People’s Republic of Bangladesh

FY2023 Ex-Post Evaluation Report of Japanese ODA Loan Project

“Khulna Water Supply Project”

External Evaluator: Hideyuki Takagi, Ernst & Young ShinNihon LLC

0. Summary

This project was a co-investment between JICA and the Asian Development Bank (ADB) to establish a water supply system in Khulna, the third largest city in Bangladesh, in order for the city to prepare for future growth in demand for water. The objective of this project was to improve the living environment of the residents in target areas, through the actions of the Khulna Water Supply and Sewerage Authority (KWASA), the implementing agency of this project, to provide a safe and stable water supply system as well as to address saltwater intrusion caused by climate change.

This project was consistent with Bangladesh’s policy for providing a safe water supply system and drinking water, the city’s increased demand for water, and Japan’s country assistance policy at the time of both the ex-ante evaluation and the ex-post evaluation. Additionally, it was confirmed that as a co-financed water supply facility development by ADB, collaboration by other development support agencies with the water supply sector in Khulna resulted in successful outcomes. Therefore, its relevance and coherence are high. The establishment of the water supply system, the output of this project, was implemented mostly as planned. Both the project cost and period slightly exceeded the plan. Therefore, efficiency of the project is high. As the population estimates at the time of the ex-ante evaluation were inflated in comparison to the actual population growth, the effectiveness and impact of this project were evaluated after revising the values of relevant indicators based on the water demand estimates at the time of the ex-ante evaluation. Since the water treatment plant constructed by this project is operating as expected at the time of the ex-ante evaluation, the water supply meets demand in Khulna, and the plant ensures hygiene in the daily lives of the city’s water supply users. However, KWASA needs to take action to achieve the objective of this project, which is to provide a safe and stable water supply system and address saltwater intrusion caused by climate change as described in recommendations. Therefore, effectiveness and impacts of the project are moderately low. While there are minor issues regarding the operation, maintenance and management in terms of the organizational/institutional and financial aspects, there is high probability of improvement/resolution. Therefore, sustainability of the project effects is high.

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

1. Project Description

Project location
(Source: External evaluator)

Water treatment plant constructed by the project (Source: Evaluator, April 2024)

1.1 Background

The Bangladeshi government has identified improving people's access to safe water as one of its priority issues. The government's policies for the water supply sector state that urban areas must secure sufficient water supply to satisfy a demand that is expected to keep growing in the future, as well as to build efficient systems to provide water services. Before the implementation of this project, the *National Water Resources Management Plan (2004)* and the *Sector Development Programme (2005)* had established a target to equip 90% of the country's four main cities (Dhaka, Chattogram, Khulna and Rajshahi) with a water supply system by 2025.

Khulna is the third largest city in the country behind Dhaka and Chattogram. However, unlike these two larger cities, no large-scale improvement of the water supply system has been carried out in Khulna, and the city had typically depended on groundwater for its water supply. KWASA had provided the water supply from groundwater sources with pipes, communal taps and wells with hand pumps. In the preparatory survey for this project, it was estimated that approximately 58% of the city's demand for water was supplied by KWASA, and the rest was from privately-owned wells. The demand for water in Khulna was expected to increase with the growth of the city's population. However, there was concern that increasing water supply by extracting more groundwater would cause a decline in groundwater levels and water quality due to an increase in the amount of water being withdrawn. For this reason, the city needed to establish a water supply system that uses surface water (river) as its water source. Additionally, the downstream basin of the Ganges, where Khulna is located, experiences saltwater intrusion from the Bay of Bengal during the dry season when water levels are lower. The effect of climate change is likely to increase the impact on the area in the long-term. As a consequence, this needed to be taken into account at the

stage of designing the water supply system. This project to provide a safe and stable water supply system in Khulna was co-financed with the ADB, which supports the establishment of water supply and sewage systems in urban areas of Bangladesh.

1.2 Project Outline

The objective of this project is to establish a water supply system in Khulna, the third largest city in Bangladesh, and to address the issues of providing a safe and stable water supply system and saltwater intrusion caused by climate change, thereby improving the living environment for residents of the target area.

Loan Approved Amount / Disbursed Amount	15,729 million yen / 15,406 million yen	
Exchange of Notes Date / Loan Agreement Signing Date	May 2011 / May 2011	
Terms and Conditions	Interest rate	0.01%
	Repayment period	40 years (Grace period: 10 years)
	Conditions for procurement	General untied
Borrower / Executing Agency	The Government of the People's Republic of Bangladesh / Khulna Water Supply and Sewerage Authority (KWASA)	
Project Completion	June 2019	
Target Area	Khulna, Khulna District	
Main Contractor(s) (Over 1 billion yen)	• CHINA GEO ENGINEERING CORPORATION (China) • CHINA HARBOUR ENGINEERING COMPANY LIMITED (China)	
Main Consultant(s) (Over 100 million yen)	• SMEC INTERNATIONAL PTY LTD. (Australia) • AECOM ASIA COMPANY LTD. (Hong Kong)	
Preparatory Survey	JICA "Preparatory Survey for Khulna Water Supply Improvement Project" (2009-2011)	
Related Projects	ADB "Khulna Water Supply Project" (2011-2019)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Hideyuki Takagi (Ernst & Young ShinNihon LLC)

2.2 Duration of Evaluation Study

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

Duration of the Study: December 2023-January 2025

Duration of the Field Study: The first field study was conducted on April 21, 2024 and from April 27, 2024 to May 10, 2024. A remote study replaced the second field study which could not be conducted due to the outbreak of nationwide protests and conflict in Bangladesh in July 2024. All necessary surveys were conducted during the period from July to October 2024.

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

3.1 Relevance/Coherence (Rating: ③[2])

3.1.1. Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Bangladesh

At the time of the ex-ante evaluation of this project, Bangladesh's national development plan *6th Five-Year Plan (FY2011-FY2015)* positioned supplying safe drinking water and sanitation as the main objective of urban development, and targeted achieving 100% access to safe drinking water in urban areas by 2015. Additionally, the "Poverty Reduction Strategy Paper" (2005), regarded as the most important national development strategy, positioned supplying safe water and sanitation as a part of "human development of the poor," as well as one of the eight points on its mid-to-long term strategic agenda. Envisioning the attainment of the United Nations Millennium Development Goals, this strategy aimed to provide all people in the country with safe drinking water by 2011.

The *8th Five-Year Plan (FY2020-FY2025)* at the time of the ex-post evaluation continues to promote policies for supplying safe drinking water in human development strategies, in order to improve the population's health and sanitation. The plan also emphasizes the need for investment in improving sanitation in urban areas via improving water supply and other systems to address the outbreak of COVID-19.

From the above, this project is consistent with Bangladesh's national policies and development policies for the sector in relation to supplying safe drinking water and establishing a water supply system in the country, at the time of both its ex-ante evaluation and ex-post evaluation.

3.1.1.2 Consistency with the Development Needs of Bangladesh

Water supply in Khulna typically depended on groundwater. At the time of the ex-

[1] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[2] ④: Very High, ③: High, ②: Moderately Low, ①: Low

ante evaluation, the demand for water supply in Khulna city was expected to increase with the growth of the city's population. However, there was concern that increasing water supply by extracting more groundwater would cause a decline in groundwater levels and water quality due to the amount of water being withdrawn. At the time of the ex-post evaluation, demand for water continues to increase with population growth in Khulna, the target city for this project.

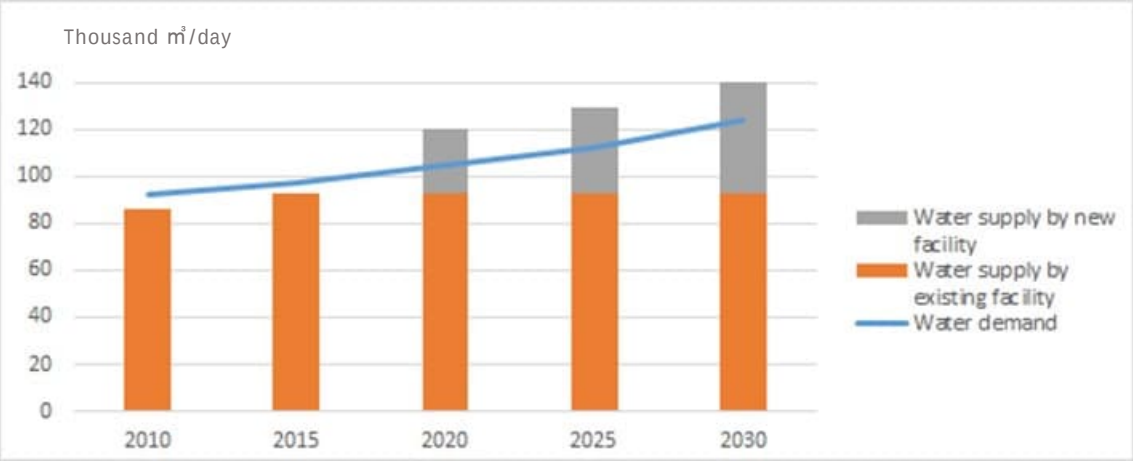

Figure 1. Estimate of water supply and demand in Khulna at the time of appraisal
Source: Prepared by the evaluator based on documents provided by JICA and census.

In addition, the estimates of the demand for water at the time of the ex-ante evaluation were calculated in the preparatory survey for this project, based on the population of Khulna city in the 2001 census. However, the actual population of Khulna city recorded in the 2011 and 2022 censuses fell around 60%, far below these estimates. For this reason, in this ex-post evaluation, the indicators for the effectiveness and impact of the project have been revised according to the demand of water supply which was calculated based on the actual population of Khulna city in the 2011 and 2022 census.

From the above, Khulna city required improvement in water supply to address the increase in demand for water at the time of both the ex-ante evaluation and ex-post evaluation of this project and therefore, the development needs associated with this project were high.

3.1.1.3 Appropriateness of the Project Plan and Approach

Lessons learned from similar previous projects indicate the importance of approaching and carrying out the intake, treatment, transmission and distribution of water as a unified project according to plan, in order to achieve the expected outcome. This project was implemented as a single project for the overall water supply system as

a co-investment with the ADB. Appropriate supervision was achieved through a common JICA and ADB project management unit and a management committee. In addition, in response to indications that management of water businesses would need to be improved and enhanced for the purpose of project continuity, consulting services provided through ADB's portion of the project to improve the organizational management capabilities of KWASA were planned and carried out appropriately.

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

At the time of the ex-ante evaluation of this project, the priority area of "Social development with human security" in Japan's *Country Assistance Program for Bangladesh (2006)* highlighted alternative water resources as a focus for support measures. In light of this program, JICA regarded the water supply system of Bangladesh as a development issue in line with the "Environment" portion of the priority area for "Social development with human security." From the above, this project was consistent with the assistance policies implemented by the Japanese government at the time of the ex-ante evaluation.

3.1.2.2 Internal Coherence

JICA previously provided support that targeted urban areas in Bangladesh for the water supply sector, and supported establishing a water supply system and improving the organizational management capabilities of water businesses in Chattogram.[3] No other projects had been implemented in Khulna, the target for this project, and there were no particular synergies or benefits from collaboration between this project and other JICA projects.

3.1.2.3 External Coherence

This project was planned and implemented as a co-investment with the ADB which employed parallel financing[4], and is consistent with support provided to the water supply sector in Khulna by other development support agencies. In this project, JICA and the ADB collaborated and coordinated as planned to establish water intake/treatment facilities and water transmission/distribution facilities respectively.

[3] Support projects for establishing a water supply system include the Karnaphuli Water Supply Project (2006-2017) and its phase 2 (2013-2022). Support projects to improve the organizational management capabilities of water businesses include the "Project for Advancing NRW Reduction Initiative of Chittagong WASA in the People's Republic of Bangladesh" (2009-2012) and its phase 2 (2014-2017).

[4] A system which apportions the project according to the responsibility and financing provided by the respective development support agencies.

This has enabled improvement in water supply in Khulna, which was the expected outcome of this project.

This project was consistent with Bangladesh's policies for providing a safe water supply system and drinking water, the increased demand for water in Khulna, and Japan's country assistance policy at the time of both the ex-ante evaluation and the ex-post evaluation. Additionally, there were successful outcomes brought about by collaboration with other development support agencies to support the city's water supply sector. Therefore, its relevance and coherence are high.

3.2 Efficiency (Rating: ③)

3.2.1 Project Outputs

This project established a water supply system in Khulna city through co-financing with the ADB. Intended and actual outcomes of the project include (1) construction and equipment procurement for establishing the water supply system and (2) consulting services. The outputs of this project were generated mostly as planned.

Figure 2. Location map of water supply facilities

Source: Documents provided by JICA (Planning Documents)
Note: Numbers indicate the facilities detailed in the below Tables 1 and 2.

1) Construction and equipment procurement to establish the water supply system JICA's financing portion (ODA loan project):

Main changes from the plan are as follows.

- Expanding the capacity of water intake facilities: Capacity was added to supplement the amount of water lost after the water treatment plant.
- Using transmission pipes with a larger diameter: Transmission pipes were changed from plan to enable local procurement of the materials and increased water supply.

Table 1. Comparison of the planned and actual project outputs of JICA's Financing Portion

	Facility	Plan	Actual
(1)	Intake	110,000 m^3/day	129,600 m^3/day
(2)	Transmission pipe	φ1,350 mm, L = 33 km	φ1,400 mm, L = 33 km
(3)	Impounding reservoir	775,200 m^3	775,200 m^3
(4)	Water treatment plant	110,000 m^3/day	110,000 m^3/day

Source: Documents provided by JICA and the executing agency

Photo 1. Water intake location (Source: Evaluator, April 2024)

Photo 2. Water pump in water treatment plant (Source: Evaluator, April 2024)

ADB's financing portion:

Main changes from the plan are as follows.

- Reducing the number of water supply connections: As of March 2018, installation of the project's planned connections was delayed and only 5,000 connections had been completed. The plan was changed to a realistic total of 40,000 connections including existing installations.[5]
- In addition, the extension of water pipes and the number of water distribution

[5] There were 15,032 water supply connections as of 2010, the time of the planning of this project. While the plan was to install 50,019 locations including these existing connections, it was later changed to approximately 40,000 locations.

reservoirs and elevated water tanks installed have been changed.

Table 2. Comparison of the planned and actual project outputs of ADB's financing portion

	Facility	Plan	Actual
(5)	Water supply pipes	φ300-1100 mm, L = 25km	φ300-1100 mm, L = 45km
(6)	Distribution reservoirs	5 locations in total	7 locations in total
(6)	Elevated water tank	11 locations in total	10 locations in total
(6)	Water distribution network	φ50-400 mm, L = 700km	φ50-400 mm, L = 663km
(6)	Number of water supply connections	50,019 connections (including existing installations)	Approx. 40,000 connections (including existing installations)

Source: Documents provided by JICA and the executing agency
Note: As there were inconsistencies in the planned number of water supply connections between JICA and ADB materials, the accurate plan was confirmed with the executing agency in this ex-post evaluation. The number of connections planned in ADB materials[6] enabled confirmation for consistency between the number of connections and values relating to water system coverage at the time of the planning and therefore, were regarded as accurate and used to analyze related matters.

Photo 3. Water distribution reservoir and elevated water tank (Source: Evaluator, April 2024)

Photo 4. Community water supply connection (Source: Evaluator, April 2024)

The number of water supply connections as of the project completion date had achieved approximately 80% of the plan. Following project completion, KWASA continues to construct additional water supply connections.

[6] The base number and value as of 2010 were a total of 15,032 water supply connections and water system coverage of 22.6%. The estimates for the project completion date were a total of 50,019 water supply connections and water system coverage of 62.3%. KWASA's water supply connections are counted for each building. In the preparatory survey report, it was stated that the project targeted 90,000 water supply connections per household. ADB has set the number of water supply connections per building based on KWASA's method of counting the number of water connections. As a result, there was a difference in the planned number of water connections.

Table 3. Changes in the number of water supply connections

	2018	2019	2020	2021	2022	2023
Number of water supply connections	18,500	40,020	40,250	40,485	40,565	41,500

Source: Documents provided by the executing agency

2) Consulting services

Supervision of project implementation:

JICA and the ADB each implemented detailed design, bidding assistance, construction supervision, monitoring and evaluation of project effects, and social and environment management plans for their respective portions of project. According to KWASA, overall supervision of the project implementation was appropriate.

Capacity building (for ADB's portion of the project):

The following support measures were implemented in relation to the business plan for the coming 20 years, to improve the organizational management capabilities of KWASA. According to KWASA, the details and measures of the support were both appropriate.

- Revamping the organizational chart
- Formulating a five-year incremental water tariff system, personnel allocation, and action plan
- Building community groups within low-income areas
- Securing water supply through the new water distribution system
- Launching on-line customer services
- Reinforcing organizational capabilities for appropriate invoicing and asset management

3.2.2 Project Inputs

See "Comparison of the Original and Actual Scope of the Project" on the final page of this report for details.

3.2.2.1 Project Cost

The actual project cost was JPY35,777 million and slightly exceeded the planned cost of JPY31,082 million (115% of plan). The primary reason was due to fluctuation in foreign exchange[7] rates, and the actual costs exceeded the planned costs for the portion of financing provided by the ADB and the portion of the Bangladesh's

[7] Rates at the time of plan: USD1 = JPY85.5, USD1 = BDT69.4, BDT1 = JPY1.23 Average rates across the project period: USD1 = JPY102.7, USD1 = BDT79.6, BDT1 = JPY1.29 ADB's financing portion: Plan: USD75 million, Actual: USD66 million (88% of plan) Bangladesh's government budget portion: Plan: BDT7,269 million, Actual: BDT9,401 million (129% of plan)

government budget, when converted into Japanese Yen. In addition, detailed project plan was revised during the implementation of the project, which resulted in the increase of Bangladesh government's budget for construction costs.

Table 4. Comparison of the planned and actual project cost

(Unit: JPY million)

	Plan			Actual			Ratio against the plan
	Foreign currency	Local currency	Total	Foreign currency	Local currency	Total	%
JICA's financing portion	10,848	4,881	15,729	11,165	4,241	15,406	98
ADB's financing portion	5,375	1,037	6,412	6,311	1,036	7,347	115
Bangladesh's government budget portion	–	8,941	8,941	–	13,024	13,024	146
Total	**16,223**	**14,859**	**31,082**	**17,476**	**18,301**	**35,777**	115

Source: Documents provided by JICA and the executing agency

3.2.2.2 Project Period

The project period, beginning on the signing of the loan agreement until the start of the operations of the facilities, was planned to be 80 months (May 2011-December 2017). The actual project period was 98 months (May 2011-June 2019) and slightly exceeded the plan (123% of planned duration). The main factor causing this longer period were the delays arising in the bidding process, land acquisition[8] and obtaining road construction permits, in addition to damage caused by cyclones.

Table 5. Comparison of the planned and actual project period

	Plan	Actual	Ratio against the plan
JICA's financing portion	62 months (May 2011-June 2016)	98 months (May 2011-June 2019)	158%
ADB's financing portion	79 months (June 2011-December 2017)	97 months (June 2011-June 2019)	123%
Total	**80 months (May 2011-December 2017)**	**98 months (May 2011-June 2019)**	**123%**

Source: Documents provided by JICA and the executing agency

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

1) Financial Internal Rate of Return (FIRR)

[8] The process for land acquisition was outsourced to the NGO Christian Commission for Development in Bangladesh. Delays were attributable to protracted negotiations with affected residents.

As the FIRR was not announced at the time of the ex-ante evaluation of the project, it has not been included in the scope for re-calculation for the purpose of this ex-post evaluation.

2) Economic Internal Rate of Return (EIRR)

In this ex-post evaluation, the assumptions for the EIRR at the time of the ex-ante evaluation were revised[9], and the figures for the planned EIRR and EIRR based on actual conditions at the time of the ex-post evaluation were re-calculated. EIRR based on actual conditions at the time of the ex-post evaluation was 0.05%, lower than the revised planned value of 2.0%. The reason the actual EIRR fell below the planned EIRR was due to the reduction in the number of water supply connections compared to the plan.

Table 6. Comparison of the planned and actual EIRR

	Planned		Actual	Difference
	At ex-ante evaluation	Corrected value		(comparison with corrected value)
EIRR (%)	14.9	2.0	0.05	1.95

Assumptions for re-calculation of the EIRR
Cost: project cost, operation and maintenance cost
Benefits: households' affordable to pay for water

The establishment of the water supply system, the output of this project, was implemented mostly as planned. The project cost and period both slightly exceeded the plan. Therefore, efficiency of the project is high.

3.3 Effectiveness and Impacts[10] (Rating: ②)

3.3.1. Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

Among the quantitative effects established in the ex-ante evaluation of this project, those applicable as direct/short-term effects were categorized and analyzed as Operation and Effect Indicators. For Operation Indicators, in addition to "Facility utilization rate (%)" for water treatment plant, in this ex-post evaluation, a new indicator "Water output volume (m^3/day)" has been created for the purpose of confirming the relationship between facility utilization and amount of water supply (effect of establishing the water supply system).

Target values for each of the indicators were initially established by using the water

[9] Assumptions for the EIRR at the time of the ex-ante evaluation were inconsistent with the actual conditions influencing the EIRR at the time of the ex-post evaluation, and approximately 60% of the economic benefits were estimated as the willingness to pay by commercial use (users of KWASA's water supply connections as of 2022 are: 41,262 households and 162 commercial tenants). In this ex-post evaluation, the assumptions were revised for the purpose of comparing the planned EIRR and actual EIRR, and conducted a re-calculation using a benchmark against disposable income.

[10] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

demand estimates based on population estimates at the time of the ex-ante evaluation. As previously stated in section 3.1.1.2 “Consistency with the Development Needs of Bangladesh,” the population estimates based on the census were inflated at the time of the ex-ante evaluation and, therefore, in this ex-post evaluation, figures for water demand estimates have been corrected using the 2011 and 2022 censuses, and target values have also been corrected to align with these corrected estimates and the timing of the project completion.

3.3.1.1.1 Operation Indicators

The status of operation at the water treatment plant constructed in this project have mostly reached its corrected target values for their operation indicators, as described in Table 7. The project aimed to achieve the facility utilization rate of 27% two years after project completion, and the actual rate was 30% of the target value (111% of plan). The targeted water output volume was 29,600m^3/day, and the actual volume was 33,000m^3/day (111% of plan).

Table 7. Achievement of the operation indicators

	Baseline	Original target	Corrected target	Actual		
	2010	2018	2022	2021	2022	2023
		2 years after completion	2 years after completion	2 years after completion	3 years after completion	4 years after completion
Indicator 1: Facility utilization rate (%)	Not applicable	51	27	30	33	34
Indicator 2: Water output volume (m^3/day)	Not applicable	56,100	29,600	33,000	36,200	37,400

Source: Documents provided by JICA and the executing agency

Note: There is no baseline value as the indicators are for newly constructed water treatment plant. Target values have been corrected to align with census data and the project completion date, and hence have been updated from the initial values.

3.3.1.1.2 Effect Indicators

The ex-ante evaluation uses the “Amount of the water supply (m^3/day)” and “Non-revenue water rate (%)” attributable to the water supply through KWASA water pipes as indicators to show the effectiveness of the project for establishing a water supply system in Khulna. These quantitative effect indicators have mostly reached the corrected target values, as described in Table 8. While the corrected target value for water supply two years after project completion was 66,500m^3/day, the actual value was 58,000m^3/day (87% of plan). While the target value for non-revenue water rate was 20% (a 44% improvement on the baseline value), the actual value was 22% (a 39% improvement from the baseline value) (89% of planned improvement from the baseline value was achieved).

Table 8. Achievement of the effect indicators

	Baseline	Original target	Corrected target	Actual		
	2010	2018	2022	2021	2022	2023
		2 years after completion	2 years after completion	2 years after completion	3 years after completion	4 years after completion
Indicator 1: Volume of water supply (m^3/day)	30,100	96,500	66,500	58,000	61,200	62,400
Indicator 2: Non-revenue water rate (%)	36	20	20	22	22	22

Source: Documents provided by JICA and the executing agency

Note: The volume of water supply is the total water supply provided through KWASA water pipes (the amount of water supply through KWASA wells with hand pumps and privately-owned wells have been excluded from the values stated in project plan documents). Target values have been corrected to align with census data and the project completion date, and hence have been updated from the initial values.

3.3.1.2 Qualitative Effects (Other Effects)

The ex-ante evaluation establishes “The improvement of the living environment of the residents of the target areas” and “Adaptation to climate change” as the qualitative effects of this project. In this ex-post evaluation, this has been categorized as an indirect/long-term effect of the project and analyzed in section 3.3.2 “Impacts.” The direct/short-term effect of improvement in water supply was analyzed for the qualitative effects of the project.

1) Survey conducted with beneficiaries of the project

The following is a summary of the survey[11] which interviewed 25 households that receive water supply from KWASA water pipes and were beneficiaries of the project in locations in Khulna.

1. Improvement in drinking water quality

a. Source of drinking water

Survey results: Before implementation of this project, the main source of drinking water was deep wells (KWASA deep wells with hand pumps or privately-owned wells). Most households (19 out of 25) continue to use water from the deep wells as drinking water after the implementation of this project. Four households drink tap water, one household drinks mixed water from a deep well and their water tank, and one household drinks mineral water. Many public facilities also continue to drink water from deep wells, while also using water dispensers.

b. Tap water quality

Survey results: Households and other facilities continue to use water from deep wells

[11] Interviews were conducted with 25 households, institutions (three hospitals, three schools, and two mosques) in April and May of 2024 in 18 of the 31 wards in Khulna. Demographic of the 25 households: 11 women, 11 men, three married couples. One person in their 20s, three in their 30s, nine in their 40s, ten in their 50s, four in their 60s and one in their 70s.

for drinking water as their perception is that tap water is not suitable for drinking (due to a bad taste or a lack of trust in tap water). Some feedback said that the water tasted of chemicals including chlorine, or sometimes even smelled as if it had been contaminated with sewer water. According to interviews with health care institutions, groundwater includes iron in some areas but no patients present symptoms of gastric illnesses caused by drinking well water, and there are no particular health issues associated with it.

2. Longer periods of water supply, water pressure, obtaining sufficient water supply with tap water, and satisfaction of the project beneficiaries

a. Longer periods of water supply

Survey results: Many households (18 of 25) reported that water supply was intermittent (several instances of interruptions to supply, almost every day). One household reported that it had a 24-hour water supply. Five households were unaware of interruptions to water supply (due to using household water tanks), and confirmation is pending for one household.

b. Water pressure

Survey results: Many households (21 of 25) reported that water pressure is good when there is supply. Three households were unaware of the water pressure (due to using household water tanks), and confirmation is pending for one household.

c. Obtaining sufficient water supply with tap water

Survey results: Many households (23 of 25) reported that their daily usage of water for non-drinking purposes had increased by 1.5 to 3 times, and they still were able to secure enough water within their households. One household reported there were no changes as they were continuing to use water from deep wells, and one household did not measure their water usage.

d. Satisfaction of the project beneficiaries

Survey results: Many households (22 of 25) reported that they were satisfied with the water supply, mainly for daily use for non-drinking purposes. With the exception of the four households drinking tap water, this is the satisfaction for daily water use for non-drinking purposes. One household reported that they were not satisfied (due to intermittent supply), and confirmation is pending or there were no comments from two households.

2) Water quality examination data

Public health agencies test the quality of the water being used by Khulna residents, and the results of those sample-based tests at the time of appraisal and ex-post evaluation were compared. The water quality test results as of the time of the ex-ante

evaluation are for tap water sourced from wells with hand pumps, privately-owned wells and deep wells. The results show that the level of iron and e. coli are higher than the tolerable range. The results of the water quality test at the time of the ex-post evaluation show that these levels are contained within the tolerable range, due to a shift to the usage of tap water sourced from treated water and deep wells.

Table 9. Comparison of water quality test results at the time of appraisal and ex-post evaluation

Test items	Tolerable range	At the time of ex-ante evaluation (2009)	At the time of ex-post evaluation (2023)
pH	6.5 - 8.5	6.5 - **8.9**	7.6 - 7.7
Electric Conductivity (μS/cm)	-	-	1380 -1435
Total dissolved solid (mg/L)	1000	-	800 - 832
Chloride (mg/L)	150 - 600	34 - **836**	70 - 585
Hardness (mg/L)	200 - 500	-	403 - 415
Alkalinity (mg/L)	-	-	298 - 325
Arsenic (mg/L)	0.01 - 0.05	0.0 - 0.0268	0.001 - 0.002
Iron (mg/L)	0.3 - 1.0	0.2 - **6.5**	0.1 - 0.27
Fecal Coliform (N/100mL)	0	0 - **31**	0
Total Coliform (N/100mL)	0	0 - **4**	0
Turbidity (NTU)	10	-	1 - 6

Source: Documents provided by JICA and the executing agency
Note: The tolerable range is stipulated by the Bangladeshi government and WHO. The water quality at the time of the ex-ante evaluation is the test result for a tap water sampled from wells with hand pumps, privately-owned wells, and deep wells which are listed in the preparatory survey. The water quality at the time of the ex-post evaluation is the result of a test conducted by the Department of Public Health Engineering[12] in June and November 2023, sampling tap water and water from a KWASA deep well. Values in bold indicate test results that exceeded the tolerable range.

3.3.2 Impacts

3.3.2.1 Intended Impacts

The output of this project was the establishment of a water supply system to accommodate the growth in mid-term demand for water. The main intended impact from the implementation of the project was increased water system coverage in Khulna, an improved living environment for the residents enabled by a water supply system, and adaptation to climate change. Among the quantitative effects established in the ex-ante evaluation of this project, “Population served (thousand persons)” and “Percentage of population served (%)” which are applicable as direct/short-term effects were categorized and analyzed as quantitative impact indicators. As previously stated in

[12] A government organization that oversees the provision of safe drinking water and public health facilities.

section 3.3.1. “Effectiveness,” in this ex-post evaluation, the values for the indicators were corrected in line with the corrections in the water demand estimates. For the qualitative effects established in the ex-ante evaluation, analysis was based on the survey on beneficiaries of the project for “The improvement of the living environment of the residents of the target areas,” and based on KWASA’s water quality test results for chlorine concentration for “Adaptation to climate change.”

1) Quantitative impact

Increased water supply enabled by this project has accommodated increased demand for water due to population growth as well as causing a shift from the status-quo of using groundwater. The quantitative effect indicators have mostly reached the corrected target values, as described in Table 10. While the corrected target value for the population served with the water supply system two years after project completion was 470,000 people, the actual value was 381,000 people (81% of plan). Additionally, while the corrected target value for the percentage of population served was 66%, the actual value was 53% (80% of plan).

Table 10. Achievement of the quantitative impact indicators

	Original baseline	Corrected baseline	Original target	Corrected target	Actual		
	2010	2010	2018	2021	2021	2022	2023
			2 years after completion	2 years after completion	2 years after completion	3 years after completion	4 years after completion
Indicator 1: Population served (Thousand persons)	237	152	706	470	381	382	390
Indicator 2: Percentage of population served (%)	23	23	62	66	53	53	54

Source: Documents provided by JICA and the executing agency
Note: Baseline values and target values have been corrected from the initial values based on census data. Corrections also take into account the project completion date.

2) Qualitative impact

1. The improvement to the living environment of the residents in the target areas

Qualitative survey results: Many households (23 of 25) reported that sufficient water supply has ensured hygiene in their daily lives. Water usage for cooking, laundry, cleaning and bathing has increased in these households. One household reported there were no changes as they were continuing to use water from deep wells for daily use, and one household reported that they were undecided on the topic.

Interviews with health care institutions revealed that juice sold at street stalls during the summer, and not drinking water, is the main cause of waterborne diseases. There were 5,397 patients in 2018 and 5,158 patients in 2019 treated for waterborne diseases before the start of water supply from the water treatment plant. There has been little change to these numbers in recent data; there were 4,934 patients in 2023.

2. Adaptation to climate change

This project was expected to contribute to the preparations for climate change through constructing impounding reservoir and implementing water management plans to address the impact of saltwater intrusion associated with the future expected rise in sea level. Since completion of the project, the chloride ion concentration of raw water being transmitted to the water treatment plant has exceeded the limits (1,000mg/L or under) established by the Department of Environment (DOE), which is housed under the Ministry of Environment, Forest and Climate Change. This has required measures such as revising the capacity of impounding reservoir to address saltwater intrusion associated with climate change.

Water management plan: The plan was to 1. use impounding reservoir to temporarily retain raw water during the rainy season, which has low chloride ion concentration, and to 2. use the retained water to dilute raw water during the dry season, which has high chloride ion concentration, in order to improve the water quality and keep the concentration within limits.

Current status of water management: Due to extremely low precipitation during the 2020 and 2021 dry season which runs from mid-April to mid-June (after the project completion date), the chloride ion concentration at the river water intake location continued to largely exceed limits. Even in circumstances where the low capacity of the impounding reservoir does not allow the water management plan to be implemented properly, KWASA pumps the water from the intake facilities through reservoir to the treatment plant, in order to keep the chloride concentration level of the raw water as low as possible. For this reason, if the chloride concentration of the raw water remains at a level that exceeds the limit for a prolonged period, the chloride concentration of the treated water can also exceed limits.

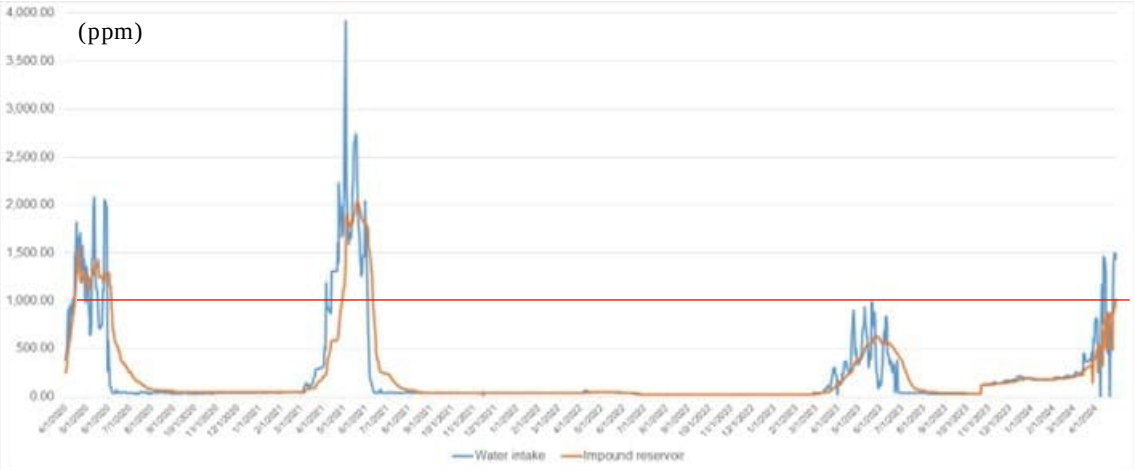

Figure 3. Changes in chloride ion concentration in water intake locations and impounding reservoir

Source: Prepared by the evaluator based on the documents provided by the executing agency[13]
—— DOE's limits for the chloride ion concentration

3.3.2.2 Other Positive and Negative Impacts

1) Impacts on the Environment

At the time of the ex-ante evaluation, the project was categorized as Category B[14] under the *Japan Bank for International Cooperation Guidelines for Confirmation of Environmental and Social Considerations (April 2022)* as the target areas of this project were not classed as national parks or surrounding areas, or other locations vulnerable to the impact of the project, and undesirable impact on the environment would be minimal. The target areas of this project were not classed as national parks or surrounding areas or other locations vulnerable to the impact of the project, and the undesirable impact on the natural environment was minimal. No negative impact was anticipated during or after construction of the project. According to KWASA, there have been no negative impacts during or after the construction of the project. Construction was carried out in accordance with the Environment Management Plan (EMP), and there was no pollution that exceeded environmental limits. The environmental impact was within limits in an environmental monitoring report submitted on completion of the project to the Local Government Division (LGD), within the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC), the governing agency for the water supply and sewage system of Bangladesh.

2) Resettlement and Land Acquisition

At the time of the ex-ante evaluation, an estimated 125 residents were to be impacted due to the land acquisition of 29.58 hectares (ha), of which 25.15 ha was privately-owned land, and it had been confirmed that the project would not require any residents to relocate. Land acquisition was carried out in accordance with the domestic process of Bangladesh, and the project planned to pay compensation to affected residents at replacement cost of the land. Additionally, arrangements were made to establish a committee responsible for handling possible claims from the affected residents.

The actual size of the land acquired was 31.19 ha, of which 30.64 ha was privately-owned), 148 land-owning residents were affected, and the final compensation amount was BDT962.6 million.

[13] KWASA website https://kwasa.gov.bd/site/page/ec98677f-9482-4810-8772-3166f8c199ff/Water-Quality-Testing-Reports
[14] Definition of category B: A project of which the impacts are site-specific, few if any are irreversible, and mitigation measures are more readily available.

Table 11. Breakdown of land acquisition by project site

Water facilities	Project site	Area (Acres)	Affected residents (Persons)
Water intake	Mollarhat	2.52	6
Impounding reservoir, Water treatment plant	Samanto Sena	64.25	68
Distribution reservoirs, Elevated water tank	Khulna city	10.29	74
Total		77.06	148

Source: Documents provided by the executing agency

The total amount of other compensation for the 380 residents affected by land acquisition (for fees to temporarily vacate the land, reconstruct buildings, or recover their lives financially) was BDT24 million.

Table 12. Breakdown of other compensation associated with land acquisition

Water facilities	Project site	Affected residents (Persons)
Transmission pipe, water supply pipes, Water distribution network	From Mollarhat to Khulna	335
Distribution reservoirs, Elevated water tanks	Khulna	44
Water distribution office	Khulna	1
Total		380

Source: Documents provided by the executing agency

During the implementation period, KWASA established an effective claims handling committee for residents. According to interviews conducted with the affected residents[15], compensation payments have been completed for either land acquisition or relocation purposes, and their claims have been handled appropriately.

3) Gender Equality

At the time of the ex-ante evaluation, implementation of this project was planned with consideration for gender equality, by ensuring equal opportunities for both men and women to participate in water user groups and training. In the course of this project, various initiatives were carried out in accordance with a gender action plan. Water user groups were formed and meetings were held to raise awareness of public health, efficient use of water, and issues relating to gender. There were a total of 351 meetings

[15] The interview was conducted in May 2024 with a total of 7 affected residents at construction locations for transmission pipes and elevated water tanks.

that ensured equal participation opportunities for women, with a total of 9,904 people participating (of which 6,629, or 67% were women). Leaflets about public health and efficient use of water were distributed at these meetings. KWASA has stated that participants learned about appropriate use of water through these initiatives.

In addition, as detailed below in 4), implementing communal taps for water supply within low-income communities has reduced women's labor to collect water.

4) Marginalized People, Social Systems and Norms, People's Well-being and Human Rights, other

At the time of the ex-ante evaluation, this project planned to implement communal taps for water supply in low-income communities and to thereby improve access to safe water for deprived groups. According to interviews conducted in the ex-post evaluation with users of communal taps, the water is not considered drinking water but in daily use for non-drinking purposes. Drinking water is collected and transported from nearby deep wells. Households within the community share management of the communal taps, collecting fees and making payments to KWASA. The water tariff for each household is approximately BDT150-300 per month, which is within the affordable range for all households within the community.

While water treatment plant provided through this project are operating at the capacity estimated at the time of the ex-ante evaluation, water supply satisfies the demand for Khulna, and the plant ensures hygiene in the daily lives of the city's water supply users. However, KWASA needs to take action to achieve the objective of this project, which is to provide a safe and stable water supply system and address saltwater intrusion caused by climate change. This project has achieved its objectives only to a certain extent. Therefore, effectiveness and impacts of the project are moderately low.

3.4 Sustainability (Rating: ③)

3.4.1 Policy and System

The water supply and sewage system of Bangladesh is managed and controlled by the LGD, which is within the MLGRDC. The agency oversees the Water Supply And Sewerage Authorities (WASA) for urban cities, 12 city corporations, and 324 municipalities. Among urban areas, WASA, which is under the direct control of LGD, is established in Dhaka, Chattogram, Khulna and Rajshahi, and constructs and provides water facilities and services for water supply. In urban areas other than these four cities, the Department of Public Health Engineering of the MLGRDC constructs and repairs water facilities. Responsibility for the maintenance and management of the facilities is

later transferred to the water businesses divisions of local government.

1) Governing agency: The LGD, the governing agency for the water supply and sewage system, is the responsible agency for all matters relating to drinking water, development of water supply and sewage systems in rural and urban areas, waste management, development in low-income communities, and urban health. The agency retains authority for granting in-advance approvals for water tariff revisions and other matters.

2) Executing agency: KWASA, the responsible agency for the operation, maintenance and management of this project, was established in February 2008 based on the WASA Authority Act 1996. KWASA's responsibilities are to construct (new and additional), repair, operate, maintain and manage water supply, sewage and other facilities that contribute to the environment and health in Khulna.

The *WASA Authority Act 1996* (to which there have been no major changes as of the time of the ex-post evaluation) stipulates the main responsibilities of WASA as follows: (i) Construction, operation, and maintenance of water treatment plant, water intake facilities, and water distribution systems to provide drinking water to public, industrial, and commercial organizations; (ii) Development, operation, and maintenance of sewage systems and sewage treatment plant; (iii) Development, operation, and maintenance of storm drainage systems to remove flooding; and (iv) Collection and disposal of solid waste.

3.4.2 Institutional/Organizational Aspect

KWASA was established in 2008, and underwent organizational reforms in 2010. At the time of the ex-post evaluation, it had 284 employees (of which 157 were part-time workers approved by the LGD). Many of the employees that had worked on the operations and maintenance of the groundwater systems before the water facilities provided through this project had started its operations have continued onto currently working on the operations for the new water supply system. In addition, technicians who participated in this project and received training from the contractor during the maintenance period have been employed by KWASA as full-time workers after the project completion.

At the time of the ex-ante evaluation, KWASA was drafting plans for its organization to accommodate the growth in the scale of this project. KWASA's draft for the organization proposed the establishment of a new water distribution office (management office for the customer service department). As of the time of the ex-post evaluation, three water distribution offices have been established for the four total water supply jurisdictional areas of Khulna city, and all customer service are provided by these offices.

Table 13. Water distribution offices of KWASA

Water distribution office	Jurisdictional area	Number of water supply connections (as of 2024)
Fulbari ge office	Area 1: 1 - 11 ward, 14 ward	11,887
Alam Nagar office	Area 2: 12, 13 ward, 15 - 19 ward	9,890
Former KWASA office	Area 3: 20 - 23 ward, 29 - 31 ward	10,092
	Area 4: 24 - 28 ward	10,023

Source: Documents provided by the executing agency

In addition, as described in Table 14, the number of employees at the time of the ex-post evaluation fell far below the number proposed in KWASA's draft organizational plan. Numbers of employees have not increased, especially within the customer service department. However, according to KWASA, water meter inspection and invoice delivery for customers are being outsourced, and there are no issues in terms of managing this work. As detailed later in Section 3.4.4 "Financial Aspect," KWASA is planning revisions of water tariff standards to improve its financial health. Additionally, additional water supply connections are to be installed in the following phase of ADB portion of the project. Reduced future deficits and improved cash flow can be expected if these improvements are carried out as planned along with appropriate business management. This should enable the increase in the number of employees. KWASA plans to secure an appropriate number of employees in accordance with the growth in the scale of the project, and its organizational structure is likely to improve in the future.

Table 14. Plans and status of staff allocation of KWASA

(Unit: person)

	At the time of ex-ante evaluation (2010)	Proposal to increase the number of employees	Draft organizational plan (2017)	At the time of ex-post evaluation (2024)
Management	4	10	14	5
Financial and administrative	43	28	71	58
Technical	165	42	207	169
Customer service	72	138	210	43
Total	**284**	**218**	**502**	**275**

Source: Documents provided by the executing agency

Note: Prior to the completion of this project, it was assumed that the KWASA Management Committee would reorganize the organization based on the draft organizational plan proposed by the JICA and ADB research teams.

3.4.3 Technical Aspect

This project was the first time for KWASA to operate, maintain and manage a water

supply system sourced from surface water. For this reason, at the time of the ex-ante evaluation, KWASA deemed it necessary for there to be training for intake facilities/pumps, impounding reservoir, water treatment plant (including its components such as flocculation basins, sedimentation basins, sand filtration facilities, storage tanks for clean water, chlorination facilities and water quality testing laboratories), as these would require a particular set of skills for operation, maintenance and management. To address this issue, KWASA's five-year business plan (2012-2017), whose formulation was being supported by the ADB, included measures to reinforce the organization by expanding the organizational structure to two levels. The plan was to implement measures to enhance KWASA's capabilities through operations by contractors and consultants, during the period of ADB's support measures to improve the organizational management capabilities of KWASA (2012-2016) as well as the period of maintenance during the one year following project completion.

As discussed in section 3.2.1 "Project Outputs," capabilities of KWASA were enhanced successfully. Water facilities provided through this project were operated by contractors during the one year following project completion (2019-2020), and simultaneously, measures were implemented to enhance the capabilities of the technical staff in the Table 15 below through on-the-job training (OJT) for the operation, maintenance and management of the facilities. Technical staff that have received this training have currently been allocated to each of the water supply facilities. Operators work on a two-shift system, and staff in the central control room work on a three-shift system. In addition, manuals provided by the contractor through the implementation of the project are stored at KWASA headquarters, for reference and effective use by engineers as necessary. While there is no program-based training, technical staff who have received a one-year long training from the contractor are currently providing OJT to new staff. From the above, at the time of the ex-post evaluation, the technical aspect of water facility operations is appropriately maintained.

Table 15. Allocation of technical staff of KWASA at water supply facilities

Water supply facility	Allocation of technical staff
Water intake	Supervising engineers, executive engineers, assistant engineers, sub-assistant engineers (for machines), technicians/operators
Impounding reservoir, Water treatment plant (Including central control room)	Executive engineers, assistant engineers, sub-assistant engineers (for machines), technicians/operators (for electric/machines), SCADA operators (central control room), research room analysts, power generator operators
Distribution reservoirs, Elevated water tanks	Supervising engineers, executive engineers, assistant engineers (zone engineers), sub-assistant engineers, pump operators, technicians/operators (for electric/machines)

Water supply facility	Allocation of technical staff
Monitoring of water quality and quantity	Supervising engineers, executive engineers, assistant engineers (zone engineers), sub-assistant engineers

Photo 5. Water quality testing laboratories and water quality inspection staff in water treatment plant (Source: Evaluator, April 2024)

Photo 6. Central control room and a SCADA operator (leader) in the water treatment plant (Source: Evaluator, April 2024)

3.4.4 Financial Aspect

As of the time of the ex-post evaluation, KWASA's income and expenditure as well as operating cash flow after project completion for the past five years have both ranged in the negative. In response to these circumstances, KWASA is undergoing revisions to water tariff systems and improvements in tariff collection in order to secure budget for the operation, maintenance and management for water facilities. The customer service department utilizes a smart billing system to manage water usage, invoicing, and tariff collection of customers with connections to the water supply.

Table 16. Income and expenditure and operating cash flow of KWASA

(Unit: BDT million)

	FY2019	FY2020	FY2021	FY2022	FY2023
Income statement item					
Water tariff revenue	39	65	98	132	202
Public connection subsidy	155	155	160	160	139
Other revenue	1	10	9	7	16
Operation and maintenance expense	123	152	198	214	252
Depreciation expense	38	1,093	1,040	989	942
General administration expense	5	7	33	1	1
Operating income (loss)	28	(1,021)	(1,066)	(974)	(839)
Other income (expense)	13	17	(1,641)	(324)	(524)
Net income (loss)	41	(1,004)	(2,707)	(1,298)	(1,363)

	FY2019	FY2020	FY2021	FY2022	FY2023
Cash flow item					
Operating cash flow	79	89	(1,667)	(308)	(421)

Source: Prepared by the evaluator based on the documents provided by the executing agency[16]
Note: As the figures in the table are for comparison over the years, figures for the income statement items are after the reclassification of interests payable on long-term debts (as the total of interests payable are recorded under the current period P/L, the interests have been reclassified to only record the portion attributable to the current period as expenses), and figures for the operating cash flow under cash flow item are after excluding the fluctuations of current assets and liabilities. Period of the fiscal years in the table end on June 30 of each year (FY2019 = July 2018 - June 2019).

KWASA is planning a revised water tariff plan indicated in the Table 17. In addition, currently, additional water supply connections are planned to be installed in the ADB portion (following phase)[17] of the project, which is currently undergoing the stage of its preparatory survey. While operating loss will still continue as described in Table 18 even when these are carried out according to plan along with appropriate business management, improvements in financial conditions can be expected due to reduced future deficits and positive cash flow.

Table 17. Water tariff plan of KWASA

Year	Tariff (Tk /m3)	
	Domestic	Commercial
2023	8.98	14
2024	11.22	17.5
2025	11.22	17.5
2026	13.46	21
2027	13.46	21
2028	16.82	25.2

Source: Documents provided by the executing agency

Table 18. Financial projections based on the plans for water tariff revision and water connections increase

(Unit: BDT million)

	FY2025	FY2026	FY2027	FY2028
Income statement item				
Water tariff revenue	311	373	373	455
Public connection subsidy	139	139	139	139
Other revenue	16	16	16	16
Operation and maintenance expense	265	265	265	265
Depreciation expense	1,129	1,075	1,024	975
General administration expense	1	1	1	1
Operating income (loss)	(930)	(814)	(763)	(632)
Other income (expense)	(253)	(241)	(228)	(216)

[16] KWASA website https://www.kwasa.org.bd/kwasa/en/AuditReport.aspx
[17] The ADB, which was responsible for the water supply connections in this project, plans to conduct a preparatory survey (fact-finding survey) in 2024, in preparation for the next phase of the project. The ADB plans to increase the number of water supply connections in this next phase of the project. ADB website https://www.adb.org/projects/57188-001/main

	FY2025	FY2026	FY2027	FY2028
Net income (loss)	(1,183)	(1,055)	(991)	(848)
Cash flow item				
Operating cash flow	(54)	20	32	127

Source: Prepared by the evaluator based on the documents provided by the executing agency

3.4.5 Environmental and Social Aspect

In regard to the following environmental monitoring items in the Table 19 indicated at the time of the ex-ante evaluation, KWASA has established internal systems and is conducting monitoring appropriately. According to KWASA, there have been no negative environmental or social impact arising from the current operations of its water businesses.

Table 19. Status of response to the environmental monitoring

Monitoring items	Status of response
Contact point for resident claims	KWASA handles claims via phone and other channels, and is committed to addressing the claims in a timely manner.
Functions to address rapid deterioration in water quality (only for emergencies)	While there has been no rapid deterioration in water quality under the operations of KWASA so far, the organization has secured personnel with experience in preparation for these circumstances.
Checking for and addressing water leakages	KWASA has formed a total of four teams as work groups to handle water leakage inspections and repairs.
Periodic inspection of facilities	KWASA has formed teams that conduct inspections of facilities, and implements periodic inspections and reporting.

Source: Documents provided by the executing agency

3.4.6 Preventative Measures to Risks

At the time of the ex-ante evaluation, maintaining the appropriate water tariff standards required for securing the financial health of the executing agency was regarded as a measure needed for risk control. As discussed in section 3.4.4 “Financial Aspect,” KWASA plans to revise water tariffs, and its financial condition can be expected to improve with the implementation of this plan.

3.4.7 Status of Operation and Maintenance

In this ex-post evaluation, inspections were conducted for the water intake facilities, impounding reservoir, water treatment plant, and water distribution facilities that had

been constructed through this project. As detailed below, results confirm that there are no major issues regarding the status of operation, maintenance and management of the facilities.

Table 20. Status of operation and maintenance of the water supply facilities

Main items of observation	Result of observation
Status and utilization of facility	While there are no major issues regarding maintenance and management, chlorination devices have been switched to manual operation for chlorine input (as manual operations facilitate easier dosing than automatic operations, and the meter on the device has become corroded, according to interviews and inspection). In regard to the utilization of pumps at water treatment plant, three out of four large pumps and one out of two small pumps were in operation according to the amount of water demanded at the time of the field survey.
River water level and chlorine concentration at the water intake location throughout the year	While there has been no decline in river water levels, the chlorine concentration rises when there is a continued period with small precipitation. Chloride ion concentration at water intake locations, impounding reservoir and water treatment facilities are inspected every day at full tide and low tide.
Water transmission amount	Facilities are operating with water transmission amounts of 37 thousand m^3/day for FY2023, and 42 thousand m^3/day for FY2024.
Status of maintenance of sand filtration facilities	At the time of the inspection, three of the 16 sand filtration facilities were undergoing maintenance (the facilities undergo maintenance in turns).
Status of securing and storing spare parts	Parts and expendable items needed for daily maintenance are secured and stored.
Maintenance and management capabilities and status of establishing manuals	As discussed in 3.4.3 “Technical Aspect,” there are no issues.
Status of obtaining and storing chemicals used at water treatment plant	Flocculants (PAC, ALUM), lime hydrate, and chlorine are appropriately obtained, stored and used.
Status of obtaining and storing chemicals for water quality inspection	Water quality inspection is conducted at laboratories at water treatment plant every day, and chemicals are appropriately obtained and stored.

Slight issues have been observed in the institutional/organizational and financial aspects, however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was a co-investment between JICA and the ADB to establish a water supply system in Khulna, the third largest city in Bangladesh, in order for the city to prepare for future growth in demand for water. The objective of this project was to improve the living environment of the residents in target areas, through the actions of KWASA, the implementing agency of this project, to provide a safe and stable water supply system as well as to address saltwater intrusion caused by climate change.

This project was consistent with Bangladesh's policy for providing a safe water supply system and drinking water, the city's increased demand for water, and Japan's country assistance policy at the time of both the ex-ante evaluation and the ex-post evaluation. Additionally, it was confirmed that as a co-financed water supply facility development by ADB, collaboration by other development support agencies with the water supply sector in Khulna resulted in successful outcomes. Therefore, its relevance and coherence are high. The establishment of the water supply system, the output of this project, was implemented mostly as planned. Both the project cost and period slightly exceeded the plan. Therefore, efficiency of the project is high. As the population estimates at the time of the ex-ante evaluation were inflated in comparison to the actual population growth, the effectiveness and impact of this project were evaluated after revising the values of relevant indicators based on the water demand estimates at the time of the ex-ante evaluation. Since the water treatment plant constructed by this project is operating as expected at the time of the ex-ante evaluation, the water supply meets demand in Khulna, and the plant ensures hygiene in the daily lives of the city's water supply users. However, KWASA needs to take action to achieve the objective of this project, which is to provide a safe and stable water supply system and address saltwater intrusion caused by climate change as described in recommendations. Therefore, effectiveness and impacts of the project are moderately low. While there are minor issues regarding the operation, maintenance and management in terms of the organizational/institutional and financial aspects, there is high probability of improvement/resolution. Therefore, sustainability of the project effects is high.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

1. Conducting a survey regarding using tap water for drinking purposes: The survey on the beneficiaries of the project revealed that some had the perception that tap water is not suitable for drinking due to a bad taste and smell. In addition, some

areas experience interruptions in water supply several times a day due to the operation method of the pumps at distribution reservoirs. This can cause negative pressure within the water pipes, which can in turn result in pollution within the pipes. It is recommended that KWASA conducts surveys with a wide range of tap water users, in order to ensure the safety of tap water and promote its use among residents for the purpose of drinking water.

2. Reconfirming the operation method of pumps at distribution reservoirs: If KWASA conducts a survey with tap water users as recommended above and finds that water supply is intermittent, it will need to improve water supply so that there is no interruptions in supply, in order to prevent pollution within the water pipes. It is recommended that KWASA reconfirms the operation method of pumps according to the design of the facilities provided through this project, and make corrections as necessary if there are any discrepancies between the design and current conditions.
3. Considering measures to address saltwater intrusion, including increasing the capacity of impounding reservoir: In this project, impounding reservoir to store surface water (raw water) was constructed as a means to address saltwater intrusion caused by climate change. The anticipated water management plan was to 1. use impounding reservoir to temporarily retain raw water during the rainy season, which has low chloride ion concentration, and to 2. use the retained water to dilute raw water during the dry season, which has high chloride ion concentration, in order to improve the water quality and keep the concentration within limits (1,000mg/L). According to the data provided by the executing agency, due to the extremely low precipitation during the 2020 and 2021 dry season which runs from mid-April to mid-June (after the project completion date), the chloride ion concentration at the water intake location of the river continued to largely exceed limits.

   Currently, even in circumstances where the low capacity of the impounding reservoir do not allow the water management plan to be implemented properly, KWASA pumps the water from the intake facilities through impounding reservoir to the treatment plant, in order to keep the chloride concentration level of the raw water as low as possible. For this reason, if the chloride concentration of the raw water remains at a level that exceeds the limit for a prolonged period, the chloride concentration of the treated water can also exceed limits. In order to improve this situation, it is recommended that KWASA re-estimates the necessary capacity of impounding reservoir, and take measures such as increasing the capacity of existing impounding reservoir or constructing new impounding reservoir along the route of transmission pipes.

4.2.2 Recommendations to JICA

None.

4.3 Lessons Learned

Designing impounding reservoir with consideration to climate change impacts: In this project, impounding reservoir to store surface water (raw water) was constructed as a means to address saltwater intrusion caused by climate change. The scale of impounding reservoir was planned based on the JICA test results of chloride ion concentration at the location of water intake, which was conducted in the dry season of 2010 (March 1 to June 5), during which period the chloride ion concentration exceeded the limit (1,000mg/L) for 15 days. The impounding reservoir would have been capable of handling saltwater intrusion equivalent to that of 2010. However, after the project completion, there have been years where the chloride ion concentration exceeded the limit for a considerably longer period than 15 days. In these circumstances, it is safe to assume that the capacity of the impounding reservoir is insufficient. JICA should have planned and designed the scale of the impounding reservoir with consideration to the future climate change impacts. In addition, JICA also should have prepared a detailed plan for addressing the potential necessity of increasing the capacity of impounding reservoir in the future.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

None.

5.2 Additionality

The Managing Director of KWASA attended the 3rd and 4th Executive Forum for Enhancing Sustainability of Urban Water Service in Asian Region, which were held in 2014 and 2017 respectively, and discussed ideals for water supply in low-income communities and business plans with executives of water businesses who gathered from countries across Asia. KWASA was able to obtain the opportunity to attend these occasions for raising awareness for water related issues by partnering with JICA.

(End)

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1. Project Outputs	JICA's financing portion Intake: 110,000 m^3/day Transmission pipe: φ1,350 mm、L = 33km Impounding reservoir: 775,200 m^3 Water treatment plant: 110,000 m^3/day	JICA's financing portion Intake: 129,600 m^3/day Transmission pipe: φ1,400 mm、L=33 km Impounding reservoir: 775,200 m^3 Water treatment plant: 110,000 m^3/day
	ADB's financing portion Water supply pipes: φ300-1100 mm, L = 25 km Distribution reservoirs: 5 locations in total Elevated water tank: 11 locations in total Water distribution network: φ50-400 mm, L = 700 km Number of water supply connections: 50,019 connections (including existing installations)	ADB's financing portion Water supply pipes: φ300-1100 mm, L = 45 km Distribution reservoirs: 7 locations in total Elevated water tank: 10 locations in total Water distribution network: φ50-400 mm, L = 663 km Number of water supply connections: Approx. 40,000 connections (including existing installations)
2. Project Period	May 2011 - December 2017 (80 months)	May 2011 - June 2019 (98 months)
3. Project Cost Amount Paid in Foreign Currency Amount Paid in Local Currency Total ODA Loan Portion Exchange Rate	16,223 million yen 14,859 million yen (12,080 million BDT) 31,082 million yen 15,729 million yen 1 BDT = 1.23 yen (As of November 2010)	17,476 million yen 18,301 million yen (13,394 million BDT) 35,777 million yen 15,406 million yen 1 BDT = 1.29 yen (Average from 2012 to 2019)
4. Final Disbursement	August 2021	