehabilitation:57.0 km Construction:19.1 km 10 cities	Rehabilitation:43.0 km Construction:24.4 km 10 cities
Water treatment plant	Rehabilitation: 2 facilities (35 l/s) Construction: 2 facilities (305 l/s) 4 cities	Rehabilitation: 2 facilities (35 l/s) Construction: 2 facilities (305 l/s) 4 cities
Distribution reservoir	Rehabilitation: 11 facilities (3,934 m^3) Construction: 7 facilities (7,440 m^3) 8 cities	Rehabilitation: 9 facilities (3,884 m^3) Construction: 7 facilities (7,440 m^3) 8 cities
Water main / distribution pipes	Rehabilitation:65.4 km Construction:191.0 km 11 cities	Rehabilitation and Construction:286.3 km 11 cities
Connection	Rehabilitation:21,033 Construction:9,332 11 cities	Rehabilitation and construction: 33,741 11 cities
Sewerage		
Connection	Rehabilitation:18,383 Construction:12,168 11 cities	Rehabilitation and construction: 30,896 11 cities
Sewer pipes	Rehabilitation: 191.9 km Construction: 81.1 km 11 cities	Rehabilitation and Construction: 285.0 km 11 cities
Pumping station	Construction 3 facilities 2 cities	Construction 1 facility 1 city
Sewage Treatment Plant	Construction: 8 facilities (18,517 m^3/day) 8 cities	Construction: 5 facilities (14,809 m^3/day) 5 cities
② Project period	March 2009 - September 2011 (31 months)	March 2009 - Not completed as of June 2021. (136 months, 439% of plan)
③ Project cost		
ODA loan	4,995 million yen	4,793 million yen
Peruvian funds	6,138 million yen	14,438 million yen
Total amount	11,133 million yen	19,231 million yen
Exchange rate	1 Sol = 35.13 yen (October 2008)	1 Sol = 33.21 yen (Average rate from 2009 to 2020)
④ Final disbursement	May 2015	

Republic of Paraguay

FY 2020 External Ex-Post Evaluation of Japanese Grant Aid Project
"The Project for Improvement of the Drinking Water System for Coronel Oviedo City"

External Evaluator: Hajime Sonoda, Global Group 21 Japan, Inc.

0. Summary

The Project for Improvement of the Drinking Water System for Coronel Oviedo City (hereinafter referred to as "the Project") was implemented for the purpose of ensuring stable supply of safe water for Coronel Oviedo City by means of constructing such water supply facilities as a water treatment plant (hereinafter referred to as "WTP"), transmission pipeline, etc., thereby contributing to improvement of the living environment for residents. The Project is highly consistent with the national development policies, plans and needs of Paraguay at the time of both planning and ex-post evaluation. As it is highly consistent also with Japan's ODA policies at the time of planning, the relevance of the Project is high. Although the outputs of the Project were generally as planned with the project cost being within the plan, the project period exceeded the plan, making the efficiency of the Project fair. Through the implementation of the Project, a stable and safe water supply has been achieved in Coronel Oviedo City and the convenience of water use in daily life has improved. The secondary effect in Villarrica City was achieved as planned. While there is a possibility of an increase of the discharge volume of untreated domestic wastewater from households in the post-project period, such expected impacts as improvement of the living environment and improvement of hygiene in the city have been realized. As such, the effectiveness and impacts of the Project are high. As the institutional/organizational, technical and financial aspects of the operation and maintenance of the Project pose no problems, the sustainability of the project effects is high.

In light of the above, the Project is evaluated to be highly satisfactory.

1. Project Description

Project Location

WTP Constructed under the Project

1.1 Background

In the Republic of Paraguay (hereinafter referred to as "Paraguay"), 70.4% of the total population (approximately 6.2 million) had access to a water supply system such as piped water supply in 2012, while the remaining some 30% did not have stable access to safe water. The water supply service in cities with a population of 10,000 or more was operated by Sanitary Service Company of Paraguay (ESSAP). At the time, some 1.2 million people in 29 cities nationwide received water supply from 21 water supply systems.

Coronel Oviedo City (population of 62,000 in 2012) was one of the major cities after three major urban areas, including the Asunción metropolitan area, in Paraguay. Water was supplied to this city from the Tebicuarymi WTP which is located some 20 km of Coronel Oviedo City, uses Tebicuarymi River as the water source, which also supplied water to Villarrica (population of 52,000 in 2012), Mbocayaty (population of 2,800 in 2012) and Yataity (population of 2,100 in 2012) cities. However, as this WTP lacked a sufficient water treatment capacity to meet the increased water demand in each city, the water supply coverage in Coronel Oviedo City was only 61% in 2012. Some 2,000 applications for new water supply connection were pending and water supply was restricted to a maximum of 16 hours a day. Meanwhile, Tebicuarymi River flooded every few years and inundation of the WTP caused stoppage of its operation for a long period of time with a severe impact on the citizens' life. In view of such situations, it was considered essential to construct a new WTP as well as transmission pipeline in order to ensure stable water supply in response to the ever-increasing water demand.

Under these circumstances, the Government of Paraguay made a request to the Government of Japan for grant aid for the construction of a new WTP (hereinafter referred to as "the new WTP") at the site of the Tebicuarymi WTP (hereinafter referred to as "the existing WTP") and a new transmission pipeline to Coronel Oviedo City.

1.2 Project Outline

To ensure stable supply of safe water to residents of Coronel Oviedo City by means of constructing such water supply facilities as a WTP, transmission pipeline, etc., thereby contributing to improvement of the living environment for residents.

Grant Limit / Actual Grant Amount	1,827 million yen / 1,827 million yen
Exchange of Notes Date Grant Agreement Signing Date	June 2014 / September 2014
Executing Agency	Directorate of Drinking Water and Sanitation (DAPSAN) / Ministry of Public Works and Communications (MOPC)
Project Completion	October 2017

Target Area	Coronel Oviedo City, Caaguazu Department (target area for water supply), Yataity City, Guaira Department, (construction site of the new WTP)
Main Contractor	Hazama Ando Corporation
Consultant	Kyowa Engineering Consultants Co., Ltd.
Basic Design Study/ Preparatory Study	May 2013 to February 2014
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of the Study: December 2020 to January 2022

Duration of the Field Survey: May 2021 (by local consultants)

2.3 Constraints During the Evaluation Study

The external evaluator was unable to travel to Paraguay because of the COVID-19 pandemic. Accordingly, interviews with the Directorate of Drinking Water and Sanitation (hereinafter referred to as "DAPSAN") of the Ministry of Public Works and Communications (hereinafter referred to as "MOPC") and ESSAP, physical inspection of the water treatment and transmission facilities newly constructed under the Project and interviews with officials of Coronel Oviedo City and water users were conducted by local consultants with remote supervision by the external evaluator.

3. Results of the Evaluation (Overall Rating: A[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Consistency with the Development Plan of Paraguay

"The Public Policy for Social Development 2010 - 2020" prepared by the Government of Paraguay in 2009 included actions designed to achieve a target water supply coverage of 80.5% in 2015 as a millennium development goal as soon as possible. Moreover, the country's "Strategic Economic-Social Plan 2008 - 2013" included such targets as "increased social investment to reduce poverty" and "improved access to public services." In this plan, Coronel Oviedo City was

[1] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

[2] ①: Low; ②: Fair; ③: High

considered to be a priority city for the development of water treatment facilities in reference to such indicators as the quality of supplied water, population served and water supply coverage.

At the time of this ex-post evaluation, "poverty reduction and social development" as one of three strategic pillars of "National Development Plan: Paraguay 2030" of Paraguay aims at improving both the water supply coverage (64% in 2014) and sewerage coverage (11% in 2014) to 100% by 2030. The National Poverty Reduction Plan prepared on the basis of the National Development Plan includes improvement of the water supply as part of improvement of the living and sanitary environment for the poor. Meanwhile, "National Development Plan for Water and Sanitation" prepared by DAPSAN in August 2018 lists projects/programs to achieve the target of the national development plan along with three axes, i.e. i) organizational development and capacity building in the water supply and sewerage sector, ii) improvement of the financial and water charge systems and iii) expansion and sustainability of the water supply and sewerage systems.

Based on the above, the Project which aimed at achieving stable water supply in Coronel Oviedo City is highly consistent with the national development policies of Paraguay at the time of both planning (2014) and ex-post evaluation.

3.1.2 Consistency with the Development Needs of Paraguay

As already described in "1.1 Background", expansion of the water supply service and operating hours were restricted in Coronel Oviedo City in addition to the occasional suspension of the water supply for a long period of time due to flooding of the existing WTP.

At the time of ex-post evaluation, the new WTP constructed under the Project is performing stable water treatment and playing an important role not only in water supply for Coronel Oviedo City but also in improved water supply service for Villarrica City as a secondary effect (refer to "3.3 Effectiveness and Impacts"). This means that the needs for the Project was maintained at the time of ex-post evaluation.

Based on the above, the Project is highly consistent with the development needs of Paraguay at the time of both planning and ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

In the Japanese ODA Policy for Paraguay, Japan considers "sustainable economic development" to be a priority area. The Project is classified under the development theme of "consolidation of economic and social infrastructure" under "sustainable economic development". JICA's country analysis paper also considered the water resources sector to be a priority issue. As such, the Project was consistent with Japan's ODA policy at the time of planning.

Based on the above, the Project is highly relevant to Paraguay's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

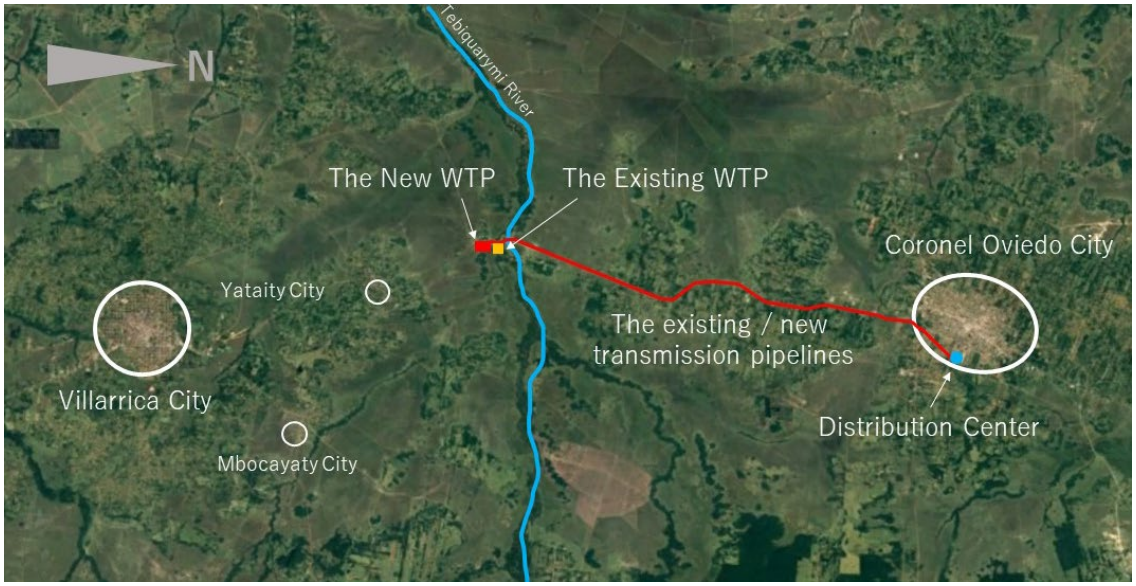
3.2.1 Project Outputs

Under the Project, the new WTP was constructed on the site of the existing WTP and a new transmission pipeline was also constructed from the new WTP to the water distribution center in Coronel Oviedo City. New water intake facilities for existing and new WTPs were also constructed. The Paraguayan side also rehabilitated the existing transmission pipeline from the existing WTP to Coronel Oviedo City and constructed an additional distribution reservoir at the site of the distribution center in Coronel Oviedo City. As shown in Table 1, the outputs of the Project were generally realized as planned.

Table 1 Planned and Actual Outputs

	Planned	Actual
Japanese Side Intake Facilities	Planned intake volume: 28,900 m^3/day Intake, sedimentation basin, intake pump, conduit, etc.	Generally as planned
New WTP	Planned water treatment volume: 13,500 m^3/day Receiving well, flocculation basin, rapid filtration tank, distribution reservoir (at the site of the WTP), transmission pump, etc.	
New Transmission Pipeline	Planned transmission volume: 12,300 m^3/day Total length: 22.7 km	
Consulting Service	Detail design, bidding support, construction supervision, training on the operation and maintenance of the WTP (soft component)	
Paraguay Side	• Embankment at the new WTP site • Construction of an access road at the new WTP site • Fencing and other exterior work • Power supply extension work to the site • Construction of an additional distribution reservoir at the distribution center in Coronel Oviedo City • Repair/rehabilitation of the existing transmission pipeline to Coronel Oviedo	Generally as planned

Source: Materials provided by JICA, DAPSAN/MOPC and ESSAP.



Source: Prepared by the evaluator

Fig. 1 Locations of Facilities Constructed under the Project and Target Cities for Water Supply

Regarding some of the planned works of the Japanese side, minor modifications were made to the routes of the conduit, transmission pipeline, etc. and the construction methods to reflect the actual geological features. These modifications were needed in order to adjust to the plan for the access road by the Paraguayan side, to improve operability, convenience and safety of operation and maintenance, and to improve workability of construction, all of which were made upon technical reviews and are judged to be appropriate.

The works planned for the Paraguayan side was completed with some additions, including the installation of fire extinguishing equipment at the distribution facility and the replacement of valves for the existing transmission pipeline. Moreover, the Paraguayan side newly constructed a transmission pipeline to Villarrica from the existing WTP and a distribution reservoir (1,500 m^3) in Villarrica in 2017. Although these facilities are outside the scope of the Project, they are believed to have further boost the effects of the Project in Villarrica (refer to Effectiveness).

While the executing agency for the Project was DAPSAN, ESSAP is responsible for the operation and maintenance of the water supply facilities constructed under the Project.


Water Treatment Facility (left) and Pumping Facility (right) of the New WTP

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost at the time of planning was 2,114 million yen (Japanese portion of 1,822 million yen and Paraguayan portion of 292 million yen). The actual outputs were almost as planned and the actual total project cost was 1,962 million yen (Japanese portion of 1,827 million yen and Paraguayan portion of 135 million yen) which was 93% of the planned cost. As mentioned earlier, some additions were made to the work by the Paraguayan side. However, the overall project cost was within the plan as the embankment at the WTP site and construction of the access road to the construction site were conducted as part of the road maintenance works of the MOPC. Therefore, the efficiency in terms of the project cost is high.

3.2.2.2 Project Period

The project period, including the detailed design and tender periods, was assumed to be 27 months from June 2014 to August 2016.

For the works by the Japanese side, the consultancy contract and civil engineering contract were signed in October 2014 and May 2015 respectively. Prior to the commencement of the works, the embankment by the Paraguayan side was delayed by persistent rain and flooding. On the other hand, the handing over of the temporary yard for materials was delayed by more than two months as some time was required for the relevant ministries to reach an agreement. Moreover, the overturning of a crane during the construction work by the Japanese side resulted in this crane being unrepairable. The subsequent decision to import an alternative crane from Japan as one could not be procured in Paraguay lengthened the construction period by approximately eight months. Following such incidents, the works by the Japanese side was finally completed in October 2017.

In regard to the works by the Paraguayan side, the new distribution reservoir in Coronel Oviedo City began operation in October 2019. Although its construction had already started at the time of the planning of the Project, the relevant contract was cancelled twice because of problems involving the contractors. The work was completed under the third contract. The rehabilitation work of the existing transmission pipeline started in October 2017, after the commencement of the new transmission pipeline (constructed by the Japanese side), and was completed in December 2018. In order not to interrupt the transmission to Coronel Oviedo City, this work could not have been started before the commencement of operation of the new transmission pipeline.

The formal completion date for the Project was October 2019 when the construction of the new distribution reservoir was completed by the Paraguayan side. However, the principal project effects were already apparent in Coronel Oviedo City when 24 hour water supply using the existing distribution reservoir and new transmission pipeline began after completion of the construction of the new WTP by the Japanese side.[3] Accordingly, for the purpose of evaluating the efficiency of the Project, the project period is set at 37 months (137% of the planned period) from the signing of the consultancy contract in October 2014 to the completion of the construction of the new WTP in October 2017. As this project period exceeded the planned period, the efficiency in relation to the project period is judged to be fair.

In summary, although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the Project is fair.

3.3 Effectiveness and Impacts[4] (Rating: ③)

3.3.1 Effectiveness

The purpose of the Project was to ensure safe and stable water supply for residents of Coronel Oviedo City by means of constructing water supply facilities, including a WTP and transmission pipeline. In this section, achievement of the project purpose is analyzed based on the indicators set at the time of planning, following the analysis of the operating situation of the WTPs. Further analysis is conducted regarding other effects of the Project, including the secondary effects of the Project.

[3] After the completed rehabilitation of the existing transmission pipeline, water from the new WTP is supplied to the distribution centre in Coronel Oviedo City via the new and existing transmission pipelines. The rehabilitated existing transmission pipeline and new distribution reservoir not only contribute to a stable water supply for the city but have also created extra capacity to accommodate a demand increase in the future.

[4] Sub-rating for effectiveness is to be put with consideration of Impacts.

3.3.1.1 Operating Status of the WTPs

The construction work of the new WTP under the Project was completed on October 31, 2017 and this new WTP has maintained a high operating rate of around 98% since 2018. According to the ESSAP, most operational stoppages are caused by power outages.[5] In regard to the existing WTP, replacement of the broken-down power generating facility by the ESSAP in 2013 and replacement of the transmission pump in 2019 and the transmission pipeline in 2020 (all outside the scope of the Project) have led to a slightly better operating rate than the new WTP since 2019. In 2020, the operating rate of the existing WTP recorded 100%.

The annual water treatment volume of the new WTP in 2020 was 4,875,675 m^3 with an average daily treatment volume of 13,056 m^3 which was 97% of the planned volume. Some 10% of the treatment volume is consumed on site for back wash, etc. and the remaining water is conveyed to Coronel Oviedo. The treated water by the existing WTP is conveyed to Villarrica and two other cities. The total annual water treatment volume of these two WTPs was 9,557,423 m^3 in 2020 which was 181% of the annual treatment volume of the existing WTP in 2016.

Table 2 Operating Situation of the New and Existing WTPs

	2016	2017	2018	2019	2020
Annual operating rate: annual operating hours ÷ (24 hours x 365 days or 366 days)					
Existing WTP	93.2%	95.7%	95.1%	99.3%	100.0%
New WTP	(Under construction)	(Completed on October 31)	97.3%	98.7%	98.6%
Annual water treatment volume (m^3)					
Existing WTP	5,292,500	4,422,500	3,650,000	4,423,419	4,681,748
New WTP	-	738,000	4,489,500	4,826,990	4,875,675
Total	5,292,500	5,160,500	8,139,500	9,250,409	9,557,423

Source: Materials provided by DAPSAN and ESSAP

3.3.1.2 Degree of Achievement of Project Goals (Coronel Oviedo)

Table 3 shows the indicators set at the planning stage in relation to the project purpose and their baseline, target and actual values at the time of ex-post evaluation. The degree of achievement is high for all the indictors.

[5] At the time of the preparatory study, the installation of a generator at the new WTP was not planned because of the decreasing trend of power outages. According to ESSAP, while power outages have been decreasing and power supply is restored within 15 minutes in most cases, power generating equipment would be necessary for the operating rate of the WTP to be increased further.

Table 3 Target and Actual Indicator Values

Indicator	Baseline Value (2012)	Target Value (2020) (4 years after completion)	Actual Value (2020)
Population served	37,620	52,000	48,210
Number of connections (Reference)	7,524	10,400	9,642
Average distribution volume	6,600 m^3/day	12,300 m^3/day	12,343 m^3/day
Water supply hours	16 hours/day	24 hours/day	24 hours/day

Note: Data is for Coronel Oviedo City.
Source: Materials provided by JICA for the reference values and target values and materials provided by DAPSAN and ESSAP for actual values.

Population Served

The estimated population served by piped water in Coronel Oviedo in 2020 was 48,210 which was 128% of the 37,620 in 2012 and 93% of the target population of 52,000. As actual data on the population served was unavailable, estimation for the purpose of ex-post evaluation is made based on the number of household connections, assuming that the number of persons served per connection has remained unchanged since the time of planning (5.0 persons per household).

Average Distribution Volume

The average daily distribution volume to the distribution area by ESSAP in Coronel Oviedo City in 2020 was 12,303 m^3 which was almost as planned and was 186% of the baseline value of 6,600 m^3/day in 2012. The distribution volume per person (water usage volume + leakage volume) increased from 175 liters/day in 2012 to 255 liters/day in 2020 (146% of the 2012 level), suggesting the increased use of piped water by residents.

Water Supply Hours

The average water supply hours per day in Coronel Oviedo City used to be 16 hours or less. 24 hour water supply operation started as planned immediately after the completion of the new WTP in October 2017.

In this ex-post evaluation, the “annual days of water supply cut-off” and “water quality after treatment” before and after the Project were compared as additional indicators. As described below, both indicators have recorded a high level of improvement.

Annual Days of Water Supply Cut-Off

In Coronel Oviedo City, water supply cut-off totaling 2 - 3 weeks a year used to occur up to 2016 due to flooding of the existing WTP. Since 2017, no suspension n of operation due to flooding has been recorded with both the new and existing WTPs. The reasons for this are that the new WTP is constructed on the site banked by the Paraguayan side to avoid flooding and that an increase of the discharge capacity of Tebicuarymi River after bridge replacement work by the MOPC (a project planned in parallel with the Project) has prevented the occurrence of severe flooding. There have been no incidents of the simultaneous suspension of operation of both the new and existing WTPs due to reasons other than flooding. Consequently, there have been no widespread or long water supply cut-off incidents in Coronel Oviedo.

Water Quality After Treatment

The water quality after treatment at the new WTP in 2020 (sampled at the said plant) showed a pH value of 7.0 (Paraguayan standard: 6.0 ~ 8.0), turbidity of 0.6 NTU (Paraguayan standard: ≤ 1.0)[6] and chromaticity of 3 (Paraguayan standard: ≤ 5), indicating generally good quality of the treated water. No coliforms were detected. The water quality test by the Regulatory Body for Sanitation Services (ERSSAN) did not point out any problems[7], suggesting that the water quality of both plants is suitable for drinking. In the case of turbidity which was an issue prior to the commencement of the Project, even though the turbidity of the raw water significantly fluctuates from one season to another (11 to 290 NTU), the turbidity after treatment is generally constant (0.5 to 0.8 NTU), suggesting that appropriate treatment is conducted in response to the quality of the raw water. Meanwhile, although the average post-treatment turbidity at the deteriorated existing WTP improved from 2.4 NTU at the time of planning (June 2012 to May 2013) to 2.0 NTU in 2020, the post-treatment turbidity can reach a maximum of 2.8 NTU, failing to meet the Paraguayan standard. In short, the quality of the water supply to Coronel Oviedo City has improved due to the distribution of water from the new WTP constructed under the Project.

Based on the above, as the degree of achievement in Coronel Oviedo City is high for such indicators as the population served, water supply hours, annual days of water supply cut-off and

6 NTU (Nephelometric Turbidity Unit) indicates the degree of turbidity and a larger value indicates a higher level of turbidity.

7 The ERSSAN was established as an independent administrative body aimed at supervising and guiding water supply and sewerage services under Article 8 of Law No. 1614/2000 concerning the regulations and framework to determine charges for water supply and sewerage services. The authority and obligations of the ERSSAN as set forth in Article 10 include the evaluation of water service providers, ensuring of technical levels, confirmation of the set scope of water supply, setting of the water charge, punishment of offenders of the relevant laws and regulations, approval of tender documents, management of service quality and supervision of the general activities of water service providers and others. Water quality testing by the ERSSAN is conducted by means of sampling water at the WTPs, distribution reservoirs and taps of water users.

water quality, the purpose of the Project is judged to have been achieved. According to the officials of Coronel Oviedo City, many complaints regarding water supply were made to the municipal office before the Project and the local radio station often talked about problems relating to water supply, but such situations greatly improved after the Project. According to the Coronel Oviedo Office of the ESSAP, the city did not experience any problems in the dry season of 2020 when many other cities suffered water shortages.

Construction of the new distribution reservoir by the Paraguayan side under the Project meant the construction of a new reservoir (tower type: 1,500 m^3) near the existing distribution reservoirs (1,400 m^3 semi-underground type and 500 m^3 elevated type). Before the Project, the elevated distribution reservoir which could be used during power outages was too small to prevent cutting off of the water supply. The capacity of the distribution reservoir has been substantially increased under the Project to maintain water distribution for several hours when a power outage occurs, meaning that no water supply cut-off takes place as long as the power outage is short. At present, ESSAP is considering the installation of a generator at the pumping station of the new WTP to prevent cutting-off of the water supply due to a long power outage.

Since 2016, ESSAP has been proceeding with expansion (two areas with some 110 households) and renewal (some 350 households) of the water distribution network in Coronel Oviedo City. The positive effect of the Project mentioned earlier is in fact the synergy effect of such work and the Project. At the time of the preparatory study, improvement of the distribution network was proposed to improve the water pressure based on the results of water pressure measurement at various locations in the city and its implementation by the Paraguayan side was expected, but the relevant work was not included in the work of the Paraguayan side for the Project. According to ESSAP, this proposal has not been implemented as such but the identification of concrete problems of the distribution network was found to be useful. ESSAP prepared a plan to ensure an appropriate water pressure throughout the city by means of dividing the distribution network in the city into multiple areas and supplying water to areas with a high elevation from an elevated distribution reservoir. The draft improvement plan proposed by the preparatory study was incorporated in this later plan which was the result of the capacity building of ESSAP under JICA's technical cooperation project titled "Project for Capacity Development of Distribution Network Management of the ESSAP (2011 - 2014)". However, there is no concrete schedule for the implementation of this plan.

At the time of planning, 15 water and sanitation cooperatives using wells as water sources were operating in some areas of Coronel Oviedo City and supplying water to some 2,200 households at a lower charge than ESSAP. The interview survey at the time of the preparatory study found that some of these cooperatives were willing to receive water supply from ESSAP if its water supply service improves after the Project. However, no cooperative has actually switched to water supplied by ESSAP at the time of ex-post evaluation. In fact, some cooperatives use

water supplied by ESSAP through illegal connection to ESSAP's distribution network. The joint efforts of ESSAP and ERSSAN to solve this problem have been made but not yet been successful.

3.3.1.3 Other Effects

(1) Improved Water Supply Service in Villarrica City

Prior to the Project, the existing WTP supplied water not only to Coronel Oviedo City (population of 61,600 in 2012) but also to Villarrica City (population of 51,500 in 2012), Mbocayaty City (population of 2,800 in 2012) and Yataity City (population of 2,100 in 2012). Water supply in Villarrica City was restricted to 12 - 16 hours a day. The combined water supply capacity of the existing and new WTPs substantially increased after the construction of the latter under the Project. In particular, improved water supply service for Villarrica City among the other three cities mentioned above was expected as a secondary effect of the Project with an expected increase of the water supply volume to Villarrica City.

The total water supply volume to these three cities increased from 7,400 m^3/day in 2012 to 10,963 m^3/day in 2020. The number of connected households in Villarrica City increased from 8,598 in 2016 to 10,200 in 2020.[8] The water supply coverage in Villarrica City increased from 72% in 2012 to 98% in 2020, and 24 hour water supply was achieved in 2018.[9] Based on the above, it is judged that the improved water supply service expected in Villarrica was realized and the planned secondary effect of the Project was achieved. The executing agency constructed a new transmission pipeline (21.3 km) to and a distribution reservoir (1,500 m^3) in Villarrica City in parallel with the Project. The above-mentioned secondary effect was in fact the effect of synergy between these works and the Project.

(2) Improved WTP Operation and Maintenance Skills

Technical assistance in the form of training (the Soft Component) was provided under the Project as part of the consulting services to enhance the operation and maintenance capacity at the new WTP. 16 persons underwent this training and all were assigned to the new WTP.

According to the executing agency, the contents, duration, method, etc. of this training were appropriate and the manuals and document formats used for the training have continued to be used up to the time of ex-post evaluation. The executing agency highly values the fact that the learning of various treatment methods (adjusted quantity of coagulant, etc.) in response to the quality of the raw water during the training has led to appropriate water treatment.

[8] The actual number of households in Villarrica receiving piped water supply is larger than 10,200 because of bulk supply to housing estates. However, the exact number of such households is unclear.

[9] In the other two smaller cities, the water supply coverage ratio was 100% with 24 hour supply prior to the implementation of the Project.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The improved water supply service in Coronel Oviedo City due to the implementation of the Project was expected to contribute to an improved living environment for the residents. To find out the achievement situation of such impact, 20 household water users and five commercial water users in the city were interviewed as part of the ex-post evaluation.[10]

In regard to any changes of the water supply service after the Project, 40% and 30% of residents interviewed said that "much improved" and "improved" respectively. None of those interviewees said that "worsened". In regard to any changes of the water supply hours, water pressure and water quality, more than 60% said either that "much improved" or "improved" for each of these aspects. Meanwhile, some residents pointed out sudden cutting-off of water supply and/or deterioration of the water quality, both of which were presumably the result of construction works of water supply facility. The degree of satisfaction with the current water supply service is high as two-thirds of the residents replied that they are very satisfied. Some reported that "there has been no long cutting-off of the water supply since three years ago" and "while the water supply volume was low with poor water quality in the past, there are currently no problems".

Many residents reported that "there is no longer a need to use a well" or "the use of a well has declined". Nearly half of the residents replied that the volume of water use has increased and some people purchased a washing machine. It was reported that the frequency of washing or taking a bath has increased and the COVID-19 pandemic was pointed out as a reason for this along with the improved water supply service. Most people obtain information on sanitation from television or the Internet. Some residents said that they consciously control their water consumption to keep the water bill low. Many residents welcome the facts that they can take a bath whenever they want or whenever necessary and that they can maintain good hygiene habits, both of which are the result of the around the clock supply of water. Half of the residents believe that the number of cases of diarrhea has fallen due to improved hygiene habits and improved water quality. On the other hand, there is a fixed concept wide-spread among the residents that "the water supplied by ESSAP is undrinkable" because of the frequent clouding of the water before the Project and many people still buy and use bottled water for drinking and cooking even after the completion of the Project.

Some residents pointed out that there had been frequent incidents of street flooding caused by leaking water and cutting off of the water supply as well as deterioration of the water quality because of the work to repair water leaks. Many requested that the ESSAP should promptly deal

[10] The target persons to be interviewed were randomly selected from the ESSAP's list of water users. As this ex-post evaluation study was restricted by the COVID-19 pandemic, these interviews were conducted by telephone by a local consultant. The 20 household water users consisted of 14 males and 6 females. 15 of them received water supply even before the Project and 5 were new users. The 5 business users included an everyday dishes and sweet shop, a supermarket and a general store. Efforts to interview a medical institution in Coronel Oviedo were unsuccessful as medical staff were too busy to respond due to the COVID-19 pandemic.

with leakage from the old distribution network. It was also pointed out that the sewerage system properly functioned in only certain areas of the city center.

In the case of the interviews with the commercial water users, three out of the five reported improvement of the water quality and four reported improvement of the water supply hours and water pressure. Four replied that they were very much satisfied with the current water supply service and the remaining one also described the service as being satisfactory. It was mentioned that accessibility to water supply had not only improved the hygiene situation at a store but also contributed to longer business hours. On the other hand, some critical comments were made that the level of the water charge for commercial use is too high and that it is unreasonable for a house to be included in the commercial category simply because a small store with little water usage is attached to the house.

Based on the above, it is verified that the expected impact of the Project to contribute to improvement of the living environment of residents of Coronel Oviedo City has been achieved.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on Natural Environment

At the time of planning, the Project was classified in Category B as any adverse impacts on the environment would not be severe in the light of the JICA Guidelines for Environmental and Social Considerations (published in April 2010). Following approval of the environmental impact assessment and environmental management plan, and promulgation of the Environmental Impact Declaration by the Ministry of Environment of Paraguay, the Project obtained an environmental license in August 2014. During the construction period and after commissioning of the new facilities, environmental monitoring was conducted in line with the environmental management plan. Alleviation measures were implemented in relation to soil, water, atmosphere, noise, vibration and landscape and the implementation situation of these measures has been regularly reported to the Ministry of Environment. The latest approval by the Ministry of Environment was obtained in January 2021. According to DAPSAN and ESSAP, no serious impacts on the environment have occurred in relation to the Project.

Although Coronel Oviedo City has a sewerage system with a sewage treatment plant using oxidation ponds, the number of sewer connections in 2020 was approximately 6,000 which was 60% of the number of water supply connections. In view of the fact that the water supply volume to Coronel Oviedo City substantially increased with the completion of the Project and a lack of the proper functioning of the sewerage system in some areas as pointed out by the residents, there is a possibility that the volume of untreated domestic wastewater from households has increased since the implementation of the Project.

(2) Resettlement and Land Acquisition

As the project sites were premises of the existing WTP and land owned by the ESSAP, the acquisition of land for the Project was unnecessary. During the project period, the Project did not produce any notable negative impacts on the social environment.

To summarize the Project's effectiveness and impacts, the Project achieved its purpose of realizing a safe and stable water supply service in Coronel Oviedo City. The positive secondary effect on Villarrica City was also realized as planned. In Coronel Oviedo City where the water supply service has improved, the convenience of water use for daily life has increased. Even though there is a possibility that the volume of untreated domestic wastewater has increased, the expected impacts of the Project, such as an improved living environment and hygiene habits in the city, were duly realized. As the expected results of the Project were realized as planned, the effectiveness and impacts of the Project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspects of Operation and Maintenance

The operation and maintenance of the facilities constructed under the Project are conducted by ESSAP. To be more precise, Coronel Oviedo office of ESSAP conducts meter readings, collection of the water charge and operation and maintenance of the distribution reservoirs and distribution network in the city. The operation and maintenance of the new WTP, the existing WTP and the transmission lines are conducted by staff members of these WTPs as a separate body from the said local office of ESSAP. The head office of ESSAP is responsible for the control of the procurement of goods by the WTPs and its local offices and external subcontracting which is conducted as required. It also provides technical guidance and proposals to improve the water supply and sewerage services.

The new WTP and the existing WTP have 13 and 15 operators respectively. The total number of staff members is 35, including the manager of the WTPs, electrical and mechanical engineers, water quality testers and cleaners. This means the employment of an additional 12 persons from a manpower strength of 23 at the time of the preparatory study. Given the fact that both WTPs have been smoothly operating without any serious problems and have supplied the planned volumes of treated water in the last three years, there appear to be no institutional/organizational constraints relating to the operation and maintenance of the WTPs. According to ESSAP, its Coronel Oviedo office has sufficient manpower to perform its duties described above. As such, there are no problems with the institutional/organizational aspects of the operation and maintenance of the Project.

Table 4 Personnel Deployment at the Tebicuarymi WTP

Position	At the Time of Preparatory Study	At the Time of Ex-Post Evaluation	Remarks
Manager	1	1	Manages both the new and existing WTPs
Operators	12	28	New WTP: 13 Existing WTP: 15
Electrical and mechanical engineers	2	2	One each for the new WTP and existing WTP
Water quality testers	2	2	Working for both the new WTP and existing WTP
Storage workers	4	0	Storage is directly managed by the manager
Cleaners	2	2	One each for the new WTP and existing WTP
Total	23	35	

Source: Materials provided by the ESSAP

3.4.2 Technical Aspects of Operation and Maintenance

According to the report of defect inspection in November 2018, daily operation and maintenance at the new WTP was conducted in accordance with the manuals and did not pose any problems as it fully reflected the outcomes of the technical training conducted by the consultant as the Soft Component of the Project. All the completion drawings, list of equipment and operation and maintenance manuals were properly stored and used when needed.

The site visit as part of the ex-post evaluation confirmed similar situations. All the staff members who underwent training (the Soft Component) are still working at the new WTP. No special technical problems have been reported regarding the operation and maintenance of the new WTP. The new and existing WTPs use rapid filtration systems as in the case of many other WTPs run by ESSAP and no particularly advanced technologies are required for the operation and maintenance of these WTPs. As described in "3.3.1 Effectiveness", the operating rate of the new WTP has been high and appropriate treatment is conducted in response to the varying quality of the raw water. Therefore, no special technical issues are found regarding the operation and maintenance of the Project.

It should be noted that ESSAP head office is conducting the training of the staff members of WTPs mainly on the safety management of WTPs, i.e. handling of chlorine gas and fire extinguishing equipment.

3.4.3 Financial Aspects of Operation and Maintenance

Table 5 shows the revenue and expenditure of ESSAP for FY 2017 through FY 2019. During this period, the revenue mostly consisting of the collected water charge exceeded the expenditure, producing an average annual operating profit of 60,000 million G. (approximately 1 billion yen).

The operating profit ratio was between 5% and 20% (average: 14%), showing a sufficient level of profitability. The debt ratio of 105% to 119% indicates a sound financial condition in general. The current ratio improved from 95% in FY 2017 to 119% in FY 2019, indicating increasing financial stability. During the site visit, no special financial constraints were reported in relation to the operation and maintenance of the Project. Therefore, there are no problems regarding the financial aspects of the operation and maintenance of the Project.

Table 5 Financial Results of ESSAP

(Unit: Million Guarani)

	2019	2018	2017
Revenue	525,956	396,752	387,979
Public sector sales	75,226	51,723	43,803
Private sector sales	428,078	330,832	296,677
Other revenue	22,651	14,197	47,499
Expenditure	359,439	310,219	276,756
Operating cost	219,795	200,414	176,528
Sales cost	14,837	9,974	9,659
Administration cost	124,807	99,831	90,570
Profit before interest payment and tax exemption	166,517	86,533	111,223
Financial expenses	66,096	46,546	38,268
Provisions	13,051	10,287	-7,940
Depreciation cost	5,142	8,282	4,664
Operating profit	82,228	21,418	76,231
Other adjustments	-1,958	-164	-603
Income tax	11,229	3,587	8,862
Net profit	72,957	17,996	67,972
Operating profit ratio (operating profit ÷ revenue)	16%	5%	20%
Debt ratio (debt ÷ capital)	105%	119%	111%
Current ratio (current assets ÷ current debt)	119%	96%	95%

Source: Materials provided by ESSAP

3.4.4 Status of Operation and Maintenance

The average annual operating hours of the new and existing WTPs for 2019 - 2020 were 8,604 hours with an operating rate of as high as 98.2%. As described in “3.3.1 Effectiveness”, stoppages of these WTPs were mainly caused by power outages.

At the WTPs, electrical and mechanical engineers check the pumps, control panel and chemical injection system every day. Operators conduct the back washing of the filtration tank every 48 hours or more frequently if required. The settling basin of the intake, coagulation basin, sedimentation basin and filtration basin of the WTPs are cleaned once a month.

Up to the time of the ex-post evaluation, no facilities or equipment at the new WTP have experienced any major problems. With the highly deteriorated existing WTP, renewal of the transmission pumps, replacement of the filtering materials and replacement of the porous blocks

(baseplates supporting the filtering materials) as well as wooden gates of the sedimentation basin has been conducted in stages. However, staff members of the existing WTP believe that full-scale rehabilitation is necessary in view of the substantial cost and labor involved in operation and maintenance and occasional exceeding of the post-treatment turbidity above the relevant standard.

According to the officials of Coronel Oviedo City, there have been frequent leakage incidents in the city from water pipes deteriorated due to road paving work by MOPC. Insufficient checking of the state of water pipes when planning paving work is the background for such damage and a need for inter-organizational coordination can be pointed out.

Based on the above, no major problems have been observed regarding the institutional/ organizational, technical and financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the emerged effects of the Project is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project was implemented for the purpose of ensuring stable supply of safe water for Coronel Oviedo City by means of constructing such water supply facilities as a WTP, transmission pipeline, etc., thereby contributing to improvement of the living environment for residents. The Project is highly consistent with the national development policies, plans and needs of Paraguay at the time of both planning and ex-post evaluation. As it is highly consistent also with Japan's ODA policies at the time of planning, the relevance of the Project is high. Although the outputs of the Project were generally as planned with the project cost being within the plan, the project period exceeded the plan, making the efficiency of the Project fair. Through the implementation of the Project, a stable and safe water supply has been achieved in Coronel Oviedo City and the convenience of water use in daily life has improved. The secondary effect in Villarrica City was achieved as planned. While there is a possibility of an increase of the discharge volume of untreated domestic wastewater from households in the post-project period, such expected impacts as improvement of the living environment and improvement of hygiene in the city have been realized. As such, the effectiveness and impacts of the Project are high. As the institutional/organizational, technical and financial aspects of the operation and maintenance of the Project pose no problems, the sustainability of the project effects is high.

In light of the above, the Project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

- It is desirable for ESSAP together with ERSSAN to conduct awareness raising activities designed to inform the residents that the quality of supplied water in Coronel Oviedo City is suitable for drinking with a view to facilitating the use of the city's water supply service.
- It is necessary for ESSAP together with ERSSAN and the municipal government of Coronel Oviedo City to consult with the water and sanitation cooperatives in the city to eliminate illegal connection to the distribution network of ESSAP by some cooperatives. At the same time, it is desirable to facilitate the lawful use of water supplied by ESSAP by the water and sanitation cooperatives.
- It is desirable for DAPSAN and ESSAP to implement the water distribution network improvement plan in Coronel Oviedo City as soon as possible.
- It is essential for ESSAP to sufficiently coordinate with the Directorate of Roads of MOPC so that road repair work by the said directorate can avoid damaging the water distribution network.
- It is necessary for DAPSAN and ESSAP to evaluate the current situation of the sewerage service in Coronel Oviedo City and to plan and implement an investment scheme necessary to contain the discharge of untreated sewage into the environment.

4.2.2 Recommendations to JICA

JICA should encourage the DAPSAN and ESSAP to implement the recommendations listed above and monitor their implementation situation.

4.3 Lessons Learned

<u>Meeting the preconditions to realize expected impacts of a project in the water supply and sewerage sector</u>

The construction of the WTP and the transmission pipeline under the Project has substantially increased the volume of water supply to Coronel Oviedo City and the water quality has also improved. Following such improvement, the number of connections has increased with 24 hour water supply of safe drinking water. However, many residents have maintained their pre-Project habit of using purchased bottled water for drinking and cooking. DAPSAN/ESSAP have prepared a distribution network improvement plan for Coronel Oviedo City as its necessity was pointed out at the timing of the planning of the Project, but it has not yet been implemented. There are many water and sanitation cooperatives in the city which use wells as water sources and some of them still have illegal connections to the water supply system of ESSAP, indicating the

existence of the inappropriate use of the ESSAP's water supply by some cooperatives. Meanwhile, the Project is appraised as having positively contributed to improvement of the living environment of residents. In the meantime, there is concern regarding the slow development of the sewerage system and an increase in the discharge of untreated domestic wastewater which could possibly lead to environmental contamination.

In the light of the above, it is desirable to analyze the conditions to achieve the expected impacts in the case of a project to improve a part of water supply and sewerage systems so that the necessary conditions are internalized by means of including such works in the scope of the project as much as possible. When some important conditions are left as external conditions, it is desirable to prepare concrete recommendations or a plan to achieve such conditions, while considering the possibility of collaboration with other organizations if necessary, and to monitor the implementation of such recommendations or plan by both the executing agency and JICA. In this context, it is desirable to broadly analyze the relevant conditions relating not only to the water and sewerage infrastructure but also to the operating and maintenance bodies of these services, their users and other stakeholders.

END

India

FY2020 Ex-Post Evaluation Report of

Japanese ODA Loan “Tamil Nadu Urban Infrastructure Project”

External Evaluator: Keishi Miyazaki, OPMAC Corporation

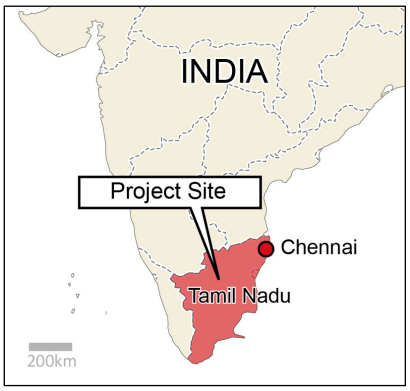
0. Summary

The objective of this project was to provide a safe water supply and sewerage facilities for small and medium sized municipalities in Tamil Nadu in southern India, where the population is growing, by providing long-term funds through the Tamil Nadu Urban Development Fund (TNUDF), thereby contributing to the economic development of small and medium sized municipalities as well as to the improvement of the living conditions of residents.

The project was highly relevant and fully consistent with the development plan and development needs of India at the time of appraisal and of the ex-post evaluation, and with Japan's ODA policy at the time of the appraisal. Although the project cost was within the plan, the project period exceeded the plan, and therefore the efficiency of the project is fair. The reasons for the delay in the project period were due to delays in the start of each sub-project caused by the re-selection of the target sub-projects, the delay in land acquisition, the time required to obtain the necessary permits for laying water pipes, the delay in contractor selection due to unsuccessful bidding, and the delay in construction progress due to deterioration of the contractor's financial base. The operation and effect indicators for the nine completed target sub-projects were generally achieved. It seems that a certain level of project effect was realized in the improvement of the financial and facility operation and maintenance capacity of the target municipalities. Through a qualitative survey of 50 beneficiary households of the project, it was recognized that the increase in water quantity following the implementation of the project had led to an improvement in the convenience of daily life. There were generally no problems with water quality, water supply volume, water supply time, or water charges, and the overall evaluation of the water supply service was very high. No negative impact on the natural environment was observed, most of the land acquired was public land, and there was no resettlement of residents. Therefore, the effectiveness and impact of this project are high. No problems were observed in terms of the institutional/organizational, technical, financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the project is also high.

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

1. Project Description



Project Location

Water Purification Facility constructed by the Project (Thoothukudi)

1.1 Background

The State of Tamil Nadu, located in southeast India, had a total population of 62.11 million in 2001. The urban population ratio of Tami Nadu was 44% in 2001 compared to an average urban population ratio in India of 28%, making Tamil Nadu one of the most urbanized states in the country. Although the contribution of the cities in Tamil Nadu amounted to 70% of the state's GDP, the water supply and sewerage networks could not keep up with the surge in the urban population. Small and medium sized municipalities in Tamil Nadu (157 municipalities) were unable to supply the target amount of water defined by the state. In addition, only 11 municipalities had sewerage treatment facilities, which led to a deterioration in the sanitary environment.

For this reason, the State Government of Tamil Nadu set the goal of raising the water supply from seven days a week to 24 hours a day by 2012. Regarding sewerage, by 2012, 157 municipalities with a population of 30,000 or more in the state had established a policy to improve sewerage facilities, aiming to improve the urban sanitary environment. Despite this effort, although there was an abundance of support schemes for large cities and municipalities offered by the central and state governments, small and medium sized municipalities lacked budgets and were financially weak due to insufficient support by the central and state governments for urban infrastructure development. Therefore, it can be said that there was a pressing need to strengthen the financial capacity of small and medium sized municipalities and to promote the development of water and sewerage facilities.

1.2 Project Outline

The objective of this project was to provide a safe water supply and sewerage facilities for small and medium sized municipalities in Tamil Nadu in southern India where the population is growing, by providing long-term funds through TNUDF, and thereby contributing to the economic

development of small and medium sized municipalities as well as to the improvement of the living conditions of residents.

Loan Approved Amount/ Disbursed Amount	8,551 million yen / 6,818 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2008 / March 2008
Terms and Conditions	Interest Rate 0.45% (Sewerage) 1.20% (Water supply) Repayment Period 30 years (Grace Period 10 years) Conditions for Procurement General untied
Borrower / Executing Agency(ies)	The President of India / TNUDF
Project Completion	November 2021
Target Area	10 municipalities in Tamil Nadu State
Main Contractor(s) (Over 1 billion yen)	P&C Project Pvt. Ltd (Water supply subproject in Dindigul)
Main Consultant(s) (Over 100 million yen)	None
Related Studies (Feasibility Studies, etc.)	None
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Keishi Miyazaki (OPMAC Corporation)

2.2 2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: December 2020 – March 2022

Duration of the Field Study: September 12 – September 26, 2021

2.3 Constraints during the Evaluation Study

Due to the COVID-19 pandemic, the first field survey scheduled for May 2021 was delayed by four months and the duration of the field survey was shortened. The second field survey was canceled for the same reason. Therefore, site surveys were conducted by either an evaluator or an Indian local consultant in 6 out of 10 target municipalities in Tamil Nadu. For the remaining 4 municipalities, information was gathered by the local consultant through telephone interviews. In addition, the COVID-19 pandemic required that the staff of the executing agency and the target 10 municipalities work from home for an extended period, which also caused some restrictions on data collection.

Furthermore, it was expected that the values of the operation and effect indicators would be reviewed and revised after the target subprojects were completed, but this did not take place during project implementation. Therefore, in this ex-post evaluation, it was necessary to analyze the quantitative effect of the project based on the value of the operational and effect indicators set by each target municipality, rather than the value of the operational and effect indicators agreed by JICA and the executing agency.

3. Results of the Evaluation (Overall Rating: A[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Consistency with the Development Plan of India

At the time of appraisal, the Government of India's *11th Five-Year Plan* (April 2007-March 2012) included the following: (1) Sustainable access to drinking water throughout India based on the standard minimum drinking water quantity, (2) Purification of major contaminated rivers and improvement of their basin environment, (3) Early development of waste landfills and drainage canals necessary for urban sanitation and environmental conservation, (4) Financial soundness of operation and maintenance organizations that are the premise of sustainable water and sewerage projects, (5) Strengthening the capacity of local governments at the municipal level, which is a prerequisite for promoting the transfer of authority for water and sewerage projects to local areas. In addition, in its *National Water Policy* (April 2002), the Ministry of Water Resources aimed to prioritize the allocation of water resources in the order of drinking water, irrigation, and hydropower generation, to limit groundwater pumping according to water retention capacity, and to provide sufficient and safe drinking water to all citizens. Furthermore, the Ministry of Environment and Forests was working on water quality conservation through sewerage system development based on *the National River Conservation Plan* (July 1995), and *the Jawaharlal Nehru National Urban Renewal Mission* launched in December 2005, planning

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[2] ③: High, ②: Fair, ①: Low

to support urban infrastructure development, including water supply, sewerage and sanitation facilities.

At the time of the ex-post evaluation, the Government of India's *Three-year Action Agenda* (2017/18-2019/20)[3] included the promotion of the sustainable use of water resources by improving groundwater management, introducing smart water meters, and strengthening environmental regulations. *The Jal Jeevan Mission*, a water supply development program launched in August 2019 by the Ministry of Water and Environment, incorporating the existing *National Rural Water Supply Program*, aims to provide a safe and adequate water supply to all households in rural India through house service connections by 2024. This policy has also been included in the budget proposal of the Central Government of India for fiscal year 2021.

In addition, Tamil Nadu's strategic plan for infrastructure development, *Vision Tamil Nadu 2023* (formulated in March 2012), has the goal of providing a 24-hour daily water supply service and of developing sewerage systems to raise the infrastructure of the Chennai metropolitan area and major regional cities to a world-class standard. Therefore, the development of the water supply and sewerage systems in the rural cities of Tamil Nadu is considered to have been consistent with the development plan at the time of ex-post evaluation.

3.1.2 Consistency with the Development Needs of India

The delay in water supply and sewerage infrastructure development in small and medium sized municipalities in Tamil Nadu at the time of appraisal was as described in "1.1 Background". In order to support the development of urban infrastructure by small and medium sized municipality governments in the state, TNUDF was established in 1996 by a joint capital investment between the state government and private financial institutions. TNUDF has promoted the development of water supply and sewerage systems by local governments.

At the time of the ex-post evaluation, as shown in "3.3.1 Effectiveness" below, of the ten water supply sub-projects implemented under the project, the water supply volume had increased in all nine municipalities where the sub-projects were completed, and 88,787 households were newly provided with water supply services in these nine municipalities. Meanwhile, the Tamil Nadu government set the target for all households in the state to have access to water supply at least two hours every day. Two of the nine target municipalities have only been able to provide water services for 4 hours once every 3 days or 1 hour every day. The other seven municipalities have achieved the 2-hour daily water supply service but have yet to achieve a 24-hour daily water supply service. In the water supply sector of the state, the daily water supply per capita in

[3] The Government of India decided to terminate the existing National Development Five-Year Plan with the 12th Five-Year Plan (April 2012-March 2017), and instead set up a new framework of the 15-Year Vision (2017/18-2031/32), the 7-Year Strategy (2017/18-2023/24) and the 3-Year Action Agenda (2017/18-2019/20) starting in 2017. According to information provided on the website of the National Institution for Transforming India Commission (former Planning Commission), the 15-Year Vision and the 7-Year Strategy were in the draft stage at the time of ex-post evaluation.

Municipal Corporations (four of the ten target municipalities are classified in this category) is 135 liters, and the daily water supply per capita in Municipal Councils (6 target municipalities are classified in this category) is 135 liters (if a sewerage system is in place) or 90 liters (without a sewerage system). They are the achievement rates for the daily water supply per capita set by the state. However, some of the target municipalities do not meet the above achievement standards. Therefore, the need for waterworks improvement in the target municipalities of this project continues to be recognized.

3.1.3 Consistency with Japan's ODA Policy

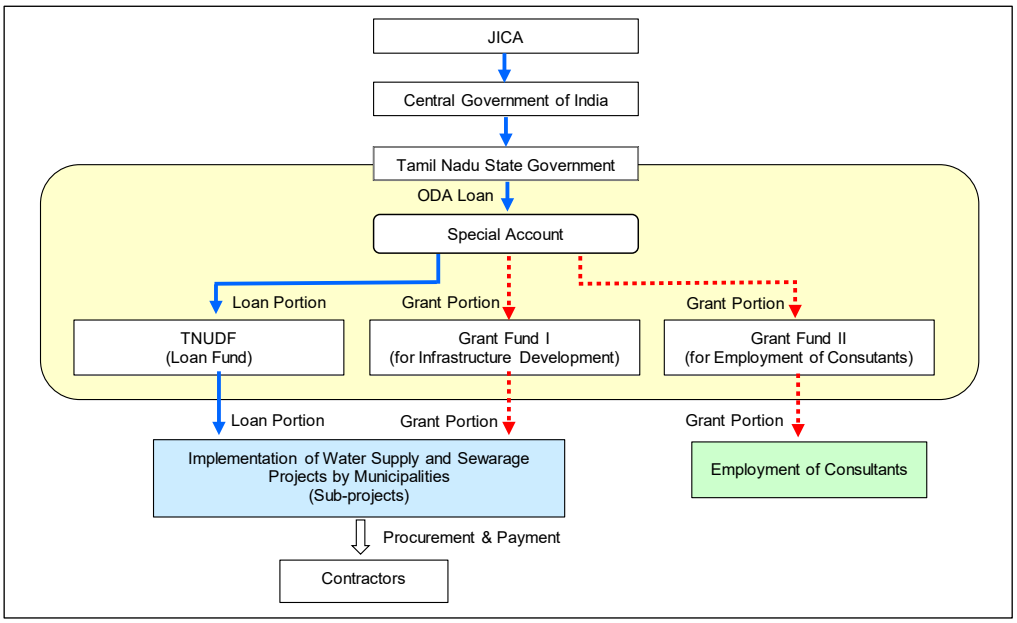
At the time of appraisal, Japan's *Country Assistance Program for India* (May 2006) listed three priority objectives: (1) promotion of economic growth, (2) improvement of poverty and environmental problems, and (3) support for human resource development and expansion of human exchange. (2) Improvement of poverty and environmental problems included "support for water supply and sewerage systems". In addition, "development of economic infrastructure", "local development that benefits the poor", and "response to environmental issues" were positioned as priority areas for assistance to India in JICA's *Medium-Term Strategy for Overseas Economic Cooperation Operation*.

3.1.4 Appropriateness of the Project Plan and Approach

This project provided long-term funds (loans) and grants to small and medium sized municipalities with weak financial foundations and insufficient access to funds for infrastructure development through TNUDF to support the development of water and sewerage infrastructure (Figure 1).

In addition, unlike conventional project-type loans, this project was a two-step loan, similar to a sector loan, in which eligible sub-projects were determined based on the selection criteria given and the eligibility requirements for projects in the water supply and sewerage sector. At the time of appraisal, the Indian side shortlisted one water supply sub-project and six sewerage sub-projects as candidate projects for assistance, and it was assumed that these would be implemented. However, at the first Project Coordination and Monitoring Committee held in the September after the signing of the loan agreement in March 2008, one water supply sub-project and three sewerage sub-projects were selected for the loan, while the remaining three sewerage sub-projects were excluded from this project due to the difficulty in land acquisition and the submission of a feasibility study report called DPR (Detailed Project Report). Subsequently, five water supply sub-projects were newly selected in 2010, and four water supply sub-projects were newly selected in 2011. On the other hand, the three sewerage sub-projects selected in September 2008, which were still under implementation, were excluded from the loan in 2011 due to unsuccessful bidding and delays in land acquisition, as well as the possibility of support from

other donors and the Indian central government. As a result, 10 water supply sub-projects and no sewerage sub-projects were finally implemented under this project.



Source: Prepared by the evaluator with reference to materials provided by JICA.
Note 1: Depending on the profitability of each sub-project, the state government was to provide funds to municipalities by setting a grant ratio of up to 20% for water supply projects and 40% for sewerage projects out of the ODA loan funds.
Note 2: In this project, the municipalities borrowing funds were to bear at least 10% of the sub-project cost, and the rest was to be covered by loans from TNUDF and grants from the state government.

Figure 1: Fund Flow of ODA Loans for this Project

In the selection of sub-projects, projects that met the eligibility requirements of the target municipality, such as population size, financial soundness criteria, target sectors, confirmation of water demands, proration of DPR, etc., were selected as the targets of loans, and the selection process was conducted in a proper manner.

Based on the above, it is considered that the changes in the target sub-projects that occurred during the implementation of this project were appropriate for the following reasons: the project was supported by a two-step loan similar to a sector loan, the sub-projects were selected through an appropriate selection process, and the selected sub-projects also met the project objective of improving water supply and sewerage in municipalities in Tamil Nadu.

This project has been highly relevant to India's development plan and development needs, as well as to Japan's ODA policy. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

At the time of appraisal, it was assumed that one water supply sub-project and six sewerage sub-projects would be implemented in seven municipalities, but in the end, ten water supply sub-projects were implemented in ten municipalities (Tiruchirappalli, Palani, Coonoor, Idappadi, Devakottai, Thoothukudi, Dindigul, Mettupalayam, Udumalpet, Madhavaram), with no sewerage sub-project implemented. As of September 2021, when the field survey for this ex-post evaluation was conducted, the water storage facility (water tower) of the Madhavaram water supply sub-project had not been completed (scheduled for completion in November 2021), but the water supply sub-projects in the other nine municipalities had been completed. These water supply sub-projects were implemented mostly as planned (see "Comparison of the Original and Actual Scope of the Project" on the last page of this report for details). At the time of appraisal, Madhavaram was a municipality[4], but was subsequently merged into the Greater Chennai Corporation (i.e. Chennai Metropolitan City) as the latter expanded and the project there is currently being implemented as a project of the Greater Chennai Corporation.

At the time of appraisal, six sewerage sub-projects (Chidamnaram, Pattukottai, Rameswaram, Ambur, Madhuranthagam, Peranampat) and one water supply sub-project (Tiruchirappalli) had been presented by India as candidates for support. However, at the first Project Coordination and Monitoring Committee held in the September after the signing of the loan agreement in March 2008, one water supply sub-project (Tiruchirappalli) and three sewerage sub-projects (Chidamnaram, Pattukottai, Rameswaram) were selected for the loan. The remaining three sewerage sub-projects (Ambur, Madhuranthagam, Peranampat) were excluded, as it was difficult to submit DPR due to the lack of prospects for land acquisition. In 2010, five water supply sub-projects (Madhavaram, Palani, Coonoor, Idappadi, Devakottai) were selected as targets for the loan, and in 2011, four water supply sub-projects (Thoothukudi, Dindigul, Mettupalayam, Udumalpet) were also selected. On the other hand, the three sewerage sub-projects that had been selected and were being implemented were removed from the target projects of the loan in 2011 due to unsuccessful bidding and delays in land acquisition, as well as the possibility of support from other donors and the central government of India. The project budget for the sewerage sub-project was reallocated to the water supply sub-projects.

Regarding the six sewerage sub-projects that were eventually excluded, three have been completed, two are under implementation, and one is under preparation for implementation[5]

[4] Local governments in India have different systems for urban and rural areas, and the urban municipalities targeted by this project are the Municipal Corporation (Nagar Nigram) in large cities, the Municipal Council (Nagar Palika) in small cities, and the City Council (Nagar Panchayat) in areas undergoing rural-urban development.

[5] (1) The Chidambaram sewerage project under the Urban Infrastructure Development Scheme for Small and Medium Sized Towns (UIDSSMT) (Central Government of India scheme) completed in December 2020; (2) The Patukkottai sewerage project by the Integrated Urban Development Mission (IUDM) (Tamil Nadu Flagship Scheme) completed in November 2021; (3) The Rameswaram sewerage project is being implemented (to be completed in June 2022) by the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) (central government of India scheme); (4) The

with the support of the central government of India, the Tamil Nadu state government, or other donors.

The municipalities implementing the water supply sub-projects under the project were provided with loans through TNUDF and grants from the state government. These municipalities were selected for financing if they met eligibility requirements, such as population size, financial soundness criteria, target sectors, confirmation of water demand, and the preparation of DPR. DPR also includes environmental and social considerations screenings, financial analysis of the municipality, and water tariff simulation.

In addition, a quality assurance consultant and an environmental management consultant were hired to assist in the preparation of the DPR for the sub-projects covered by this loan, to confirm environmental and social considerations, and to provide advice. In the plan, it had been assumed that the quality assurance consultant would be hired under the budget of this project and that the environmental management consultant would be hired under the project budget of the World Bank. In the end, however, both consultants were hired under the project budget of the World Bank.

Meanwhile, TNUDF hired a water supply engineer from the Tamil Nadu Water Supply and Drainage Board (TWADB) on a contract basis and conducted regular monitoring of the project progress, including site visits. Monthly monitoring meetings (participating members: TNUDF, the project management consultant, TWADB, and municipality representatives) were held once a month for each sub-project. A Project Coordination and Monitoring Committee, consisting of state government officials, municipality chiefs, the executing agency, and representatives of related organizations, also met quarterly to assist in expediting procedures for obtaining land use permits from the National Highways Authority of India and Indian Railways, and for environmental clearances.

Implementation Structure/System of the Sub-Projects

The implementation structure of the sub-projects differs depending on the municipalities. Three large municipalities (Tiruchirappalli, Thoothukudi, and Dindigul) hired project management consultants to implement the project, while four municipalities (Palani, Coonoor, Devakottai, and Idappadi) implemented the project by commissioning TWADB [6]. Two municipalities (Udumalpet, Mettupalayam) did not hire consultants but implemented the project directly as the scope of the project (including transmission and distribution pipes, water towers, house service connections) was relatively small. Sub-project of Madhavaram, which has been

Ambur sewerage project is being implemented with the support of AMRUT and the Asian Development Bank (ADB) (to be completed in March 2022); (5) The Madhuranthagam sewerage project by IUDM completed in December 2019; and (6) The Peranampat sewerage project is under planning and preparation for implementation.

[6] The municipality pays a commission to TWADB, and TWA performs the same services as a project management consultant, such as designing, bidding assistance, and construction management.

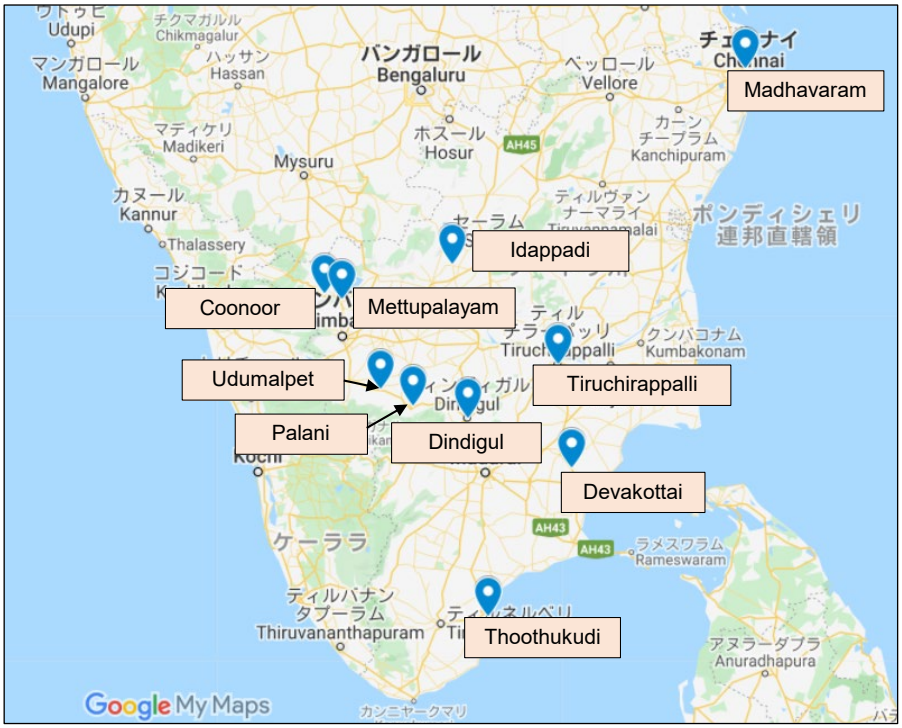
merged into the Greater Chennai Corporation, is being implemented by the Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB).

Water Supply Facilities Constructed by this Project

Water Intake Facility (Dindigul)

Pumping Facility (Tiruchirappalli)

Water Storage Facility (Devakottai)



Source: Prepared by the evaluator using the Google Map.

Figure 2: Location Map of Sub-projects Covered by the Project

3.2.2 Project Inputs

3.2.2.1 Project Cost

The project cost at the time of planning was 9,824 million yen. This was calculated on the premise that the one water supply sub-project and six sewerage sub-projects shortlisted by the Indian side as candidate projects for assistance at the time of appraisal would be implemented. However, the actual number of sub-projects covered by the loan was ten, which exceeded the number of sub-projects assumed at the time of the appraisal, and these only included the water supply sector. In principal, if, during the project implementation, the sub-projects for which

loans are to be provided change in size or number from the time of appraisal (i.e. if the planned output changes), the planned project cost should be revised to reflect the project cost of the sub-projects that are finally selected (according to changes in the planned output), and the revised planned cost will be compared with the actual project cost. However, no discussions were held between JICA and TNUDF regarding the revision of the planned project cost in accordance with the above change in output.

This project was designed to determine eligible sub-projects based on the prescribed selection criteria and eligibility requirements, and JICA agreed to the selection of individual sub-projects, including the project cost, based on the formal procedures. In addition, when the decision was made to exclude three sewerage sub-projects from the loan in 2011, it was agreed with TNUDF that the project budget of the sewerage component would be reallocated to the water supply portion. In the ex-post evaluation, it was determined that it would be appropriate to revise the planned project cost to reflect the cost of the ten selected water supply sub-projects and compare this with actual project cost.

The actual project cost was 10,507 million yen (including ODA Loan 8,551 million yen) against the revised planned project cost of 13,433 million yen (including ODA Loan 6,181 yen), which was within the plan (78% of the plan) (see Tables 1 and 2).

Table 1: Planned and Actual Project Cost

Unit: Million yen

Item	Plan (2008)				Revised Plan	Actual
	Foreign currency	Local currency	Total	ODA loan	Total	Total
Loan Portion						
- Water Supply facilities	0	3,840	3,840	3,840	11,416	9,688
- Sewerage facilities	0	3,967	3,967	3,967	0 (No sewerage)	0 (Same as left)
Sub-total	0	7,807	7,807	7,807	11,416	9,688
Technical support & training	0	302	302	0	302	0
Price escalation	0	337	337	337	337	-
Physical contingency	0	407	407	407	407	-
Interest during construction	240	0	240	0	240	626
Commitment charge	68	0	68	0	68	-
Land acquisition	0	83	83	0	83	-
Administration	0	238	238	0	238	193
VAT	0	342	342	0	342	-
Total	308	9,516	9,824	8,551	13,433	10,507

Source: Documents provided by JICA

Note 1: Funding will be provided for the sub-project costs, excluding the costs to be borne by each municipality (minimum 10% of the project costs).

Note 2: Exchange rate: Planned: 1 rupee = 2.85 yen (October 2007); Revised (post-revision): 1 rupee = 1.93 yen (2009); Actual: 1 rupee = 1.72 yen (average of 2009-2021)

Note 3: The planned project cost after the revision was assumed to be the same as that at the time of planning (2008) except for the water supply and sewerage facility cost items.

Note 4: The actual amount of administration expenses was calculated as 2% of the same funding (total of water supply and sewerage facility costs) as the plan (post-revision).

Note 5: In the actual project cost, except for the interest during construction and administration expenses, all other expenses were included in the funding (total of water supply and sewerage facilities costs).

Table 2: Planned and Actual Project Cost of Sub-projects

Sub-project	Planned					Actual				
	ODA Loans		Municipal Self-financing	Total	Total	ODA Loans		Municipal Self-financing	Total	Total
	Loans	Grants				Loans	Grants			
	Mill. Rp	Mill. Rp	Mill. Rp	Mill. Rp	Mill. yen	Mill. Rp	Mill. Rp	Mill. Rp	Mill. Rp	Mill. yen
Tiruchirappalli	1,112.5	664.3	437.4	2,214.2	4,273.4	933.0	534.5	380.4	1,847.9	3,075.4
Palani	129.6	64.8	21.6	216.0	416.9	129.6	64.8	21.6	216.0	359.5
Coonoor	83.1	41.6	13.8	138.5	267.3	74.9	37.4	12.4	124.8	207.7
Idappadi	100.0	66.7	18.5	185.2	357.4	88.0	55.9	18.9	162.8	270.9
Devakottai	49.9	25.0	8.3	83.2	160.6	45.0	20.5	8.3	73.8	122.8
Thoothukudi	706.1	706.1	1,412.2	2,824.4	5,451.1	706.1	1,835.9	282.4	2,824.4	4,700.5
Dindigul	211.5	141.0	352.5	705.0	1,360.7	211.5	141.0	352.5	705.0	1,173.3
Mettupalayam	27.5	18.3	45.8	91.6	176.8	27.5	18.3	45.8	91.6	152.4
Udumalpet	53.6	35.7	89.4	178.7	344.9	53.6	32.0	87.0	172.6	287.3
Madhavaram	330.0	165.0	55.0	550.0	1,061.5	198.7	99.4	77.3	375.4	624.8
Total	2,803.8	1,928.50	2,454.5	7,186.8	13,870.6	2,467.9	2,839.7	1,286.6	6,594.3	10,974.6
Excluding state and local self-financing					11,416.0					9,688.0

Source: Documents provided by JICA and response to questionnaires by 10 targeted municipalities
Note 1: Depending on the profitability of each sub-project, the state government provides municipalities with construction funds and funds for hiring consultants by setting a grant ratio of up to 20% for water supply projects out of the ODA loan.
Note 2: For Thoothukudi, the municipal self-financing of Rs. 1,412.2 million includes grant of Rs. 1,129.8 million from Tamil Nadu.
Note 3: The exchange rate at the time of planning was 1 rupee = 1.93 yen (2009), and 1 rupee = 1.72 yen (2009-2021 average) at time of evaluation.

The main reasons why the actual project cost was lower than the revised planned project cost was due to some changes in scope in sub-projects such as Tiruchirappalli, Coonoor, Idappadi, and Madhavaram, to reduced project cost due to cancellations, to possible non-expenditure for technical assistance and training, and to changes in the foreign currency exchange rates used at the time of planning and ex-post evaluation.

3.2.2.2 Project Period

The planned project period was 64 months (March 2008 to June 2013), while the actual project period was 165 months (March 2008 to November 2021). However, for the water supply sub-project in Madhavaram, the tender for selection of the contractor could not be announced for 12 months due to COVID-19. Therefore, in the ex-post evaluation, the actual project period is 153 months, which is 165 months minus above 12 months. Therefore, the revised actual project period was 153 months, which significantly exceeded the plan, compared to the planned project period of 64 months (239% of the plan). The project completion date for the actual project period is November 2021, when the Madhavaram water supply sub-project is scheduled to be completed (see Table 3 and Table 4).

Table 3: Planned and Actual Project Period

Item	Planned	Actual
L/A signing	March 2008	March 2008
Sub-project selection	October 2007-February 2008	July 2008-April 2015
Bidding/Contract	February 2008-June 2008	April 2009-November 2021 (scheduled)
Construction	April 2008-June 2013	
Technical support/Training	April 2008-March 2010	N.A.

Source: Documents provided by JICA and response to the questionnaires by 10 targeted municipalities

Table 4: Planned and Actual Project Period for Sub-projects

Sub-projects	Planned	Actual
Tiruchirappalli	April 2009-January 2013	April 2009-February 2014
Palani	February 2012-February 2013	February 2012-October 2019
Coonoor	February 2011-February 2013	February 2011-March 2015
Idappadi	February 2012-February 2013	February 2012-February 2015
Devakottai	January 2012-January 2013	January 2012-November 2013
Thoothukudi	June 2013-August 2015	June 2013-December 2020
Dindigul	February 2015-August 2016	February 2015-January 2019
Mettupalayam	May 2015-November 2016	June 2015-May 2018
Udumalpet	January 2015-June 2016	February 2015-December 2016
Madhavaram	August 2012-August 2014	April 2013-November 2021 (scheduled)

Source: Documents provided by JICA and response to questionnaires by 10 targeted municipalities
Note: For Madhavaram, as of September 2021, the construction was scheduled to be completed in November 2021.

As described in "3.2.1 Project Outputs", the reasons for the delay were that the sub-projects for the loan were selected again after the signing of the loan agreement, and that the three sewerage sub-projects that had been selected were subsequently excluded from targets of the loan. Due to this, the start of each sub-project was delayed by one to seven years from the planned start dates. The implementation of sub-projects was also delayed due to delays in land acquisition, time taken to obtain the necessary permits from the National Highway Authority of Indian (NHAI) and Indian Railways for the laying of water pipes, delays in contractor selection due to unsuccessful bidding, poor performance due to deterioration of the contractor's financial base, and the consequent delays in construction progress. It has been pointed out by the executing agency that in parallel with the implementation of this project, other regional water supply and sewerage improvement projects were being implemented in Tamil Nadu with the support of the Government of India, the state governments, the World Bank, and Asian Development Bank (ADB), and this concentration of projects being carried out at the same time led to a shortage of contractors and unsuccessful bidding.

Although the project cost was within the plan, the project period significantly exceeded the plan. Therefore, efficiency of the project is fair.

3.3 Effectiveness and Impacts[7] (Rating: ③)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of appraisal, the operation and effect indicators of the water supply and sewerage sub-projects were set on the basis of the candidate projects for support presented by the Indian side, but the values were to be reviewed after the sub-projects were confirmed. However, JICA and TNUDF did not review the operation and effect indicators during project implementation. Therefore, in this ex-post evaluation, the nine target municipalities, excluding Madhavaram which is still under implementation, were asked to provide the baseline, target, and actual values of the operation and effect indicators for each sub-project set by each municipality, and the quantitative effects were measured with these figures. These operation and effect indicators were prepared based on the project plan at the time that the DPR were prepared for each sub-project. However, it should be noted that these operation and effect indicators cover not only the water supply facilities constructed and/or replaced by this project, but also all the water supply facilities of each municipality. The table below shows the operation and effect indicators of the nine completed target water supply sub-projects.

Table 5: Operation and Effect Indicators for 9 Completed Target Water Supply Sub-projects

(1) Tiruchirappalli

Indicators	Baseline	Target	Actual	
	2008	2013	2014	2021
		Project Completion	Completion Year	7 Years After Completion
Population served (no. of persons)	920,660	1,111,570	1,111,570	1,306,000
No. of house service connections (nos.)	81,225	111,513	111,513	111,513
Water supply amount (m^3 per day)	85,000	150,000	150,000	150,000
Water supply amount per day/capita (liters per capita/day)	92	135	135	115
Water supply service time (hours)	2 hours every other day	2 hours daily	2 hours daily	2 hours daily

Source: Response to the questionnaire from Tiruchirappalli.

[7] Sub-rating for Effectiveness is to be put with consideration of Impacts.

(2) Palani

Indicators	Baseline	Target	Actual	
	2008	2013	2019	2021
		Project Completion	Completion Year	3 Years After Completion
Population served (no. of persons)	79,519	90,069	90,069	100,620
No. of house service connections (nos.)	7,401	10,601	9,140	10,601
Water supply amount (m^3 per day)	7,157	8,106	8,106	8,106
Water supply amount per day/capita (liters per capita/day)	90	90	90	81
Water supply service time (hours)	2 hours every other day	2 hours every other day	2 hours every other day	2 hours every other day

Source: Response to the questionnaire from Palani.

(3) Coonoor

Indicators	Baseline	Target	Actual	
	2008	2015	2015	2021
		Project Completion	Completion Year	6 Years After Completion
Population served (no. of persons)	50,196	49,134	49,472 (2017)	54,221
No. of house service connections (nos.)	5,784	8,654	7,664	8,654
Water supply amount (m^3 per day)	3,000	7,000	7,000	7,000
Water supply amount per day/capita (liters per capita/day)	60	142	118	129
Water supply service time (hours)	2 hours every three days	3 hours every three days	4 hours every three days	4 hours every three days

Source: Response to the questionnaire from Coonoor.

(4) Idappadi

Indicators	Baseline	Target	Actual	
	2008	2013	2015	2021
		Project Completion	Completion Year	6 Years After Completion
Population served (no. of persons)	53,062	56,670	56,670	58,460
No. of house service connections (nos.)	4,203	10,682	9,526	10,682
Water supply amount (m^3 per day)	2,000	5,600	5,600	5,600
Water supply amount per day/capita (liters per capita/day)	38	99	99	96
Water supply service time (hours)	1 hour daily	1 hour daily	1 hour daily	1 hour daily

Source: Response to the questionnaire from Idappadi.

(5) Devakottai

Indicators	Baseline	Target	Actual	
	2008	2013	2013	2021
		Project Completion	Completion Year	8 Years After Completion
Population served (no. of persons)	43,136	51,865	51,865	58,800
No. of house service connections (nos.)	6,910	9,010	7,566	9,167
Water supply amount (m^3 per day)	3,260	4,180	4,180	4,180
Water supply amount per day/capita (liters per capita/day)	76	81	81	71
Water supply service time (hours)	2 hours daily	2 hours daily	2 hours daily	2 hours daily

Source: Response to the questionnaire from Devakottai.

(6) Thoothukudi

Indicators	Baseline	Target	Actual	
	2008	2015	2019	2021
		Project Completion	Completion Year	3 Years After Completion
Population served (no. of persons)	794,228	848,104	848,104	957,382
No. of house service connections (nos.)	39,932	62,960	58,207	62,960
Water supply amount (m^3 per day)	65,000	110,000	110,000	110,000
Water supply amount per day/capita (liters per capita/day)	82	130	130	115
Water supply service time (hours)	2 hours daily	2 hours daily	2 hours daily	2 hours daily

Source: Response to the questionnaire from Thoothukudi.

(7) Dindigul

Indicators	Baseline	Target	Actual	
	2008	2016	2019	2021
		Project Completion	Completion Year	3 Years After Completion
Population served (no. of persons)	215,105	217,075	217,075	226,925
No. of house service connections (nos.)	28,446	58,446	55,746	58,446
Water supply amount (m^3 per day)	12,000	16,000	16,000	16,000
Water supply amount per day/capita (liters per capita/day)	56	74	74	71
Water supply service time (hours)	2 hours daily	2 hours daily	2 hours daily	2 hours daily

Source: Response to the questionnaire from Dindigul.

(8) Mattupalayam

Indicators	Baseline	Target	Actual	
	2008	2016	2018	2021
		Project Completion	Completion Year	3 Years After Completion
Population served (no. of persons)	68,620	74,206	74,206	76,454
No. of house service connections (nos.)	8,864	9,151	10,744	11,734
Water supply amount (m^3 per day)	6,480	8,360	8,360	8,450
Water supply amount per day/capita (liters per capita/day)	94	113	113	111
Water supply service time (hours)	2 hours daily	2 hours daily	2 hours daily	2 hours daily

Source: Response to the questionnaire from Mattupalayam.

(9) Udumalpet

Indicators	Baseline	Target	Actual	
	2008	2016	2016	2021
		Project Completion	Completion Year	5 Years After Completion
Population served (no. of persons)	58,880	61,900	61,900	62,650
No. of house service connections (nos.)	8,790	10,236	10,236	10,794
Water supply amount (m^3 per day)	6,480	8,360	8,360	8,450
Water supply amount per day/capita (liters per capita/day)	110	135	135	135
Water supply service time (hours)	2 hours daily	2 hours daily	2 hours daily	2 hours daily

Source: Response to the questionnaire from Udumalpet.

Water Taps and Water Storage Tanks in Households (Tiruchirappalli)

Water Tap

Underground Water Storage Tank

Rooftop Water Storage Tank

As shown in Table 5, it is considered that the target values for the nine target sub-projects already completed under this project had been generally achieved at the time of project completion, although there were constraints on evaluation as mentioned earlier. Even if some of the indicators had not been achieved earlier, they had all been achieved by the time of ex-

post evaluation in 2021. After the implementation of the project, the water supply volume increased in all nine target municipalities, and the total number of households supplied increased from 191,555 households before the project to 280,342 households, with 88,787 households being newly served thanks to the project. On the other hand, while Tamil Nadu has the target of providing water supply services for at least two hours daily, the two municipalities of Palani and Coonoor have not reached this target. Each household is equipped with underground and rooftop water storage tanks, and during the hours when water is supplied, water is stored in the tanks and used for domestic purposes.

Table 6: Comparison of Population Served, Number of House Service Connections, and the Water Supply Amount in the Nine Target Municipalities at the Time of Planning and the Ex-Post Evaluation

Municipality	Population served (persons)		Number of house service connections (nos.)		Water supply amount (m^3/day)	
	2008	2021	2008	2021	2008	2021
Tiruchirappalli	920,660	1,306,000	81,225	111,513	85,000	150,000
Palani	79,519	100,620	7,401	10,601	7,157	8,106
Coonoor	50,196	54,221	5,784	8,654	3,000	7,000
Idappadi	53,062	58,460	4,203	10,682	2,000	5,600
Devakottai	43,136	58,800	6,910	9,167	3,260	4,180
Thoothukudi	794,228	957,382	39,932	62,960	65,000	110,000
Dindigul	215,105	226,925	28,446	58,446	12,000	16,000
Mettupalayam	68,620	76,454	8,864	11,734	6,480	8,450
Udumalpet	58,880	62,650	8,790	10,794	6,480	8,450
Total	2,283,406	2,847,291	191,555	294,551	190,377	317,786

Source: Prepared by the evaluator based on questionnaire responses from the nine target municipalities.

Comparing the status of the nine target municipalities with completed sub-projects at the time of planning (2008) and the ex-post evaluation (2021), the population served had increased 1.25 times from 2,283,406 (2008) to 2,847,291 (2021). The number of units connected to water supply facilities increased 1.54 times from 191,555 (2008) to 294,551 (2021), and the water supply volume expanded 1.67 times from 190,377 m^3/day (2008) to 317,786 m^3/day (2021) (see Table 6). However, even since the completion of the project, each municipality has continued to improve water supply systems, including the expansion of the number of house service connections by utilizing the schemes of the Tamil Nadu government, etc. The actual values of each indicator at the time of ex-post evaluation include the contribution of these factors.

3.3.1.2 Qualitative Effects (Other Effects)

(1) Enhancement of the financial, and facility operation and maintenance capacities of municipalities

At the time of appraisal, it was assumed that the training for the enhancement of financial capacity, including the collection of water bills, and the operation and maintenance capacity for municipal engineers and facility operators would be provided through the Directorate of Municipal Administration (DMA) within the Tamil Nadu government budget. However, in a survey conducted with TNUDF and the ten target municipalities in the ex-post evaluation, there was no recognition of any training regarding the enhancement of financial capacity, including the collection of water bills, or for operation and maintenance capacity specific to this project. On the other hand, according to DMA, their technical wing provides regular training to municipalities, and another independent organization, the Tamil Nadu Institute of Urban Study[8], also conducts training for municipalities. The institute provides appropriate training in various fields such as engineering, sanitation, finance, urban planning, etc. and refresher training in response to requests from municipalities. Normally, municipal engineers are in charge of a wide range of infrastructure projects including water supply, sewerage, and roads, which are implemented by the municipality, and the technical training provided by the institute includes the area of water supply.

It is thought that the coordination with DMA related to the training planned at the time of appraisal and the monitoring of training would normally be conducted mainly by the executing agency, TNUDF, and the quality assurance consultants who support it, and that JICA should have confirmed the implementation status of the above training through its project monitoring system. However, since the quality assurance consultant who was initially planned to be hired under the project budget was eventually hired under the World Bank project budget, JICA was not in a position to directly supervise the quality assurance consultant. As a result, implementation of a systematic training program, as well as its monitoring, may have been difficult.

TWADB provided technical guidance and support for the operation and maintenance of the facilities through on-the-job training to the four municipalities (Palani, Coonoor, Idappadi, Devakottai) that implemented the sub-projects outsourced to TWADB, during the one-year warranty period from the completion of the facilities to their handover to the municipalities. As described in “3.4.2 Technical Aspect of Operation and Maintenance” later, no technical problems in the operation and maintenance of the target municipalities were observed during the ex-post evaluation.

[8] Tamil Nadu Institute of Urban Study (TNIUS) is an organization that was established in 1981 to improve the management capacity of municipalities by providing training to municipality officials, research and consulting services.

Based on the above, it is observed that throughout the project period, DMA, Tamil Nadu Institute of Urban Study, and TWADB provided training, guidance, and advice on improving the financial and facility operation and maintenance capacities of municipalities, and no technical problems in the operation and maintenance of the target municipalities were observed. Therefore, it seems there was a certain effect on the capacity development of the targeted municipalities.

3.3.2 Impacts

3.3.2.1 Intended Impacts

(1) Improvement of living conditions in and the environment of municipalities

In order to understand the impact of this project, an interview survey (qualitative survey)[9] was conducted with 50 beneficiary households that receive a direct water supply from the water supply facilities developed and improved by this project. The results of the survey are as follows.

The main uses of the water were for drinking (94%), cooking (92%), showering and bathing (86%), and toilets (78%). Comparing the results before and after the implementation of the project, there was no significant change in the way that water was used.

As for the change in the labor of fetching water, 96% of the respondents answered that there was no change as most of the respondents had already been receiving a water supply at their respective houses (house connection services) before the project was implemented. However, one resident, who was not one of the households interviewed in this study, said that before the project, the water collection point had been located several kilometres away from their house, and it required a lot of time and energy to collect water. However, after the implementation of the project, they were able to use a communal water tap near their house, which freed them from the labor of collecting water.

Regarding the change in sanitation, 96% of the respondents indicated that there was no change. In terms of the prevalence of waterborne diseases, 92% of the respondents answered that there was no change.

On the other hand, 64% of the respondents answered that “the convenience of their daily life improved” due to the increase in water supply volume after the project was implemented, while 36% answered that there was “no change”. Regarding the impact on the natural environment after the implementation of the project, 86% of the respondents answered “not at all” and 14%

[9] In the selection of municipalities for the survey, five municipalities were selected from those where site surveys were feasible, Tiruchirappalli, Idappadi, Devakottai, Thoothukudi, and Dindigul, based on geographical conditions and other factors. In each municipality, the sample (ten households per municipality) was selected by significant sampling, taking into account gender ratio, age group, income, and other factors.

answered “not much”, indicating that the increased water supply did not have any negative impact on the environment such as bringing bad odors or pest infestation.

A survey was also conducted on the degree of satisfaction with the water supply service after project implementation. Regarding water quality, 98% of the respondents answered “no problem” (the remaining 2% answered “do not know”). Regarding the water supply volume, 98% of the respondents answered “no problem”; regarding the water pressure, 92% of the respondents answered “no problem”; and regarding water outages, 98% of the respondents answered “no problem”. Regarding water supply time, 78% of the respondents answered that there was “no problem”, while 12% of the respondents replied that there were “some constraints/limitations”. In terms of water charges, 90% of respondents answered that there was “no problem”, while 6% of respondents answered that they were expensive and 4% answered that they were “expensive to some extent”. The households that felt that the water rates were high had used public wells in their neighbourhoods, but after the implementation of this project, they started receiving a water supply to their individual households. The water rates for individual households were higher than the previous water rates. As for the evaluation of the water supply service as a whole, 92% of the respondents were “very satisfied” and 8% were “satisfied to some extent”, indicating a high degree of satisfaction.

To summarize the results of the above survey, improvements in the living environment of municipalities thanks to the project, through the expanded volume of daily water supply to each household, and the convenience of storing water in household water storage tanks, was recognized. It was also found that there were generally no problems with the water supply service after the project was implemented in terms of water quality, water pressure, water outages, water supply time, and water charges. There were, however, some comments that the two-hour water supply time per day was insufficient.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

In *the Japan Bank for International Cooperation (JBIC) Guidelines for Confirmation of Environmental and Social Considerations* (2002), this project was classified as Category FI as it satisfied all of the following conditions: that “JICA’s funding of projects is provided to a financial intermediary or executing agency; the financial intermediary or executing agency substantially undertakes the selection and appraisal of sub-projects under the projects, only after JICA’s approval of the funding, so that the sub-projects cannot be specified prior to JICA’s approval for the funding (or prior to JICA’s appraisal of the project); and those sub-projects are expected to have potential impacts on the environment and society”. The environmental and social considerations were included in the DPR for each sub-project, and no critical negative environmental impacts were envisaged at the time of planning. For this project, World Bank

project funds were used to hire an environmental management consultant who worked with TNUDF to review the reports submitted to each municipality by contractors, to conduct quarterly site surveys, and to monitor the environmental impacts during implementation. According to the target municipalities, no negative impact on the natural environment was confirmed during project implementation. Also, there has been no negative impact on the natural environment related to the project since project completion, and no grievances have been voiced by local residents.

(2) Resettlement and Land Acquisition

The environmental and social considerations were included in the DPR for each sub-project, and resettlement of residents was not expected at the time of planning, nor did it occur. Although land was acquired for the construction of water towers and distribution reservoirs, most of the land was publicly owned. In cases where private land was acquired, compensation was provided in accordance with the prescribed procedures of Indian domestic law. There were no grievances and disputes associated with the land acquisition.

Summarizing the above, looking at the operational effect indicators for the water supply sub-projects set for each of the nine target municipalities, it is considered that the target values at the time of project completion had largely been achieved. Even though there were some indicators yet to be achieved, all have been achieved at the time of the ex-post evaluation in 2021. Regarding improvement of the financial and facility operation and maintenance capacity of municipalities, DMA and the Tamil Nadu Institute of Urban Study have conducted regular trainings for municipality officials. In addition, the four municipalities that implemented the sub-projects commissioned to TWADB received technical guidance and support from TWADB, which is expected to have had a certain effect in improving their capabilities for financial and facility operation and maintenance. The qualitative survey results from 50 beneficiary households of this project showed no change in the labor of drawing water. In the sanitary environment, or in the incidence of waterborne diseases after the project, as most of the survey targets were households that had been supplied with water before the implementation of the project. However, the increase in water quantity was perceived as an improvement in the convenience of daily life. There were generally no problems with water quality, water supply volume, water supply time, or water charges, and the overall evaluation of the water supply service was very high. There was no negative impact on the natural environment due to this project, and the majority of land acquisition was of land that was publicly owned, so no resettlement occurred.

This project has mostly achieved its objectives. Therefore, the effectiveness and impacts of the project are high.

3.4 Sustainability (Rating: ③)

3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

[Municipalities]

Since completion, each municipality has been responsible for the operation and maintenance of its own water supply facilities. Many municipalities outsource the day-to-day operation and maintenance of facilities to private contractors (private service providers). Each municipality has a technical department, where there is a chief engineer who supervises the outsourced operation and maintenance. CMWSSB is in charge of the operation and maintenance of the water supply facilities in Madhavaram. No problems were found in the operation and maintenance systems and structures of the municipalities.

[Others]

TNUDF was established in 1996 as the first state development fund in India. It was funded by joint capital investment of the public and private sectors, and is responsible for promoting urban infrastructure development, including water supply and sewerage, in Tamil Nadu. While the majority of TNUDF's funding comes from foreign donors, new projects are selected every year, and although the disbursement amount decreased in FY2019/20 due to the impact of COVID-19, the total project cost and the amount of disbursement of newly selected projects have both increased compared to FY2009/10, and this continues to play an important role in the urban infrastructure development of municipalities in Tamil Nadu[10]. Since 2016, TNUDF has introduced an ex-post evaluation system for completed projects to review the financial status and technical level and capabilities of municipalities, and to evaluate the operation and maintenance status of municipalities. TNUDF expects to carry out an ex-post evaluation once a year for each project and will continue to do so for 15 years after completion. For the water supply sub-project of Idappadi, which is a target of this project, the ex-post evaluation has already been conducted and technical advice has been provided to Idappadi based on the evaluation results. The ex-post evaluation of other sub-projects has been temporarily suspended due to COVID-19.

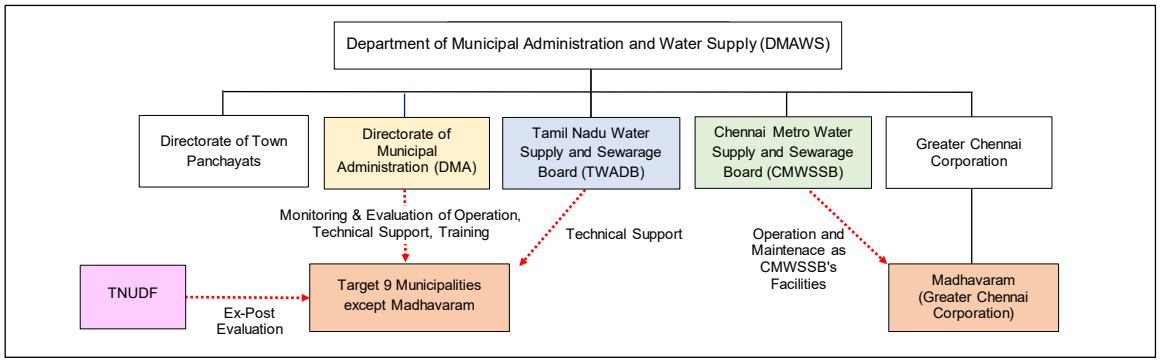
DMA is an organization under the Department of Municipal Administration and Water Supply (DMAWS) which administers and guides municipalities in the state except for the Greater Chennai Corporation. The nine target municipalities for this project, excluding Madhavaram, are basically under the control of DMA, and DMA regularly monitors and evaluates the water supply operations of each municipality, including the amount of water supplied. If there are any

[10] In FY2009/10, TNUDF approved 16 local urban infrastructure projects (including water supply and sewerage as well as road maintenance, etc.) with a total project cost of Rs. 2,730 million and a disbursement amount of Rs. 1,514 million. In the last three years, there were 11 approvals (total project cost Rs. 5,414 million) with a disbursement amount of Rs. 4,417 million in FY2017/18, 13 approvals (total project cost Rs. 29,285 million) with a disbursement amount of Rs. 3,767 million in FY2018/19, and 6 approvals (total project cost Rs. 38,376 million) with a disbursement amount of Rs. 2,137 million in FY2019/20. (Source: TNUDF Annual Report).

problems, TWADB will be dispatched to the site of the municipality at the request of DMA to provide technical support.

TWADB is the public corporation responsible for the development of water supply and sewerage facilities in the state of Tamil Nadu, excluding the Greater Chennai Corporation, and has 80 divisional offices in 36 districts in the state (allocated 2-3 divisional offices per district). If a problem occurs with a water supply facility, the municipality will consult with the nearest TWADB divisional office, and TWADB will provide technical support free of charge. TWADB also belongs to DMAWS.

The support system for the operation and maintenance of the project described above is shown in Figure 3.



Source: Prepared by the evaluator referring to DMA web site (https://www.tn.gov.in/maws/hod.htm).

Figure 3: Project Operation and Maintenance Support System

3.4.2 Technical Aspect of Operation and Maintenance

[Municipalities]

The engineers of each municipality mainly supervise the operation and maintenance of the facilities conducted by the outsourced private companies/contractors. Although the engineers of each municipality are mainly civil engineers, the water supply facilities use conventional technology, and their technical level is sufficient. Some of the private companies/contractors to which the project is outsourced are large-scale contractors, while others are small and medium-sized contractors mainly doing business locally. However, in general, the private contractors have an adequate level of technical capability, and no problems have been observed in the operation and maintenance of the project facilities. While some municipalities use maintenance plans and manuals to carry out maintenance, some municipalities do not archive and share manuals at site level, but respond individually using the experience and knowledge of private contractors. CMWSSB, which is in charge of the operation and maintenance of the water supply facilities in Madhavaram, has not faced any technical problems.

[Others]

As mentioned above, TNUDF conducts ex-post evaluations and provides technical advice to municipalities based on evaluation results. In addition, each municipality can receive technical assistance from TWADB as needed. DMA and the Tamil Nadu Institute of Urban Study provide regular training to municipal officials, which includes training on water supply maintenance.

3.4.3 Financial Aspect of Operation and Maintenance

According to the questionnaire survey and interviews with the nine target municipalities for which the sub-projects have already been completed, sufficient measures have been taken by each municipality for the operation and maintenance budget, and no financial problems were found. The operation and maintenance budgets of the six target municipalities who responded to the questionnaires are shown in table below. The CMWSSB, which oversees the operation and maintenance of water supply facilities in Madhavaram, does not have any particular problems in terms of the operation and maintenance budget. In Tamil Nadu, water meters have not been installed, except for some facilities and industries, so water rates are fixed. With the increase in the volume and duration of supply, a future shift to metered rates is being considered.

Table 7: Operation and Maintenance Budgets of Target Municipalities

Unit: 1,000 Rupee

Municipality	2019		2020		2021	
	Plan	Actual	Plan	Actual	Plan	Actual
Tiruchirappalli	45,000	56,388	110,000	104,790	130,000	44,324
Coonoor	120	150	135	164	150	185
Idappadi	216	216	216	216	216	216
Devakottai	5,000	4,740	5,000	4,793	5,000	4,812
Mettupalayam	34,894	33,232	42,531	40,506	44,356	42,244
Udumalpet	34,894	33,232	42,531	40,506	44,356	42,244

Source: Response to the questionnaires from target municipalities.
Note: Three municipalities (Palani, Thoothukudi, Dindigul) out of nine municipalities did not provide operation and maintenance budget data.

3.4.4 Status of Operation and Maintenance

Through site surveys in five municipalities (Tiruchirappalli, Idappadi, Devakottai, Thoothukudi, Dindigul) and telephone interviews with four municipalities (Palani, Coonoor, Mettupalayam, Udumalpet), it was confirmed that the water supply facilities of the project are generally maintained in good condition and no problems were found.

No major problems have been observed in the institutional/organizational, technical, financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The objective of this project was to provide a safe water supply and sewerage facilities for small and medium sized municipalities in Tamil Nadu in southern India, where the population is growing, by providing long-term funds through the Tamil Nadu Urban Development Fund (TNUDF), thereby contributing to the economic development of small and medium sized municipalities as well as to the improvement of the living conditions of residents.

The project was highly relevant and fully consistent with the development plan and development needs of India at the time of appraisal and of the ex-post evaluation, and with Japan's ODA policy at the time of the appraisal. Although the project cost was within the plan, the project period exceeded the plan, and therefore the efficiency of the project is fair. The reasons for the delay in the project period were due to delays in the start of each sub-project caused by the re-selection of the target sub-projects, the delay in land acquisition, the time required to obtain the necessary permits for laying water pipes, the delay in contractor selection due to unsuccessful bidding, and the delay in construction progress due to deterioration of the contractor's financial base. The operation and effect indicators for the nine completed target sub-projects were generally achieved. It seems that a certain level of project effect was realized in the improvement of the financial and facility operation and maintenance capacity of the target municipalities. Through a qualitative survey of 50 beneficiary households of the project, it was recognized that the increase in water quantity following the implementation of the project had led to an improvement in the convenience of daily life. There were generally no problems with water quality, water supply volume, water supply time, or water charges, and the overall evaluation of the water supply service was very high. No negative impact on the natural environment was observed, most of the land acquired was public land, and there was no resettlement of residents. Therefore, the effectiveness and impact of this project are high. No problems were observed in terms of the institutional/organizational, technical, financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the project is also high.

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

4.2 Recommendations

4.2.1 Recommendations to the target municipalities

In some municipalities, the operation and maintenance manuals of the facilities (usually prepared by the suppliers of materials and equipment) are not properly archived in the municipality, or shared with the outsourced private contractors. Therefore, each municipality needs to improve the management and the archive system of these manuals.

Among the municipalities targeted by the project, Tiruchirappalli regularly conducts water quality inspections at water supply facilities, while in the other municipalities, water quality

inspections are conducted only when problems, such as tap water pollution, occur. In order to ensure the safety of tap water, it is recommended that each municipality consider (1) conducting daily inspections for TDS (total dissolved solids) and residual chlorine levels at water intake facilities, water purification facilities, and water storage facilities, and conducting tests for all water quality standard items once a month; (2) establishing a system for conducting the above water quality tests; and (3) submitting water samples once every six months to the TWADB Water Quality Inspection Laboratory or the National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratory and obtain a third-party analysis report in order to make a comparison of water quality with age.

4.2.2 Recommendations to JICA

During the implementation of the project, the JICA India Office dispatched a monitoring mission at least once a year, and consultations with the executing agency (TNUDF) were conducted on a regular basis. However, since the end of the loan period in March 2016, communication with the executing agency has become less frequent, and is mainly via email. The Madhavaram water supply sub-project, which is currently under implementation, is scheduled to be completed in November 2021 and will start operation in March 2022 after commissioning. JICA is expected to monitor the progress of the project by closely communicating with the executing agency by e-mail, telephone, etc. until the sub-project is completed and operational.

4.3 Lessons Learned

(1) Establishment of a Project Monitoring System including Confirmation of Technical Support and Training

At the time of the appraisal, it was planned that training on maintenance, financial improvement and toll collection improvement would be provided to the engineers and operators of project facilities in the municipalities targeted for sub-projects through DMA. However, through the surveys with TNUDF and the target municipalities, it was confirmed that the situation of the above training, including whether or not implementation had taken place, was unclear, making it difficult to confirm the actual achievements of the improvement of the capacity of municipality staff based on the plan and to verify the effectiveness of the training.

It is considered that monitoring of the above training programs should have been conducted mainly by TNUDF and the quality assurance consultants who support the work of TNUDF. However, since the quality assurance consultant who was initially planned to be hired with the project budget was eventually hired with the World Bank's project budget, JICA was not in a position to directly supervise the quality assurance consultant. As a result, there may be difficulties in the implementation of a systematic training program as well as its monitoring.

In order to ensure and enhance the sustainability of the targeted sub-projects, a project management consultant who is responsible for overall project management should be employed under the project budget, and the above project management consultant should be assigned to assist TNUDF in overall management of project progress including the supporting and monitoring the implementation of training programs for municipality staff. Alternatively, it would be desirable to include support for the implementation of training programs for municipality staff as one of the mandates of the Project Coordination and Monitoring Committee.

A mechanism for an adequate project monitoring system, including the implementation of training programs for municipality staff, should have been established through such measures as mentioned above.

(2) Necessity of Reviewing Operation and Effect Indicators Due to Changes in Target Sub-projects

In this project, the operation and effect indicators for the water supply and sewerage sub-projects were set on the basis of the candidate projects shortlisted by the Indian side at the time of the appraisal. If any changes occurred after the sub-projects were confirmed, the indicators were to be reviewed again. However, JICA and TNUDF did not review the operation and effect indicators during project implementation and did not agree on the revised operation and effect indicators. In order to avoid such a situation, it would have been better if the DPR, one of the eligibility requirements when selecting each sub-project, had included operation and effect indicators including baseline values (at the time of planning) and target values (at the time of project completion), and if JICA and TNUDF had confirmed the DPR, including the validity of the operation and effect indicators, when considering whether or not to select the sub-project.

End

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs Construction of water supply facilities in ten municipalities		
(1) Tiruchirappalli		
- Chlorination facility	- 1 No.	- Same as plan
- Water intake facility	- 3 Nos.	- Same as plan
- Pumping facility	- 12 Nos	- Same as plan
- Transmission pipes	- 82.3 km	- 80.4 km
- Distribution pipes	- 558.2 km	- 366.6 km
- Service reservoir	- 37 Nos	- Same as plan
- House service connection	- 30,258	- Same as plan
(2) Palani		
- Water purification plant	- Capacity 16,000 m^3/day (Repair of the existing plant)	- Capacity 16,500 m^3/day (Repair of the existing plant)
- Chlorination facility	- 1 No.	- Same as plan
- Water intake facility	- 1 No.	- Same as plan
- Pumping facility	- 1 No	- Same as plan
- Transmission pipes	- 13.9 km	- Same as plan
- Distribution pipes	- 74.0 km	- Same as plan
- Service reservoir	- 7 Nos	- Same as plan
(3) Coonoor		
- Water purification plant	- Capacity 5,800 m^3/day (Replacement of existing plant)	- Same as planned
- Water intake facility	- 1 No.	- Same as planned
- Pumping facility	- 2 No.	- 1 No.
- Transmission pipes	- 10.0 km	- 9.5 km
- Service reservoirs	- 5 No.	- Same as planned
- New feeder main	- 14.6 km	- 17.48 km
- Internal water distribution system	- New: 22.5 km Replacement: 14.2 km	- 31.3 km (including replacement)
- House service connection	- 2,870	- 1,880
(4) Idappadi		
- Water purification plant	- Capacity 5,600 m^3/day	- Capacity 6,800 m^3/day
- Water intake facility	- 1 No.	- Same as planned
- Pumping facility	- 1 No.	- Same as planned
- Transmission pipes	- 11.0 km	- 9.7 km
- Distribution pipes	- 25.63 km	- 105.0 km
- Feeder main	- 18.10 km	- Same as planned
- Service reservoir	- 3 Nos.	- 4 Nos.
- House service connection	- 2,352	- 1,120
(5) Devakottai		
- Water intake facility	- 1 No.	- Same as planned
- Pumping facility	- 1 No.	- Same as planned
- Transmission pipes	- 10.3 km	- Same as planned
- Distribution pipes	- 35.6 km	- Same as planned
- House service connection	- 2,100	- 3,256

Item	Plan	Actual
(6) Thoothukudi		
- Water purification plant	- Capacity 84,000 m^3/day	- Capacity: 97,000 m^3/day
- Water intake facility	- 1 No.	- Same as planned
- Pumping facility	- 4 Nos	- Same as planned
- Transmission pipes	- 35.9 km	- Same as planned
- Distribution pipes	- 526 km	- Same as planned
- Service reservoir	- 22 Nos.	- Same as planned
(7) Dindigul		
- Water purification plant	- Capacity 16,800 m^3/day	- Same as planned
- Pumping facility	- 4 Nos.	- Same as planned
- Transmission pipes	- 19.9 km	- 21.8 km
- Distribution pipes	- 227.6 km	- 235.8 km
- Replacement of feeder main	- 5.2 km	- 6.7 km
- Service reservoir	- 4 Nos.	- Same as planned
- House service connection	- 30,000	- 27,300
(8) Mettupalayam		
- Transmission pipes	- 2.4 km	- Same as planned
- Distribution pipes	- 27.6 km	- 25.3 km
- Service reservoir	- 1 No.	- Same as planned
- House service connection	- 2,870	- 1,880
(9) Udumalpet		
- Distribution pipes	- 66.8 km	- 70.2 km
- Service reservoir	- 1 No	- Same as planned
- Disinfection system provision	- 9 Nos.	- Same as planned
- House service connection	- 6,934	- 6,645
(10) Madhavaram		
- Transmission pipes	- 4.3 km	- 3.5 km
- Distribution pipes	- 168.4 km	- 155.6 km
- Service reservoir	- 7 Nos.	- 6 Nos.
- House service connection	- 29,730	- 14,156
2. Project Period	March 2008 – June 2013 (64 months)	March 2008- November 2021 (165 months)
3. Project Cost		
Amount Paid in Foreign Currency	308 million yen	N.A.
Amount Paid in Local Currency	9,516 million yen (3,339 million rupee)	N.A.
Total	9,824 million yen	10,507 million yen
ODA Loan Portion	8,551 million yen	6,818 million yen
Exchange Rate	1 rupee = 2.58 yen (As of July 2007)	1 rupee = 1.66 yen (Average between 2009-2021)
4. Final Disbursement	March 2016	