

Democratic Republic of the Congo

FY2016 Ex-Post Evaluation of Japanese Grant Aid Project

“The Project for Rehabilitation of Ngaliema Water Treatment Plant in Kinshasa City” and

“The Project for Extension of Ngaliema Water Treatment Plant in Kinshasa City”

External Evaluator: Koichi Sekita, Chuo Kaihatsu Corporation

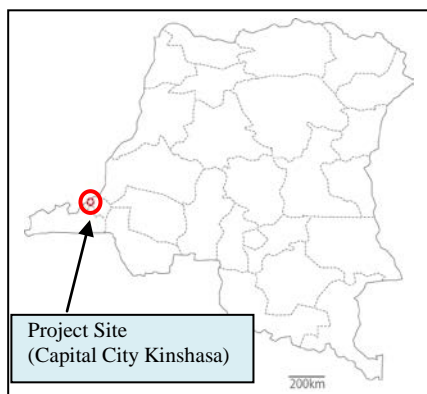
0. Summary

The Project aims to stabilize and increase the amount of water supply by replacing deteriorated facilities/equipment and expanding the water treatment facilities in the Ngaliema Water Treatment Plant, which is the existing water treatment plant in Kinshasa City, the capital of the Democratic Republic of the Congo (hereinafter referred to as “the DRC”), and to contribute to the improvement of living conditions for the residents of Kinshasa urban area.

The DRC is striving to repair, expand and newly build the water supply infrastructure with the goal to improve accessibility to safe drinking water. The Project holds high consistency with the developmental policy and needs of the DRC and also with the aid policy of the Government of Japan for the DRC, which includes “better access to safe water and hygiene” as an essential development issue. The relevance of this project is high. The rehabilitation and expansion (development of new facilities) of the Ngaliema Water Treatment Plant was carried out as planned. The efficiency is evaluated as fair since the Project period exceeded the plan while the Project cost was within the plan. The amount of supplied water (m³/day) and the amount of supplied water per capita (l/p/d; liter per person per day) reached the target; however, reduction of rate of loss of the volume of water treated at the water treatment facility did not meet its target. The effectiveness and impact are high since the users of water service is showing higher satisfaction for the water supply amount and an impact has been seen that the patients with diarrhea, one of the waterborne infectious diseases, have decreased in number. The sustainability is evaluated as fair as there are minor problems in the operation and maintenance institution and finance of the executing agency, maintenance techniques for facilities/equipment and also a fair equipment maintenance problem.

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

1. Project Description



Project Location



New Water Treatment Plant (extension) and Control Office

1.1 Background

Kinshasa City, the capital of the DRC, had a population of 6.22 million in 2005 and the coverage rate of drinking water service in the city was estimated at 76%. However, the amount of water produced per capita was only about 50 l/p/d and the estimated amount of supplied water was approximately 30 l/p/d taking into account the water leakage rate. This amount of water supply was equal to the level of rural water supply. The water pressure was insufficient in the outlining and higher altitude areas in the water supply service areas. Therefore, suspension of water supply was occurring on a daily basis.

To improve this situation, REGIDESO (Régie de Distribution d'Eau; a public-sector water company and an organization responsible for water supply in the DRC) developed a Master Plan on Drinking Water Supply for Kinshasa City. This master plan included the water demand forecast from 2005 to 2027 and the plan for increasing water supply capacity through new construction and expansion of water treatment plants in order to cope with the increasing water demand. However, the increased water supply capacity by 2009 was still 55% of 266,000 m³/day of the planned water supply capacity targeted for the FY 2012. The water supply amount¹ of the Ngaliema Water Treatment Plant was 80,000m³/day, which covered 16% of the total water supply amount for the whole of Kinshasa City (486,000m³/day)of planned year(2009). The benefited population in the water supply service area was 920,000. It had passed from 20 to 50 years since the construction of the Ngaliema Water Treatment Plant. Due to deterioration of the main core equipment such as transmission and distribution pumps for supplying treated water to the water supply service area, failure on equipment could have occurred at any time. The water supply capacity was fragile.

With such a background, the Government of the DRC requested grant aid from Japan for implementing the plan for increasing the water supply capacity. Consequently, grant aid projects for the rehabilitation and extension of the Ngaliema Water Treatment Plant, namely, 1) Plan for Rehabilitation of

¹ "Water supply amount" refers to the amount of production and supply of clean water.

Ngaliema Water Treatment Plant (Rehabilitation Project) and 2) Plan for Extension of Ngaliema Water Treatment Plant (Extension Project) were implemented.²

1.2 Project Outline

The objective of this project is to stabilize and increase the amount of drinking water supply by replacing the deteriorated facilities/equipment and expanding the water treatment facility in the Ngaliema Water Treatment Plant in Kinshasa City, the capital of the Democratic Republic of the Congo. Consequently, the Project will contribute to the improvement of the living environment for the residents in the Kinshasa urban area.

<Grant Aid Project>

G/A Grant Amount / Actual Grant Amount	(1) Rehabilitation: 1,944 million yen / 1,295 million yen (2) Extension: 1) Detailed Design: 81 million yen / 69 million yen 2) Main Works: 3,633 million yen / 2,847 million yen
Exchange of Notes Date /Grant Agreement Date	(1) Rehabilitation: February 2010/ February 2010 (2) Extension: 1) Detailed Design: February 2010/ February 2010 2) Main Works: May 2010/ June 2010
Executing Agency	Public-sector water company (REGIDESO)
Project Completion	(1) Rehabilitation: March 2012 (2) Extension: June 2013
Main Contractors	(1) Rehabilitation: Joint Venture by Toda Corporation and Suido Kiko Kaisha, Ltd. (2) Extension: Joint Venture by Dai Nippon Construction, Iwata Chizaki Inc. and Swing Corporation.
Main Consultant	Tokyo Engineering Consultants Co., Ltd.
Basic Design	(1) Rehabilitation: February 2009 – December 2009 (2) Extension: February 2009 – December 2009
Related Projects	None

2. Outline of the Evaluation Study

2.1 External Evaluator

Koichi Sekita, Chuo Kaihatsu Corporation

2.2 Duration of Evaluation Study

² The two Projects are integrated for evaluation since the extension plan improved the capacity based on the improvement and maintenance of existing capacity of the water treatment plant in the rehabilitation plan.

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

Duration of the Study: September 2016 – January 2018

Duration of the Field Study: February 12, 2017 – February 27, 2017 and May 21, 2017 – May 27, 2017

3. Results of the Evaluation (Overall Rating: B³)

3.1 Relevance (Rating: ③⁴)

3.1.1 Consistency with the Development Plan of the Democratic Republic of the Congo

At the time of Project planning, better accessibility to social services including water and hygiene sector was touted within *the Poverty Reduction Strategy* (2006 – 2010). The target for the water sector was to improve the access to safe drinking water from 25% in 2005 to 26.9% in 2008 and 49% in 2014. In the Government's five development pillars announced by President Kabila, the water sector has been chosen as one of the top five priority sectors. *The Priority Action Plan* (2009 – 2010), which is the action plan to achieve the targets set out in *the Poverty Reduction Strategy*, focused on the improvement of access to water in urban areas.

At the time of ex-post evaluation, *the Second Poverty Reduction Strategy* (2011 – 2015) pointed out the improvement of access to clean water as an improvement of access to basic social service. As for the water supply in urban areas, the policy to improve access to drinking water through rehabilitation, extension and building new water supply infrastructures has been shown. In the official notice of policies for drinking water supply service sector in urban areas (*Public-Sector Water Company Reconstruction Program*), the development and extension of water supply service infrastructure has been noted.

Therefore, the objective of the Project is consistent with the Government's development policies at the time of planning and ex-post evaluation.

3.1.2 Consistency with the Development Needs of the Democratic Republic of the Congo

At the time of planning, the main facilities of the Ngaliema Water Treatment Plant, which produces 16% of the 486,000m³/day (equivalent to 77,760m³/day) water supplied for Kinshasa, had deteriorated after 20 to 50 years from its construction. The water supply from the Ngaliema Water Treatment Plant was 50 l/p/d⁵ and taking into account the water leakage amount between the water treatment plant and households, the actual amount of water reaching (being supplied to) households was estimated as approximately 30 l/p/d. This is at a very low level for water supply in urban areas; therefore, it was necessary to expand the water supply capacity.

At the time of ex-post evaluation, the water supply from the Ngaliema Water Treatment Plant had expanded to 120,000m³/day and 121 l/p/d, and the estimated amount of water reaching households expanded to 70 l/p/d. The 70 l/p/d of water supply is not sufficient compared to the desirable level of

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

⁴ ③: High, ②: Fair, ①: Low

⁵ This means that the water supply (water that comes out of the water treatment plant) per capita per day is 50 L.

urban water supply (100 – 300 l/p/d). Of the clean water that has been discharged from the water treatment plant, approximately 50 l/p/d is still wasted (approximately 42% of water coming out of the plant is wasted by leakage etc.). From these points, it is judged at the ex-post evaluation stage that there is the need to increase the water supply further and also to reduce the amount of water wasted.

Therefore, the Project is consistent with the development needs at the time of planning and ex-post evaluation.

3.1.3 Consistency with Japan's ODA Policy

At the time of planning, one of the priority areas of assistance in Japan's *Country Assistance Policy* for the DRC was the "improvement of access to social services" and one of the critical development issues was the "improvement of access to safe water and hygiene" (*Japan's ODA Data by Country* 2010 by the Ministry of Foreign Affairs). Therefore, the Project which aims to improve access to safe water in Kinshasa was relevant to the Japanese assistance policy. Furthermore, the Yokohama Action Plan issued at the 4th Tokyo International Conference on African Development (TICAD IV: 2008) pointed out that the water and hygiene area is one of the essential areas. In sum, the Project is highly relevant to Japan's assistance policies 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. Therefore, its relevance is high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The Project implemented the rehabilitation and extension (building new facilities) for capacity improvement of the existing Ngaliema Water Treatment Plant. The plant covers 16% of 486,000m³/day of water supply in Kinshasa and the benefited population is 920,000.

3.2.1.1 Rehabilitation Plan

Table 1 shows the comparison between the rehabilitation plan at the time of planning and the results at the time of Project completion. According to reports provided by Japan International Corporation Agency (hereinafter referred to as "JICA"), there are no changes between the plan and actual results.

Table 1 Outputs which Japanese side provided or procured in the Rehabilitation Plan (plan and actual)

Name of Facility	Contents (mainly Exchange of Facility Equipment)	Quantity		Difference
		Plan	Actual	
Sedimentation Basin	Sludge draining pipe, sludge valve, sluice valve, and control panel.	4 basins	4 basins	As planned
Filtration Basin	Water collecting device, air purifier device, counter-current wash device, blower device, and control panel.	24 basins	24 basins	As planned
Water Conveyance Facilities	Discharge pump, control panel for discharge pump, electric control panel for existing intake pump, electric control panel for new intake pump, and incoming panel.	1 set	1 set	As planned
Reagent Injection Equipment	Alumina sulfate injection equipment, slaking lime injection equipment, calcium hypochlorite injection equipment, and service pump.	1 set	1 set	As planned
Other Equipment	Water level gauge for water purification basin, turbidity-meter, pH meter, flowmeter, and transducer board.	1 set	1 set	As planned

Source: Preparatory study report and other documents provided by JICA

3.2.1.2 Extension Plan

Table 2 shows the comparison between the extension plan at the time of planning and the results at the time of Project completion.

Table 2 Outputs which Japan side provided or procured in the Extension Plan (plan and actual)⁶

Facility	Contents (mainly Exchange of Facilities)	Quantity		Difference
		Plan	Actual	
Intake Facility	Intake pipe, intake pump, electric power facility, and water quality monitoring facility, etc.	1 set	1 set	Expanded the embankment area of the land for intake pump room. Change the excavation work method for the intake pumping room from the "open cut and sumping method" to the "steel sheet pile method". During the detailed design stage, it was planned to intake all the raw water at the point of the newly constructed intake facility. However, to ensure the production level at 110,000m ³ /day, with a change of the detailed design above, the existing water intake facility and newly constructed intake facility were connected.
Receiving Well	Receiving well, chemical mixing basin, communicating exit door of receiving well, flow meter, stirrer, distribution tank, and overflow weir	1 set	1 set	As planned.
Coagulation sedimentation Basin	New coagulation sedimentation basin, new inclined plate sedimentation basin, desludging equipment, and water quality monitoring equipment	1 set	1 set	As planned.
Filtration Basin	Filtration basin, siphon facility, cleaning facility, and drainage facility	1 set	1 set	Mostly as planned.
Reagent Injection Facility	Sulfate band, automatic water supply pump, and PVC piping, etc.	1 set	1 set	As planned.
Water Purification Pond	Water purification pond and communicating pipe	1 set	1 set	Change the route of the existing water supply pipes and the connecting pipes with water purification pond due to the temporary works of the existing water purification pipe
On-site Piping	Raw water pipe, water distribution pipe, sluice valve chamber, flow meter box	1 set	1 set	As planned.
Water Conveying Pump	Water conveying pump	2 sets	2 sets	As planned.
Administration Office	Offices (917.13m ² in total)	1 set	1 set	As planned.
Exterior Facilities	Rainwater drainage facility, interior lighting, interior pavement, safety measures, tree planting, and lightning rod	1 set	1 set	Aggregate the drainage system in the plant. Material handling entrance, concrete pavement in the plant, gate and others were added.

3.2.1.3 Capacity Building Program (Soft Component⁷)

On the Job Training (herein after referred to as "OJT"⁸) was provided by consultants for the purpose of enhancing operation and maintenance skills of the operators at the water treatment plant.

The target (plan) of this soft component (OJT for the operation and maintenance at the water

⁶ The output on the DRC side was the acquisition of land that had been necessary for the extension plan. Tax exemption equivalent to the land price was provided to the private business operators who owned the land.

⁷ A soft component refers to the technical training for improving the management ability and the maintenance skills of the recipient country so that the outcomes expected to occur through facility construction and equipment procurement by grant aid are continued after the project completion.

⁸ On the Job Training is a vocational education for employees through practical work experience at the workplace.

treatment plant) was for the operators at the Ngaliema Water Treatment Plant to be able to operate the facilities with the comprehension of the theory of the coagulation sedimentation and the rapid filtration methods, to adjust the operating methods according to the water quality situations, and to form a maintenance plan for cleaning the sedimentation basin and backwashing the filtration basin by themselves.

Table 3 shows the specific action plan, confirmation methods and the implemented results of this soft component. For each of the four technical items, it was confirmed that the work for maintenance was implemented as planned. Therefore, the target for the soft component has been achieved.

Table 3 Action Plan, Confirmation Methods and Implemented Results of the Soft Component

Item	Action	Confirmation Methods	Implemented Results	Difference
Comprehend the theory and process of coagulation sedimentation and rapid filtration methods	Hold seminars (2 times) on water treatment, sedimentation basin and filtration basin. Explanation on operating manual for each facility. Practical training on facility operation and inspection.	Confirm the comprehension by asking questions at seminars, manual explanation and OJT. Conduct practical exercise on operating and inspecting facilities and evaluate according to the items conducted. Conduct written exams to confirm the comprehension.	Written exams were conducted to confirm the comprehension. The average on the 13 examinees was 75 points (out of 100 points) in the first exam, which was quite high in the beginning. In the last exam the average (24 examinees) rose to 88 points, which showed further comprehension	Comprehension has improved further, which is the improvement of skill as planned
Acquire skills for operating the coagulation sedimentation basin	Cleaning according to the sedimentation basin cleaning manual. Setting adjustment of the desludging timer.	Confirm if the cleaning is conducted according to the manual. Confirm if the setting adjustment of the desludging timer is conducted according to the desludging changing manual and daily reports for desludging control.	It was confirmed that the cleaning was conducted under the leader's direction according to the manual. It was confirmed that the daily reports for desludging control and filtration basin washing control were used to check the setting based on desludging changing manual and that the changing timing was comprehended.	Operational skills were acquired as planned
Acquire skills for operating the rapid filtration basin	Operate control panel for rapid filtration basin and change the washing intervals etc. Conduct washing by operating the electromagnetic valve(s) of the local panel according to the electromagnetic valve operating manual. Control washing according to the	Confirm if the changing of washing intervals etc. is conducted by operating the control panel for rapid filtration basin. Confirm if the washing is conducted by operating the electromagnetic valve(s) of the local panel according to the electromagnetic valve operating manual. Confirm if the washing control is conducted according to the filtration	It was confirmed that the operators were able to operate the control panel and change the washing time. It was confirmed that three groups were formed and washing was conducted by each group by operating the electromagnetic valve(s) of the local panel according to the electromagnetic valve operating manual. It was confirmed that washing time and situation of head loss were checked using the	Operational skills were acquired as planned

	filtration basin washing manual and daily reports for filtration basin washing.	basin washing manual and daily reports for filtration basin washing.	daily reports for desludging control and filtration basin washing control (fixed time totalization sheets) and appropriate washing interval was judged. Comprehension was made on the treatment method(s) in a situation when the head loss is high.	
Be capable of forming a maintenance plan	Confirm annual maintenance plan throughout the year. Use totalization sheets to confirm and inspect, and check the operation control.	Confirm if the daily reports for operation control, desludging control, filtration basin washing control and forms for facility inspections have been made. Confirm if the methods of filling in the totalization sheets and inspection have been comprehended.	The annual maintenance plan for the new water treatment facility has been made. It was confirmed that the forms such as the daily report for operation control was made, and that inspection, adjustment and maintenance request were conducted using the forms.	Operators have become capable of forming maintenance plans as planned, and inspection and adjustment are conducted.

Source: Documents provided by JICA.

3.2.2 Project Inputs

3.2.2.1 Project Cost

For the rehabilitation plan, the limit of the grant by the Japanese side was 1,944 million yen. The actual Project cost was kept at 1,295 million yen without using the 13% contingencies. This was 67% of the planned cost and was kept within the plan. The Project cost to be borne by the DRC was planned to be 2 million yen; however, no evidence was found to show the actual figure.

For the extension plan, the limit of the grant by the Japanese side was 3,633 million yen (including 81 million yen for the detailed design). The actual Project cost was 2,916 million yen (including 69 million yen for the detailed design), this amount is 80 % of the planned cost, and was kept within the plan. The Project cost to be borne by the DRC was planned to be 5 million yen; however, no evidence was found to show the actual figure. According to the interview with REGIDESO, 1,200,000 U.S. Dollars compensation was paid to the landowners when acquiring the extension land for the water treatment plant. The compensation was made by tax exemption corresponding to land price for the landowners.

When totaling the Project costs of the rehabilitation plan and the extension plan, the actual Project cost borne by the Japanese side was 4,211 million yen (1,295 million yen + 2,916 million yen) while the limit of the grant by the Exchange Notes (E/N) and Grant Agreement (G/A) was 5,577 million yen (1,944 million yen + 3,633 million yen). The cost was 87% of the plan and was kept within the plan.

3.2.2.2 Project Period

For the rehabilitation plan, while the planned Project period⁹ was 20 months (including the detailed design and bidding period), the actual period was 26 months from February 2010 to March 2012 (completion date), which exceeded the plan (130%). The causes of the actual period exceeding the plan were that the detailed design took 6.6 months whereas it was planned as 2.9 months, and the period from the bid announcement to the construction start took 6.5 months for an unknown reason whereas it was planned as 2.6 months. (The period from the start to the completion of the construction was 12 months both in the plan and the actual result.)

For the extension plan, while the planned Project period was 34 months (including detailed design works, tender period and soft component period), the actual period of the Project was 42 months from February 2010 to July 2013 (soft component completion), which exceeded the plan (124%). The causes of the actual period exceeding the plan were that the detailed design took 6.6 months, which was 2.7 months more than the plan of 3.9 months, the period from the tender announcement to the bidding took 2.5 months, which was 0.5 months more than the plan of 2.0 months; as for the construction, the period from the agreement with the contractor to the start of construction took 3.0 months, which was 2.4 months more than the plan of 0.6 months, and the period from the construction start to the completion took 28 months, which was 5 months more than the plan of 23 months. The major causes for the period from the start to the completion of the construction to exceed the plan were the delays in land acquisition, procurement of rebar due to the lack of electricity, cargo transportation due to the presidential election, and the delay due to the cement factory shutdown. The construction was divided into Term I, Term II and Term III. Since Term I was delayed 8 months, the beginning of Term II and Term III had to wait for the dry season in the next fiscal year (May to October); therefore, the term was postponed.

When totaling the period for the rehabilitation plan and the extension plan, it was 54 months when planned, but it was 68 months in actual which exceeded the plan (126%).

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

3.3 Effectiveness¹⁰ (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

3.3.1.1 Operation Indicators

Since the rehabilitation plan and the extension plan have the same target of increasing the water supply, they will be evaluated integrally. As the completion of the rehabilitation plan was in March 2012 and the completion of the extension plan was in June 2013, the data from June 2013 onwards will be basically used for comparative analysis considering integral evaluation. In order to

⁹ Within the ex-ante evaluation table, the revitalization plan was set at 18 months and the expansion plan was set at 33 months. However, here as the starting point is unknown, we adopted the period of the bar chart of the Preliminary Survey Report on which the signing of the Exchange of Notes was as the starting point. Incidentally, the number of months is calculated including both starting and ending months.

¹⁰ When evaluating effectiveness, impact is also considered when evaluating the rating.

grasp change over the years, some data from FY 2012 are shown. The operation indicators are the daily water supply amount (10,000m³/day) and reduction of loss rate of the volume of water treated at the water treatment facility. Table 4 shows the achievement status of the indicators.

Table 4 Operation Indicator: Status of Achievement

Index	Baseline	Target	Actual				
	2009	(as below)	2012	2013	2014	2015	2016
	Planned Year	Completion Year	1 Year Before Completion	Completion Year	1 Year After Completion	2 Years After Completion	3 Years After Completion
Volume of Water Supply (10,000 m ³ /day)	8	11 (yr 2012)	8.3	10.5	12.5	12.5	12.6
Reduction of loss rate of the volume of water treated at the water treatment facility	Approx. 10%	0% (yr 2011)	2.3%	4.1%	5.4%	5.3%	5.4%

Note1: Water supply volume is the amount of water per day received from the Ngaliema Water Treatment Plant into the water supply area. The reduction rate in the amount of purified water is calculated by comparing the amount of purified water produced to the amount of water withdrawn from the raw water source.

Note2: Actual value of loss rate is including not only loss rate by facility's troubles but normal loss rate.

Source: Reports provided by JICA and from the questionnaire results at the time of ex-post evaluation (REGIDESO response)

Of the two indicators, the water supply amount has reached the target from FY 2014 onwards (up to FY 2016) with the actual result of approximately 125,000m³/day, although it did not quite reach the target in FY 2013 when the extension plan was completed. The other indicator, the reduction of loss rate of the volume of water treated at the water treatment facility, improved compared to the reference figure, but has not reached the target value, and has slightly increased later and ended up at 5.4% in the FY 2016. REGIDESO explains that the causes for this increase are the sedimentation of sludge emerging in the water purification process and the increase of treatment water for washing filter in the filtration basin¹¹. Also, there was no flowmeter to measure the intake amount of raw water up to 2012, so the accurate intake amount had not been measured. Therefore, one of the causes is that it has become actually possible to measure the accurate loss with the figures since the Project was conducted.

3.3.1.2 Effect Indicator

The effect indicator is the water supply amount per capita (l/p/d). From 2012, when the rehabilitation plan completed, and onwards up to 2016, the water supply amount per capita is significantly exceeding the target of 77.7 l/p/d. Their main causes are that the produced water amount supplied by the Ngaliema Water Treatment Plant has stabilized by the rehabilitation plan and that the produced water amount of the Ngaliema Water Treatment Plant has increased by the extension plan.

¹¹ Due to malfunction of sludge pump, sludge's drained from the sedimentation basin, and clogs the filter.

Table 5 Effect Indicators: Achievement Status

Index	Baseline	Target	Actual				
	2009	2011	2012	2013	2014	2015	2016
	Planned Year	Completion Year	1 Year Before Completion	Completion Year	1 Year After Completion	2 Years After Completion	3 Years After Completion
Water supply per person (liter / person / day)	56.5	77.7	90.0	111.0	127.9	123.5	121.2

Note: The per capita water supply volume is the amount of water distributed per day from the Ngaliema Water Treatment Plant to the water supply area divided by the population of the water supply area.

Source: Ex-ante evaluation and questionnaire survey result at the time of ex-post evaluation (REGIDESO response)

The water supply amount per capita includes the amount of leakage etc. that occurs in the distribution pipe network reaching the households. In other words, the amount of water that actually reaches the residents of the water supply service area is smaller than this water supply amount. According to the financial statements made by REGIDESO, the rate of revenue water (the amount of water that be charged out of the water supply amount) was 58% in 2015 and 55% in 2016. The remaining 45% is the rate of non-revenue water. The percentage of leakage due to the defect of distribution pipes, etc. and the water that has not been charged is high; therefore, it is necessary to reduce such non-revenue water.

3.3.2 Qualitative Effects (Other Effects)

Satisfaction on the water supply

A beneficiary survey was conducted targeting the residents in the water supply service area of the Ngaliema Water Treatment Plant¹². When they were asked about their degree of satisfaction with the water supply itself in 5 grades, 28% of them responded that they were “very satisfied” or “satisfied” at the situation before the Project was implemented. Satisfaction rate was improved to 43% at the situation after the Project was implemented. Degrees of satisfaction on water quality and quantity at the time of ex-post evaluation were also surveyed. The degree of satisfaction on water quality was low and 42% of them responded that they were satisfied (answered in Yes or No). On the other hand, there were some degree of satisfaction on water quantity (also answered in Yes or No), and seventy (70) percent of the users responded that they were satisfied.

3.4 Impacts

¹² A questionnaire survey was conducted covering whole area within the water supply service area of the Project in Kinshasa City and targeting general residence, restaurants, shops, hotels etc. (sample size: 120). The surveyors distributed the questionnaires to the survey cooperators, then collected them or conducted direct hearing and filled them out. Survey cooperators were selected by nonrandom selection so that the ration of male and female becomes half and the gender ratio was male: 58, female: 61, N/A (blank): 1. The questions were: the monthly amount of water used (61 valid respondents), monthly water charge (83 valid respondents), main usage of water (115 valid respondents), water supply suspension time before and after the Project implementation (78 valid respondents), water drawing time (72 valid respondents), effect on the reduction of waterborne infectious diseases (33 valid respondents), satisfaction for the water supply amount (119 valid respondents) and satisfaction for the water quality (118 valid respondents).

3.4.1 Intended Impacts

3.4.1.1 Quantitative effect

The indicator for quantitative effect pertaining to the improvement of living environment of residents in urban areas considered as the Project's impact, was "to contribute to the hygienic improvement such as reduction of waterborne infectious diseases and reduction of disease risk by conducting appropriate water treatment." Data on the number of diarrhea patients were collected in regard to waterborne infectious diseases. Table 6 shows the number of diarrhea patients from 2012 to 2016. Although the Ngaliema Water Treatment Plant contributes only to a part of water supply areas in Kinshasa City and it is assumed that there are other contributing factors, patients with diarrhea have significantly decreased when comparing the numbers up to 2013 and those from 2014 and onwards.

Table 6 Change in the Number of People Suffering from Diarrhea in Kinshasa City (2012-2016)

(Unit: Person)

	2012	2013	2014	2015	2016
Number of persons suffering from diarrhea (Overall)	9,339	17,349	670**	1,417	710
Number of children with diarrhea between the age of 1 to under 5*	5,699	10,272	670**	684	690

Source: Kinshasa City Health Center

Note: *The number of children suffering from diarrhea in 2014 of children between the age of 1 and under 6 and Overall is the same. During the field study, the team inquired to REGIDESO, but did not receive a response.

3.4.2 Other Positive and Negative Impacts

(1) Water supply suspension time

As the water supply amount from the water treatment plant was to increase, it was expected that the water supply suspension time would decrease. In the beneficiary survey, the respondents were asked about the time water supply being suspended. The percentage of the water users who responded one hour or less per day was 17.9% before the Project completion and has significantly increased to 33.8% after the Project completion. Also, while the percentage of the respondents who replied that they experience water supply suspension for 12 hours or more was 23.1% before the Project completion, the percentage dropped to 11.3% after the Project completion. The positive impact of water supply suspension time decreased has clearly occurred.

Table 7 Water Outage before and after Project Completion

Water Outage Time	Before Project Completion (Before 2013)		After Project Completion (After 2013)	
	Number of Responses	Ratio (%)	Number of Responses	Ratio (%)
0 - 1 hr	14	17.9	27	33.8
1 - 3hrs	17	21.8	11	13.8
3 - 8hrs	12	15.4	16	20.0
8 - 12hrs	17	21.8	17	21.3
12hrs and over	18	23.1	9	11.3
Total	78	100.0	80	100

Source: Results of the Beneficiary survey

(2) Relocation of residents

At the time of planning, there were three illegal settled houses and some illegally cultivated land along the Congo River within the site of the Ngaliema Water Treatment Plant. The relocation of these had to be completed before starting the construction works. Twenty-six (26) farmers became subject of actual relocation. REGIDESO gave compensation fee according to the land areas to those people subject of relocation according to the domestic law. Four out of twenty-six farmers are continuing farming outside the site of the water treatment plant. The other two farmers passed away after the relocation. Implementation of relocation of residents is the responsibility of the Government of DRC, therefore, REGIDESO had no information on the relocated places of the farmers and their situation after relocation and it was not possible to confirm with the Government. Although additional information was not able to obtain from REGIDESO, no issues have been reported with relocated residents.

(3) Land acquisition

The land to build the facility was necessary for the extension plan of the Ngaliema Water Treatment Plant. Forty-two (42) ares(0.42 ha) of land, which the neighboring textile factory company owned, was acquired. The negotiation for acquisition required time; however, it was realized by the Government of the DRC compensating through tax exemption to the company in place of the land price. Additional information about process for agreement with the textile factory company was not obtained, although inquiry was made to REGIDESO.

(4) Environmental consideration

The environmental impact assessment which was based on the initial environment survey for the extension plan was approved by the Ministry of Environment, Nature Conservation and Tourism as of April 1, 2010. As a measure to mitigate the impact on the natural environment, trees were planted in the peripheral area of the water treatment plant. Since REGIDESO could not secure the budget for tree planting, the cost was not borne by them but by the construction contractor of the extension plan. Although planted various trees are in growth of the process and their height is low, and interval of tress are not constant, with this tree planting, the mitigation of environmental impact has been implemented to some degree. As for the wastes, they need to be

recycled or disposed according to the environmental and social management plan submitted to the environmental authority. The old equipment exchanged in the Project is stored in the warehouse in the site of the Ngaliema Water Treatment Plant and is planned to be recycled in the future.

This project has largely achieved its objectives. Therefore, effectiveness and impact of the project are high.

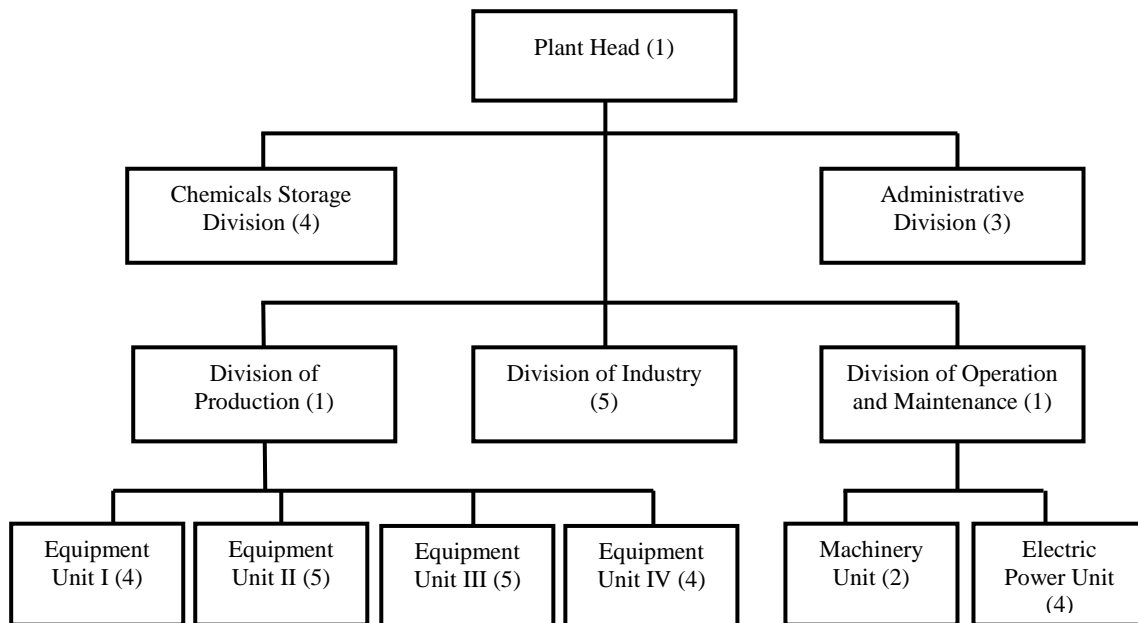
3.5 Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

The Ngaliema Water Treatment Plant is an organization that belongs to the Kinshasa Production Division in Kinshasa Province Office of REGIDESO. The number of staffs at the time of ex-post evaluation was 39. Chart 1 shows the organizational chart of the Ngaliema Water Treatment Plant. In the Production Division which is responsible for the production of drinking water, there are 4 Equipment Teams under the head of the division and a total of 18 staffs are employed. In the Maintenance Division which is responsible for the maintenance of the facility, there are two teams (Machine Team and Electric Power Team) under the head of the division and a total of 6 staffs are employed. Adding the operational department and maintenance department, there are 26 staffs employed in total.

According to the preparatory survey report, a minimum of 23 staffs were necessary for the double shifts of daytime and nighttime. The number of staffs has increased compared to the time of the preparatory survey. The results of the interview revealed that it has been partially difficult to cope with someone's absence in the team operation to record the operation status of the water treatment plant with daytime and nighttime shift. Although the staff has been increased by this reason, it is regarded that there should be more consideration on how to place the staffs. It was said that the headquarters of REGIDESO believed that the number of the staff could be kept low by automated operation of facilities.

As a matter of fact, the number for the implementation system is secured; however, it is considered that the scheduling of shifts is not appropriate when the control department should be monitoring for 24 hours but that level of achievement is not realized when a member of staff is absent.



Note: Numbers above in parentheses are the number of staff

Source: The Ngaliema Water Treatment Plant

Chart 1 The Ngaliema Water Treatment Plant: Organization Chart

3.5.2 Technical Aspects of Operation and Maintenance

Regarding the technical aspect of the Project, the operation control of the water treatment plant is conducted with no problems by the staffs of the plant. It is judged that the staffs possess technical skills for daily maintenance control.

The records of operating status for each facility are kept. By checking the status of the water supply amount at the intensive monitoring system with the records and visual observation, it was confirmed that the daily water amount of more than the target of 110,000m³/day was supplied. This demonstrates that the guidance for operating and controlling the plant was appropriate and effective to strengthen the capability of the staffs. As for the soft component, 18 staffs of the Ngaliema Water Treatment Plant have received training¹³. With the personnel changes after that, only two trainees are left currently; yet, it is evaluated that the details of the soft component training for operation and maintenance control are inherited properly.

The manual included with the soft component was utilized to operate the water treatment plant. Water quality inspection of raw water and clean water is conducted in the laboratory established in the Ngaliema Water Treatment Plant at a fixed frequency. When checking the results of the water quality inspection, figures surpassing the control values on several items (color, turbidity) set in the soft component's manual were found. A hearing survey of staffs at the water treatment plant was conducted in regard to this point. Since there are cases when the results surpass the control values set specifically by the Ngaliema Water Treatment Plant depending on the quality of raw water, the operation procedures were changed to be controlled within the range of World Health Organization

¹³ With regards to the software component, a total of 35 people including the Ngaliema Water Treatment Plant staff received guidance.

(WHO)'s drinking water quality standard. The manual is followed basically and controlling method is being revised according to the situation of the Ngaliema Water Treatment Plant.

The operation status of each facility is recorded in the daily reports. The water supply amount, water quality, chemicals etc. are recorded in detail. Partially, there were some days that only half a day worth of report was recorded for water supply since there was a problem in allocating staffs for day and night shifts.

The computer(s) in the intensive monitoring room have equipment to monitor the amount of water intake and water supply at all times. However, continuous record has not been printed because the printer is not working. The use of computers is restricted to independent use except for the connection to the equipment in the plant only in order to avoid virus infection. Internet connection and USB memory connection are not allowed and the data cannot be transferred. Since there is a facility to automatically obtain the control data such as water supply amount and water quality, more efficiency can be achieved by improving the operating method to utilize such obtained data.

3.5.3 Financial Aspects of Operation and Maintenance

Table 8 shows the data on the balance sheets of REGIDESO from 2014 to 2016.

Table 8 Annual Income and Expenditure of REGIDESO

(Unit: million CDF¹⁴)

Expenditure		2014	2015	2016
Revenue	Income (fee)	123,921	136,968	160,121
	Construction fee	1,763	2,049	2,280
	Other	40,736	50,920	42,777
	Total	166,420	189,937	205,178
Expense	Personnel	50,871	59,324	66,072
	Maintenance	8,171	2,627	3,332
	Material	1,821	1,584	▲25,268
	Power	1,809	2,240	2,027
	Chemical treatments	4,286	3,303	8,018
	Miscellaneous	110,865	151,237	171,183
	Total	177,823	220,315	225,364
Term-Balance		▲11,403	▲30,379	▲20,186

Note1: Financial Year, 01 January to 31 December

Note2: Total amount does not match due to rounding off.

Source: REGIDESO

The annual data of income and expenditure of REGIDESO as shown in the above table are the financial data of the REGIDESO as a whole including the Ngaliema Water Treatment Plant and other water treatment plants. While REGIDESO has no subsidy income from the government, the water charges that the government should be paying are in delinquency.

The balance sheets from 2014 to 2016 reveal that all three years have seen deficit.

According to the REGIDESO financial balance sheet (2014), REGIDESO supplied

¹⁴ Congo Franc 1CDF=0.1077 Yen (From IMF: International Financial Statistics; Yearbook 2017. Average rate of FY 2016.)

295,287,805m³ amount of water, of which revenue water was 176,414,023m³ and the revenue water rate was 60%, and the non-revenue water rate was 40%. According to the REGIDESO financial balance sheet (2015), REGIDESO supplied 311,021,769m³ amount of water, of which revenue water was 181,406,155m³ and the rate of revenue water was 58%, and the non-revenue water rate was 42%. Comparing 2014 and 2015, the revenue water rate has dropped and the unit price of water per 1m³ has risen from 693.08CDF/m³ (2014) to 740.29CDF/m³ (2015). One of the causes for the decrease of the revenue water rate from 60% (2014) to 58% (2015) is thought to be the leakage from the piping network. Deterioration of the piping network increases the leakage and reduces the water charges income; furthermore, it is influencing the water cost. The causes of the increase of the unit price of water per 1m³ are thought to be the reduction of income by non- revenue water and increase of water production cost. As an example of the increase of water production cost, REGIDESO refers to the chemicals used for water treatment, which rely on the imports; therefore, it is heavily influenced by the exchange rates between U.S. Dollars and Congo Franc. Congo Franc is weak against the U.S. Dollars, which brings a disadvantageous situation for procuring import materials.

Table 9 shows the operational cost of the Ngaliema Water Treatment Plant for the three years from 2014 to 2016. The financial statement provided by REGIDESO has some records of the repair cost of each water treatment plant; however, there were no records on the budget allocation of all treatment plants and the Ngaliema Water Treatment Plant.

Table 9 Status of Operating Costs of the Ngaliema Water Treatment Plant

(Unit: CDF)

Expense	2014	2015	2016
Materials, Chemical Treatments & Power Cost	2,614,448,579	1,492,280,289	2,811,970,624
Transportation	58,030,063	1,568,333	
Outside service	27,519,315	40,690,412	8,340,561
Taxes			38,828,589
Bonuses/Allowances	3,475,985	2,317,324	72,943,064
Personnel	358,991,556	179,036,778	389,861,312
Depreciation	790,643,612	487,095,741	1,540,217,148
TOTAL	3,853,109,110	2,202,988,877	4,862,161,298

Source: REGIDESO provided documents

As for the finance pertaining to the operation and maintenance of the Ngaliema Water Treatment Plant, the labor cost of the staffs is secured. The procurement of spare parts which relies on the imports or the repairs that need overseas technology are difficult; nevertheless, the repairs needed in daily maintenance is outsourced, of which expense budget is regarded to be secured.

3.5.4 Current Status of Operation and Maintenance

(1) Daily operation control

As seen in 3.3.1.1, the water supply amount has risen from the beginning of operation in 2013, and it has surpassed the target of 110,000m³ by maintaining supply of more than 120,000m³. At the time of ex-post evaluation, the target of water supply amount was set at 127,000m³ per day and sometimes it reached a maximum of 130,000m³. In the aspect of maintaining the water supply amount, the operation of the water treatment plant is controlled fully appropriately.

(2) Purchasing and renewing spare parts and expendables

According to the interview from the Ngaliema Water Treatment Plant, quantity of the spare parts stored for facilities and equipment is decreasing. For example, the lamps (made by a Japanese manufacturer) for the automatic turbidimeters of the water intake facility have been exchanged four times in two years and there is no stock of spare parts. Also, the battery of the operation panel in the monitoring facility has reached the timing of renewal (five years) but it is being used continuously since there are no spare parts. These spare parts cannot be procured inside the DRC, so they need to be imported. Some equipment that was out of order in the facilities was not repaired at the time of ex-post evaluation. This is because the budget is limited and the repair cannot be ordered, as the parts that cannot be procured inside the country have to be imported and require higher repair cost.

While there are financial issues for the repair cost, there are some attempts made to procure from lower cost suppliers. For example, as for the automatic turbidimeters in the water intake facility that were not being used because the parts procurement was not possible according to the interview at the first field survey, a quick check had been made that procuring the parts from the manufacturer's overseas branch would be cheaper than procuring them from Japan, and they were ordered and are being waited for arrival according to the interview at the second field survey.

In the Ngaliema Water Treatment Plant, there are four water conveying pumps set in the Project and two water conveying pumps that the EU rehabilitated. Of the four pumps set in the Project, one is out of order. Repair within the DRC has been tried since March 2016, but it was still being repaired at the time of the field survey for the ex-post evaluation (February 2017). However, the target conveying capacity of the Ngaliema Water Treatment Plant is being maintained by the three water conveying pumps and the two EU water conveying pumps that are currently in operation.

In the chemical injection facility, one of the four injection pumps is out of order. As the spare parts could not be found in the marketplace, it was exchanged for an injection pump (made by PEDROLLO) obtainable in the DRC.

As can be seen, there are some innovations made such as researching the suppliers and exchanging for alternatives. The expendables such as calcium hypochlorite and alumina sulfate etc. necessary for water treatment are essential, so they are included in the budget as costs and are purchased to operate the water treatment plant.

The target set for the soft component was “for the operators at the Ngaliema Water Treatment Plant to be able to operate the facilities with the comprehension of the theory of coagulation settling and rapid filtration method, to adjust the operating methods according to the water quality situations,

and to form a maintenance plan for cleaning the sedimentation basin and backwashing the filtration basin by in-house.” This is regarded as being able to control the facility and conduct daily operation and maintenance. It is premised that the repairs of the equipment are left in the charge of outside professionals, and the system of ordering the repairs is established. Since the daily operation and control are fulfilled, it is judged that the target for the soft component has been achieved.

Some minor problems have been observed in terms of the institutional aspect and financial aspects and some problems are on current status. Therefore, sustainability of the Project effects is fair.

4 Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The Project aims to stabilize and increase the amount of water supply by replacing deteriorated facilities/equipment and expanding the water treatment facilities in the Ngaliema Water Treatment Plant, which is the existing water treatment plant in Kinshasa City, the capital of the Democratic Republic of the Congo (hereinafter referred to as “the DRC”), and to contribute to the improvement of living conditions for the residents of Kinshasa urban area.

The DRC is striving to repair, expand and newly build the water supply infrastructure with the goal to improve accessibility to safe drinking water. The Project holds high consistency since it is consistent with the developmental policy and needs of the DRC and also with the aid policy of the Government of Japan for the DRC, which includes “better access to safe water and hygiene” as an essential development issue. The relevance of this project is high. The rehabilitation and expansion (development of new facilities) of the Ngaliema Water Treatment Plant was carried out as planned. The efficiency is evaluated as fair since the Project period exceeded the plan while the Project cost was within the plan. The amount of supplied water (m³/day) and the amount of supplied water per capita (l/p/d; liter per person per day) reached the target; however, reduction of rate of loss of the volume of water treated at the water treatment facility did not meet its target. The effectiveness and impact are high since the users of water service is showing higher satisfaction for the water supply amount and an impact has been seen that the patients with diarrhea, one of the waterborne infectious diseases, have decreased in number. The sustainability is evaluated as fair as there are minor problems in the operation and maintenance institution and finance of the executing agency, maintenance techniques for facilities/equipment and also a fair equipment maintenance problem.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

(1) On continuous operation of the water treatment plant facilities

To procure the parts whose spare parts have been used up or are now with only a few remaining, the Ngaliema Water Treatment Plant should make the list of exchange parts in order to operate the water treatment plant facilities continuously. REGIDESO should take budgetary measure

for the procurement of the equipment that has reached or is nearly reaching the renewal time and implement renewal while the facility is in operation.

(2) On storing the control records

The electronation of the control records should be promoted so that the past control records in the Ngaliema Water Treatment Plant can be confirmed. Computers and database will be prepared, the format for control records will be made and the data will be input. In addition, by renewing the output equipment (printer) to utilize the data automatically recorded by the monitoring system, the control recording method can be made more efficient and the data backup can be performed. When the control records are made into a database, the past operation status of the water treatment plant facilities can help to detect the failure early and to grasp and respond to the change in the quality of raw water, and such operation will be possible.

4.2.2 Recommendations to JICA

On renewal of equipment of water treatment plant

Some facilities of which exist in plural have stopped operation. For example, one of the six water conveying pumps is undergoing a long-term repair. It is necessary to conduct a survey on current situation and suggest to the government or the executing agency of the partner country for taking necessary measures.

4.3 Lessons Learned

On selection of equipment considering the operation and maintenance

There are some spare parts for the equipment in the water treatment plant that are difficult to procure in the DRC, which is causing delay in replacement. Also, there are equipment aimed at being repaired but it is taking an unusual amount of time. In order to have the facilities operated continuously, it is important to secure the necessary function and quality and yet to select the equipment whose spare parts that the executing agency can easily procure and those that can be repaired, when designing the water treatment plant. Such construction of the Project facilities leads to their continuous operation.