Republic of the Philippines

FY2019 Ex-Post Evaluation of Japanese Grant Aid Project

"Project for Improvement of Water Supply System in Metro Cebu Water District"

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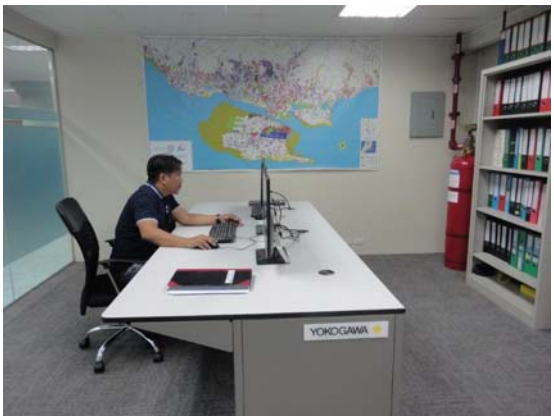
0. Summary

This project introduced the Supervisory Control And Data Acquisition (hereinafter referred to as "SCADA") system to monitor the water supply condition accurately almost in real time and to establish an appropriate operation management system for water supply facilities in the Metropolitan Cebu Water District (hereinafter referred to as "MCWD") water supply service area, thereby contributing to the improvement of water supply in the target area. This project, which aims to reduce water leakage, monitor operating status of pumps, and improve shortage of water volume and pressure from water taps, is consistent with the Philippines' development policy, development needs and Japan's assistance policy at the time of planning and the ex-post evaluation. Therefore, the relevance of the project is high. In terms of project implementation, although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair. As for project effects, actual figures of operation indicators set at the time of planning are on the decline and are below the targets. Although the introduction of the SCADA system is improving the work and efficiency of daily operations of the staff in charge of operation and maintenance in the field, and that this project has produced certain effects, effectiveness and impacts of the project is fair when comprehensively judged based on the results of interviews with local residents and the content of complaints received by the MCWD. No negative impacts on natural environment and resettlement have been reported. Regarding operation and maintenance, some problems have been observed in terms of the current status. Therefore, sustainability of the project effects is fair.

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

1. Project Description

Project Location



SCADA Room inside the MCWD Main Office

1.1 Background

Metropolitan Cebu, located in the central part of the Philippines, is the second largest metropolitan area in the Philippines comprising 7 cities including Cebu City and 6 municipalities in the province of Cebu. With a rapid rise in population and urbanization, Metro Cebu has faced a number of urban problems. Basic urban infrastructure facilities for providing water, sewage drainage, waste, transportation, energy and other such services have been weak, and as such have become major impediments to economic and urban development in Metro Cebu. In Metro Cebu, the MCWD, which is a public water utility, is responsible for water supply service in 4 cities and 4 municipalities, which is the largest water supply service area in the Philippines. But the MCWD has faced challenges – 24-hour water supply was not achieved in some areas, and problems such as inadequate water pressure and high non-revenue water rate of 27.6%[1] as of 2012 were the issues to be tackled. In addition, although the MCWD has been considering expanding the water supply service area and increasing the water volume to meet the needs of the recent population increase and to develop Metro Cebu as a regional economic base, the groundwater resources that provide 96%[2] of water sources were nearly completely utilized, considering the amount of groundwater recharge and the risk of salination. So, efficient water supply was necessary. Therefore, there was an urgent need to improve the MCWD's water supply service.

[1] Information from the materials provided by JICA.
[2] Ibid.

1.2 Project Outline

The objective of this project is to develop a system to monitor the water supply condition accurately almost in real time and to establish an appropriate operation management system for water supply facilities by introducing the SCADA system in the MCWD water supply service area, thereby contributing to the improvement of water supply situation in the target area.

Grant Limit / Actual Grant Amount	1,165 million yen / 1,020 million yen
Exchange of Notes Date / Grant Agreement Date	March 2014 / April 2014
Executing Agency	Metropolitan Cebu Water District: MCWD
Project Completion	September 2016
Target Area	Water supply service area by the MCWD (700 km^2)
Main Contractors	Hitachi, Ltd. / Yokogawa Solution Service Corporation (JV)
Main Consultants	NJS Consultants Co., Ltd. / Yokohama Water Co., Ltd. (JV)
Preparatory Survey	June 2013 – March 2014
Related Projects	- Development survey "The Study for Improvement of Water Supply and Sanitation in Metro Cebu" (January 2019 – August 2010) - Technical Assistance Program Related to ODA loan "Technical Assistance Project on Water Supply Operation and Management for Metro Cebu Water District" (March 2012 – March 2013)

2. Outline of the Evaluation Study

2.1 External Evaluator

Masumi Shimamura, Mitsubishi UFJ Research and Consulting Co., Ltd.

2.2 Duration of Evaluation Study

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

Duration of the Study: August 2019 – September 2020

Duration of the Field Study: November 2 – 16, 2019, February 16 – 22, 2020

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

3.1 Relevance (Rating: ③[4])

3.1.1 Consistency with the Development Plan of the Philippines

At the time of planning, the Philippine government's *Philippine Development Plan (2011-2016)* emphasized as priority to strengthen the capacity of central and local governments to supply water and to utilize sustainable water resources, and to carry out initiatives for equitable water supply at economic growth areas. In addition, local capacity building for reliable water supply was stated as a priority program in *the Philippine Water Supply Sector Road Map (2008)*. Furthermore, the MCWD has set goals of achieving 24-hour water supply in all water supply service areas, reducing non-revenue water rates, and improving water supply pressure and water quality in *the 2020 Plan* (prepared in 2011).

At the time of the ex-post evaluation, the Philippine government's *Philippine Development Plan (2017-2022)* promotes investment to reform institutions related to water supply. In addition, enhancement of water supply capacity and expansion of safe water supply areas are regarded as urgent projects in *the Metro Cebu Vision 2050*. The MCWD's *2020 Plan* (revised in 2018), has not changed its corporate direction. Thus, the implementation of the project is consistent with the development policy of the Philippines at the time of the ex-post evaluation as well.

3.1.2 Consistency with the Development Needs of the Philippines

At the time of planning, 24-hour water supply was not realized in some area of the MCWD's water supply service area, and insufficient water pressure and high non-revenue water rates were the issues to be tackled. Also, it was necessary to improve the MCWD's water supply services, including enhancement of efficient water supply.

At the time of the ex-post evaluation, stable supply of water by the MCWD is still in high demand for socio-economic activities of residents. However, 24-hour water supply has not been realized, and insufficient water pressure has been pointed out. Also, as shown in Table 1, population in the MCWD water supply service area is increasing by an average of about 2% per year, but the MCWD's water supplied population ratio[5] in its service area is about 40% of the population. Furthermore, as shown in Table 2, the ratio of the MCWD's billed water volume[6] to the average daily water demand[7] in the MCWD water supply service area is less

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[4] ③: High, ②: Fair, ①: Low
[5] The MCWD's water supplied population ratio is the ratio of the population served by the MCWD to the population of the MCWD water supply service area.
[6] Billed water volume is the total amount of metered water.
[7] Average daily water demand is an estimated volume calculated by the MCWD based on the demand forecast.

than 40%. Although water shortages are covered by private water distribution companies[8], private wells, water tank trucks, and use of rivers, the MCWD is expected to expand its water supply as demand continues to grow. From the above, development needs for the project is still maintained at the time of the ex-post evaluation.

Table 1: Population, Water Supplied Population and Water Supplied Population Ratio in the MCWD Water Supply Service Area

	2014	2015	2016	2017	2018
Population in the MCWD water supply service area (person) Note1)	2,232,892	2,278,913	2,328,032	2,377,126	2,426,148
The MCWD's water supplied population (person) Note 2)	859,345	904,156	934,381	975,058	1,002,318
The MCWD's water supplied population ratio in its service area (%) Note 3)	38%	40%	40%	41%	41%

Source: Results from questionnaire survey of the MCWD

Note 1) The MCWD's water supply service area covers 4 cities and 4 municipalities – Cebu City, Lapu Lapu City, Mandaue City, Talisay City, Municipality of Compostela, Municipality of Consolacion, Municipality of Cordova and Municipality of Liloan.

Note 2) In addition to the MCWD, private water distribution companies supply water to the MCWD water supply service area.

Note 3) The MCWD's water supplied population ratio in its service area = MCWD's water supplied population / Population in the MCWD water supply service area.

[8] 5 private companies (ABEJO, Mactan Rock, FOREMOST, BC HOMES, PWRI) are undertaking water supply business. These companies are operating in areas where the MCWD water supply and distribution network is not in place, such as in the mountains and sloping areas, because of the costs involved in developing the MCWD water source and connecting water pipes.

Table 2: The MCWD's Daily Average Water Supply Volume and Average Daily Water Demand in the MCWD Water Supply Service Area

	2014	2015	2016	2017	2018
The MCWD's daily average water supply volume (m^3/day)	201,267	212,722	214,095	223,806	232,971
Of which, billed volume (m^3/day)	157,118	162,627	164,525	166,766	173,951
Average daily water demand in the MCWD water supply service area (m^3/day)	407,263	414,845	422,344	429,906	437,529
Ratio of billed water volume to the average daily water demand in the MCWD water supply service area Note 1)	38.6%	39.2%	39.0%	38.8%	39.8%

Source: Results from questionnaire survey of the MCWD

Note 1) Billed Volume / Average daily water demand in the MCWD water supply service area.

3.1.3 Consistency with Japan's ODA Policy

At the time of project planning, Japan's *Country Assistance Program for the Philippines (April 2012)* placed "sustainable economic growth through investment promotion" as the important development goal and indicated its support for the development of infrastructure such as the water environment for the enhancement of regional bases as "infrastructure development program for local base development." The purpose of the project is to improve water supply situation in the water supply service area by the MCWD, which is consistent with the above policy.

3.1.4 Appropriateness of the Project Plan and Approach

As mentioned later in "3.3 Effectiveness and Impacts," actual figures of operation indicators set at the time of planning are on the decline and are below the targets. The reasons behind this can be regarded that unexpected situation caused malfunction of the facilities and equipment developed by the project. Specifically, unstable power supply by the local power company, internet connection problems in some areas, and water quality problems in some wells are pointed out. However, surveys were conducted on electricity, communication and water quality situations, and no problems were expected at the time of planning.

According to the survey at the time of planning, regarding the electric power situation in Metro Cebu, the voltage fluctuation was within ±10%. Based on the past power outage time of the MCWD, the survey results concluded that there was no problem with voltage changes

that occur during off peak usage. As described later in "3.3.1.1 Quantitative Effects (Operation and Effect Indicators)," given that the DC/AC inverters (electric power converters) themselves, which were procured as an additional scope during the project after the individual commissioning of well pump stations, began to malfunction before project completion, it can be considered that this was an unexpected problem. Regarding communication situation, at the time of the survey, interviews with two mobile phone companies available in Metro Cebu were conducted. Although the internet environment expected at the time of planning was 3G, the survey report did not mention that internet environment in some areas (mountainous areas) in Compostela was 2G. However, it was limited to 2 (2% of the total) of the whole (126 distribution monitoring points). The MCWD negotiated with the mobile phone company when it found problems with the internet connection. Regarding water quality, the main aquifers in the areas around Cebu were confirmed during the survey, and 1 Talamban well where a defect occurred was less than 1% of the total (126) wells.

In addition, after the project, problems with water volume and water pressure from the taps are continuing at the time of the ex-post evaluation. This is due to lack of rainfall as an effect of the El Niño phenomenon that occurred in the fourth quarter of 2018. Specifically, while the demand for tap water is increasing, the MCWD's water production volume is decreasing due to decreased water volume in water sources and shortages of water sources. It can be considered that the effects of such serious water shortages were not expected at the time of planning.

This project has been highly relevant to the country's development plan and development needs, as well as Japan's ODA policy. In addition, there were no major problems regarding appropriateness of the project plan and approach. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

This project introduced the SCADA system in the MCWD water supply service area to develop a system to monitor the water supply condition accurately almost in real time and to establish an appropriate operation management system for water supply facilities. Table 3 compares the planned and actual outputs of major outputs.

Table 3: Comparison of Planned and Actual Outputs

Facility Construction and Procurement of Equipment Note 1)		
Plan		Actual / Comparison
Item	Quantity	
Central monitoring system (MCWD Main Office)	1 set	As planned
SCADA Client (Talamban Satellite Office)	1 set	As planned
Tisa Reservoir monitor (Flow)	1	As planned
Talamban Reservoir monitor (Flow)	1	As planned
Casili Reservoir monitor (Flow)	1	As planned
B.C. Homes Reservoir monitor (Level)	1	As planned
Lagtang Reservoir monitor (Flow)	1	As planned
Liloan Reservoir monitor (Flow)	1	As planned
Compostela Reservoir monitor (Level)	1	As planned
Well pump station monitor (Flow)	53	As planned
DMA (District Metered Area) monitor (Flow)	55	As planned
Low pressure point monitor	15	As planned
Transmission line monitor (New Bridge Line)	1	As planned
Transmission line monitor (Old Bridge Line)	1	As planned
Buhisan dam monitor (Level)	1	As planned
Purchased water monitor (Flow)	10	As planned
Consulting Services		
Item		Actual / Comparison
Detailed design, tendering assistance, construction supervision		As planned
Capacity building program (soft component): transfer of technology on operation management system to SCADA system administrators		As planned

Source: Results from questionnaire survey of the MCWD

Note 1) The initial operation instructions (technology transfer regarding how to use the equipment – during normal operations and how to deal with errors etc.) were carried out by the contractor as planned.

The initially planned facility construction, installation of equipment (including instructions for initial operation of equipment) and consulting services (including capacity building program [soft component]) were implemented as planned, and there were no particular changes.

As the outputs that were not expected at the time of planning, additional 60 units of DC/AC inverters (electric power converters) were procured and installed. This was conducted as a

countermeasure against equipment damages that occurred during the commissioning. It was due to the unstable power supply (voltage fluctuation etc.) by the local power company, and it was a necessary measure to prevent further damage to the equipment.

Design changes took place from the time of the outline design – change of diameter of flow meters, change and addition of non-suspension construction, change of connection piping inside facilities, change of installation location of flow meters, and change of water level gauge model, etc. They were necessary changes because adjustments were made at the time of the detailed design, taking into account the connection with existing pipes and the actual conditions at the site.

As a result of interviews with the MCWD and the project consultants, all the tasks to be undertaken by the Philippines side on matters necessary for the project implementation, such as designation of the department in charge of the SCADA operation, securing of appropriate personnel, advance notice of construction and implementation and public relations activities, have been duly implemented without any problems.

SCADA Client in Talamban Satellite Office

Well Pump Station Electro-Magnetic Flow Meter, PLC Board

Reservoir

Flow Meter

3.2.2 Project Inputs

3.2.2.1 Project Cost

While the total project cost was initially planned to be 1,310 million yen, the actual cost was 1,123 million yen, which is within the plan (86% of the planned amount). This includes the cost of 60 units of additional output of DC/AC inverters (power converters). Of the total project cost, the government of the Philippines disbursed 103 million yen which is within the plan (140 million yen).

Pressure Sensor at Water Pressure Monitoring Point

3.2.2.2 Project Period

While the overall project period was planned as 24 months – from April 2014 (signing of Grant Agreement) to March 2016 (completion of construction), the actual period was 30 months – from April 2014 (signing of Grant Agreement) to September 2016 (completion of construction), which is longer than planned (125% of the initial plan). Table 4 summarizes the comparison of planned and actual project period.

Table 4: Comparison of Planned and Actual Project Period

Plan	Actual
April 2014 – March 2016 (24 months)	April 2014 – September 2016 (30 months)
Breakdown: Detailed Design and Tendering Period	
October 2014 – April 2015 (7 months)	July 2014 – May 2015 (11 months)
Breakdown: Construction	
May 2015 – March 2016 (11 months)	July 2015 – September 2016 (15 months)

Source: Information provided by JICA and results from questionnaire survey of the MCWD

Note 1) The definition of project completion is at the time of completion of construction. Project period does not include warranty period for both plan and actual.

Main reasons for project delay were (1) delay in detailed design, etc. and (2) delay in construction work. Regarding (1), project was delayed because of design changes which took time to modify the bid documents. As a result, start of bid was delayed. Regarding (2), in addition to the time required for the transportation of additional non-suspension construction materials from Japan and customs clearance at the port, additional time for procurement and installation of DC/AC inverters which were not originally planned delayed the project.

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

3.3 Effectiveness and Impacts[9] (Rating: ②)

3.3.1 Effectiveness

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

At the time of planning, "increase in real-time monitoring points (for water flow and pressure)", "number of remote controlled well pump stations" and "improvement in monitoring frequency (flow)" were set as quantitative effects of the project. Table 5 summarizes baseline, target and actual figures between 2017 and 2019 for each indicator. As the project completion is September 2016, the target year to be compared is 2019, 3 years after completion.

Table 5: Quantitative Effects of the Project

Indicators	Baseline	Target	Actual		
	2013	2019 3 Years After Completion	2017 1 Year After Completion	2018 2 Years After Completion	2019 3 Years After Completion
Operation Indicators					
Increase in real-time monitoring points (for water flow and pressure)	0 point	Flow: 126 points Pressure: 125 points	Flow:123 points Pressure:122 points	Flow: 114 points Pressure: 108 points	Flow: 107 points Pressure: 95 points
Number of remote controlled well pump stations	0 station	53 stations	50 stations	41 stations	34 stations
Effect Indicator					
Improvement in monitoring frequency (flow)	Once every month	Once every hour	- Well pump stations: Once every hour - DMA inflow points: Once a day		
Additional Indicator (Reference Figures)					
Non-Revenue Water Rate	—	—	25.49%	25.33%	23.85%

Source: Information provided by JICA and results from questionnaire survey of the MCWD

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

As regards the operation indicator "increase in real-time monitoring points (for water flow and pressure)", figures have been decreasing year by year after the completion of the project, and the actual figures in 2019 are below the targets at 107 points (flow) and 95 points (pressure). (Achievement rates are 85% and 76% of the targets, respectively.) According to the MCWD, the reason why both flow points and pressure points have already fallen below the 2019 targets (126 points, 125 points) by 3 points each in 2017 is that as described previously in "3.1.4 Appropriateness of the Project Plan and Approach", there was a weak internet connection at 2 monitoring points in Compostela and the shutdown of 1 well in Talamban due to water quality problem rendered the equipment unoperational.

The number of "remote controlled well pump stations", which is an operation indicator, has been decreasing year after year since the project was completed, and the actual figure in 2019 is 34 stations, which is below the target. (Achievement rate is 64% of the target.) The reason why the number of remote controlled well pump stations has fallen below the 2019 target (53 stations) by 3 stations in 2017 is due to the premature malfunctioning of the devices which was not expected.

The fact that the actual figures of the above-mentioned operation indicators are on the decline and below the target values is due to the occurrence of defects of the facilities and equipment developed by the project. Specifically, there are the problems shown in Table 6.

Table 6: Background of Unachieved Targets for the Operation Indicators

Indicators	Problems
Decrease in monitoring points (flow)	Due to defective flow meter and water level gauge sensors, power supply unit and DC/AC inverters.
Decrease in remote controlled well pump stations	
Decrease in monitoring points (pressure)	Due to defective pressure gauges.

Source: Results from questionnaire survey of the MCWD

The causes of equipment malfunctions are listed in Table 7 below. As described above in "3.2.1 Project Outputs," DC/AC inverters were procured and installed as additional outputs to prevent damage to equipment that occurred during the commissioning, however they also caused defects. The MCWD has pointed out that unstable local power supply may have shortened the life of the equipment.

Table 7: Reasons for Defective Equipment

Defects	Reasons
Defective flow meter and water level gauge sensors	Malfunctioned equipment due to the effect of water quality (high content of minerals).
Defective power supply unit and DC/AC inverters	Problems due to unstable power supply (voltage fluctuation, etc.) from the local power company.
Defective pressure gauges	Stolen pressure sensor in Talamban.

Source: Results from questionnaire survey of the MCWD

The effect indicator "monitoring frequency (flow)" has maintained hourly monitoring frequency at well pump stations and once a day at the DMA inflow points for each year from 2017 to 2019. Although it was not possible to confirm from the existing information and interviews with the MCWD, which point was assumed at the time of planning, the target has been achieved if it was assumed to be the well pump stations.

As an additional indicator, "non-revenue water rate" was set at the time of the ex-post evaluation, and analysis was made as reference figures. The "non-revenue water rates" obtained from the MCWD have been declining year by year, and the actual figure in 2019 is 23.85%. In its corporate plan, the MCWD has set the goal of reducing non-revenue water rate to 23% by 2020. As described below in "(3) Contribution to the MCWD management improvement by reducing non-revenue water rate" in "3.3.1.2 Qualitative Effects (Other Effects)," the MCWD aims to further reduce the figures by developing a system to monitor water supply condition almost in real time and to establish an appropriate operation management system.

3.3.1.2 Qualitative Effects (Other Effects)

As qualitative effects of the project, it was expected that (1) improvement of water volume and water pressure shortage from the taps, (2) decrease in the number of complaints, and (3) contribution to the MCWD management improvement by reducing non-revenue water rate would be realized.

(1) Improvement of water volume and water pressure shortage from the taps

An interview survey was conducted with 15 local residents[10] during the project site survey. There were various responses, and 6 out of 15 residents (40%) responded that they

[10] The interviewees consisted of 5 men (2 in 30s, 2 in 50s, and 1 in 60s) and 10 women (2 in 30s, 2 in 40s, 2 in 50s, and 4 in 60s), with the total of 15 people. Locations were: 12 people in Cebu City (including 2 people in the mountains and slope areas), 2 in Compostela Municipality, and 1 in Liloan City. Occupations include store owners (selling miscellaneous goods and groceries), restaurant owners, water station owner, driver, livestock farmer (pig raising), housewives, etc.

were satisfied with the water supply service of the MCWD. Of the 15 local residents, 4 has been receiving water supply from the MCWD since before the project, and of which 3 had no problem with water volume and water pressure in the past but pointed out that they encounter problems now. There were 11 residents[11] who had used well water before the project, but now receiving water supply from the MCWD. Of these, only 3 residents responded that there was no problem in both water volume and water pressure and the remaining 8 replied that there are problems. (2 out of 8 residents are living in the mountains and sloping area where water pressure was low before the project.) Since the sample size of the interviewees is extremely limited, it is not appropriate to generalize, but what could be understood within the range of the interview is that residents other than those (2 people) living in the mountains and sloping areas, which are considered to have trouble with water supply due to water pressure problem, are also complaining. In other words, complaints were heard from residents regardless of where they live.

(2) Decrease in the number of complaints

Table 8 shows the number of complaints (cumulative total number) received by the MCWD. For reference, the number of the MCWD customers (number of water supply service contracts) is shown in Table 9. The number of complaints in 2019 is much higher than that in 2017 and 2018. According to the MCWD, due to the El Niño phenomenon that occurred in the fourth quarter of 2018, the amount of rainfall decreased, and water shortage became serious in 2019, and it turned out that the number of complaints in 2019 was larger than the previous year. According to the MCWD, major complaints were shortage of water supply volume and insufficient water pressure[12], all of which are consistent with the findings obtained from the interviews with local residents.

[11] Note that these residents did not decide to get water service from the MCWD as a result of the project.

[12] The contents and ratio of the top 5 complaints in each year are as follows. (Source: Materials provided by the MCWD)

- 2017: 1. Water leakage in water supply and distribution pipes (23.54%), 2. Water meter failure (22.30%), 3. Trace up high* (17.94%), 4. Trace up low * (11.48%), 5. Insufficient water pressure/water volume (5.55%)
- 2018: 1. Water leakage in water supply and distribution pipes (24.76%), 2. Trace up high (20.45%), 3. Water meter failure (20.15%), 4. Trace up low (7.27%), 5. Insufficient water pressure/water volume (5.33%)
- 2019: 1. Trace up low (29.83%), 2. Water leakage in water supply and distribution pipes (16.83%), 3. Water meter failure (15.43%), 4. Trace up high (13.13%), 5. Insufficient water pressure/water volume (5.43%)

*Trace up high: When the actual usage is high due to water leakage between the water meter and the tap.
Trace up low: When the actual water usage is low due to a water meter failure or water theft in the water distribution pipe.

For each year, number of complaints regarding insufficient water pressure/water volume is the fifth, with the number of complaints being 2,658 (2017), 2,552 (2018) and 3,735 (2019). (The figure for 2018 is rounded, so the number does not match.)

Table 8: Number of Complaints (Cumulative Total Number) (Breakdown by Districts)

	2017	2018	2019
Cebu City	25,173	25,329	35,662
Lapu Lapu City	4,818	4,793	7,062
Mandaue City	8,205	7,967	11,946
Talisay City	3,119	3,304	4,279
Municipality of Compostela	349	325	380
Municipality of Consolacion	2,684	2,769	4,076
Municipality of Cordova	906	763	1,202
Municipality of Liloan	2,646	2,599	4,182
Total	47,900	47,849	68,789

Source: Information provided by the MCWD.

Note 1) Since the number of complaints is the total number, even if the same person makes several complaints, the number of complaints is counted.

Table 9: Number of MCWD Customers (Number of Water Supply Service Contracts)

2017	2018	2019
185,801	193,239	198,157

Source: Information provided by the MCWD.

Note 1) The number of customers as of December in each year.

According to the MCWD, behind the severe water supply situation are, in addition to water shortage due to decrease in rainfall as an effect of El Niño phenomenon, salination of groundwater, decrease in groundwater recharge, and decrease in water production due to deterioration of water quality of water sources as a result of population increase. It is necessary to develop new water sources to solve the fundamental problem, and the MCWD has a plan to develop new groundwater sources mainly in the mountainous area where water pressure is low in Cebu City, where water supply population is the largest.

(3) Contribution to the MCWD management improvement by reducing non-revenue water rate

As shown as a reference information in Table 5, non-revenue water rates are declining year by year, and the actual figure for 2019 is 23.85%. The MCWD is working to reduce non-revenue water rate by using the SCADA system, and the MCWD has pointed out that after the introduction of the SCADA, remote monitoring of water volume and water pressure was realized, and it became possible to shorten the response time when problems

occurred. Specifically, regarding water flow, before the introduction of the SCADA, it was necessary for the staff in charge of operation and maintenance to directly check on-site in order to grasp the operation status of the well pumps. Since they are scattered in 8 local governments (LGUs), it took time and labor to move to the site and confirm the situation. However, after the introduction of the SCADA, it became possible to identify problems in well pumps remotely from the SCADA room inside the MCWD main office in almost real time. For this reason, the MCWD uses the SCADA system to optimize water production volume of each well. For example, when water flow is decreasing, the staff in charge of operation and maintenance can be promptly dispatched to the well with problems to check the conditions of the pump and do the repair. Regarding water pressure, low pressure points and the DMA inflow points are monitored once a day using the SCADA system, and based on the data from the SCADA system, water pressure and water volume at the DMA inflow points are adjusted and optimized. For example, if there is a considerable water pressure in a certain area, the SCADA system is used to control water pressure by diverting extra water volume to other low-pressure areas through manual manipulation in the field. In this way, introduction of the SCADA has significantly reduced the response time and work load of the staff in charge of operation and maintenance when problems occur, and made their work more efficient, which also contributes to the reduction of non-revenue water rate. The MCWD plans to 1) develop a system that can monitor, control, and analyze the SCADA operations 24 hours a day, 2) increase the number of staff in the Non Revenue Water Management Division (a plan to increase 12 staff), 3) introduce the SCADA system to all water distribution networks in the next 4 years (2020-2023), and 4) develop a new software system[13] linked with the SCADA system to identify leak, etc. in order to develop a system to reduce non-revenue water rate, and aims to further improve management and water supply service.

According to the MCWD, the SCADA system introduced by the project covers the water supply service area of the MCWD and 35.57%[14] of production facilities. As

[13] According to the MCWD, the SCADA system introduced by the project must be working properly for the new software system to function.

[14] According to the MCWD, calculation basis for the SCADA system coverage is as follows. (Calculation is made based on the number of flow monitors installed in the well pumps.)

- Number of the MCWD's inhouse wells: 132.
- Number of wells for bulk water from private companies from which the MCWD receives water: 17
- From the above, the number of wells in the water supply service area by the MCWD is 132+17=149.
- Thus, the SCADA coverage is 53/149=35.57%.

※ There are 53 well pumps with flow monitors installed by the project.

However, since the produced water volume varies depending on the wells, it is more appropriate to calculate the coverage by the ratio of the flow volume of wells in which the SCADA is introduced, which is 22.98%. (Flow volume of wells where the SCADA is installed is 51,696m^3, and the total flow volume is 225,000m^3, thus 51,696/225,000=22.98%.) Although the SCADA system not only monitors flow volume but also water pressure, etc., the coverage shown here is calculated by the flow volume for convenience.

described above, it can be considered that the frequent occurrence of malfunctions of facilities and equipment due to unstable power supply and shortage of water sources are hampering the effects of the project.

From the above, when taking into consideration the actual figures of operation indicators are on the decline and are below the targets, as well as considering the results of interviews with local residents around the project sites, the contents of complaints received by the MCWD, and improvement of efficiency of daily operations of staff in charge of operation and maintenance in the field by introducing the SCADA, it is considered that the effects of the project have been achieved to a certain degree when comprehensively judged.

3.3.2 Impacts

3.3.2.1 Intended Impacts

Although "the improvement of water supply in the target area" was indicated as the project impact, it was unclear by what exactly this should be achieved. For this reason, at the time of the ex-post evaluation, the impact indicator (underlined part) was set with the following logic [15], after consultation and agreement with the MCWD, taking into consideration of the "qualitative effect" in the effectiveness.

"By monitoring flow volume and water pressure with the SCADA system introduced by the project, the MCWD can detect interruptions and leakages of water supply and shorten the reaction time when problems occur. In addition, the MCWD can turn on pumps remotely utilizing the SCADA system. As such, the MCWD can improve its operation and maintenance work. As a result, the MCWD can maintain appropriate water volume and

On the other hand, JICA has a different view from the MCWD. JICA considers that "the SCADA system covers almost all water supply service area of the MCWD." According to JICA, it is not necessary to install flow meters in all wells in order to grasp flow volume. JICA pointed out that flow volume covered by the SCADA system can be grasped if flow meters are installed at the water inflow point of the DMAs, confirming that there is no water inflow from other areas. JICA indicated that among all 58 DMAs under the control of the MCWD, inflow monitors have been installed at 55 points by the project, thus the SCADA system covers almost the entire water supply service area of the MCWD.
Based on the views of JICA, reconfirmation to the MCWD was made. According to the MCWD, inflow monitors installed to the DMAs by the project is utilized to monitor night flow, determine possible leaks and any irregular pressure. The MCWD responded that data of water flow at the inflow points of the DMAs cannot be provided. Moreover, the MCWD explained that on top of 55 DMA inflow monitors installed by the project, it aims to install additional 214 DMA monitors in the next 10 years. The MCWD pointed out that these additional DMA monitors would give them the capability to monitor flow and pressure all throughout the MCWD water supply service area. Based on the above explanations by both the MCWD and JICA, theoretically, as pointed out by JICA, the SCADA system covers almost all the water supply service areas of the MCWD, however, in actual operation by the MCWD, it seems that this is not the case. In other words, it can be considered that it is not possible to monitor water volume and water pressure of the entire water supply service area of the MCWD by the 53 well pump station flow monitors and the 55 DMA inflow monitors installed by the project.

[15] The effects shown in the logic do not cover all the effects of the SCADA. Since the impact indicators were set at the time of the ex-post evaluation retroactively, the effects highlight the current undertakings of the MCWD, which is not completely in conformity with JICA's recognition.

water pressure for 53 SCADA operated well pumps[16] in the MCWD water supply service area."

Table 10 summarizes the data of the MCWD organizational targets and actual figures of flow volume and water pressure in the MCWD water supply service area. Although flow volume achieved more than 90% of the MCWD organizational targets after the completion of the project since 2017, because they are figures at the water source level, they are not appropriate to be considered from the perspective of improvement of water supply situation in the target area. Therefore, the figures are provided as available references.[17]

Table 10: Organizational Targets and Actual Figures of Flow Volume and Water Pressure in the MCWD Water Supply Service Area

	2016		2017		2018		2019 Note 2)	
The MCWD organizational target and actual figures	Target	Actual	Target	Actual	Target	Actual	Target	Actual
The MCWD's daily average water supply volume (m^3/day) Note 3)	236,261	214,095 (91%)	237,005	223,806 (94%)	235,074	232,971 (99%)	235,172	223,841 (95%)
Production volume of the MCWD inhouse wells (m^3/day) Note 4)	170,891	149,334 (87%)	168,260	156,290 (93%)	167,941	161,195 (96%)	156,632	155,241 (99%)
Amount of water received (m^3/day) Note 5)	-	64,761	-	67,516	-	71,776	-	68,600
Average pressure (psi) Note 6)	10	11.59 (116%)	10	12.95 (130%)	10	12.97 (130%)	10	10 (100%)

Source: Data provided by the MCWD.

[16] As explained in footnote 14, the MCWD considers that the SCADA system introduced by the project covers a part of the water supply service area of the MCWD. The MCWD considers the SCADA coverage ratio is calculated by the number of flow monitors installed in the well pumps. Thus, flow volume and water pressure of 53 well pumps where the SCADA system has been installed (not the MCWD's entire water supply area) are targeted.

[17] The Preparatory Survey Report states that "the total supply amount per each DMA will be more accurately measured by adding up the outlet flow of the reservoirs and the intake of the well pumps that are directly connected to the system."

Note 1) Figures in parentheses in the table are achievement rates.

Note 2) According to the MCWD, the actual figures of the MCWD's daily average water supply volume, production volume of the MCWD inhouse wells, and average pressure in the MCWD water supply service area in 2019 are below the previous year's figures, respectively due to the El Niño phenomenon that occurred in the fourth quarter of 2018.

Note 3) The MCWD's daily average water supply volume = Production volume of the MCWD inhouse wells + Bulk water supply

Note 4) According to the MCWD, it is not possible to separate the data of 53 wells with the SCADA system out of 132 inhouse wells. Therefore, for the flow volume, targets and actual figures for 132 MCWD inhouse wells (which can be regarded as the most approximate figure in the available data) were compared.

Note 5) Number of wells for bulk water that the MCWD receives from private companies are 17 in total. No SCADA system has been installed in any of them.

Note 6) The unit is psi. (pounds per square inch). According to the MCWD, it is not possible to separate the average water pressure data only for areas where the SCADA system is installed. Therefore, targets and actual figures of average pressure in the entire the MCWD water supply service area were compared.

From the viewpoint of improving water supply situation in the target area, the average water pressure, which is an indicator that can be used for evaluation, has reached the organizational target, and it is considered that the SCADA system has had a certain contribution. On the other hand, considering the results of interviews with local residents and the contents of complaints described in "3.3.1.2 Qualitative Effects" above, on the water users' side, unlike the results (achievement status) of the MCWD's organizational targets, they take slightly stricter views. This is due to the fact that the effect of the El Niño phenomenon that occurred in the fourth quarter of 2018 (occurrence of serious water shortage due to decrease in rainfall) has continued up to the time of the ex-post evaluation, and it can be considered that the positive effects of the introduction of the SCADA system have been reduced by such effects. However, it is difficult to objectively verify to what extent these risk factors have negative impacts on the realization of the project effects.

3.3.2.2 Other Positive and Negative Impacts

(1) Impacts on the Natural Environment

This project was classified as Category C because it was determined in the *JICA Guidelines for Confirmation of Environmental and Social Considerations* (promulgated in April 2010) that undesirable impacts on the environment was minimal. Preparation of an Environmental Impact Assessment for the project was not required by the DENR (Department of Environment and Natural Resources). The MCWD has obtained prior permission from each related local governments (LGUs) for the construction. In addition, the MCWD has made prior notification and explained to the local residents that it will avoid

the burden on the environment during construction as much as possible.

According to the MCWD and project consultants, environmental monitoring (noise, vibration, soil and waste) during the project implementation has been carried out by visual observation, etc. In addition, as environmental mitigation measures, nighttime construction around residential areas were avoided, and noise-suppressing equipment was used, or manual excavation was carried out. As for the nighttime construction in front of stores, coordination with the stores was made in advance. Attention was made to minimize the use of transportation of construction materials (use of large trucks). As a result, no negative impact on the natural environment has been reported and no complaints have been received from the residents. Based on the interviews with the MCWD and local residents during project site survey, as well as the result of site inspection, it is considered that there is no major problem with the natural environment.

(2) Resettlement and Land Acquisition

Land acquisition and resettlement did not take place for the project. Regarding the construction site, it was found that part of the initially planned land was private lands, so the target site was changed to a public road.

(3) Other Impacts

The operation manuals developed under the soft component of the project were prepared through repeated discussions between Yokohama Water Co., Ltd.[18], the project consultant, and the MCWD in accordance with the "Water Safety Plan." The "*Water Safety Plan*" is a water quality management methodology advocated by the World Health Organization (WHO) and originally comes from the HACCP (Hazard Analysis and Critical Control Point) guidelines for food safety and hygiene management. The MCWD initially tried to refer to the guidelines of Yokohama City, but because it was complicated and did not match the actual situations of the MCWD, it decided to refer to the guidelines of international organizations while incorporating the knowledge of Yokohama City Waterworks Bureau. The completed guidelines are referred to and utilized in the daily work of the MCWD's SCADA monitoring, as described below in "3.4.2 Technical Aspect of Operation and Maintenance."

This project has achieved its objectives to some extent. Therefore, effectiveness and impacts of the project are fair.

[18] Yokohama Water Co., Ltd. is fully invested by Yokohama City Waterworks Bureau.

【BOX: Utilization and dissemination of know-how and technology possessed by Yokohama City/ Yokohama Water Co., Ltd.】

This project is a grant aid project in collaboration with Yokohama City, through the participation of Yokohama Water Co., Ltd., the project consultant in charge of capacity building program (soft component), and know-how and technology of the City's water supply service were utilized and disseminated.

Based on the comprehensive cooperation agreement signed with Yokohama City in 2011, JICA, with the cooperation of Yokohama City, conducted "*Survey on Information Collection and Confirmation for Sustainable Urban Development in Metro Cebu*" (2013). Prior to that, Yokohama Water Co., Ltd., wholly-owned by Yokohama City Waterworks Bureau, conducted "*Metro Cebu Water District Water Utility Current Status Confirmation Survey*" from February to March 2011. In addition to participating in the training in Japan conducted by JICA Yokohama, Yokohama Water Co., Ltd. has also supported the formulation of "*Mega Cebu Vision 2050,*" which is the medium to long-term vision of Cebu. Furthermore, the company has conducted "*Technical Assistance Project on Water Supply Operation and Management for Metro Cebu Water District*" (2012-2013: Technical Assistance Project Related to ODA Loan) for the MCWD to contribute to realize reducing the MCWD's non-revenue water rate and to provide 24-hour water supply. In other words, Yokohama City / Yokohama Water Co., Ltd. have already established good relationship with the MCWD through various supports before the implementation of the project, and the project was carried out building onto that good relationship. According to the interviews with the MCWD and Yokohama Water Co., Ltd., there was a feeling of camaraderie and things that could be shared with each other as the same water utility company, and there was always a partnership spirit of "let's work together" by understanding each other well. They've pointed out that there was a sense of harmony, and sometimes tensions were diminished, but that was also the flip side of the relationship of trust. In addition, the MCWD pointed out that there was a consciousness to actively learn and incorporate to the MCWD what is effective and functioning in the water supply service in Yokohama City. The MCWD also mentioned that sharing of knowledge about the water supply service in Yokohama City and learning about their best practices was very inspiring. For Yokohama Water Co., Ltd., it was pointed out that a series of cooperation with Cebu has contributed to the transfer of its know-how and technology backed by many years of experience and achievements and further deepening of trusting relationships, which is a very significant initiative.

3.4 Sustainability (Rating: ②)

3.4.1 Institutional / Organizational Aspect of Operation and Maintenance

Regarding the operational structure of the SCADA system, operation and maintenance of the facilities and equipment developed by the project is carried out by the MCWD's Production

Department and ICT Department. Production Department, which is the department with the primary responsibility, monitors and controls the flow volume and the pressure data sent from the field to the SCADA room, and when problems occur, the relevant division within Production Department cooperate and cooperate to conduct repairs in the field. When problems occur in the SCADA system, Production Department works with ICT Department to check and repair the system. The MCWD does not have a team dedicated to the SCADA, and as shown in Table 11, staff members who are also responsible for the SCADA operation and maintenance work are assigned to the existing departments and divisions.

Table 11: Staff Members in Charge of Operation and Maintenance of the SCADA System in the MCWD

The MCWD (Number of total staff members at the time of ex-post evaluation: 831)		
Production Department (Staff members who are also in charge of the SCADA are assigned in each Division)	Water Production Division	Of the 35 staff members, 4 members conduct the SCADA monitoring in the SCADA room, and 30 members undertake operation and maintenance of equipment in the field.
	Electro Mechanical Division	Of the 26 staff members, 12 members are in charge of maintenance of electrical equipment including the SCADA in the field.
	Water Distribution Division	Of the 47 staff members, 3 members conduct the SCADA monitoring in the SCADA room.
	Water Meter Maintenance Division	Of the 32 staff members, 4 members provide support for the SCADA system.
ICT Department (Responsible for both hardware and software maintenance of the SCADA)	System Application Division	Of the 7 staff members, 3 members are in charge of the SCADA system maintenance.
	System Development Division	Of the 8 staff members, 1 member is in charge of the SCADA system maintenance.

Source: Prepared based on the information provided by the MCWD.

Regarding the operation system of the SCADA room, the SCADA room (central monitoring system) is in the 4th floor of the MCWD main office. In addition, there is the SCADA Client (district monitoring system) in the Talamban satellite office. In the SCADA

room in the main office, daily monitoring and control are carried out in 2 shifts from 6 am to 10 pm. No staff is stationed in the SCADA room from 10 pm to 6 am and no night-time monitoring is conducted, but there is a system in place that the staff in charge will stand by at home and can promptly go to the SCADA room to respond to complaints, etc. from water users.

At the time of the ex-post evaluation, 7 staff members are taking turns and undertaking monitoring work while concurrently carrying out other work. The MCWD has a plan to increase the number of technical staff members in the future and will allocate 4 SCADA dedicated staff in 3 shifts to develop a system that can monitor, control and analyze 24 hours a day, including nighttime monitoring and flow analysis.

According to the MCWD, there are no particular problems with the current system, including the number of staff members, decision-making, and cooperation/coordination system of related departments/divisions. The MCWD organizational restructuring has been underway since 2019, and the organizational structure will be partially reorganized according to the guidance from the Local Water Utilities Administration (LWUA), but this will not affect the operation and maintenance system of the SCADA.

Regarding development of a system for decreasing non-revenue water rate, it is as described in "(3) Contribution to the MCWD management improvement by reducing non-revenue water rate" in "3.3.1.2 Qualitative Effects (Other Effects)" above.

From the above, no particular problem has been identified regarding the institutional/organizational aspect of operation and maintenance.

3.4.2 Technical Aspect of Operation and Maintenance

The staff in charge of operation and maintenance are those who have completed bachelor's degrees in civil engineering, mechanical engineering, electronic engineering, etc. or graduates of vocational schools. Staff members with highly specialized knowledge such as electricians, civil engineers, and electronics engineers certified by the Professional Regulation Commission, which is the government's quality assurance agency are deployed. All of them are technical staff who have accumulated sufficient technology and experience and are at a level sufficient to carry out ordinary operation and maintenance work.

The contractor of the project provided operation instruction on how to use the equipment. In addition, technical guidance on system operation management was provided in the capacity building program (soft component) of the project. (A total of 127 staff members took 365 hours of training between September 2015 and January 2019.) The contents of the training and guidance have been shared and utilized by other MCWD staff including the staff in charge of operation and maintenance in the field. In addition, the operation manuals prepared under the

soft component is always kept on the bookshelf in the SCADA room, and are referred and utilized for their daily work. According to the MCWD, it is not necessary to review and revise the operation manuals at the present moment. After the training, there were no new recruits in charge of the SCADA monitoring, and the trainees have been in charge of the monitoring work.

The staff in charge of operation and maintenance have deepened their understanding of the SCADA system since they attended the training. They are making efforts to improve efficiency of daily work and to respond promptly when problems occur through utilizing the SCADA system to improve water service and to reduce non-revenue water rate as described above in "(3) Contribution to the MCWD management improvement by reducing non-revenue water rate" in "3.3.1.2 Qualitative Effects (Other Effects)."

Therefore, the technical capacity of the staff seems to be sufficient to carry out usual operation and maintenance work, and no particular problem has been identified regarding the technical aspects of operation and maintenance.

3.4.3 Financial Aspect of Operation and Maintenance

The operation and maintenance costs of the SCADA system needs to be estimated by Financial Group of the MCWD and consulted with the Board to obtain approval. Table 12 shows budget (requested amount), actual allocation and actual expenditure of operation and maintenance cost of the SCADA system. The necessary amount of operation and maintenance cost has been secured, and no problem is observed at the time of the ex-post evaluation.

Table 12: Operation and Maintenance Cost of the SCADA System

(Unit: Thousand PHP)

	2016	2017	2018	2019
Budget (requested amount)	1,411.2	1,411.2	1,411.2	2,050.0
Actual allocation	1,411.2	1,411.2	1,411.2	2,050.0
Actual expenditure	0	1,200.0	1,440.0	2,050.0

Source: Results from questionnaire survey of the MCWD

Note 1) Operation and maintenance cost consists of mobile network, DSL subscription (internet connection), and system maintenance (updates of programs).

Note 2) There is no record of spending in 2016 because the SCADA utilized the MCWD's existing internet connection. However, the MCWD applied for separate internet connection specially for the SCADA from 2017 onwards, since internet connection for other MCWD operations were affected.

Note 3) Budget for the system has been increased in 2019 because 3 years have passed since the project was completed.

Table 13 shows the MCWD's water tariff revenue. From a comparison with the actual operation and maintenance expenditures in Table 12 above, the operation and maintenance costs of the SCADA system are fully covered by the water tariff revenue.

Table 13: MCWD's Water Tariff Revenue

(Unit: Thousand PHP)

2016	2017	2018	2019
1,666,960,851	1,711,501,260	1,810,933,063	1,819,752,633

Source: Results from questionnaire survey of the MCWD

According to the MCWD, as of December 2019, the number of the MCWD customers (number of water supply contracts) was 198,157 (see Table 9), and the tariff collection rate was high at 93-94%. Payment of water tariff can be made by cash or credit cards at shopping malls, convenience stores, post offices, etc., in addition to the payment counter established in the first floor of the MCWD main office. Since there are many choices of payment place and method, it is considered that the convenience is high for water users.

Water tariff is set for each category (household, commercial, government/public facilities, subdivision, and condominium) according to the size of diameter of the water pipe. For household use, the first 10m^3 (monthly) usage tariff is shown in Table 14. The water tariff is scheduled to be revised in 2020 and is expected to increase. The charge setup complies with the regulations of the Local Water Utilities Administration (LWUA) and is decided after conducting public hearings (meetings to explain to local residents, etc.) and the approval of the LWUA.

Table 14: Monthly Water Tariff for Households

Diameter of water pipe (inch)	Monthly Tariff (PHP)
1/2"	152.00
3/4"	243.20
1"	486.40
1～1/2"	1,216.00
2"	3,040.00
3"	5,472.00
4"	10,944.00
6"	18,240.00
8"	29,184.00
10"	41,952.00

Source: Information provided by the MCWD.

Table 15 shows the financial data of the MCWD. The MCWD does not receive subsidies from the central government or related local governments and operates the water utility with financially independent system. Looking at the financial data, both total income and total expenses are growing steadily, and the institution continues to be profitable.

Table 15: Financial Data of MCWD

(Unit: PHP)

	2016	2017	2018	2019
Service and Business Income (including Waterworks System Fee)	1,701,507,722	1,755,942,585	1,865,547,778	1,893,726,265
Other Income	19,461,570	22,211,181	98,342,994	81,920,682
Total Income	**1,720,969,292**	**1,778,153,766**	**1,963,890,772**	**1,975,646,946**
Personnel Services	521,569,443	529,786,335	569,094,603	580,110,688
Maintenance and Other Operating Expenses	747,231,532	816,952,494	832,125,620	914,613,741
Financial Expenses	36,384,924	30,525,481	37,773,744	29,877,343
Non-Cash Expenses	140,943,087	107,991,007	197,758,018	226,011,895
Total Expenses	**1,446,128,986**	**1,485,255,317**	**1,636,751,986**	**1,750,613,666**
Income before Tax	**274,840,306**	**292,898,449**	**327,138,786**	**225,033,280**
Income Tax Expenses	1,141,347	747,430	1,104,750	1,849,464
Income after Tax	**273,698,959**	**292,151,019**	**326,034,037**	**223,183,816**
Net Subsidy etc.	11,813,382	11,706,319	12,552,313	11,832,353
Net Income for the Period	**261,885,577**	**280,444,700**	**313,481,724**	**211,351,463**

Source: Prepared based on the MCWD Annual Report and the information provided by the MCWD.

Note 1) Partial inconsistency of figures exists due to rounding the number to the nearest integer.

Note 2) Non-Cash Expenses include depreciation expenses, etc.

From the above, no particular problem has been identified regarding the financial aspect of operation and maintenance.

3.4.4 Status of Operation and Maintenance

Table 16 shows the operating status of the facilities and equipment developed by the project. Many facilities and equipment are defective. Those that are operating as introduced are central monitoring system (SCADA room in the MCWD main office), SCADA client (in Talamban

satellite office), B.C. Homes reservoir monitor (level), Compostela reservoir monitor (level) and Buhisan dam monitor (level), and the others are not working, partially not working, or out of order. Purchased water monitors (flow) from water suppliers (10 sets) were procured collectively as planned in the project, but the input/output ports could not be installed since the existing device has already been used for connecting to other device, and there was no input/output port slots available for this equipment, and thus they have not been working since the completion of the project.

Table 16: Operating Status of Facilities and Equipment

Facilities and Equipment	Quantity	Operating Status
Central monitoring system (MCWD Main Office)	1 set	Working
SCADA Client (Talamban Satellite Office)	1 set	Working
Tisa Reservoir monitor (Flow)	1	Not working due to defective flow meter and water level sensor
Talamban Reservoir monitor (Flow)	1	Not working due to defective flow meter and water level sensor
Casili Reservoir monitor (Flow)	1	Not working due to defective flow meter and water level sensor
B.C. Homes Reservoir monitor (Level)	1	Working but reservoir cannot be filled because demand in the service area exceeds supply
Lagtang Reservoir monitor (Flow)	1	Not working due to defective flow meter and water level sensor
Liloan Reservoir monitor (Flow)	1	Not working due to defective flow meter and water level sensor
Compostela Reservoir monitor (Level)	1	Working
Well pump station monitor (Flow)	53	34 working
DMA monitor (Flow)	55	51 working
Low pressure point monitor	15	12 working (Problems are theft and destruction of water pressure related equipment, and damage due to typhoon)
Transmission line monitor (New Bridge Line)	1	Working but defective flow meter sensor
Transmission line monitor (Old Bridge Line)	1	Working but defective pressure sensor

Buhisan dam monitor (Level)	1	Working
Purchased water monitor (Flow)	10	None of them have been working since the completion of the project (while they were compatible with the SCADA system existing device, they could not be installed due to limited slots of the input/output ports)

Source: Results from questionnaire survey of the MCWD

Regarding the procurement of flow meter and water level sensors, power supply units, DC/AC inverters, etc., which are defective, it became clear at the time of the ex-post evaluation that prospect of their procurement was uncertain or that it would take a long time before it could be obtained, when inquired the MCWD[19]. (See also Table 7 for the cause of defects.) The MCWD has a stock of old mechanical (dial type) flow meters, and as a second-best measure (alternative means), the MCWD has replaced the defective meters with the mechanical ones to get flow data of the well pump station. Even if remote or real-time monitoring is not possible, the MCWD is checking water supply status manually or through field visits. However, the MCWD admitted that it is inevitable that the actual figures of the

[19] According to the MCWD, status of procurement for each equipment is as follows. Before the issues of undecided Board members occurred (*), it took time for the MCWD to check the equipment that was not working due to defects and detect the cause of failure, and to prepare budget plan necessary for procurement, and thus it was not possible to respond flexibly.

- Flow meter and water level sensors and flow meters: Both can be procured domestically. The MCWD's Board of Directors' approval is required because the procurement cost is 1 million PHP or above. However, there are a mountain of issues to be approved by the Board of Directors other than this, and no specific approval is expected at the time of the ex-post evaluation. (*) Following the change of the Mayor of Cebu City on June 30, 2019, the members of the Board of Directors have not been decided for a long time, and the procurement procedure was suspended. According to the MCWD, the Board members are decided through the Mayor's appointment, but due to various political backgrounds, the appointment was delayed, and 5 Board members were finally officially decided on February 17, 2020, which is about 8 months later.
- Power supply units: Domestic procurement is possible, and Board approval is not required. After the approval by the MCWD Finance Group, it will take 3-6 months to start procurement, and then the bidding process will take 3-5 months. Therefore, it will take about 1 year before the power supply unit can be obtained.
- DC/AC inverters: Board approval is not required. Since they cannot be procured domestically, the MCWD needs to place orders with a Japanese vendor and is looking for a domestic supplier that can mediate. The MCWD will be able to get a support from a candidate supplier to intermediate as a result of the fact that the JICA Philippines Office requested that supplier to intermediate the purchase of the DC/AC inverters, after the ex-post evaluation mission reported to the Office regarding the issue. However, procurement has not progressed due to the subsequent spread of the new Coronavirus worldwide, and there is no concrete prospect of procurement at the time of the ex-post evaluation.
- Data loggers: They can be procured domestically, and the MCWD has already purchased 50 sets, but they were not completely compatible with the SCADA system and could not be used as they are. As a result of the mission's report to the JICA Philippines Office at the time of the field survey of the ex-post evaluation, the Office contacted the contractor of the project, and the contractor mediated to support the SCADA system modification.
- Batteries: Board approval is not required. Since they cannot be procured domestically, the MCWD needs to find a domestic supplier who can mediate. If a supplier is found, it will take 5-6 months for the bidding process, and about 3 months for subsequent procedures and transportation.
- Pressure sensors: Domestic procurement is possible. The MCWD has one spare unit but needs to purchase 2 more units. After placing order, it will take 8-9 months to obtain.

quantitative effects of the project (actual figures in the future, after 2020) will tend to decrease while acquisition of equipment etc. is pending.

According to the MCWD, maintenance of facilities and equipment is mainly focused on maintenance when problems occur, and preventive maintenance is not carried out. As described above in "(3) Contribution to the MCWD management improvement by reducing non-revenue water rate" in "3.3.1.2 Qualitative Effects (Other Effects)," utilization of the SCADA system has facilitated leak detection and leak repair activities, and made it possible to deal with problems, but appropriate measures of facilities/equipment against theft/destroy and typhoons have not quite taken place.

From the above, it is considered that there are problems that cannot be overlooked regarding operation and maintenance situation at the time of the ex-post evaluation.

Some minor problems have been observed in terms of the current status. Therefore, sustainability of the project effects is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project introduced the SCADA system to monitor the water supply condition accurately almost in real time and to establish an appropriate operation management system for water supply facilities in the MCWD water supply service area, thereby contributing to the improvement of water supply in the target area. This project, which aims to reduce water leakage, monitor operating status of pumps, and improve shortage of water volume and pressure from water taps, is consistent with the Philippines' development policy, development needs and Japan's assistance policy at the time of planning and the ex-post evaluation. Therefore, the relevance of the project is high. In terms of project implementation, although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the project is fair. As for project effects, actual figures of operation indicators set at the time of planning are on the decline and are below the targets. Although the introduction of the SCADA system is improving the work and efficiency of daily operations of the staff in charge of operation and maintenance in the field, and that this project has produced certain effects, effectiveness and impacts of the project is fair when comprehensively judged based on the results of interviews with local residents and the content of complaints received by the MCWD. No negative impacts on natural environment and resettlement have been reported. Regarding operation and maintenance, some problems have been observed in terms of the current status. Therefore, sustainability of the project effects is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Importance of facilitating measures to restore the function of the SCADA system

The MCWD is preparing for the procurement of spare parts that need to be replaced due to problems with the facilities and equipment developed by the project. However, due to various reasons, there is no prospect of procurement or there are several spare parts that require a long time to obtain them at the time of the ex-post evaluation. Therefore, it is important for the MCWD to promptly proceed with the internal approval process and negotiation/coordination with other related organizations to recover the function of the SCADA system. In addition, as mentioned above, considering the frequent occurrence of equipment defects and the need for much time and workload to procure new equipment, it is proposed that the MCWD carries out (1) preventive maintenance with a focus on monitoring equipment or (2) hold a certain amount of inventory mainly for long-delivery items.

Newly establishing a division specialized for the SCADA system

The MCWD does not have a division dedicated to the SCADA and deploys staff in the existing departments and divisions who are also in charge of operation and maintenance of the SCADA. However, it was raised by several MCWD staff members that under the current system, it is inconvenient to secure unifying force and momentum and to take agile response in order to proceed with internal approval procedures, and to negotiate and coordinate with other related organizations for the procurement of spare parts related to the SCADA. Thus, it is recommended that the MCWD considers establishing a dedicated SCADA team as part of the institutional development to reduce non-revenue water rate in the future.

Importance of securing continuous cooperation with the power company and the telecommunications company, and to prevent theft and destruction in order to avoid further defects and to restore functions of the facilities and equipment developed by the project

It is important that the MCWD continues to work with the local electric power company and the telecommunications company and continue to seek ways to deal with the unstable power supply problems and the internet connection problems pointed out in this project. In addition, as part of the maintenance work, it is critical to recover stolen and damaged facilities and equipment and take measures against theft, to prepare for typhoons, and to promptly replace batteries for equipment with dead batteries.

4.2.2 Recommendations to JICA

Need for follow-up survey to improve sustainability of the project

In the process of the ex-post evaluation, it became clear that there were differences of views about the SCADA system coverage between the MCWD and JICA. However, it is not possible to accurately measure the MCWD's utilization status of the SCADA system through indicators on quantitative and qualitative effects in the ex-post evaluation. For this reason, it is desirable for JICA to reconfirm the operation and maintenance status and provide guidance to the MCWD once the spare parts have been procured to a certain extent and the system become fully operational.

4.3 Lessons Learned

For system development projects, it is important to carry out more careful and cautious survey of the status of basic infrastructure development, such as electric power situation and communication environment.

Main causes of defective facilities and equipment developed by the project include unstable power supply by the local power company, problems with internet connection in some areas, and problems with water quality in some wells. At the time of planning, surveys on power situation, internet environment and water quality were conducted, and problems were not foreseen. However, in reality, problems beyond expectations at the time of planning have occurred, causing malfunctions and negatively affecting the realization of the project effects. Therefore, for system development projects, such as this project, it is important to carry out more careful and cautious survey of the status of basic infrastructure development, which is a major precondition. For example, it is important to ensure continuous communication with local power company and telecommunications company so that they can understand the SCADA system, improve the compatibility of connections with each infrastructure, and reduce possible risk factors. It is also important to consider countermeasures and backup system, anticipating the occurrence of problems. To this end, it is desirable that JICA assigns experts in more subdivided field of electric power, telecommunications, and water quality compared to the ordinary preparatory surveys, and to conduct more thorough survey analysis.

When implementing the SCADA system development project, it is important to examine specifications of monitoring equipment in more detail during the design stage.

In this project, many equipment that constitute the SCADA system have become defective between after the commissioning and the ex-post evaluation. As mentioned above, considering that it will take a lot of time and work load to procure new equipment, it is important to examine specifications of monitoring equipment in more detail during the design stage when implementing

the SCADA system development projects in the future. Specifically, it is important to examine specifications of monitoring equipment by thoroughly considering the effects of the water quality of the target area on the procured equipment, power supply situation, and security measures to prevent theft of the target equipment.

At the time of planning, it is important to set indicators which measure impacts and to confirm the logic leading to the effects.

Concrete indicators for measuring impacts were not set at the time of planning for this project. For this reason, the logic leading to the effects and the specific indicators to measure impacts were set in consultation and agreement with the MCWD at the time of the ex-post evaluation. However, as symbolized by the manifestation of difference of views between the MCWD and JICA regarding the coverage of the SCADA system, it became clear that the interpretation of the logic leading to the effects and the indicators are different between them at the time of the ex-post evaluation of the project. Under such circumstances, problems of perception gap between them will occur and impacts cannot be measured accurately. Therefore, it is important for JICA to set concrete indicators to measure impacts at the time of the preparatory survey and confirm the logic leading to the effects. It is also essential that these indicators and logic be specified in the ex-ante evaluation report and that they be appropriately shared with the executing agency and related organizations from the planning stage.