FY2023 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

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Duration of the Study: September 2023 – January 2025

Duration of the Field Study: March 4, 2024 – March 18, 2024

Country Name	**The Project for Improvement and Extension of Water Supply System in Comayagua City**
Republic of Honduras	

Location of the Project site (source: Prepared by the evaluator)

Overall view of the Project
(Source: Comayagua City Water Service: SAC)

I. Project Outline

Background	Comayagua City (population 98,000 in 2013) was a key distribution hub near the capital Tegucigalpa, and its population growth rate exceeded the national average, leading to a rapid increase in water demand. In 2016, the city's existing water treatment plant was out of operation due to high electricity costs, challenges in obtaining spare parts because of differing standards, and the plant's complex operation, which made it difficult for staff to manage. As a result, water from rivers, which constitutes 76% of the city's water supply, was being supplied untreated. Additionally, frequent water outages occurred due to insufficient capacity in the distribution reservoirs, leaving nearly all residents with less than 12 hours of water supply per day. As a result, residents relied on water storage tanks, but did not turn off even when the tanks were full, so significant overflow occurred, leading to around 25% of the total water supply being unaccounted for.[1] Furthermore, there were concerns about the deteriorating water quality, as E. coli was detected in household water storage tanks used to cope with the frequent water outages. The incidence of water-borne disease in the city was 33.4 cases per 1,000 people,[2] roughly 1.6 times higher than the national average of 21.7 for cities with a population of 50,000 or more. These sanitation issues were also affecting residents' daily lives. Against this background, a grant agreement for "The Project for Improvement and Extension of Water Supply System in Comayagua City" (hereinafter referred to as "the Project") was signed in June 2017.
Objectives of the Project	The Project aims to improve water quality and sanitation in Comayagua City, a key distribution point in Honduras, by constructing and expanding water supply facilities, including a water treatment plant, thereby contributing to rural development in the region.
Contents of the Project	1. Project Site: Comayagua City 2. Japanese side: Construction of a water treatment plant (15,500 m³/day) and a distribution reservoir (5,000 m³), procurement of equipment and spare parts, and provision of consulting services, including detailed design, construction supervision, and training for the Comayagua Water Service (SAC) staff in the operation and management of the water treatment facilities (soft component). 3. Honduras side: provision of water for construction and testing, supply of disinfectants, implementation of the environmental management plan and the environmental monitoring plan, participation in the planning of the soft component, and employment of an expert as the person responsible for water quality management at the facility.

[1] Unaccounted-for water refers to the uncertified volume of water supply remaining after subtracting measurement errors and leakages from total water loss.
[2] Based on data from the Ministry of Health of Honduras (2015) at the time of the preparatory study of the Project.

Implementation Schedule	E/N Date	June 20, 2017	Disbursement Date	
	G/A Date	June 20, 2017	Completion Date	March 2021
Project Cost	E/N Grant Limit / G/A Grant Limit: 1,728 million yen, Actual Grant Amount: 1,645 million yen			
Executing Agency	Comayagua City and the Comayagua Water Service (SAC)			
Contracted Agencies	Main Contractor: Hazama Ando Corporation Main Consultant: TEC International Co., Ltd. Agent: Not applicable			

II. Result of the Evaluation

Summary

The Project was implemented to enhance water quality in Comayagua City by constructing a new water treatment plant to treat the majority of water from rivers, which constitutes 76% of the total supply, extending water supply hours and improving sanitary conditions by constructing a reservoir with a sufficient capacity to supply water for the Project's target distribution area (four water distribution sectors) 24 hours a day, thereby contributing to rural development in the region. The Project closely aligned with the development policy of Honduras and the needs of the water supply sector in Comayagua City at the time of the ex-ante evaluation. It was also consistent with Japan's development cooperation policy. No specific effects of collaboration with other JICA projects were anticipated during the planning or implementation phases of the Project. During the planning phase, it was anticipated that the World Bank's (hereinafter referred to as "WB") support for capacity building in non-revenue water management within the water supply service would enhance the effective use of water treated at the Project's water treatment plant. Drawing on this experience, the executing agency promoted the installation of water meters, which may have contributed to the efficient use of treated water in some target areas. In this sense, the anticipated effects of collaboration have been partially realized. Therefore, the relevance and consistency of the Project are high. The outputs were achieved almost as planned, with both the Project period and cost staying within the initial plan. Therefore, the efficiency of the Project is very high. All quantitative effect indicators set in the ex-ante evaluation, treated water volume and turbidity, were met. The Project successfully treated the majority of water from rivers, which now accounts for around 60% of the city's water supply. However, it couldn't be determined whether qualitative effects, such as longer water supply hours and a reduction in water-borne disease cases, were achieved. Due to frequent leaks and overflows in the water distribution network, the executing agency continues to impose water supply restrictions (timed water supply), and the continuity of water supply in their operation plan remains unchanged even after the Project. Interviews with water users suggest that the actual water supply hours for some part of the target area may have increased due to the expanded capacity of the water distribution reservoir. However, water supply hours within the distribution area are not uniform, and it could not be confirmed that the supply hours have increased across the entire target area. Due to these restrictions, citizens continue to rely on water storage tanks, which limits the positive impacts (improvement in water use and hygiene habits). Additionally, the qualitative effect of reducing the number of cases of water-borne diseases could not be confirmed. Therefore, the overall effectiveness and impact of the Project are moderately low. The facilities and equipment constructed under the Project are operated and maintained appropriately, with no issues observed in the policy/system, institutional/organizational and financial aspects as well as technical aspect concerning the operation and maintenance of the water treatment facilities. However, the executing agency has indicated that extending water supply hours is not feasible without addressing non-revenue water issues, such as reducing overflow by installing water meters and minimizing leakage by improving the water distribution network. These issues impact the realization of the project effects. Therefore, to ensure the continued effectiveness of the Project, it is essential to extend water supply hours through the steady implementation of measures against non-revenue water. Nevertheless, since an implementation plan for these measures has not yet been established, technical challenges remain. Consequently, the sustainability of the project effects is high.

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

Overall Rating[3]	**B**	**Relevance & Coherence**	③[4]	**Effectiveness & Impacts**	②	**Efficiency**	④	**Sustainability**	③

<Special Perspectives Considered in the Ex-Post Evaluation／Constraints of the Ex-post Evaluation>

None.

1 Relevance/Coherence

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[4] ④ : Very High ③: High, ②: Moderately low, ①: Low

<Relevance>

・Consistency with the Development Policy of Honduras at the Time of Ex-Ante Evaluation

The government of Honduras has prioritized water and sanitation development in its long-term national plans, *Vision of the Country 2010-2038* and *National Plan 2010-2022*. The *Drinking Water and Sanitation Sector Framework Law*, enacted in 2003, mandated the transfer of water supply operations from the National Water and Sewerage Service (hereinafter referred to as "SANAA") to local governments, facilitating the enhancement of water services in municipalities. The Project aimed to improve water supply hours and quality in Comayagua, a major regional city with a rapidly growing population, aligned with the country's development policies.

・Consistency with the Development Needs of Comayagua City at the Time of Ex-Ante Evaluation

Comayagua was a key distribution hub, and water demand had been rising due to population growth exceeding the national average (98,000 people in 2013, with a population growth rate of 4.5% from 2001 to 2013). Since the city's existing water treatment plant was out of operation,[5] water from rivers, which accounts for 76% of the city's supply, was being delivered untreated. Over 70% of residents were dissatisfied with water quality during the rainy season. Additionally, the distribution reservoirs had insufficient capacity—only 2.5 hours' worth compared to the Honduran standard of 12 hours—leading to frequent water outages. Residents used water storage tanks, but did not turn off even when the tanks were full, excessive overflow occurred, causing approximately 25% of the total water supply to be unaccounted for. There were also concerns about deteriorating water quality in household storage tanks (used during outages), as E. coli was detected in 5 out of 14 locations in a sample survey conducted during the rainy season. Data from the Honduran Ministry of Health showed the city had 33.4 water-borne disease cases per 1,000 people, about 1.6 times the average of 21.7 for cities with populations over 50,000. These sanitation issues were affecting residents' lives. The Project aimed to improve the city's sanitary conditions by enhancing water quality with a new treatment plant and extending water supply hours through a new distribution reservoir, aligning with the development needs of Comayagua City.

<Coherence>

・Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation

Rural development was a priority area in the Japanese government's *Country Assistance Policy: the Republic of Honduras* (April 2012). In *JICA Country Analysis Paper for the Republic of Honduras* (February 2016), rural development, including water supply projects, was also identified as a priority area. The Project was therefore consistent with both Japan's development cooperation policy and JICA's assistance policy at the time of ex-ante evaluation.

・Internal Coherence

At neither the planning nor implementation stages of the Project were any specific collaborative effects with other JICA projects anticipated.

・External Coherence

In Comayagua, WB supported capacity building in technical and management aspects related to non-revenue water management, as well as facility construction, through the "Water and Sanitation Sector Modernization Project" (Proyecto de Modernización del Sector de Agua y Saneamiento, hereafter referred to as "PROMOSAS").[6] It was expected that the reduction in water consumption through these non-revenue water measures was expected to contribute to the effective use of treated water from the Project. Although PROMOSAS aimed to install 5,000 water meters since 2009, only 380 were installed due to opposition from residents who concerned about possible higher costs associated with a metered water rate system.

Drawing on its experience with PROMOSAS, the Comayagua Water Service (Servicio Aguas de Comayagua, hereinafter referred to as "SAC") had thorough talks with residents, so that it launched a pilot project to promote the installation of water meters throughout the area, under the condition of ensuring a 24-hour water supply in three areas—water distribution sector 01, part of sector 02, and sector 11—and then realized a 24-hour water supply. Additionally, leak repairs were carried out alongside the installation of water meters, contributing to a reduction in non-revenue water. These efforts occurred before the implementation of the Project, and one of the three areas (Sector 01) is included in the Project's water supply target area.

At the time, the goal was to install water meters in all the households in the city (approx. 20,000 households) by 2020. However, after the general manager who had actively promoted the initiative left, the effort was suspended, and the installation rate remained at 63% of households in 2020. Since then, priorities have shifted to responding to the COVID-19 pandemic and

[5] The existing treatment plant was shut down due to high electricity costs, difficulties in obtaining spare parts due to differing standards, and the plant's complex operation, which made it challenging for staff to manage.

[6] Phase 1: 2008-2013, Phase 2: 2014-2016.

hurricanes, further delaying progress in water meter installation. As of March 2024, when the field survey was conducted, SAC has continued its efforts to promote water meter installation by educating residents, collaborating with Comayagua City authorities to make water meter installation a requirement for road construction,[7] and requiring meter installation for residents when entering into new contract or when resuming service after a water supply suspension (see "Effectiveness").

The direct contribution of the water meter installation through PROMOSAS to the effective use of water treated at the Project's water treatment plant is considered limited, given the small number of meters installed. However, the subsequent efforts by SAC to install water meters were based on the experience gained from PROMOSAS. If this is viewed as an impact of PROMOSAS, it can be seen as making a certain contribution to the effective use of water treated at the Project's water treatment plant. Additionally, a variety of technical assistance and leak repairs to the piping network provided by PROMOSAS likely contributed, albeit to a limited extent, to improving SAC's water services. Based on the above, the collaborative effects of the World Bank's PROMOSAS in enhancing the effective use of water treated at the Project's water treatment plant have been partially realized.

<Evaluation Result>

In light of the above, the relevance and coherence of the Project are high[8].

2 Efficiency

・ Project Outputs

The project outputs were largely achieved as planned. Although some of the soft component were postponed until January 2022 due to COVID-19, construction was completed as scheduled, and the facilities began operations in March 2020.

Table 1 Contents of Outputs

Contents
Civil Engineering Works (Facilities and Equipment): ・ Water Treatment Plant: Rapid filtration method with a capacity of 15,500 m³/day ・ Water Reservoir: a volume of 5,000 m³ ・ Spare parts for the above facilities Consulting Services: ・ Detailed design, bidding support, and construction supervision ・ Capacity building for the operation and maintenance of water treatment facilities (soft component)

Source: Prepared by the evaluator based on materials provided by JICA

・ Project Cost

The planned project cost was 1,744 million yen (1,728 million yen covered by the grant aid). The actual cost came to 1,656 million yen (1,645 million yen covered by the grant aid), or 95% of the planned budget, which was within the plan.

Table 2 Planned and actual project costs (million yen)

Expense Item	Planned			Actual		
	whole	Japan	Honduras	whole	Japan	Honduras
Construction works of water treatment plant and distribution reservoir	1,473	1,473	0	1,474	1,474	0
Spare parts for water treatment plant and distribution reservoir	14	14	0	11	11	0
Consulting Service (including detailed design, construction supervision and soft component)	159	159	0	159	159	0
Contingency (5%)	82	82	0	-	-	-

[7] If an application to pave an unpaved road in front of a residence or store is submitted to Comayagua city, the permit will require the installation of a water meter by SAC. The city will commence road paving once the meter installation is complete.

[8] Relevance: ③, Coherence: ③

Banking service fees*	3	0	2	0	0	0
Acquisition of Environmental clearance	13	0	14	11	0	11
Provision of water for works, water tightness test and disinfection chemicals	0	0	0	not clear	0	not clear
Total project cost	1,744	1,728	16	1,656	1,645	11

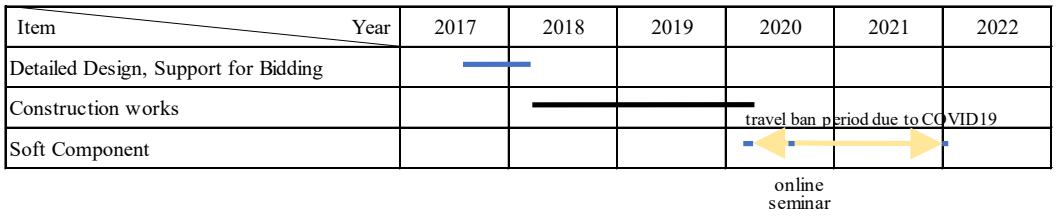
Exchange rate: 1HNL = 4.778 yen *Honduras bank processing fees after May 2018 are unknown.
Source: Prepared by the evaluator from information provided by JICA

・ Implementation Period

The project implementation period was planned for 35 months, from May 2017 to the start of operation in March 2020. The grant agreement was signed in June 2017 and the Project was completed in 34 months (97% of the planned duration), with operations commencing in March 2020. Thus, it remained within the plan.[9]

・ Implementation Process

The water treatment plant and distribution reservoir of the Project were put into service in March 2020 as planned. During implementation, nine design changes were made to address construction needs and client requests, after technical consideration by JICA. All are deemed appropriate. Due to COVID-19, some parts of the soft component were not yet implemented at the start of operation, leading to an extension of the consultant contract and continued technical support through the component. Although operational training for the water treatment plant was nearly completed, some technical training related to operation and maintenance (including on-site training and general seminars) remained to be completed. In August 2020, when Japanese consultants were unable to travel, they held an online Q&A session on the operation and maintenance guidelines with SAC to check their understanding. After travel restrictions were lifted in January 2022, the consultants provided on-site training and confirmed there were no issues with the operation and maintenance of the treatment plant by reviewing operation records and the facility's status. The postponement of some parts of the soft component did not affect the operation of the water treatment facility.



Source: Prepared by the evaluator based on materials provided by JICA
Note: The blue belt indicates the period during which consulting services, including soft component were provided.

Figure 1 Project implementation period

Water and disinfectants required during construction and trial operation, which were the responsibility of the Honduran side, were provided as planned. Additionally, as originally intended, one water quality control officer has been assigned to the Project water treatment plant.

<Evaluation Result>

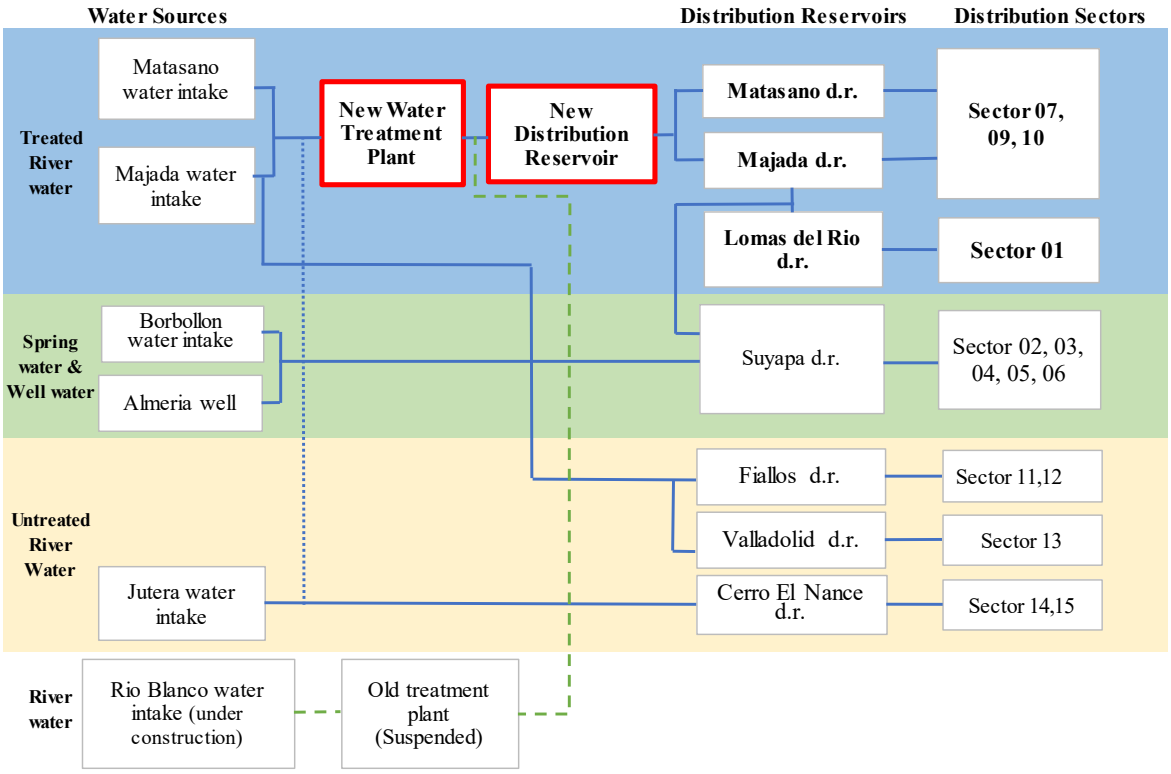
As mentioned above, both the project cost and project period were within the plan. Therefore, the efficiency of the Project is very high.

3 Effectiveness/Impacts[10]

[9] The construction contract for the Project includes a one-year warranty period, with the Project considered complete at the start of service.
[10] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

<Effectiveness>

・ Overview of Comayagua City's Water Supply



Source: SAC

Note: The dotted line from the Jutera intake to the Project water treatment plant represents the pipeline for use only in emergency and maintenance, while the dashed line from the Rio Blanco intake indicates the planned pipeline.

Figure 2 Relationship Between Water Sources, Distribution Reservoirs and Distribution Areas (Sectors) of the SAC Water Service

Since 2009, the water supply service in Comayagua City has been transferred from SANAA to the city and SAC now manages the urban water supply operations. The primary sources of urban-area water supply managed by SAC are rivers and springs. Additionally, many businesses and hospitals in the city rely on their own well water. The city has two water treatment plants: an existing plant that was non-operational when the Project was planned and a newly constructed plant developed through the Project. Currently, only the new water treatment plant is in operation.

The current relationship between water sources, distribution reservoirs, and water distribution sectors for SAC's water supply is illustrated in Figure 2. Raw water is conveyed from the Majada and Matasano intakes to the Project's water treatment plant. Treated water is then supplied to the distribution sectors in the city through the Majada and Matasano distribution reservoirs. Additionally, a portion of the treated water is conducted to the Suyapa distribution reservoir, that is primarily sourced from spring water, accounting for approximately 30% of the reservoir's water. During the maintenance of intake facilities, water volume is temporarily adjusted by diverting water from the Jutera intake as needed.

In this report, the Comayagua city's water distribution sectors (areas) are defined as follows:

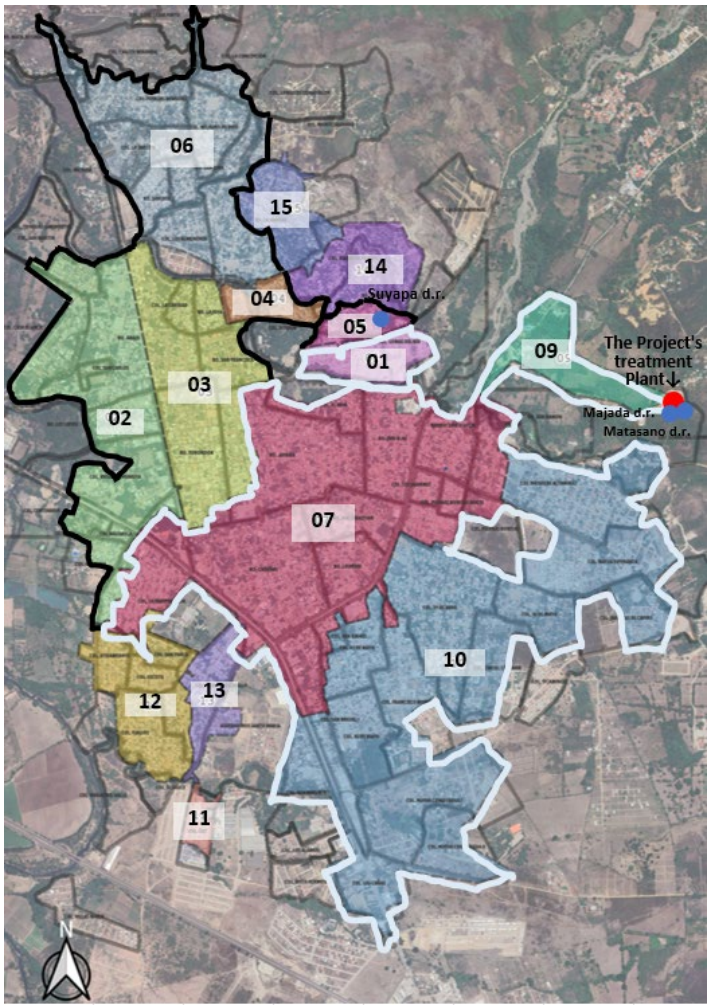
Target Water Distribution Sectors: The main destinations of the Project's treated water, comprising sectors 01, 07, 09, and 10[11]. These four sectors are enclosed in white in Figure 3.

Other Water Distribution Sectors: These include:

Mixed Water Distribution Sectors: Sectors where a mix of spring water and treated water is supplied, specifically sectors 02, 03, 04, 05, and 06. These five sectors are enclosed in black in Figure 3.

Untreated River Water Sectors: Sectors where water from rivers is supplied untreated, specifically sectors 11, 12, 13, 14, and 15.

[11] Among these, water distribution sector 09 is a small area that supplies water to a golf club and around 30 surrounding households. It has been providing water 24 hours a day since its initial installation.



Source: SAC

Figure 3 Map of Comayagua City Water Distribution Sectors (Areas)

[Quantitative Effects]

The quantitative effect indicators for the Project are the treated water volume (m³/day) and turbidity (the annual maximum value during the rainy season in NTU, a turbidity unit), both of which use river water as the raw water source. The baseline, target and actual values for these indicators are as shown in Table 3. In the baseline year, river water was distributed without treatment, only disinfected by chlorine, resulting in a treated water volume of 0 m³/day and a turbidity of 300 NTU. The target value was set by adding the baseline value (0 m³/day) to the projected capacity of the new water treatment plant (15,500 m³/day) with an estimated operation rate of 95%. Turbidity data has been confirmed for the most recent year, 2023.

Table 3 Quantitative Effect Indicators: Baseline, Target and Actual Values

	Baseline value	**Target value**	actual values[12]			
	2015	**2023**	2020	2021	2022	2023
	Baseline year	**Three years after project completion**	Project completion year	One year after project completion	Two years after project completion	Three years after project completion
Volume of Treated Water whose sources are rivers (m3/day)	0	**14,725**	14,988	19,017	14,677	14,800
Turbidity (Annual maximum in the rainy season, NTU)	300	**Less than 5**				0.69

Source: Prepared by the evaluator with JICA documents (baseline and target values) and SAC's answers to the questionnaire (actual values)

[12] According to SAC, in 2021, the amount of treated water exceeded the facility's capacity; however, there were no issues with the water quality after treatment, and proper water treatment was consistently performed. The facility has been operated and maintained appropriately based on the raw water turbidity, following the operation and maintenance guidelines.

・ Performance of Operation and Effect Indicators

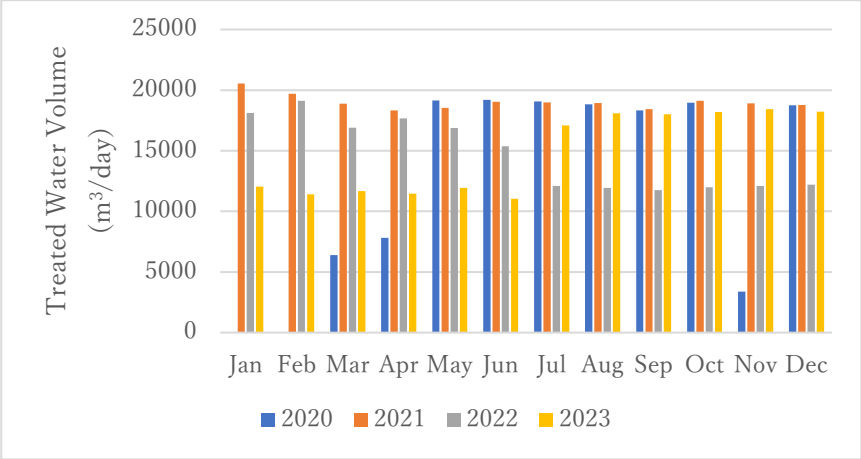
(1) Volume of Treated Water Sourced from Rivers

Table 3 shows the water treatment volume of the Project from the start of service through 2023. In November 2020, the water treatment plant was forced to suspend operations for 23 days due to hurricane damage. In 2023, the treated water volume decreased between January and June due to reduced water intake caused by lower rainfalls. However, it was 14,800 m³/day on average in 2023, exceeding the Project's target of 14,725 m³/day for average water treatment volume in 2023.[13]

Table 4 Monthly Treated Water Volume (m³/day) from 2020 to 2023

year	Baseline value	Target value	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2020					6,401	7,828	19,152	19,185	19,069	18,840	18,314	18,966	3,377	18,753	14,988
2021			20,551	19,706	18,884	18,332	18,548	19,038	18,995	18,943	18,426	19,111	18,910	18,765	19,017
2022			18,117	19,114	16,896	17,672	16,880	15,370	12,094	11,946	11,740	11,990	12,099	12,210	14,677
2023	**0**	**14,725**	12,034	11,417	11,668	11,453	11,936	11,047	17,095	18,085	18,008	18,201	18,440	18,212	**14,800**

Source: SAC



Source: SAC

Figure 4 Monthly treated water volume from 2020 to 2023

Based on SAC's monthly report data, the total water supply to the urban area of Comayagua City averaged 23,092 m³/day in 2023, with the treated water from the Project accounting for approximately 60% of the city's total water supply.

Table 5 Proportion of Treated Water Volume from the Project in the Total Water Supply Over the Past Three Years

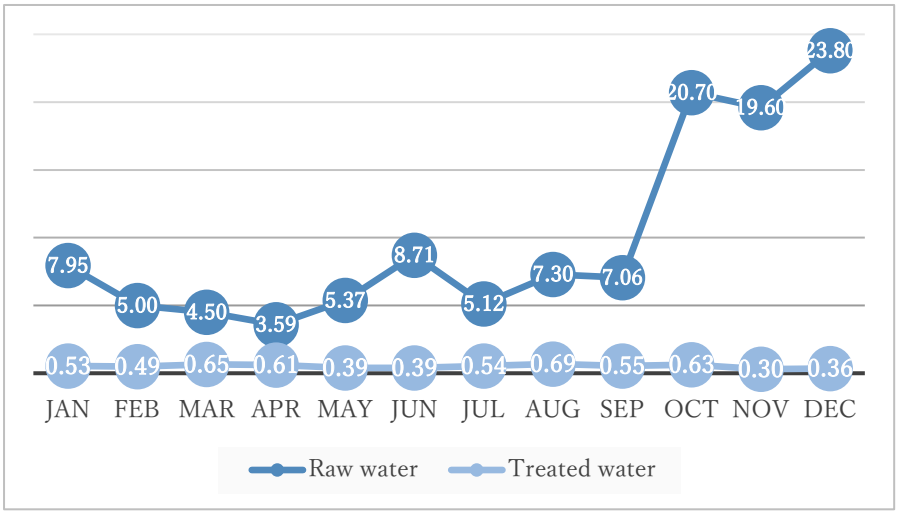
year	Total water supply (m³/day)	Treated water volume (m³/day)	ratio
2021	24,617	19,017	77%
2022	24,625	14,677	60%
2023	23,092	14,800	64%

Source: SAC

(2) Turbidity (measured as the annual maximum value during the rainy season in NTU, a turbidity unit)

As the Project enabled river water to be treated, the quality of tap water, which was previously supplied almost untreated, has improved significantly. As shown in Table 5, the annual turbidity in 2023 remained well below the Honduran water quality standard (less than 5 NTU), even during periods of high raw water turbidity (October to December). Prior to the Project, highly turbid raw water was supplied without adequate treatment.

[13] Honduras' rainy season lasts from May to December; however, according to SAC, the amount and timing of rainfall have varied significantly in recent years due to climate change.



Source: SAC

Figure 5 Monthly turbidity at this water treatment plant in 2023 (turbidity unit: NTU)

・ Other Water Quality Indicators

According to the SAC's water quality test results for 2023, the pH of the treated water from the Project was at 7.48, which is within Honduran standard range (6.5-8.5). The chromaticity was 2.5-3.3 degrees, and during the rainy season reached 4 up to 13.59 degrees, both of which are below the Honduran standard of 15 degrees. The nitrogen concentration is between 0.35-0.57 mg/l, well below the standard limit of 50 mg/l. Other water quality parameters also meet the standards, indicating that appropriate water treatment is being effectively applied based on the raw water quality.

・ Satisfaction with Water Supply Services

Interviews were conducted with water users in both the target water distribution sectors of the Project and other water distribution sectors for comaprison. Please note that the findings are for reference only and do not necessarily reflect the views of all water users[14].

Overall, satisfaction with the current water supply service among general water users was high in both the target and other distribution sectors. All respondents expressed positive feedback about the current water quality, with nearly half noting that it was cleaner than before the Project. Although some users said water was sometimes dirty during the rainy season, these instances were fewer compared to before the Project. In the other distribution sectors, more users than the target area mentioned it, with no significant change before or after the Project. This suggests that water quality in the target distribution sectors is better than that of other distribution sectors. While the water from the Project's treatment plant meets water quality standards, including turbidity, some residents in the target sectors still reported occasional dirty water during the rainy season. The cause of occasional dirty water is unknown but the turbidity could temporarily increase depending on raw water quality during rainfall.

・ Summary of Water Quality

The treated water from the Project exhibits low turbidity, and other water quality test results meet national standards. Water users have also expressed high satisfaction with the service. Therefore, it can be concluded that the quality of water supplied to the target distribution sectors has significantly improved as a result of the Project.

・ Qualitative Effects: Longer Water Supply Hours

At the time of planning, it was anticipated that water supply hours in the target water distribution sectors would be extended after the project completion, based on the assumption that all households in Comayagua would have water meters installed by 2020, which would reduce overflow from individual households. To support a 24-hour supply to the target water

[14] We conducted interviews with a total of 23 water users, including 16 individuals from three of the four target distribution sectors of the Project and seven individuals from four of the ten other distribution sectors. The latter group consisted of three sectors that receive a mixture of spring water and treated water from the Project, and one sector that relies on untreated river water. With the cooperation of SAC, we selected various areas for interviews, including areas of higher and lower elevation, the city center, surrounding residential neighborhoods, and areas with relatively low-income residents. We visited and interviewed one to two residents from each selected area. Additionally, we interviewed businesses, including restaurants (nine individuals from the target distribution sectors and one from other distribution sector), health centers (three out of four in the city, including one in the target sector and two in other sectors), and clinics (two in the target sector). However, due to time constraints and safety restrictions, we were unable to interview certain areas. As a result, most respondents from the other distribution sectors were from areas with a relatively stable water supply.

distribution sectors, the Project included the construction of a 5,000 m³ water distribution reservoir adjacent to the water treatment plant, aiming to stabilize the water supply in Comayagua where water outages were frequent.

SAC still plans and releases water supply schedules by distribution district, and continue water supply restrictions by operating water supply valves according to this schedule. The water supply hours in SAC's operation plan have remained unchanged before and after the Project. Based on the water supply hours and the number of water users by distribution sector in 2023, the distribution of users based on water supply hours is shown in Table 6: 14% of users receive a 24-hour supply (though this includes some districts within sectors that receive only 8-hour supplies), 10% receive 9 hours, and 76% receive 8 hours or less.[15] Among the target distribution sectors, sectors 07 and 10 still experience supply restrictions, with water supply hours generally ranging from 7 to 8 hours.

Table 6 Number of Water Users by Hours in SAC Service Area in 2023

Water supply hours (SAC's Operation plan)	Number of users	Ratio	Water distribution sectors
24	2,706	14%	**01**, 02*, **09**, 11
9	1,936	10%	12, 13, 14, 15
8	10,266	55%	03, 04, 05, 06, 07
7 hours or less	3,868	21%	**10**
total	18,776	100%	

Source: Prepared by the evaluator based on materials provided by SAC
Note: Water distribution district 02 includes areas with 8-hour water supply.
The sectors in bold are the target sectors of the Project.

However, according to interviews with water users, the actual water supply does not always follow the SAC operational plan, and the supply hours varies depending on the user's location within the water distribution area and network. More than half of the general water users and business water users in the target water distribution sectors reported that "water supply hours have increased compared to before the Project." Although the SAC's planned water supply hours have not changed, the newly installed reservoir from the Project has likely helped secure storage capacity to deal with daily fluctuations in water demand, allowing water to be delivered in some areas more as planned than before the Project.

On the other hand, some users reported that "water supply hours have decreased," while others in districts where water is supposed to be supplied for 8 hours mentioned they only received 4 to 5 hours, two days a week. As a result, it could not be confirmed that the overall water supply hours have increased across the entire target distribution sectors of the Project.

Since extending water supply hours without addressing water waste (overflow) —caused by the absence of water meters and leaks in the distribution networks—would lead to an increase in non-revenue water, SAC believes it is necessary to first resolve these issues before extending supply hours, and considers leak prevention in the distribution network and water meter installation as priorities. As a result, SAC is working to improve the water distribution network and promote the installation of water meters, aiming to implement a 24-hour water supply throughout the city in 2026.[16]

・ Measures to Reduce Non-Revenue Water

(1) Installation of Water Meters (Overflow Prevention Measures)

The preparatory study of the Project conducted during planning stage indicated that leakage from the water distribution network accounted for only 16.8% of non-revenue water, while waste water (overflow) by users represents a higher share, at around 30%. To reduce overflow, installing water meters to promote the appropriate use of water is effective. Therefore, SAC has been promoting a five-year plan for water meter installation during the implementation of the Project, aiming to achieve a 100% water meter installation rate by the Project's completion. However, this target was not met, and the plan was delayed due to other priorities, such as recovery efforts from COVID-19 and hurricane damage. As of 2023, the water meter installation rate in the city stands at 65%. SAC plans to continue promoting the installation of water meters (see External Coherence), but specific targets have yet to be set.

[15] This figure represents the number of users and does not necessarily correspond to the population served.

[16] According to information received from SAC on December 14, 2024, they are also working on the "Rio Blanco" project to develop new water sources. When the project is completed in June 2025, the water supply is expected to increase significantly. SAC is considering reviewing the water distribution plan once the "Rio Blanco" project is completed.

Table 7 Comayagua City Water Meter Installation Rates: Planned and Actual

year	2015	2016	2017	2018	2019	2020	2021	2022	2023
Planned	50%	53%	65%	77%	89%	100%	-	-	-
Actual	38%*	50%*-	-	-	61.4%	62.7%	63.3%	64.4%	65.3%

Source: Prepared by the evaluator based on JICA documents and SAC responses
Note: Figures for 2015 and 2016 are as of October each year.

According to interviews with water users, just under 70% have installed water meters. Several respondents mentioned benefits such as "It has helped me save water," "I think I am paying for the water I use," and "The price has gone down." These responses suggest that the installation of water meters may be promoting appropriate water use.

(2) Solving Water Distribution Network Issues (Water Leakage Prevention Measures)

According to SAC, after the Project's completion, when they opened valves that had previously not been fully opened to allow maximum water flow into the distribution pipes for pressure testing, they discovered many new leaks that had not been detectable before the Project. SAC believes that such undetected leaks exist across various water distribution sectors. Additionally, other challenges were identified, such as high water pressure in sectors of lower elevation (mitigated by installing pressure adjustment valves in November 2023) and excessive water use in these sectors leading to a decrease in water pressure within the distribution pipes, resulting in water shortages in sectors at higher elevation, etc.

To address these water distribution network issues, SAC is currently using QGIS (a mapping application) to map the city's water distribution network and analyze the water flow. In parallel, they are progressively replacing old pipes, installing water pressure adjustment valves, and setting up flow meters.

・ Summary of Effectiveness

The quantitative effect indicators established in the ex-ante evaluation for the Project, namely water treatment volume and turbidity, were achieved. The Project successfully treated majority of water from rivers, supplying 60% of the city's water. Water users in the target distribution sectors reported no issues with water quality, and satisfaction with the water supply service significantly improved. However, it couldn't be determined whether the anticipated qualitative effects, extended water supply hours and a reduction in water-borne diseases, were achieved. Due to persistent leaks in the water distribution network and overflows, the executing agency continues to impose water supply restrictions (time water supply), and the continuity of water supply in their operation plan remain unchanged even after the Project. Although interviews with water users suggest that the expanded capacity of the water distribution reservoirs may have increased actual water supply hours for some part of the target area, the overall water supply hours within the distribution area are not uniform, and it could not be confirmed that supply hours have increased across the entire target area.

<Impacts>

・ Changes in the Lifestyle and Hygiene Habits of Water Users (with some improvements observed)

According to interviews with water users in the target distribution sectors, some in districts where water is supplied 24 hours a day "do not use a water storage tank." However, since the Project's completion, there has been no new distribution sectors where a 24-hour water supply has begun.

In addition, general water users who reported extended water supply hours noted improvements such as, "The water quality has improved and the water supply hours have been extended, so I can use water with less worry than before," and "Because the water supply hours have been extended, I don't have to get up early." Some business water users mentioned, "Because the water supply hours have been extended, we don't purchase as much potable water for water outages as before, leading to cost savings." However, the majority of both general and business water users in the target distribution sectors with water supply restrictions still own water storage tanks, and there have been no significant changes in water consumption and usage before and after the Project.

Regarding hygiene habits, some general users reported an increase in the frequency of hand washing and cleaning due to extended water supply hours. Others noted changes in their hygiene practices since COVID-19. Many water users learned about good hygiene habits through television, social media, and campaigns by health centers and schools. It is possible that the Project, combined with the COVID-19 countermeasure campaigns, contributed to improved hygiene habits.

・ Qualitative Effects: Reduction in Water-Borne Diseases Cases

No statistical data was available from the Ministry of Health or other sources regarding the number of waterborne disease cases in Comayagua City. In interviews with water users, several respondents mentioned that they "thought the number of diarrhea cases had decreased compared to before the Project" due to "increased water supply hours" and "more frequent hand

washing and cleaning" in the target distribution sectors. However, most respondents reported never having experienced diarrhea, and no definitive changes in disease rates before and after the Project could be confirmed.

Due to ongoing water supply restrictions, most water users in both the target and other distribution sectors continues to rely on water storage tanks. A water quality survey conducted during the preparatory study found E. coli in 5 of 14 water storage tanks during the rainy season, raising concerns about water quality deterioration from the time of preparation. Therefore, even if the water quality has been improved with the Project, the risk of water quality deterioration would remain to some extent as long as people continue to use water storage tanks.

Health centers and hospitals in the target water distribution sectors—which serve patients not only from the target sectors but also from the entire city and peripheral areas—have reported an increasing trend in cases of diarrhea and dengue fever. These institutions have attributed the rise in diarrheal diseases to several factors, including inadequate hygiene habits at home, limited access to water supply in peripheral areas, potential infectious diseases like rotavirus, and behavioral changes after the COVID-19 pandemic, such as increased social interactions and a reduced frequency of disinfection.

Additionally, Comayagua City's public hospital has noted a rising number of diarrheal cases among individuals (aged 15 and under) in the peripheral areas of the city, outside the SAC's service coverage, suggesting that water quality in these areas might be a contributing factor.[17] While the hospital acknowledges that the current tap water quality in the city is generally good, there is no specific indicator which shows the relation between the water quality and the number or frequency of waterborne disease cases.

Given the above, it was not possible to confirm that the Project has led to improvements in water services or a reduction in waterborne disease cases. According to health centers and clinics, as of March 2024, diarrheal diseases continue to rise in the surrounding areas of the Comayagua, and the exact causes remain unidentified.

・ Other Positive and Negative Impacts

(1) Impacts on the Environment

The Project was classified as Category B based on the *JICA Guidelines for Environmental and Social Considerations* (April, 2010) for sensitive sectors because it was not included in the lists of sensitive characteristics and areas.

From April 2018 to March 2020, during construction, and since the start of operations to the present, no significant environmental or social impacts have been observed, and no complaints have been reported from nearby residents. All necessary mitigation measures were implemented during construction, and no significant environmental impacts were occurred. The partial collapse of the cut slope occurred in December 2018 was addressed with slope protection measures.[18] No further issues were identified on the slope during site visit. After the facility began operations, SAC regularly conducted water quality tests on the drain water between the sludge tank and the solar drying bed as part of the Project's environmental monitoring. So far, the monitoring results have shown no issues. The water quality tests in February 2023 met national standards for all parameters. No significant environmental impact has been observed. Although dried sludge is not weighed, as it is not legally required, it is transported to a designated disposal site. Additionally, SAC is collaborating with a local university on research regarding the potential reuse of dried sludge for agriculture. Based on these findings, no significant negative impact on the natural environment has been identified. Observations during the site visit also confirmed no adverse effects on the environment.

(2) Resettlement and Land Acquisition (no problems)

A landowner donated approximately 11 hectares of land to the city of Comayagua, and the water treatment plant under the Project was constructed on a portion of 1 hectare of the land. According to SAC, there are few residents around the Project site, and no resident relocation was required for the Project. No issues arose from the donation process from the landowner to the city. There is also an agreement that SAC will supply water in the future to residentially developed area in the southern part of the city, owned by the landowner.

(3) Other Impacts: Benefiting the Poor

Interviews with general water users were also conducted in areas with relatively poor residents, and no significant differences in water supply services compared to other areas were observed. It is believed that the Project's effects have reached all residents in the target water distribution area, including the poor.

[17] A joint survey conducted by the hospital and the U.S. military in these areas found cases of dysentery bacteria detected in water storage tanks.

[18] Part of the bottommost cut slope on the reservoir side collapsed due to rainwater infiltrating the slide surface, which was difficult to foresee in advance. This issue was addressed by installing a concrete slope protection frame, incorporating concrete spraying and rock bolt insertion techniques to prevent further slides, along with the installation of a drainage pipe to manage water flow.

・ Summary of Impact

Only a portion of water users reported positive changes in hygiene practices and reductions in diarrhea as a result of the improved water services. On the other hand, most users continue to rely on water storage tanks with ongoing concerns about water quality deterioration. Consequently, the Project's contribution to improving people's lifestyles and hygiene habits has been limited. Although it was expected that the improved water quality would reduce waterborne diseases, no statistical data was available to confirm changes in these diseases within the target water distribution sectors. It is believed that the Project has benefited all residents in these sectors, including the poor.

<Evaluation Result>

The Project has achieved its objectives only to a certain extent. Therefore, effectiveness and impacts of the Project are moderately low.

4 Sustainability

・ Policy and System

The National Development Plan, *Vision de País 2010-2038*, identifies the water and sanitation sector as a priority area, aiming to provide over 90% of the population with access to sustainable water supply services by 2034. The National Water and Sanitation Sector Policy, formulated by the National Council for Water and Sanitation (CONASA) in 2013, also targets universal access to improved water and sanitation services by 2038. In pursuit of this goal, the National Plan for the Water Sector, *PLANASA 2022-2030*, emphasizes further reforms and capacity building to enhance transferred water utilities, promotion of infrastructure investment, strengthening of non-revenue water measures, and ensuring transparency. The Comayagua City Development Plan, *Plan de Desarrollo Municipal Con Enfoque de Ordenamento Territorial del Municipio de Comayagua2022-2026*, similarly outlines the expansion and quality improvement of water supply services as one of its priorities.

In light of the above, no policy or institutional issues are anticipated to affect the sustainability of the project effects.

・ Institutional/Organizational Aspect

Since 2009, SAC has been managing the water supply in the urban area of Comayagua City.[19] Based on the 2003 Framework Law on Water and Sanitation, CONASA formulates the national water sector plan, while Water and Sewage Services Regulatory Entity (ERSAPS) oversees and regulates water supply and sewerage services. In Comayagua City, Comayagua Local Water Supervision and Control Unit (USCLAC), a subsidiary of ERSAPS, oversees the water supply and requires SAC to report water quality test results. SAC's business plans are implemented with the approval of its Board of Directors, which includes representatives from citizens, private companies, and SAC itself. According to the Municipal Law, the Comayagua Municipality Water and Sanitation Commission (COMAC/COMAS), composed of citizens, water supply and sewerage companies, and Comayagua City officials, provides advice, coordination, and evaluation for the city's water supply operations.

The SAC Operation and Maintenance Department, responsible for the Project's operation and maintenance, expanded its staff from 29 in 2017 to 41 in 2023. Many of them have worked with the company since when the Project was underway. Of the department's staff, 13 members are directly involved in the water treatment plant's operation and maintenance, including the water quality management staff, a requirement of the Project. The number of operators has increased from five before the Project to seven, ensuring adequate staffing levels.

In light of the above, there are no institutional or organizational issues that are expected to affect the sustainability of the Project.

・ Technical Aspect

Among the 13 current staff members at the water treatment plant, seven have completed the soft component training provided by the Project. Additionally, an expert as the person responsible for water quality management, required for the Project, has been hired and is stationed at the plant on a full-time basis. SAC has trained the remaining six employees in the facility's operation and maintenance, so all the staff are now fully capable of managing the plant's operations. According to SAC, regular departmental training sessions are conducted approximately twice a year.

For the Project, alongside the facility operation and management guidance provided by the contractor, technical guidance (soft component) was offered by the consultant, so there are currently no issues with plant operations. The water treatment plant uses a gravity filtration method, which differs from the existing plant's pressurized filtration system. This method consumes less electricity and simplifies operation and maintenance, so there is no technical concerns. Furthermore, the

[19] The authority to operate Comayagua's water supply was transferred from the National Water Supply and Sanitation Corporation (SANAA) to the city in 2009. In the same year, a city ordinance established the SAC, which operates the city 's water supply.

operation and maintenance guidelines created during the Project are actively in use.

While SAC can request technical assistance from SANAA, if necessary, no such assistance has been needed to date. As additional technical support from external organization, SAC is currently enhancing the city's water distribution network, including leakage prevention and water pressure adjustments, with the technical assistance from the IDB.

As additional technical support from external organizations, SAC is currently receiving technical cooperation from the IDB while progressing with the improvement of the urban distribution network (including leak prevention and pressure adjustment measures)

As mentioned above, the development of the water distribution pipe network and the installation of water meters are crucial for addressing non-revenue water to extend future water supply hours. However, SAC has not yet established specific targets for these initiatives, which may delay their completion. If progress on reducing non-revenue water continues to be slow, water supply restrictions will persist, and the Project's treated water may not be supplied in adequate quantities, so, therefore it is necessary to closely monitor its progress.

In conclusion, while there are no technical issues with the operation and maintenance of the water treatment facilities, some challenges remain in implementing non-revenue water reduction measures, affecting Project's water supply hours. Therefore, consistent implementation is desired.

・ Financial Aspect

SAC operates and maintains water supply facilities using revenue generated from water fees. The income and expenditure for the past three years are shown in the table below. SAC has remained profitable from 2021 to 2023, maintaining a very high operating profit margin of over 30%. Expenses related to the Project's facilities are included under the "cost of services" category. Currently, SAC is also working on a project to install water intake facilities and pipelines from the Rio Branco water system as part of new water source development. However, the funding for the Rio Branco project is allocated separately from the Comayagua City budget and is not reflected in the table below.

Table 8 SAC Financial Performance

(Unit: HNL)

Item	2021	2022	2023
Income	35,003,206	32,423,059	31,855,780
Operating income	31,088,897	31,505,702	31,283,144
Non-operating income	4,000,808	990,770	455,937
Water bill discount	-187,222	-179,016	-174,219
Other Income	100,723	105,602	290,917
Expenses	19,977,473	22,551,949	22,418,701
Cost of Services	10,694,623	14,165,389	13,920,881
Operating Expenses	9,282,850	8,386,561	8,497,820
Net profit (balance)	15,025,732	9,871,109	9,437,078
Operating Profit Margin*	48.6%	31.5%	30.3%

Source: SAC

*Operating profit Margin = Net profit / (Operating income + Water bill discount)

The expenses for chemicals and electricity at the Project's water treatment plant over the past three years are shown in the table below. The highest expenditure during this period, approximately HNL 3.8 million in 2022, accounted for about 12% of the operating income that year. Since SAC maintained profitable that year, the expenses are considered to be within a manageable range.

Table 9 Expenses for the water treatment plant under the Project

(Unit: HNL)

Water treatment plant expenses	Chemicals cost	Electricity expense
2021	2,027,357.27	828,014.87
2022	2,613,106.60	1,237,067.49
2023	1,754,880.50	815,585.46

Source: SAC

・ Environmental and Social Aspect

SAC is required by law to continue environmental monitoring. In addition to water quality testing at the water treatment plant, water quality tests are also conducted at 10 locations in the city monthly. These results are reported to Comayagua's supervising unit, USCLAC, which is a subordinate body of the national regulatory entity, ERSAPS. The submitted water quality test results for the discharged water from the water treatment plant's dried sludge bed, and the most recent city water quality tests, both complied with the country's environmental standards. The dried sludge generated by the water treatment plant is transported to a designated disposal site as industrial waste, and no significant issues have been reported. Currently, joint research is being conducted with a local university on the potential for sledge reuse.

Based on the above, there are no particular concerns regarding environmental or social aspect.

・ Preventative Measures to Risks

SAC has established a series of standard response procedures, covering the water source area, the water treatment plant and headquarters, to address tropical storms such as hurricanes. In November 2020, when hurricanes ETA and IOTA damaged the intake facilities and conveyance pipes (not covered by the Project) of the Majada and Matasano water systems, the inflow of raw water to the treatment plant was suspended for several weeks. In response, SAC promptly initiated construction to switch water conveyance to the Jutera water source, allowing operations of the treatment plant to resume in December of the same year. Water conveyance from the Jutera water source remains an option if needed. SAC has demonstrated its ability to respond swiftly to hurricane damage and has sufficient capacity to manage such risks.

・ Current Status of Operation and Maintenance

The water treatment facilities of the Project have been operating 24 hours a day without any interruptions from the start of service until the time of ex-post evaluation, except for the 23-day suspension of water intake due to the hurricanes in November 2020. Water treatment plant operators work in shifts around the clock. A full-time staff specializing in water quality management conducts daily water quality tests and monitor the dosage of coagulants. Backwashing of the rapid filter basin occurs every 24 to 36 hours. All water treatment facilities and equipment, including flow meters and turbidity meters, are being properly utilized and have experienced no breakdowns to date. Spare parts are abundant and stored appropriately[20]. SAC conducts maintenance work twice a year in cooperation with the headquarters and the water treatment plant, while daily operation and maintenance are carried out according to established guidelines.

Based on the above, the operation and maintenance status of the water treatment facilities of the Project is considered appropriate.

<Evaluation Result>

Slight issues have been observed in the technical aspect, however, there are good prospects for improvement. Therefore, sustainability of the project effects is high.

III. Recommendations & Lessons Learned

・ Recommendations to Executing Agency

To extend water supply hours in the targeted water distribution sectors using the Project facilities, SAC is recommended to develop and steadily implement plans to address non-revenue water, such as improving the water distribution network and installing water meters.

・ Recommendations to JICA

JICA should monitor the implementation of the recommendations above as needed and provide advice when requested.

・ Lessons Learned

<Identifying and Promoting the Fulfillment of Key Prerequisites>

In the Project, it was assumed that the city's water meter installation rate would reach 100% by 2020 through non-revenue water measures, such as installing water meters and other initiatives by SAC. And the construction of a water treatment plant and a distribution reservoir with a 24-hour supply capacity was expected to improve water quality and extend supply hours in the target water distribution sectors.

However, following a policy shift in SAC after the change of general manager in 2019, the pace of meter installation

[20] This water treatment plant has a mechanism to bypass the coagulation sedimentation basin, which is not needed when the raw water turbidity is low. However, since the facility began operation, the raw water turbidity has been high for most of the year, making coagulation sedimentation treatment necessary. As a result, the bypass pipe for the coagulation sedimentation basin has not been used.

slowed, resulting in an installation rate of only 65% in 2023. In the target water distribution sectors, two out of four sectors have a 24-hour water supply. In the other two sectors, water meters were not installed sufficiently, nor were the associated leakage prevention measures implemented. As a result, no new water distribution sectors have transitioned to a 24-hour water supply. Consequently, no increase in water supply hours can be confirmed across the target distribution sectors.

The water supply is a system, and the Project effects of the water treatment plant and distribution reservoir can only be realized with an appropriate water distribution network. To ensure the realization of the effects of the water treatment plant and distribution reservoir constructed under the Project, implementing measures to reduce non-revenue water, such as the installation of meters, should have been considered as an important prerequisite.

In light of the above, if there are important prerequisites for achieving project effects and the executing agency has a plan to realize them, it is crucial for JICA to properly evaluate its feasibility during the planning stage. Additionally, JICA should confirm the executing agency's commitment to implementation through agreement documents or similar means. Continuous monitoring of the implementation status and encouraging its implementation are also essential. If feasibility is deemed low, JICA should at least request the prompt implementation of the parts of the plan that directly contribute to realizing project effects, such as prioritizing meter installation in the target distribution sectors.

IV. Non-Score Criteria

- Performance
  - Objective Perspective (None)
- Additionality (None)

Panoramic view of the water treatment plant and water reservoir (Source: SAC)

Sedimentation pond and filtration pond (photographed by the evaluator)

Sedimentation pond and filtration pond (photographed by the evaluator)

Appearance of the new reservoir (photographed by the evaluator)

Sludge drying bed (photographed by the evaluator)

Flow meter (photographed by the evaluator)

(end)